BOOK OF ABSTRACTS

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ORAL PRESENTATIONS
Presentation # 101

**Rapid, real-time, point-of-care confirmation of correct endo-tracheal tube position by ultrasound**

**Presenter:** Heidi Hadley, MD, Resident  
University of Arizona

**Authors:** Heidi Hadley, MD  
Kai Schoenhage, MD (Faculty Mentor)

Determination of endotracheal tube (ETT) depth is a routine assessment performed after each intubation. Current practice involves confirmation of correct placement above the carina via indirect means (auscultation/observation) or direct means (chest x-ray or bronchoscopy), both of which have drawbacks. Prior articles have demonstrated the ability to use ultrasound to directly visualize the ETT within the trachea, however have not referenced ETT depth relative to the carina or only studied one age/size group. Our study demonstrates the use of ultrasound to quickly confirm an ETT’s correct position in the trachea of all ages/all patient sizes. Although neither the carina nor the ETT tip can be visualized on ultrasound, surrogates for both structures are used: the carina lies predictably below the aortic arch (which is visible), and the ETT cuff lies predictably above the ETT tip (which is visible when inflated with fluid); and the distance from tip to cuff is always less than distance from carina to aortic arch. Thus, when the ETT cuff is be visualized above the aortic arch, the ETT tip therefore must be above the carina. We used age/size matched control CT scans to measure aortic arch to carina distance and created a regression model whereby to reliably predict aortic arch to carina distance based on patient age/size. In this study, we describe the use of ultrasound to confirm correct ETT placement (verified by gold standard bronchoscopy) in 100% of subjects from neonates to pediatrics to adults. The entire exam can be completed at the bedside, in less than one minute, with immediate results after short training.
Background: Although direct laryngoscopy is a reliable method for endotracheal intubation, there are situations when direct visualization of the vocal cords may be difficult or impossible. For example, if blood or gastric contents have compromissed the airway, it may be impossible to visualize the vocal cords using any optical means. To provide an improved means for non-optical intubation, a device was developed that detects and visually represents the location of a magnetic intubating sylet relative to the trachea to help facilitate blind endotracheal intubation.

Methods: A prototype device was designed, built, and tested. The device was developed on a flexible PCB, such that the apparatus could easily conform to the patient’s anterior neck. The device has an array of magnetometers that detect the magnetic field produced by an external magnet incorporated into the tip of an intubating stylet. A microcontroller aggregated sensor data and controlled a series of LEDs that visually represent the location and depth of the intubating stylet. The device was tested on intubation mannequins.

Results: A prototype device was successfully developed and tested in a simulation environment. The visual targeting apparatus accurately represented the 3-dimensional location and trajectory of the intubating stylet. The stylet could be reliably guided into the trachea using magnetic guidance. Ambient room lighting, skin tone, or neck size did not affect guidance.

Conclusion: A novel method for endotracheal intubation using magnetic guidance was developed. This technique potentially offers several advantages over conventional intubation techniques, which include: 1) insensitive to blood or other fluids in the airway, 2) neck manipulation is not required, 3) not affected by ambient room lighting, 4) not affected by skin tone, and 5) not affected by neck size. Future studies will aim to optimize the firmware and incorporate additional sensing modalities to further increase the reliability of the guidance system.
Inhibition of Free Fatty Acid Receptor GPR40 Prevents Rescue of Bupivacaine-Induced Cardiotoxicity by Intralipid

Presenter: Soban Umar, PhD, Resident
University of California, Los Angeles

Authors: Soban Umar, MD
Alex Centala, BA/BS
Mariam Barseghyan, BA/BS
Parisa Partownavid, MD
Mansoureh Eghbali, PhD (Faculty Mentor)

Introduction: Bupivacaine toxicity leads to cardiac arrest. Intralipid is cardioprotective and rescues Bupivacaine-induced cardiotoxicity. Although both lipid sink and metabolic theories have been proposed, the exact molecular mechanism of this rescue is not clearly understood. G-protein-coupled receptor-40(GPR40), or free fatty acid receptor-1 is activated by medium and long chain fatty acids and is expressed in the heart. We hypothesized that GPR40 mediates Intralipid’s rescue of Bupivacaine-induced cardiotoxicity.

Methods: In protocol-1(n=6), rats received Bupivacaine (10mg/kg, intravenously) and asystole was documented with ECG and Echocardiography. Resuscitation with Intralipid 20% (5ml/kg bolus, and 0.5ml/kg/min maintenance) and chest compressions were initiated. In Protocol-2(n=6) rats were pre-treated with GPR40-antagonist GW1100 intravenously (low dose 50uM or high dose 200uM) 30-minutes before asystole. Heart rate (HR) and ejection-fraction(EF) were measured before and 30-min after GW1100. In both protocols HR, EF and fractional-shortening(FS) were measured before asystole (baseline) and at 1, 5 and 10 minutes after Intralipid. Means±SEM are reported.

Results: In protocol-1, baseline HR and EF were 321±21 beats/min and 72.3±4.6%. Bupivacaine resulted in asystole. Intralipid improved HR and function gradually within 10min; HR was 86±13 at 1min (27% recovery), 216±10 at 5min (67% recovery), and 228±14 at 10min (71% recovery). LV-function fully recovered within 5 min of Intralipid treatment as EF and FS were similar to baseline (EF=72±5%, FS=42±4%). To test our hypothesis, rats were pretreated with GW1100, 30-min before inducing asystole. There were no significant differences between HR and EF before (HR=316.6±3.3, EF=68.0±2.3%) and 30-min after GW1100 (HR=330±5.7, EF=71.6±1.5%) indicating that GW1100 alone has no hemodynamic effects. Pre-treatment with high dose GW1100, however prevented Intralipid’s rescue in a dose dependent manner, with no recovery of cardiac function within 10min of Intralipid administration.

Conclusions: GPR40 is involved in Intralipid’s rescue of Bupivacaine-induced cardiotoxicity. Discovery of GPR40 as a receptor for Intralipid’s effects will help understand Intralipid-induced cardioprotection.
Figure: A) Heart rate (beats/min) and B) Ejection Fraction (EF, %) of saline pre-treated Control (CTRL) rats and GPR40 antagonist GW1100 pre-treated rats that received Bupivacaine to induce asystole followed by Intralipid (ILP) administration.
**Propofol Induced Anesthetic Toxicity: the Role of RhoGTPases in Growth Cone Morphology and Axonal Transport**

**Presenter:** Anna Bovill Shapiro, MD, Resident  
University of California, San Diego

**Authors:**  
Anna Bovill Shapiro, MD  
Matthew Pearn, MD (Faculty Mentor)  
Brian Head, PhD  
Piyush Patel, MD  
Celine DerMardirossian, PhD

**Background:**

There is evidence that anesthetic exposure during synaptogenesis is detrimental. However, the exact mechanism is unknown. Previous work demonstrated that preferential signaling of proBDNF leads to RhoA activation, actin dysregulation, and loss of dendritic spines and synapses. Actin dynamics are also crucial for growth cone dynamics and axonal transport. Because our previous findings showed propofol induced actin dysregulation, we hypothesized that propofol exposure during the vulnerable period of DIV5-7 would also induce growth cone collapse and impair retrograde axonal transport. Furthermore, RhoA inhibition prior to anesthetic exposure would rescue neurons from these derangements.

**Methods:**

Primary rat embryonic neurons (E18) were cultured for 5 days in vitro (DIV5-7) and human forebrain neurons were cultured for 4 weeks in vitro. For immunofluorescence microscopy (IF), all neurons were plated on glass coverslips pre-coated with poly-D-lysine (rat neurons) or poly-ornithine and laminin (human neurons). Prior to exposure, neurons were pretreated with TAT-C3 (selective RhoA inhibitor). Growth cones were stained with the F-actin marker, phalloidin, for morphometric analysis of area. Retrograde axonal transport was assayed by live cell imaging of quantum dot labeled brain derived neurotrophic factor (BDNF).

**Results:**

Propofol exposure at DIV5-7 results in increased RhoA activation, actin dysregulation, growth cone collapse, and impaired retrograde axonal transport; these deleterious effects were attenuated TAT-C3 pre-treatment. In human fetal forebrain neurons, propofol exposure resulted in significant neurite loss; pre-treatment with TAT-C3 prevented propofol induced neurite loss.

**Conclusions:**

These results demonstrate that propofol exposure in developing neurons results in increased RhoA activation, growth cone collapse and impaired retrograde axonal transport, all of which were attenuated with RhoA inhibition. Of clinical relevance, propofol exposure in fetal human neurons induced neuritic changes that were prevented with RhoA inhibition. These data identify a novel target for therapeutic intervention to prevent neurotoxicity in the developing brain with serious clinical translation.
REDUCED SURGICAL BLEEDING WITH PRETREATMENT OF SPRAGUE DAWLEY RATS WITH C. ATROX VENOM: IDENTIFICATION OF POTENTIAL TARGET PROTEINS

Presenter: Margaret Barnhart, MD/DO, Resident  
Loma Linda University School of Medicine

Authors: Margaret Barnhart, MD/DO  
Ronak Raval, MD/DO  
Karen Hays, MS/MA/MPH  
Richard Applegate, MD/DO (Faculty Mentor)  
John Zhang, MD/DO (Faculty Mentor)

Introduction

Crotalus atrox venom contains proteins known to affect platelet aggregation, blood coagulation, and fibrinolysis. We previously found preconditioning with 2% LD50 of C. atrox venom decreased bleeding and increased fibrinogen levels in a rat surgical model.

Our work investigates coagulation profiles of C. atrox venom fractions. We hypothesize that proteins in specific fractions disrupt the formation of fibrin clots and platelet aggregation and trigger a compensatory response in rats ultimately leading to decreased bleeding in a surgical model.

Methods

Whole C atrox venom was separated into ten fractions by SE chromatography. Each fraction was incubated with human blood for measurement of coagulation parameters. At each time point, soluble fibrin levels, time to formation of platelet micro-clumps, time to formation of larger platelet clumps with sticking to vial, and whole-sample coagulation were measured.

Results

Target proteins in the fractions show dramatic differences in platelet activation and fibrin formation. Fraction B1 shows a sharp increase in platelet micro-clump formation time and time to vial wall stick, indicating loss of platelet activity. Clotting time in this fraction is prolonged. Fraction D1 shows no change in platelet activity or clotting time, but significant soluble fibrin increase. Fraction H1 had no effect on platelet function, clotting time, or soluble fibrin.

Conclusions

Platelet activation and coagulation times for C atrox venom proteins differ. Fraction B1 proteins affect platelet function with no effect on clotting or soluble fibrin. Fraction D1 increases levels of soluble fibrin with no effect on platelets. In this fraction clotting time is unchanged, suggesting fibrin cross-link malfunction since soluble fibrin increased. Fraction H1 shows no change in platelet activation, clotting, or soluble fibrin.

We expect that further work will identify the active proteins that confer the decreased bleeding effect found in rats following pretreatment with 1/50th LD50 of C. atrox venom.
Abnormal placental implantation delivered by Cesarean-Hysterectomy (C-Hyst): a comparison of main operating room versus L&D operating room outcomes.

Presenter: Carlos Delgado, MD, Fellow
University of Washington

Authors: Carlos Delgado, MD (Faculty Mentor)
Laurent Bollag, MD (Faculty Mentor)
Christopher Cilibero, MD (Faculty Mentor)
Brian Theodore, PhD (Faculty Mentor)
Ruth Landau, MD (Faculty Mentor)

Background

In most institutions, suspected or confirmed cases of abnormal placentation are scheduled as cesarean-hysterectomy (C-Hyst) in the main operating room (mOR) rather than in L&D OR, to facilitate access to massive transfusion, embolization, specialized surgical interventions and technical support. However, unsuspected or emergency cases are often effectively managed in the L&D OR. We decided to compare the management, outcomes and resources in C-Hyst performed in both locations at our institution. The Obstetric Anesthesia team manages all accreta cases, however.

Methods

We conducted a retrospective chart review from 2009-2014, based on ICD-9 and CPT codes and analyzed all hysterectomies performed in L&D OR, and all C-Hyst brought to mOR. Maternal and obstetric data (previous cesarean, uterine surgeries or previa), surgical outcomes (procedure, duration, blood loss), anesthetic management (general, neuraxial or combination), intraoperative management (monitoring, vasopressors, fluids & blood products), postoperative outcomes (ICU admission & length of stay) and cost were recorded.

Results

During the 5-year interval, 14 C-Hysts were performed in the L&D ORs and 35 scheduled in mOR, out of which 12 (34%) did not require a hysterectomy. There were no differences in demographic data, except for gestational age at delivery. The likelihood of having a C-Hyst in the mOR was increased with a diagnosis of placenta previa and previous CD. The rate of general anesthesia was similar for C-Hyst in both locations. The length of stay was longer with mOR C-Hyst as was the cost.

Conclusions

Overall, maternal management & outcomes were similar irrespective of location. Of importance, 34% of cases scheduled in the mOR ended up not requiring a hysterectomy. Since the cost is almost double when a cesarean delivery (± hysterectomy) is performed in the mOR, further evaluations are needed to provide a clinical algorithm to decide the best location and reduce unnecessary, unjustifiable costs.
<table>
<thead>
<tr>
<th></th>
<th>C-Hyst in L&amp;D OR N=14</th>
<th>C-Hyst in main OR N=35</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>C-Hyst N=23</td>
<td>Cesarean delivery N=12</td>
</tr>
<tr>
<td>Maternal Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>33.9 ± 5</td>
<td>34.2 ± 5.3</td>
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<tr>
<td>Weight (kg)</td>
<td>82.5 ± 17.3</td>
<td>78 ± 14</td>
</tr>
<tr>
<td>Gestational age (weeks)</td>
<td>36.1 ± 4.2 #</td>
<td>33.6 ± 2.5</td>
</tr>
<tr>
<td>Nulliparous (N=)</td>
<td>4 (28%) ##</td>
<td>0</td>
</tr>
<tr>
<td>Obstetric Data</td>
<td></td>
<td></td>
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<tr>
<td>Number of previous CD (N=)</td>
<td>1.2 ± 0.6 ##</td>
<td>2.1 ± 1.1</td>
</tr>
<tr>
<td>Placenta Previa (N=)</td>
<td>3 (21%) #</td>
<td>16 (70%)</td>
</tr>
<tr>
<td>Previous uterine surgery (N=)</td>
<td>4 (28%) #</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Surgical procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elective case (N=)</td>
<td>1 (7%)</td>
<td>14 (61%)</td>
</tr>
<tr>
<td>Surgical duration (min)</td>
<td>248.9 ± 50.7</td>
<td>278.1 ± 79.1</td>
</tr>
<tr>
<td>EBL (ml)</td>
<td>3742.9 ± 1712.4</td>
<td>3578.5 ± 2245.9</td>
</tr>
<tr>
<td>Anesthesia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuraxial for entire case (N=)</td>
<td>5 (36%)</td>
<td>8 (35%)</td>
</tr>
<tr>
<td>GA for entire case (N=)</td>
<td>2 (14%)</td>
<td>4 (17%)</td>
</tr>
<tr>
<td>Neuraxial &amp; GA (N=)</td>
<td>7 (50%)</td>
<td>11 (48%)</td>
</tr>
<tr>
<td>Management</td>
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<tr>
<td>Arterial line (N=)</td>
<td>10 (71%)</td>
<td>22 (96%)</td>
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<tr>
<td>Central line (N=)</td>
<td>1 (7%)</td>
<td>2 (9%)</td>
</tr>
<tr>
<td>Phenylephrine Infusion (N=)</td>
<td>11 (78%)</td>
<td>20 (87%)</td>
</tr>
<tr>
<td>Colloids (ml)</td>
<td>5292.9 ± 2517.5</td>
<td>6157.6 ± 3848</td>
</tr>
<tr>
<td>RBC (ml)</td>
<td>750 ± 424.9</td>
<td>1055.6 ± 583.6</td>
</tr>
<tr>
<td>FFP (ml)</td>
<td>1473 ± 987</td>
<td>1465 ± 1029</td>
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<tr>
<td>Platelets (ml)</td>
<td>1327 ± 587</td>
<td>952.9 ± 507.9</td>
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<tr>
<td>Cryoprecipitate (ml)</td>
<td>501.3 ± 2.5</td>
<td>376.3 ± 158.6</td>
</tr>
<tr>
<td>Interventional radiology (N=)</td>
<td>444 ± 279 #</td>
<td>242 ± 143</td>
</tr>
<tr>
<td>Post-Operative Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICU admission (N=)</td>
<td>4 (29%)</td>
<td>3 (13%)</td>
</tr>
<tr>
<td>ICU length of stay (days)</td>
<td>1.8 ± 1.5</td>
<td>2 ± 0.6</td>
</tr>
<tr>
<td>Total length of stay (days)</td>
<td>5.9 ± 4.7 #</td>
<td>28 ± 25.7</td>
</tr>
<tr>
<td>Cost Analysis</td>
<td></td>
<td></td>
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<tr>
<td>Indirect</td>
<td>$8,999.3 ± 4,500 #</td>
<td>$18,271.5 ± 14,076.6</td>
</tr>
<tr>
<td>Direct</td>
<td>$15,000 ± 7,850.7 #</td>
<td>$27,113.8 ± 18,514.9</td>
</tr>
<tr>
<td>Total cost</td>
<td>$23,999.3 ± 12,265.6 #</td>
<td>$45,385.3 ± 32,203.3</td>
</tr>
</tbody>
</table>

Data presented as mean ± SD unless otherwise indicated, p significant if <0.005

Direct cost is the cost that is attributable to the patient and service provided (supplies, hospital stay, medical resources).

Indirect cost is the cost affected by institutional cost (operating room, staff) as whole and cannot specific to patient or procedure.

* p < 0.05 - different between C-Hyst in the main OR vs CD in the main OR
** p < 0.001 - different between C-Hyst in the main OR vs CD in the main OR
# p < 0.05 - different between C-Hyst in L&D vs C-Hyst in the main OR
## p < 0.001 - different between C-Hyst in L&D vs C-Hyst in the main OR

Comparisons between C-Hyst in L&D and CD in main OR where not performed.
INCIDENCE OF ABSENCE OR REVERSAL OF END DIASTOLIC FLOW IN THE UMBILICAL ARTERY DURING OPEN FETAL SURGERY

Presenter: Jina Sinskey, MD, Resident
University of California, San Francisco

Authors: Jina Sinskey, MD
Mark Rollins, MD (Faculty Mentor)
John Feiner, MD (Faculty Mentor)
Marla Ferschl, MD (Faculty Mentor)

Introduction:
Umbilical artery (UA) Doppler ultrasound is used to assess uteroplacental insufficiency during pregnancy. Absent or reversed end diastolic flow (AREDF) in the UA is associated with increased perinatal mortality, which is 4 times greater in pregnancies with absent EDF and 10 times greater with reversed EDF vs. normal forward EDF. We describe UA Doppler during open fetal surgery.

Methods:
We performed a retrospective review of patients undergoing open in utero fetal myelomeningocele repair between 2008-2013. Intermittent UA ultrasound and fetal echocardiography were used intraoperatively. Records were reviewed to determine the incidence of UA Doppler abnormalities and adverse outcomes. Patients with vs. without AREDF were analyzed using Wilcoxon rank-sum and Chi square or Fisher’s exact test.

Results:
21 of 28 patients (75%) had UA Doppler abnormalities. 9 (32%) had reversed EDF, 9 (32%) had absent EDF, and 3 (11%) had other abnormalities. Most AREDF episodes occurred immediately following induction of general anesthesia or with uterine incision. One patient had fetal asystole with intraoperative fetal demise with absent EDF prior to arrest. One case was aborted without uterine incision due to reversed EDF and bradycardia; no other adverse outcomes were noted. AREDF improved in 4 patients with volume infusion into the uterus. Patients with AREDF received less colloid (441±429 mL vs. 1,000±707 mL, p=0.023), but otherwise no differences were noted (Table 1). Pre- and post-operative UA Dopplers were normal in all patients excluding the case of fetal demise.

Conclusions:
UA Doppler ultrasound provides useful information about fetal well-being. Changes in intraoperative UA Dopplers could indicate impending fetal distress and should be evaluated at critical points of the surgery. Anesthesiologists play a significant role in optimizing maternal-fetal hemodynamics and intraoperative fetal well-being. Future prospective studies of UA flow during open fetal surgery are needed to help guide and improve perioperative care.
Table 1. Absent or Reversed End-Diastolic Umbilical Artery Flow (AREDF) and Patient Characteristics

<table>
<thead>
<tr>
<th></th>
<th>AREDF</th>
<th>No AREDF</th>
<th>All</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Patients</td>
<td>18 (64%)</td>
<td>10 (36%)</td>
<td>28 (100%)</td>
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<tr>
<td>Preoperative Vital Signs</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>HR (bpm)</td>
<td>83 ± 13</td>
<td>81.5 ± 22.0</td>
<td>82.8 ± 16.3</td>
<td>0.56</td>
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<tr>
<td>Systolic BP (mm Hg)</td>
<td>118 ± 10</td>
<td>112 ± 10</td>
<td>116 ± 10</td>
<td>0.20</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>67 ± 7</td>
<td>65 ± 8</td>
<td>66 ± 7</td>
<td>0.74</td>
</tr>
<tr>
<td>Mean BP (mm Hg)</td>
<td>86 ± 8</td>
<td>81 ± 9</td>
<td>84 ± 9</td>
<td>0.23</td>
</tr>
<tr>
<td>Intraoperative Vital Signs</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Maximum HR (bpm)</td>
<td>130 ± 15</td>
<td>131 ± 12</td>
<td>131 ± 14</td>
<td>0.96</td>
</tr>
<tr>
<td>Maximum Systolic BP (mm Hg)</td>
<td>153 ± 17</td>
<td>147 ± 22</td>
<td>151 ± 19</td>
<td>0.44</td>
</tr>
<tr>
<td>Maximum Diastolic BP (mm Hg)</td>
<td>90 ± 14</td>
<td>85 ± 11</td>
<td>88 ± 13</td>
<td>0.55</td>
</tr>
<tr>
<td>Maximum Mean BP (mm Hg)</td>
<td>114 ± 14</td>
<td>110 ± 15</td>
<td>113 ± 14</td>
<td>0.49</td>
</tr>
<tr>
<td>Minimum HR (bpm)</td>
<td>60 ± 10</td>
<td>63 ± 8</td>
<td>61 ± 9</td>
<td>0.28</td>
</tr>
<tr>
<td>Minimum Systolic BP (mm Hg)</td>
<td>86 ± 10</td>
<td>87 ± 11</td>
<td>86 ± 10</td>
<td>0.68</td>
</tr>
<tr>
<td>Minimum Diastolic BP (mm Hg)</td>
<td>45 ± 10</td>
<td>46 ± 6</td>
<td>46 ± 8</td>
<td>0.68</td>
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<tr>
<td>Minimum Mean BP (mm Hg)</td>
<td>61 ± 9</td>
<td>60 ± 8</td>
<td>61 ± 9</td>
<td>0.75</td>
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<tr>
<td>Anesthetic Agent</td>
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<td>0.22</td>
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<tr>
<td>Desflurane</td>
<td>5 (27.8%)</td>
<td>6 (60.0%)</td>
<td>11 (39.3%)</td>
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<tr>
<td>Sevoflurane</td>
<td>12 (66.7%)</td>
<td>4 (40.0%)</td>
<td>16 (57.1%)</td>
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<tr>
<td>Isoflurane</td>
<td>1 (5.6%)</td>
<td>0 (0.0%)</td>
<td>1 (3.6%)</td>
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<td>Intraoperative Drugs</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Total Phenylephrine (mcg)</td>
<td>6,976 ± 3,660</td>
<td>7,668 ± 3,049</td>
<td>7,223 ± 3,413</td>
<td>0.34</td>
</tr>
<tr>
<td>Total Ephedrine (mg)</td>
<td>21 ± 13</td>
<td>17 ± 15</td>
<td>20 ± 13</td>
<td>0.33</td>
</tr>
<tr>
<td>Use of Nitroglycerin</td>
<td>3 (16.7%)</td>
<td>1 (10.0%)</td>
<td>4 (14.3%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Intraoperative Fluids</td>
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<td></td>
<td></td>
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<tr>
<td>Crystalloid (mL)</td>
<td>1,362 ± 852</td>
<td>960 ± 576</td>
<td>1,213 ± 775</td>
<td>0.23</td>
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<td>Colloid (mL)</td>
<td>441 ± 429</td>
<td>1,000 ± 707</td>
<td>648 ± 602</td>
<td>0.023</td>
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<tr>
<td>EBL (mL)</td>
<td>294 ± 478</td>
<td>308 ± 269</td>
<td>299 ± 404</td>
<td>0.23</td>
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<td>Any pRBC (units)</td>
<td>1 (5.6%)</td>
<td>0 (0.0%)</td>
<td>1 (3.6%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Presence of IUGR</td>
<td>7 (38.9%)</td>
<td>4 (40.0%)</td>
<td>11 (39.3%)</td>
<td>1.0</td>
</tr>
<tr>
<td>Birth Weight (g)</td>
<td>2,485 ± 724</td>
<td>2,624 ± 437</td>
<td>2,536 ± 627</td>
<td>0.74</td>
</tr>
<tr>
<td>Gestational Age at Birth (weeks)</td>
<td>34 ± 3</td>
<td>35 ± 2</td>
<td>34 ± 3</td>
<td>0.54</td>
</tr>
</tbody>
</table>

Data are mean ± SD, or n (%). HR, heart rate; BP, blood pressure; pRBC, packed red blood cells; IUGR, intrauterine growth restriction.
REMOTE ISCHEMIC PRE-CONDITIONING CAN MODULATE THE SYSTEMIC RESPONSE TO VVS AND DECREASE SYNCOPAL EPISODES IN RAT MODELS

Presenter: Andrew Barnett, MD, Resident
Loma Linda University School of Medicine

Authors: Sameer Soliman, MD
Richard Applegate, MD (Faculty Mentor)
Devin McBride, PhD
Andrew Barnett, MD
Jiping Tang, MD (Faculty Mentor)

Introduction: Vasovagal syncope (VVS) is caused by a decrease in cardiac output and cerebral perfusion. The goal of this study is to determine if remote ischemic limb preconditioning (RIPC) will attenuate the effect of a vasovagal event and potentially offer a treatment mechanism.

Methods: Adult male rats were anesthetized using ketamine. A burr hole was created to allow cerebral blood flow measurement by laser Doppler flowmetry. Femoral catheterization provided blood pressure/heart rate monitoring and blood collection. Sinusoidal galvanic stimulation (sGVS) achieves similar hemodynamic effects to VVS and was induced by running a current through electrodes placed over the mastoids. Control group had 8 rats. In the test rats, RIPC was produced by placing a tourniquet on the hindlimb for 4 cycles of 10 minutes on/off for 5 or 10 consecutive days (4 rats in each group). Five days after RIPC, syncope was induced using sGVS, and parameters recorded in the same manner.

Results: Our results indicate initiation of sGVS is a good model for a syncopal event with MAP, heart rate, and cerebral perfusion all falling with sGVS and recovering over time. When comparing the the drop in MAP:HR:Perfusion during sGVS amongst the groups, the RIPC groups demonstrated an attenuation of the drop. Control (-11±8.6 : -38±17 : -44±26), 5 day RIPC (-1.7±1.2 : -1.9±4.4 : 1.5±27), 10 day RIPC (-0.3±2.4 : 2.4±2.4 : -2.3±2.4). At 5 minutes post-sGVS, the control rats matched the 5 day RIPC group and the 10 day RIPC group remained unchanged.

Conclusions: Data suggests RIPC decreases the extent of VVS response to sGVS 5 and 10 days after RIPC. Experiments are ongoing to produce statistical significance. We are also in the process of comparing serum catecholamine levels amongst the groups.
Do I really have to be asleep? Finding the Goldilocks of Anesthesia for Transcatheter Aortic Valve Replacement

Presenter: Yuan Jiun Nicole Chao, MD/DO, Resident
University of California, San Francisco

Authors: Martin Stechert, MD/DO (Faculty Mentor)
Yuan-Jiun Nicole Chao, MD/DO

In patients with severe aortic stenosis who are at increased surgical risk, Transcatheter Aortic Valve Replacement (TAVR) now presents an alternative to surgical aortic valve replacement. This technology is rapidly evolving in engineering and methodology, with new evidence emerging annually about its benefits and drawbacks (Kodali et al. N Engl J Med 2012;366:1686-95; Adams et al. N Engl J Med 2014;370:1790-8).

While studies for TAVR in patients with moderate surgical risk are on-going, this procedure is currently reserved for the high-risk patient: one who is elderly, frail, with history of CABG and associated hazard of a redo-sternotomy, or a combination of cardiovascular diseases likely to lead to post-operative complications after a major open surgical procedure. The choice of anesthesia for TAVR must account for invasive monitoring (pulmonary artery catheter, central line, and echocardiographic choice (TTE/TEE/ICE)) required for a successful and controlled valve placement while balancing against risks of anesthesia in a patient with serious comorbidities. Outcome measures include post-operative paravalvular regurgitation, stroke, and all-cause mortality.

Reported anesthesia techniques for TAVR include general anesthesia and local/MAC, as well as rare regional or neuraxial approaches. Yet, to date, no randomized prospective studies comparing either technique have been performed. In the US, most procedures are done using general anesthesia while in Europe there is an increasing trend using sedation for TAVR (Oguri et al, Circ Cardiovasc Interv. 2014;7:602-610).

I would like to present a discussion on the successes and difficulties of the case of a 64 year old female with severe aortic stenosis (AVA 0.45 cm²), morbid obesity, heart failure with preserved EF (HFrEF), chronic atrial fibrillation, obstructive sleep apnea, and severe persistent asthma on chronic steroids who underwent a transfemoral TAVR successfully under sedation with a combination of dexmedetomidine/remifentanil, with invasive monitors including arterial/central lines, intracardiac pacemaker lead placement, and transthoracic echocardiography.
The Effect of Dexamethasone on the Duration of Intercostal Nerve Blocks As Measured by Pulmonary Function Testing

Presenter: Dermot Maher, MD, Resident  
Cedars-Sinai Medical Center

Authors:  
Dermot Maher, MD  
Otto Thomas, MD  
Xiao Zhang, PhD  
Roya Yumul, MD  
Vida Zhang, MD (Faculty Mentor)

Background: Pain following Video Assisted Thorascopic Surgery (VATS) can be controlled with intercostal nerve blocks. However, the use of single injection blocks is limited by the analgesic half-life of local anesthetics, such as bupivacaine. The hypothesis of this study is that the addition of 4 mg dexamethasone to a bupivacaine solution will prolong the duration of an intra-operatively placed intercostal nerve block following VATS. The study also addresses whether there is added benefit of perineural dexamethasone in the setting of systemic dexamethasone.

Methods: In a double-blind, placebo controlled, prospective controlled trial, 40 patients were randomized to receive an intercostal nerve block containing 1) 0.5% bupivacaine with 1:200K epinephrine and 4 mg dexamethasone or 2) 0.5% bupivacaine with 1:200K epinephrine and 1 ml of 0.9% saline. All patients received 8 mg of intravenous (IV) dexamethasone. The primary outcome was pulmonary function testing (PFT) done every 4 hours following surgery. Secondary endpoints were pain as measured by an 11 point numerical rating scale (NRS-11) and opioid consumption both measured every 4 hours following surgery.

Results: The results indicate that, compared to preoperative PFTs, the dexamethasone had greater FEV1 measured at 24 hours, 32 hours and 48 hours, greater FVC compared to baseline at 24 hours, 28 hours and 48 hours, greater PEF compared to baseline at 32 hours, 36 hours, and 48 hours. There were no differences in FEV1/FVC compared to baseline. NRS-11 scores were lower in the dexamethasone group at 20 and 24 hours. Finally, equianalgesic opioid consumption was decreased in the dexamethasone group at 32 hours. No adverse events were noted.

Discussion: The addition of dexamethasone prolonged the duration of a single-injection bupivacaine intercostal nerve block as measured by objective PFTs and subjective NRS-11. The degree of prolongation was observed to last between 20 and 32 hours after surgery depending on the endpoint. Perineural infiltration with dexamethasone appears to confer additional benefit even in the setting of IV dexamethasone.
Self-Reported Exercise Tolerance and Perioperative Morbidity in Pulmonary Hypertension: March 2015 Update

Presenter: Aalap Shah, MD, Resident
University of Washington

Authors: Aalap Shah, MD
Kevin Ma, BA/BS
Alec Rooke, MD
Gail Van Norman, MD (Faculty Mentor)

Introduction: Patients with pulmonary hypertension (PHTN) presenting for elective surgery are at significantly higher risk for adverse perioperative outcomes, including increased hospital length of stay, right ventricular failure, cardiac arrhythmia, persistent postoperative hypoxemia, coronary ischemia and death. The diagnosis of PHTN is based on costly echocardiographic examination and right heart catheterization and should be reserved for high risk patients. No studies have assessed the role of self-reported functional classification on PHTN severity stratification, and few studies have achieved a sufficiently large patient sample size. We evaluate the predictive value of self-reported exercise tolerance on pre-operative echocardiogram findings, outcomes, and length of stay (LOS) after non-cardiac, non-obstetric surgery.

Methods: We queried the University of Washington AMALGA database for all PHTN seen in pre-operative anesthesia clinic for non-cardiac, non-obstetric procedures from April 2007 through September 2013. Inclusion criteria mandated an echocardiogram <1 year prior to the procedure and available patient-reported functional status (< or >= 4 METs). Univariate analyses were used to compare functional status with echocardiographic findings, complication rates, and length of stay (LOS). To date, we have collected information on 315 eligible patients (50.2% female, average age 61.3 +/- 14.4 years) with pre-operative evaluations and functional status (FS) classification, out of an estimated total of ~600 patient charts.

Results: Poor self-reported exercise tolerance (FS < 4 METs; 143 patients) was associated with ASA class >=III (p=.015) and BMI (34.6 +/-16.1 vs. 29.4 +/- 10.3; p=.001) as well as comorbidities including a history of angina (p=.008), CHF (p=.027), ventricular dysrhythmias (p<001), DMII (p=.004), and the use of supplemental oxygen (p=.009). Echocardiographic findings notable in the FS < METS group included a PASP > 59mmHg (p=.039) and aortic insufficiency (p=.036). Significant differences in pre-anesthesia clinic data including SBP (120.7 +/- 20.9 vs. 126.6 +/- 21.8; p=.027), HR (78.7 +/- 17.6 vs. 74.0 +/- 15.7; p=.022) and SaO2 (96.3% vs 97.6%) (p=.002), as well as an elevated pCO2 on ABG, were seen in the poor functional status group. Group 2 (poor FS) patients trended towards a higher complication rate at discharge (14.6% vs. 7.0%, p=.041), and had a higher cumulative number of complications (33 vs. 13; p=.035). However, there was no association with poor functional status and complications at 30 days after surgery (p=.122). At discharge, there were 3 deaths (2.0%) in the poor functional status group; however, three deaths occurred in the good functional status group patients by 30 days. The overall mortality for all PHTN patients at 30 days post-surgery was 2.0% (6 deaths). Poor functional status was associated with a longer length of stay (7.21 +/- 9.91 vs. 4.75 +/- 13.16 days; p=.047). Logistic regression analysis identified poor functional status (OR 2.09 (95% CI: 1.02-4.26; p=.044) and an open surgical approach (OR 2.39, 95% CI: 1.56-3.66; p=.052) as independent predictors of a LOS > 7 days.

Conclusions: Patient-reported functional status demonstrates associations with multiple cardiopulmonary comorbidities and independently predictive of a longer duration of hospital stay. Complications were minimal, without an incidental difference in the functional status groups at 30 days post-surgery.
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<td>2:</td>
<td>7.21 +/- 13.20</td>
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<td></td>
<td>2:</td>
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<td>Surgical Approach (OPEN)</td>
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<td>0.052</td>
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![ROC Curve](image)
Perioperative Risk Stratification of Critically Ill Patients

Presenter: Curtis Copeland, MD, Resident
University of California, Los Angeles

Authors: Curtis Copeland, MD
Anahat Dhillon, MD (Faculty Mentor)
Vadim Gudzenko, MD (Faculty Mentor)

Background:
Historically, preoperative risk stratification emphasized cardiac related morbidity and mortality in outpatients undergoing elective non-cardiac surgery. However, a growing population of critically ill patients present for diagnostic or therapeutic interventions, corresponding with advances in medicine, surgery, and anesthesia. Therefore, our study investigated the relationship of ASA class, RCRI, and SOFA score with postoperative survival to discharge in critically ill patients with advanced airways.

Methods:
After IRB-approval, medical records of ICU patients were reviewed over a 1 year time period. Eligible patients underwent a procedure and had a preexisting advanced airway. 1251 cases met the inclusion criteria. Cases were excluded for the following reasons: routine or bedside procedures, no documented advanced airway/procedure, pediatric patients, no anesthesia, cardiac surgery, and no preoperative ICU. Demographic, clinical, and surgical variables were collected from the electronic pre-anesthesia evaluation form and ICU flow sheet. The primary outcome was survival to discharge.

Results:
Between July 1, 2013 and July 31, 2014, 200 critically ill patients with advanced airways underwent 301 procedures, with 48 patients (24%) not surviving to discharge. There were significant differences between survivors and non-survivors for ASA class (3.7 vs 3.9, p=0.03), RCRI (1.7 vs 2.5, p=0.001), and SOFA score (8.8 vs 11.2, p=0.005). Based on the area under the curve for these relationships, there was only modest discrimination between the groups, ranging from the most useful RCRI (0.66) to SOFA (0.64) to the least useful ASA (0.59).

Conclusions:
This retrospective study quantified the exceptionally high perioperative risk of critically ill patients with advanced airways: one in four patients do not survive to discharge. Preoperative ASA score, revised cardiac risk index, and SOFA score partially delineated survivors and non-survivors, providing evidence for risk stratification of these patients. Interestingly, ASA class, the most ubiquitous of preoperative risk assessments, performed the worst of the three scores.
Antifibrinolytics Reduce Blood Loss in Adult Spinal Deformity Surgery: A Prospective, Randomized, Controlled Trial

Presenter: Austin Peters, MD, Resident
Oregon Health & Science University

Authors: Austin Peters, MD
Kushagra Verma, MD
Kseniya Slobodyanyuk, MD
Baron Lonner, MD
Thomas Errico, MD (Faculty Mentor)

Study Design:
This is a prospective, randomized, double-blinded comparison of Tranexamic Acid (TXA), aminocaproic acid (EACA), and placebo used intra-operatively in patients with Adult Spinal Deformity (ASD).

Objective:
The purpose of this study was to provide high-quality evidence regarding the comparative efficacies of TXA, EACA, and placebo in reducing blood loss and transfusion requirements in patients undergoing posterior spinal fusion surgery.

Summary of Background Data:
Spine deformity surgery usually involves substantial blood loss. The antifibrinolytics TXA and EACA have been shown to improve hemostasis in large blood loss surgeries.

Methods:
Fifty-one patients undergoing posterior spinal fusion of at least five levels for correction of ASD were randomized to one of three treatment groups. Primary outcome measures included intraoperative estimated blood loss (EBL), total loss (TL) (EBL + post-op blood loss) and transfusion rates.

Results:
Patients received TXA (n=19), EACA (n=19), or placebo (n=13) in the operating room (mean ages 60, 47, and 43, respectively); TXA patients were significantly older and had larger estimated blood volumes than both other groups. Total losses were significantly reduced for EACA vs. control, and there was a demonstrable but non-significant trend towards reduced intra-operative blood loss in both antifibrinolytic arms vs. control. EACA had significant reductions in post-operative blood transfusions vs. TXA.

Conclusions:
The findings in this study support the use of antifibrinolytics to reduce blood loss in posterior adult spinal deformity surgery.

Figure 2: Comparison of Peri-Operative Blood Loss
Illustration of blood loss for all groups. Statistical significant was reached for total losses between EACA and control. Intra-operative EBL and post-operative drainage were not statistically significant between any groups.
DIFFUSE CEREBRAL EDEMA AND CENTRAL HERNIATION FOLLOWING STATUS ASTHMATICUS: A CASE REPORT

Presenter: Joelle Karlik, MD/DO, Resident
Oregon Health & Science University

Authors: Joelle Karlik, MD/DO
Ansgar Brambrink, MD/DO (Faculty Mentor)

BACKGROUND:

Known non-traumatic causes of cerebral edema include central nervous system infections, anoxic brain injury, hyponatremia, malignant hypertension, and cerebral vascular insults. We present the case of a patient with cerebral edema resulting in central herniation following status asthmaticus with hypercarbic respiratory failure. Few descriptions of the link between status asthmaticus and brain pathology exist in the current literature.

METHODS:

Case report and review of the pertinent English-language literature.

RESULTS:

A 24 year-old female presented to an outside hospital in acute status asthmaticus after 24 hours of worsening shortness of breath and headache. After a short course of BiPAP, she was emergently intubated and paralyzed for difficult ventilation with high peak pressures. On hospital day two, she was noted to have a fixed dilated right pupil. Non-contrast head CT showed diffuse cerebral edema with central herniation. She was treated with mannitol and hyperventilation and was then transferred to our neurological sciences ICU. PaCO2 at the time of transfer was 58 mmHg. On arrival, an EVD was emergently placed and hypertonic therapy was initiated. Subsequent brain MRI showed diffuse leptomeningeal enhancement and known cerebral edema. Infectious workup revealed respiratory syncytial virus as a likely trigger of her asthma flare. No other infectious, metabolic, cardiovascular, rheumatological derangements or focal intracranial lesions were found. After significant workup from neurosurgical and neurology services, it was thought that her status asthmaticus and hypercarbia contributed to her severe cerebral edema. She was eventually discharged with normal respiratory and neurological status.

CONCLUSION:

To our knowledge, this is a rare case that reports the relationship between severe hypercarbia and cerebral edema. Physiological links between hypercarbia and cerebral edema will be reviewed. Successful treatment requires an appropriately high level of suspicion followed by targeted cerebral edema resuscitation strategies and restoring normocarbia.
Assessment of Preoperative Anxiety Using Visual Facial Anxiety Scale vs. Verbal Rating Scale

Presenter: Julianne Ahdout, MD/DO, Resident
Cedars-Sinai Medical Center

Authors: Julianne Ahdout, MD/DO (Faculty Mentor)
Roya Yumul, MD/DO (Faculty Mentor)

Background: The evaluation of preoperative anxiety level prior to elective surgery can be a difficult task for physicians. The Visual Facial Anxiety Scale (VFAS) was designed to (1) compare and correlate the relationship between the VFAS and the Verbal Rating Scale (VRS, 0 = none to 10 = extreme anxiety) when used by patients and anesthesiologists, and to (2) determine whether or not preoperative anxiety is formally evaluated by anesthesiologists.

Methods: After obtaining IRB approval, 200 patients were asked in the preoperative holding area to report their current anxiety level using the VFAS and the VRS, as well as to categorize their anxiety level as mild, moderate, or severe. The anxiety level were then asked of the attending anesthesiologists after they had visited the patients. In addition, the anesthesiologists were asked whether or not they had evaluated the patient directly for anxiety, answering “yes” or “no”. Results: There was a significant correlation between the VRS and VFAS in both patients (r=0.79, p<0.0001) and anesthesiologists (r=0.92, p<0.0001), but utilization of the VFAS resulted in 58% concordance of anxiety level between the patient and anesthesiologist, while the VRS resulted in 35% concordance. Interestingly, 70% of anesthesiologists did not evaluate the patients’ preoperative anxiety level, and none used a measurement tool.

Conclusion: Anesthesiologists do not routinely evaluate patients’ anxiety levels preoperatively. The use of VFAS was more reliable than the VRS for assessing preoperative anxiety by both patients and anesthesiologists. Compared to the VAS, the new VFAS reduces the discrepancy between patients and anesthesiologists when evaluating preoperative anxiety level, which could improve care of the patient by the anesthesiologist in reducing preoperative anxiety.
A comparison of mortality risk with propofol, ketamine, or combination ketamine+propofol as induction agents in adults undergoing non-cardiac surgery

Presenter: Godwin Tse, BA/BS, Student
University of Southern California

Authors: Godwin Tse, BA/BS
Aren Nercisian, BA/BS
Noel Bennett, BA/BS
Ergit Paparisto, BA/BS
Mary Joseph, MD/DO (Faculty Mentor)

Introduction: Propofol is commonly used for induction of anesthesia for elective surgery, whereas ketamine is usually used for emergent or hemodynamically unstable cases. Our goal is to determine if combination ketamine+propofol or ketamine alone is associated with reduced 30-day mortality when compared to propofol alone for anesthesia induction in patients undergoing non-cardiac surgery.

Methods: In this retrospective cohort study, electronic medical records of 12330 patient observations aged 18 years or older undergoing non-cardiac surgery at LAC+USC Medical Center were reviewed from Jan 1, 2009 to Jun 1, 2014 as approved by our institutional review board. Patients administered combination ketamine+propofol or ketamine alone were compared to propofol alone with the outcome being 30-day mortality. Logistic regression and Cox regression were used to compare observations in each agent group while controlling for covariates such as age, gender, race, anesthesia duration, ASA physical status, and American Heart Association (AHA) surgical risk stratification.

Results: The odds of 30-day mortality for combination ketamine+propofol were nearly the same as propofol (OR=1.03, 95%CI: 0.51-2.04) whereas for ketamine, the odds were 3 times larger than that of propofol (OR=3.05, 95%CI: 1.79-5.19, p<0.0001). In addition, combination ketamine+propofol showed a mortality hazard ratio of 1.09 (95%CI: 0.57-2.07) compared to propofol. Ketamine showed a higher mortality hazard ratio of 2.83 (95%CI: 1.80-4.44, p<0.0001) than propofol.

Discussion: Our results do not suggest a statistical association between combination ketamine+propofol and 30 day mortality. There is a statistically significant association between ketamine and the incidence and rate of 30 day mortality. This is potentially because ketamine is used as an induction agent for sicker patients. A prospective study may be beneficial in further exploring mortality risk and our selected agents.
Interventions to Improve the Quality of Written Feedback

Presenter: William Alexander Edwards, MD, Resident  
University of California, San Francisco

Authors: W. Alex Edwards, MD  
Marla Ferschl, MD (Faculty Mentor)  
Manny Pardo, MD (Faculty Mentor)

Introduction: Feedback, while easy to neglect, is important for learners. The 2012-2013 ACGME survey at our institution indicated that only 31% of our anesthesia residents were satisfied with feedback after assignments. We sought to examine our existing feedback model and design a new feedback tool to increase the quantity and quality of faculty’s written feedback for residents.

Methods: We distributed a pre-intervention needs assessment survey to residents and faculty. Based on these data we created a new weekly feedback tool using SurveyMonkey. We designed a 3-minute online video for faculty, entitled “Tips and Tricks for Effective Written Feedback”. To determine the effectiveness of our two interventions, we collected six months of pre-and post-intervention data. The quantity of evaluations was assessed, and evaluation comments were coded as reinforcing global, reinforcing specific, corrective global, or corrective specific (1). Individual comments could contain statements that satisfied more than one qualifier. A logistic regression model was performed and results were controlled for repeated measures, gender, primary clinical site, and professorship rank/title.

Results: We found a significant effect of the intervention on the quantity and the quality of comments. In the post intervention group, significantly more specific reinforcing and corrective comments were written for residents. There was no effect of rank, site, or gender on the difference between quality of the pre and post-intervention comments.

Conclusions: A novel feedback tool improved the quantity and quality of written feedback in our residency program. Future directions may be to determine if higher quality comments lead to improvement in resident performance or satisfaction with their evaluations.

<table>
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<td>n</td>
<td>2255 (78.3%)</td>
<td>624 (21.7%)</td>
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<tr>
<td>Reinforcing Global</td>
<td>185 (8%)</td>
<td>131 (21%)</td>
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<td>Reinforcing Specific</td>
<td>290 (13%)</td>
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<tr>
<td>Corrective Global</td>
<td>25 (1%)</td>
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<tr>
<td>Corrective Specific</td>
<td>47 (2%)</td>
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Applicant Perceptions of Web-Based Anesthesiology Residency Interviews

Presenter: Alex Serafin, MD/DO, Resident
Loma Linda University School of Medicine

Authors: Alex Serafin, MD/DO
Marissa Vadi, MD/DO (Faculty Mentor)
Mathew Malkin, MD/DO (Faculty Mentor)
Robert Martin, MD/DO (Faculty Mentor)
Richard Applegate II, MD/DO (Faculty Mentor)

Background:
Traditional anesthesiology residency interviews involve in-person meetings at each prospective training site. For many applicants, interviews require significant travel, time away from medical school, financial hardship and decreased educational productivity. We investigated applicant satisfaction with web-based residency interviews as an alternative to traditional in-person interviews.

Methods:
During the 2014-2015 residency match cycle, applicants to the Loma Linda University Medical Center anesthesiology residency program were asked to request either web-based (FaceTime® or Skype™) or in-person interviews. To approximate traditional interviews, web-based applicants were provided a voice-over version of the introductory slide presentation given to in-person applicants on interview days, and a video tour of Loma Linda University Medical Center and its surrounding area. Web-based applicants were also able to interact with current residents via audio-visual Google Hangouts™ on interview days. We compared applicant characteristics, their reasons for choosing an interview modality, and assessed perceptions of interview quality via anonymous surveys.

Results:
Of scheduled interviews, 124 (73.4%) selected in-person and 45 (26.6%) selected web-based. Technical failure prevented initiation of 1 web-based interview. 111 applicants completed surveys (Table). More web-based lived outside California. The most common reasons for selecting a web-based interview were conflict of interview dates between programs or financial limitations.

Web-based interviews met or exceeded expectations of all completing the survey. Technical aspects met or exceeded expectations for nearly all respondents. A few respondents gave suboptimal ratings to audio (n=1), video (n=2) or eye contact (n=3). After completing web-based interviews, 59% of respondents favored initial web-based interviews with a later option to tour facilities; 34% indicated in-person to be their preferred modality.

Residency match results are pending.

Conclusions:
Web-based anesthesiology residency interviews are a viable alternative to traditional in-person interviews and may allow applicants to complete more residency interviews without unduly increasing financial burdens.

Table 1

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<td>West other than California</td>
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<td>Midwest</td>
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<td>Geographic region of Medical School # (%)</td>
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This study examined the roles of various stakeholders in the role of drug shortages.

Drug Shortages Crisis

The number of total drug shortages has almost tripled from 2010 to 2013 while the number of drug shortages prevented has also grown in number. Certain medical fields, such as anesthesiology and oncology, encounter the highest percent of drugs shortages.

Government Response

In 2012, the FDA received authority to expedite reviews and inspections. In 2013, the FDA issued another report aimed to mitigate current drug shortages and develop long-term prevention strategies.

Stakeholders’ Responses

Pharmaceutical manufacturers, largely represented by the International Society of Pharmaceutical Engineering (ISPE), have found that the lack of a “quality system”, defined as a system that complies with regulations enforced by the FDA as well as the presence of internal procedures and specifications, to be the most common cause of drug shortages. They recommended ten additional factors to mitigate drug shortages.

Professional medical organizations are actively conducting research, lobbying Congress, and partnering with other stakeholders.

The U.S. Government, through the FDA, has updated its drug shortage website and begun to track artificial drug price mark-ups.

Health care providers are sharing information with websites and RSS feeds.

Hospitals have begun to prioritize distribution of their medications and to appoint staff to manage drug shortages.

Looking Ahead

The Drug Quality and Security Act, signed in November 2013 by President Obama, requires all drugs to have a complete transaction list of all purchases and sales each drug from the time of manufacture in order to ensure a steady supply and high quality product to potential buyers.
**Survival and Neurological Outcomes of Cardiac Arrests at a University-Affiliated Tertiary Care Veterans Affairs Health Care System**

**Presenter:** Felipe Perez, MD, Resident  
Stanford University

**Authors:**  
*Felipe Perez, MD*  
*Steven Howard, MD*  
*Edward Mariano,*  
*Geoffrey Lighthall, MD*  
*T.Kyle Harrison, MD (Faculty Mentor)*

**BACKGROUND:** Up to 750,000 in-hospital cardiac arrests occur annually in the United States with a small percentage surviving resuscitation attempts. There is no widely accepted quality metric to gauge the effectiveness of a hospital’s response to these events. Recently the cardiac arrest survival post-resuscitation in-hospital (CASPRI) scoring system has been developed (Chan et al 2012) which has given a potential benchmark for hospital to use to evaluate their resuscitation efforts.

**METHODS:** With IRB approval all “code blue” events at a tertiary care university-affiliated Veterans Affairs hospital (VA Palo Alto), were reviewed from fiscal year 2010 to 2013. CASPRI scores were used to measure the VA Palo Alto’s performance, and these results were compared with Get With The Guidelines (GWTG) national registry hospitals. Multivariate logistic regressions were performed to identify the variables associated with return of spontaneous circulation (ROSC) and favorable neurological outcome at discharge.

**RESULTS:** 70 patients met inclusion criterion of which 25 (35.71%) had ROSC and 19 (27.14%) had a favorable neurological state at discharge. Compared to the GWTG national registry, VA Palo Alto had more patients discharged from the hospital in a favorable neurological state (p<0.01). Patients who had kidney failure prior to cardiac arrest had an increased likelihood of having a poor neurological state at discharge (OR 11.65, 95% CI 1.42-94.45, p=0.02). Patients who had congestive heart failure prior to cardiac arrest had an increased likelihood of leaving the hospital in a favorable neurological state (OR 0.15, 95% CI 0.03-0.74, p=0.02).

**CONCLUSION:** CASPRI scores can be used to measure the effectiveness or a hospital’s response to cardiac arrest and when compared to the GWTG registry it can provide a means to track quality improvement. Further research is warranted to explore positive and negative risk factors associated with a favorable neurological outcome at discharge following in-hospital cardiac arrest.
Fig. 1: Percent of Favorable Neurological Survival at Hospital Discharge. The patients were stratified into Cardiac Arrest Risk Scores that were based on Chan et al 2012 Get With the Guidelines (GWTG)-Resuscitation registry Cardiac Arrest Survival Post-Resuscitation In-Hospital (CASPRI) score card. The bar graphs demonstrate the total number of patients that had favorable neurological outcomes and poor neurological outcomes after return of spontaneous circulation at the VA Palo Alto. A favorable neurological outcome is a Cerebral Performance Categories (CPC) Scale score of 1 (confusional, mild neurological or psychological deficit) and 2 (sufficient neurological function for independent activities of daily life (ADLs)), A score of 3 (inability to perform independent ADLs), 4 (comatose or vegetative state), or death are scores of a poor neurological outcome. The line graphs demonstrate the percentage of favorable outcomes at the VA Palo Alto and the average percentage of favorable outcomes at the hospitals that contributed to the national GWTG-Resuscitation registry.
Introduction

Malpractice suits are the main driver of medical quality in the US healthcare system and remain the primary focus by which providers are held accountable for providing care. Anesthesiologists are considered among the highest risk group.

Methods

Information was gathered from the National Practioner Data Bank which is a federal repository that collects and disseminates adverse information regarding healthcare practitioners in the United States. During the 9-year period between 2005 and 2013, 2,408 medical malpractice claims were attributed to physician anesthesia providers and met criteria for inclusion in the study.

Results

Of the included claims, 1,841 (76.5%) occurred in the inpatient setting and 567 (23.5%) occurred in the outpatient setting. The median payment for all anesthesia-related claims is $245,000 (IQR = $457,589). Inpatient claims are significantly more expensive than outpatient claims (p<0.001). The median payments for inpatient and outpatient claims are $261,742 (IQR = $483,611) and $189,349 (IQR = $415,719), respectively.

Over the 9-year period, the frequency of anesthesia-related claims decreased 41.4% (4.6%/year). Inpatient claims decreased a total of 45.5% (5.1%/year) and outpatient claims decreased 24.3% (2.7%/year).

Conclusions

The frequency of outpatient claims has remained stable over time compared to the decrease in inpatient claims. Outpatient claims represent an increasing proportion of spending for anesthesia malpractice.
Concurrence of intraoperative hypotension, low minimum alveolar concentration, and low bispectral index is associated with postoperative death

Presenter: Elliott Karren, MD, Resident
University of Utah

Authors: Elliott Karren, MD
Mark Willingham, MD
Michael Avidan, MD/DO (Faculty Mentor)

There is ongoing controversy regarding the association between increased postoperative mortality and intraoperative hypotension, deep hypnosis, and low anesthetic dose. Current research has yielded conflicting results as to whether the concurrence of these variables at clinically insignificant thresholds are associated with poor outcomes, including post-operative mortality. We sought to further evaluate this relationship in a multicenter population. A retrospective, observational study was performed that included 13,198 patients who were enrolled in B-Unaware, BAG-RECALL, and Michigan Awareness Control Study clinical trials. The triple low (TL) state was defined by a minimum alveolar concentration (MAC) <0.7 with a concurrent mean arterial pressure (MAP) <75 mmHg and bispectral index values (BIS) <45. We propensity matched patients who had at least 15 minutes of triple low to controls with similar demographic characteristics and comorbidities. We then used a multivariable cox proportional hazards model to evaluate the association between triple low duration and postoperative mortality. Thirty-day mortality was 0.8% overall, 1.9% in the TL cohort, and 0.4% in the non-TL cohort (Odds Ratio (OR) [95% Confidence Interval (CI)] = 5.16 [4.21 to 6.34]). After matching and adjusting for comorbidities, cumulative duration of triple low was significantly associated with an increased risk of mortality at 30 days (Hazard Ratio (HR) 1.10 [1.05 to 1.14] per 15 minutes) and 90 days (HR 1.09 [1.06 to 1.12] per 15 minutes). Cumulative exposure to MAP <75 mmHg, BIS<45, and MAC <0.7 was independently associated with increased 30 and 90 day post-operative mortality. Further research, including prospective controlled clinical trials should be performed to determine whether this effect is causal or epiphenomenal
Use of Advanced Monitoring is Associated with Fewer Alarm Events During Planned Moderate Procedure Related Sedation: A Two-Part Pilot Trial

Presenter: Oliver Small, MD/DO, Resident
Loma Linda University School of Medicine

Authors: Oliver Small, MD/DO
Richard Applegate II, MD/DO (Faculty Mentor)
John Lenart, MD/DO (Faculty Mentor)
Mathew Malkin, MD/DO (Faculty Mentor)
Alison Kruger, MD/DO

Background: Diagnostic and interventional procedures are frequently facilitated by moderate sedation. While studies support overall safety of this sedation, adverse cardiorespiratory events are reported in up to 70% of these procedures. Pulse oximetry may under report hypoventilation during sedation, particularly if supplemental oxygen is provided. Capnometry may give false alarms during sedation. Advanced monitors may allow detection of events before complications develop during sedation. This two-part study used advanced monitors during planned moderate sedation to: 1) determine incidences of desaturation, low respiratory rate and deeper than intended sedation alarm events; and 2) determine if advanced monitor use is associated with fewer alarm events.

Methods: Adults undergoing scheduled gastroenterology or interventional radiology procedures with planned moderate sedation by procedural sedation teams were monitored per standards (ECG, blood pressure, pulse oximetry and capnometry) with advanced monitors (acoustic respiration and processed EEG). Data collected continuously to computers. In Part 1 (Standard), advanced monitor parameters were not visible to procedural sedation teams; for Part 2 (Advanced) they were. Alarm events were defined: desaturation – SpO2 ≤92%; respiratory depression – acoustic respiratory rate ≤8BPM; deeper than intended sedation indicated by processed EEG. The number of alarm events was compared.

Results: 100 enrolled; 10 were excluded for data collection malfunction or consent withdrawal; 90 analyzed. Advanced had 34.6% fewer total alarms (p=0.04). Thirty-seven Standard and 34 Advanced patients had ≥1 alarm event (p=0.24). 35% fewer Advanced patients had ≥1 respiratory depression event (p=0.03) and 40% fewer had ≥1 desaturation event (p=0.02). We found no difference in deeper than intended sedation events (overall 31.1%; p=0.89)

Conclusions: Use of advanced monitoring during planned moderate sedation was associated with 35% to 40% fewer alarm events and patients experiencing desaturation or low respiratory rate alarm events. This pilot study supports further investigation into impacts of advanced monitoring during procedure related sedation.
Standard had more total (A) and per patient (B) alarm events recorded during moderate procedure related sedation than Advanced (p=0.04). Fewer Advanced patients had respiratory rate ≤8 breaths per minute (p=0.03) or SpO2 ≤92% (p=0.02) alarm events.
Use of actigraphy to assess outcomes in the pediatric perioperative period: literature review and future research agenda

Presenter: Joelle Karlik, MD/DO, Resident
Oregon Health & Science University

Authors: Joelle Karlik, MD
Nicole Conrad, MD
Amy Holley, PhD
Anna Wilson, PhD
Jeffrey Koh, MD/DO (Faculty Mentor)

Actigraphy is a validated measure of sleep and physical activity that is increasingly being used to evaluate the effects of surgery. This poster provides a literature review of perioperative pediatric actigraphy and presents an agenda for future research.

A literature search was completed using OVID. Terms included: actigraphy, pediatrics, perioperative period and anesthesia. Included studies utilized perioperative actigraphy assessment in a pediatric population and were published in peer-reviewed journals. Of 18 articles identified, 11 met inclusion criteria. Studies were published between 2005-2014 and included actigraphy data ranging from 3-10 days pre/post procedure with follow-up ≤12 months.

Across studies participants were 3-52 years (1 study included 8 patients over 18) and ranged from ambulatory surgery patients to post cardiac surgery and critically ill. Studies were grouped into 1) descriptive studies of sleep after ambulatory surgery, 2) studies evaluating post-op energy expenditure in critically ill children, and 3) studies focusing on the impact of perioperative interventions on post-op activity or sleep.

Overall, studies revealed that surgery has a negative impact on post-op sleep, activity and energy expenditure. Findings from group 1 show that children had significantly less efficient sleep post operatively and that poor sleep was associated with preoperative anxiety and worse post-op pain control [1]. Predictors of poor sleep included pre-op sleep patterns, post-op pain and parental anxiety [2]. Conclusions from group 2 indicate that critically ill children have significantly reduced activity and energy expenditure post-op. Group 3 studies demonstrate no differences in post-op sleep or activity with the tested interventions. For instance, one study found no difference in post-op sleep when using sevoflurane vs halothane [3]. Using actigraphy to assess interventions is an important potential focus of future pediatric perioperative research.

This review describes current actigraphic research in pediatric perioperative medicine. Sleep and activity are important to post-op recovery and results show surgery has a negative impact on sleep and activity levels. Previous work shows that children have significant sleep disturbances after surgery but there have been few studies comparing sleep patterns and activity levels when manipulating different anesthetic variables. More extensive adult literature has used actigraphy as an outcome when comparing different perioperative variables. Children cannot always provide reliable or accurate self-report, particularly perioperatively. Actigraphy may be used as an objective assessment tool in pediatric patients, particularly those with neurologic diagnoses or developmental delay.


Incidence and Risk Factors for Intraoperative Seizures during Elective Craniotomy

Presenter: Rachel Kutteruf, MD, Fellow
University of Washington

Authors: Rachel Kutteruf, MD
Deepak Sharma, MD (Faculty Mentor)
James Hecker, MD

Background & Aim: Intraoperative seizures during craniotomy may contribute to adverse outcomes. The knowledge of potential risk factors may be helpful in identifying patients at higher risk of seizures and institute appropriate prophylactic anticonvulsant therapy. The aim of this study is to identify the risk factors for intraoperative seizures during elective craniotomy.

Methods: This is an IRB approved, retrospective chart review study of adult patients who underwent elective craniotomy at Harborview Medical Center between June 2006 and December 2014. We will compare clinical characteristics of patients who had seizures during craniotomy with those who did not have seizures and perform appropriate statistical analyses to identify the risk factors for intraoperative seizures. We will also compare the effectiveness of various anticonvulsant medications in preventing intraoperative seizures.

Initial Observations:

1) The average annual incidence of intraoperative seizures during craniotomy was 1.5% during years 2006-2009, which increased to 8.3% in 2010.

2) The seizures occurred during or immediately following removal of the bone flap, were independent of the indication for craniotomy and none of the affected patients had a history of preexisting seizures.

3) All patients with seizures received propofol-remifentanil anesthesia and evoked potential monitoring.

4) There was a temporal correspondence with an increase in the use of levetiracetam (instead of phenytoin) for intraoperative seizure prophylaxis.

5) Replacement of levetiracetam with fosphenytoin in the later part of year 2011 resulted in a decrease in the incidence of seizures to 5.3%.

6) Only one intraoperative seizure was noted during craniotomy in 2012.

Discussion: While craniotomy has the potential for irritation of the cerebral cortex and motor evoked potential monitoring, remifentanil, propofol and hyperventilation can all lower the seizure threshold, levetiracetam in this series may have permitted intraoperative seizures to occur at an increased frequency. This observation requires confirmation from completion of ongoing investigation.
Power Outage in the OR: Electrical Power and Anesthesia Safety

Presenter: Robin Robbins, MD, Resident
University of California, San Diego

Authors: Robin Robbins, MD
Gerard Manecke, MD (Faculty Mentor)
Rekha Chandrabose, MD (Faculty Mentor)

Background:

Health care facilities are critically dependent on electrical power. Power outages in the operating room are rare events but can endanger patient safety and be life-threatening emergencies. This case discusses clinical management during total power failure in the operating room.

Case Description:

This is a case of a 65 year-old woman with a remote history of throat cancer who presented for bilateral distal femur open reductions and intermedullary nail fixations secondary to a dune buggy accident. Preoperatively, we placed two peripheral intravenous lines and a radial arterial line. We proceeded with an uneventful induction and intubation. Glidescope was used due to history of soft palate radiation and presence of a c-collar. General anesthesia was maintained with nitrous oxide, sevoflurane, and oxygen. While in the process of closing the right femur incision, a complete OR power outage occurred. Backup power to the anesthesia machine failed. Endotracheal tube was connected to a Mapleson circuit with a backup tank as oxygen source, ventilation was confirmed and anesthesia was maintained with propofol. A portable monitor was used for continuous vitals monitoring. Power returned approximately 8 minutes later. Patient was reconnected to the ventilator circuit and anesthesia machine monitors. We were notified that power loss could recur and it was determined that definitive fixation of the left lower extremity should be deferred. Therefore, external fixation of the left lower extremity was completed with plan to return to operating room at a later date. Patient remained stable throughout the remainder of surgery without evidence of recall upon emergence from anesthesia.

Discussion:

Anesthesiology is a resource-intensive specialty with heavy reliance on computerization and electricity. Anesthesia providers must educate themselves about how the anesthesia machine uses electricity, and develop contingency plans in the event of a complete electrical power failure.
Validation of COLDS Score: A Pre-anesthetic Risk Assessment

Presenter: Marsha Kristel Bernardo, MD/DO, Resident
University of California, Los Angeles

Authors: Marsha Kristel Bernardo, MD/DO
Lisa Lee, MD/DO
Katherine Chiu, MD/DO
Wendy Ren, MD/DO (Faculty Mentor)

Background and Purpose: Perioperative respiratory adverse events (PRAE) are a major cause of morbidity and mortality. These events have been implicated in 30% of perioperative cardiac arrests in the pediatric population during anesthesia. However, there are currently no widely accepted risk assessment tools to aid in decision making on whether or not to proceed with surgery or anesthesia. The purpose of this study is to validate the COLDS score proposed by Lee and August. This risk assessment scale consists of 5 questions to the acronym COLDS for Current signs and symptoms, Onset of Symptoms, presence of Lung disease, Device for airway management, and Surgery type. We evaluated the correlation between the COLDS score and the incidence of PRAE.

Methods: Data was prospectively collected on 325 patients under 6 years of age presenting for surgery at Ronald Reagan UCLA Medical Center. Patients with cyanotic heart disease, tracheostomy or endotracheal tube in-situ were excluded. Anesthesia providers preoperatively filled out the COLDS score and intra-operatively recorded the occurrence of any perioperative respiratory complications during induction, maintenance, emergence and in the PACU phase. Predictive value was assessed using a receiver operating characteristic (ROC) curve.

Results: In the ROC curve analysis, the area under the curve (AUC) for the total COLDS score was 0.714. The scoring system appears to be better at predicting the incidence of bronchospasm (AUC 0.75, p-value 0.003), oxygen desaturation (AUC 0.718, p-value <0.001) than laryngospasm (AUC 0.545, p-value 0.627). The predictive value of the scoring system appears to be better in a younger population, ages 0-1 year (AUC 0.791) and ages 1-2 years (AUC 0.759).

Conclusion: The COLDS score has the potential to be a valuable risk assessment system in the prediction of perioperative respiratory complications.

<table>
<thead>
<tr>
<th>C</th>
<th>Current signs and symptoms</th>
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<tbody>
<tr>
<td>None</td>
<td>Mild</td>
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<tr>
<td>- Parent confirms URI and/or congestion, rhinorrhea, sore throat, sneezing, low fever, or dry cough</td>
<td>- Purulence, wet cough, abnormal lung sounds, lethargy, toxic appearance, or high fever</td>
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<td>&gt;4 weeks ago</td>
<td>2-4 weeks ago</td>
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<tr>
<th>L</th>
<th>Lung Disease</th>
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<tbody>
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<td>None</td>
<td>Mild</td>
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<tr>
<td>- Hx of RSV, mild intermittent asthma, CLD if &gt;1 year old, loud snoring, or passive smoking</td>
<td>- Moderate persistent asthma, infant with CLD, OSA, or pulmonary HTN</td>
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<td>D</td>
<td>Airway Device</td>
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<tr>
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<tr>
<td>None or face mask</td>
<td>Laryngeal mask airway or supraglottic</td>
</tr>
</tbody>
</table>

**Table 1.** The COLDS Score, from Lee, B. J. and August, D. A. (2014), COLDS: A heuristic preanesthetic risk score for children with upper respiratory tract infection. Pediatric Anesthesia, 24: 349–350.
GENERAL ANESTHESIA IS NOT NECESSARY FOR HEMODIALYSIS ACCESS SURGERY

Presenter: Gurpreet Dhaliwal, MD, Resident
Harbor-UCLA Medical Center

Authors: Jerry Kim, MD
Gurpreet Dhaliwal, MD
Gloria Kim, BA/BS
Janette Derdemezzi, MD
Christain de Virgilio, MD (Faculty Mentor)

Introduction: A large meta-analysis has identified chronic kidney disease (CKD) as an independent risk factor for mortality after elective procedures under general anesthesia (GA, odds ratio 5.1). Nevertheless, a recent study showed that more than 85% of arteriovenous fistulas (AVF) in the U.S. are performed under GA, with all deaths occurring in the GA group.

Objective: To demonstrate that GA can be avoided in patients with CKD and end-stage renal disease undergoing hemodialysis access surgery by using local anesthesia (LA) under monitored anesthesia care or brachial plexus block (BPB).

Methods: A retrospective review of a prospectively collected database was performed that included all AVF and arteriovenous graft (AVG) procedures performed between January 2011 and July 2014 at a single institution. Demographic information, anesthetic approach, and types of drugs administered were reviewed. Main outcome measures included need for conversion to GA, major peri-operative complications, and 30 day mortality. Patients who received LA were compared to those who received BPB. Chi-squared test and two-tailed student’s t-test were used for statistical analysis.

Results: Four-hundred and fifteen hemodialysis access procedures were performed by seven vascular surgeons between January 2011 and July 2014. The median age was 52 and most patients were male (64%). AVF was placed in 378 (91%) patients, AVG was placed in 32 (7.7%) patients, and 4 (1%) received unsuccessful extremity exploration. There were 267 (60%) diabetics and 272 (66%) were hemodialysis dependent at the time of surgery. Anesthetic approach was LA with monitored anesthesia care in 344 (83%) and BPB in 65 (15.7%). GA was initially induced in 3 (0.7%) patients and 3 (0.7%) additional patients required conversion to GA from LA. There were no cardiopulmonary events or peri-operative deaths. When comparing LA and BPB groups; there was no statistical difference in age, diabetes, or peri-operative complications. However, the BPB group had more females (51% vs. 33%, p = 0.03), a higher rate of hemodialysis dependence at the time of surgery (77% vs. 63%, p = 0.03), a higher rate of AVG (17% vs. 5%, p<0.001), a lower mean ASA classification (3.3 vs. 3.5, p = 0.02), and fewer intravenous anesthesia medications administered (mean 1.7 vs 2.1, p = 0.002).

Conclusion: GA can be avoided in hemodialysis access surgery. LA and BPB were associated with no cardiopulmonary events or death and conversion to GA was rare.

*** Please note this abstract was also submitted and accepted to Southern California Chapter American College of Surgeons.
Mental Rotation Test for Evaluation of Visual-Spatial Abilities in Ultrasound Guided Regional Anesthesia

Presenter: Manna Hagos, MD, Student
University of Southern California

Authors: Gligor Gucev, MD (Faculty Mentor)
Manna Hagos, BA/BS
Dimiter Arnaudov, MD
Chuck Nguyen, MD
Michael Tom, MD

Visual-spatial abilities have been recognized as important factor in acquisition of complex skills based on image interpretation.1,2 The mental rotation test (MRT) is a powerful test of visual-spatial abilities that is easy to use and has been validated in learning of psychomotor skills.3 This study explored the use of MRT in assessment of visual-spatial aptitude for learning of ultrasound guided regional anesthesia skills. It may also offer a new screening tool for ultrasound guided regional anesthesia (UGRA) education.

This prospective study evaluated the correlation of visual-spatial ability measured with MRT and block design test (BDT) with performance on UGRA high fidelity simulator. For that purpose, after IRB approval, 38 first and second-year medical students without any prior experience in UGRA were recruited for the study. Each subject then completed the two visual-spatial aptitude tests. Mental rotation test is designed to evaluate subject’s visual-spatial aptitude. It consists of 20 sets of rotated images that the subject needs to analyze in 10 minutes. The BDT consists of assembly of 2-dimensional patterns using 3-dimensional blocks. BDT is a subtest of the Wechsler Adult intelligent Scale III (WAIS-III) designed to assess visual-spatial aptitude. This test was used to determine whether participants' ability to construct 2-dimensional patterns from 3-dimensional objects would correlate with simulated UGRA task performance. The performance was measured with a UGRA skills rating scale that was developed at USC Department of Anesthesiology to capture generic and task specific UGRA skills.

Out of 38 registered, 31 medical students completed all of the assignments. Seven students did not complete all three assignments and were excluded from the study. The results of our study suggest higher correlation ($r=.522$) between the results of the MRT and performance of UGRA than the results from the BDT and performance of UGRA ($r=-.102$).
Timeout Compliance during Regional Anesthesia Training

Presenter: Jason Johns, MD, Resident
Stanford University

Authors: Jason Johns, MD
Luke McCage, MD
Jean-Louis Horn, MD (Faculty Mentor)

Intro:
The American Society of Regional Anesthesia and Pain Medicine (ASRA) recently published a pre-block safety checklist designed to be incorporated into the “timeout”. Given this growing emphasis on safety and timeout performance, we evaluated the compliance to the standardized pre-block timeout by the individual trainees placing the block.

Methods:
This project was approved by our IRB. One hundred surveys were filled out by the attending anesthesiologist supervising a resident or fellow performing a peripheral nerve block in the preoperative area. The primary question was whether or not the resident or fellow performing the block initiated the mandated pre-block timeout. We calculated the percentage representing timeout compliance, analyzed compliance according to training level, and tabulated both the distribution and the duration of the timeout itself.

Discussion:
Complex medical procedures inherently involve a number of risks including: over sedation during block placement, infection, LAST, and wrong-site block. Current literature has demonstrated that one method to minimize the risk of medical errors, reduce operator variability, and improve compliance with mandated protocols is the use of cognitive aids or checklists. Recognizing this, ASRA recently published its 9 point checklist designed to aid the regionalist in providing safer anesthesia care. Despite a low complication rate, there is clear value in utilizing a safety checklist prior to block placement. In this case, the timeout was not initiated by the trainee 44% of the time, despite the quick nature of it. This raises the concern that trainees, and possibly many practicing anesthesiologists, frequently forget to perform a timeout. The perceived barrier of “production pressure” is a poor excuse not to perform a timeout given that in the majority of cases it takes less than one minute to perform. Overall, more emphasis needs to be placed on training providers to adhere to this valuable safety protocol.
A Comparative Pulmonary Function Study of Continuous Interscalene, Supraclavicular, and Suprascapular Nerve Catheters after Shoulder Arthroplasty

Presenter: Stephen Sills, MD, Resident
Virginia Mason

Authors: David Auyong, MD (Faculty Mentor)
Neil Hanson, MD (Faculty Mentor)
Stanley Yuan, MD

BACKGROUND

Continuous interscalene blocks (ISB) have improved postoperative analgesia by reducing the length of hospitalization after shoulder surgery [1]. However, infusion of local anesthetics near the brachial plexus can cause up to 100% diaphragmatic paresis[2]. Supraclavicular nerve blocks (SCB) and suprascapular nerve blocks (SSB) are performed further from the phrenic nerve, which may improve pulmonary function. The aim of this study was to evaluate pulmonary function after continuous infusions at three locations along the brachial plexus.

METHODS

Sixty-three patients undergoing total shoulder arthroplasty were randomized to receive a continuous ISB, continuous SCB, or continuous SSB. Catheters were placed pre-operatively through an ultrasound-guided technique. Ropivacaine (0.2%) at 6 mL per hour was then administered for 24 hours. Vital capacity (primary outcome), diaphragmatic excursion, pain scores and opioid use were measured pre-block and 24 hours post-operatively.

RESULTS

Vital capacity reduction was significantly different (p< 0.001) between the three groups (Table 1). Subgroup analysis demonstrated differences in vital capacity between both the SSB-ISB groups (p<0.001) and the SSB-SCB groups (p=0.009). Ipsilateral diaphragmatic excursion was also different between the three groups (p<0.001). Pain scores and morphine-equivalent consumption were also statistically significant (Table 1).

DISCUSSION

This study reveals that the suprascapular block is associated with the least diaphragmatic dysfunction at 24 hours. Phrenic nerve paralysis can result in up to a 38% decrease in vital capacity, and patients with pulmonary disease may not tolerate such reduction. In such cases, substituting an ISB with a SSB should be considered. If SSB is not possible, SCB may be an alternative block, but compared to the standard ISB, attenuation of lung dysfunction did not reach statistically significant differences.

REFERENCES

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Interscalene Group (n = 22)</th>
<th>Supraclavicular Group (n = 19)</th>
<th>Suprascapular Group (n = 22)</th>
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<td>Vital Capacity Reduction (%)</td>
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<td>&lt; 0.001</td>
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<td>Diaphragmatic Excursion Reduction (%)</td>
<td>77.7</td>
<td>53.2</td>
<td>32.6</td>
<td>&lt; 0.001</td>
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<td>Average Pain Scores (Mean)</td>
<td>2.43</td>
<td>1.37</td>
<td>3.23</td>
<td>0.037</td>
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<td>Mean 24 Hour IV MEQ Use, mg</td>
<td>10.6</td>
<td>8.3</td>
<td>18.9</td>
<td>0.047</td>
</tr>
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</table>

Values are shown as mean (SD). NRS = numerical rating scale. IV = Intravenous. MEQ = Morphine Equivalents.
Acute Changes in Pain Scores, Opioid Requirements, and Outcome Measurements in Surgical Patients after Perioperative Intravenous Acetaminophen.

Presenter: Joseph Stuart, MD, Resident Cedars-Sinai Medical Center
Authors: Charles Louy, MD (Faculty Mentor) Joseph Stuart, MD Roya Yumul, MD

Multiple studies showed perioperative IV acetaminophen (IVA) reduced opioid requirement over the first 24 hours after orthopedic surgery and gynecologic surgery. Also, a meta-analysis showed a decrease in postoperative nausea and vomiting after administration of prophylactic IV acetaminophen. This study aims to describe changes in pain scores, opioid requirements and outcome measurements after perioperative IVA for patients undergoing abdominal or spine surgery.

We performed a retrospective chart review study of abdominal and spine surgery patients who received intravenous acetaminophen perioperatively at Cedars-Sinai Medical Center from 2013-2014 and compared them to a similar subset of patients who did not receive IVA. The data collected included demographics, PACU and 24h pain scores, PACU and 24h postoperative opioid use, and multiple outcome measurements. 110 patients were included in the analysis. Paired/unpaired t-tests and Wilcoxon sum-rank tests were used to analyze the data.

Results include decreased 24 hour opioid intake in spine and abdominal surgery patients who received intraoperative IVA vs. control patients with Wilcoxon mean score 20.2 vs. 32.8 (p=0.003) and 13.1 vs 25.5 (p=0.0015) respectively. As well as decreased 24h pain scores in spine and abdominal surgery patients who received intraoperative IVA vs. control patients with mean pain scores 4.5 vs 5.4 (p=0.021) and 5.2 vs 6.2 (p=0.01) respectively.

Our newly expanded analysis supports the idea that intraoperative IVA may lead to decreases in 24 hour pain scores and opioid requirements. This same decrease is not seen in patients who received IVA after surgery.
Acute respiratory distress syndrome after orthotopic liver transplantation

Presenter: Xupeng Ge, MD, Resident
University of California, Los Angeles

Authors: Xupeng Ge, MD
Victor Xia, MD (Faculty Mentor)

Acute respiratory distress syndrome (ARDS) is a major complication and is associated with worse postoperative outcome after orthotopic liver transplantation (OLT). Although the definition of ARDS has been updated and revised in 2012, this Berlin definition has not been studied in OLT population. The aims of this study were to identify the incidence, risk factors and clinical outcomes of patients with post-transplant ARDS. After institutional review board approval, clinical data of all adult OLT patients between 2012 and 2013 at our center were reviewed. Postoperative ARDS was determined using the 2012 Berlin definition. Preoperative and intraoperative factors were compared between patients with and without postoperative ARDS. Risk factors of ARDS were determined using multivariable logistic analysis. Postoperative outcomes were also compared between patients with or without ARDS. Among 278 adult patients who underwent OLT during the study period, 14 (5.0%) developed ARDS following OLT. There were no significant demographic differences between patients with and without ARDS. Univariate analysis showed ARDS was associated significantly with preoperative factors including the incidence of encephalopathy, gastrointestinal bleeding, requirement of endotracheal intubation, requirement of pressors, and requirement of hemodialysis. ARDS was also associated with intraoperative factors including significantly higher requirement for blood transfusion. Multivariate logistic analysis showed that preoperative requirement of pressors (Odds ratio of 35.81, P<0.05) was associated with ARDS. Postoperatively, ARDS was associated with significantly longer hospital stay, increased incidence of graft failure and patient mortality (all p < 0.05). In conclusion, ARDS occurred at a rate of 5.0% following OLT in adult patients and was associated longer hospital stay, increased incidence of graft failure and patient mortality. Preoperative requirement of pressor was a risk factor for postoperative ARDS in patients undergoing OLT.
Upregulation of MicroRNA miR 125b-3p in the Novel Combined Pulmonary Fibrosis and Pulmonary Hypertension Model in Rats

Presenter: Soban Umar, PhD, Resident  
University of California, Los Angeles

Authors: Soban Umar, MD  
Salil Sharma, PhD  
Alex Centala, BA/BS  
Mariam Barseghyan, BA/BS  
Mansoureh Eghbali, PhD (Faculty Mentor)

Introduction: Pulmonary fibrosis may become complicated with the subsequent development of pulmonary hypertension. We recently established first combined model of pulmonary fibrosis and pulmonary hypertension in rats. MicroRNAs are emerging as novel non-coding RNA molecules that regulate gene expression at a post-transcriptional level. MiR-29 and miR-21 have been implicated in pulmonary fibrosis. Role of microRNAs particularly miR 125b-3p in combined pulmonary fibrosis and pulmonary hypertension is not fully elucidated. MicroRNA-125 family plays a crucial role in various diseases by targeting transcription factors and matrix metalloproteinases and therefore could have a potential role in this combined model.

Methods: Wistar rats (~200g, n=7) received intra-tracheal Bleomycin (2.5 mg/kg) at day 0. A sub-group of Bleomycin injected rats (n=4) received a single subcutaneous injection of pulmonary endothelial toxin monocrotaline (MCT, 60mg/kg) 2-weeks after Bleomycin, whereas others received saline (n=3). Rats were followed with serial echocardiography. Cardiac catheterization was performed 5-weeks after Bleomycin. Lungs and heart were harvested. Trichrome staining of lungs was performed. miR 125b-3p was quantified in lungs using QPCR.

Results: Bleomycin+MCT rats developed more severe pulmonary hypertension than rats with Bleomycin alone (RVSP 58.02±4.34 vs. 40.06±2.50 mmHg, p<0.05). Rats with Bleomycin+MCT also displayed more severe pulmonary fibrosis and pulmonary vascular remodelling. Both groups developed severe right ventricular hypertrophy. Bleomycin+MCT group showed echocardiographic evidence of progressively worsening pulmonary hypertension and RV dilatation. Interestingly, miR 125b-3p was significantly upregulated in Bleomycin alone group vs. control (0.75±0.43 vs. 0.27±0.04 relative expression units, p<0.05) whereas it was even more robustly elevated in the combined Bleomycin+MCT (5.03±1.74; p<0.05 vs. control).

Conclusions: MicroRNA 125b-3p is robustly upregulated in lungs of rats with combined pulmonary fibrosis-pulmonary hypertension. Our experiments demonstrate an important role for miR 125b-3p in fibrotic lung disease and suggest a novel approach using miRNA therapeutics in treating clinically refractory pulmonary fibrosis complicated by pulmonary hypertension.
Introduction: Preoperative epidural catheters placed for post-operative pain management are often only started after conclusion of the surgery. Consequences of delayed epidural initiation include increased post surgical pain and prolonged recovery room stay time by delaying patient discharge, and it is thus recommended that these infusions be started early on during surgery.1-3 In our institution, a large academic medical center, a baseline audit of patients receiving pre-operative epidurals revealed that infusions were started pre or intra-operatively only 57% of the time despite them being placed pre-operatively. We describe the use of a near real-time decision support system to improve compliance to starting epidural infusion.

Methods: We used an Anesthesia Information Management System (AIMS) based decision support system called Smart Anesthesia Manager (SAM), to institute a computer reminder system to encourage the timely initiation of post-operative pain control epidurals. Through SAM, selected issues related to quality of care and documentation are brought to the attention of the anesthesia provider via “pop-up” message screens. As part of the patient time-out feature, we instituted an optional check box to note whether an epidural is placed for post-operative pain control. If the provider checked “Yes”, SAM system generated reminders every 24 minutes via “pop-up” screens to encourage providers to start and document the epidural. (Figure 1) The messages are stopped when either an epidural infusion has been started or if the provider documents an epidural contraindication. We reviewed the compliance for cases for 1 month before (Baseline: September 2014) and 1 month after the SAM intervention was instituted (Intervention: November 2014).

Results: Compliance to starting epidural infusion increased from 57% (49 out of 86 epidurals) during the baseline period to 74 % (68 out of 92 epidurals) during the intervention period (p=0.02). However, during the intervention period, providers used the checkbox for post-operative pain control epidural only 25% of the time (334 out of 1322 cases). Also, among the 92 pre-operative epidurals placed during the intervention period in only 32 instances was there a confirmatory answer in the AIMS epidural checkbox (34.8% compliance). Compliance to starting epidural in cases when providers documented a confirmatory answer in the AIMS epidural checkbox, thus triggering a SAM reminder, was 90.6%. This was higher than the 65% compliance for cases that did not use the AIMS checkbox and SAM reminders (p=0.01). The time elapsed until epidural initiation was shorter in patients for whom an answer was provided to the SAM prompt, compared to those in whom the prompt was ignored (35.4 vs 58.5 min), a statistically insignificant trend (p=0.10).

Conclusion: Near real-time notifications to initiate epidural infusions were modestly effective. An optional documentation feature in AIMS to note whether a patient has an epidural for postoperative pain management had poor compliance, which in turn meant SAM reminders were not triggered for a significant number of epidural patients. Triggering SAM reminders based on epidural orders in the hospital EMRs, rather than on voluntary documentation may be a more effective way to improve compliance to epidural initiation.
Smart Anesthesia Manager™ (SAM)

Patient Name: ZZTEST, PAT
OR #: U9996230
OR #: OR10

Additional Information

Messages

EPI: Please INITIATE epidural infusion. If contraindicated, please document using Intraoperative Notes -> Epidural Infusion

Close
Perioperative management in the setting of extreme opioid tolerance

Presenter: Dmitry Garmaev, MD, Resident
University of New Mexico

Authors: Dmitry Garmaev, MD
Elizabeth Steele, MD (Faculty Mentor)

Patients with chronic pain on chronic opioid therapy are known to develop opioid tolerance and opioid-induced hyperalgesia. This presents a certain challenge in perioperative pain management in this patient population. Opioid sparing multimodal analgesia proves to be an important strategy in this situation. Nonopioid analgesics (Acetaminophen), NSAIDs (Ketorolac), alpha-2-agonists (Clonidine, Dexmedetomidine), and NMDA-antagonists (Mg++, Ketamine, Methadone) can provide effective analgesia when used in combination.

Herein, we present a case report of perioperative management of a 60yo male with cervical stenosis/myelopathy on chronic opioid therapy with Morphine 720mg daily undergoing posterior cervical fusion. First of all, we made sure the patient received his usual morning dose of oral Morphine and Pregabalin. As we strongly felt the patient would benefit from transitioning to Methadone therapy, the patient was given 50mg of methadone PO before induction, as well as 2 grams of MgSO4 IVPB. After induction of anesthesia with 200mg of Propofol IV and asleep fiberoptic intubation, the anesthesia was maintained with Propofol infusion at 80-100mcg/kg/min and 0.5MAC of Sevoflurane to provide optimal conditions for intraoperative neuromonitoring while minimizing the risk of awareness. In lieu of opioid infusion, we opted for Ketamine and Dexmedetomidine infusions. Ketamine infusion was run at 1.5mg/kg/hr up to a total dose of 300mg, while Dexmedetomidine infusion – at 0.5mcg/kg/hr with a loading dose of 1.5mcg/kg given over 20 min. 1 gram of Acetaminophen IVPB was given at the end of the surgery. Ketamine infusion was continued in the ICU, where the patient was transferred postoperatively for close observation, at 20mg/hr and was subsequently titrated down. Methadone was continued postoperatively starting at 10mg q8h and titrated up to allow for oral Morphine taper.

Our case is a demonstration of multimodal analgesia techniques applied to perioperative management of an extremely opioid tolerant patient taking extraordinary amount of oral opioids.
Botulinum Toxin Chemodenervation: A potential role in chronic muscle pain related to skeletal scoliosis

Presenter: Brittany Grovey, MD, Resident
University of California, San Diego

Authors: Brittany Grovey, MD
Gemayel Lee, MD
Timothy Furnish, MD (Faculty Mentor)

Background:
The skeletal muscle relaxation and anti-nocioceptive properties of botulinum toxin type A (BoNT-A) have made it a widely therapy for patients with chronic pain. The adjuvant use of BoNT-A in the correction of neuromuscular scoliosis is well documented but reports of its use for symptomatic treatment of the chronic muscle pain associated with skeletal scoliosis are lacking.

Case Description:
The patient is a 37 year-old female with severe scoliosis secondary to osteogenesis imperfecta (OI) referred to our clinic for the treatment of chronic back pain. Due to the severity of her OI, both her neurosurgeon and orthopedic spine surgeon recommended non-operative management of her chronic pain. The patient reported an aching, cramping pain radiating from the right mid-thoracic region to the right flank. Musculoskeletal exam was significant for hypertrophy of the right paraspinal muscles and quadratus lumborum; right > left thoracic and lumbar paravertebral tenderness to palpation; kyphosis and scoliosis with the right lower rib in contact with the right iliac crest.

The patient had a limited response to oral analgesics and severe intolerance of oral opiate therapy. She initially received a series of ultrasound guided, trigger point injections with 0.25% bupivacaine into the right thoracic paraspinal and quadratus lumborum muscles with 80-90% pain relief lasting 5-10 days. Given the short duration of effect, we proceeded to chemodenervation of the same muscles with BoNT-A. She experienced 90% pain relief lasting almost 3 months. The BoNT-A chemodenervation injections have been successfully repeated every 3 months for the past year.

Discussion:
Skeletal scoliosis can create musculoskeletal changes including hypertrophy and spasm that can lead to chronic muscle pain. BoNT-A injections may improve range of motion, spasms, and pain in these patients thus improving function and quality of life.

Presenter: Damoon Rejaei, MD, Resident
University of California, Davis

Authors: Damoon Rejaei, MD
Samir Sheth, MD (Faculty Mentor)
Naileshni Singh, MD

Spinal cord stimulation has been used successfully as an option to treat chronic pain for a variety of conditions. Although beneficial to many patients, SCS is often inadequate as some patients may continue to experience intractable pain necessitating additional interventions. As such, neuromodulation techniques such as peripheral nerve stimulation (PNS) as well as peripheral nerve field stimulation (PNfS) have been used to manage some of these difficult to treat patients with pain conditions such as chronic low back pain, migraines, post thoracotomy pain, and ilioinguinal pain. Recently, PNfS has been used both independently, or as an adjunct to SCS as a novel approach to the treatment of axial low back pain when SCS alone has failed to render appropriate pain reduction. While there is general agreement that PNfS with or without SCS can be an effective treatment for a variety of different pain conditions, there continues to be a paucity of literature on the unique role this treatment modality may have in cases where the epidural space is not accessible. Inaccessibility of the epidural space makes the use of SCS impractical and is often secondary to post surgical changes, such as posterior spinal fusions, where the epidural space has been obliterated. In this poster, we report two successful cases of intractable axial spine pain treated with PNfS in patients where the epidural space has been obstructed.
Case report: Ketamine infusion successful in treating refractory headaches in a patient with Lupus.

Presenter: Sherif Said, MD, Resident University of Southern California

Authors: Sherif Said, MD
Steven Richeimer, MD (Faculty Mentor)
Cora Dong, MD

Ketamine infusion is successful in treating refractory headaches in a patient with Lupus.

I will be discussing more details about the patient, the treatments and the outcomes. I will also be discussing the background of IV ketamine use and its effects on the immune system, as well as possible future studies.

There are about 28 million people in the U.S. that suffer from migraines. Migraines cause an estimated 15.5 billion in lost revenue yearly due to loss of work and use of medical facilities.

Ketamine is a non-competitive antagonist of NMDA-type receptors, known to play a role in pain transmission. It blocks the release of excitatory neurotransmitter glutamate, providing anesthesia, amnesia, and analgesia. It works by decreasing central sensitization and the wind-up phenomenon. It is also a serotonin and norepinephrine reuptake inhibitor, and is lipophilic, crossing the blood-brain barrier.

It has also been shown that small doses of ketamine before induction of anesthesia resulted in attenuation of secretion of the proinflammatory cytokines IL-6 and TNF-α, and in preservation of IL-2 production at its preoperative level. Previously, it has been suggested that this anesthetic may be of value in preventing immune function alterations in the early postoperative period. This brings up the idea of its use to alter immune function on an outpatient basis.

Some open label studies of IV ketamine have shown a decrease in pain scores in patients with migraine headaches. However, little data exists on the NMDA receptor in migraine/headache pathophysiology and treatment.

It would be interesting to have a prospective study that enrolled patients with autoimmune diseases like lupus to determine whether IV ketamine infusion improved headaches and other symptoms associated with their underlying disease.
Ongoing treatment of CPRS

Presenter: J. Anthony Suit, MD, Resident
University of Arizona

Authors: J. Anthony Suit, MD
Justin Sirianni, MD
Patrick Alger, MD
Amol Patwardhan, MD (Faculty Mentor)

Introduction:

55 year-old right-handed female with history nonunion right ulna after mechanical fall who presented with neuropathic pain involving the right olecranon/antecubital region and posterior right hand along the MP and PIP joints. At initial presentation symptoms and signs included tactile allodynia and decreased sensation to cold and temperature change. She was initially treated with lidoderm patches and gabapentin, but was unable to tolerate due to GI upset. Three weeks later she was started on Pregabalin, topical compounding crème with ketamine and bupivacaine and scheduled for stellate ganglion block. Two weeks later, a successful stellate ganglion block was performed under fluoroscopy after identifying Chassaignac’s tubercle at the C6 vertebral level and using a 22ga needle to inject 6 mL Marcaine 0.25% with Dexamethasone 5mg in 1cc increments. The stellate ganglion block provided symptomatic relief within minutes and a Horner’s syndrome was noted. At her follow-up visit 1 month later she continued to have greatly improved pain (decreased from a 7 to 3 out of 10 on pain scale), with increased sensation, decreased swelling and improved range of motion allowing her to more fully participate in physical therapy. Due to her significant improvement she was scheduled for and subsequently underwent a second stellate ganglion block 6 weeks after the initial block, with 6mL 0.25% bupivacaine and 10mg dexamethasone. Following the second block she developed transient improvement in temperature sensation for 5 days and continues to show improvement in her pain and swelling over posterior aspect of her hand. She also gained pain relief from transdermal compounding ketamine/bupivacaine crème. She was continued on the compounding crème TID, continues with lidoderm patches as needed, and participates in regular physical therapy. She will continue to be scheduled for stellate ganglion blocks as needed to maintain her comfort.

Discussion:

CPRS type I is an uncommon chronic pain syndrome. The identification and treatment of CPRS early in the natural history of the disease is paramount.

Multimodal therapy is aimed at maximizing patient participation in physical therapy while limiting adverse reactions. Ultimately, allowing the patient to resume daily activities and limiting further disease sequela.
SUBJECTS OF ACADEMIC PAIN PHYSICIANS REGARDING CONVERSION OF INTRAVENOUS TO NEURAXIAL OPIOIDS

Presenters: Jillian Maloney, MD/DO, Fellow
Mayo Clinic

Authors: Jillian Maloney, MD/DO
Andrew Gorlin, MD/DO (Faculty Mentor)
Jonathan McGarvey, BA/BS
Chris Wie, MD/DO
David Rosenfeld, MD/DO

Purpose: Standard opioid conversions for oral to intravenous have been widely published and adopted; however, consistent conversions of opioids from intravenous (IV) to epidural (ED) and intrathecal (IT) routes have yet to be well defined. The majority of epidural and intrathecal opioid conversions are based on anecdotal evidence and expert opinion. Herein, we evaluated the variability of opioid conversions for the commonly used agents - morphine, hydromorphone, and fentanyl - between IV to ED and IT routes.

Methods: A ten question survey was sent to 50 pain physicians practicing at six academic institutions regarding their opinions on IV:ED:IT dose conversions. Eighteen (36%) of physicians completed the survey. The IV doses physicians were asked to convert were: morphine 1000mg/24hrs, hydromorphone 100mg/24hrs, and fentanyl 2000mcg/24hrs. The mean and median as well as a coefficient of Variance (CoV) were calculated.

Results: The mean dose for morphine ED and IT was 120.6mg and 13.2mg respectively. The mean dose for hydromorphone ED was 12.04mg and IT was 1.73mg. The mean dose for fentanyl ED was 622.5mcg and IT was 115.2mcg. Agreement upon the mean recommended dose ranged from CoV 0.35 to 1.117 (Figure 1). Fentanyl had the highest degree of variability for both dose conversions. These results suggest that there is poor standardization between specialists in terms of dosing morphine, hydromorphone, and fentanyl between different delivery routes.

FIGURE 1

Conclusions: This pilot survey proposes there is variability among pain physicians regarding opioid conversions between delivery routes. This study surveyed physicians on only high dose narcotic conversions and may not be applicable to lower dose conversions. This data cannot be applied to single injection intrathecal or epidural injections. Future surveys addressing broader narcotic conversions, as well as a larger survey sample, would better elucidate the lack of consensus in pain physician opioid conversions for epidural and intrathecal routes.
Background: Growing evidence indicates that opioid-sparing anesthetic techniques may be associated with decreased cancer recurrence rates following cancer resection surgeries. A possible explanation is that opioids may have an immunomodulatory effect by acutely suppressing cellular and humoral immunity in the peri-operative period. Although associations have been demonstrated between increased peri-operative opioid usage and certain types of cancer, any postulated association between opioid usage and uterine carcinoma has not yet been explored. This question is particularly important given the uterus's unique status as an immune privileged organ. This retrospective analysis tested the hypothesis that greater opioid use in the postoperative period is associated with a higher incidence of recurrences after surgery for uterine cancer.

Methods: The medical records of 100 patients at a single center who underwent total abdominal hysterectomy surgery for biopsy-proven uterine carcinoma were reviewed. Peri-operative information including patient characteristics, laboratory data, and surgical, anesthetic, nursing, and pharmacy reports were collected. Doses of opioids administered intra-operatively and for the first 96 h after operation were converted into equianalgesic doses of oral morphine using a standard conversion table.

Results & Conclusions: Pending data analysis.
Sexual dysfunction is a well-known side effect of antidepressants. Painful ejaculation is a rare side effect that has been reported with the use of some psychiatric drugs such as tricyclic antidepressants. Cyclobenzaprine is a muscle relaxant that is structurally similar to tricyclic antidepressants. It is the most commonly prescribed muscle relaxant in the United States and accounts for 18% of all prescriptions written for chronic back pain. We present a case of painful ejaculation secondary to cyclobenzaprine use, provide proposed mechanisms, and offer a literature review of this side effect with other related drugs.
Case of a patient with trigeminal neuralgia with asymptomatic bradycardia down to the 20s with extreme facial pain onset. Bradycardia improved with pain improvement and cardiac workup was negative, otherwise demonstrating that the patient's extreme bradycardia was in fact secondary to the mandibulo-maxillary-cardiac reflex, a reflex similar in pathway to the ocul-ocardiad reflex.
Poster # AA10

**Postoperative respiratory events and pain management following major noncardiac surgery**

**Presenter:** Rachel Steckelberg, MD, Resident  
University of California, Los Angeles

**Authors:** Rachel Steckelberg, MD  
Anahat Dhillon, MD  (Faculty Mentor)

Background: Postoperative pulmonary complications (PPCs) are expensive and associated with significant morbidity and mortality. Furthermore, respiratory failure in the postoperative period is known to be a marker of poor health. Further data is needed to determine how peri-operative management techniques can be applied to minimize PPCs and improve outcomes.

Hypothesis: Overall morbidity and mortality will be higher in those patients with pain medication orders over the recommended amount.

Methods: Demographic information and data regarding PPCs was collected retrospectively from patients undergoing 3 types of surgeries considered to be high risk for PPCs: (1) thoracic, (2) lower extremity vascular, &/or (3) abdominal surgery. All patients without PCEAs (or otherwise managed by the Acute Pain Service) had pain medication orders analyzed by the PACU resident, who compared the patient’s post-op PACU and post-PACU pain medication orders to a pain management algorithm designed by the study authors. If the pain medication orders were not in accordance with the algorithm, the responsible party was notified. The primary and secondary end points for each group were then observed and recorded as such: (1) Primary end point: Incidence of postoperative pulmonary complications up to 30 days post-op, (2) Secondary end point(s): 7-day all-cause mortality rate, 30-day all-cause mortality rate

Results/Conclusion: The incidence of hydromorphone PCA orders over the recommended limit was 46.5%. The incidence of morphine PCA orders over the recommended limit was 100%. The overall incidence of PPCs during the study period in patients with PCA or other pain medication orders was 3.6%. The study results indicate that the incidence of pain medications ordered over the recommended limit by our Acute Pain Service is higher than previously thought. Further studies are needed to address the implementation of future interventions that may decrease the number of PPCs related to inappropriate pain medication orders.
Acute & Chronic Pain

Poster # AA11

Acute pain after craniotomy in neurovascular surgery

Presenter: Wendy Smith, MD, Resident
University of California, San Francisco

Authors: Wendy Smith, MD
Joyce Chang, MD
Mylene LeCours, MD
Adrian Gelb, MD
Chanhung Lee, MD (Faculty Mentor)

Introduction: Acute post-craniotomy pain is a potentially debilitating postoperative complication, negatively impacting a patient’s quality of life. In patients undergoing craniotomy for neurovascular lesions, little is known regarding predisposition for and prevention of acute pain. Our primary aim was to examine perioperative risk factors, in this population, as well as intraoperative treatment modalities that may be associated with mitigation of post-craniotomy pain.

Methods: A retrospective review of neurovascular surgery cases from July 2012 through October 2014 was performed to identify adult patients, with a Glasgow Coma Scale ≥ 13, who underwent elective craniotomy for intracranial vascular lesions. The primary outcome was incidence of moderate to severe pain in the first 24 hours after surgery, defined as a pain score ≥ 4 on a scale of 0 to 10. Preoperative risk factors including comorbidities and medications as well as intraoperative medications were reviewed.

Results: 479 patients met the inclusion criteria. Of them, 174 patients had postoperative pain scores recorded at ICU admission, 1, 2, 8, 16 and 24 hours. The majority of these patients experienced moderate to severe postoperative pain within the first 24 hours (Figure 1). Neither preoperative comorbidities (headache, depression, anxiety, seizure) nor preoperative medications (anti-depressants, anxiolytics, anti-epileptics, chronic narcotic use) were significantly associated with postoperative pain in the first 24 hours. Intraoperative use of Remifentanil or Acetaminophen also showed no difference.

Conclusion: Our data shows a strikingly high incidence of postoperative pain after craniotomy in the neurovascular patient population that does not appear to be associated with discrete preoperative risk factors. This suggests that intraoperative anesthesia management may be the area to exact change and would support future prospective studies focused on identifying these potential variables that can be used to decrease acute postoperative craniotomy pain.

References:
Early femoral nerve block for acute hip fractures: How can we overcome barriers to implementation of a multidisciplinary pain pathway?

Presenter: Amanda Kumar, MD, Resident
Stanford University

Authors: Christopher Webb, MD
Amanda Kumar, MD
Pedro Tanaka, MD
Jean-Louis Horn, MD (Faculty Mentor)

Introduction: Hip fractures are common injuries often sustained by elderly patients with an elevated burden of comorbidities, resulting in substantial post-operative morbidity and mortality. This study investigates the impact of early femoral nerve catheter (FNC) placement as part of a multidisciplinary pain pathway after hip fracture requiring surgical correction.

Methods: After receiving IRB approval with waiver of informed consent, we conducted a retrospective cohort study of consecutive primary unilateral total hip arthroplasty, hemiarthroplasty or cephalomedullary nail placement for patients with hip fractures. Cases were matched for multiple variables over 8 months. Primary outcomes were pain scores and opioid use. Secondary outcomes were length of stay and perioperative delirium.

Results: 105 patients underwent surgical correction for hip fracture during the study period, with 58 patients meeting inclusion criteria (29 who received a FNC and 29 who did not receive a FNC). In the FNC group, pain scores (mean +/- SD) were significantly decreased immediately following block placement (2 +/- 2.2, p=0.001). Pain scores and opioid use on post-operative day 0, 1, and 2 were not significantly different between the two groups. There was no significant difference in total opioid consumption, length of stay, or the incidence of perioperative delirium.

Discussion: Pain scores were significantly decreased in patients who received a FNC immediately after block placement compared to pre-block pain scores. Limitations of our study include a small sample size. We are currently investigating other outcome data, including incidence of cardiopulmonary complications, renal failure, and chronic post-surgical pain, which are not significant at this time due to the small cohort of patients. We also discovered several challenges to implementation of a multidisciplinary pain pathway, including early use of multimodal drugs in the emergency department. Further research is needed to determine the beneficial effects of regional anesthesia and multimodal analgesia in this population.
Airway management practice in adults with an unstable cervical spine: the Harborview Medical Center experience

Presenter: Michael Holmes, MD/DO, Resident
University of Washington

Authors: Michael Holmes, MD/DO
Armagan Dagal, MD/DO (Faculty Mentor)
Aaron Joffe, MD/DO (Faculty Mentor)

Introduction

Airway management in patients with unstable cervical spines (CS) is challenging. In order to most limit CS motion during intubation and reduce the potential for further injury, fiberoptic intubation (FOI) has been suggested. However, recent literature suggests that FOI rates, and clinical experience, have sharply declined as newer video laryngoscopes (VL) have risen in popularity. Thus, continuing to recommend FOI in these patients as the best initial intubation technique is questionable. Our primary aim was to describe the airway management strategies in unstable CS at our level one trauma center.

Methods

The University of Washington Human Subjects Division (UW-HSD, Seattle, WA) approved this study. Adult patients presenting for CS surgery without a tracheal tube in situ between September 2010 and December 2013 were identified using our anesthesia information management system. Patients were defined as having an unstable CS if special care to reduce CS movement during intubation was taken, including use of surgical traction, manual in-line stabilization, presence of a cervical immobilization collar, or any other effort made to limit further CS extension. Data is descriptive and presented as mean±SD or n (%) unless otherwise noted.

Results

453 patients were included. Overall, patients had an median (range) ASA class of 3 (1-3), were 61% male, were 57±17 years old, and had a BMI of 27±8 kg/m2. 78% of patients underwent surgery for isolated CS disease while 22% included thoracic spine involvement. Awake FOI was rarely performed over the 3-year examination period (n=12, 2.9%). A summary of intubation techniques is presented in table 1.

Conclusion

Among patients with an unstable CS presenting for surgery at a high-volume academic level one trauma center, awake FOI is rarely performed. VL has supplanted FOI (awake or asleep) as the most common intubation technique in these patients. DL remains commonly performed.

Table 1

<table>
<thead>
<tr>
<th>Technique</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Attempt n (%)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Attempt</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Attempt Success (%)</th>
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<tr>
<td>n=429</td>
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<td>n=44</td>
<td>n=46</td>
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<tr>
<td>DL</td>
<td>79 (17.3)</td>
<td>sFOI n=1</td>
<td>VL n=4</td>
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<td>191 (42.1)</td>
<td>iSGA n=2</td>
<td>FOB/VL n=5</td>
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<tr>
<td>aFOI</td>
<td>11 (2.4)</td>
<td>VL n=1</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>%</td>
<td>DL n=1</td>
<td>FOB/VL n=4</td>
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<tr>
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<tr>
<td>iSGA</td>
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</tbody>
</table>

DL= Direct Laryngoscopy, VL= Video Laryngoscopy, aFOB= Awake Fiberoptic Intubation, sFOB= Asleep Fiberoptic Intubation, FOB/VL= Combination Asleep Fiberoptic and Video Laryngoscopy, iSGA= Intubating Supraglottic Airway
Airway Management of a Patient with Medial Maxillectomy and an Unexpected Orbital Floor Defect.

Presenter: Sepehr Rejai, MD, Resident
University of California, Los Angeles

Authors: Sepehr Rejai, MD
Marshall Kaplan, MD (Faculty Mentor)

A 61-year-old male with a history of oral squamous cell carcinoma status post right medial maxillectomy and radical neck dissection presented for resection of a submandibular metastatic mass. The patient’s past medical history was significant for being an active smoker with COPD, head and neck radiation, DM II, GERD, OSA, and opiate-dependence. Airway exam revealed a large right maxillary sinus defect (image 1), and an edentulous mouth. Limited mouth opening prohibited Mallampati scoring. After establishing that it would be impossible to achieve an adequate seal to mask-ventilate the patient, we planned for an awake nasal fiber optic intubation through the existing sinus opening.

On the morning of surgery, the patient had taken 60mg PO oxycodone at home. In the pre-op area we administered 0.2mg glycopyrolate, 0.5mg midazolam, albuterol and began topicalizing the nasopharynx and oropharynx with 4% lidocaine via the LMA MADgic™ atomizer. In the operating room we initiated pre-oxygenation while applying standard monitors and utilized a propofol/ketamine (1mg/cc) infusion titrated to light sedation. At the moment of fiberoptic scope insertion into the maxillary sinus our ENT surgeon notified us of the patient’s orbital floor defect. We therefore aborted this approach and secured the airway as follows:

1. With further sedation a size 4 LMA Classic was placed. Adequate ventilation was confirmed and Sevoflurane included in the anesthetic technique.

2. An intubating flexible fiberoptic bronchoscope was loaded with an Aintree catheter. The bronchoscope was introduced into the trachea through the LMA under direct visualization.

3. We then removed the fiberoptic scope and measured the Aintree at the lips.

4. The LMA was removed and an armored 6.5mm endotracheal tube was advanced over the Aintree catheter.

5. The Aintree catheter was removed and the fiberoptic scope used to confirm correct ETT placement above the carina.

Note: We obtained permission from the patient to take photos during this intubation. I would like to include this image to demonstrate the impressive sinus defect.
It is well known that patients with either Hurler Syndrome or Pierre Robin Sequence may have certain craniofacial abnormalities that render them a difficult airway. In fact, it has been reported that the incidence of difficult and failed intubation in patients with Hurler Syndrome alone is 54% and 23% respectively (Walker et al. 1994).

Our patient with diagnoses of both Hurler Syndrome and Pierre Robin Sequence presented for general anesthesia to undergo C1-4 laminectomy. Preoperative airway examination revealed associated musculoskeletal manifestations including micrognathia, macroglossia, cleft palate status post repair, glossoptosis, and limited neck extension (<30°) secondary to cervical stenosis with a modified Mallampati Grade IV view. An airway management plan was devised in line with the guidelines posed by the Task Force for Management of the Difficult Airway (Anesthesiology 2013).

After administering two sprays one minute apart of Afrin and 4% Lidocaine (1:1) for mucosal constriction and anesthesia, respectively, we used the Olympus LF-GP 4.1 mm flexible fiberoptic bronchoscope to perform an awake right transnasal pre-induction airway examination in head-neutral position. Further risk factors were identified, including considerable encroachment from the patient’s lateral pharyngeal walls and an anteriorly displaced glottis inlet. However, we were able to visualize the vocal cords and decided to proceed with intubation using the fiberoptic bronchoscope. After preoxygenation and IV induction with propofol 150 mg, ability to bag-mask ventilate the patient was confirmed prior to administering rocuronium 50 mg. The trachea was successfully intubated on the first try using a 6.5 mm ID cuffed endotracheal tube, which was confirmed by immediate detection of end-tidal carbon dioxide.

Somatosensory evoked potentials were monitored throughout the procedure and were unchanged post-intubation. The surgery was performed without complication, but the patient remained intubated post-operatively secondary to the patient’s difficult airway status and increased risk for additional airway edema resulting from a prolonged surgery in the prone position. After confirming the patient was neurologically intact, sedation was restarted and the patient was transferred to the neurosurgical ICU and successfully extubated on postoperative day #1.
Progressive Angioedema in the ED: Who best to secure the airway?

Presenter: Patrycja Olszynski, MD, Resident
Stanford University

Authors: Kelly Yeh, MD (Faculty Mentor)

Background:
Angioedema manifests as localized swelling of the deep dermis, subcutaneous or submucosal tissues due to vascular leakage. Acute episodes of angioedema can affect the face, lips, tongue, and eyes. When it involves the airway, an episode can cause complete obstruction, leading to fatal consequences if left untreated. Angioedema is a well known side effect of ACE inhibitors and occurs more commonly in African American patients, especially females. Cases of angioedema with developing severe airway obstruction pose a unique challenge for both anesthesiologists and surgeons and require effective communication between them to provide safe airway management.

Case Report:
A 59yo African American female with history of Parkinson's, polysubstance abuse, HTN, DM, and undiagnosed OSA presented to the ED with a two hour history of progressively worsening tongue swelling and dysphonia. Home medications included fosinopril, benztropine, and metformin. Anesthesia was called STAT to the ED for emergent intubation. On initial exam, the patient was in acute respiratory distress with a massively swollen tongue and minimal mouth opening, already on face mask oxygen. The patient had received diphenhydramine, epinephrine, and methylprednisolone, all with minimal effect on her. A quick attempt at topicalization was made using nebulized lidocaine, but the patient was panicking and did not tolerate the attempt. Awake oral fiberoptic intubation, and then nasal fiberoptic intubation were attempted, but were both unsuccessful because of the severity of the airway swelling, secretions, patient intolerance, and emesis. Due to concern for relaxation of pharyngeal tissues, further airway obstruction, and possible apnea, no sedative or hypnotic medications were administered. The patient was able to maintain oxygen saturation greater than 90% when her airway was not manipulated. Therefore, the decision was made to transport the patient to the operating room for an emergent awake tracheostomy. In the operating room, dexmedetomidine was given in small increments (4-8 mcg at a time) for anxiolysis by the anesthesia team, and a local field block of the pre-tracheal tissue was performed by the surgeons. The patient was spontaneously breathing on face mask oxygen throughout the procedure. A size 6 Shiley tracheostomy tube was successfully placed and general anesthesia was induced. The procedure took approximately 10 minutes. On postoperative day #1, all sedative agents were discontinued and patient was taken off sedation.

Discussion:
In this case report, emergent awake tracheostomy was performed in the setting of severe airway obstruction secondary to angioedema not amenable to awake fiberoptic intubation. With the patient’s history of OSA and severe airway edema, administration of sedatives, hypnotics or paralysis was a relative contraindication and may have further compromised the patient’s airway, leading to death. A quick look through the difficult airway algorithm brought the team to an awake tracheostomy to secure the airway. In addition, given the risk of recurrence of angioedema secondary to ACEI use, a tracheostomy was almost inevitable. In this case, communication between anesthesiologists, surgeons, and the patient was critical for airway management.
Preoperative Assessment and Airway Management in an Adult Hunter Syndrome Patient

Presenter: Ann Ng, MD, Resident
Stanford University

Authors: Ann Ng, MD
Eric Gross, MD (Faculty Mentor)
Hendrikus Lemmens, MD (Faculty Mentor)

Hunter syndrome is a lysosomal enzyme deficiency resulting in glycosaminoglycan (GAG) deposition in tissues. GAG accumulation can present obstacles for the anesthesiologist, particularly in airway management. We describe the preoperative assessment and management of an adult with Hunter syndrome.

Case:
A 44-year-old 60kg, 5’2” male presented for C2-C4 laminectomy. His medical history was significant for Hunter syndrome, aortic stenosis, and OSA. He previously had an aortic valve replacement where extubation was complicated by shortness of breath treated with steroids. Outpatient medications included idursulfase, enzyme replacement therapy (ERT) for Hunter syndrome, and aspirin.

Preoperatively, the patient was evaluated with attention to the airway and cardiovascular system. Cervical MRI showed no tracheal obstruction. Echocardiogram was unremarkable after aortic valve replacement. Patient had a Mallampati IV airway, small mouth opening, and limited cervical range of motion. With this evaluation and concern for tracheomalacia, we chose to perform an awake fiberoptic intubation. Significant tracheomalacia was observed. A 5.0 microlaryngeal tube was inserted, and dexamethasone given to prevent airway edema. Trachea was extubated over an exchange catheter. No upper airway obstruction was observed, and he was discharged on post-operative day three.

Discussion:
Hunter syndrome patients have accumulation of GAGs in multiple organs; airway compromise with stenosis and tracheomalacia is of principle concern to anesthesiologists. Despite ERT, there has not been a decreased incidence of difficult airway management. Based on the pathophysiology, management is expected to be difficult as patients age. An MRI is required to visualize endotracheal stenosis caused by GAG accumulation, which is not visible on x-ray, and use of a smaller endotracheal tube considered.

Hunter Syndrome patients can present for treatment of associated comorbidities, including cervical myelopathy, cardiac valvulopathies, and hip dysplasia. A focused preoperative assessment, carefully planned airway management, and post-operative monitoring for airway obstruction should be the mainstay of perioperative management.
DIFFICULT POSITIVE PRESSURE VENTILATION VIA TRACHEOSTOMY IN AN ADULT WITH AIRWAY MALACIA

Presenter: Li Li, MD, Resident
University of Washington

Authors: Li Li, MD
Sanjay Bhananker, MD (Faculty Mentor)

Background

Tracheomalacia and tracheobronchomalacia (TBM) are rare disorders of weakened airway prone to excessive compression typically during expiration. Although continuous positive airway pressure (CPAP) or positive end-expiratory pressure (PEEP) is generally recommended to sustain airway caliber[1], we present a case in which positive pressure ventilation was insufficient and possibly even counterproductive.

Case Description

A 57-year-old woman with Weill-Marchesani syndrome, TBM (Figure 1), and a permanent tracheostomy presented for a suspension microlaryngoscopy, tissue excision, and tracheostomy replacement. She was induced with alfentanil and sevofluorane and was ventilated via an endotracheal tube through her tracheostomy. She was given intermittent positive pressure ventilation (IPPV), but had difficulty maintaining adequate ventilation, oxygenation, and tidal volumes even with PEEP addition. These respiratory metrics, however, markedly improved with spontaneous respiration, but worsened again when IPPV was re-trialed. The endotracheal tube was checked to ensure it was neither kinked nor obstructed. Thus, the patient was allowed to spontaneously breathe for the remainder of case.

Discussion

It is unusual to experience difficulty ventilating through a tracheostomy given the direct airway access. In this case, the insufficient ventilation and tidal volumes likely resulted from changes in the patient’s dynamic airway compliance from a combination of reactive airway disease and lower airway collapse. The latter was likely precipitated by general anesthesia and IPPV in the setting of severe TBM, and appeared to improve as sedation was weaned and IPPV discontinued to allow for spontaneous respiration. We liken the airway malacia physiology to that of an anterior mediastinal mass[2] in terms of the increased risk to airway collapse, and recommend a similar approach in its anesthetic management.

References


Clinic flexible laryngoscopy in this patient from 2 years ago showed severe tracheomalacia with significant changes in tracheal caliber during inspiration (left) and forced expiration (right).
Severe Upper Airway Obstruction due to Cricoarytenoiditis in a Twenty-Eight Year Old Male Patient with Systemic Lupus Erythematosus Flare

Presenter: Joshua Garza, MD, Resident
University of Arizona

Authors: Joshua Garza, MD (Faculty Mentor)
Jennifer Parod, MD (Faculty Mentor)
Bruce Stewart, MD

Cricoarytenoid arthropathy is a known yet infrequent cause of airway obstruction in patients with systemic lupus erythematosus (SLE). The laryngeal involvement in SLE has not been completely described but the pathophysiology is likely related to immune complex deposition in tissues with subsequent activation of the complement system leading to tissue destruction, as has been implicated in many of the other clinical manifestations seen in SLE. Laryngeal involvement in SLE can range in severity from minor mucosal inflammation to bilateral vocal cord paralysis related to laryngeal joint fixation or recurrent laryngeal nerve palsy. This case describes a twenty-eight year old male patient with previously diagnosed SLE and end stage renal disease (ESRD) secondary to lupus nephritis requiring dialysis three days per week who initially presented to the emergency department with hoarseness, lower extremity swelling, and some respiratory difficulty. The voice changes and respiratory difficulty began several days before presentation to the emergency department while the lower extremity swelling had been progressing for the week preceding his presentation to the emergency department. Several hours following admission, the patient subsequently developed increasing respiratory difficulty and he was taken to the operating room for emergent tracheostomy placement after flexible laryngoscopy revealed bilateral vocal cord fixation in the midline position. This case demonstrates the importance of including SLE in the differential diagnosis of patients who present with upper airway obstruction as well as reviewing the management of a patient with severe upper airway obstruction due to vocal cord paralysis.
Difficult Airway Requiring Pre-operative Consultation to Otolaryngology in a Patient Presenting for Cervico-Thoracic Spine Surgery

Presenter: Kerry Bigelow, MD/DO, Resident
University of Colorado

Authors: Kerry Bigelow, MD/DO
Claudia Clavijo, MD/DO (Faculty Mentor)
Brandon Way, BA/BS

The management of a difficult airway is arguably one of the most important skills of clinician anesthesiologists. In particularly challenging patients a preoperative consultation to otolaryngology may be beneficial.

A 58-year-old male presented for a C7-T5 posterior arthrodesis and T2 subtraction osteotomy for correction of severe cervico-thoracic kyphotic deformity under general anesthesia. He had sustained a fall two years prior resulting in fractures of the C7, T1, and T2 spinous processes and was treated with a Miami J-collar. Two months after his discharge he presented with respiratory distress and stridor. Attempts to intubate him at that time were unsuccessful and he required an emergent tracheostomy. Other pertinent history included vocal cord paralysis, supraglottic and subglottic stenosis, morbid obesity (BMI 40.4), and COPD. His physical exam revealed a hoarse voice, severe cervico-thoracic kyphosis with his chin nearly touching his upper chest, minimal to no cervical extension, Mallampati class III, 4-5 cm of mouth opening and a TM distance of 5-6 cm. Previous records or imaging were not available on the day of surgery. Otolaryngology was consulted. They performed a fiberoptic examination the larynx and found no supraglottic stenosis or vocal cord paralysis. Dynamic subglottic stenosis was found. We elected to proceed with an awake fiberoptic intubation. The airway was anesthetized with 4% nebulized lidocaine and topical lidocaine ointment and the vocal cords were then sprayed with 2% lidocaine when visualized on the fiberoptic monitor. A 7.0 ETT was placed without difficulty and the operation was completed. Extubation was delayed until the first post-operative day given the potential for airway edema and was performed without complication.

This case illustrates the utility of an interdisciplinary evaluation for safe planning of airway management in particularly challenging patients.
Airway

Poster # BB09

**Anesthetic Management of a Patient with Post-Intubation Tracheal Stenosis**

**Presenter:** Jessica Murphy, MD, Resident  
Cedars-Sinai Medical Center

**Authors:**  
*Jessica Murphy, MD*  
*Taizoon Dhooon, MD*  
*Manxu Zhao, MD (Faculty Mentor)*

**Introduction**

Tracheal stenosis is a potential sequela of prolonged intubation. An endotracheal tube cuff pressure above 30 mmHg exceeds capillary perfusion pressure which can lead to ischemia with subsequent ulceration and fibrosis with circumferential narrowing.

**Case presentation**

A 21 year old obese male was scheduled for flexible bronchoscopy with balloon dilation for severe tracheal stenosis. He had a history of complicated pneumonia with prolonged intubation and reintubation four months prior, after which he developed dyspnea progressing to stridor at rest. Computed tomography revealed 5 mm tracheal narrowing approximately 5 cm distal to the vocal cords. The decision was made to proceed with bronchoscopy with dilatation of the stenosis.

The patient was induced with propofol and a size 5 laryngeal mask airway was placed. General anesthesia with spontaneous ventilation was maintained with propofol infusion and sevoflurane. A flexible bronchoscope was passed through the LMA into the trachea, revealing a stenotic web narrowed to 5 mm approximately 7 cm distal to the vocal cords. Dilatation to a maximal diameter of 15 mm was achieved using a 6-French balloon dilator. The patient tolerated the procedure without complication and noted an immediate improvement in his symptoms. He was transferred to the ICU for monitoring and discharged on post-operative day one.

**Discussion**

Suspicion for tracheal stenosis should arise in patients who present with unexplained shortness of breath and stridor following a period of prolonged ventilation. With narrowing to 30% of normal or 5 mm, patients may develop stridor at rest. Diagnosis may be confirmed by radiography, computed tomography or bronchoscopic visualization. Treatment of symptomatic stenosis may involve bronchoscopy with dilatation, laser surgery, stent placement or surgical resection. In patients with severe tracheal stenosis, a slow, gentle induction with maintenance of spontaneous ventilation is desired, at least until surgical access is secured distal to the lesion.
Emergent Airway After Cosmetic Surgery

Presenter: Taizoon Dhoon, MD, Resident
Cedars-Sinai Medical Center

Authors: Roya Yumul, MD (Faculty Mentor)

Introduction:
Over 100,000 Rhytidectomies (facelifts) are performed annually. Though infrequent, hematomas are the most common complication after rhytidectomy. The timely recognition and treatment of postoperative hematoma is crucial in preventing catastrophic sequelae.

Case Report:
A 50 year old male POD #1 post rhytidectomy arrived in the Emergency department by EMS due to stridor and dyspnea. En route, the patient became hypoxic and bradycardic. A code blue was initiated by the ED team. The anterior and lateral neck was markedly ecchymotic and edematous upon arrival. Two attempts of Glidescope intubation had been unsuccessful by the ED physicians. The anesthesiologist secured the airway using a nasal fiberoptic intubation on the first attempt. No medications were administered for intubation.

The bilateral periauricular incisions were opened by the surgical team. Copious amounts of well-formed clot were removed from the bilateral anterior cervical compartments. The patient was stabilized and taken to the SICU.

Discussion:
Postoperative hematoma is the most common complication of rhytidectomy. The incidence is estimated to be between 0 to 15% of cases. The death rate from facial surgery varies between 1/1000 to 1/10,000 cases.

Risk factors associated with hematoma formation are male gender, hypertension, anticoagulant medications, postoperative activity, and increased intraabdominal pressure. Though males comprise 10% of rhytidectomy cases, they have double the risk of their female counterparts. Optimally, patients should maintain bed rest for 48-hours postoperatively and be educated on hematoma formation.

Hematomas generally occur within twenty-four hours after surgery. Major hematomas can lead to skin necrosis, dyspnea, and potentially acute airway obstruction. Treatment requires prompt suture removal, evacuation, and hemostasis. Timely recognition and treatment of major postoperative rhytidectomy hematoma are critical in preventing cardiac arrest, respiratory failure, irreversible brain damage, and death.
Intervention: Submental intubation is a safe and efficient method for securing an airway when other methods are prohibited, surgical exposure is a priority and/or restoration of occlusion is necessary. Two methods described include the more commonly practiced “Altemir Sequence”, which is associated with fewer complications and the “Green and Moore Sequence”. The most common indication is trauma precluding nasotracheal intubation (86%), followed distantly by elective facial ostotomy and transmaxillary cranial base tumor access.

Case Report: A 52-year-old male presented after motorcycle accident with multiple injuries including Le Fort 3 fracture requiring repair with coronal, transoral and left transconjunctival approaches as well as recreation of proper occlusion. After standard ASA monitors were placed, the patient was sedated, maintaining spontaneous ventilation and was orally intubated with a reinforced endotracheal tube via fiberoptic endoscope. Upon confirmation of positioning, the surgeon made an incision approximately 1 cm behind the anterior body of the mandible, dissecting to the floor of the mouth, and the endotracheal tube was transposed through the created submental path (Figure 1). Again using fiberoptic, the tube placement was verified and secured with suture. At the conclusion of the surgery, once the patient met criteria for extubation, he was extubated via the submental tract, which was then sutured. To date, the patient has had no complications related to the submental intubation.

Discussion: Prolonged submental intubation of 72 hours has not been found to have adverse effects but longer than this is not encouraged and may be converted to oral endotracheal tube. When prolonged intubation intubation or multiple surgeries are anticipated, a tracheostomy should be considered.

Comparing submental intubation with tracheostomy, the most common complications of the former are less severe and include superficial skin infection, damage to tube apparatus, fistula formation, scarring, transient lingual nerve paresthesia, and mucocele. The major complication reported with submental intubation involves tube dislodgment.
Difficult Airway due to a Massive Retrosternal Thyroid Nodule in the Setting of Severe Pulmonary Hypertension.

Presenter: Todd Meckling, MD/DO, Resident
Virginia Mason

Authors: Todd Meckling, MD/DO
Lila Sueda, MD/DO (Faculty Mentor)

Abstract
This case report details an incident of a difficult airway in a patient with a massive retrosternal thyroid nodule, with discussion of subsequent airway management.

Introduction
A difficult airway is defined as the inability of a conventionally-trained anesthesiologist to either mask ventilate, perform tracheal intubation, or both.

An enormous thyroid mass with tracheal compression would itself present a significant airway challenge. Ablation of spontaneous respiration can create a situation where intubation and mask ventilation is impossible.

A patient with severe pulmonary hypertension faces additional risk beyond airway catastrophe. Failure to maintain adequate ventilation and oxygenation can result in increased pulmonary hypertension leading to acute right heart failure.

Case report
A 67-year-old man presented for resection of his massive thyroid nodule. Imaging revealed a significantly enlarged right thyroid lobe. The trachea was deviated leftward, with compression measuring 5mm at its narrowest point, at the level of the suprasternal notch. The lobe extended from the right superior horn of thyroid cartilage into the mediastinum. The mass measured 90mm by 60mm by 55mm. Review of cardiac records revealed a right ventricular systolic pressure of 82 mmHg with a flattened interventricular septum in systole and diastole, consistent with RV pressure and volume overload.

Upon examination, the patient’s airway was Mallampati III, with decreased thyromental distance and extremely poor dentition, including multiple loose teeth.

After placement of large bore peripheral IVs and a radial arterial line, awake nasal fiberoptic intubation was undertaken. The airway was topicalized with Lidocaine atomizer to the posterior pharynx and each tonsillar pillar. The nares and nasopharynx were topicalized with cocaine. Sedation was achieved with dexmedetomidine. Using a fiberoptic scope, a 5.0 endotracheal tube was inserted nasally and passed through the vocal cords beyond the level of the obstruction. Spontaneous ventilation was ablated and general anesthesia induced.
Airway compromise due to soft tissue swelling after Anterior Cervical Discectomy and Fusion (ACDF) requiring cricothyrotomy.

Presenter: Joseph Stuart, MD, Resident
Cedars-Sinai Medical Center

Authors: Roya Yumul, MD (Faculty Mentor)
Joseph Stuart, MD

Postoperative airway compromise is a rare, but potentially lethal, adverse side effect of Anterior Cervical Discectomy and Fusion (ACDF). The most common causes include wound hematoma, CSF leak, and soft tissue swelling. Not only can these lead to airway obstruction they can also distort pharyngeal anatomy making traditional methods of airway management difficult.

Here I describe a case of cardiopulmonary arrest due to airway compromise after ACDF. Briefly, the 65 year old male patient on POD #0 was found to be cyanotic in respiratory distress before decompensating and cardiac arrest. During the ensuing resuscitation effort attempts at intubation, mask ventilation, and LMA placement were made without success. An emergent bedside cricothyrotomy was performed as a life saving measure. Following successful resuscitation and stabilization he was taken to the operating room for wound exploration and formal tracheostomy placement. Intraoperatively he was found to have severe unilateral pharyngeal soft tissue swelling without hematoma causing complete upper airway obstruction. A review of the relevant anatomy, literature, and management strategies will also be discussed.
Whole Lung Lavage in a Difficult Airway

Presenter: Rebecca House, MD, Resident
Virginia Mason

Authors: Rebecca House, MD
Francis Salinas, MD/DO (Faculty Mentor)

Whole lung lavage (WLL) is the most effective treatment for pulmonary alveolar proteinosis (PAP). The process involves large volume bronchial lavage (up to 20 liters) of a single lung. Isotonic saline, given one liter at a time, is washed through an entire lung. Chest percussion and gravity are then used to drain the fluid. As the lavage progresses, returned fluid becomes clearer. To prevent fluid from entering the opposite lung, proper placement and seal of a double lumen endotracheal tube (DLT) and bronchial cuff are imperative. To do so, the use of both a fiberoptic bronchoscope and visual leak test (air bubble method) proves critical. Placement of the DLT becomes more challenging when a difficult airway is encountered. Here, we describe a 37 year old male with worsening dyspnea diagnosed with PAP. He presented for WLL; he was 140kg, BMI of 41. He had a short, thick neck and full beard. After induction, he proved to be both a difficult mask ventilation—requiring two providers—and a difficult intubation. After using several different tools, including a video laryngoscope, gum elastic bougie, and airway exchange catheter, a DLT was eventually placed. Once the bronchial cuff was confirmed in the left main stem bronchus, the bronchial balloon was inflated until it passed the air bubble leak test at a pressure of 50 cm H2O. He was then maintained on total intravenous anesthetic with one lung ventilation. WLL with 20 liters of isotonic saline over 1.5 hours was uneventful. At the end, he was extubated over an airway exchange catheter to a non rebreather mask. He was able to maintain SpO2 in the low 90s which improved in the PACU. He was admitted overnight for observation. The patient has subsequently undergone WLL two additional times without difficulty.
Cervical Hematoma Upon Emergence from Parotidectomy

Presenter: Ashley Joseph, MD/DO, Resident
University of California, San Diego

Authors: Ulrich Schmidt, MD, PhD
Ashley Joseph, MD/DO

The patient is 53 year old white male, 85kg, 185cm, with no significant past medical history who presented in September of 2014 to ENT clinic for a progressively enlarging palpable left sided neck mass over 3 months time. CT scan revealed a 17 x 11 mm mass at the inferior aspect of the left parotid gland with scattered lymph nodes and FNA results showed a benign salivary neoplasm. No airway compromise was evident on imaging and they patient denied symptoms of dyspnea, shortness of breath, or cough. The patient was subsequently scheduled for left parotidectomy under general anesthesia.

On the day of surgery the patient was induced with fentanyl, propofol and succinylcholine, a grade 1 view of the airway was achieved with direct laryngoscopy, and a 7.0 ETT was placed into the trachea and taped at 22cm at the teeth. Anesthesia was maintained with 1 MAC sevoflurane. Vital signs were stable throughout the case. Upon emergence, but prior to extubation the patient experienced significant bucking and a left sided large cervical hematoma developed. The patient was bolused with 50mg of propofol to facilitate hematoma evacuation. No single source of bleeding was identified. Upon the second attempt at emergence, an additional 100mg of lidocaine was injected 5 minutes prior to extubation to help mitigate bucking. The patient bucked twice, the tube was pulled, and again a left sided hematoma developed. The patient's airway remained patent with no signs of respiratory distress. The patient was informed of the complication and verbally agreed to repeat anesthetic induction. He was again induced and intubated easily with a Grade 1 view with a 7.0 ETT and maintained with sevoflurane a third time. This time the ENT team placed a JP drain was placed at the site of cervical hematoma. At this time the Anesthesia team decided to again change the approach to extubation in an effort to prevent continued hematoma formation. Anesthesia was deepened with Sevoflurane titrated to a MAC of 1.2. The Spontaneous respirations with tidal volumes > 500 and a rate of 10. The tube was removed and the patient maintained spontaneous respirations and minimal blood loss into the JP drain. He required some positive pressure for mild laryngospasm prior to waking, but 02 saturations continued to be 100% throughout emergence. The patient was discharged home on POD 2.
Management of Delayed Angioedema in the Post Operative setting

Presenter: Asim Khan, MD/DO, Resident
University of Arizona

Authors: Kai Schoenhage, MD/DO (Faculty Mentor)

Introduction: Angioedema in the operative setting can be a dangerous and possibly fatal process if not managed appropriately by anesthesia providers. The prompt diagnosis and management is crucial in the prevention in airway compromise and complications from hypoxemia. The presentation describes a case in which a developed angioedema four hours after surgery that resulted in airway management with an awake intubation.

Case Description: A 59 yr old female presented with postmenopausal bleeding with PMH including COPD, asthma, HTN, poorly controlled GERD for vaginal hysterectomy with possible salpingo- oophorectomy w/ possible staging, debulking. The patient had an uneventful 3 hour operative course.

Four hours following surgery the patient had numbness that progressed to enlargement of the tongue. She had mild difficulty breathing, no hoarseness was present and lungs were clear. The patient was administered 0.5 mg of epinephrine subcutaneously, 50mg IV Benadryl, 20 of famotidine, and 500 of solumedrol for possible allergic reaction.

The patient was taken to the OR for nasal intubation due to worsening respiratory status. Nasal trumpets coated with lidocaine ointment placed with progressive dilation. A 7.0 ETT tube placed in warm saline and placed via dilated nostril over red rubber catheter. A fiberoptic bronchoscope placed through ETT and allowed to pass through vocal cords under direct visualization. She was taken the ICU for further care after securing the ETT with tape and benzoin.

Discussion: Airway edema can occur due to numerous causes including airway irritation, allergic reactions or hereditary disposition. This can pose numerous concerns for patency of the airway, which in this case required an awake fiberoptic intubation. Careful management must be utilized for patients to ensure no further worsening or loss of airway. The angioedema was thought to have resulted from her ace-inhibitor and self resolved following her course in the ICU.
Masseter rigidity following induction of general anesthesia with fentanyl and propofol

Presenter: Koorosh Elihu, MD, Resident
Harbor-UCLA Medical Center

Authors: Koorosh Elihu, MD/DO
David Cho, MD/DO (Faculty Mentor)

Masseter rigidity during induction can complicate mask ventilation and prevent intubation. We present a case of a 48 year-old woman, ASA 2 with an uneventful previous history of anaesthesia, who exhibited bilateral masseter rigidity following induction with midazolam, fentanyl and propofol. Masseter rigidity made direct laryngoscopy impossible and complicated mask ventilation. Two previous reports have described similar episodes of masseter rigidity, one following induction with remifentanil and propofol and the other following induction with midazolam, remifentanil, propofol and rocuronium. Our case and possible etiologies of this phenomenon are discussed.
Cleft Palate and Malocclusion Presenting as Potential Difficult Airway in a Two Year Old Patient

Presenter: Andrew Chen, MD/DO, Resident
University of Arizona

Authors: Patrick Boyle, MD (Faculty Mentor)

Introduction:

Children with cleft palate have a higher incidence of difficult intubation relating to age, site, and degree of deformity. Airway complexity is compounded when an occlusal cant is present. While more than 150 different syndromes are associated with cleft palate, the link between cleft palate and occlusal cant has not been commonly reported in literature. We present the case of a previously unknown occlusal cant affecting the intraoperative and postoperative care of a cleft palate patient.

Case Report:

A 2 year old male born with cleft palate with no known syndromes presented for palatoplasty. Inhalation induction was performed and a Miller 1 blade was inserted with a grade 2 view. We placed a 4.5cm oral RAE endotracheal tube. It was noted that during direct laryngoscopy, the mandibles were restricted and additional force was required to lift the epiglottis. We discontinued sevoflurane and continued anesthesia with propofol TIVA. Malignant hyperthermia was ruled out and patient continued to be stable. Mandibular rigidity persisted despite rocuronium and surgery was cancelled due to anatomical difficulty. Subsequently, a maxillofacial CT scan showed a shortened left ramus and condylar neck. This caused an occlusal cant which explained the mandibular rigidity. We continued patient on mechanical ventilation and emerged him in PACU. A 8.0 french airway exchanger was used and patient was extubated uneventfully with the removal of airway exchanger shortly after.

Discussion:

When an occlusal cant is present with cleft palate, it is prudent for clinicians to have a heightened awareness for airway complications. With rigidity present, MH needs to be ruled out. Advanced airway instruments and surgeons should be standing by. Due to the potential for lost airway, we recommend placing a pediatric airway exchanger for extubation as it can be well tolerated and potentially serve as a life saving measure in the setting of unrepaired cleft palate with an occlusal cant.
**TO TRACH OR NOT TO TRACH?**

**Presenter:** Efrain Cubillo, MD/DO, Resident
Mayo Clinic

**Authors:**  
Efrain Cubillo, MD  
Narjeet Khurmi, MD (Faculty Mentor)

**Introduction** When encountering a patient with a known or suspected difficult airway, health care professionals take appropriate care to manage the airway in a safe manner. The art and science of managing the difficult airway has been studied extensively and the result of this careful analysis has lead to many practice recommendations. We report a case of a patient with a prior history of a difficult airway with multiple intubation attempts who was spared a tracheostomy due to a simple video laryngoscopic exam.

**Case Report** A 41yo obese African American female presented to our facility for a renal transplant. On post-operative day 1 the patient was taken for allograft explant. Initial laryngoscopy proved to be quite challenging secondary to large tongue and swollen oropharyngeal tissue and resulted in an esophageal intubation. Repeat laryngoscopy with a glidescope was successful. The patient met extubation criteria and the ETT was removed although became confused, restless and obtunded. Using the glidescope the patient was successfully reintubated, transferred to the ICU and remained intubated for the next 72 hours. She returned to the operating room for a tracheostomy where a glidescope was utilized to assess the degree of glottic edema. It was deemed that whatever edema existed days before had subsided and the patient was successfully extubated.

**Discussion** By using the glidescope to assess the degree of pharyngeal and laryngeal edema in a patient that is fluid overloaded secondary to being anephric and third spacing, one might choose to keep the patient intubated at the conclusion of surgery. As in our case the glidescope was utilized to assess the degree of laryngeal edema during a trial of extubation. It may be prudent to add this technique to the list of assessment points in determining whether a patient can be extubated safely and successfully.

![Image](image_url)

**Figure 1.** Noticeable edema of the free edge of the vocal folds with heightened vascular pattern as well as interarytenoid mucosa edema and erythema.
Figure 2. Significant vocal cord edema: Vocal cord edges irregular and complete closure against each other impeded.
Airway

Poster # BB20

**Request Re-intubation for “Cuff Leak” in a Patient with Gastrobronchial Fistula**

Presenter: Mary Zatochill, MD, Resident
Virginia Mason

Authors: Mary Zatochill, MD
Carli Hoaglan, MD (Faculty Mentor)
Joseph Neal, MD (Faculty Mentor)

**Introduction**

Gastrobronchial fistula is a rare complication of esophageal surgery that poses unique challenges in the perioperative and critical care setting.

**Case Report**

A 67-year-old man was intubated at an outside hospital for aspiration and subsequent respiratory failure. Seven years previously he had undergone neoadjuvant chemoradiotherapy and esophagogastrectomy for esophageal adenocarcinoma. Chest imaging was suspicious for a fistula communicating between the left mainstem bronchus and the stomach. On hospital day #4 the on-call anesthesia team was asked to replace the endotracheal tube (ETT) because it “had developed a cuff leak that was losing tidal volume.” Upon examining the patient, we determined that the ETT cuff was intact however a portion of the tidal volume was being translocated through the fistula from bronchus to stomach and then removed via nasogastric tube (NGT) suction. This diagnosis was confirmed by intermittently turning off the NGT suction which subsequently reduced the air leak. We initially attempted to minimize the fistula “shunt” into the gastric system by purposefully intubating the right mainstem bronchus, but this intervention was poorly tolerated by the patient. Instead, we directly visualized the NGT within the fistula tract using flexible fiberoptic bronchoscopy and then guided the NGT deeper into the stomach. This maneuver decreased the air leak and successfully temporized the patient’s ventilation.

**Discussion**

This case demonstrates the importance of a thorough evaluation rather than merely “reacting” to a request. Although the primary team was aware of the gastrobronchial fistula, they did not fully appreciate its contribution to the air leak. One cannot overemphasize the benefit that a new perspective and examination by experienced experts, especially in the context of critically ill patients.
Neuraxial Anesthesia in Patients with Histories of Failed Intubation: a Report of Two Cases and the Medical Decision Making Behind Them

Presenter: Benjamin Ekstrom, MD, Resident
Virginia Mason

Authors: Matthew Henry, MD
Karen Roetman, MD (Faculty Mentor)
Neil Hanson, MD (Faculty Mentor)

Introduction

The presence of a difficult airway is an important consideration for the anesthesiologist when deciding whether or not to utilize a neuraxial anesthetic technique for lower extremity surgery. This is primarily because anesthetic and surgical complications can necessitate emergent airway management.

Case Presentation

We present two patients with previous histories of failed intubation and difficult mask ventilation scheduled for elective lower extremity surgery and describe their intraoperative course and outcomes. Both patients had documented unanticipated failed intubation attempts with subsequent successful positive pressure ventilation either via mask or laryngeal mask airway (LMA). Prior to attempting neuraxial blockade, IV access was obtained, standard ASA monitors were applied, and difficult airway equipment and resuscitation medications were made. Both patients had successful subarachnoid blockade upon initial attempt. Intraoperatively, one patient had premature regression of the subarachnoid block necessitating conversion to general anesthesia via LMA. The second patient had no intraoperative events. Both patients were kept breathing spontaneously throughout their procedures. No surgical or anesthetic complications were encountered.

Discussion

In the formulation of our anesthetic plans for these two cases, we identified important considerations regarding the safety of performing neuraxial anesthesia in patients with confirmed or suspected difficult airway management. Our decision tree is summarized in Figure 1. These considerations could guide clinicians to avoid neuraxial anesthesia when all criteria are not met or to cautiously proceed with neuraxial blockade if the criteria are met. These considerations also may apply to other patient populations such as parturients.

References:

Figure 1: A Decision Tree for Neuraxial Anesthesia in Patients With a History of Difficult Airway

1. Neuraxial anesthesia is a viable option for the surgical procedure and offers some advantage over general anesthesia to the patient.

2. Neuraxial anesthesia is not contraindicated by other factors (i.e. patient refusal, significant coagulopathy, critical valvular stenosis, technical issues, etc).

3. Endotracheal intubation is not required by patient-specific concerns (i.e. high risk of aspiration in operative position, difficult ventilation in operative position, expected hemodynamic instability, etc).

4. The operative position allows adequate access for airway management.

5. There is documentation of successful positive pressure ventilation by mask or LMA or minimal risk factors for difficult mask ventilation.

6. The patient’s psychological state and coping mechanisms predict that he or she would be able to tolerate the procedure with no sedation or light sedation only.

7. The patient is being treated in a location in which there is rapid availability of difficult airway equipment and availability of other personnel with advanced skills in airway management.

If all of these criteria are not met, neuraxial anesthesia is not advisable and alternative approaches to airway management including awake fiberoptic intubation should be explored.
Near fatal pneumopericardium during tracheal stent exchange

Presenter: Nichole Townsend, MD/DO, Resident
Mayo Clinic

Authors: Nichole Townsend, MD
Efrain Cubillo, MD
Dawn Jaroszewski, MD
Ricardo Weis, MD (Faculty Mentor)

Introduction

Bronchial fistulas are an infrequent complication of airway stents and rarely may communicate with the pericardial space. When these fistulas are present, positive pressure ventilation has a high likelihood of developing cardiac tamponade.

Case Report

A 37 y.o. male with tracheobronchomalacia was taken to the OR for rigid bronchoscopy to evaluate his airway stents. After induction of anesthesia, the left bronchial stent was seen but had migrated and collapsed. A wire was advanced into the stent and what was thought to be the left lower lobe bronchus. Simultaneously, the patient became tachycardic and hypotensive. Multiple boluses of saline were administered without improvement. While invasive monitors were placed, epinephrine and vasopressin were given boluses to maintain hemodynamics. Fluoroscopy revealed a pneumothorax requiring a chest tube. The tachycardia persisted despite pneumothorax resolution, and a chest x-ray revealed a pneumopericardium. The chest was prepped and thoracoscopy revealed a tense pneumopericardium creating tamponade. A pericardial window allowed release of air and normalization of the vitals. The patient was transferred to the ICU in stable condition, transitioned to spontaneous ventilation and successfully extubated.

Discussion

Pneumopericardium is a rare, but life-threatening condition with progression to tension pneumopericardium in 37% of cases. In our patient, a fistula had developed after migration of one of his left bronchial stents eroded through the bronchial wall into the pericardial space. The symptoms of tension pneumopericardium reflect those of tamponade: chest pain, dyspnea, and syncope – none of which can be appreciated under the effects of anesthesia. Other manifestations include tachycardia, hypotension, neck vein distension, diminished heart tones and pulsus paradoxus. A “mill-wheel” murmur may be auscultated and x-ray may reveal a “halo sign.” Electrocardiography may reveal low voltages and/or electrical alternans. Early identification and treatment is imperative as continued tension results in cardiovascular instability followed by cardiovascular collapse and death.
Figure 3: AP chest x-ray demonstrating dislodged stent (red arrow), pneumomediastinum and pneumopericardium (blue arrows).
Anterior Displacement of the Dens Process into the Posterior Pharynx in a High C-spine Fracture: A Case Report

Presenter: Jay Shen, MD/DO, Resident
University of California, Irvine

Authors: Jay Shen, MD/DO
Navid Alem, MD/DO (Faculty Mentor)
Joseph Rinehart, MD/DO

Case Report:
A 96 year-old male with Parkinson’s disease was transferred to the OR emergently for cervical spine decompression after sustaining a fall resulting in a C1/C2 fracture. CT of the head and neck demonstrated a non-displaced fracture of the anterior arch of C1 with significant spinal canal compression. Neurological examination revealed bilateral lower extremity numbness with retention of full strength. Airway exam showed an edentulous mouth with a less than 3cm opening secondary to the C-collar impediment. Cervical spine precautions were exquisitely appreciated.

In the operating room, the patient was pre-medicated with fentanyl and glycopyrolate. 4% lidocaine via nebulizer was administered to the awake patient. He then gargled and spit 4% lidocaine before a fiberoptic bronchoscope was advanced into the posterior oropharynx. An approximately 3cm x 2cm round mucosal mass was visualized in the midline. After carefully driving the bronchoscope past the mucosal mass, we were able to visualize the vocal cords. A single lumen 7.5 endotracheal tube was subsequently inserted with minimal resistance. The case was completed successfully utilizing TIVA technique and intraoperative SSEP/MEP neuromonitoring. The patient was successfully extubated on POD # 1, and discharged after 9 hospital days with retention of the ability to move all extremities.

Discussion:
We describe an unusual case of upper airway anatomy distortion due to high cervical spine fracture. As noted in Figure 1, the mucosa of the posterior pharynx was anteriorly displaced by the fractured dens process. This airway alteration was represented by the 3cm x 2cm round mass that was unexpectedly visualized upon fiberoptic bronchoscope advancement. This case-report exemplifies the importance of multidisciplinary collaboration in emergency situations and also further supports the usage of a technique that maintains spontaneous ventilation while manipulating the airway in a patient with a high cervical spine fracture.
Unilateral hypoglossal nerve injury following the use of a classic laryngeal mask.

Presenter: Janice Man, MD, Resident
University of California, San Francisco

Authors: Janice Man, MD
Seema Gandhi, MD (Faculty Mentor)

Background: We present a case of unilateral hypoglossal nerve injury following an atraumatic placement of a classic laryngeal mask.

Case Description:
A 30 year old, 68 kg (BMI 20.3) male, ASA 1, presented for an elective ambulatory right shoulder arthroscopy. The patient received a pre-operative right interscalene block with 25 ml of 0.5% ropivacaine under ultrasound guidance for post-operative pain control. Patient was induced with propofol, a size 4 classic LMA was placed without issues with the cuff inflated with 15ml of air, and general anesthesia was maintained with desflurane and a propofol infusion while on oxygen and air. In recovery, the patient reported some difficulty swallowing and change in speech. He was examined and was noted to have significant tongue deviation to the left as well as noted decreased sensation to cold on the left tongue. An hour post-operatively the patient was then re-examined with noted improvement in the tongue deviation and sensory change. Given the residual nerve injury, the patient was seen by the otolaryngologists in the emergency room later that afternoon and a nasopharyngeal fiberoptic exam was performed which confirmed unilateral left hypoglossal nerve injury.

Discussion:
Only 10 case reports have been published regarding unilateral hypoglossal nerve injury with the use of a laryngeal mask in both pediatric and adult patients. The proposed mechanism of injury is compression of the hypoglossal nerve due to pressure from the laryngeal mask cuff in the pharynx and the hyoid bone. Upon review of literature, risk factors of developing injury include use of nitrous oxide, inappropriate size of laryngeal mask, lateral positioning, extreme head rotation, and difficult placement of the laryngeal mask. Our case demonstrates that nerve injury can occur with the use of a laryngeal mask without any of those risk factors.
Airway complications of Tuberculosis and management of severe tracheobronchial stenosis

Presenter: Brooks Ohlson, MD, Resident
Virginia Mason

Authors: Wyndam Strodtbeck, MD (Faculty Mentor)

We present the case of a 41-year-old African man with chronic tracheobronchial stenosis undergoing attempted rigid bronchoscopy in the setting of previously treated tuberculosis and a reported history of difficult airway. On transfer from an outside hospital he had near total distal tracheal and right mainstem bronchial stenosis. The patient related a possible history of difficult intubation and multiple bronchoscopies with previous, unsuccessful stenting. The patient underwent uneventful intravenous induction of anesthesia but proved impossible to pass a rigid bronchoscope. Additionally, he was found to be a difficult mask ventilation and direct laryngoscopy. While video laryngoscopy was successful, seating the endotracheal tube cuff distal to his vocal cords and proximal to his stenosis proved challenging. Ultimately, multiple rigid bronchoscopy attempts were unsuccessful and the patient was awakened. For chronic airway management a tracheostomy as performed and future attempts at bronchoscopy were performed through his tracheal stoma. We review the airway complications of tuberculosis, surgical/non-surgical management options of tracheobronchial stenosis as well as the anesthetic considerations of both.
Practice of Anesthesia in a Third World Country: Case Presentation of a Patient With Large Multi-Nodular Thyroid Goiter Undergoing a Thyroidectomy.

Presenter: Stephanie Schock, MD, Resident
University of Arizona

Authors: Anthony Lucas, MD (Faculty Mentor)

Operation Giving Back Bohol Mission is a partnership of surgeons, anesthesiologists, and nurses that provides major surgical procedures yearly for the people of Bohol, Philippines. Bohol was devastated in 2013 by the deadliest recorded Typhoon in their history. Surgical and anesthetic resources in this area remain scarce and required us to rely on basic assessment skills instead of modern equipment.

This case describes a 62 y/o female with a massive multinodular thyroid goiter that caused a significant deformity and deviation of the neck. She was scheduled to undergo a total thyroidectomy. The patient was able to lay supine for a short period of time without significant shortness of breath although she slept upright at night due to discomfort. These symptoms were suggestive of some tracheal compression although no imaging studies were available. On physical exam, this massive midline goiter was firm, mobile, and completely obscured the thyroid cartilage.

Given the concern for the potential loss of airway at induction and available equipment, the anesthetic induction was carefully planned. Fiberoptic intubation was not an option due to lack of available equipment. The patient was positioned with the surgeon at bedside lifting the goiter. After ensuring adequate spontaneous ventilation in the supine position, an inhalation induction with sevoflurane proved successful. Assisted ventilation followed by controlled mask ventilation and paralysis with succinylcholine and intubation with a disposable MAC 3 blade followed without difficulty. The total thyroidectomy was successfully performed with identification and preservation of the parathyroids and both recurrent laryngeal nerves.
We report the case of a 56 year-old female patient who presented to our institution for planned elective T10-ilium fusion in prone position. The patient had a 30-pack year history of tobacco use as well as a diagnosis of asthma made at age 50. During preoperative interview the patient was incidentally noted to have mild hoarseness of voice.

Induction of anesthesia was carried out with propofol, fentanyl, and rocuronium; the patient was easily bag-mask ventilated. Direct laryngoscopy (DL) with a Macintosh 3 blade was performed by the anesthesia intern; he described his Cormack-Lehane view as grade 1 but stated he was unable to pass the 7.5 oral ETT through the cords. Intubation was taken over by the senior anesthesia resident, who visualized bilateral arytenoids and a right-sided mass obstructing the view of the right vocal fold. A Glidescope was then used to visualize the glottis and to demonstrate the finding to the surgical team (Figure 1). The patient was then intubated with a Glidescope and an Eschmann using a 6.0 oral ETT, to facilitate an in-OR ENT consultation. The surgery was cancelled. In the PACU, the patient continued to have hoarseness but no stridor; she has follow-up scheduled with our ENT colleagues at the time of this abstract.

This case demonstrates limitations of teaching direct laryngoscopy when the instructor is unable to simultaneously view the airway. The ideal tool would allow the trainee to visualize the airway with an instrument that mimics direct laryngoscopy while simultaneously displaying video laryngoscopy to the teacher. Two devices, the GlideScope Direct and C-MAC provide the learner with a DL view in the manner of Macintosh Blades and have cameras which allow the teacher to visualize the learner’s view, and two studies investigate their use in teaching modalities.
Building a DIY Video Laryngoscope for less than $100

Presenter: Joshua Christiansen, MD/DO, Resident
Virginia Mason

Authors: Joshua Christiansen, MD/DO
Robert Hsiung, MD/DO (Faculty Mentor)

Direct Laryngoscopy has seen little change since it was first described over 100 years ago, and remains the most common method for endotracheal intubation. In the last 20 years, airway management has seen significant technological advances, most notably, the video laryngoscope (VL). Beginning in the early 2000’s, it has rapidly become an invaluable tool in OR airway management as well as emergent ICU and field intubations, almost re-defining the difficult airway. Studies have shown that the VL improves laryngoscopic views, increases first-attempt success rates, and is a valuable aid in education for unexperienced providers.2,3 High costs associated with this equipment have restricted its complete adoption as standard of care and limited its availability for training/education as well as for medical missions and healthcare in impoverished nations. This presentation will demonstrate how a simple VL can be made with easily available technology and basic tools. It requires little prior experience with electronics. Examples will be available for inspection and demonstration on airway mannequins. Hopefully this will ultimately stimulate discussion that will encourage innovation and lead to superior equipment with decreasing costs, ultimately benefiting patients.


Anterior Mediastinal Mass Resection: A Case study of anesthetic management and considerations.

Presenter: Nick Mondek, MD/DO, Resident
Harbor-UCLA Medical Center

Authors: Nick Mondek, MD/DO
J.C. Li, MD/DO (Faculty Mentor)

The anterior mediastinal mass presenting as a significant and challenging pathology for the anesthesiologist and surgeon alike. Airway compromise and hemodynamic collapse are known complications of the perioperative period during resection. A case study and review of the anesthetic management of a patient presenting with an anterior mediastinal mass for surgical resection will be presented. The patient was a 60 year old male of previous healthy status who was noted to have shortness of breath with exertion and positional dyspnea. Radiological imaging confirmed a 10cm by 9cm by 6cm mass located in the anterior mediastinum with evident compression of the distal trachea and bronchi, as well as compression of the superior vena cava. Subsequent CT guided biopsy was significant for thymoma. The patient underwent a successful mediasternotomy for removal of the mass under general anesthesia with induction via awake-fiberoptic intubation. The anesthetic details of the case will be reviewed along with current recommended approaches for perioperative management and considerations for those patients presenting with an anterior mediastinal mass to the operating theater.
Perioperative Glucose Variability in Elective Surgery Patients: A Retrospective Study

Presenter: Charles Carspecken, MD, Resident
University of Washington

Authors:
Charles Carspecken, MD
Jonathan Myers, MD
Shu-Feng Newman, MS/MA/MPH
Bala Nair, PhD

Introduction

Perioperative glucose measurement and prompt institution of algorithm-based therapy is standard of care for most diabetic patients; however hyperglycemic avoidance is often overlooked in the non-diabetic general surgical population (1). Targeted plasma glucose levels for all surgical patients are based mostly on outcomes studies in the critically ill or cardiac cases (2) with a paucity of data on glycemic variability in the perioperative setting in non-cardiac elective cases. Some data suggest that surgical outcomes are worse for hyperglycemic non-diabetics than diabetics (3). Moreover, many glycemic algorithms involve infusing insulin with dextrose to promote normo-glycemia while also avoiding a surgical catabolic state (4) to promote recovery. The objective of this retrospective clinical study was to examine glucose levels in diabetic and non-diabetic patients receiving algorithmic based therapy both during surgery and in the 24 hours perioperative period. We hypothesized that glucose variability might be more pronounced in diabetic patients or in patients receiving insulin with dextrose.

Methods

All patients (n= 2618) ages 17 to 95 undergoing non-emergent general surgery who had intraoperative glucose recorded were initially evaluated in this single center study. Data was extracted from the AIMS and hospital EMR systems from 2011 to mid-2013. To examine the effects of intraoperative treatment on glucose and glycemic variability, only surgeries longer than 3 hours were included and type1 diabetics (less than 2% of patients) were excluded. We analyzed a patient cohort (n = 1512) of diabetic (n=563) and non-diabetic patients (n=949). Average intraoperative, 24 hour perioperative glucose values for three intraoperative interventions (insulin, insulin with D5W and no insulin) were examined along with patient characteristics such as BMI, intraoperative steroid use and gender. Patient characteristics and type of surgery were consistent between groups.

Results

The average glucose levels of diabetic and non-diabetic patients were not statistically different in the operative or 24 perioperative period as shown in Figure 1 below. 27%, 24% and 48% of diabetics received no insulin, insulin alone or insulin with D5W infusion respectively while 65%, 14% and 20% of non-diabetics received these interventions. On average roughly 4 and 11 measurements of plasma glucose were made during and in 24 hour perioperative period respectively. Perioperative glycemic levels were not statistically different either in variability or average plasma levels in obese patients (BMI>30) or with intraoperative steroid administration (data not shown). Though not statistically significant, the data suggest non-diabetics are most likely to have decreases in blood glucose over 24 hours when treated with insulin.

Conclusions

This study demonstrated that using insulin vs. insulin with dextrose did change rates of hyperglycemia or glucose variability in either diabetic or non-diabetic patients undergoing elective surgery in the perioperative period. Further investigation will examine the effect of pre-existing glucose intolerance, HbA1c levels and severity of diabetes on...
glucose response and segment perioperative glycemic control by surgery type. Moreover, we will be examining perioperative infectious and mortality outcomes in context of this data.

Figure 1. Average Glucose Levels During and After Surgery with Standard Deviations (Error Bars).

References


SUSCEPTIBILITY TO HIGH ALTITUDE PULMONARY EDEMA (HAPE) IS ASSOCIATED WITH A MORE UNIFORM SPATIAL DISTRIBUTION OF ALVEOLAR VENTILATION

Presenter: Michael Patz, MD, Resident
University of Washington

Authors: Michael Patz, MD
Rui Sá, PhD
Chantal Darquenne, PhD
Erik Swenson, MD (Faculty Mentor)
Susan Hopkins, MD (Faculty Mentor)

Background: Uneven hypoxic pulmonary vasoconstriction HPV is thought to incite high altitude pulmonary edema (HAPE) by increasing capillary pressure. We have shown using magnetic resonance imaging (MRI) that those susceptible to HAPE (S) but not HAPE-resistant (R) develop increased spatial heterogeneity of pulmonary perfusion in hypoxia consistent with uneven HPV as a characteristic of HAPE susceptibility. Why HPV is spatially uneven is unknown but may result from heterogeneously distributed alveolar PO2 stemming from heterogeneity in baseline ventilation.

Methods: We tested the hypothesis that ventilation is more heterogeneous in S than R using multi-breath inert gas washout (MBW) in normoxia and hypoxia (FI\textsubscript{O2} = 0.125), where indices Scond and Sacin, represent heterogeneity in ventilation from conductive and respiratory airways respectively. Specific ventilation imaging (SVI), a functional MRI technique, was used to measure regional specific ventilation; with the RD of SVI used to quantify heterogeneity. Data were obtained in S (n=6, 1F, 5M), with a history of physician-diagnosed HAPE, and R (n=7, 1F, 6 M), frequent sojourners to > 3,500m without illness.

Results: Contrary to our hypothesis Sacin tended to be more uniform in S than R (S 0.09±0.01, R 0.11±0.03, p=0.08), and Scond and Sacin did not change significantly with hypoxia (p=0.19, 0.72, respectively). S had significantly lower ventilation heterogeneity in normoxia on SVI than R (1.30±0.60 vs 2.30±0.87, p=0.04).

Conclusion: Increased ventilation heterogeneity in normoxia is not a feature of HAPE S, and does not increase with hypoxia. This suggests that the basis for uneven HPV in HAPE involves a vascular mechanism. Further study may delineate a physiologic underpinning of the unexpectedly uniform distribution of ventilation in HAPE S.
TOLERANCE TO OPIOID-INDUCED RESPIRATORY DEPRESSION AFTER FENTANYL AND MORPHINE ADMINISTRATION

Presenter: Chinwe Nwaneshiudu, MD, Resident
University of Washington

Authors: Chinwe Nwaneshiudu, MD
Michael Emery, PhD
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Charles Chavkin, PhD (Faculty Mentor)
Greg Terman, MD (Faculty Mentor)

Opioids cause untoward side effects, the most pronounced being respiratory depression, which limit their therapeutic use as analgesics. Studies have shown that acute analgesic tolerance to fentanyl is dependent on mu-opioid receptor (MOR) inactivation thru GRK3/arrestin signaling, whereas acute tolerance to morphine is contingent on JNK2 and arrestin-independent signaling in mice. However it is largely unknown whether there is acute tolerance to opioid-induced respiratory depression, and if tolerance to respiratory depression is dependent on MOR inactivation through GRK3 or JNK2-mediated signaling. The purpose of this study was first to examine the presence of respiratory depression with fentanyl and morphine using non-invasive pulse oximetry in a mouse model, to determine whether there was acute tolerance to opioid-induced respiratory depression, and observe the effect of genetic knockout of GRK3 or JNK2. Adult male C57BL/6 mice were injected with 2 doses of either fentanyl or morphine 5 hours apart, and oxygenation was monitored by pulse oximetry. Animals injected with a single dose of either fentanyl or morphine demonstrated rapid and profound decreases in oxygenation as measured by pulse oximetry. Additionally, the oxygen desaturation was transiently corrected by administration of 95% oxygen suggesting a mechanism of opioid-induced hypoventilation. Upon injection with a repeat dose of either fentanyl or morphine 5 hours later, oxygen desaturation was also present, albeit an attenuated effect as compared to the first injection (demonstrating acute tolerance). Genetic knockout to GRK3 or JNK2 had no effect on this response. Collectively, these findings demonstrate the presence of acute tolerance to opioid-induced respiratory depression. These findings also suggest that GRK3 and JNK2 mediated signaling, which is known to lead to MOR inactivation by fentanyl and morphine respectively, had no effect on acute tolerance to opioid-induced respiratory depression.
Metabolomic Characterization of Kappa Opioid Receptor Antagonist Stress Response

Presenter: Charles Carspecken, MD, Resident
University of Washington

Authors: Charles Carspecken, MD
Selena Schautter, PhD
Haiwei Gu, PhD
Charles Chavkin, PhD
Daniel Raftery, PhD (Faculty Mentor)

Introduction

The kappa opioid receptor (KOR) system has been implicated as the critical stress-response activator for anxiety, depression and drug seeking behavior (1). Specific KOR antagonists such as Norbinaltorphimine (Nor-BNI) may promote stress resilience and thus have therapeutic potential (2); however the signaling pathways that underlie their duration of action are incompletely understood. Our aim was to use targeted metabolomic analysis to characterize the physiological state of neuronal tissue of mice treated with norBNI prior to stress exposure with those treated with vehicle alone.

Methods

A group of mice (n=28) were either administered an intraperitoneal dose of normal saline or 10 mg/kg norBNI. Half of each group were then stressed with a validated standard swim test over three days or not stressed. At the end of three days, hippocampal and prefrontal cortex tissue were harvested from each mouse then immediately frozen at -80C to quench the tissue’s metabolism. Tissue samples were homogenized, methanol extracted and filtered to obtain metabolic and protein fractions. The metabolic extractions were run on an Agilent 1290 Infinity Liquid Chromatography (LC) system using a HILIC column with a Trip Quad 6410 Mass Spectrometer. The integrated peak intensity for each metabolite was obtained and normalized to the protein concentration. Data analysis was performed using MetaboAnalyst 3.0(3).

Results

Mass spectrometric analysis detected 42 distinct metabolites (amino acids, TCA cycle, glycolysis, and nucleotide intermediates) in each tissue sample, which were validated using retention times and external standards. In hippocampal tissue, which have ion channels known to be regulated by KOR, glutamine and threonine were increased (FC 2.89 and 2.08 respectively, p<0.05, Wilcoxon Sum Rank test) in stressed mice versus stressed mice pretreated with norBNI. In the prefrontal cortex, lysine was increased (fold change 2.5, p value = 0.01) in stressed mice treated with norBNI versus stress alone. There were no statistically significant changes in tryptophan or glycolysis metabolites though stress induced changes in TCA intermediates across all samples. Changes in metabolite correlations in each tissue type are shown in Figure1.

Figure 1. Non-parametric Spearman Correlation Coefficients of Metabolites in Stress v. Stress/NorBNI Treated Mice.

Conclusions

This study identified amino acid metabolites in hippocampal and prefrontal cortex cells that may be important in norBNI’s KOR antagonism. Changes in glutamine, threonine and lysine levels may give insight into how KOR pathways alter the physiologic stress response or help identify upstream protein signaling events. Further work to characterize the correlations between the various metabolites using statistical modeling will help better understand the complex neuropharmacology of opioid signaling.
Protection Conferred by Y-Chromosome Against Pulmonary Hypertension is not Due to Ddx3y Gene

Introduction: Pulmonary hypertension (PH) is an incurable lung disease characterized by elevated pulmonary arterial pressures, vascular remodelling, and lesions leading to right heart failure. It is 4 times more likely to occur in females than males. Our previous work showed that in gonadectomized (GDX) Four Core Genotypes (FCG) mice (XX and XY males, XX and XY females, C57BL6/J), XY mice (XYM, XYF) develop less severe PH than XX (XXM, X XF). In the GDX XY* C57BL/6J model, right ventricular systolic pressure (RVSP) in mice with Y-chromosome (ChrY) (XY, XXY) was significantly lower than that of mice without a ChrY (XO, XX). Since RVSP directly correlates with PH severity, we concluded that ChrY confers protection against PH in GDX mice. Four ChrY genes are expressed consistently in lung and heart (Ddx3y, Kdm5d, Uty, Eif2x3y) and are thus candidate protective genes.

Methods: We investigated whether the Y-gene Ddx3y, a cellular growth suppressor, is protective against PH. Since Ddx3y transgenic mice were available on an outbred MF1 background, we first examined the ChrY protective effect in MF1 XY* mice (n=5/group). Secondly, we compared PH in MF1 XX female mice with and without a transgenic copy of Ddx3y (n=10/group). Mice were gonadectomized at day-75 and 4-weeks after gonadectomy, were exposed to hypoxia (10% O2) for 3-weeks. RVSP was measured through direct catheterization.

Results: We confirmed that in MF1 XY* mice ChrY protects against hypoxic insult as it does in C57BL6/J mice. RVSP was significantly lower in XXY or XY mice compared to XX or XO mice (p=0.03). We did not find a significant difference between the RVSP of XX mice with or without a transgenic copy of Ddx3y.

Conclusions: We conclude that Ddx3y does not confer protection against PH. Next we plan to investigate effects of the other Y candidate genes Kdm5d, Uty, and Eif2x3y.
Effect of Neuraxial Analgesia on Transthoracic Echocardiographic Parameters of Diastolic Function in Term Parturients

Presenter: Benjamin Illum, MD/DO, Resident
University of California, San Diego

Authors: E. Orestes O’Brien, MD/DO (Faculty Mentor)
David Gambling, MD/DO (Faculty Mentor)
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Krause, MD/DO

Background: Echocardiographic assessment of diastolic function during pregnancy demonstrates that LV compliance deteriorates from early gestation to term. The mechanism is unknown, but sympathetic activation has been demonstrated to contribute to impairment of LV performance in congestive heart failure, ischemic coronary disease and other hypertensive and pre-hypertensive disorders. Neuraxial analgesia blunts sympathetic output to the peripheral vasculature and changes peripheral and central hemodynamics, but its effect on maternal LV compliance has not been reported. We hypothesize that blunting of sympathetic output might change LV diastolic function and propose to use transthoracic echocardiography to investigate the existence and magnitude of those changes.

Methods: In this prospective, observational study, healthy term parturients without known structural heart disease or hypertensive disorders of pregnancy will be recruited and divided into two arms, continuous labor epidural (CLE) and combined spinal and epidural (CSE) analgesia. Prior to initiation of neuraxial analgesia, an apical 4-chamber (A4C) view of the LV is obtained using transthoracic echocardiography. Measurements obtained from this view include: peak early (E) and late or “atrial” (A) mitral inflow velocities, E-deceleration time, and tissue doppler of early diastolic motion at the septal and lateral mitral annulus (e’). Approximately 1 hour after initiation of neuraxial analgesia, these measurements are repeated in the same subject. E/A, E/e’, and E-deceleration time are compared in each patient before and after neuraxial analgesia.

Results: To date 18 patients have been enrolled. On 2 patients, post-neuraxial analgesia data could not be obtained. Of the remaining 16, 9 received CSE. For patients who received CSE, E/e’ was lower after receiving neuraxial analgesia and was significant (6.441 vs. 5.433, p<0.05). For patients who received CLE, E/e’ was higher after receiving neuraxial analgesia and was not significant (5.223 vs. 6.431, p=0.3336). For patients receiving CSE, the E/A ratio was lower after neuraxial analgesia but was not significant (1.717 vs. 1.564, p=0.31516). For patients who received CSE, the E/A ratio was higher after receiving neuraxial analgesia and was not significant (1.587 vs. 1.599, p=0.9697).

Discussion: To date, this study indicates that CSE but not CLE may reduce the E/e’ ratio one hour after administration in healthy term parturients. This suggests that CSE may be a more effective modality than CLE at improving diastolic compliance in patients without structural heart disease at term.
Coronary artery unroofing procedure in a patient who sustained sudden cardiac arrest secondary to an anomalous right coronary artery

Presenter: Lauren Frizzell, MD/DO, Resident
cedars-Sinai Medical Center

Authors: Lauren Frizzell, MD/DO
Alistair Phillips, MD/DO
Lorraine Lubin, MD/DO

Introduction: In young persons with sudden cardiac death, the cause has been linked to anomalous coronary arteries in approximately four to fifteen percent (1). Of coronary anomalies, ones with an inter-arterial course have been associated with a higher incidence of major adverse cardiac events. For arteries with an intramural course coronary artery unroofing is the preferred treatment for those identified by echo or after sudden cardiac arrest (2).

Case Presentation: A previously healthy 18 year old male was transferred from an outside hospital after suffering cardiac arrest while playing basketball. Initial echo on presentation showed a left ventricular ejection fraction of 25% and moderately depressed right ventricular function. He required an intra-aortic balloon pump for hemodynamic support. Coronary CT was remarkable for an anomalous right coronary artery (RCA) from the left coronary sinus coursing between the aorta and pulmonary artery with a 1.1 cm intramural segment. The patient suffered anoxic brain injury, renal failure and required tracheostomy and a G tube for feeding. He was discharged to rehabilitation almost two months later and was scheduled for coronary artery unroofing. At the time of presentation for surgery the patient no longer required trachostomy or G tube support and only had mild residual memory defects. He underwent uncomplicated RCA unroofing to remove the intramural portion and the ostium was moved to the right sinus. Post-operative transesophageal echo was notable for the origin of RCA from right sinus without any significant wall motion or valvular abnormalities.

Discussion: Anomalous coronary arteries are a rare, but important cause of sudden cardiac arrest in children and young adults, particularly with exercise. Currently, coronary artery unroofing is the most common method of repair, however coronary artery bypass grafting, reimplantation, pulmonary artery translocation or patch angioplasty have also been used previously (2).
**Incidental finding of a ventricular septal defect after surgical aortic valve replacement in a patient presenting for mitral valve clip**

**Presenter:** Lauren Frizzell, MD/DO, Resident  
Cedars-Sinai Medical Center

**Authors:** Lauren Frizzell, MD/DO  
Lorraine Lubin, MD/DO  
Antonio Hernandez Conte, MD/DO  
Saibal Kar, MD/DO  
Rebecca Aron, MD/DO (Faculty Mentor)

**Introduction:** Ventricular septal defect (VSD) following surgical aortic valve replacement (AVR) is a rare complication. The VSD may be of little clinical significance or may cause significant shunting and require subsequent repair.

**Case Presentation:** An 84 year-old woman with severe mitral regurgitation (NYHA class III) presented to the interventional cardiology suite for mitral valve clip procedure. Past medical history included aortic stenosis status post redo-replacement, hypertension and atrial fibrillation. Transesophageal echo (TEE) post induction was notable for severe mitral regurgitation. During evaluation of the tricuspid valve, an unexpected color Doppler jet was noted. On continuous wave Doppler, it was noted to be a holosystolic left-to-right shunt consistent with a perimembranous VSD, a presumed complication of her prior AVR. Although shunt fraction was not measured, the VSD appeared small and restrictive. A single mitral clip was placed resulting in residual mild MR. The decision was made to defer VSD closure due to shunt size, lack of LV volume overload and lack of consent. Post-procedure the patient had a drastic improvement in her shortness of breath and the VSD was followed up clinically.

**Discussion:** VSD is a rare, but described complication of surgical AVR. It can occur in either the membranous, and less commonly, muscular portion of the septum. In many instances these go unnoticed; however they can be detected when patients continue to have unexplained heart failure after valve replacement. Currently, it is recommended to defer closure of asymptomatic VSDs, and/or those without evidence of LV volume overload or a left to right shunt fraction of 1.5 given the morbidity associated with redo sternotomy. A percutaneous approach requires a small defect size (<2cm) and an adequate rim of subaortic tissue to seat the device. Route of implantation (transseptal, vs. transaortic vs. apical approach) must also be considered in patients requiring repair.
Cardiac

Poster # DD04

Transfemoral Aortic Valve Replacement: A Case Report of Three Deployed Valves

Presenter: Melanie Hall, MD/DO, Resident
University of California, San Francisco

Authors: Melanie Hall, MD/DO
Martin Stechert, MD/DO (Faculty Mentor)
Brian Cason, MD/DO

A 78 year-old male with a past medical history significant for severe aortic stenosis (AVA 0.53), and peripheral vascular disease (PVD) was scheduled for open aortic valve replacement (AVR) but was subsequently delayed after he developed bacteremia requiring an ICU admission. The patient was then found to be too frail for open AVR and transcatheter aortic valve replacement (TAVR) workup was initiated. The operative plan was for Transfemoral (TF) AVR with fallback to direct aortic approach if the femoral approach was unsuccessful given the extent of PVD.

On the day of the procedure, large bore IVs were placed as well as a 20G right radial arterial line and left internal jugular cordis introducer. Anesthesia was induced with etomidate, rocuronium, and fentanyl. The patient was an easy mask ventilation and grade 1 view with elective glidescope intubation. Anesthesia was maintained with sevoflurane and a remifentanil infusion.

The TF AVR procedure was accomplished with moderate difficulty, leading to placement of three 31mm Corevalve prosthetic valves. Examination by echocardiogram and aortogram of the first Corevalve showed improvement in aortic insufficiency (AI). However, there appeared to be an in-folding of the frame of the Corevalve from a piece of calcium in the native valve. A second balloon was then deployed across the valve under rapid pacing. The second valve was partially deployed but while pulling it up to prevent a deep implant it popped out of annulus and could not be retrieved. It was then was pulled into the first Corevalve in the ascending aorta and deployed. The third Corevalve was deployed successfully with trace AI seen on TEE. The patient was extubated awake in the OR and transferred to the ICU. TTE on POD#2 showed all three valves well seated. The patient was discharged home on POD#4.
Figure 1. A. Angiogram from the pigtail catheter that was placed in the bowl of the Corevalve, demonstrated an infolding of the frame from a piece of calcium in the native valve itself. B. A 26 mm true balloon was deployed across the valve and under rapid pacing a balloon valvuloplasty was performed, however, during this balloon inflation, he lost capture of his rapid pacing, which then caused the heart to eject the Corevalve device out of the annulus. C. Because the valve was ejected out of the annulus, a snare inserted through the brachial artery was used to pull it above the sinotubular junction. D. Third Corevalve deployed in correct position.
Trans-Apical Approach for Transcatheter Aortic Valve Replacement – A Case Report Involving an Intra-Operative Death

Presenter: Robyn Hilles, MD, Resident
University of California, San Francisco

Authors: Martin Stechert, MD (Faculty Mentor)

Our case involves an 89 year old man with severe, symptomatic aortic stenosis (AS) with a past medical history of CAD s/p three vessel CABG, HTN, COPD, history of CVA without residual deficit, extensive PVD, as well as an infra-renal AAA who was not a candidate for re-do sternotomy given his prior revascularization and was deemed too great of a surgical risk for surgical aortic valve repair given his extensive co-morbidities. As his iliac and femoral vessels were severely diseased, he underwent Trans-catheter Aortic Valve Replacement (TAVR) via the trans-apical (TA) approach. His operative course was significant for profound hypotension requiring chest compressions and subsequent apical rupture, which was unable to be surgically corrected.

In the PARTNER (Cohort B) trial,¹ patients with severe symptomatic AS who were deemed not to be suitable conventional surgical candidates were randomized to TAVR via the trans-femoral (TF) approach or standard medical therapy. The TAVR group had significantly reduced rates of death at 30 days and 1 year. For patients with contra-indications to the TF route, alternate procedural techniques have been developed including direct aortic, trans-axillary/subclavian and, most commonly, trans-apical approaches. Direct comparison of TA and TF approaches is often hindered by selection bias, as TA patients using standard scoring systems are often sicker at baseline.²³ Yet, in high volume centers, such as the Cleveland Clinic, it appears that after a steep learning curve, TAVR-TA can be safely performed.⁴ Conversely, in institutions with predominant TF approaches, the data on the TA approach demonstrates worse outcomes.⁵ With the development of smaller TAVR delivery systems, reducing the fraction of patients with contra-indications to the TF approach, as well of the advancement of other alternate approaches, the future role of the TA approach needs to be elucidated by further study.

References

A Case Report of Three Uncomplicated General Anesthetics in a Patient with Brugada Syndrome

Presenter: Benjamin Ekstrom, MD, Resident
Virginia Mason

Authors: Matthew Henry, MD
Christopher Fellows, MD
Eliott Fagley, MD (Faculty Mentor)

Introduction:

Brugada syndrome is a rare inherited cardiac sodium channelopathy which is associated with malignant ventricular arrhythmias and sudden cardiac death. Arrhythmias can be triggered by many medications, especially those which block cardiac sodium channels. With respect to anesthetic medications, propofol, ketamine, tramadol, and local anesthetics have been reported to trigger characteristic electrocardiographic changes in patients with Brugada syndrome. In addition, many medications commonly administered perioperatively can trigger dangerous arrhythmias in this syndrome: for example, diphenhydramine, edrophonium, metoclopramide, and most anti-arrhythmics. Familiarity with the condition, avoidance of triggering agents, and preparation for treating malignant rhythms with appropriate agents are prerequisite to anesthetizing patients with Brugada syndrome.

Case Presentation:

We present a case of a 43 year old women with an established diagnosis of Brugada syndrome who underwent three uncomplicated general anesthetics. The patient had a history of sudden cardiac death from ventricular fibrillation from which she was resuscitated. She subsequently had an implanted cardiac defibrillator placed. All cases were elective. Continuous ECG monitoring was maintained, and the patient’s ST-segments did not degenerate to the typical (type 1) Brugada morphology. No ventricular arrhythmias were encountered. We report a list of the medications administered during each of the anesthetics.

Conclusion:

Relatively few reports of anesthetics in patients with Brugada syndrome have been published. We report the techniques and medications utilized in three uneventful anesthetics to add to the body of experience of safely managing this condition. In particular, single propofol boluses were utilized for the induction of anesthesia in each case without incident. This supports the hypothesis previously put forward that propofol is safe in single induction doses in this patient population.

References:

Mizusawa et al. Circ Arrhythm Electrophysiol. 2012;5:606-16
Poster # DD07

**Complete Heart Block During Placement of Methylmethacrylate in Total Knee Arthroplasty**

Presenter: Helen Chan, MD, Resident  
University of Arizona

Authors: Helen Chan, MD  
Craig Palmer, MD (Faculty Mentor)

**Introduction:**

Bone cement, methylmethacrylate, is often used in orthopedics to stabilize prostheses. However, its use has been reported to cause cardiovascular and hemodynamic changes. We present a patient with mild prior cardiac history during a total knee arthroplasty (TKA) who suffered resistant bradycardia within minutes of methylmethacrylate placement.

**Case Description:**

60-year-old obese female with PMH of diabetes mellitus type 2, hypertension, and hyperlipidemia was admitted for a right TKA. The patient had a history of left TKA without complication. A prior ECG showed RBBB with borderline first-degree block; a nuclear study was negative and TTE showed borderline LVH and diastolic dysfunction.

The surgery under general endotracheal anesthesia was progressing uneventfully until at the time of cementing the prosthesis. The patient converted from sinus rhythm to a bigeminal sinus with ectopic QRS with a rate of 50 bpm. The patient then converted to sinus with entire ectopic QRSs and the rate decreased to below 40 bpm. The rate decreased to below 30 bpm. Carotid pulses were palpable. Chest compressions started with measurable end tidal CO2. External pacer pads were not able to verify capture. Patient was transferred to cardiac catheterization laboratory with continuous chest compressions for a transvenous pacer, which was successfully placed. Cardiac catheterization and follow up TTE were both unremarkable. Cardiology was unable to determine other causes of the complete heart block and the patient was discharged with a permanent pacemaker.

**Discussion:**

Methylmethacrylate has been previously reported to cause hemodynamic changes intraoperatively. There have been reports regarding methylmethacrylate association with second degree AV block and cardiovascular collapse during hip arthroplasties. However, very few have reported specifically regarding methylmethacrylate association with complete heart block during TKA, displaying the degree of cardiovascular responses encountered with methylmethacrylate.
Epicardial and Endocardial Strain Response to Acute Alterations in Preload

Presenter: Reed Harvey, MD, Fellow
University of California, Los Angeles

Authors: Reed Harvey, MD (Faculty Mentor)
Kimberly Howard-Quijano, MD (Faculty Mentor)
Kentaro Yamakawa, MD
Tatsuo Takamiya, MD
Jennifer Scovotti, MS/MA/MPH

Intro: Left ventricular strain has emerged as a comprehensive index of myocardial function that can accurately measure strain in longitudinal and circumferential planes as well as endocardial and epicardial layers. There are known differences in these measures at baseline, however, the effect of changing loading conditions on endocardial and epicardial strain have not been previously described. We hypothesize that due to LV anatomic differences in myocardial fiber orientation acute alterations in preload will have differential effects on global and regional LV systolic function in the epicardium and endocardium, as measured by two-dimensional longitudinal and circumferential speckle tracking strain imaging.

Methods: 2D echocardiography with simultaneous intracardiac hemodynamic monitoring was performed on 7 juvenile Yorkshire pigs after GETA and median sternotomy at baseline and during conditions of reduced preload (incremental IVC occlusion) and increased preload (rapid volume bolus). Strain measurements were performed offline using GE's EchoPAC software.

Results: Endocardial longitudinal strain was significantly reduced during acute reductions in preload (50% IVC occlusion; endo -6.9% vs. epi -2.3%, Full IVC occlusion; endo -6.2% vs. epi -3.8%, p < 0.002) while circumferential strain was relatively spared. This reduction in strain demonstrated an apical to basal gradient. Acute increase in preload caused regional differences in LV function, as the LV septal wall had a significant increase in longitudinal strain while the free wall had a significant reduction.

Conclusions: The differential global and regional changes in longitudinal and circumferential strain with acute alterations in ventricular preload provide insight into the interplay of cardiac structure and function.
Figure 1: Changes in left ventricular global longitudinal strain (A) and circumferential strain (B) with progressive changes in preload. Data expressed as mean; * = endocardial strain significantly greater than epicardial strain p<0.05; † = significant reduction in strain from baseline; p<0.05
Background: Speckle tracking echocardiography (STE) has emerged as a novel modality for assessment of myocardial function. However, the temporal effects of acute ischemia and reperfusion on left ventricular (LV) epicardial and endocardial myofibrils, as measured by longitudinal and circumferential strain, have not been fully characterized. We hypothesize that STE can detect regional differences in LV function and myocardial perfusion associated with acute ischemia and reperfusion.

Methods: Two-dimensional surface echocardiography was performed in 7 juvenile Yorkshire pigs in an open chest porcine model after induction and median sternotomy at time points of: baseline; 1, 5, and 15-minutes ischemia; and 1, 15, and 30-minutes reperfusion. The left anterior descending artery at the second diagonal branch was occluded to induce ischemia. Peak systolic longitudinal and circumferential segmental strain and rotation were measured in epicardial and endocardial myofibril layers offline using GE’s EchoPAC software. Statistical analysis was completed using a paired T-test.

Results: At baseline, longitudinal strain was greater than circumferential, and endocardial strain was higher than epicardial. Endocardial and epicardial longitudinal strain was decreased significantly at 1, 5, and 15-minutes ischemia within the infarct zone. Apical endocardial strain decreased dramatically at 1-minute ischemia in both the presumed infarct zone as well as the non-infarct zone; strain in the infarct zone continued to decrease while the non-infarct zone stabilized at 5 and 15-minutes ischemia. Reperfusion was associated with recovery of LV function, though recovery within the ischemic penumbra remained incomplete at 30 minutes.

Conclusions: We found that ischemia and reperfusion have differential effects on longitudinal, circumferential, and rotational LV myofibril function in epicardial and endocardial layers. Longitudinal endocardial myofibril function, particularly in the apex, appears most susceptible to acute ischemia. These results may provide new insight into LV coronary perfusion characteristics and the associated dynamic changes in LV mechanics during acute ischemia.
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Transient Laryngospasm and Cardiac Arrest in an Adult with Occult Atrial Septal Defect

Presenter: Greta Hockett, MD, Fellow
Virginia Mason

Authors: Greta Hockett, MD
Joseph M. Neal, MD (Faculty Mentor)

Introduction:
Atrial septal defects (ASD) in adults often are asymptomatic until the fifth decade of life. Left untreated, they may lead to pulmonary hypertension, intracardiac shunting, paradoxical emboli, and stroke.

Case:
A 56 year old male presented for elective lower extremity hardware removal. He had untreated severe obstructive sleep apnea (OSA) and supraventricular tachycardia with ablation 4 years previously. Cardiac exam revealed regular rhythm without murmur. Immediately after LMA placement, the patient’s cardiac rhythm changed to stable atrial fibrillation. Just prior to incision, the patient forcefully coughed and developed what was thought to be laryngospasm. He exhibited mild O2 desaturation and marked decrease in end tidal CO2. The presumed laryngospasm resolved quickly after succinylcholine administration; O2 saturation improved and ETCO2 rose to the low 20s. However, the patient’s cardiac function rapidly deteriorated with progressive bradycardia, hypotension, and diffuse ST-segment elevation. Despite intubation and vasopressors, the patient developed pulseless electrical activity. CPR was effective and achieved return of spontaneous circulation within several minutes. Intraoperative transesophageal echocardiography (TEE) revealed a large secundum ASD with bidirectional shunting of air. Emergent coronary catheterization was negative for thrombosis or stenosis; the myocardium was diffusely hypokinetic; the right heart appeared slightly dilated. Two days after arrest, the patient suffered a massive embolic stroke. The patient has made a remarkable neurologic and cardiac recovery.

Discussion.
This case highlights complications that can occur in an adult with an untreated large ASD. We speculate that transient hypoxia and hypercapnia consequent to transient respiratory distress combined with likely increased right heart pressures from untreated severe OSA to cause bidirectional shunting across his large ASD. Air from intravenous and drug administration sources caused transient air emboli to his cardiac and cerebral circulations. Of particular interest, transthoracic echocardiography did not reveal the ASD, which was only confirmed after bubble test and TEE.
Infective endocarditis and isolated tricuspid insufficiency is most commonly associated with intravenous drug abuse. The annual incidence is approximately 1.7 - 6.2 cases per 100,000 patients with an associated mortality rate of 40-50%; it typically affects men more than women. Staphylococcus aureus infection is the most frequent IE etiology. Pulmonary septic emboli is an unfortunate complication that is difficult to treat. We report the case of a 48 year-old male with asthma and chronic intravenous opioid and amphetamine abuse who presented to the emergency room with a three-day history of back pain, shortness of breath, fever, and altered mental status. Computed tomography of the chest revealed extensive consolidation and cavitary lesions. TEE performed eight hours later showed a thickened tricuspid valve, severe tricuspid regurgitation, a mobile echo density on the tricuspid valve, and a ruptured chordae. Blood cultures were positive for MRSA within 12 hours. After one week of IV antibiotics, the patient remained bacteremic with enlargement of the valvular mass. Prior to surgery, a chest tube was placed for pleural fluid drainage. The patient underwent replacement of the infected native valve with a mechanical valve and ligation of a small PFO. A tracheostomy was placed on POD 1. On POD 10, he developed a pericardial tamponade and an emergent pericardial window was performed. TEE demonstrated a mechanical valve without vegetation. The patient required respiratory support until POD 16, when he was weaned to trach collar. Respiratory cultures no longer grew MRSA but now was positive for Pseudomonas aeruginosa. Mortality and morbidity from isolated right sided infective endocarditis is high, with septic embolism increasing those numbers. Consideration of a tracheostomy tube should be emphasized if prolonged ventilation is expected. Antibiotic coverage should be frequently re-evaluated for potential ventilator associated pneumonia or line colonization. Indications for surgery include persistent sepsis with systemic emboli, increased and/or persistent vegetation, and clinical deterioration. This clinical case underscores the difficulty in treating the pulmonary complications of right sided endocarditis, despite a successful valve repair.
Prevalence and descriptive analysis of congenital heart disease in parturients: Obstetric, Neonatal, and Anesthetic outcomes

Presenter: Christine Warrick, MD/DO, Resident
University of Colorado

Authors: Christine Warrick, MD/DO
Jan Hart, MS/MA/MPH
Ann Lynch, MD/DO
Joy Hawkins, MD/DO
Brenda Bucklin, MD/DO (Faculty Mentor)

STUDY OBJECTIVE: To: 1) Assess prevalence of congenital heart disease (CHD), 2) Describe outcomes of pregnancies in women with CHD, 3) Compare outcomes in women with and without CHD and, 4) Characterize neonatal outcomes in pregnancies complicated by CHD.

DESIGN: This was a retrospective cohort study of women who delivered at the University of Colorado Hospital. Diagnosis of CHD was identified based on history of cardiac disease, pulmonary disease, or subacute bacterial endocarditis (SBE) prophylaxis during labor, and confirmed with echocardiogram when available. Comprehensive retrospective review of anesthetic, obstetric, and neonatal outcomes was performed.

SETTING: University of Colorado Hospital

PATIENTS: 18,226 women

INTERVENTIONS: Medical record review

MEASUREMENTS: Valvular abnormalities, New York Heart Failure Association (NYHA) classification scores, types of CHD, maternal age, race, gravidity, parity, maternal pre-pregnancy body mass index, cigarette use, type of delivery, type of analgesia used, early initiation of neuraxial labor analgesia, arrhythmias, need for peripartum diuretics, prolonged maternal hospital stay, preterm birth, small for gestational age, neonatal CHD, neonatal or maternal intensive care unit (ICU) admissions, and maternal or neonatal death

MAIN RESULTS: We identified 117 pregnancies in 110 women with CHD. Parturients with CHD were more likely to have operative vaginal delivery (P <0.0001), neonatal ICU admissions (P = 0.003), and had prolonged hospital stays. Occurrence of CHD in neonates was 6%. Moderate to severe valvular disease was associated with increased rates of operative vaginal delivery, early initiation of neuraxial labor analgesia, cardiac complications (including arrhythmia and use of diuretics), prolonged hospital stay, and maternal ICU admission. However, the majority of deliveries and births were uncomplicated; and there were one case each of maternal mortality and fetal death after birth.

CONCLUSION: Operative vaginal deliveries and neonatal ICU admissions are more common in women with CHD, but these pregnancies are generally well tolerated with low mortality rates.
IMPELLA PLACEMENT IN A 37 YEAR OLD MALE WITH TRANSPOSITION OF THE GREAT VESSELS

Presenter: Sarang Koushik, MD, Resident
Mayo Clinic

Authors: Ricardo Weis, MD (Faculty Mentor)

INTRODUCTION

Transposition of the great vessels is the most common cyanotic congenital heart defect with several variants, most commonly dextro-transposition of the great arteries (DTGA) and levo-transposition of the great arteries (LTGA). Due to progressive decline of the RV in the setting of systemic pressures, patients with levo-transposition are at risk for RV failure and often require mechanical devices to augment cardiac function. An Impella is an axial flow pump placed percutaneously, retrograde through a peripheral artery, to reach the aortic valve. It is capable of producing anywhere from 2.5-5L of flow per minute depending on model type.

CASE REPORT

Our patient is a 37-year old male with a past medical history significant for dextro-transposition of the great vessels s/p mustard procedure at the age of 9 months causing congestive heart failure diagnosed in December of 2013. Congenital transthoracic echocardiogram reported a right ventricular ejection fraction at 10% (systemic ventricle). The patient eventually had placement of an Impella device via the left axillary artery. This was done with a graft placed in the left axillary artery, which the Impella was placed through, that was then tunneled to the lateral chest wall.

DISCUSSION

As the right ventricle serves as the systemic circulation in patients undergoing mustard procedure it is not uncommon for these patients to have systemic ventricular failure requiring transplantation. If cardiac function deteriorates rapidly before donor heart is available, the use of a ventricular assist device may be the only suitable remaining option. Wiklund et al first described the implantation of a left ventricular assist device in a patient with transposition of the great vessels after surgical repair (6). An Impella is a suitable option for short term cardiac support in anticipation of cardiac transplantation.
Anesthetic management for radical nephrectomy for renal cell carcinoma complicated by caval thrombus and right atrial tumor metastasis

Presenter: Jared Hylton, MD, Resident
University of California, Davis

Authors: Jared Hylton, MD
Anna Kowalczyk, MD (Faculty Mentor)

Case Description:
A 72-year-old man with renal cell carcinoma (RCC) with caval thrombus and right atrial (RA) tumor metastasis presented for radical nephrectomy, caval thrombectomy, and RA tumor resection. Renal artery embolization was performed the day prior. General anesthesia was supplemented with a thoracic epidural catheter. Vascular access included a right internal jugular (IJ) 7 French (Fr) sheath, left IJ 9 Fr catheter, and bilateral femoral vein 7 Fr sheaths. A pulmonary artery catheter was not placed due to possible dislodgement of RA tumor. Transesophageal echocardiography (TEE) confirmed RA tumor location. Urologist, surgical oncologist, and cardiothoracic surgeon worked to mobilize renal tumor, institute cardiopulmonary bypass (CPB) with deep hypothermic circulatory arrest (DHCA), and resect tumor and thrombus. CPB was reinstituted, patient rewarmed, and sinus rhythm recurred spontaneously. Upon procedure completion the patient was transferred to the ICU intubated in stable condition.

Discussion:
Caval tumor thrombus is a unique feature of RCC (1). Supradiaphragmatic venous thrombus extension occurs in 4-10% of patients. 2-10% may have extension into the RA (2,3). Anesthetic management poses numerous challenges. A high incidence of thrombus migration may risk pulmonary embolism. Cardiovascular collapse upon induction may be due to obstruction of the IVC/RA junction. Establishment of vascular access for emergent venovenous bypass is essential and timing of placement should be agreed upon prior to induction. DHCA increases the risk for left ventricular dysfunction and induces profound coagulation dysfunction, which requires complex management including point-of-care testing and blood product transfusion. Tumor embolization may be performed prior to surgery. Epidural catheter placement for pain control should be placed at this time. The anesthesiologist must be cognizant of neuraxial catheter management in the setting of anticoagulation and possible postoperative coagulopathy. A comprehensive anesthetic plan with communication with all services involved is critical to maximize patient safety and optimize surgical outcome.

Sudden-onset dyspnea in the post-operative period has a broad differential diagnosis. In this case, a 65-year-old woman with a past medical history of hypothyroidism, degenerative joint disease, and paroxysmal atrial fibrillation presented for cryoballoon ablation of ectopic atrial foci, performed in the electrophysiology laboratory. Diaphragmatic pacing was preformed throughout the ablation, and no loss of phrenic nerve capture was noted. After regaining consciousness in the PACU, the patient complained of new-onset shortness of breath, which she had not experienced prior. Physical exam revealed decreased breath sounds in the right lower lung zones not noted in the anesthesia pre-operative examination record. An AP chest x-ray was ordered in PACU which was suggestive of an elevated right hemi-diaphragm. The primary team was notified and the patient brought to fluoroscopy where the diagnosis of hemi-diaphragmatic paralysis was confirmed.

Hemi-diaphragmatic paralysis is a rare complication following atrial fibrillation ablation.

Differential diagnosis of post-operative dyspnea is broad, and includes anesthetic, surgical and patient-related causes. One rare cause of dyspnea following atrial fibrillation ablation is hemi-diaphragmatic paralysis secondary-to phrenic nerve injury. Use of intra-operative diaphragmatic pacing with concomitant abdominal palpation may detect phrenic nerve damage, but does not guarantee its prevention. Prognosis in these patients is generally good, but recovery of diaphragmatic function is variable and a minority of patients will not recover completely. Patients who do not recover full diaphragmatic function and remain symptomatic may benefit from surgical plication of the diaphragm. Suspicion of the diagnosis of phrenic nerve palsy secondary-to atrial fibrillation ablation is based on history and initial physical examination and is confirmed by radiologic imaging.
Prosthetic valve endocarditis s/p repair with development of Gerbode ventricular septal defect.

Presenter: Deena Perotti, MD/DO, Resident
Cedars-Sinai Medical Center

Authors: Deena Perotti, MD/DO (Faculty Mentor)
Harish Ram, MD/DO
Antonio Conte, MD/DO (Faculty Mentor)
Daniel Ramzy, MD/DO
Lorraine Lubin, MD/DO

Prosthetic valve endocarditis is now more commonly encountered due to changes in etiology of infective endocarditis. Presented is a patient with endocarditis who underwent successful cardiac surgery however with a complicated post-operative course.

A 50-year-old male with past medical history significant for aortic valve endocarditis seeded from osteomyelitis requiring bio-prosthetic aortic valve replacement and subsequent repair for recurrent endocarditis was admitted with Staphylococcus aureus bacteremia. On admission, the patient was found on TEE to have a large 4.3 cm by 1.8 cm heterogeneous mass in the posterior aortic root, extending down into aortic-mitral continuity, anterior mitral valve leaflet and septal tricuspid leaflets. The patient underwent debridement of infected tissue including the aortic root, anterior mitral leaflet, inter-atrial septum, portions of right and left atria, septal tricuspid leaflet with replacement of the aortic prosthetic valve, aortic root replacement and re-suspension of mitral and tricuspid valves. Post-operatively, the patient had neither positive blood cultures nor evidence of endocarditis on echocardiogram. However he was noted to have an abnormal flow from the LVOT to both the right ventricle and the right atrium consistent with a Gerbode ventricular septal defect (Figure).
Carcinoid heart disease is a rare condition that develops in about 50% of patients with metastatic carcinoid tumors who exhibit the carcinoid syndrome. It is characterized by endocardial plaques and valvular fibrosis that most commonly involves the tricuspid and pulmonic valves. Resultant distortion of the valves can cause stenosis, regurgitation, or both; ultimately leading to right heart failure. The vasoactive substances secreted by metastatic carcinoid cells, particularly serotonin, are implicated in the formation of these fibrous plaques.

A 42-year-old man with stage IV carcinoid tumor of the small bowel with metastasis to the liver status post small bowel resection was referred to our institution for progressive shortness of breath due to right heart failure. Echocardiography revealed severe tricuspid regurgitation, moderate pulmonary regurgitation, mild pulmonary stenosis, and moderate right ventricular enlargement. The patient was scheduled for mechanical tricuspid and pulmonic valve replacement given the risk of fibrosis with bioprosthetic valves. Preoperatively, an octreotide drip at 10mcg/hr was initiated, and 25mg of diphenhydramine administered IV to prevent histamine release. Anesthetic goals included prevention of mediator release, hourly blood gas evaluation (including glucose monitoring), prevention of right ventricular failure and normothermia. Separation from cardiopulmonary bypass involved use of dopamine, and was without side effects. Aside from mild intraoperative hemodynamic fluctuation, the rest of the perioperative course was uneventful.

Our case highlights the need for avoidance of stimulation and blockade of humoral mediator responses in these cases. Significant systemic congestion from tricuspid regurgitation with pulmonic stenosis can cause hepatic dysfunction and alterations in drug response. Although not seen in our case, paradoxical hypotension (due to serotonin and histamine release in response to pressors) can occur. Octreotide therapy remains the mainstay of management, though optimal dosing regimen is not agreed upon, and is a potential area for further research.
Figure 1: Transesophageal echo four chamber view with color flow doppler highlighting severe tricuspid regurgitation.
33-year-old woman with a history of migraine headaches and uterine leiomyoma’s status post open myomectomy in 2009 and 2011 who initially presented to the hospital in hypertensive emergency and was started on vasodilators. Subsequent lab and imaging studies revealed a large abdominal and pelvic tumor possibly of uterine origin with contiguous extension via the right iliac vein into the IVC and extending to the right atrium. Transthoracic echocardiography (TTE) showed the tumor mass invading and almost completely filing the right atrium and abutting the tricuspid valve, but without evidence of significant valvular pathology. Cardiac MRI revealed some suggestion of extension across the tricuspid valve into the right ventricle, but this was possibly tumor thrombus. Biopsy of the mass (transvascular and transabdominal) revealed the finding of uterine smooth muscle consistent with uterine origin.

The patient was placed on systemic heparinization, and surgical consultations were obtained with Gyn Onc Surgery, Vascular Surgery, Cardiothoracic Surgery, and Urology. After a meticulous preoperative evaluation and detailed multidisciplinary discussions between surgery and anesthesia, the decision was made to proceed with a combined operation given that no further neoadjuvant therapy was deemed to be likely to provide significant benefit.

The poster presentation will include anesthetic technique and intraoperative considerations focused on hemodynamic goals, as well as trans esophageal echocardiogram (TEE) views of the mass before and after removal. The patient underwent successful removal of the large mass without complications. She also had an uneventful postoperative stay in the hospital and was doing well upon discharge. Her post hospital visits have shown she is doing well.
**Complete Heart Block During Central Line Placement**

**Presenter:** Tiffany Thornton, MD, Resident  
University of Arizona

**Authors:**  
Tiffany Thornton, MD  
Paul Ford, MD (Faculty Mentor)

**INTRODUCTION:**

Complete heart block is a well-known but rare complication of central line placement in a patient with pre-existing LBBB.

**CASE REPORT:**

The patient is an 82 year-old woman with a history of hypertension, paroxysmal atrial fibrillation, CKD and severe mitral stenosis undergoing mitral valve replacement. Preoperative EKG revealed sinus rhythm with a LBBB.

Controlled induction was uneventful. During central line placement, the EKG transitioned from sinus rhythm to asystole during guide wire placement. Chest compressions were started within 5 seconds of the transition to asystole and continued for 45 seconds. Concurrently, the guide wire was pulled back and 20 mcg of epinephrine were administered.

The patient was then in a junctional rhythm with pulse 35-50s and SBP 80s-150s. The MVR was started and the remainder of her operative course was uneventful. She was taken to the CT ICU for continued care and eventually started on CRRT.

**DISCUSSION:**

Transient RBBB block can occur during guide wire insertion because of mechanical trauma to the conduction system with an incidence of 3-12%. This is due to the superficial location of the RBB in the right ventricular endocardium just below the tricuspid valve (2).

Complete heart block occurs in only 0.1% of patients undergoing catheterization of the right heart (1). In this case, the patient developed catheter-induced AV nodal block or, more likely, RBBB which caused bilateral bundle branch blocks. The patient did not have an escape rhythm and therefore developed asystole. In patients with preexisting LBBB, some suggest prophylactic temporary pacing in patients undergoing right heart catheterization.

Guide wire tips are more rigid and less flexible than PA catheters and therefore more arrhythmogenic (2). If the guide wire is inserted less than 22 cm, the incidence of complications is decreased by 70%. The typical safe upper limit of guide wire insertion in an adult patient is 18 cm (2).

**REFERENCES:**


The Use of Transesophageal Echocardiography in Intra-Operative Diagnosis of Caseous Calcification of the Mitral Annulus

Presenter: Kevin Zimmermann, MD, Resident
Virginia Mason

Authors: James Helman, MD (Faculty Mentor)
Joseph Neal, MD

Introduction. Caseous calcification of the mitral annulus (CCMA), a rare evolution of mitral annulus calcification (MAC), is a benign chronic degenerative disorder involving the mitral valve annulus. It may be misdiagnosed as tumor, abscess, or vegetation, thereby requiring further imaging or spurring inappropriate surgical intervention or treatment.

Case. We report a case of a 77 year old female with diabetes mellitus type II, severe aortic stenosis and single vessel right coronary artery disease who presented for aortic valve replacement and coronary bypass graft. Post-induction transesophageal echocardiography (TEE) of the mitral valve annulus revealed an echogenic circular mass with an echolucent interior. Color Doppler failed to show flow within this structure. Upon further evaluation, the mass was observed not to obstruct left atrial emptying. The pre-operative TEE report did not comment on the presence of this mass. In consultation with the patient’s cardiologist, an intra-operative diagnosis of CCMA was made. The original operation was carried out as planned without further intervention regarding the CCMA. The patient had an uneventful recovery.

Discussion. The most common presentation of CCMA is incidental finding on cardiac imaging, although some patients may experience palpitations and dyspnea. CCMA and MAC are believed to be associated with high calcium score, aortic valve disease, atrial fibrillation, and hypertension. CCMA may be complicated by systemic embolization such as stroke, retinal artery occlusion, or acute coronary syndrome. Because of the complications of surgical intervention and the ability for CCMA to spontaneously resolve, current consensus is to not surgically correct the lesion when the diagnosis is certain and there is no obstruction to left atrial emptying.
Figure 1. Two dimensional transesophageal echocardiogram, in a modified 2 chamber view. Circular calcific mass (arrows) with echolucent center (X) is shown within color Doppler selection window. LV = left ventricle, LA = left atrium.
Upper Body Congestion as a Sign of Right Heart Failure in a Critically Ill Patient

Presenter:  Swayta Reddy, MD, Resident
University of California, Los Angeles

Authors:  Swayta Reddy, MD
Curtis Copeland, MD
Nir Hoftman, MD (Faculty Mentor)

Background:
Identifying heart failure, especially right heart failure, is extremely difficult when the patient is intubated and sedated. The following is a case that used the clinical finding of discoloration of the upper body as one of the first signs of acute right heart failure and one that used TEE as the key diagnostic tool to change management.

Case Presentation:
An 85 yo Caucasian male was red lined to the operating room for control of bleeding with Hgb of 6.4 and a presser requirement of Vasopressin at 4 units/hr and Norepinephrine at 1 mcg/kg/min. By the time he arrived to the OR, he had received 17 units of pRBCs, 4 units of FFP and 2 units of platelets. All the components of his clinical exam, lab findings and previous imaging suggested that his shock was hemorrhagic in nature. However, his appearance was striking in that the upper portion of his chest, neck and face looked purple in color, which did not support the story of a man who was in shock due to massive blood loss. At that time, a TEE was introduced which actually showed a depressed and fluid overloaded right ventricle.

Discussion:
The subpapillary plexus in the face, neck and upper trunk are sensitive to the effects of autonomic nervous system and of cutaneous vasodilators. This is the usual distribution in which people flush due to embarrassment, heat, menopause, and some medical conditions (i.e. Carcinoid). In this case, the autonomic derangements from heart failure may have led to the appearance of congestion and flushing in the upper body.

This case also highlights the importance of having a low threshold to employ TEE in the management of critically ill patients undergoing non-cardiac operations, especially when little is known about the patient’s past medical history.
Pectus Excavatum: Unexpected Cardiac Arrest in the Ambulatory Setting

Presenter: James Nelson, MD, Resident
University of Arizona

Authors: James Nelson, MD
Joelle Boeve, MD (Faculty Mentor)

Objective:
To describe pectus excavatum as a possible risk factor for intra-operative hemodynamic instability and cardiac arrest.

Background:
Pectus excavatum is an anterior chest wall defect, typically considered to be a benign condition, with largely cosmetic implications. However, associated EKG abnormalities have been reported in the literature including: intra-ventricular conduction delay, ST-segment depression and/or elevation, P-wave morphological changes, Brugada’s phenocopy, and supraventricular, as well as ventricular, arrhythmias. To date, most reported intraoperative events focus on complications during surgery for correction of the disorder. Very limited data exist on intraoperative cardiac complications during non-corrective surgery.

Case:
Our patient was a 49 year old female with a history significant for pectus excavatum and breast cancer (s/p bilateral mastectomy) who presented for insertion of bilateral tissue expanders to our ambulatory surgery center. Following an uneventful induction, she experienced two episodes of unexplained bradycardia, the second of which resulted in asystole with loss of spontaneous circulation. This second episode was preceded by multiple PACs, while operating on the chest wall. CPR was initiated with return of spontaneous circulation after 2 minutes of CPR. Subsequent workup revealed mild to moderate RV dysfunction, without other cardiopulmonary abnormalities.

Discussion:
Multiple EKG and echo abnormalities have been associated with pectum excavatum. The literature describes intraoperative complications during repair of pectus excavatum, however very little about intraoperative outcomes in non-corrective procedures. This case is significant in that a previously healthy female with no cardiorespiratory abnormalities had a significant intraoperative event secondary to bradycardia progressing to arrest. Although no long term morbidity resulted, it represents a possible catastrophic outcome for the patient. Proposed mechanisms for intraoperative rhythm disturbances include an electrophysiological etiology secondary to direct compression of the myocardium, and compression of the RV leading to underfilling and secondary cardiac dysfunction.
Irreversible Electroporation in a Patient with an Implantable Electronic Cardiac Device

Presenter: Aaron Dahl, MD, Resident
Virginia Mason

Authors: Aaron Dahl, MD
Francis Salinas, MD (Faculty Mentor)

Background:
Electroporation is a molecular biology technique, which utilizes the application of low voltage electrical fields to cellular suspensions causing an increase in cell membrane permeability for intracellular incorporation of ions, small molecules, macromolecules, and exogenous drugs (1).

Irreversible electroporation (IRE) refers to the application of high voltages to a cellular mass causing irreversible membrane permeability and cell death (2). This therapy uses pulsed electrical currents between electrodes inserted in situ around a tumor to treat what were previously thought to be unresectable tumors (3). Although IRE offers certain advantages over radiofrequency ablation, anesthetic management is fraught with the complications of applying high voltage electrical fields to the human body (4,5).

Case Description:
We present the case of an 81 year old male with a history of hepatocellular carcinoma (HCC) secondary to alcohol induced cirrhosis, type 2 diabetes mellitus, hypertension and atrial fibrillation requiring an automated implantable cardioverter/defibrillator and pacemaker set at DDDR 65-130. The patient presented for open irreversible electroporation of a newly discovered segment 3 HCC.

Pre-induction transcutaneous pacemaker pads were placed on the patient and his cardiac device was switched to DOO at 70 beats per minute in order to avoid triggering the defibrillatory function by intraoperative electroporation (6). A preoperative thoracic epidural was placed along with two large bore peripheral IV’s. General endotracheal anesthesia was induced followed by placement of a transesophageal pacemaker. A cisatracurium infusion was utilized to maintain neuromuscular blockade and the operation was completed with the only complication being persistent neuromuscular blockade requiring 45 minutes before a reversal agent could be administered (4).

Discussion:
Irreversible electroporation is a novel technique used to treat otherwise unresectable tumors, however, considerations must be made with regard to the application of high electrical voltages to the human body and the impact on normal physiology, implanted devices, and surgical goals.

References


Takotsubo’s Cardiomyopathy Following Foot and Ankle Surgery with Regional Anesthesia in a Patient with Mitochondrial Myopathy

Presenter: Shawn Coleman, MD, Resident
Cedars-Sinai Medical Center

Authors: Shawn Coleman, MD
Daniel Cherkassky, MD
Kapil Anand, MD (Faculty Mentor)
Brian Mendelson, MD
Matthew Eng, MD

BACKGROUND

Takotsubo’s cardiomyopathy (TC) involves transient left ventricular dysfunction thought to be caused by excess catecholamines. Regional anesthesia has been proposed to mitigate the risk of TC development by suppressing the perioperative adrenergic surge.

CASE REPORT

We report a case of a 55-year-old female who developed TC after elective revision of right hallux metatarsophalangeal fusion under regional anesthesia. Past medical history included mitochondrial myopathy complicated by CHF with EF 40-50%. She described a history of apnea with light sedation; she received 0.6mg of midazolam titrated in 0.2mg aliquots. Shortly after saphenous and popliteal nerve blocks with lidocaine (without epinephrine), she became delirious, babbling incoherently while complaining of shortness of breath. Her oxygen saturation and hemodynamics were unchanged. She received flumazenil without return to baseline mentation. In PACU the patient complained of chest pain. EKG revealed acute ST elevations. TTE revealed an EF of 27% and diminished contraction of the apex with hypokinesis of the basal segments. Subsequent cardiac cath on POD 1 revealed no evidence of coronary disease and her EF returned to baseline by POD 4.

Although rare, TC is being increasingly recognized in the perioperative period. Proposed mechanisms include the heightened catecholamine state occurring around the time of surgery. Nearly all of the cases described in anesthesia literature are under general anesthesia. Regional has been proposed as a strategy to attenuate circulating catecholamines and prevent recurrence in patients with a history of TC. To our knowledge, however, this is the first case described in the literature of a case of TC occurring during or after regional anesthesia. Possible explanations include insufficient anxiolysis/sedation vs. abrupt reversal with flumazenil. Although flumazenil itself has not been reported to cause TC, abrupt drug withdrawal has.
Combined heart/liver transplant in repaired congenital heart patient with congestive hepatopathy.

Presenter: Kendell Klingler, MD, Resident
University of Utah

Authors: Kendell Klingler, MD
Elliott Karren, MD
Nathaniel Birgenheier, MD
Mark Harris, MD

Our patient was a 28-year-old female with complex congenital heart disease complicated by congestive hepatopathy. She had D-transposition of great arteries, hypoplastic left heart, pulmonary atresia, and persistent left SVC. Prior surgeries include bilateral Blalock-Taussig shunt, bilateral Glenn anastomosis, and lateral tunnel Fontan. The patient suffered worsening heart failure symptoms, hypoxia and cirrhosis with hepatic encephalopathy, and was listed for heart and liver transplantation. Donor organs became available. General anesthesia was induced with midazolam (0.2 mg/kg), sufentanil (1 mcg/kg) and rocuronium (1.2 mcg/kg). Anesthesia was maintained with isoflurane, sufentanil and vecuronium infusions. Radial and femoral arterial lines, groin MAC introducer and internal jugular MAC were placed. A Swan-Ganz catheter was inserted in the internal jugular MAC and advanced after heart transplant was completed. Milrinone infusion was continued throughout perioperative period. Orthotopic bicaval heart transplant was performed. Separation from CPB was initially uneventful with vasopressin infusion for hemodynamic support. Subsequently, liver transplantation was performed using the piggyback method. Volume resuscitation was hindered by poor RV function with dilation, severe tricuspid regurgitation and hepatic congestion. The decision to place a right ventricular assist device was made. RVAD was removed uneventfully on POD#4.

This case illustrates the effect of increased pulmonary vascular resistance post-heart transplant impairing fluid resuscitation during liver transplantation. RV failure is common after heart transplant, as the transplanted RV is unaccustomed to the higher pressures. The volume resuscitation required for liver transplant puts additional load on an already stressed RV. Placement of an RVAD at the first sign of RV dysfunction (prior to liver transplant) would have been beneficial by facilitating resuscitation and reducing hepatic congestion during liver transplantation.
Case report: Paroxysmal supraventricular tachycardia after preoperative intravenous glycopyrrolate and metoclopramide.

Presenter: marc huh, MD/DO, Resident
Harbor-UCLA Medical Center

Authors: Marc Huh, MD/DO
Kevin Dewalt, MD/DO (Faculty Mentor)

Patients are frequently premedicated with glycopyrrolate and metoclopramide in the preoperative setting as an antialagogue and antiemetic, respectively. Glycopyrrolate, an anticholinergic agent, is known to decrease airway secretions which may make visualization of the glottis and adjacent structures difficult and may induce cough and laryngospasm. Moreover, decreasing these secretions may also improve effectiveness of local anesthetics applied to the pharyngeal and laryngeal mucosa. Metoclopramide, a dopamine antagonist with structural similarities to procainamide, is used to decrease postoperative nausea and vomiting by acting on 5-HT3, 5-HT4, and D2 receptors and increasing gastrointestinal motility in a dose dependent fashion. Although it is well documented in the literature that metoclopramide may induce certain cardiac rhythm abnormalities including supraventricular tachycardia (SVT), the parasympatholytic effects of glycopyrrolate may promote this untoward effect. We present a case report of a 39-year-old male patient who received a preoperative intravenous dose of glycopyrrolate and metoclopramide and developed paroxysmal SVT refractory to intravenous adenosine and attenuated by intravenous esmolol.
Asystole Secondary to Trigeminal Neuralgia

Presenter: Gurpreet Dhaliwal, MD, Resident
Harbor-UCLA Medical Center

Authors: Gurpreet Dhaliwal, MD
Dora Hsu, MD (Faculty Mentor)

Introduction: The Trigeminalcardiac reflex (TCR) has been well documented during surgical procedures and other iatrogenic manipulations of the trigeminal nerve however in rare cases pain from trigeminal neuralgia can trigger the TCR and lead to asystole.

Case Description: JD is a 56-year-old male with a past medical history of trigeminal neuralgia and a forty year history of chronic left periorbital pain with autonomic features presented with three days of continuous severe facial pain. The pain would extend from the patient’s left ear up to left eye and would radiate down into his jaw. Associated symptoms included left sided headaches, nausea, vomiting and near syncopal episodes which occur during the episodes of facial pain. While in the Emergency department JD was noted to have symptomatic bradycardia with a sinus pauses that lasted 20 seconds and coincided with his presenting symptoms. Intrinsic conduction abnormalities or structural heart disease were ruled out. He was diagnosed with SUNCT/SUNA (Short-lasting unilateral neuralgiform headache with conjunctival injection and tearing (SUNCT) and short-lasting unilateral neuralgiform headache attacks with cranial autonomic symptoms (SUNA)). The patient was started on Indomethacin, Topamax, gabapentin, and carbamazepine and admitted to telemetry. His symptoms proved to be refractory to medical management as his facial pain persisted and he continued to have episodes of symptomatic bradycardia and sinus pauses while admitted. Occipital nerve block was attempted but only provided mild pain relief. MRI FIESTA/CISS (Fast Imaging Employing Steady-state Acquisition/Constructive Interference Steady State) demonsttrated a vascular loop abutting the root entry zone of the left trigeminal nerve. The culprit vessel was believed to be an ectatic basilar artery. Left retrosigmoid craniectomy and microvascular decompression showed that the ectatic basilar artery was indeed impinging of the trigeminal nerve at the root entry zone. Post operatively the patient experienced significant relief of symptoms. He subsequently returned to the ER a week later with return of symptoms but on future follow up visits patient expressed complete resolution of autonomic symptoms and less severe headaches.

Discussion: This case illustrates how challenging the diagnosis and management of Trigeminal Neuralgia with autonomic features and SUNCT/SUNA can be. Current literature supports the idea that the spectrum of these diseases’s share a common pathophysiological mechanism and may represent a continuum. Treatment options vary from pharmacologic management, microvascular decompression to trigeminal, occipital, sphenopalatine or Gasserian ganglion nerve blocks and neurostimulation techniques. These management options should be catered to the specific presentation of the patient.
Mitral Valve Endocarditis Complicated by Mycotic Aneurysm and Hemorrhagic Conversion of Cerebral Septic Emboli

Presenter: Jason Lang, MD, Resident
University of California, San Francisco

Authors: Jason Lang, MD
Odmara Barreto-Chang, MD PhD
Wade Smith, MD (Faculty Mentor)

A 24 year old male with a history of chronic sinusitis initially presented with ten days of progressively worsening URI symptoms culminating in fevers and generalized constitutional symptoms. He was found to have H parainfluenzae bacteremia complicated by MV endocarditis with severe MR. Upon presentation to the ED he developed acute left-sided hemiparesis and was found to have septic emboli to the brain, kidneys, and spleen. He was treated with ceftriaxone, underwent successful MV repair, and had been doing well until post-operative day 5 when he developed new left-sided weakness prompting admission to the ICU. He was found to have hemorrhagic conversion of his known right MCA embolic stroke. On ICU day 3, he had increased somnolence. A repeat non-contrast head CT revealed increased edema, midline shift, and trapping of his left lateral ventricle. He was additionally found to have a mycotic aneurysm of his right MCA on angiography. He underwent successful hemicramiection for decompression, trapping of his mycotic aneurysm, and M2-M2 bypass. This case is presented to highlight several points. First, Haemophilus species account for roughly 1% of cases of infective endocarditis, of which H parainfluenzae accounts for roughly 60%.[i] The source of his infection is unclear, but is likely related to chronic sinusitis – he had been using a netipot for sinus irrigation without cleaning it stringently. It is also unclear why an otherwise healthy patient would develop an unusual infection – he is currently being worked up for immunodeficiencies. Furthermore, this case highlights some of the complications of infective endocarditis. The incidence of stroke in patients with infective endocarditis is 9.6-39%. Notably, patients with MV endocarditis have greater risk of stroke than patients with AV endocarditis.[ii] It is important to be keenly aware of the potential for hemorrhagic conversion of embolic strokes, since prompt management can prevent rapid deterioration.
**Perioperative Considerations in Renal Cell Carcinoma with Inferior Vena Cava Tumor Extension**

**Presenter:** Lauren McLaughlin, MD/DO, Resident  
University of Colorado  

**Authors:** Lauren McLaughlin, MD/DO  
Keleigh McLaughlin, BA/BS  
Benjamin Abrams, MD  
Maung Hlaing, MD (Faculty Mentor)

**Introduction:**
Renal cell carcinoma (RCC) is a highly vascular tumor with tumor thrombus extension into the renal vein or the inferior vena cava (IVC) in 4-10% of cases, and into the right atrium in 1% of cases. Surgical resection remains the definitive and potentially curative treatment for patients without extensive metastatic disease.

**Case Report:**
A 62-year-old previously healthy man with unexplained weight loss was found to have an 11 cm right renal mass with tumor thrombus extending into the suprahepatic IVC and surgical resection was planned. After induction of general anesthesia, a cardiac anesthesiologist performed transesophageal echocardiography (TEE) to monitor cardiac function and the extent of the tumor thrombus. Initial examination of the heart confirmed normal cardiac structures and function. During the case, as the liver was mobilized, the tumor was no longer visible in the IVC. Additionally, the right ventricle became acutely dilated with severe dysfunction. Due to a high suspicion for intraoperative pulmonary embolism (PE), the patient was taken directly to the CT scanner where the diagnosis of large, bilateral tumor emboli was confirmed. The patient returned to the OR shortly thereafter and underwent pulmonary thromboendarterectomy without further complication. He was discharged home on POD 7.

**Discussion:**
PE is a rare but well known potential fatal complication that occurs in up to 5.4% of resections of RCC with IVC involvement. The presence of a cardiac anesthesiologist and cardiac surgeon allowed for rapid intraoperative diagnosis, seamless transition to the CT scanner and rapid mobilization of the cardiac team which potentially contributed to the patient’s uneventful recovery. The availability of cardiac subspecialty providers in both anesthesia and surgery should be discussed preoperatively before RCC resection and IVC thrombectomy when the potential for a catastrophic complication is increased, as illustrated in this case report.
Transesophageal Echocardiography During Cardiopulmonary Resuscitation for Cardiac Tamponade Complicating a Laser Lead Extraction

Presenter: Gemayel Lee, MD, Resident
University of California, San Diego

Authors: Gemayel Lee, MD
Brittany Grovey, MD
Swapnil Khoche, MD (Faculty Mentor)

BACKGROUND

Laser lead extraction of transvenous cardiac pacemaker leads can result in acute and catastrophic complications in about 1% of the patients. Transesophageal echocardiography (TEE) aids intraoperative clinical decision-making by providing valuable information on cardiac contractility, volume status, flow and valvular function. Despite the many applications of TEE, its utility during laser lead extraction and in the assessment of external chest compressions during cardiopulmonary resuscitation is not well documented.

CASE DESCRIPTION

A 45-year-old female with heart failure with reduced ejection fraction (LVEF~40%), atrial fibrillation, 3rd degree AV block with Bi-Ventricular pacemaker presented for laser extraction and replacement of three transvenous pacing leads. Following the removal of the right atrial lead the patient became severely hypotensive along with disappearance of the arterial line tracing. CPR was initiated and TEE demonstrated adequate external chest compressions, a paced ventricular rhythm, a rapidly accumulating pericardial effusion with decreased LV filling volume and normal LV systolic function. Color flow Doppler imaging showed severe tricuspid regurgitation with reduced, but adequate, cardiac output. The decision was made to proceed with emergent median sternotomy and pericardotomy while fluids and vasopressor administration continued. Cardiopulmonary bypass was initiated and she underwent repair of the right atrium, mechanical tricuspid valve insertion and permanent epicardial lead placement. She was extubated on POD#1 and discharged home on POD#13 at her neurological baseline.

DISCUSSION

In our case, TEE was helpful for the rapid etiological diagnosis of hypotension, assessment of response to therapy, and the qualitative evaluation of external chest compressions and cardiac output. This information guided the surgical decision to proceed with median sternotomy and pericardotomy in lieu of pericardiocentesis. Utilizing TEE and having surgical presence during hybrid room lead extraction is of immense value during complications that occur. Further studies are needed to determine the cost effectiveness, feasibility and impact on outcome.
Pulling the Plug: Intraoperative coronary vasospasm with non-obstructed coronary arteries

Presenter: Daniel Hansen, MD, Resident
Mayo Clinic

Authors: Daniel Hansen, MD
Ryan Van Woerkom, MD
Krishnaswamy Chandrasekaran, MD

Introduction
Coronary artery spasm (CAS) covers a variety of clinical presentations and is identified by a similar variety of names. Cardiac syndrome X, variant angina, chest pain with normal coronary arteries (CPNA), and microvascular angina are all used in the current literature to describe the phenomena of angina-like discomfort and electrocardiographic evidence of cardiac ischemia in the setting of normal epicardial coronary arteries. The pathogenesis for CAS is still uncertain, though two proposed mechanisms dominate current research and thought. The first is microvascular dysfunction (i.e. excessive vasoconstriction and/or vasodilation) and the second is enhanced sensitivity to intracardiac pain. Diagnosis of CAS requires clinical symptoms, EKG changes, and normal angiography. Treatment is based on symptomatic management of angina episodes and angina prevention with either beta-blocker or calcium channel blocker therapy.

Case Report
A 57 year old white male was scheduled for elective nasal polypectomy after evaluation by otolaryngology. In preparation, the patient was seen in preoperative clinic for medical evaluation. The patient has a past medical history significant for nasal polyposis, hypertension, and possible obstructive sleep apnea. Patient had a 30 pack year smoking history but quit approximately 3 years ago. Patient had no known coronary artery disease. Following preoperative evaluation, the patient was counseled to continue his lisinopril 20 mg on the day of surgery and proceed with the planned procedure.

On the day of surgery the patient was taken to the operating room and anesthesia was induced with a propofol bolus, initiated on a continuous propofol drip as well as inhaled anesthetic. Patient was normotensive at the time of induction and following induction, became hypotensive and received several 100 mg boluses of phenylephrine. The patient also received a small 3ml lidocaine with epinephrine intranasal injection. Approximately 50 minutes following induction, and before any surgical incisions had been made, the patient was noted to develop ST segment elevation in lead II on the telemetry monitor. The case was aborted and a transesophageal echocardiogram was performed with no evidence of regional wall abnormalities. A nitroglycerin drip was initiated. Troponins and CKMB were checked and were within normal limits.

Once in the post-anesthesia care unit, cardiology was consulted for further evaluation. The patient had emerged from anesthesia and was without any symptoms of chest pain, diaphoresis, shortness of breath, or other anginal equivalents. He was no longer receiving nitroglycerin and his vital signs were within normal limits. Patient was admitted for observation and serial troponins as well as a scheduled stress echocardiogram the following day.

During the stress echocardiogram, the patient exercised 6.8 minutes on a Bruce protocol without any anginal symptoms or ST segment changes. No regional wall motion abnormalities were noted during the stress period. However, at 3 minutes into the recovery period, the patient developed some left neck pain and diaphoresis. ST segment elevation was noted on the inferior leads of the EKG. The echocardiogram showed evidence of regional wall abnormalities in the anterio-septal regions. The patient was given 4 chewable aspirin immediately, 20mg PO metoprolol and within a few minutes, the symptoms resolved and soon thereafter, the EKG normalized.
The patient was then taken directly to the catheterization lab for angiography. Angiography demonstrated a 40% stenosis of the left anterior descending artery but was otherwise free of significant stenosis. Attempts to induce vasospasm were not undertaken.

The patient was started on Cardizem, aspirin, and fluvastatin for primary prevention given his cardiac risk factors and his lisinopril was continued at a dose of 5mg daily. Patient was scheduled for follow up with cardiology for further evaluation and maintenance.

At the time of patient’s follow up appointment, patient was symptom free with no further episodes of angina. He was continued on a Cardizem SR 120 mg daily, Fluvastatin 80mg ER daily, and Lisinopril 5mg daily and encouraged to continue his new exercise regimen.

Discussion

This case demonstrates a new diagnosis of CAS discovered intraoperatively and presents a unique dilemma facing clinicians. Preoperative evaluation and workup had been thorough and appropriate yet an elective operative procedure was terminated due to concerning telemetry findings. Subsequent workup was reassuring for normal coronary vasculature and the eventual diagnosis of CAS was made. Patient was treated and informed he would likely tolerate the elective procedure without complication in the future. To date, the patient has not re-scheduled.

In all cases of acute ST segment elevation, as many as 7 percent of patients do not have a critical coronary artery lesion on angiogram 10-12. Differential diagnosis for acute ST segment elevation includes: myocardial infarction, CAS, acquired or inherited coagulation disorders, toxins, collagen vascular disease, embolism, myocarditis, and microvascular disease13.

Intraoperative ST segment elevation is not uncommon, and prompt evaluation and management essential to favorable outcomes. CAS is a reported occurrence and requires vigilance by the operative team. No known cardiac history, but a history of tobacco use and lipid disorders are known risk factors for CAS14. Providers should be aware of the basic mechanisms involved in CAS to inform the intraoperative and post-operative evaluation and management of CAS. Intraoperative administration of nitroglycerin has been reported to correct the CAS without need to abort the procedure15-16. Recurrent episodes of CAS intraoperatively are rarely reported and patients should be educated about expectations for future procedures.

In conclusion, this case demonstrates the constant need for vigilance in the intraoperative period and provides insight into CAS and perioperative dilemmas surrounding the difficulty of anticipating, detecting, and treating CAS and patient hesitation to undergo future procedures following an intraoperative CAS episode.
Intraoperative Development of a New Rate Related Right Bundle Branch Block as an Indicator of AMI, a Case Report

Presenter: Tyler Paradis, MD/DO, Resident
Oregon Health & Science University

Authors: Tyler Paradis, MD/DO
David Wilson, MD/DO (Faculty Mentor)

When paired with symptoms compatible with STEMI, a new onset left bundle branch block is treated as a STEMI equivalent. In addition, bundle branch blocks, which are rate related, can be indicators of CAD and myocardial ischemia as well as predictors for adverse events. When combined, a bundle branch block, which is both new onset and rate related, can be a poor prognostic indicator. When compared to its LBBB equivalent, new onset rate-related RBBB is less well established in the literature as a marker for ischemia. We describe a case of intraoperative development of a new rate related right bundle branch block during major vascular surgery, which in this patient was found to be an indicator of intraoperative acute myocardial infarction requiring reperfusion therapy.
Anesthetic Management of a Patient with an Insulinoma

Presenter: Yelena Neyman, MD, Resident
Cedars-Sinai Medical Center

Authors: Yelena Neyman, MD
Roya Yumul, MD
Robert Kariger, MD (Faculty Mentor)

In this case report we present the anesthetic management of a patient with an insulinoma who is undergoing a pancreaticoduodenectomy.
Challenging Cases

Poster # EE02

**Post-Operative Pancreatitis: What Was the Cause? A Case Report**

Presenter: Lauren Steffel, MD,
Stanford University

Authors: Radhamangalam Ramamurthi, MD (Faculty Mentor)

Introduction:
The pathogenesis of drug-induced pancreatitis is associated with over 100 medications. Propofol, one of the most commonly utilized anesthetic agents, has been implicated as a causative agent through the proposed mechanism of altered lipid metabolism. We report a case of likely drug-induced post-operative pancreatitis, with propofol as one of multiple possible contributing medications.

Case Report:
A 16 year-old male with refractory seizures developed acute epigastric pain on the first post-operative day following craniotomy with grid and strip electrode placement, during which he had received boluses of propofol at 1-2 mg/kg doses.

Laboratory values were significant for elevated lipase of 1575 U/L and serum triglycerides within normal limits. Abdominal ultrasound revealed no evidence of gallstones and increased echogenicity of the pancreas.

After consideration of risks and benefits, his care team chose to continue chronic depakote and lacosamide therapy. Clinically, his symptoms improved within two days, and his lipase decreased to 780 U/L on post-operative day five.

Upon his second craniotomy for grid removal on post-operative day seven, the patient remained asymptomatic after rechallenge with propofol boluses, but demonstrated elevated lipase of 1054 U/L.

Discussion:
Among etiologies of acute pancreatitis, drug-induced pancreatitis is rare, accounting for less than 2% of cases. Our patient was exposed to two medications with potential adverse reactions of pancreatitis, including depakote, which carries an FDA black box warning for this association, as well as propofol, which has been linked to post-operative pancreatitis in case reports, including cases in which propofol was used as a single anesthetic agent. Of note, the association between propofol and pancreatitis may occur in the absence of significant hypertriglyceridemia, as was the case for this patient. Although recurrence after rechallenge is not often observed to prove the causation, caution should be exercised to avoid possible offending agents.
**Cervical Intramedullary Arteriovenous Malformation: Endovascular, Surgical and Anesthetic challenges**

**Presenter:** Odmara Barreto-Chang, MD, Resident  
University of California, San Francisco

**Authors:** Odmara Barreto-Chang, MD  
Wade Smith, MD (Faculty Mentor)

**Introduction**

Spinal Arteriovenous Malformations (AVM) in the cervical cord are rare and are characterized by an indolent presentation. They can lead to progressive myelopathy, sensory disturbances, and potentially death if not treated. Treatment and management of AVMs represent a challenge since surgical and/or endovascular interventions have a high risk of spinal cord ischemia affecting ascending and descending sensorimotor pathways.

**Case Presentation**

A healthy 48-year-old man presented with progressive neurologic decline for the past 8 months starting with numbness of the hand about 10 years ago and more recently affecting his ability to walk and perform his work due to severe clonus and spasticity. He was initially evaluated with an MRI. Spinal Angiography demonstrated an intramedullary AVM spanning the base of C2 to the inferior endplate of C4, measuring up to 31 x 14 x 14 mm. There were 2 nidal aneurysms each measuring 3 mm at the C2-3 level. Arterial supply was via multiple enlarged segmental arteries. Venous drainage was via intramedullary, ventral and dorsal spinal veins.

The patient was taken to the operating room for resection of the AVM under general anesthesia. Blood pressure was tightly controlled to maintain adequate spinal cord perfusion with a mean arterial pressure goal of 95 mmHg. Balanced anesthetic consisted of propofol, remifentanyl, methylprednisolone and vasopressor infusions to maintain MAP >95. The patient was transported to the Intensive Care Unit for vasopressor support and continuous monitoring of neurological status.

**Discussion**

There are different modalities for the treatment of AVMs. The decision of whether to pursue endovascular treatment or surgical resection should be taken on an individual case basis. The anesthetic implications in these cases are very important since perfusion to the spine should be kept optimal with vasopressor support intraoperatively, if necessary, and during the postoperative critical care period.
We report on a thirty year old male with a history of idiopathic dilated cardiomyopathy and malignant hyperthermia (MH) who presented for orthotopic heart transplant. MH had been diagnosed the year prior, at our institution, when he developed hyperthermia, lactic acidosis, and elevated creatine kinase enzymes (CK) following exposure to succinylcholine and isoflurane during left ventricular assist device implantation with cardiopulmonary bypass (CPB). He was treated with dantrolene and recovered. Subsequent genetic testing for seven major RYR1 mutations was negative.

Given this history, we implemented a comprehensive non-triggering anesthetic plan with fentanyl, propofol infusion, ketamine, and rocuronium. Appropriate precautions were taken for all anesthetic machines and emergency equipment including MH cart and dantrolene stock was verified prior to his transplant. Nonetheless, the patient developed a similar constellation of signs and symptoms starting intraoperatively, with hyperthermia, lactic acidosis, and CK elevations. He received dantrolene again. Within the first 24 hours postoperatively, all physiologic parameters normalized and the patient recovered without sequelae.

This case exhibits an uncommon phenomenon of an MH episode in a patient with a history suspicious for MH, despite receiving a non-triggering anesthetic. As such the existing paradigm of MH is called into question for this patient. This report will review the differential diagnosis of MH in the perioperative setting, examine the utility of diagnostic testing for MH, and highlight evidence in the literature for non-classical triggers of MH in susceptible individuals. Future research may better delineate a spectrum of perioperative hypermetabolic syndromes, and identify an important role for non-pharmacologic triggers of MH and related disorders.
Anesthetic considerations for a patient with epidermolysis bullosa

Presenter: Ahlia Kattan, MD/DO, Resident
Stanford University

Authors: Ahlia Kattan, MD/DO
Divya Chander, MD/DO (Faculty Mentor)

24F with a past medical history significant for epidermolysis bullosa presents for skin graft of her lower extremity. This article discusses the anesthetic considerations for intraoperative, perioperative and pain management for patients with epidermolysis bullosa.
Absence of urine color change after routine intravenous administration of methylene blue during robotic prostatectomy

Presenter: Jill Yaung, MD/DO, Resident
Cedars-Sinai Medical Center

Authors: Jill Yaung, MD/DO
Manxu Zhao, MD/DO (Faculty Mentor)

Background:

Methylene blue (MB) is a dye commonly used to identity fistulas and ureteral orifices during genitourinary surgery. When given intravenously in patients with normal renal function, the urine will turn blue-green within a few minutes. There have been rare reports of failure of methylene blue to appear in the urine.

Case Description:

A 67-year-old male with hypertension, hyperlipidemia, and prostate cancer presented for radical Da Vinci robotic prostatectomy. Preoperative laboratory values were normal. The case proceeded uneventfully, and MB 10 mg was administered intravenously towards the end of surgery. There was no change in urine color after approximately 75 minutes, so another ampule was given along with furosemide 20 mg. Approximately 20 minutes later, there was still no change, so the trocars were reinserted for exploration. There was free efflux of clear urine noted from both ureteral orifices and no sign of obstruction. Postoperatively there was no evidence of urinary discoloration.

Discussion:

Intravenous dyes are used intraoperatively to help confirm ureteral patency. MB is a frequently used dye with a half-life of 5-6.5 hours. It is about one-third renally excreted when administered intravenously. About one-third of this renally excreted fraction is a colorless metabolite, leukomethylene blue (1), created from the redox reaction catalyzed by biliverdin reductase B (2). Blue-green urinary discoloration typically resolves within 24-48 hours.

Because metabolism of MB may vary between patients, MB may be an unreliable diagnostic indicator (3). In this patient, the lack of discoloration raised a concern for obstruction and led to abdominal reexploration, prolonging the surgery by 1-2 hours. Indigo carmine may be superior over MB, as it is principally excreted unchanged in the urine. Recent studies have indicated that biliverdin reductase B is significantly overexpressed in prostate cancer tissue (4). This upregulation may explain the absence of color change in this patient with confirmed prostate adenocarcinoma.
Background: All patients with amyotrophic lateral sclerosis (ALS) are at significant risk for respiratory complications. Progressive degeneration of both upper and lower motor neurons affects all of the muscle groups of respiration. The inexorable result of this degeneration is ventilatory failure characterized by both CO2 retention and inability to clear secretions. Death from respiratory failure occurs within 3 to 5 years of onset. Respiratory pacing through laparoscopic implantation of a diaphragm pacing system (DPS) in patients with ALS may confer some improvement in quality of life and prolong survival in selected patients. There is a paucity of literature concerning anesthetic management in this cohort. The following case series highlights the Pacific Northwestern perioperative management of the respiratory complications which were encountered in this high risk population.

Subjects and Methods: The anesthetic strategy outlined includes the use of rapidly reversible short-acting amnestic and analgesic agents. No neuromuscular blocking agents were used in this cohort. Extubation to BIPAP as well as early postoperative screening chest x-ray for pneumothorax is described.

Results: The study population consisted of a total of five patients undergoing elective laparoscopic diaphragm pacing implantation between 2012 and 2013. Age at implantation ranged from 34 to 68 and the percent predicted forced vital capacity (FVC) while sitting ranged from 49% to 67%. There were no failures to extubate or 30 day mortalities using this protocol.

Conclusion: Preoperative weakness of the major muscles of respiration is further exacerbated by the effects of general anesthesia in patients with ALS undergoing DPS. Direct implantation of pacing electrodes to the diaphragmatic surface in these patients increases the risk for pneumothorax which may further compromise respiratory mechanics. Laparoscopic surgery with TIVA anesthesia can be safely performed in patients with ALS undergoing DPS and aggressive perioperative respiratory support strategies in this cohort may be beneficial.
Introduction:

Trauma is the leading cause of death in the US for adults less than 44 years of age. Prior research suggests that patients with multi trauma are more likely to have missed injuries. However, even patients suffering from multi trauma can have a good prognosis with timely and appropriate interventions. We present a case of a 21 year old male who suffered multiple gunshot wounds resulting in multi organ damage.

Case Report:

A 21 year old male with unknown past medical history was brought in with multiple stab and gunshot wounds. His FAST scan was positive for pneumothorax, pericardial fluid, and hemoperitoneum. He was intubated in the ED for airway protection. Because the patient was hemodynamically stable, he was taken to CT. Imaging showed three bullets, two of which remained superficial. The third was in the vicinity of the patient’s heart, but the precise location was equivocal. Imaging also demonstrated liver lacerations, renal laceration, and bowel injury. The patient was taken to the operating room for emergent exploratory laparotomy. General anesthesia was maintained with sevoflurane and fentanyl as tolerated. The patient began to exhibit tamponade physiology, which improved after pericardiocentesis and tube thoracostomy. Trauma surgery subsequently achieved hemostasis within the abdomen, and then performed a partial colectomy and cholecystectomy. Cardiac surgery then performed a median sternotomy during which a bullet was identified immediately adjacent to the LAD. The patient was placed on cardiopulmonary bypass and the bullet was retrieved. The patient tolerated the procedures well.

Discussion:

The overall mortality rate for trauma patients is significantly less when care is provided in a trauma center compared to when it is provided at a non-trauma center. In this case, both early mobilization of appropriate resources and effective communication between a multidisciplinary care team played crucial roles in improving the patient’s outcome.
Intraoperative Use of a Home CPAP Machine During Monitored Anesthesia Care: A Case Report

Presenter: Lindsay Borg, MD/DO, Resident
Stanford University

Authors: Lindsay Borg, MD/DO
John Dazols,
Edward Mariano, MD/DO (Faculty Mentor)

Background:

Patients with obstructive sleep apnea (OSA) present a challenge to the anesthesiologist especially during monitored anesthesia care (MAC) with intravenous sedation. While perioperative use of continuous positive airway pressure (CPAP) is recommended by the American Society of Anesthesiologists, an intraoperative delivery system is not typically available or appropriately fitted. We present the use of a patient’s home CPAP machine during outpatient surgery under MAC.

Case Report:

A 50 year-old man with severe OSA, status post uvulopalatopharyngoplasty and treated with nightly nasal CPAP, presented for outpatient neuroma excision of his foot. The patient brought his home CPAP machine to the hospital as recommended by preoperative clinic staff. After discussion of CPAP delivery options, including the patient’s preference for his own nasal pillows over a facemask, the team agreed to bring his machine into the operating room. Supplemental oxygen (10 L/min) was connected to the inflow tubing via a T-piece adaptor and end-tidal carbon dioxide monitoring was achieved by taping the end of the gas sampling line to the exhalation vent just proximal to the nasal pillows. The surgery was performed under MAC with local anesthesia. Intravenous sedation consisted of 2 mg of midazolam, 100 mg of fentanyl, and propofol infusion (25 mcg/kg/min). Intraoperatively, the patient’s oxygen saturation remained above 97% and no airway obstruction occurred throughout the case.

Discussion:

Home CPAP machines potentially provide a preferable alternative to more invasive methods when managing patients with OSA during MAC. There are minor equipment compatibility issues as well as biomedical engineering and infection control concerns to consider prior to intraoperative use.
Poster # EE11

ASA IV patient with Multiple Comorbidities undergoes Radical Nephrectomy with Caval Extension complicated by Massive Bleeding, an application of the Surgical Home

Presenter: Jared Breaux, MD, Resident
University of Southern California

Authors: Jared Breaux, MD
Sofia Peeva, MD
Kimberly Simms, MD
Rodney McKeever, MD (Faculty Mentor)
Durayiah Thangathurai, MD (Faculty Mentor)

We present the case of a 53 year old female who presented for robotic radical nephrectomy with level II caval extension for right sided RCC. The patient’s comorbidities included Child’s class A Cirrhosis secondary to Hepatitis C with portal hypertension, prior PE, narcotic dependence, and essential hypertension.

The surgeon requested transfusion of platelets and cryoprecipitate for her thrombocytopenia and coagulopathy. Additional monitoring included IABP, CVP, and cerebral oximetry to monitor tissue oxygenation. General anesthesia was induced with ketamine, propofol, fentanyl, and cisatracurium and maintained with desflurane. An intraoperative TEE was utilized to visualize and evaluate the tumor extension into hepatic IVC, but we also noticed external IVC compression from the enlarged tumor. The patient was placed in flex position with pneumoperitoneum on pressure control ventilation to minimize peak airway pressures.

The surgeons encountered bleeding along with inadequate exposure, so the decision was made to open. After opening and further resection around the tumor thrombus, significant bleeding occurred which was exacerbated by her portal hypertension, coagulopathy, and the tumor size. We used a titratable nitroglycerin infusion to minimize the caval and portal pressures which, in turn, helped to minimize the bleeding. The patient quickly went into massive hemorrhage and all available units of PRBCs were transfused quickly. By the time the bleeding was controlled, her resuscitation required 32 PRBCs, 19 FFP, 10 Platelets, and 30 Cryoprecipitate. Her total blood loss was estimated to be 10,500cc to 11,000cc. During the massive transfusion, her academia, hyperkalemia, hypocalcemia, and base deficit were aggressively corrected. She remained intubated with low dose vasopressor requirements for transport to the ICU.

The same anesthesiology team members continued her care post-operatively in the ICU. Her metabolic and electrolyte disturbances following the massive transfusion were aggressively corrected throughout the night including a metabolic alkalosis, hypercalcemia, and hypernatremia. She was successfully extubated on POD 2 and stepped down on POD 3. The patient did not develop any organ dysfunction and importantly did not develop ARDS after the massive transfusion.
Veno-venous Extracorporeal Membrane Oxygenation for Severe Acute Respiratory Distress Syndrome

Presenter: Sonya Seshadri, MD, Resident
University of California, San Diego

Authors: Sonya Seshadri, MD
Orestes O'Brien, MD (Faculty Mentor)

A 25 year-old Vietnamese male with no significant past medical history presented with hematemesis, abdominal pain and melena. A workup of his upper gastrointestinal bleed revealed signet ring adenocarcinoma of the stomach for which he underwent a laparoscopic distal gastrectomy with Roux-en-y reconstruction. On post-operative day 1, he became tachycardic, diaphoretic and had an acute drop in his hematocrit for which he was taken back to the operating room for an exploratory laparotomy. During direct laryngoscopy, a copious amount of blood was seen in the oropharynx and intraoperative bronchoscopy after intubation revealed aspiration of a significant amount of blood. The patient was taken to the ICU intubated post-operatively due to significant hypoxemia, hypovolemic shock with continued transfusion requirements and frank pulmonary edema. He subsequently developed acute respiratory distress syndrome (ARDS) with severe hypoxemia despite inhaled pulmonary vasodilators, muscle paralysis and numerous ventilator strategies. Due to his refractory hypoxemia with elevated plateau pressures on the ventilator, the decision was made to start veno-venous extracorporeal membrane oxygenation (ECMO) two days after his aspiration event. The patient developed pigment nephropathy from hemolysis and required continuous renal replacement therapy (CRRT) two days after ECMO was initiated. His course was also complicated by aspiration pneumonia requiring antibiotic therapy and heparin resistance requiring antithrombin III infusions for anticoagulation while on ECMO. He was successfully weaned off of ECMO after 5 days once he could maintain oxygenation with mechanical ventilation. He then underwent bedside tracheostomy 12 days after his aspiration event and was weaned off mechanical ventilation shortly thereafter. This case illustrates the utility of veno-venous ECMO for refractory hypoxemia from ARDS. It also highlights the importance of monitoring kidney function and maintaining adequate diuresis, aggressively treating infection and maintaining adequate anticoagulation to optimize the utility of ECMO once it is initiated.
TREATMENT OF REFRACTORY VENTRICULAR ARRHYTHMIAS WITH DEXMEDETOMIDINE: TWO CASE REPORTS

Presenter: Ashley Quan, MD, Resident
University of California, San Francisco

Authors: Ashley Quan, MD
John Turnbull, MD (Faculty Mentor)

Various sedatives, including propofol and opioids, are administered to patients experiencing recurrent ventricular tachyarrhythmias, a clinical syndrome termed VT storm. Case reports describe the use of dexmedetomidine for termination of tachyarrhythmias in the pediatric population. We describe two cases of termination of recurrent ventricular tachycardia following the addition of dexmedetomidine in adult patients with ischemic cardiomyopathy.

Case 1

A 79-year-old man with a history of ESRD, CHF with an EF of 15%, and CAD was admitted to the ICU following a cardiac arrest due to in-stent thrombosis of a bare metal stent. Following revascularization, the patient developed recurrent ventricular tachyarrhythmias. Despite ACLS and anti-arrhythmics, the patient had daily episodes of ventricular tachycardia. A dexmedetomidine infusion at 0.4 mcg/kg/min was initiated followed by stabilization of his cardiac rhythm. Despite aggressive medical management, the patient’s condition worsened and he transitioned to comfort care.

Case 2

A 66-year-old man with severe multi-vessel CAD and ischemic cardiomyopathy (EF 15%) presented with >100 ICD discharges in 24 hours. Despite multiple anti-arrhythmic infusions, unstable ventricular tachycardia continued. Following the addition of a dexmedetomidine infusion at 0.6 mcg/kg/min, the arrhythmias significantly decreased and weaning of the infusion led to increased ventricular tachycardia. The infusion was continued until the patient received an LVAD.

The antiarrhythmic effect of dexmedetomidine may be due to attenuated adrenergic tone via decreased norepinephrine and prolonged refractory period via enhanced vagal activity. Dexmedetomidine provides analgesia, sedation and suppression of adrenergic activity without requiring endotracheal intubation. Such patients avoid the risks of mechanical ventilation while allowing for participation in health care decisions and rehabilitation. Further studies are needed to define the role of dexmedetomidine in the management of malignant arrhythmias.

Post operative respiratory failure in the setting of palliative spine surgery for metastatic hepatocellular carcinoma

Presenter: Vinod Singaram, MD, Resident
University of California, San Diego

Authors: Vinod Singaram, MD
Ulrich Schmidt, MD (Faculty Mentor)

A 60 year old male with metastatic HCC to the spine was admitted with symptoms of back pain, bilateral arms and numbness to torso and legs, and bilateral lower extremity weakness. MRI showed mass effect at C4 and T7. The patient underwent three surgeries to debulk the tumor and stabilize the spine with instrumentation from C3 to T7 (see figure). Subsequent to the primary surgery patient was admitted to the ICU due to the length of surgery and intraoperative transfusion of 8 units of PRBCs. He was unable to be weaned from mechanical ventilation secondary to respiratory muscle weakness on POD #1. The patient's sensory and motor deficits did not improve and in fact worsened post operatively in the lower extremities, and continued to worsen after subsequent two surgeries. The patient continued to fail trials to liberate him from mechanical ventilation (Table). He declined tracheostomy. He was compassionately extubated per his wishes and passed away 2 days post extubation.

Determination of the risk of post-operative respiratory failure (PRF) before undergoing this very invasive palliative surgery would have been very valuable. Multiple studies have attempted to estimate post op respiratory failure with different scoring systems. For the patient above the risk varies between 0.5%1, 2.2%2 and 5.55%3 using three different scoring systems. All 3 studies found certain patient characteristics were predictive of increased risk of PRF: type of surgery, emergency case, comorbidities, and higher ASA class. In this patient cough strength and overall weakness was a determining factor for his negative outcome. However these parameters are not included in above mentioned scoring systems. There is as of yet no single widely accepted method of determining risk of post op respiratory failure. However this determination would be of the highest value to avoid the outcome of palliative surgery as described in our case.
36 Year Old Female With Dapsone-Induced Methemoglobinemia

Presenter: Gregory Blair, MD, Resident
           Virginia Mason
Authors:   Gregory Blair, MD
           Hashim Mehter, MD (Faculty Mentor)

Introduction: Methemoglobinemia may be caused by several oxidizing medications, presents as cyanosis or an oxygen “saturation gap,” and can be treated with IV methylene blue. Cimetidine is an alternative treatment option specific to dapsone-induced methemoglobinemia. We present a case of methemoglobinemia caused by dapsone.

Case Report: A 36-year-old female with acute lymphoblastic leukemia in remission status post recent chemotherapy presented to the critical care unit with pancytopenia, febrile neutropenia, and sepsis with GNR and MSSA bacteremia. She had been on dapsone for PJP prophylaxis, which was continued on admission. She improved with antibiotic treatment but on hospital day six was found to have increasing oxygen requirements and a pulse oximetry reading of 91% on high flow nasal cannula with an FIO2 of 1.0. She had no subjective increase in dyspnea. A methemoglobin level was drawn and found to be markedly elevated at 26%. She was treated with two doses of IV methylene blue and her oxygen saturation markedly improved. Dapsone was discontinued.

Discussion: Methemoglobinemia is a condition in which an abnormally high amount of methemoglobin is produced in the blood. This form of hemoglobin has a higher affinity for oxygen than standard hemoglobin and impairs oxygen release, shifting the dissociation curve leftward. Hereditary predispositions to methemoglobinemia exist, but it is more commonly acquired after exposure to an oxidizing agent (e.g. metoclopramide, dapsone, sulfonamides, benzocaine, others). The effect of methemoglobin formation is more pronounced in patients who are anemic. Clinical presentation correlates with methemoglobin level; cyanosis occurs at approximately 15%. A “saturation gap” may appear on pulse oximetry, plateauing at about 85% and unresponsive to supplemental oxygen. Treatment options include IV methylene blue (which acts as a cofactor in the methemoglobin reductase system) or the addition of cimetidine, which inhibits conversion of dapsone to its oxidizing metabolite.
Perioperative Rhabdomyolysis and Acute Kidney Injury

Presenter: Rachel Chard, MD, Resident
University of Washington

Authors: John Lang, MD/DO (Faculty Mentor)

Rhabdomyolysis resulting in acute kidney injury (AKI) is an important cause of morbidity and mortality in perioperative period. Patients presenting for urgent or emergent surgery may have risk factors for the development of rhabdomyolysis. Early recognition and treatment is critical in the prevention of renal injury and failure. Two cases of rhabdomyolysis resulting in renal failure requiring renal replacement therapy following emergent surgery were reviewed. The patients presented with a crush injury and acute aorto-iliac occlusion, respectively. These cases illustrate the importance of recognizing at-risk patients in the peri-operative period.
Intensive care medicine provides rigorous medical care to critically ill patients. This has led to increased survival to hospital discharge and reduced 28 day mortality rates. However, utilization of an intensive care unit (ICU) has significant drawbacks. Girard et al. in 1985 coined the term “chronic critical illness” to describe a classification of patients that neither improve nor die but linger chronically in the ICU. There have been studies that have attempt to identify determinants of survival following ICU admission. Pre-admission the severity of illness and age are important factors. The majority of these studies were done solely in medical ICUs (MICU). To date, there has not been a study that is specific to surgical ICU patients. It is thus of great importance to study those patients admitted to a surgical ICU, as their issues are frequently different from those admitted to MICUs. The UCSD Health care system performs over 9000 inpatient procedures annually between its two campuses. The UCSD La Jolla campus focuses on interventional treatments for cancer and cardiovascular diseases. Long-term outcomes following prolonged surgical ICU stay are largely unknown. We performed a retrospective analysis of surgical ICU admissions spanning two years examining outcomes of those who had ICU stays greater than 48 hours. Outcomes included in-hospital and post-discharge mortality, readmissions, and discharge location. We have focused on identifying modifiable risk factors i.e aspiration events that if ameliorated will improve outcomes and shorten surgical ICU stays.
The relationship between two bedside assessments of circulating volume and directly measured total circulating blood volume in neurosurgical patients

Presenter: Matthew Pennington, MD, Resident
University of Washington

Authors: Aaron Joffe, MD/DO (Faculty Mentor)

Hypovolemia in the setting of moderate or severe cerebral vasospasm in patients with aneurysmal subarachnoid hemorrhage (SAH) increases the risk of delayed cerebral infarction (DCI). Thus, consensus recommendations are to maintain euvolemia. Our primary aim was to examine the correlation between 1) the change in calculated total body solute (an estimate of the extracellular fluid volume) over time and 2) the shock index (SI) at a single point in time with the change in directly measured blood volume (BV) over time and BV status at a single point in time.

BV was measured as part of routine care using iodinated I131 albumin injection and the BVA-100 (Daxor Corp, New York, NY). Total body solute (TBS) was estimated at the time of BV measurement by multiplying the calculated total body water (TBW) by the sum of the serum Na+ and K+ plasma concentrations. TBW on admit was estimated with Watson’s formula accounting for the patient’s sex, height and weight. Daily water balance was estimated using nurse entered daily fluid balances. SI was calculated as heart rate/systolic blood pressure in mmHg. Linear regression was performed relating 1) repeated calculations of total body solute over time to repeated blood volume measurements in the 12 patients who had more than one BV measurement, and 2) shock indices and total blood volume for each patient who had at least 1 BV measurement and is reported as a coefficient of variation (r2).

Overall, 56 patients were included. BV ranged from 75-150% of ideal. Shock indices ranged from 0.3 to 1.1 mmHg-1min-1. SI and BV were not correlated (r2=0.054, p=.09). Despite this, it appears that at values of shock index exceeding 0.85 mmHg-1min-1, the probability of hypervolemia becomes very small. Linear regression of change in total Na++K+ between measurements was very poorly correlated with change in blood volume between measurements (r2=.3, p=0.6).
Management of Post-operative Serotonin Syndrome in the PACU

Presenter: Maaz Iqbal, MD, Resident
University of Arizona

Authors: Maaz Iqbal, MD  
David Lucas, MD (Faculty Mentor)

Introduction:
Serotonin syndrome is a potentially life threatening condition caused by drug interactions leading to an excess of serotonin and its subsequent effects on the central and peripheral nervous system. It can lead to a spectrum of symptoms that can be fatal if not properly recognized and addressed.

Case Description:
A 51 year old female presented for an elective first rib resection for thoracic outlet syndrome. Her past medical history included hypertension, depression, anxiety, and chronic low back pain. Patient's home medications consisted of fluoxetine, lisinopril and tramadol. After arrival, patient was taken to the operating room where she had an uneventful surgery and was extubated awake. Intra-operatively, patient received 450mcg of fentanyl, 2mg of dilaudid and 4mg of zofran.

Upon arrival to PACU, patient was sedated but responsive to verbal stimuli. Patient complained of nausea and was treated with a dose of phenergan and reglan. Thirty minutes after arrival to PACU, the nurse informed the resident that the patient was unresponsive and exhibiting "seizure-like activity" in her upper extremities. Upon examination, patient was found to be tachycardic and febrile. Although her eyes were open, she was indeed unresponsive and not following any commands. Patient was also noted to have myoclonus in both upper extremities. Post-operative labs revealed a normal blood gas and electrolytes all within normal limits.

After reviewing patient's home medications and given her acute clinical presentation, a presumed diagnosis of serotonin syndrome was treated with 2 doses of ativan and labetalol. Patient had resolution of her myoclonus and was more alert shortly after the second dose was given. Supportive care was continued post-operatively with avoidance of any offending agents with complete resolution of her symptoms within 24 hours.

Discussion:
With the multitude of patients taking anti-depressants today, it is imperative to take into consideration which peri-operative medications potentiate the serotonergic effects. With a potential for life threatening serotonin syndrome, anesthesiologists should try to avoid unnecessary medications in the peri-operative period.
The Use of IABP in Cerebral Vasospasm

Presenter: Sarah Khorsand, MD/DO, Resident
University of Washington

Authors: Sarah Khorsand, MD/DO
Matthew Triplette, MD/DO
Kevin Luk, MD/DO (Faculty Mentor)

We report the case of a 55 year-old female with severe aneurysmal subarachnoid hemorrhage (aSAH) who developed cerebral vasospasm. Vasospasm of bilateral MCAs and ACAs was diagnosed by transcranial Doppler (TCD) & CTA on post-bleed day 8 (PBD), and required astronomical doses of vasopressors to maintain adequate cerebral perfusion pressure (CPP). Angiography showed severe narrowing of the right M1, left M1 and bilateral A1 segments. Vasospasm persisted despite multiple attempts at balloon angioplasty (Figure 1). On exam, the patient was moaning to pain with purposeful movement in her LUE.

On PBD 9, a TTE demonstrated severe LV dyskinesis with an EF of 14%, consistent with stress-induced cardiomyopathy. Given poor neurologic exam and presence of heart failure, lithium dilution cardiac output (LiDCO) monitoring was initiated and a continuous central venous oximetry catheter was placed. It was hypothesized that the cardiac index was too low while the systemic vascular resistance was too high. Dopamine and phenylephrine were weaned off. Dobutamine and vasopressin were started in addition to norepinephrine. The infusions were titrated to the following hemodynamic goals: CI>2.2, SVR<1200dyns/cm²-5, pulse-pressure variation<8%, and ScvO2>65%.

Unfortunately the patient was comatose with extensor posturing. Cardiology was consulted for placement of an intraaortic balloon countercpulsation pump (IABP) in an attempt to improve CPP. Once IABP was placed, NE and dobutamine were weaned to a lower HR for better augmentation. The patient’s neurologic exam improved as her hemodynamics continued to improve. Repeat TTE demonstrated improving LV function, and IABP was eventually weaned off.

This case highlights two important concepts in the management of cerebral vasospasm with concomitant stress-induced cardiomyopathy: 1) the effective use of LiDCO and continuous ScvO2 to achieve goal-directed optimization of hemodynamics using fluid therapy and vasoactive infusions; and 2) the use of IABP as bridging therapy to augment CPP as the stress-induced cardiomyopathy recovers.
Delayed Extreme Metabolic Alkalosis in the Setting of Massive Blood Product Transfusion

Poster # FF10

Sofia Peeva, MD, Resident
University of Southern California

J Breaux,
K Ghadjar,
K Simms, MD
R McKeever, MD

Fifty-three year old woman, ASA 4 with comorbidities including renal clear cell carcinoma with large mass and co-commitment IVC thrombus, Hepatitis C with cirrhosis, thrombocytopenia with coagulopathy, heavy tobacco smoking history with chronic lung disease, IV drug abuse on methadone therapy, HTN and history of PE. Patient underwent emergent robotic converted to open radical nephrectomy with level 2 caval extension with extensive exploration and massive bleeding likely due to coagulopathy and venous injury. Intra-operatively patient received a 32 units of pRBC, 20 units of FFP and 6 units of PLT in addition to 2 liters of cell saver. The continuity of care was maintained – the anesthesiologist during the case provided all post-operative ICU care and management.

During admission to the ICU and upon review of the anesthesia records it was found that patient was experiencing metabolic acidosis intra-operatively which required a bicarbonate drip totaling 5 amps of bicarb. During the last 2 hours of the case the serial ABG’s showed mild metabolic alkalosis with sodium 144-147, bicarb 20-24, base excess remained negative throughout the case ranging from -7.1 to -0.6 at the conclusion of the case. During the first 6 hours immediately post-op the patient began to develop severe metabolic alkalosis (pH > 7.5) with bicarb trending up from 24.2 to 40.8 despite no additional bicarbonate or blood product administration. Pt did not experience any neurological sequela. Intravascular volume was maintained with UOP ranging between 120-150 cc/hr. Blood pressure was maintained MAP’s 80-100 with levophed. Diuretic therapy with Diamox, Lasix and Bumex was administered to correct the alkalosis. Bicarb was gradually down trending to 35.4 by post-op day 2.

In addition to the metabolic alkalosis the patient also developed hypernatremia. At the conclusion of the operation the sodium level was 146. Within one hour post-op the sodium levels increased to 154. In the post-op period mainly sodium free solution were administered in addition to free water. As the alkalosis began to resolve so did the sodium levels which eventually normalized within 12 hours of the end of the operation.

Conclusion: Delayed metabolic alkalosis was likely secondary to massive blood transfusion where citrate from blood products was converted bicarbonate in the liver. Contraction alkalosis was excluded given positive fluid balance. An interesting a novel finding was parallel hypernatremia was also observed and corrected with the correction of the alkalosis.
Intra-aortic Balloon Pump for Acute Flail Mitral Regurgitation

Presenter: Elizabeth Hansen, MD, Resident
University of Washington

Authors: Elizabeth Hansen, MD
Kristina Goff, MD

Learning Objectives:
1. Risk factors and complications of endocarditis
2. Physiology and management of acute mitral regurgitation
3. Strategies for afterload reduction
4. Identification of indications for Intra-aortic balloon pump

Case description:
25 year old female with history of hepatitis C, deep vein thrombosis, and polysubstance abuse who presented with left sided weakness, confusion, and headache in the setting of possible overdose. Her initial CT scan showed right malignant MCA infarct, and she was emergently taken for decompressive craniotomy. A large mitral valve vegetation was noted on ECHO, and blood cultures were positive for Enterococcus faecalis and Candida albicans.

Her course was complicated by recurrent embolic stroke and moderate ARDS, and on day 7 of hospitalization, she acutely developed tachycardia, hypotension, and hypoxia. Repeat ECHO showed flail anterior leaflet from likely chordae rupture. Nitroprusside was started for afterload reduction, with marked reduction in oxygenation, likely from impaired hypoxic pulmonary vasoconstriction. An intra-aortic balloon pump was inserted for afterload reduction and to bridge to valve replacement surgery, with improvement in her oxygenation. Unfortunately, arterial thrombi developed leading to ischemic lower limbs. At this point, her family elected to transition to comfort care.

ECHO image
Focusing Feedback: How a Web-Based Tool Enhances the Quality of Feedback Conversations

Presenter:  Lena Scotto, MD, Resident
Stanford University

Authors:  Sylvia Bereknyei, MS/MA/MPH
Kim Walker, PhD
Jennifer Zocca, MD
Lena Scotto, MD
Pedro Tanaka, MD (Faculty Mentor)

Background

Feedback is an integral part of education. As residency programs implement the ACGME milestones to assess residents’ competence and progress, multiple valid and informative evaluation instruments are essential. We sought to create a feedback tool which anesthesiology residents would find instructive and which would also guide their development through the milestones.

Methods

Resident focus groups were conducted during which residents expressed a desire for more concrete, behavior-specific feedback in real-time. Based on this needs assessment, we developed a web-based tool that consisted of four sections: evaluator’s name, specific learning objective demonstrated well by the resident, specific learning objective that the resident may improve, and steps to meet or exceed this objective. Residents initiated the feedback sessions by asking supervising faculty to fill out the forms ideally on a daily basis.

Results

In a three-week period, 20 residents voluntarily participated in the pilot during their multi-specialty and pediatric anesthesia rotations, and completed 62 feedback tool sessions. We evaluated the outcome by eliciting resident ratings of the feedback tool. The residents rated it as “valuable” (mean 3.6 out of 5) and described it as a “useful structure that is also flexible” and an “efficient template.” Although “documentation was sometimes difficult,” the tool allowed residents to directly “implement recommendations...and continue improving with daily feedback.”

Discussion and Future Direction

The feedback tool allows for comments based on real-time observations by multiple observers. It creates an environment of frequent, formative feedback to shape behavior and caters to the milestones’ focus on lifelong learning. Residents found the tool to be a systematic way to reinforce positive behaviors and identify gaps. We will continue to evaluate how the feedback tool will foster growth and allow for complication of a summative report based on the ACGME milestones.
Background: Transesophageal echocardiography (TEE) is being used with increasing frequency by anesthesiologists in the perioperative care of both cardiac and non-cardiac surgical patients. As such, many residency programs are now providing basic education in echocardiography for their trainees. Certification in TEE was once offered only to fellowship-trained cardiac anesthesiologists, but Basic Certification from the National Board of Echocardiography is now available to residents. While designing a curriculum intended to prepare Stanford anesthesia residents for the Basic Perioperative TEE Exam, we conducted a survey of the residency program with the intention of assessing residents’ current level of comfort with TEE, learning preferences, and any perceived barriers to obtaining certification.

Methods: A survey was sent to CA1-3 Stanford Anesthesia residents via email. Responses were gathered anonymously.

Results: 26/76 (34%) of residents responded to the survey. 77% were senior residents who had completed required TEE and cardiac rotations. Of this subset, only 10% felt “very comfortable” with their ability to acquire and interpret TEE images. Of the total respondents, 35% indicated that they intend to obtain echo certification and an additional 50% reported they were considering certification. When asked about barriers to obtaining certification, 62% felt they lacked adequate educational resources to prepare, 58% felt they did not have enough time to prepare, and 46% indicated that the cost of the exam was prohibitive. 88% indicated they would make use of a web-based curriculum if it were available.

Conclusions: The results of our survey demonstrate that residents are interested in pursuing echocardiography certification, but many feel inadequately prepared to do so after completing existing TEE training. The barriers identified in this study may be addressed by incorporating a web-based interactive TEE curriculum into our training program. Our results can likely be extrapolated to other residency programs aiming to enhance their TEE curriculum.
Impact of an innovative lecture series on resident evaluations of an anesthesiology

Poster # GG03

Presenter: Lindsay Borg, MD/DO, Resident
Stanford University

Authors: Pedro Tanaka, MD (Faculty Mentor)
David Yanez, PhD
Hendrikus Lemmens, MD
Adam Djurdjulov, MD
Lena Scotto, MD

Introduction

Although the lecture is an efficient way to disseminate knowledge to large groups, new teaching methods may be well received by housestaff. The goal of this study was to measure how “Overall Teaching Quality of this Rotation” changed before and after an innovative lecture series given three times daily for 15 minutes with a predetermined format and focused discussion of an ABA keyword.

Methods

After approval by the human subjects committee, rotation evaluations were entered anonymously by residents into Medhub. The primary endpoint was “Overall Teaching Quality of this Rotation” using a 5-point Likert scale. A secondary endpoint was satisfaction with “Teaching not directly involved with case management.” Resident rating of “Goals of the Rotation were Defined” was included as a control question, a construct the new lectures did not address. Two rotations at other hospitals that did not participate in the lecture series served as control groups during the same time periods. Lastly, we collected qualitative data with an online survey.

Results

More than 1800 evaluations were completed by residents in the 2 years before implementation of the new lecture series and the 12 months after implementation. The daily lecture program covered 219 topics. The “overall teaching quality” (before and after 3.8 and 4.1 out of 5, p=0.0001) and “teaching not directly involved with case management” (before and after 3.9 and 4.2, p=0.004) both significantly improved in the rotation where the lecture program was instituted but not at the control rotation sites. There was no change in ratings of the control question. Resident satisfaction (mean=4.6 out of 5) was high and 64% of residents indicated it contributed to ABA exam preparation. Residents felt the lectures were “high yield,” and helped stay “more intellectually engaged throughout the day”.

Discussion

Rotation evaluation scores improved after an innovative daily lectures series.

Authors continued after Scotto, L: Borg, Lindsay (MD), Walker, Kim (PhD), Berenknyei, Sylvia (PhD), Macario, Alex (MD)
Anesthetic Training in Resource-Poor Settings – Our Experience in Uganda

Presenter: Shin-e Lin, MD, Resident
University of California, San Francisco

Authors: Shin-e Lin, MD
Brian Kim, MD
Fred Bulamba, MD
Cornelius Sendagire, MD
Gerald Dubowitz, MD

AIMS:
Inadequate anesthetic workforce and limited capacity for anesthesia training are major obstacles to the provision of surgical services in low-income countries. Recent increases in enrollment of anesthesia residents at Makerere University (Uganda) have brought new opportunities for cross-institutional collaboration. Our goal was to determine whether the implementation of a self-sustaining, low-cost orientation course based on those used for residents at UCSF would improve access to high-quality anesthetic education in Uganda.

METHODS:
We created an orientation course modeled after the new anesthesia resident orientation program at UCSF. We established standardized lectures that can be easily presented by any of the staff, an airway workshop, and a simulation center. We built the low-cost simulation center ($400) using repurposed parts from the UCSF and Makerere and donated SimMon software. We taught senior residents how to run full simulations with audiovisual recordings that could be used in real-time teaching. Trainee satisfaction was evaluated at the end of the course.

RESULTS:
The senior residents and staff gave the lectures to the new anesthesia trainees over a two-week period with most lectures adhering to the standardized content. The airway workshop introduced new techniques and has been further expanded to include an advanced airway workshop. Since its assembly, the simulation center has remained in use on a regular basis by both the anesthesia department as well as other departments for resident training purposes. Based on participant surveys, the simulation center and airway workshop were amongst the top-rated activities in terms of education benefit.

CONCLUSIONS:
We constructed a low-cost, self-sustaining orientation course for new anesthesia residents consisting of lectures, an airway workshop, and a new, fully-functional simulation center. This orientation course has been well-received by the trainees and represents a model for sustainable, positive improvement in the quality of anesthesia education in a resource-poor setting.
Rotations through different specialties are an integral part of a medical student’s process of deciding on a future career path. This is particularly true in anesthesia where exposure to the field is limited and the overall scope of the practice of anesthesia is often under-appreciated by medical students. Medical student education in anesthesia is challenging due to time pressure in the operating room, patient safety concerns, and the rapid nature of decisions in the operating room. An increasing number of medical students possess disabilities that pose particular challenges in the operating room environment. Of particular interest is the instruction of a Hard of Hearing (HOH) medical student. While significant advances in the classroom setting have been made to accommodate HOH students, education in the clinical environment has lagged. This particular case is of a student with near total hearing loss as well as limited knowledge of American Sign Language as she had previously had functioning cochlear implants that had stopped working during medical school. Despite these obstacles, an effective learning environment was created in which the student was able to obtain valuable experience in the anesthesia environment as well as participate in patient care in a proactive and safe manner. Hopefully the skills gained from this experience will help in the education of future HOH medical students in the field of anesthesia as this will potentially allow for further insight in the care of HOH patients as well as provide additional skills to make us better clinician educators as anesthesiologists.
Purpose:
Currently, the University of California, Davis Department of Anesthesiology and Pain Management does not offer an elective international rotation that provides Accreditation Council for Graduate Medical Education (ACGME) credit towards a resident’s training. The purpose of this project is to determine the feasibility of creating an elective international rotation in China that will provide ACGME credit.

Methods:
The ACGME along with the American Board of Anesthesiology (ABA) provide two options for receiving credit for an international rotation - (1) travel to an international site that has already been approved by the ACGME/ABA or (2) petition the ABA for approval of a self-designed international rotation. From the ACGME/ABA guidelines, the international site and the elective rotation must fulfill certain requirements to ensure the traveling resident receives a supervised and educational experience.

The investigator of this study traveled to Ruijin Hospital affiliated with Jiao Tong University, a major academic and quaternary care hospital in Shanghai, China, to determine whether that specific hospital or any other major hospital in China would fulfill requirements for an ACGME/ABA overseas site. Two weeks were spent interacting with the faculty and residents of the Department of Anesthesiology.

Conclusion:
An elective international rotation in China would provide the traveling resident with a rich educational experience; allowing them to interact with physicians of a different cultural background, exposing them to a new health care system, and highlighting different approaches to the delivery of an anesthetic. Issues involving cost, housing, language, and transportation do need to be addressed but should not be major hurdles. Perhaps the greatest challenge would be creating a program that would allow the traveling resident to directly participate in patient care.
Acquisition of Basic and Rescue TEE Skills and Knowledge by Novice Anesthesiology Residents Using High-Fidelity Simulation

Presenter: Dennis Kirby, MD, Resident
Virginia Mason

Authors: Dennis Kirby, MD/DO
Lila Sueda, MD/DO (Faculty Mentor)
Eliot Fagley, MD/DO (Faculty Mentor)
James Helman, MD/DO (Faculty Mentor)
Carli Hoaglan, MD/DO (Faculty Mentor)

INTRODUCTION

Simulation-based education provides a controlled environment that fosters proficiency in team communication, acquisition of procedural skills, and strengthening of clinical knowledge. Mannequin-based transesophageal echocardiography (TEE) simulators are powerful teaching tools that can play a major role in resident education by allowing for a standardized approach to teaching normal anatomy and common pathology in addition to providing trainees with the opportunity to increase their manual dexterity skills. We hypothesize that a five-week, TEE-simulation training program would be more effective at facilitating resident learning of basic and rescue TEE skills, both cognitive and technical, when compared to traditional lectures.

METHODS

This study was designed to include TEE-naïve, first-year, anesthesiology residents and will be conducted over a two-year period. To date, nine residents have been tested. Each was randomly assigned to either a simulation or a traditional lecture group. Over five weeks, both groups received five sixty-minute training sessions that followed the National Board of Echocardiography’s content outline for basic TEE. Each participant took a written pre-test prior to the training sessions as well as a written and practical skills test afterwards.

RESULTS

Inferential statistical analyses are being postponed until study completion. The raw data and descriptive statistics from the cognitive skills test can be found in Tables 1 and 2, respectively. A visual representation of the raw data from the technical skills test for both groups can be found in Figures 1 and 2.

CONCLUSIONS

The preliminary data suggest a trend towards better performance in the simulation group on both tests. This argues in favor of incorporating more simulation-based training into residency education. Simulation training may help flatten the learning curve associated with the acquisition of basic intraoperative echocardiography skills. The long-term effects of brief, high fidelity, simulation training on skill retention and clinical application remain a topic for future investigation.
Impact Assessment of Perioperative Point of Care Ultrasound Training on Anesthesiology Residents

Presenter: Jennifer Elia, MD, Resident
University of California, Irvine

Authors: Davinder Ramsingh, MD (Faculty Mentor)
Joseph Rinehart, MD
Zeev Kain, MD
Suzanne Strom, MD
Cecilia Canales, MS/MA/MPH

Background: The perioperative surgical home model highlights the need for trainees to include modalities that are focused on the entire perioperative experience. The focus of this study was to design, introduce, and evaluate the integration of a whole-body point of care (POC) ultrasound (US) curriculum (F.O.R.E.S.I.G.H.T: Focused periOperative Risk Evaluation Sonography Involving Gastro-abdominal Hemodynamic and Transthoracic ultrasound) into residency training.

Methods: For two-years, anesthesiology residents (n=42) received lectures using a model/simulation design and half were also randomly assigned to receive pathology assessment training. Post-training performance was assessed through Kirkpatrick Levels 1 to 4 outcomes based on resident satisfaction surveys, multiple-choice tests, pathologic image evaluation, human model testing, and assessment of clinical impact via review of clinical examination data.

Results: Evaluation of the curriculum demonstrated high satisfaction scores (n=30), improved content test scores (n=37) for all tested categories (48 % ± 16% to 69 %± 17, p <0.002), and improvement on human model examinations. Residents randomized to receive pathology training (n=18) also showed higher scores compared to those who did not (n=19) ( 9.1± 2.5 vs. 17.4 ±3.1  p < 0.05). Clinical exams performed in the organization following the study (n=224) showed that POC US affected clinical management at a rate of 76% and detected new pathology at a rate of 31%.

Conclusion: Results suggest that a whole body POC US curriculum can be effectively taught to anesthesiology residents and that this training may provide clinical benefit. These results should be evaluated within the context of the perioperative surgical home.
The Validity of Simulation-based Training in Pediatric Anesthesiology Fellowship

Presenter: Eleain Tu, MD, Resident
University of California, Los Angeles

The use of simulation based curriculum in the training and evaluating of anesthesia trainees in the specialty of pediatric anesthesiology is expanding. Previous studies have validated simulation based scenarios as methods for evaluating and assessing trainees, however, these are still not widely utilized.

The ACGME will be implementing outcomes-based milestones as a framework for determining trainee performance within the six ACGME Core Competencies. In this study, our goal is to validate eight pediatric simulation scenarios and to implement these scenarios as assessment tools for fellowship training. Fellowship performance will be evaluated with a checklist, global rating score and milestones assessments. Correlation between the simulation score and the ACGME Milestones performance will add validity that these scenarios can serve as a tool for assessing clinical competency.

Eight simulation scenarios will be designed to reflect situations encountered in pediatric anesthesia. At the UCLA simulation center, pediatric anesthesiology fellows from both UCLA Medical Center and Children’s Hospital of Los Angeles will be videotaped as they complete the same set of simulations individually. The videos will be reviewed by raters who meet select criteria.

For each scenario, the raters will evaluate the trainees using a checklist with 5-10 key items aimed to reflect the knowledge and skills needed for competent clinical care, a Global Rating Scale (GRS), and a Milestones evaluation and score. The scores will be compared with each participant’s performance on the Fellowship training ACGME Pediatric Anesthesiology Milestones assessment.

We hypothesize correlation between the simulation score and the ACGME Milestones performance will demonstrate validity that these scenarios can serve as a tool for assessment of clinical competency and identifying areas of deficiency during pediatric anesthesiology fellowship training. In doing so, we may be able to demonstrate the validity of simulation as an assessment tool for clinical practice.
Intracranial pressure management in a patient with acute liver failure undergoing orthotopic liver transplant

Presenter: Christine Nguyen-Buckley, MD, Resident
University of California, Los Angeles

Authors: Christine Myo Bui, MD (Faculty Mentor)

Unique aspects of this case include management of orthotopic liver transplant under total intravenous anesthesia for elevated intracranial pressure, regulation of hyperammonemia-associated encephalopathy with intraoperative dialysis, tight hemodynamic control via veno-venous bypass, and multidisciplinary approach with intensivists and transplant surgeons.

A 32-year-old female with history of cesarean section for eclampsia and post-partum hematoma requiring surgical evacuation, presented one week after incisional hernia repair with acute liver failure due to inadvertent acetaminophen overdose from post-operative pain. Head CT showed generalized cerebral edema. Intensivists placed her on n-acetylcysteine and keppra and continuous EEG. She arrived to the operating room intubated, on propofol infusion, with arterial line and hemodialysis catheter in situ. In discussion with intensivists, we continued 3% saline with goal sodium of 140-150 and titrated PaCO2 to 30-40.

To minimize further elevation of intracranial hypertension, we avoided volatile agents and maintained anesthesia with propofol and remifentanil infusions, using BIS to monitor anesthetic depth. We exchanged the right internal jugular hemodialysis catheter over a wire for a multi-lumen access catheter, forgoing instrumentation of contralateral neck veins to avoid compromise to cerebral venous drainage, while surgeons placed a femoral dialysis catheter. We elevated the head of bed 30 degrees, maintained neuromuscular relaxation and titrated insulin for normoglycemia. Arterial blood gasses were obtained approximately every 30 minutes. Intraoperative dialysis was initiated for electrolyte regulation and ammonia removal. In discussion with surgeons, our patient was placed on veno-venous bypass to maintain mean arterial pressure. With this approach, only intermittent phenylephrine boluses were necessary for hemodynamic stability. She tolerated caval cross-clamp and had no reperfusion syndrome. She was extubated post-operative day two and discharged 19 days later without neurologic sequelae. Intensive intracranial pressure management while managing expected fluid and electrolyte shifts, blood loss and hemodynamic change during liver transplantation led to a good outcome.
Left Frontal Craniotomy for Tumor Resection and Awake Speech Mapping with use of LMA in Farsi Speaking Patient

Presenter: Kunal Desai, MD, Resident  
University of Southern California  

Authors: Kunal Desai, MD  
Eugenia Ayrian, MD (Faculty Mentor)  

62 y/o Farsi speaking M w/PMH significant for CAD s/p CABGx3, severe MR s/p MVR, HTN, and Dyslipidemia brought to OSH after family witnessed tonic clonic seizure activity. The pt received phenytoin and CT head showed a heterogeneous 3.3 x 2.7 cm Left frontal mass. Pt was transferred to USC for further neurosurgical management. After assessment by the Neurosurgical team the pt was scheduled for Left Frontal Craniotomy for Tumor Resection and Awake Speech Mapping. Thorough preoperative evaluation was completed. Pt was transferred to the OR with a Farsi speaking nurse that would be present for the entire case. Prior to induction, B/L supraorbital, auriculotemporal, and occipital nerve blocks were performed w/Ropivacaine 0.5%. Induction w/ Lidocaine 80 mg and Propofol 120 mg. LMA#5 placed and seated well. Left Radial A-line and two 18G peripheral IVs for access. Anesthetic maintenance w/Propofol gtt 75 mcg/kg/min and Remifentanil gtt 0.2 mcg/kg/min w/PC ventilation. Thirty minutes after incision the Neurosurgeons asked the Anesthesia team to wake the pt for speech mapping. Seven minutes after stopping the Propofol and Remifentanil the pt emerged comfortably and with the assistance of the Farsi nurse and Farsi visual aids we were able to successfully assess the pt’s speech areas. Once the evaluation was complete the pt was induced again with 100 mg Propofol and LMA#5 placed with no complications and maintenance with TIVA. The Neurosurgeons were able to complete the remaining portion of the procedure and the pt emerged from anesthesia with motor, sensory and speech capabilities at baseline.
Awake Brain Tumor Resection During Pregnancy: a Case Report

Presenter: Anne Newcomer, MD, Resident
University of California, San Francisco

Authors: Anne Newcomer, MD
Julee Dalton, MD
Lingzhong Meng, MD (Faculty Mentor)
Mark Rollins, MD
Adrian Gelb, MD

Abstract:
Primary brain tumor in the pregnant patient presents a unique challenge to anesthetic management. In this case, we describe the management of a pregnant woman with a rapidly growing malignant lesion causing life-threatening mass effect, necessitating urgent tumor debulking.

Case Description:
A 31 year old female at 30 weeks’ gestation with di-di twins presented for awake craniotomy to resect a 7 x 6 x 5cm left frontoparietal brain tumor with 7mm left-to-right subfalcine herniation. Her symptoms on presentation included headache, word finding difficulties, dysfluency, right upper extremity plegia, and right lower extremity paresis. She had twice undergone tumor debulking under general anesthesia during the same pregnancy at another facility at 16 and 28 weeks’ gestation, respectively. Pathology at that time showed anaplastic astrocytoma. With much multidisciplinary foresight, the patient underwent awake craniotomy with remifentanil and propofol infusions, with an epidural catheter placed preoperatively. Pathology on POD 1 showed grade IV glioblastoma, and the patient underwent urgent cesarean section under spinal anesthesia on POD 4, delivering two viable infants both with APGARS 8/9.

Discussion:
The choice between awake craniotomy versus general anesthesia in the gravid patient undergoing craniotomy becomes complicated if the tumor is encroaching on the eloquent brain because considerations pertinent to both patient’s safety and oncological outcome, in addition to fetal wellbeing, are involved. In this case, we describe one approach to awake craniotomy in a patient at 30 weeks’ gestation with twins. We feel that key factors for success in this case were a well-informed and motivated patient, as well as a multidisciplinary, collaborative effort.

Selected references:

AMBULATORY SURGERY IN ADVANCED SECONDARY PROGRESSIVE MS: SPECIAL CONSIDERATIONS

Presenter: Angela Asemota, MD, Resident
Mayo Clinic

Authors: Angela Asemota, MD (Faculty Mentor)
Brantley Gaitan, MD (Faculty Mentor)
John Demenkoff, MD
Lopa Misra, MD/DO
Molly Kraus, MD

Introduction

There are several anesthetic considerations to minimize morbidity and mortality in patients with advanced Multiple Sclerosis (MS). These include temperature regulation, aspiration precautions, altered responses to neuromuscular blocking agents, and avoidance of pharmaceuticals and anesthetic practices that may negatively impact pre-existing pulmonary impairment or exacerbate the disease process.

Case Report

A 60-year-old, 51 kg female with advanced secondary progressive MS presented for cystolithopaxy. She was incapacitated and wheelchair bound. Respiratory accessory muscles were required for normal breathing but maintained oxygen saturation 99% on room air. Though she cannot effectively cough and auscultation revealed diminished breath sounds, her lungs were clear. Preoperative arterial blood gas demonstrated a pH of 7.42 with a pCO2 of 42.9 and pO2 of 82.8 on room air. Intraoperatively, she was in reverse Trendelenburg during preoxygenation and induction of general anesthesia. The surgery was performed in lithotomy and Trendelenburg position. She was maintained on sevoflurane and remifentanil infusion. At completion of the surgery, she was returned to slight reverse Trendelenburg and extubated. She was discharged from the PACU to home.

Discussion

Our patient with advanced MS for an elective, outpatient procedure presented a challenge due to her considerations of diminished pulmonary capacity, risk of aspiration, effective paralysis of multiple muscle groups, and surgical necessity for positioning in Trendelenburg-lithotomy position. Due to her diminished respiratory reserve, she is highly unlikely to maintain adequate spontaneous ventilation in Trendelenburg. The patient was at increased risk of aspiration due to her dysphagia, inability to clear secretions, and history of aspiration pneumonitis. This risk was minimized by keeping her head elevated during induction and emergence, cricoid pressure, NPO status, as well as medications to facilitate gastric emptying and decrease stomach acidity. Common risk factors for re-intubation such as benzodiazepines, neuromuscular blocking agents and long acting opioids were avoided.
**Objective:** The goals of the present investigation was to determine if patients with chronic migraine (CM) form circulating carboxyhemefibrinogen (COHF) and iron-bound fibrinogen (IFIB) and to exhibit plasmatic hypercoagulability.

**Methods:** Patients with CM (n=26) were recruited after informed, written consent. Whole blood was collected via venipuncture, anticoagulated with sodium citrate, and then centrifuged with plasma decanted and stored at -80ºC until analysis. COHF formation, IFIB formation and plasma coagulation kinetics were determined via a thrombelastographic methods. Incidence (95% confidence intervals) of the various parameters derived from normal control plasma were determined using the Clopper-Pearson method.

**Results:** CM patients had an 88.5% (69.8%-97.6%) incidence of formation of COHF, IFIB, or both. With regard to coagulation, 42.3% (23.4%-63.1%) had abnormally decreased time to clot initiation, 80.8% (60.6%-93.4%) had abnormally large velocity of clot formation, and 46.2% (26.6%-66.6%) had abnormally strong clot strength.

**Conclusions:** Most patients with CM form COHb, IFIB or both compounds. Further, many patients with CM had plasmatic hypercoagulability in terms of time to clot initiation, velocity of growth and final clot strength. The determination of COHb and IFIB as novel biomarkers in the setting of CM may serve to further characterize the potential role played by CO and iron in this important pain syndrome.
Intraoperative management of critically elevated ICP during OLT

Presenter: Rishi Parikh, MD, Resident
University of California, San Diego

Authors: Rishi Parikh, MD
Ruth Waterman, MD (Faculty Mentor)

Intracranial hypertension and cerebral edema are frequently encountered in fulminant liver failure. We report a case of rapidly progressive hepatic failure complicated by grade IV hepatic encephalopathy and impending cerebral herniation at the time of transplant. Our anesthetic management was specifically tailored to address ICP in order to preserve neurologic function.

A 44 year-old male with fulminant hepatic failure was taken for emergent OLT. Originally admitted with new-onset jaundice, he became encephalopathic on HD#3 and was listed for emergent OLT. An organ became available within 24 hours. During that time, he required mannitol boluses for clinical evidence of elevated ICP. Immediately prior to transplant he had disconjugate gaze, anisocoria and extensor posturing. Gaze and pupils normalized after administration of midazolam and fentanyl. The patient was taken for transplant. To maximize cerebral venous drainage, we maintained the patient in reverse trendelenberg and avoided neck veins for line placement. A femoral cordis and bilateral antecubital RICs were placed for venous access. Hemodynamic monitoring was with TEE and radial and femoral arterial lines. A balanced anesthetic with narcotic, volatile agent, and propofol gtt was titrated to burst-suppression on a SedLine monitor. Mannitol 1g/kg and fosphenytoin 20mg/kg were administered at the start of the case and 3% NaCl was infused to maintain Na ~150. We also maintained mild hypothermia and hyperventilation. OLT proceeded with a side-biting vascular clamp to preserve IVC patency. The patient was discharged on POD 21 without neurologic injury.

ICP management in fulminant hepatic failure is crucial in the perioperative care of OLT recipients. Our institution does not routinely place invasive ICP monitoring devices in end-stage hepatic failure. However, since the pre-operative clinical exam suggested critically elevated ICP, we tailored our anesthetic to optimize ICP and cerebral oxygen supply-demand. Thus, we prevented irreversible neurologic injury in the immediate perioperative period.
Anesthetic Management Of Craniectomy in Patient with Eisenmenger Syndrome

Presenter: Xiaoli Sun, MD, Fellow
University of Washington

Introduction: Eisenmenger syndrome is characterized by elevated pulmonary vascular resistance and R to L shunting of blood through systemic to pulmonary circulation connection. Noncardiac surgery in patient with Eisenmenger syndrome is associated with increased cardiovascular complications. In this case, we describe an 28 year old female with uncorrected VSD/ASD c/b Eisenmenger Syndrome presenting to ED with R temporal abscess who successfully underwent emergent craniectomy with resection of temporal mass under general anesthesia.

Case description: 28 year old female with a medical history significant for VSD/ASD complicated by severe pulmonary HTN (123mmHg) and Eisenmenger Syndrome presented to ED with headache, nausea/vomiting and loss of consciousness after 2 week history of sinusitis for which she was treated with augmentin and steroid taper by her PCP. Her baseline SaO2 was 70-80% and used O2 at home. Other medical history include TIA/Stroke/left IJ thrombosis for which she was on lovenox. CT in the ED showed a large right temporal lesion with severe midline shift and brainstem compression. Then she was taken to the OR for emergent decompression. On arrival to the OR, big bore peripheral IV was placed, she was successfully intubated with etomidate (3-4mg/kg), fentanyl (2.5mcg/kg) and rocuronium (1mg/kg) after adequate preoxygenation. Milrinone and norepinephrine infusion was started shortly after induction to maintain systemic vascular resistance and decrease pulmonary vascular resistance. She was given100% O2 and careful attention was paid to ETCO2 to avoid hypoxia and hypercapnia. The anesthesia was maintained with isoflurane and remifentanyl infusion. The procedure took 3 hours and patient was hemodynamically stable during the whole procedure. She was transferred to neuro ICU on propofol sedation with stable hemodynamics.

Discussion: Noncardiac surgery in patients with Eisenmenger syndrome is associated with increased cardiovascular complications with mortality reaching 30%. The severity of cyanosis, RV function, tricuspid regurgitation, comorbidities as long as intraop hemodynamic stability and fluid shifts are associated with perioperative mortality. Since the patients are very vulnerable to alterations in hemodynamics with a minor fall in systolic pressure can increase R to L shunting and potentiate cardiovascular collapse, maintain intraop cardiac output and systemic vascular resistance, avoid increase in pulmonary vascular resistance, periodic blood gas analysis to assess acidosis, hypercarbia and hypoxia and careful selection of anesthetic agents are important to decrease the cardiovascular events.
INTRODUCTION

Ventricular assist devices (VADs) are electromechanical devices that are used to partially or completely replace the circulatory function of a failing heart. The HeartMate II device has been approved by the FDA for bridge-to-transplant therapy, and involves a rotor that drives continuous axial blood flow throughout the body. Because these devices result in blood flowing over a non-biologic surface, blood is prone to clotting and thus patients require anticoagulation. Warfarin is often used after implantation to keep patients anticoagulated with an international normalized ratio (INR) between 2 to 3. In this case report we present a patient with a history of antiphospholipid syndrome and nonischemic cardiomyopathy with a HeartMate II LVAD who suffered a spontaneous intracerebellar hemorrhage and the anesthetic considerations involved with his care.

CASE REPORT

Our patient is a 30 year old man with a history of antiphospholipid syndrome status post deep vein and internal jugular vein thrombosis who also has nonischemic cardiomyopathy and received a HeartMate II LVAD who presented to the emergency department complaining of a severe migraine headache. He was on chronic anticoagulation therapy with Warfarin with a presenting INR of 2.57. A CT scan of his head revealed a 3 cm x 2.5 cm right cerebellar parenchymal bleed. INR was reversed with FFP and vitamin K preoperatively prior to his right occipital craniotomy. Postoperatively he remained anticoagulated in the ICU for one week and was then started back on Warfarin.

DISCUSSION

Anesthetic considerations in patients with VADs are numerous, and patients undergoing emergent noncardiac procedures require special attention. Important consideration must be given to issues involving anticoagulation, reversal of anticoagulation, intracranial pressure, positioning, and anesthetic plan. Ultimately, clinicians need to individualize the intensity and timing of anticoagulation following LVAD implantation to ensure adequate thromboprophylaxis and simultaneously minimize bleeding.
Cranietomy for Resection of Ruptured Arteriovenous Malformation in a Pregnant Woman at 32 Weeks Gestation

Presenter: Kyle Sanders, MD, Resident
University of California, San Francisco

Authors:
Kyle Sanders, MD
Mark Rollins, MD (Faculty Mentor)
Oana Maties, MD (Faculty Mentor)

Introduction: Arteriovenous malformation (AVM) rupture during pregnancy is a rare but potentially devastating event, with literature suggesting a maternal mortality rate of 28%. Although pregnancy itself does not increase the risk of AVM rupture, the risk of bleeding appears greater during the second half of pregnancy and six weeks postpartum. The management of these complex patients introduces unique anesthetic considerations at the time of surgical intervention.

Case Description: A 28-year-old woman at 32 weeks gestation is transferred from an outside hospital after presenting with sudden-onset headache and fall. Multimodal imaging revealed acute intracerebral hemorrhage originating from a Grade 3 AVM in the left cerebellar hemisphere. The patient was transferred to UCSF Medical Center for definitive surgical management. Neurological assessment on admission was notable for dysmetria of the left upper extremity and dysarthric speech. Neuroangiography confirmed the presence of an AVM, however the lesion was not amenable to endovascular intervention. The patient was scheduled for suboccipital craniectomy and resection of her AVM.

Discussion: Two principal anesthetic considerations, maintaining cerebral and uteroplacental perfusion, guided much of the decision-making for various aspects of the anesthetic plan. Maternal positioning, choice of anesthetic agents, ICP management, perioperative monitoring and ventilatory strategy each deserved special consideration, as did the potential for emergent intraoperative delivery. Preparation for this case demanded interdisciplinary communication among specialists in Maternal-Fetal Medicine, Neurosurgery, Neuroanesthesia, Obstetric Anesthesia, and Neonatology. Fortunately, our patient had a successful outcome without surgical or anesthetic complications, and now awaits a term delivery of her healthy baby.

References:

Presenter: Colby Simmons, MD/DO, Resident
University of Colorado

Authors: Colby Simmons, MD/DO
Anthony Oliva, MD (Faculty Mentor)
Benjamin Scott, MD

Background:
Hemophilia C, or Factor XI deficiency, is a rare autosomal recessive bleeding disorder often diagnosed by inappropriate bleeding associated with trauma or surgery. We present a case involving the use of epsilon-Aminocaproic acid (EACA) for the prevention of bleeding during elective spine surgery. EACA has been shown to reduce the volume of blood loss during spine procedures by preventing fibrinolysis. Reports exist of successful use of antifibrinolyticc perioperatively, however, no studies provide evidence-based guidelines for prophylaxis.

Case Description:
A 71 year-old male with multiple medical problems including heterozygozity for Hemophilia C, presents for elective Anterior Cervical Discectomy and Fusion (ACDF) of the C6-C7 vertebrae secondary to cervical stenosis. Previous surgeries, including thyroidectomy, were undertaken without bleeding complications. Pre-operative consultation with Hematology was completed, and recommendations provided for large volume Fresh Frozen Plasma or EACA administration.

EACA infusion at 1g/hr was initiated prior to incision and continued until closure. At no time was bleeding excessive and estimated blood loss was 25cc. The procedure was completed successfully and the patient was discharged to home. On post-operative day two the patient developed bilateral lower extremity weakness and urinary retention. He presented to the Emergency Department where imaging was ordered. Results revealed: prevertebral soft tissue thickening, measuring 3 cm at C6. The mass was determined to be epidural hematoma and the patient was taken emergently for evacuation.

Discussion:
Though rare, understanding of pathophysiology and proper treatment protocols in the prevention of bleeding in hemophilia C patients is of utmost importance to prevent peri-operative morbidity and mortality. Patients undergoing procedures located in confined spaces are at particularly high risk.

Given a history of diminished blood loss with prior surgeries, heterozygozity of hemophilia C, and low functional capacity, EACA was chosen. Further investigation should be undertaken to generate best-practices for patients of similar medical backgrounds.
Total Intravenous Anesthesia in Stiff-Person Syndrome

Abstract Text: Introduction
Stiff-Person Syndrome (SPS) is a rare (1 in 1,000,000) and disabling neurological disease characterized by diffuse, sudden onset, severely painful muscle rigidity and spasms in central and limb muscles1. Triggers can be emotional, auditory, visual, or tactile. SPS patients have autoimmune anti-glutamic acid decarboxylase (GAD) antibodies causing loss of GAD enzyme essential for GABA synthesis. The loss of inhibitory GABA influence in multiple areas (cerebral cortex, striatum, basal ganglia) cause motor neuron system dysfunction and observed clinical rigidity2. Treatments attempt to increase GABA activity (diazepam), improve physical symptoms (intrathecal/oral baclofen), or decrease antibody production (steroids/immunosuppressant)3. Described anesthetic complications include prolonged neuromuscular blockade with non-depolarizing muscle relaxants2 and hypotonia in patients using baclofen receiving volatiles4. Mechanism is thought to be interactions between the GABAergic effects of baclofen and volatiles. We present a successful TIVA case in a SPS patient undergoing laparoscopic cholecystectomy.

Case report
39-years-old female with SPS on oral baclofen and diazepam presented for robotic-assisted laparoscopic cholecystectomy. Past medical history is significant for central sleep apnea. After pretreatment (midazolam 2mg IV) and intubation (propofol 2.5mg/kg and remifentanil 3mcg/kg), surgical anesthesia was maintained with continuous infusions of propofol(200 mcg/kg/min), remifentanil(0.1 mcg/kg/min) and dexmedetomidine(0.007 mcg/kg/min) along with ketamine loading dose(0.5mg/kg). The patient maintained spontaneous ventilation with tidal volumes of 6.5mL/kg throughout procedure and 10mL/kg at the end of case. She remained mildly somnolent and was taken to PACU on tee-piece as a precautionary measure. She became more alert and responsive within 30 minutes and was extubated uneventfully and discharged home the same day.

Discussion
Anesthetic strategies for SPS patient:
- Avoid muscle relaxants
- Avoid volatiles in patients receiving baclofen
- Regional anesthesia if possible. Successful described cases included CSE for TKA5 and paravertebral block for inguinal hernia repair6.
- TIVA if GA required. Successful described cases include an ENT operation7 and our case above.
Continuous monitoring of cerebral hemodynamics during carotid corrective procedures offers real-time assessment of brain perfusion, and thus permits steps such as balloon down, shunting, and blood pressure augmentation to be taken to reverse acute cerebral ischemia. Cerebral tissue oxygen saturation (SctO2) measured using near-infrared spectroscopy assesses the balance of cerebral tissue oxygen consumption and supply continuously and noninvasively. We present an acute watershed ischemic stroke case in which SctO2 was monitored intra-procedurally at four different locations, bilateral frontal and bilateral parietal regions, in a patient who underwent stenting of the left distal cervical internal carotid artery (ICA).

A 79-year old man presented after a sudden fall. He had a previous left cerebral peduncle stroke with residual mild right-sided weakness. Brain MRI showed acute infarction predominately involving the left MCA watershed territory. He underwent left ICA stenting under general anesthesia. The baseline left frontal and parietal SctO2 were 75% and 69%, respectively, which increased to 84% and 76% after induction. The baseline right frontal and parietal SctO2 were 77% and 69%, respectively, which increased to 87% and 77% after induction. With balloon inflation, the SctO2 in the left frontal and parietal regions decreased from 80% to 69% and from 74% to 68%, respectively. In contrast, the SctO2 monitored at the right frontal and parietal regions remained at 86% and 76%, respectively. Following balloon deflation, the SctO2 monitored at the left frontal and parietal regions increased to levels greater than before balloon inflation.

SctO2 monitoring tracked the acute cerebral ischemia due to balloon occlusion and the acute cerebral hyperperfusion following the correction of carotid stenosis. In any case that revolves around the manipulation of the carotid artery such as endarterectomy and stenting, SctO2 monitoring appears to provide information regarding cerebral perfusion and oxygenation and thus has the potential to guide clinical care.
Fig. 1. Circle of Willis with multiple atherosclerotic occlusive diseases (dark red blocks) based on digital subtraction angiography. The left posterior communicating artery (PCoA) was not patent due to either congenital abnormality or complete occlusive disease. The flow in anterior communicating artery (ACoA) was preferentially from the left anterior circulation due to a dominant left A1 segment of anterior cerebral artery (ACA). Therefore, the left ACA and middle cerebral artery (MCA) territories relied on left internal carotid artery (ICA) flow. There was no circle of Willis collateral flow for the left hemisphere. In contrast, the right hemisphere had collateral flow from both ACoA and PCoA. On the left side, there were 85% left distal cervical ICA focal stenosis, 50% left petrous ICA focal stenosis, moderate stenosis at the origin of the superior division left M2 MCA, and mild focal stenosis of the distal left M1 segment and paraclinoid left ICA. On the right side, there were severe 70% right petrous ICA focal stenosis and moderate focal stenosis of the supraclinoid right ICA. The red arrows and lines indicate the flow direction. The red cross indicates the absence of flow. PCA = posterior cerebral artery; BA = basal artery; VA = vertebral artery.
Adding Insult to Injury: TBI associated coagulopathy

Presenter: Marisa Hernandez-Morgan, MD, Resident
University of California, San Francisco

Authors: Marisa Hernandez-Morgan, MD
Melissa Haehn, MD (Faculty Mentor)

Introduction:

Coagulopathy after traumatic brain injury (TBI) is a known phenomenon with an estimated incidence of approximately 33%. Despite its frequency, the pathogenesis remains poorly understood, as hypo- and hypercoagulable states have been described. The most commonly accepted hypothesis involves several processes, including the release of tissue factor (TF) from brain parenchyma into the systemic circulation, leading to widespread activation of the coagulation cascade. TBI-associated coagulopathy can lead to the progression of intracranial hemorrhage, and is associated with increased morbidity and mortality. Early recognition and appropriate intervention is crucial. Though not widely available, further research may support a role for recombinant factor VIIa and/or thromboelastography in the management of coagulation disorders after TBI.

Case Description:

We present a case of a 73 year-old male who suffered a ground-level fall with a brief period of loss of consciousness. Imaging revealed an epidural hematoma with midline shift and the patient was taken urgently to the operating room for hematoma evacuation. Preoperative laboratory studies were unremarkable including normal coagulation studies. The hematoma evacuation was uneventful with an estimated blood loss of 700 mL and transfusion of two units of packed red blood cells. Postoperative laboratory studies revealed an unexpected coagulopathy, including an INR of 2.1, fibrinogen of 71, and D-dimer >14,000. Repeat imaging demonstrated continued progression of the epidural hematoma in addition to blossoming intraparenchymal contusions. The patient was again taken emergently to the operating room for hematoma evacuation and decompression. The intraoperative course was significant for profound blood loss requiring extensive transfusion of blood products. In consultation with the hematologist, the decision was made to administer recombinant factor VII. Postoperative laboratory studies were monitored closely with resolution of the coagulopathy on postoperative day one. Recombinant factor VII can be considered in the management of severe coagulopathy following TBI.
**Acute intraparenchymal hemorrhage and cerebral herniation immediately following cranioplasty**

Presenter: Barrett Larson, MD, Resident
Stanford University

Authors: Christopher Miller, MD
Barrett Larson, MD
John Brock-Utne, MD (Faculty Mentor)

Our patient, a 33 year-old otherwise healthy male, presented to us approximately six months after being hit by a car while riding his bike. The accident caused a large right epidural hematoma and a left subdural hematoma, both of which were emergently evacuated and a left sided craniectomy was also performed. The traumatic brain injury left him in a persistent vegetative state, without the ability to track or follow commands and minimally responsive to noxious stimulation.

The patient came to us for a left sided cranioplasty with replacement of his original bone flap. He was taken to the operating room, where he was connected to the ventilator via his indwelling tracheostomy. Anesthesia was induced using sevoflurane and analgesia provided with fentanyl. The surgery was uncomplicated and his anesthetic was uneventful, without any vital sign instability.

The patient arrived to the PACU with a BP of 114/63, HR of 76 (NSR), RR of 10 and temperature of 36.8 C. Within 10 minutes of arriving to the PACU, the patient began to develop an irregular respiratory pattern with subsequent bradycardia to the low 40s, though he remained normotensive. On examination, the patient’s pupils were found to be 5mm bilaterally and non-reactive. An emergent CT scan of his head demonstrated an acute, large intraparenchymal hemorrhage centered within the left parietal lobe with significant mass effect, a 20 mm left-to-right midline shift, left uncal herniation, and downward transtentorial herniation. After discussions with his family, he was made comfort care and passed away 16 hours later.

There is a paucity of literature regarding the neurologic complication rate following cranioplasty. This case report highlights the importance of exceptionally close post-operative monitoring following cranioplasty. A high index of suspicion is warranted and immediate imaging should be obtained if signs and symptoms of increasing intracranial pressure are observed.
Effects of Dexmedetomidine and Ketamine on Hemodynamics and Emergence from Propofol-Remifentanil Total Intravenous Anesthesia for Elective Craniotomy

Presenter: Jeffrey Fujii, MD, Fellow
University of Washington

Authors: Jeffrey Fujii, MD
David Wright, MD
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Deepak Sharma, MD (Faculty Mentor)

Background: Total Intravenous Anesthesia (TIVA) with Propofol and Remifentanil is commonly used for craniotomy, often with the addition of adjuvants such as Dexmedetomidine. However, there are no data examining the effects of Dexmedetomidine or Ketamine on perioperative hemodynamics, and emergence from Propofol-Remifentanil TIVA for elective craniotomy.

Aims: The aim of this retrospective study is to compare three TIVA regimens for elective craniotomy – (1) Propofol plus Remifentanil, (2) Propofol plus Remifentanil plus Dexmedetomidine, and (3) Propofol plus Remifentanil plus Ketamine with respect to perioperative hemodynamic stability, vasopressor use, time to emergence and quality of emergence. We hypothesize that the addition of Dexmedetomidine or Ketamine to Propofol-Remifentanil anesthesia will be associated with greater hemodynamic stability, reduced use of vasoactive medications, and quicker and smooth emergence from anesthesia. We will also examine postoperative complications including pain, postoperative nausea and vomiting as well as duration of stay in post anesthesia care unit (PACU).

Methods: Following IRB approval, we will retrospectively analyze the electronic medical and anesthesia records of patients > 18 years of age who underwent elective craniotomy at Harborview Medical Center during the last 3 years. The primary outcomes will be systolic blood pressure and heart rate, intraoperatively, during emergence, and in PACU. Additional endpoints will be total infusion dose of vasopressors, number of treatments for hypertension, incidence of PONV, initial pain score in PACU, and length of stay in PACU. Appropriate statistical analyses will be performed.
Intraoperative hypotension commonly occurs, is usually multifactorial, and is typically responsive to vasopressors. One potential cause of intraoperative hypotension is anaphylaxis or anaphylactoid reactions. Reported incidence is 1:1,250-10,000, of which approximately 50-60% are true allergic anaphylaxis. Potential triggers are preservatives found in commonly used medications. Few anesthesia providers are aware of all medication ingredients. Additionally, day-of-surgery patient histories can be rushed and careful discussion with the patient may be better suited for preoperative anesthesia clinic.

SH is a well-appearing 59 year-old female with a non-secreting pituitary macroadenoma presenting for a transsphenoidal resection. On day-of-surgery she brought a list of 15 medications and preservatives causing anaphylaxis. Additionally, she reports anaphylaxis during anesthesia for hysterectomy. After discussion between the patient, anesthesiology, pharmacy, and surgery, a preservative-free general anesthetic was planned. After smooth arterial line placement and induction, the patient developed hypotension without tachycardia that was refractory to fluids, vasopressin, and epinephrine. No other signs of anaphylaxis or triggering agents were identified. To try to decrease peripheral vasodilation and increase MAP we switched to a preservative-free TIVA, but this was not successful. The decision was ultimately made to cancel surgery. The patient had a prolonged emergence but was at baseline neurologic function at time of extubation. Upon discussion with the patient’s husband, it came to light that the patient’s health problems began after a single large-dose pesticide exposure several years earlier.

Communication between the perioperative teams is important. Additionally, the anesthesiology pre-op clinic has an important role in working up patient health concerns, such as allergies, prior to day-of-surgery. Ultimately we did not think this was a case of anaphylaxis or simple sensitivity to medications. After discussion with the patient’s husband and additional literature review, there could be effects of organophosphate poisoning on the autonomic system and further work-up should be performed.
Predictors of Good Outcome in Patients Undergoing Endovascular Treatment of Acute Ischemic Stroke under General Anesthesia

Introduction:
General anesthesia (GA) has been shown to be associated with poor outcomes in patients undergoing endovascular treatment of acute ischemic stroke (AIS). It is unclear however, which anesthetic factors impact outcomes. The aim of this retrospective study was to identify the factors associated with good outcomes in patients receiving GA for endovascular treatment of AIS.

Methods:
Following IRB approval, patients > 18 years of age who underwent endovascular treatment of AIS under GA at Harborview Medical Center, a Comprehensive Stroke Center, from 2009-2013 were included. Primary outcome measure was the modified Rankin Score (mRS) at discharge. Good outcome was defined as mRS 0-2 and poor outcome as mRS 3-6 and logistic regression analysis was performed to examine the association between the clinical characteristics and the outcomes.

Results:
88 patients (56 males), aged 63±15 years were included. Anterior cerebral circulation was affected in 72 (82%), and the median pre-procedural National Institute of Health Stroke Scale (NIHSS) score was 16 (range 4-38). Overall, 19(22%) patients had good outcome. The patients with good outcome had lower pre-procedure NIHSS score, higher average end-tidal CO2 and highest end-tidal CO2 under GA compared to the patients with poor outcome. Fewer patients with good outcome were intubated prior to start of anesthesia while more patients with good outcome were extubated at the end of procedure and were on beta-blockers prior to the stroke. Independent predictors for the good outcomes were highest ETCO2, average ETCO2, duration and percentage of anesthetic time with ETCO2 > 40mmHg, extubation at the end of the endovascular treatment and beta-blocker use prior to stroke.

Conclusion:
In patients undergoing endovascular treatment of AIS under GA, management of CO2 and extubation at the end of procedure in patients meeting extubation criteria may impact patient outcomes. These findings need confirmation in larger studies.
Use of Isoflurane as a bridge to definitive treatment of refractory status epilepticus with electroconvulsive therapy.

Presenter: Wendy Smith, MD, Resident
University of California, San Francisco

Authors: Wendy Smith, MD
Lee-lynn Chen, MD (Faculty Mentor)

Both inhalational anesthesia and electroconvulsive therapy (ECT) have been described as treatments for refractory status epilepticus (RSE). 1, 2 We present a case in which inhalational anesthesia with Isoflurane was successfully used as bridge therapy to facilitate the use of ECT for RSE. Our patient, a previously healthy 27-year-old man, was transferred from an outside hospital with a 10-day history of escalating seizures despite treatment with multiple anti-epileptic drugs (AED). Upon arrival, continuous EEG demonstrated RSE requiring the initiation of burst suppression using a Propofol infusion. Despite multiple adjustments to his AED regimen, he required escalating doses of Propofol and the addition of Versed to prevent epileptiform discharges; elevated triglycerides prompted a switch to pentobarbital. ECT was deemed necessary as rescue therapy. The first attempt was unsuccessful because of the high doses of pentobarbital required for burst suppression. We initiated inhalational anesthesia for burst suppression, uptitrating Isoflurane for a total of 45 MAC hours; Pentobarbital was weaned off. Isoflurane’s quick offset allowed for successful ECT treatments without the danger of breakthrough native seizures. EEG improvement was seen after 4 cycles. By hospital day forty-two our patient was discharged home on a stable AED regimen. This case presented the opportunity for the novel combination of two previously described treatment modalities for RSE. While Isoflurane provides burst suppression, its administration in the ICU requires providers be continuously available to operate the anesthesia vaporizer. There are also concerns regarding the safety of long-term use of inhalational anesthesia.3 Though ECT has been an effective treatment for RSE, in this case, traditional burst suppression therapy prevented its implementation. By combining these two modalities we were able to effectively manage and treat this patient’s RSE.

Ketamine as an Alternative to Volatile Anesthetic for Treatment of Refractory Status Epilepticus

Presenter: Erica Holland, MD, Resident
Virginia Mason

Authors: Erica Holland, MD
Robert Hsiung, MD (Faculty Mentor)
Joseph Neal, MD

Introduction:

Our anesthesiology service (AS) was consulted to provide isoflurane general anesthesia for treatment of refractory status epilepticus (RSE). The infrequent use of volatile anesthetics in the critical care unit (CCU) presented the following challenges: 1) removal of waste gases, 2) AS-directed titration and refill of the volatile anesthetic, and 3) CCU staff education. We herein discuss our thought processes as we considered prolonged provision of general anesthesia in the CCU.

Case:

The patient was a 48-year-old male in status epilepticus refractory to propofol, midazolam, phenobarbital and pentobarbital infusions. As the AS was preparing to administer isoflurane, the patient developed EEG evidence of burst suppression on his infusion regimen. Unfortunately, the patient continued to have breakthrough seizures. This time, after considering the novelty and complexity of isoflurane administration in the CCU, the AS elected instead ketamine infusion to wean the patient from ineffective pentobarbital coma.

Discussion:

Because volatile anesthetics reliably induce burst suppression within minutes, they have been regarded historically as an advanced treatment option for RSE. However, recent reports also document ketamine’s effectiveness for seizure suppression. Ketamine became a reasonable alternative for our patient after we considered the logistics of setting up and managing a volatile agent in the CCU. For example, waste gas scavenging would have required a unique adapter to bypass the existing wall suction diameter index safety system (DISS) (Figure 1). Second, the AS would have been required to exclusively manage titrating isoflurane to burst suppression, and use the resultant flow rates to calculate anesthetic consumption to guide periodic vapor canister refills. Lastly, educational initiatives regarding volatile agents would have been imperative to ensure patient and staff safety. Ketamine ultimately offered an effective, but less logistically challenging alternative to isoflurane.

Figure 1: Adaptor for connection between waste anesthetic gas (WAG) purple hose and white suction hose DISS connection when only white hose hook up is available.
Seizure-Like (Myoclonic) Activity upon Emergence on Two Separate Occasions (Inhaled and TIVA) in a Young Female with Recent Post-Concussive Syndrome

Presenter: Katrina McGuire, MD, Resident
University of Arizona

Authors: Katrina McGuire, MD

Introduction:
Seizure-like (myoclonic) activity has been reported upon emergence from general anesthesia. The exact incidence is unknown due to the lack of EEG evidence. Many theories suggest the mechanism may lie in the excitation of a sensitized cortex.

Case:
An eighteen year-old female with a history of chronic eustachian tube dysfunction and hearing loss underwent two consecutive tympanoplasties.

Past history was significant for a minor closed head injury (motor vehicle collision) six months prior to the first anesthetic and fourteen months prior to the second. Post-accident the patient had concerning headaches and myoclonic activity. Workup was negative for seizures but indicative of post-concussive syndrome. Medical history was otherwise negative.

The first perioperative myoclonic episode occurred upon emergence from inhalation anesthetic (sevoflurane). After an initial lucid period she became progressively unresponsive with associated myoclonic activity. The symptoms subsided with midazolam, however did not completely resolve for thirty minutes. The second episode occurred upon emergence from a TIVA anesthetic (propofol and remifentanil). It was similar in nature and response to the first with duration of two hours.

Hospital admission and workup were negative for epileptiform seizures.

Discussion:
Perioperative myoclonic activity has been reported with the use of many anesthetic agents. It occurs more commonly in epileptic patients than in normal controls. The dichotomy between the anticonvulsant versus proconvulsant properties of anesthetic is likely rooted in the complexity of the central nervous system. It has been theorized that rapidly changing anesthetic concentrations may result in excitatory epileptiform electrocortical activity. Research also suggests that there may be a mass of neurons primed to respond to this excitement and thus enter into a seizure-like state. In this patient, with no prior history of seizures, it is hypothesized that her head injury resulted in the priming of this subset of neurons.
A TECHNIQUE TO ALLOW PRONE-POSITION SPINE SURGERY IN THE PATIENT WITH UNSTABLE SPINE FRACTURE AND FLAIL-SEGMENT RIB FRACTURES

Presenter: Matthew Pennington, MD, Resident
University of Washington

Authors: Arman Dagal, MD/DO (Faculty Mentor)
Richard Bransford, MD/DO

There is considerable interest in early fixation of unstable traumatic spine fractures due to reduced ventilator, ICU, and hospital times associated with this practice. The presence of flail-segment rib fractures and a loss of thoracic competence presents a particular challenge given the nature of chest bolsters commonly used in spine surgery. We present two patients with unstable thoracic spine fractures and coexisting flail-chest who initially experienced hemodynamic collapse upon prone positioning, resulting in aborted surgeries. Both underwent successful fixation using a novel positioning method in which we used the anterior portion of an oversized TLSO brace in conjunction with Jackson’s spinal frame to produce a wider, more anatomically shaped surface to support the chest and reduce intrusion into the thorax.

Patient #1 was a 72-year-old man with extensive crush injuries from a farming accident, with bilateral flail chest, T11 hyperextension injury, as well as other injuries. Initial echo showed severe apical hypokinesis, reduced LVEF, and moderate pulmonary hypertension. 2 attempts were made at PSIF of his unstable spine fracture, and in both cases he experienced a syndrome of difficult ventilation, reduced end tidal CO2, and hypotension requiring boluses of vasopressors, aborting surgery, and immediate return to supine position. He underwent successful anesthesia (and surgery) when we fit an oversized TLSO brace to him and used the anterior portion as the primary chest support while in prone position. Patient #2 was a 73 year old man with a similar pattern of injuries from a car v. bicycle collision who experienced one near-arrest on prone positioning for PSIF, and had his surgery aborted. We used a similarly fit brace and were able to anesthetize him successfully for PSIF at the height of critical illness – much earlier than if we had needed to wait for greater cardiorespiratory stability. Both patients left the hospital without neurologic injury, and had good functional outcomes.

Dexmedetomidine Withdrawal in the OR: Making the diagnosis under general anesthesia and how it impacts anesthetic management

Presenter: Michelle Han, MD, Resident
University of Southern California

Authors: Michelle Han, MD
Sarah Moore, MD
Mirjana Vustar, MD (Faculty Mentor)

Our patient is a 55 day old 4.3 kg infant, born at 33 weeks GA with meconium pseudocyst, peritonitis, and bowel perforation who underwent exploratory laparotomy with small bowel resection. In addition, the patient had respiratory failure requiring intubation and mechanical ventilation since birth. During the case, our patient had unexplained and persistent tachycardia (HR > 200) despite adequate volume resuscitation and pain control. We hypothesize that this observed tachycardia was related to acute withdrawal of dexmedetomidine being used for sedation in the NICU.

The sedation history in the NICU is as follows: 30 days on a combination of fentanyl and midazolam infusions, which were changed to dexmedetomidine (1.12mcg/kg/hr) and dilaudid (0.033mcg/kg/hr) for the next 22 days due to developing tolerance. On the day of surgery, per NICU policy, both infusions were acutely discontinued prior to transport to the OR.

Induction of general anesthesia with Sevoflurane, Rocuronium and Fentanyl (1mcg/kg) proceeded without incident, but 30 minutes later a sinus tachycardia developed (HR 200+) with the blood pressure remaining 80/40. The differential diagnoses for tachycardia considered were pain, awareness, and hypovolemia. The baby had been on chronic opioids since birth and was assumed to be tolerant, however despite a total of 33mcg/kg of fentanyl, accompanied by 0.375mg/kg of midazolam, the high heart rate persisted. Likewise, the tachycardia did not respond to aggressive volume resuscitation with crystalloid (30ccs/kg) and blood products (16ccs/kg RBCs and 12ccs/kg platelets) to replace an EBL of 75ccs (17ccs/kg). When all of these interventions failed to treat the tachycardia, we began to suspect the abrupt discontinuation of the dexmedetomidine infusion as the cause of the tachycardia. Since the procedure was complete, therapy with dexmedetomidine and dialudid infusions were re-instituted after transport to the NICU. The tachycardia resolved within two hours of resuming the infusions.
Propofol is an IV anesthetic known to cause the potentially fatal syndrome of metabolic acidosis, rhabdomyolysis, and renal or cardiovascular failure known as Propofol-Related Infusion Syndrome (PRIS). Although the exact mechanism is unclear, most theories include the mitochondria via alterations in fatty acid metabolism, cytochrome oxidation, complexes I/IV, Coenzyme Q, or uncoupling. Thus, patients with mitochondrial myopathy are at increased risk of PRIS, in addition to Malignant Hyperthermia (MH).

We present a 19 year-old female with history of mitochondrial myopathy (on levocarnitine and Coenzyme Q10), seizure disorder, and Neurofibromatosis Type II with a family history of MH scheduled for left vestibular schwannoma resection with neuromonitoring. While there are several recent case reports of successful total intravenous anesthetics (TIVA) for shorter operations, we present a novel case of prolonged TIVA in mitochondrial myopathy.

To avoid potential exposure to volatile agents, the CO2 absorbent and circuit were changed and vaporizers removed. We induced anesthesia with midazolam, fentanyl, propofol, and rocuronium. A propofol infusion was started and strictly limited to 100mcg/kg/min, in addition to a remifentanil infusion at 0.2-0.3mcg/kg/min. We maintained eutherma to avoid additional mitochondrial stress. The anesthesia plan included potential redosing of midazolam in case of inadequate anesthesia or hemodynamic instability, as well as ketamine as a second-line adjuvant (due to neuromonitoring). Repeated rocuronium doses were avoided due to unpredictable response in myopathy. We obtained approximately hourly ABGs throughout the case, which showed no worsening acidosis. She remained hemodynamically stable, her urine output averaged 3mL/kg/hour, and she was successfully extubated at the end of the case. She continued to be monitored in the ICU and never developed symptoms of PRIS.

In conclusion, although each patient with mitochondrial disease remains phenotypically independent, we present a case indicating that prolonged propofol infusion may be a safe alternative for select patients with mitochondrial myopathy.
Neonatal abstinence syndrome (NAS) can occur after delivery in newborns exposed to substances in-utero, most commonly opioids. Maternal use of gabapentin is increasing due to its use in pain management. Withdrawal may occur following in-utero gabapentin exposure, but symptoms and treatment are poorly understood. We report the case of a neonate who developed unique symptoms of NAS after in-utero exposure to gabapentin.

A 1.8-kilogram male infant was born to a 41-year-old female who reported taking gabapentin 800mg every eight hours for chronic pain throughout pregnancy. Within 12 hours after delivery the baby developed symptoms of NAS with hypertonicity, tremor, and poor feeding. Although the neonate was briefly exposed to alprazolam and oxycodone, the withdrawal symptoms were not characteristic of benzodiazepine or opioid withdrawal, such as hyperphagia, vomiting and loose stools. The baby remained symptomatic for 10 days, requiring gavage feedings with an orogastric tube. On day of life 11 the neonatal pain service was consulted and determined that the infant was clearly withdrawing from an intra-uterine exposure, but the withdrawal symptoms were atypical for opioids. A trial of gabapentin at a dose of 10 mg/kg/day divided every 12 hours was administered. Within 24 hours the infant’s tone normalized and tremors stopped. Finnegan abstinence scores fell to zero and within 72 hours the infant was taking all feeds orally. In addition, he developed some mild irritability and loose stools, which was thought possibly due to oxycodone exposure and was successfully treated with low dose clonidine. He was slowly weaned off gabapentin first and then clonidine over the next 3 weeks and was discharged home without any further problems and remained symptom free at follow-up. The combination of this neonate’s symptoms and the successful treatment with gabapentin argues that gabapentin was the most likely agent causing the baby’s NAS symptoms.
Anesthetic Management for Tracheoesophageal Fistula Repair in a Patient with Tetralogy of Fallot

Presenter: Clementine Vo, MD/DO, Resident
University of Arizona

Authors: Clementine Vo, MD/DO
Janelle Jambrosic, MD/DO (Faculty Mentor)

Introduction

Tracheoesophageal fistula (TEF) is an abnormal communication between the esophagus and trachea; it occurs 1 in 5000 live births1 and can lead to severe cardiopulmonary complications. TEF is commonly associated with VACTERL syndrome, which presents additional hemodynamic concerns when cyanotic cardiac anomalies exist.

Case

A 1 day-old male infant presented with Type C TE fistula, Tetralogy of Fallot (TOF), patent ductus arteriosus (PDA) and right-sided aortic arch (RAA). He was born with an O2 saturation of 75% on 30% FiO2. An orogastric catheter was unable to be placed, prompting a workup and diagnosis of TEF, which was immediately scheduled for repair.

He arrived with a 24g peripheral IV and was induced with sevoflurane and propofol while maintaining spontaneous respirations. Appropriate plane of anesthesia was maintained with fentanyl, midazolam and rocuronium. Rigid bronchoscopy revealed a large esophageal fistula above the carina. Intubation was uneventful, and endotracheal tube (ETT) tip placement was confirmed to be distal to the fistula.

In the post-induction period, the patient’s blood pressure dropped from 80/50 to 40/20, with SpO2 dropping to 70%. The ETT had migrated up 0.5cm and was likely ventilating the TEF. Despite ETT repositioning, confirming placement via auscultation, and providing supplemental hand-ventilation assistance on 80% FiO2, SpO2 only minimally increased. Right-to-left shunt flow from hypoxia and post-induction hypotension was suspected. Vasopressin 0.02 units IV was administered to increase systemic vascular resistance. Our goal was to shift his shunt from primarily a right-to-left systemic flow (Qs) to a left-to-right pulmonic flow (Qp) tract to prevent deoxygenated blood from being delivered systemically (Qp: Qs > 1). Blood pressure returned to baseline and oxygen saturation increased to 90%. After a difficult left thoracotomy approach but successful TEF repair, the patient’s SpO2 improved to mid 90’s on 50% FiO2. He was successfully extubated in the NICU on post-operative day 1.

Discussion

About 30% of patients with TEFs present with cardiac anomalies, ranging from right-sided aortic arches (4%) and TOF (5%) to atrial septal defects (20%)2,3. Management of TOF patients undergoing TEF repair should include an anesthetic approach focusing on hemodynamic stability, necessitating even greater micromanagement of ETT tip positioning and balancing pulmonary and systemic vascular resistance to avoid further shunting.

References


Effect of IV acetaminophen on pediatric tonsillectomy postoperative outcomes

Presenter: Theodora Wingert, MD, Resident
University of California, Los Angeles

Authors: Theodora Wingert, MD
Wendy Ren, MD (Faculty Mentor)

BACKGROUND: Tonsillectomy with or without adenoidectomy (T&A) is one of the most common pediatric surgeries, with consistently high postoperative pain scores and significant potential for prolonged recovery due to pain, respiratory complications, delirium, and nausea and vomiting. Intraoperative administration of IV acetaminophen therefore has several theoretic benefits.

METHODS: Records for patients ages 2-18 years undergoing T&A by a single surgeon at the UCLA Ambulatory Surgery Center between March 2013 and August 2014 were evaluated. Patients were administered intraoperative acetaminophen at the discretion of the anesthesiologist either IV, PR, or none. Outcome variables included: 1) recovery time, 2) presence of postoperative nausea and/or vomiting (PONV), 3) administration of opioid in recovery, 4) administration of supplemental oxygen in recovery, 5) lowest recorded oxygen saturation, 6) highest recorded pain score. Statistical analyses included covariate analyses of age and intraoperative opioid, as well as T-tests and Pearson’s chi-square.

RESULTS: Three-hundred and twenty-two patients were analyzed. Age- and weight-adjusted intraoperative opioid administration varied significantly between groups, however covariate analysis demonstrated age and intraoperative opioid were not associated with recovery time. Relative importance was placed on recovery time due to its summative reflection of all outcome variables. A non-significant 10-minute reduction in recovery time was seen with intraoperative IV acetaminophen use. A statistically significant 24-minute reduction in recovery time was associated with intraoperative PR acetaminophen, however sample size was small. Overall, patients who received intraoperative IV acetaminophen compared to those who received no intraoperative acetaminophen showed no statistically significant difference in recovery time, PONV, oxygen requirements in recovery, opioid requirements, or postoperative pain scores.

DISCUSSION: While IV acetaminophen has many theoretic benefits to postoperative outcomes, retrospective analysis of a relatively large, uniform group of pediatric surgical patients revealed improvements may be mild, if present at all.
Frequency and Outcomes of ICP Monitoring in Severe Pediatric TBI in the ED: Results of the Pediatric Guideline Adherence and Outcomes (PEGASUS) Study

Presenter: Stephanie Pan, MD, Resident
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Authors: Stephanie Pan, MD
Nithya Kannan, MD
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Monica Vavilala, MD (Faculty Mentor)

Background

The relationship between intracranial pressure (ICP) monitoring and outcomes in patients with severe traumatic brain injury (TBI) remains unclear. There are no data on the use of Emergency Department (ED) ICP monitoring in children with severe TBI. We aimed to examine the frequency and outcomes of ICP monitoring in the ED in children with severe TBI.

Methods

A retrospective multicenter cohort study encompassing five regional pediatric trauma centers affiliated with academic medical centers examined children under 18 years with severe TBI (admission Glasgow Coma Scale score ≤ 8, ICD-9 diagnosis codes of 800.0-801.9, 803.0-804.9, 850.0-854.1, 959.01, 950.1-950.3, 995.55, maximum head abbreviated Injury Severity Score ≥ 3) who received tracheal intubation for at least 48 hours in the ICU between 2007 and 2011. The main outcomes were in-hospital mortality and Discharge Glasgow Outcome Scale (GOS) score. A dichotomous measure of discharge GOS was used: “poor” (major impairment-vegetative state) versus “favorable” (baseline, minor-moderate impairment).

Results

Among the 224 patients admitted to the ED, 62 (28%) patients had ICP monitoring. Of those who had ICP monitoring in the ED, 50 (81%) had early ICP placement (within 4 hours of admission to ED). There was a trend towards lower in-hospital mortality with any ED ICP monitoring (aRR 0.56; 95% CI: 0.30, 1.05, p = 0.07). There was no significant difference in discharge GOS scores between patients who had any ED ICP monitoring as compared to those who did not (aRR 1.21; 95% CI: 0.85, 1.71).

Conclusions

The frequency of ED ICP placement and monitoring is low and yet, ICP monitoring initiated in the ED may be associated with lower in-hospital mortality in children with severe TBI.
An Uncommon Cause of Pulse Oximetry Malfunction in a Pediatric Neurosurgery Case

Presenter:  David Stoike, MD/DO, Resident
University of Arizona

Authors:  David Stoike, MD/DO
Wallace Nogami, MD  (Faculty Mentor)

Pulse oximetry is an ASA standard and is used in every modern anesthetic case. Pulse oximetry functions by combining the principles of oximetry and plethysmography to noninvasively measure oxygen saturation in arterial blood. This technology is based upon the observation that oxygenated and reduced hemoglobin differs in absorption of red and infrared light. The development of new technologies employing infrared science can potentially cause interference with established anesthetic monitors, such as pulse oximetry.

The patient was a 5 month old female who presented to the operating room for burr hole placement for evacuation of subdural empyema utilizing the Brainlab system. The patient had an extensive medical history from birth, which was most recently notable for late onset recurrent meningitis. Despite the current infection, the patient was hemodynamically stable in the PICU and during transport to the operating room. Once induced, intubated and positioned, the Brainlab system began to calibrate and malfunction of the pulse oximeter became apparent. The pulse oximeters signal would dampen, show desaturation and then fail. Despite multiple adjustments, placement of new probes and a separate Masimo pulse oximeter system being utilized, the same problem persisted. Only after the patient was draped and covered with blankets did the pulse oximeter function adequately.

Classic malfunctions of the pulse oximeters happen with inadequate perfusion to the probe, intrinsic issues with hemoglobin or extrinsic interference such as excessive ambient light, methylene blue dye and venous pulsations.

A less common cause malfunction has become apparent with the development of neuronavigation systems that utilize infrared light to operate. The operating wavelengths of systems such as Brainlab have a significant overlap with the infrared spectrum detected by pulse oximeters.

Fortunately, there are simple remedies to overcome the interference, and with a basic understanding of the equipment anxiety, delays, morbidity and mortality can be avoided.
Aggressive Myofibromatosis and Monosomy 12: A Case Report of Two Exceedingly Rare and Seemingly Unrelated Diagnoses in a 10-Month-Old Girl

Presenter: Ronald Tang, MD, Resident
University of Arizona

Authors: Thomas Quigley, MD (Faculty Mentor)
Ronald Tang, MD

We report a case of unusually aggressive myofibromatosis in an infantile patient with history of maternal substance abuse and deletion of chromosome 12. The patient presented for an MRI under general anesthesia to assess for possible cerebral and visceral spread of the disease. At time of encounter, the patient was ten months old and already endured amputations of seven digits involving all extremities due to uncontrolled tumor growth.

The patient presented with a small head, narrow skull, frontal bossing, small jaw, smooth philtrum, flat nasal bridge, and bilateral hearing loss. Echocardiogram revealed a mild ASD with neither valvular nor functional abnormalities. We believe these findings, including the myofibromatosis, were attributed to the deletion of chromosome 12. However, the symptoms of monosomy 12 are not well-defined. The patient’s manifestations could also be attributed to maternal substance abuse with symptoms of the Fetal Alcohol Syndrome (FAS) spectrum. Conversely, the history of maternal substance abuse could have directly caused monosomy 12.

The uncertainty of the completeness of the patient’s medical history was concerning to the anesthesiology team. The effects of congenital abnormalities such as monosomy 12 and FAS on general anesthesia are poorly understood, much less the combination of the two. These patients can have undiagnosed neuromuscular diseases, metabolic derangement, and physical qualities which may contribute to a difficult airway. With this in mind, we felt it was appropriate to continue with the MRI study under general anesthesia, although with increased vigilance, as the results would enable the medical team to further understand her disease process and guide treatment. The anesthetic performed with a laryngeal mask airway proved to be uneventful, and the MRI disclosed neither visceral nor cerebral involvement of the neoplasm. The patient continued her chemotherapy regimen and has not shown signs of recurrence.
Perioperative management of a pediatric patient with Hereditary Angioedema (HAE)

Presenter:  Kellie Arviso, MD/DO, Resident  
University of New Mexico

Authors:  Kellie Arviso, MD (Faculty Mentor)  
Codruta Soneru, MD  (Faculty Mentor)  
Amy Babb, MD

Hereditary Angioedema (HAE) is an autosomal dominant disorder resulting in a deficiency of C1 esterase inhibitor. C1 inhibitor protein is responsible for regulating the complement and coagulation systems and production of bradykinin. Patients with HAE have recurrent angioedema, resulting from excess bradykinin. These attacks are often precipitated by triggers like emotional stress, infection, and surgery and can be life-threatening. Proper management of patients with HAE is needed to decrease the likelihood of perioperative angioedema. We discuss the preoperative and perioperative management of a pediatric patient with Type III Hereditary Angioedema undergoing tonsillectomy.
Perioperative management for spinal surgery in a child with severe Marfan syndrome

Presenter: Ashkan Farzad, MD, Resident
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Authors: Ashkan Farzad, MD
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ABSTRACT: Marfan syndrome is an autosomal dominant, connective tissue disorder, which stems from a defect in fibrillin, an instrumental glycoprotein for elastin. This defect has pervasive pathological ramifications in the structure and function of the ocular lens, cardiac valves, aorta, lungs, and musculoskeletal system. The extent of disease and presentation of features can be variable. We present the case of a 12 year-old male with severe Marfan syndrome who underwent scoliosis correction surgery with posterior spinal fusion of T4-L4 and review his hospital course.

CASE DESCRIPTION: A 12 year-old male with Marfan syndrome and a history of severe kyphoscoliosis presents for posterior spinal fusion to halt progression. He has a history of pectus excavatum repair, valve-sparing Bentall surgery for aortic root aneurysm, VATS bleb resections, tracheostomy, gastrostomy, and severe pulmonary hypertension. His anesthetic management for the posterior spinal fusion consisted of placing standard ASA monitors, inhalation induction with sevoflurane and nitrous oxide in oxygen, exchanging his trach with a 5.0 cuffed ETT, placing an arterial line, a central line, and then carefully placing him in the prone position. He was breathing spontaneously while being maintained on less than a half MAC of sevoflurane, a propofol infusion, and intermittent boluses of fentanyl. At the conclusion, he was neurologically intact, he was transferred to the ICU and made a generally uneventful recovery.

DISCUSSION: Patients with Marfan syndrome can have a multitude of medical problems (1, 2). An approach that entails a thorough pre-operative medical assessment, coordination with an experienced anesthesiologist, and a detailed care plan will ensure optimal patient safety. Specifically, this care plan should address stringent blood pressure parameters, minimizing peaks in airway pressure, and positioning with proper padding and avoidance of joint hyperextension (2). Prior studies have demonstrated heightened surgical complication rates in Marfan patients, impacting the postoperative course (3).
Postoperative complications and opioid administration in children with and without developmental delay undergoing outpatient dental surgery

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Background: Developmental delay (DD) is a term used to identify children with delay as compared to their typically developing peers in meeting developmental milestones. Previous research has indicated that children with DD experience qualitative and quantitative differences in health care. Children with DD may be at greater risk for postoperative complications than their typically developing peers. Differences in the rates of administration and dosage of both intraoperative and postoperative opioids may explain this risk; however, empirical investigations are lacking.

Objective: The purpose of this research was to compare postoperative complication rates among children with DD and typically developing children, as well as to examine the role that intraoperative and postoperative opioids may play.

Method: Data was analyzed from a five-year period as obtained from the medical records of both DD and typically developing patients requiring extensive dental restoration procedures under general anesthesia.

Results: Postoperative complications including pain, nausea/vomiting and agitation were assessed. The rate of nausea/vomiting and agitation were found to be equivocal in children with DD and typically developing children. However, children with DD were significantly less likely to receive opioids for pain during the postoperative period ($X^2=8.08$, $p=0.003$). Further, while dosage of intraoperative opioids was predictive lower rates of administration of postoperative opioids among the typically developing group ($r=-0.070$, $p=0.02$), this association was not observed among the DD group ($r=0.009$, $p=0.892$).

Conclusion: Patients with DD experience similar rates of postoperative complications including nausea/vomiting and agitation as typically developing children. Children with DD are less likely to receive postoperative opioids, however this may not accurately reflect a decreased rate of postoperative pain. Additionally, neither the administration nor the dosage of intraoperative opioids appears to account for the observed difference in postoperative opioid delivery.
Case Study: Severe Hypothyroidism in a Pediatric Patient Presenting for Orthopedic Repair of Bilateral Slipped Capital Femoral Epiphyses

Presenter: Ariyah Yeskel, MD, Resident
University of Arizona

Authors: Ariyah Yeskel, MD
Peter Lichtenthal, MD (Faculty Mentor)

Background:
Hypothyroidism poses severe risks to patients undergoing anesthesia and surgery. Severely hypothyroid patients are at an increased risk of intraoperative cardiac instability and post op myxedema coma - a severe form of hypothyroidism manifested by stupor, coma, electrolyte abnormalities, coagulation dysfunction and cardiorespiratory instability.

Case Report:
An obese (89 kg) 11 year-old female presented to our institution with bilateral slipped capital femoral epiphysis (SCFE) and was scheduled for urgent bilateral SCFE repair. The perioperative team expressed concern for an underlying endocrine etiology given the patient’s young age, bilateral presentation and body habitus. A preoperative thyroid function test show a TSH of 453.5 and Free T4 level < 0.4. Surgery was delayed pending further workup of her hypothyroidism given the risks associated with surgery and anesthesia in hypothyroid patients. Following three weeks of outpatient treatment the patient’s thyroid panel normalized and she underwent bilateral hip pinning without complication.

Discussion:
This case warrants presentation because of the relative rarity of pediatric hypothyroidism, the severity of disease in this patient (TSH > 450) and the high potential for intra- and postoperative complications. In this case, the surgery was elective and we were able to cancel and reschedule after effective, outpatient thyroid replacement therapy. If emergency surgery is necessary, liothyronine (T3) therapy can be given at a dose of 25 to 50 micrograms repeated at intervals of 4-12 hours. Alternatively, if the surgery is urgent but can be delayed 24 to 48 hours IV thyroid replacement is possible and more efficacious. While intravenous levothyroxine takes several weeks to yield maximum metabolic effect, IV levothyroxine shows an initial response in 6-8 hours. This case highlights the importance of the early recognition of a hypothyroid state and an acute awareness of the anesthetic and surgical implications to prevent morbidity and mortality.
Unexpected development of an endotracheal tube leak and copious purulence in the oropharynx during resection of a neonatal neck mass

Presenter: Melissa Welker, MD, Resident University of New Mexico

Authors: Melissa Welker, MD
Ricardo Falcon, MD
Codruta Soneru, MD (Faculty Mentor)
Kelly Arviso, MD
Amy Babb, MD

Introduction:


Case Description:

We present the case of a full term newborn with a large left lateral cystic neck mass that was identified during the fifth month of gestation. Following an uneventful vaginal delivery the baby was transferred to the NICU for further evaluation. ENT evaluated the baby 12 hours after birth and elected not to proceed with acute surgical management because the baby was without signs of respiratory distress. On day four of life an MRI revealed a complex cystic mass with a small sinus tract communicating to the left pyriform sinus which was interpreted as either a lymphatic malformation or branchial cleft cyst. On day five the patient developed dramatic swelling of the mass associated with marked episodes of oxygen desaturation requiring intubation by ENT via rigid bronchoscopy. The patient remained intubated in the NICU until definitive operative management was undertaken on day 13 of life. The surgery started with direct micro laryngoscopy during which an attempt to cannulate the sinus tract was made, however this was unsuccessful. Later during the surgery after manipulation of the tumor copious purulent fluid was seen emanating from the patient’s mouth. At the same time a large air leak developed and the endotracheal tube was changed secondary to concerns over potential aspiration. The baby remained intubated and successfully extubated on postoperative day four.

Discussion:

Neonatal neck masses come in many forms, they can present with or without airway compromise. The location, physical exam characteristics, and imaging are helpful in establishing a differential diagnosis. This in turn can help make the decision between definitive operative management versus expectant medical management. In this case, the cervical neck mass was initially asymptomatic, however it progressed acutely to severe airway compromise on day five of life, requiring immediate intervention.

Conclusion:

Anesthetic management of neonatal neck masses can present with significant airway compromise requiring emergent intubation. Multidisciplinary planning for prenatal delivery, airway management and definitive treatment may reduce neonatal morbidity. In severe cases, planning may necessitate an EXIT procedure (ex utero intrapartum treatment). A multidisciplinary approach in planning is crucial to minimize the risk of neonatal morbidity and mortality.

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Sulaiman Sannoh: Cystic hygroma and potential airway obstruction in a newborn
Emergent Delivery of a Premature Infant in the setting of Maternal Type 1 von Willebrand’s Disease

Presenter: Brigid Maruszak, MD/DO, Resident
Naval Hospital

Authors: Brigid Maruszak, MD/DO (Faculty Mentor)
Nicole King, MD/DO (Faculty Mentor)
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Charles Volk, MD/DO

27 y/o G1 presented in pre-term labor at 26+0 with Type I Von Willebrand treated as an outpatient with intranasal DDAVP. Upon admission she received antenatal steroids and magnesium infusion for tocolysis and fetal neuroprotection. She remained stable with unchanged SVE for several days which allowed evaluation of factor VIII and VWF levels, performance of DDAVP stimulation and a thorough plan by Maternal Fetal Medicine, Obstetric Anesthesiology and Hematology Oncology in the event of urgent or emergent delivery. At 28+1, the patient required an emergent cesarean section under general anesthesia due to footling breach presentation. Due to low levels of VWF and unknown DDAVP challenge response, she was given Humate-P and DDAVP. The delivery was uncomplicated and EBL was 800 ml. The infant boy was placed on CPAP at 2 minutes of life and transferred to the NICU with Apgars of 5 and 7. The mother was discharged home within the normal time frame for cesarean delivery but the infant had a complicated stay in the NICU and passed away on day of life 12.

This case exemplifies the extensive literature regarding treatment of mothers and full term infants with VWD, but the paucity of data regarding the treatment of premature infants. Infants of Type I VWD mothers are assumed to have VWD but are usually devoid of symptoms at delivery and in infancy due to the stress of delivery raising VWF levels to near normal. The infant was evaluated by the NICU team, Pediatric Hematology Oncology and Genetics in an effort to establish an etiology for the patient’s multiple profound illnesses to include massive hemorrhage. In line with this literature, the conclusion of the teams was that this patient’s hemorrhage was not due to VWD but rather other co-morbidities associated with prematurity. Full genetic evaluation results are still pending.
Endothelial cells near the site of damage respond by synthesizing von Willebrand factor which is secreted in the form of large multimeric chains. Platelets express cell surface receptors, such as GPlb, that allow them to adhere to von Willebrand factor bound to subendothelial collagen fibrils.
Multi-tool approach for challenging intubation in an infant with Goldenhar syndrome

Presenter: Julee Dalton, MD, Resident
University of California, San Francisco

Authors: Julee Dalton, MD
Lawrence Long, MD
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Marla Ferschl, MD (Faculty Mentor)

A 3.2kg 5-week old female, ex-34 week gestation twin, with Goldenhar syndrome and symptoms of oral motor dysfunction and intermittent stridor, presented for laparoscopic gastric tube placement. She had a modified barium swallow study demonstrating laryngeal penetration and nasopharyngeal reflux. Hypoplastic left facies and severe retrognathia were noted on exam. Discussion with parents included risk for difficult intubation and post-procedural intubation. Given our concern for a difficult airway, the patient was kept breathing spontaneously for intubation and premedicated with 0.025mg glycopyrrolate to reduce secretions. Initial attempt with a pediatric GlideScope® demonstrated a swollen and anterior airway; despite visualization of the vocal cords, the endotracheal tube could not be passed secondary to the degree of anterior anatomy. Following multiple intubation attempts with several anesthesia providers, the patient was ultimately intubated with a 3.0 cuffed ETT by what we believe is a uncommon technique. A GlideScope® was used to maneuver oral pharyngeal tissue, and the ETT was loaded onto a 2.0mm fiberoptic scope. After failing to intubate the trachea utilizing the articulation lever, a third provider manually directed the fiber anteriorly using digital manipulation. Pulse oximetry saturation was maintained between 72-100% with stable hemodynamics during intubation. After fiberoptic confirmation, positive bilateral chest rise and lung sounds, and positive end-tidal tracing, the patient was paralyzed and given 0.4mg of dexamethasone for airway edema. Anesthesia was maintained with sevoflurane. The procedure proceeded without incident. Given the challenges of intubation, the patient was transported to neonatal intensive care unit intubated.

Discussion
This case report describes a successful intubation in a patient with Goldenhar syndrome utilizing multiple intubation tools including digital manipulation of fiberoptic scope. Our case also highlights the importance of preparation and availability of backup anesthesia providers in the setting of anticipated difficult airway of a pediatric patient.
Diaphragmatic hernia is usually encountered in the pediatric population and although management strategies are similar in the adult population there are several notable differences in management. This patient was a twenty-one year-old male with a history of Down's syndrome who initially presented with what was believed to be recurrent pneumonia and dyspnea but was found to have a large left-sided diaphragmatic hernia and was ultimately brought to the operating room for definitive management.
Anesthetic considerations in an obstetric patient with Brugada syndrome

Presenter: Sameer Khan, MD/DO, Resident
Harbor-UCLA Medical Center

Authors: Sameer Khan, MD/DO
Quy Tran, MD/DO (Faculty Mentor)
Biing-Jaw Chen, MD/DO (Faculty Mentor)
Wing-Fai Kwan, MD/DO (Faculty Mentor)

24F G1P0 at 39.4 weeks with unremarkable past medical history presents with labor. Upon further evaluation family history reveals sudden unexplained death in her father, uncle and grandfather. Laboratory work-up reveals ECG with ST elevation in the right precordial leads and RBBB. Cardiology consult confirms Brugada syndrome. Neuraxial and perioperative anesthetic considerations are discussed.
ECMO FOR CARDIAC RESCUE IN THE OPERATING ROOM AFTER POSTPARTUM SPONTANEOUS CORONARY ARTERY DISSECTION

Presenter: Kathleen Knapp, MD, Resident
Mayo Clinic

Authors: Kathleen Knapp, MD
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Ricardo Weis, MD (Faculty Mentor)

Introduction: Coronary artery dissection is an infrequent cause of acute coronary syndrome in the general population. There is however, a greater incidence of spontaneous coronary artery dissection in young women, especially in the peripartum period. The majority of cases have favorable outcomes with medical management or percutaneous coronary intervention however; coronary artery bypass grafting and transplantation are utilized in severe cases.

Case Report: This case is that of a 30 yo post-partum female with multivessel spontaneous coronary artery dissection requiring coronary artery bypass grafting with subsequent biventricular failure and inability to wean from bypass. She was transitioned to venoarterial extracorporeal membrane oxygenation to allow time for cardiac recovery. Successful separation from VA-ECMO was performed on post-operative day 4 was initiated at which time TEE revealed LV ejection fraction of 45-50% and normalizing right ventricular function. The patient underwent sternal closure on day two status post ECMO decannulation and was ultimately weaned off of inotropes/vasopressors as well as mechanical ventilation 7 days post ECMO removal. Further work up into the etiology of her coronary artery dissection failed to reveal any rheumatological component to her disease. The patient was discharged home on hospital day 19 after her cardiac function had almost completely normalized.

Discussion: At present, there are no apparent gold-standard guidelines for the management of post-partum spontaneous coronary artery dissection. There are a number of case reports and literature review articles which describe a wide variety of interventions. Our case report appears to be the first published use of venoarterial extra corporeal membrane oxygenation in a post-partum patient with spontaneous coronary artery dissection requiring emergent on pump coronary artery bypass grafting who was unable to be weaned from cardiopulmonary bypass.
Image 3. Left Main (LM) and Left Anterior Descending (LAD) coronary artery dissection flaps with Multiple LAD stents. Visualized during cardiac catheterization after CABG while on ECMO.
Handheld Ultrasound Guiding Postpartum Hemorrhage Resuscitation

Presenter: Michael Fujinaka, MD, Resident
University of California, San Diego

Authors: Michael Fujinaka, MD
David Elkin, BA/BS
Thomas Archer, MD (Faculty Mentor)

A 25 yo female delivered a healthy infant at 13:57. Soon after delivery, the patient became pale, confused, and then somnolent with BP 84/50, and HR 97.

When anesthesiologists arrived, resuscitation had not begun. Initial TTE images at 14:10 revealed “kissing papillary muscles,” suggesting an empty ventricle at end systole (LVESV = 0 mL) and severe hypovolemia. End diastolic diameter was 3.3 cm suggesting a LVEDV of 44 mL as estimated by the Teichholz method. Anesthesiologists resuscitated the patient and within 10 minutes, systolic BP was 120; at 14:33, the LVESV by TTE was 16 mL and LVEDV was 70 mL.

Despite vitals wnl, subsequent TTE at 14:59 again showed “kissing papillary muscles,” and a LVEDV of 54 mL. Based on these findings, a 3rd liter of LR was given.

Over the next several hours, 2 units of pRBCs and 2 units of FFP were transfused. TTE images throughout this time, for example as seen at 16:09, consistently showed a LVESV of 38 mL and a LVEDV of 92 mL. Vitals remained wnl.

That evening, the patient was taken to the operating room for suspected retained products of conception. Uterine curettage under monitored anesthesia care was performed. Post-operatively, 2 additional units of pRBCs and 2 additional units of FFP were transfused.

The following day, the patient was feeling well, ambulating, and eating. The HCT remained stable at 24. TTE showed a LVESV of 22 mL and LVEDV of 88 mL.

By showing the effect of fluids and blood products on cardiac filling in real time, TTE can give the team increased confidence in administering adequate resuscitation. A handheld TTE is not meant to replace a formal TTE study, but rather helps quickly evaluate volume status, contractility, and gross structural anatomy of the heart.
Peripartum cardiomyopathy and sequelae: A case study in management and outcomes around time of delivery

Presenter: Marcus Kuikka, MD, Resident
University of New Mexico

Authors: Marcus Kuikka, MD
Janet Brierley, MD (Faculty Mentor)

Peripartum cardiomyopathy (PPCM) is a rare, severe form of dilated cardiomyopathy, which may present numerous diagnostic, therapeutic, and anesthetic management challenges. In this case report, we present the management of a 26 year old G2P1, who was transferred from an outside facility, with signs and symptoms of PPCM. While managing her heart failure with diuretic therapy, the patient developed cardiac arrhythmias which hastened induction of labor with passive, second-stage, forceps delivery using epidural anesthesia. After an uneventful, post-delivery period, the patient was discharged only to be readmitted in cardiogenic shock following titration of her heart failure medications. In this case report, we also provide an overview of the diagnosis, anesthetic and therapeutic management, as well as the prognosis for PPCM.
Uterine Rupture Following Prior Successful Vaginal Birth After Caesarean

Presenter: Patrick Nguyen, MD, Resident  
University of California, San Diego

Authors: Patrick Nguyen, MD  
Lawrence Weinstein, MD (Faculty Mentor)

Background:
Trial of labor after Caesarean (TOLAC) is relatively safe for parturients with one prior low transverse Caesarean but debate still exists regarding risk of uterine rupture and its adverse outcomes for mother and neonate. Factors suggested to increase rate of uterine rupture include short interpregnancy interval, single-layer closure, and labor augmentation. We present the case of uterine rupture in a patient with prior successful vaginal birth after Caesarean (VBAC).

Case Description:
Patient was a 32-year-old G5P4 at 34w4d gestation with past history of two vaginal deliveries, Caesarean, and successful VBAC. All births occurred prematurely. She was admitted for preeclampsia workup but suddenly began contracting with associated late decelerations and fetal bradycardia 60-80s. Patient was pale, diaphoretic, and had severe abdominal pain unrelieved with repositioning prompting stat Caesarean under general anesthesia. Incision revealed hemoperitoneum (500mL) and vertically ruptured uterus with protruding placenta. Infant was taken to NICU without need for resuscitation with APGARS 2/4/8. An arterial line and second large-bore IV were inserted. Despite the trauma and bleeding, uterine tone was good and bleeding was controlled with surgical repair and oxytocin. General anesthesia was maintained with fentanyl, sevoflurane, nitrous oxide, and vecuronium. She received 1.5 L crystalloid and 1 unit PRBCs empirically given her paleness, large hemoperitoneum, and tachycardia. She was extubated and transferred to PACU without incident.

Discussion:
Uterine rupture is a clinical diagnosis and a high index of suspicion should be maintained. The most diagnostic FHR pattern is bradycardia although significant variable decelerations are also characteristic. Less frequent findings include abdominal pain, recession of the presenting vertex, and vaginal bleeding. With intraperitoneal bleeding, patients may also exhibit shoulder pain, anxiety, restlessness, dizziness, and shock. Anesthetic goals primarily involve adequate resuscitation. Epidural anesthesia, which should be considered early for TOLAC, may need to convert to general anesthesia during Caesarean.
Remifentanil PCA For Labor Analgesia in Multifocal Acquired Demyelinating Sensory and Motor Polyneuropathy (MADSAM)—a Case Report

Presenter:  Ann Cai Shah, MD, Resident
University of California, San Francisco

Authors:  Ann Cai Shah, MD
Mark Rollins, MD  (Faculty Mentor)

Appropriate management of labor analgesia for multifocal acquired demyelinating sensory and motor neuropathy (MADSAM), also known as Lewis-Sumner Syndrome, is largely undescribed. It is a rare disorder occurring in 1-9/million people. We describe the use of a remifentanil patient-controlled analgesia (PCA) for labor analgesia in a patient with MADSAM.

Case:
A 40 year-old G1P0 with MADSAM presented at 41 weeks gestational age for induction of labor.

MADSAM is an autoimmune demyelinating sensory and motor neuropathy. It typically presents in an asymmetrical multifocal pattern in the distribution of individual peripheral nerves with conduction block by electromyography studies. Our patient's symptoms were characterized by multiple self-resolving episodes of both paresthesias and motor weakness in all four extremities prior to pregnancy. With pregnancy, she experienced several weeks of paresthesia over her left lateral thigh which also self-resolved. Unlike prior symptoms, this was positional.

During labor she used a remifentanil PCA after inadequate pain relief with IV fentanyl. A setting of 25 mcg IV q2 minutes provided adequate pain control. The patient stopped utilizing the PCA during the second stage because she wanted to avoid over sedation. She had an uneventful vaginal delivery and would consider a remifentanil PCA with a future pregnancy.

Discussion:

Literature is scarce regarding management of labor analgesia in MADSAM patients. The only other case report also describes the successful use of remifentanil PCA. Given the unknown risks of neuraxial anesthesia for MADSAM, remifentanil was also chosen for our patient. The effects of pregnancy on MADSAM are unknown. The other case notes exacerbation of MADSAM with pregnancy, while our patient had only one episode of paresthesia that she felt was likely unrelated to her MADSAM.

References:

Intraoperative Fetal Monitoring: A Feasible Option for Non-Obstetric Laparoscopic Surgery

Presenter: Clair Secomb, MD, Resident
Stanford University

Authors: Kristen Telischak, MD (Faculty Mentor)
Pamela Flood, MD (Faculty Mentor)

Background

The parturient requiring abdominal surgery presents unique challenges to the anesthesiologist to monitor and protect both mother and fetus. Laparoscopic surgery, once thought of as contraindicated in pregnancy, has now become a routine treatment for the pregnant patient with appendicitis or cholecystitis. Laparoscopy introduces risks such as trauma from trochars, decreased placental perfusion from increased intra-abdominal pressure, and acidosis from absorption of CO2. Intra-operative fetal monitoring, when feasible, may be indicated to allow for alteration of anesthetic technique or delivery of a viable fetus in extremis. We present a case in which intraoperative fetal heart rate (FHR) monitoring was used successfully during laparoscopic appendectomy.

Case Report

An otherwise healthy 31-year-old woman, with a 33-week normal gestation, presented with a ruptured appendix requiring appendectomy. Fetal heart rate monitoring was initiated before induction in addition to standard ASA monitoring. After securing the airway with rapid sequence induction and video laryngoscopy, the patient was placed in left lateral decubitus position. FHR monitoring was continued throughout the procedure, including emergence and PACU care, with no FHR abnormalities. The surgeon noted excellent visualization of abdominal structures with normal insufflation pressures.

Discussion

Current ACOG guidelines regarding fetal monitoring during non-obstetric surgery recommend that at a minimum, the well being of a viable fetus should be ensured via monitoring before and after the procedure. Intra-operative monitoring may be considered, but it is not standard of care. Specifically in laparoscopic surgery, current literature expresses concerns regarding difficulty and low efficacy of intraoperative fetal monitoring. The lateral position of our patient placed the uterus in contact with the abdominal wall, allowing for transmission of FHR signals. It is important to note that if intraoperative monitoring is used for a viable fetus, a plan for emergency Caesarian section should be in place. Preparations include consent for C-section, an obstetric clinician present for monitoring, and an obstetrician immediately available to perform surgery if indicated. Our case provides an example of successful intraoperative FHR monitoring, facilitated by patient positioning and excellent communication between providers.
PIEB (programmed intermittent epidural bolus) versus CEI (continuous epidural infusion) for labor analgesia: results of a pilot set-up.

Presenter: Carlos Delgado, MD, Fellow
University of Washington

Authors: Carlos Delgado, MD (Faculty Mentor)
Laurent Bollag, MD (Faculty Mentor)
Christopher Ciliberto, MD (Faculty Mentor)
Margaret Sedensky, MD (Faculty Mentor)
Ruth Landau, MD (Faculty Mentor)

Background

Evidence that an epidural bolus provides a better spread of the injectate in the epidural space than a continuous infusion has emerged. Programmed intermittent epidural bolus (PIEB) results in reduced local analgesia dosing, motor block, instrumentation rates and physician-administered top-ups for breakthrough pain. In July 2014, each L&D room was equipped with a CADD®-Solis PIB Ambulatory Infusion System. We compared our continuous epidural infusion (CEI) protocol (10ml/h bupivacaine 0.0625%-fentanyl 2mcg/ml, 5ml PCEA bolus, 10min lock-out) with a PIEB setting using the exact same hourly & PCEA dose and lock-out time. The 1st PIEB was set to start 45min after initiation of analgesia with CSE, followed by 10ml PIEB q60min, 5ml PCEA bolus, 10min lock-out and a reset of the PIEB. We hypothesized that PIEB would result in less physician-administered top-ups compared with CEI & PCEA.

Methods

Data was collected from April to December 2014 allowing a ‘before & after’ comparison. Demographics, time to 1st physician-administered top-up, number of top-ups, and duration of 2nd stage, time to delivery and delivery modes were recorded.

Results

Data from 120 PIEB vs 120 CEI were analyzed. There was no difference in the above-mentioned variables between groups (p >0.05).

Conclusions

Contrary to our expectations, there was no difference in number or timing of top-up request between groups. This may be explained by the long interval between programmed boluses, and spinal dose and 1st PIEB dose; and the low volume of PCEA bolus. This pilot emphasizes the variations in programming that need to be further tested, such as shorter interval and larger PIEB & PCEA bolus. It also remains to be defined whether longer intervals offer other advantages such as better voiding or maternal temperature profiles.
Figure. Survival curves between groups for time from analgesia initiation (spinal dose of CSE) until 1st physician-administered top-up, representing the probability of not requesting a top-up; the crosshatches indicate time points when women delivered before requesting a top-up. There is also no difference between groups when adjusting for parity (p=0.74). There is no difference between groups in the top-up rates (per hour), unadjusted and adjusted for parity (p=0.30). The ratio between PIEB and CEI top-ups rates is 1.26 (95%CI: 0.86,1.85).

Means were compared by independent-samples t-tests, and proportions compared using the Pearson chi-square test. Times to 1st top-up were compared using survival analysis methods.
Introduction:

Horner’s syndrome is a rare complication of lumbar epidural analgesia, with an incidence of 0.4-2.5%. The majority of case reports attribute the occurrence to epidural boluses. We report the first case in the literature of transient Horner’s syndrome in a parturient receiving a novel programmed intermittent epidural bolus (PIEB) and patient controlled epidural analgesia (PCEA) protocol for labor analgesia.

Case Presentation:

A 24 year old parturient (G3P1) presented at 40 weeks gestation in spontaneous labor. A lumbar epidural catheter was placed at the L3/4 interspace using a 17-gauge Touhy needle. Loss of resistance to saline occurred at a depth of 4 cm, and 5 cm of catheter was inserted in the epidural space. Following a negative aspiration, 15 mL (5 mL every 5 minutes) of bupivacaine 0.125% and sufentanil 10 mcg was administered. A 9 mL every 45 minutes PIEB and a 12 mL every 15 minutes PCEA protocol of bupivacaine 0.0625% with sufentanil 0.4 mcg/mL was commenced. Approximately two hours later, the patient received two 5 mL bupivacaine 0.25% boluses for vaginal pain. Delivery occurred 40 minutes subsequent to this, after which she complained of a “droopy” right eye. On examination, she exhibited right eye ptosis and mild miosis. The rest of her neurological examination was unremarkable. The following day, the ptosis and miosis resolved.

Discussion:

Horner’s syndrome occurs with cephalad spread of epidural local anesthetic which interrupts 2nd order neuron signaling in the oculosympathetic track. The cause is attributed to the narrowed epidural space in pregnancy and local anesthetic boluses. PIEB protocols for labor analgesia will likely increase in popularity as they are associated with higher maternal satisfaction scores and a lower incidence of motor block and instrumental vaginal delivery. Therefore, higher vigilance will be required when monitoring patients as the incidence of Horner’s syndrome may increase.
**Pregnancy complicated by Type IV Ehler's-Danlos**

**Presenter:** Michael Holland, MD  
University of Washington

**Authors:**  
*Michael Holland, MD*  
*Carlos Delgado, MD*  
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*Emily Dinges, MD (Faculty Mentor)*  
*Christopher Ciliberto, MD (Faculty Mentor)*

**Introduction:** Ehlers–Danlos type IV-vascular results from a mutation of COL3A1 gene. Patients experience rupture - dissection of arteries, bowel and uterus. Life threatening uterine rupture complicates > 6% of pregnancies (1). Only synthesizing type I collagen; their skin, intestine and blood vessels are fragile (2). High risk associated with labor and vaginal delivery, advises early term cesarean delivery (3).

**Pre-op:** A 31 year-old female, 31+6 weeks gestation with E-D IV. History includes popliteal aneurysm ligation; right carotid artery aneurysm and left carotid occlusion (50%). She presented with ventral hernia containing gravid uterus and bowel, resulting in painful necrosis of abdominal wall. After six days of conservative management with IV hydromorphone PCA and steroids for fetal lung maturation, signs and symptoms of small bowel obstruction developed, ex-lap and caesarean delivery were indicated.

**Intra-op:** GA with thoracic epidural for post-op pain management was performed and delivery was uneventful. Surgery revealed distended bowel and necrosis thought to have potential for improvement no immediate resection was performed. Significant loss of domain resulted in inability to close fascia, patient left intubated in the ICU until after second procedure, POD #1.

**Post-op:** POD1, abdominal wash-out; POD2, mid-jejenum resection, mesh placed for hernia; POD3, IR for drain placement for anastomotic leak; POD4, TEP removed. Plan for PICC line for TPN and definitive repair.

**Conclusions:** Consideration of the patient’s diseases, anxiety, likelihood of long procedure with open abdomen, high risk of aspiration were balanced. The benefit of minimizing stress of catecholamine surge on arterial walls outweighed risk of GA. TEP was provided for post-op analgesia, due to previous narcotic use issues.

**Estimated Blood Loss During Dilation and Extraction by Anesthetic Type**

**Presenter:** Michael Holland, MD/DO, Resident  
University of Washington

**Authors:**  
Christopher Cilberto, MD/DO (Faculty Mentor)  
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**Introduction:** D&E procedures are commonly performed in the first and second trimesters with GA, neuraxial, or MAC(1). The most common complication is bleeding especially in second trimester(2) resulting in greater risk of transfusion and mortality(3). This retrospective study investigates differences in EBL between D&E’s performed under GA vs MAC.

**Materials and Methods:** Anesthetic and operative reports (n = 235) for D&Es performed at UWMC in OR over four years were reviewed. Cases were analyzed by anesthesia type, EBL as reported by anesthesia vs OB provider. 22% of cases did not have a numerical EBL these were discarded from statistical analysis.

**Results:** D&Es performed under general anesthetic, the mean EBL was 287mL ±82mL (95% CI). Of the 108 procedures performed under MAC mean EBL was significantly less at 105 mL ± 27mL (95% CI). A two-sided two sample t-test demonstrated a statistical difference in EBL (p = 6.53X10-5). None received transfusion and EBL did not vary significantly between providers.

**Discussion:** D&E cases under MAC had less blood loss compared with those under GA, which could be attributed to many factors. Volatile anesthetics are known to have effects on uterine tone, GA is more likely to be performed if the case is complicated (abnormal placentation, molar pregnancy, increased gestational age). Further research is needed to elucidate the effects of anesthesia on blood loss adjusted for complication and other cofounders.

**References**


Incidence of Post Dural Puncture Headaches and Epidural Blood Patches following Neuraxial Anesthesia: Analysis of 8,562 Anesthetics in 2014

Presenter: Anna Bovill Shapiro, MD, Resident
University of California, San Diego

Authors: Anna Bovill Shapiro, MD
David Gambling, MD (Faculty Mentor)
Debbie Lozano, BA/BS

Introduction

There were 3.9 million births in the United States in 2013. While percentages vary, it is estimated that around 60% of vaginal deliveries and almost 95% of cesarean sections receive neuraxial anesthesia. Post dural puncture headache (PDPH) is a known complication of neuraxial anesthesia. Most studies on the incidence of PDPH and epidural blood patches (EBP) have been completed at academic centers. We questioned if the incidence of inadvertent dural punctures, PDPH and EBP would be lower in an experienced private practice setting.

Methods

A review was performed on prospectively collected data from obstetric anesthesiologists at Sharp Mary Birch Hospital for Woman and Newborns for all neuraxial procedures on obstetrical patients in the year 2014. This included the type of neuraxial technique, type and size of needle used, inadvertent dural puncture, presence of PDPH and need for EBP.

Results

A total of 8,562 neuraxial anesthetics were performed during 2014 out of a total of 9400 deliveries. Of these, 4,893 were CSEs, 937 were CLEs, and 2,732 were spinal anesthetics. The obstetric anesthesiology service was consulted to evaluate 24 post anesthetic headaches, of which 22 were deemed to likely be PDPH (0.28%). The incidence of inadvertent dural puncture with large bore needles during epidural insertion was 11/5,830 (0.19%); 3 of which required an EBP (27%). Of the 2,732 single shot spinal anesthetics for cesarean delivery, 2 required an EBP (0.07%). All patients had full relief of headache following EBP.

Discussion

These numbers represent a lower incidence of inadvertent dural puncture, PDPH, need for EBP, and EBP success rates than those previously reported in the literature. It is likely these low numbers reflect the experience of the obstetrical anesthesiologists and the type of needles used.
Multiple Anesthetic Inductions Resulting in Asystole: A Review of Anesthetic Agents used in Electroconvulsive Therapy.

Presenter: Cong Li, MD, Resident
             Stanford University

Authors: Cong Li, MD
         John Brock-Utne, MD (Faculty Mentor)

A 44-year-old female was admitted for electroconvulsive therapy (ECT) for severe depression refractory to medications. She underwent a total of ten ECTs in which three of them resulted in asystole after induction of anesthesia but prior to electroconvulsive therapy. Asystole after induction of anesthesia but prior to ECT is extremely rare. No adverse effects were seen and her depression improved after her treatments.
Transient Vision Loss Associated with the Additive Anticholinergic Side Effect of Opioids

Presenter: Diem Phuc Banh, MD/DO, Resident
University of Arizona

Authors: Diem Phuc Banh, MD/DO
Joelle Boeve, MD/DO (Faculty Mentor)

Anticholinergics are medications that competitively antagonize the effects of acetylcholine neurotransmitters at the cholinergic postganglionic sites. They are frequently used in setting of sedation, antisialogogue effects, reflex-mediated bradycardia, bronchodilation, and the prevention of motion sickness. Most opioids used for acute or terminal pain have significant anticholinergic properties. Common side effects of opioid administration include sedation, dizziness, nausea, vomiting, constipation, physical dependence, tolerance and respiratory depression. Less common side effects are delayed gastric emptying, hyperalgesia, immunologic and hormonal dysfunction, muscle rigidity and myoclonus, etc...

Rare complications related to opioid usage may include vision disturbance, QT prolongation, Torsades de Pointes, and pulmonary edema. We report an uncommon case of a patient who presented for facial flap reconstructive surgery that developed transient vision loss. A 55-year old female with history of substance abuse on chronic methadone maintenance therapy was given meperidine and midazolam during the perioperative course. Her intraoperative course was uneventful. However, postoperatively, the patient developed acute blurry vision with subsequent vision loss consistent with the additive effect of multiple anticholinergics with opioid usage. Ophthalmology consultation was obtained. Six hours later, with close observation the patient’s vision returned spontaneously. The additive effect of anticholinergic medications such as the combination of meperidine, methadone and midazolam can induce transient visual loss. Thus, proper patient screening, careful history, physical examination and knowledge of additive anticholinergic side effects are essential to avoid serious complications.
**Peri-operative Emergency/Complications**

Poster # LL03

**Posterior Circulation Infarction: A Case of Bilateral Vertebral Artery Thrombi during Surgery in the Neck-Extended Position**

Presenter: Tim Clement, MD, Resident  
Virginia Mason

Authors: Joseph Neal, MD (Faculty Mentor)

Introduction: Posterior cerebral circulation strokes are associated with significant morbidity and occasionally death. Causes include atherosclerosis, thromboembolic disease, mechanical factors, and trauma. Symptoms and signs include vertigo, nausea, visual disturbance, ataxia, and dysarthria, contralateral motor and ipsilateral sensory deficits. Previous case reports have discussed iatrogenic occlusion after vertebral artery trauma. Neck extension during surgery could be a rare cause of vertebral artery occlusion and subsequent posterior cerebral circulation stroke.

Case Description: A 53-year-old man with papillary thyroid carcinoma and C5 radiculopathy presented for completion thyroidectomy and anterior cervical discectomy and fusion. Neck extension was optimized in this supine patient with six pounds of traction hanging from the mental protuberance. Surgical duration was prolonged because of extensive adhesions from his recent thyroid lobectomy. Immediately after surgery, the patient was noted to be sedated and nauseous, and reported right arm and hand numbness, weakness, and tingling. The next day, the patient remained sedated and had diplopia, dysmetria, and ongoing nausea. Magnetic resonance imaging revealed bilateral vertebral artery thrombi and a cerebellar infarction. The most likely etiology was presumed to involve surgical positioning. Conservative treatment of his stroke was undertaken. The patient gradually improved over several days and had almost complete resolution of his symptoms 4 weeks later.

Discussion: Neck extension is commonly used during cervical surgery procedures to improve visualization of the anterior neck. Prolonged neck extension is a potential cause of posterior cerebral circulation stroke. Suggestions for preventing position-related vertebral artery occlusion due to positioning include having the patient mimic the anticipated surgical position and assessing for adverse symptoms, and limiting the extent and duration of neck extension.
Who am I? A Case of Dissociative Amnesia in a Postoperative Patient

Presenter: Shin-e Lin, MD, Resident
University of California, San Francisco

Authors: Shin-e Lin, MD
David Robinowitz, MD (Faculty Mentor)

Introduction:
Postoperative retrograde amnesia is uncommon but has been noted previously in the literature. In contrast, dissociative amnesia involving loss of autobiographical information is extremely rare postoperatively with only one reported case. We describe an incident of postoperative dissociative amnesia and discuss the evaluation of a patient with postoperative memory deficits including differential diagnosis, workup, and treatment.

Case Description:
The patient was a 21 year-old woman who experienced a cardiac arrest in 2011 and was diagnosed with diffuse cardiac conduction system disease for which she received an AICD in 2011. The patient suffered anxiety and PTSD from her cardiac condition but was otherwise stable on a medications and presented for an AICD generator change.

The patient had an uncomplicated general anesthetic and was extubated deep and brought to PACU for recovery. Upon awakening, she was slightly agitated and incontinent of stool and urine. Within an hour, she was calm but although she was alert, it was noted that she had anterograde amnesia and more impressively, dissociative amnesia inclusive all autobiographical information. She was neurologically intact and able to answer questions relating to her current state (e.g. hunger). Pediatric neurology was consulted and the patient was admitted to the ICU for ongoing monitoring. The patient’s symptoms persisted for three hours at which time her anterograde amnesia resolved. By the next morning, the patient’s dissociative amnesia had also resolved.

Discussion:
The differential diagnosis includes seizure, cerebrovascular accident, migraines, metabolic derangements, medication effects, and psychological stressors. Given her negative workup, the most likely diagnosis is either an atypical pharmacologically-induced or psychologically-triggered dissociative amnesia following anesthesia. Dissociative amnesia following general anesthesia is rare and unpredictable but whatever the cause, it is important to keep in mind the differential diagnosis and perform the necessary workup to rule out any reversible causes.
Jehovah’s Witness patients present unique challenges to Anesthesia providers during surgical procedures, especially when blood loss is likely to be extensive. Although there are varying beliefs amongst practicing Jehovah’s Witnesses, the majority believe that the transfusion of any products containing red blood cells, white blood cells, platelets and plasma is prohibited. Albumin, cell saver and autologous blood transfusions are often acceptable to some patients. This case report described a 38-year-old, 173-kg (BMI 75) Jehovah’s Witness male with Down’s Syndrome who presented to UCSD Medical Center for a removal of a 60-pound pseudosarcoma of his right leg. The patient was willing to accept albumin and intra-operative autologous blood transfusion, so given the substantial amount of blood loss expected, acute normovolemic hemodilution was implemented for this case. The surgery resulted in over 4 liters of blood loss and the patient remained hemodynamically stable throughout with autologous blood transfusions and minimal vasopressor requirement. The patient participated in physical therapy on post-operative day 8 and was discharged to a skilled nursing facility on post-operative day 9. His perioperative course provide an opportunity for discussion of blood conservation strategies in patients who cannot or will not accept allogeneic blood transfusions, as well as the practical and ethical considerations in caring for Jehovah’s Witness patients.
Bedside Diagnosis of Pneumothorax by Lung Ultrasonography in the OR: a Case Report

Presenter: Kristin Pappas, MD, Resident
University of California, San Francisco

Authors: Kristin Pappas, MD (Faculty Mentor)
John Turnbull, MD (Faculty Mentor)
Monica Harbell, MD (Faculty Mentor)

While lung ultrasound is an established modality for diagnosis of pleural effusions and pleural masses, its use for diagnosis of pneumothorax (PTX) and other thoracic pathology has only increased in the past decade with clinicians’ increasing recognition of sonographic artifacts. These imaging artifacts - described as “A lines”, “B lines”, etc., represent the interaction between the ultrasound beam and the tissue/air interface.

We present a case of PTX diagnosed in the operative setting in a patient undergoing thyroid lobectomy requiring mini-sternotomy. Prior to extubation, the patient did not exhibit any signs of PTX, but immediately following extubation, he became hypoxic with poor breath sounds bilaterally. Bedside lung ultrasound revealed a lack of lung sliding and lack of B lines; a “barcode” sign on the ultrasound M-mode was identified. Chest radiography confirmed a large right PTX and a chest tube decompression quickly improved the patient’s respiratory status.

Lung ultrasonography has been shown to be significantly more sensitive than anterior-posterior chest radiography in detecting PTX, particularly for patients in the supine position, and may be more sensitive in detecting smaller PTX that are radiographically occult. Ultrasound allows fast and accurate diagnosis of PTX; its portability makes it a valuable diagnostic tool in the perioperative setting.
Bedside Diagnosis of Pneumothorax by Lung Ultrasonography

CXR: Moderate to Large Right PTX

Patient’s Left Lung: Seashore Sign

Patient’s Right Lung: Barcode Sign
Delayed Postoperative Extubation due to Inaccurate Neuromuscular Monitoring: A Case Report

Presenter: Alessandro De Camilli, MD, Resident
University of California, San Francisco

Authors: Alessandro De Camilli, MD
Matthias Braehler, MD (Faculty Mentor)

Background: Peripheral nerve stimulation by “train of four ratio” (TOF-R) assessment is the most commonly utilized method to quantify return of neuromuscular function following administration of non-depolarizing muscle relaxants. We present a case of a patient with undiagnosed ulnar neuropathy with a TOF ratio that was significantly discordant with clinical assessment of strength and resulted in delayed postoperative extubation.

Case Description: A 59-year-old male with a history of Crohn’s disease, diabetes mellitus, chronic kidney disease, and staghorn calculus was induced for an endoscopic nephrolithotomy for stone removal. A total of 40mg of rocuronium was administered during the case. The last dose was given 2 hours before the end of surgery. Extubation was delayed by several hours in the PACU due to inadequate TOF stimulation (no twitches with 75mA, weak tetanic response at 100Hz), despite adequate spontaneous ventilation and full strength by clinical assessment. Ultimately the patient was successfully extubated despite this TOF ratio. Formal EMG testing was not sought, but peripheral neuropathy due to CKD, diabetes, or muscle wasting due to malnutrition in the setting of Crohn’s disease were suspected as potential causes.

Discussion: Aside from clinical assessment, TOF stimulation is the most common method used to quantify return of neuromuscular function as a criterion for extubation. Absent response to TOF stimulation at voltages of 50-75mA is reported to signify a 90-98% receptor blockade (4), thus not qualifying patients for reversal with acetylcholinesterase inhibitors. However, baseline post-induction and pre-paralysis TOF ratios are rarely sought. Altered baseline TOF ratios in patients with neuromuscular disease (1), spinal cord injury, and diabetes mellitus (2,3) have been described resulting in clinically significant delays to extubation. This case highlights the imprecise use of TOF ratio as a sole determinant of neuromuscular function, and the importance of assessing baseline TOF ratios prior to non-depolarizing blockade.
Hypersensitivity Reaction Following Total Hip Arthroplasty: What is the Primary Suspect?

Presenter: Luke McCage, MD/DO, Resident
Stanford University

Authors: Luke McCage, MD/DO
Clifford Schmiesing, MD/DO (Faculty Mentor)
Christopher Painter, MD/DO

Introduction:
Drug hypersensitivity reactions are immune-mediated events that can be unpredictable and potentially life-threatening (1). There are multiple mechanisms, classified as IgE-mediated or non-IgE mediated, but often the clinical characteristics are indistinguishable (2). Identifying the causative medication can be challenging.

Case Report:
A 59-year-old man with a history of osteoarthritis involving bilateral complex total hip arthroplasties (THA) complicated by infection presented to the anesthesia pre-operative clinic. He was 1-month status post revision of complex left THA, now scheduled for complex right THA. His recent post-operative course after left hip surgery was complicated by diffuse skin rash with severe pruritus of unknown etiology. Symptoms started shortly after surgery, involved the entire trunk and upper arms, and resolved only with an oral steroid taper after seven weeks with advised discontinuation of Norco and Enoxaparin. No specific medication could be identified as source of allergy on pinprick testing of commonly used anesthetic agents. Out of concern for an anesthetic related drug allergy, a custom anesthetic plan was devised to avoid all suspect medications from his most recent surgery, namely ones that he did not receive with prior anesthetics in which there was no reaction. Using this unique anesthetic plan, no allergic reaction was seen in the operative or immediately post-operative period. Unfortunately, on post-op day one he again developed a diffuse rash with severe pruritus. The onset of symptoms occurred shortly after a single dose of Enoxaparin (1 mg/kg), which was now evident as the cause of his hypersensitivity skin reaction.

Discussion:
Allergic reactions to Enoxaparin have been reported, primarily via mechanism of delayed-type hypersensitivity (3). This presentation suggests nonimmunologic (pseudoallergic) hypersensitivity reaction due to timing and similar severity to prior reaction. When perioperative hypersensitivity reaction is suspected, comprehensive allergic testing and multi-discipline care coordination can be helpful in avoiding future reactions.
TENSION PNEUMOTHORAX FOLLOWING TOTAL SHOULDER ARTHROPLASTY

Presenter:  Kelly Zach, MD/DO, Resident
Mayo Clinic
Authors:   Kelly Zach, MD/DO
David Seamans, MD/DO  (Faculty Mentor)

Postoperative pulmonary complications lead to longer postoperative stays, higher costs, and increased mortality. Examples include pneumonia, pneumothorax, reintubation within 48 hours, bronchospasm, pleural effusion, and others. We present the case of a patient who underwent a total shoulder arthroplasty, but suffered from a tension pneumothorax in the recovery room. The case highlights the risks of pulmonary complications in the perioperative period and the importance of rapid identification when an event occurs.

A 78 year old female underwent a right total shoulder arthroplasty under general anesthesia. Preoperatively, she had an interscalene block performed under ultrasound guidance. Following an uneventful operation, she began complaining of chest pain and shortness of breath in the recovery room. A chest x-ray demonstrated a large left-sided pneumothorax with shift of the mediastinum to the right. She was urgently taken to interventional radiology and had a 9-French chest tube inserted. By day 2, the pneumothorax resolved, the chest tube was removed, and the patient was discharged home.

This case demonstrates the identification and management of an uncommon postoperative pulmonary complication, a tension pneumothorax. The pathophysiologic hypothesis was that the patient had a small unidentified lung bleb that ruptured, leading to the development of the pneumothorax. Positive pressure ventilation further exacerbated the condition, creating tension and leading to shift of the mediastinum. While pneumothorax has been reported following interscalene block, the pneumothorax occurred contralateral to the nerve block. It is accepted that interscalene blocks transiently block the phrenic nerve on the ipsilateral side in 100% of cases. This was considered when managing this patient due to the concern that the pneumothorax superimposed on the hemidiaphragmatic paralysis might lead to a quick deterioration. Overall, this case exhibits the importance of rapid diagnosis and treatment of a tension pneumothorax during the perioperative period.
A Case of Decompressive Needle Thoracostomy for Tension Pneumothorax: A Question of Approach

Presenter: Tyler Bevins, MD/DO, Resident
University of California, Davis

Authors:
- Tyler Bevins, MD/DO
- Rachel Russo, MD/DO
- Norma Klein, MD/DO (Faculty Mentor)

An 88 year old woman undergoing emergent laparoscopic Nissen Fundoplication for incarcerated hiatal hernia developed hemodynamic instability and decreasing arterial oxygen saturation, indicative of a developing tension capnothorax. The anesthesia team performed a decompressive needle thoracostomy using a readily available 14 gauge 5cm angiocatheter placed in the right 2nd intercostal space at the midclavicular line. Successful evacuation of the capnothorax was accomplished with improvement of hemodynamic parameters and arterial oxygenation.

Recent trends in trauma and military literature preferentially support a lateral approach for needle thoracostomy in the 4th-5th intercostal space at the anterior axillary line. Review of the literature suggests this approach may be more successful at decompression, as chest wall thickness is decreased laterally, and landmarks are easily identified. Anesthesiologists may consider a lateral approach to needle decompression a valuable alternative in the event that an anterior approach is unsuccessful.
Metastatic Paraganglioma: Anesthetic Management for Tumor Resection, Cavectomy, and Aorto-Bifemoral Bypass

Presenter: Daniela Micic, MD, Resident  
University of Southern California

Authors:  
Daniela Micic, MD  
Durai Thangathurai, MD (Faculty Mentor)  
Peter Roffey, MD (Faculty Mentor)

Introduction: Extra-adrenal paragangliomas arise from paraganglia derived from embryonic neural crest cells. They can cause neuroendocrine dysfunction secondary to spontaneous release of catecholamines and are challenging to manage peri-operatively 1.

Case Description: A 29 year-old male (49.4 kg, 160 cm) with history of malignant hypertension and previous resection of retroperitoneal paraganglioma presented to the ICU prior to metastatic paraganglion tumor resection. Imaging showed 8.7 x 11.5cm mass invading the IVC. The patient continued his home anti-hypertensive regimen of phenoxybenzamine, amlodipine, metoprolol, and terazosin. An arterial line and RIJ CVC were placed. The patient was started on midazolam and precedex drips for sedation, as well as nitroglycerin and esmolol drips for hypertension.

Vital signs prior to induction were BP 130/82 and HR 103. Smooth IVI was performed with propofol, vecuronium, and sufentanil. Nitroglycerin and esmolol drips were continued, and nicardipine and mannitol drips were started intra-operatively. Surgical resection was difficult, requiring cavectomy and aorto-bifemoral bypass. After tumor resection and significant intra-operative blood loss, the patient required hemodynamic support with norepinephrine, epinephrine, and vasopressin drips. Blood pressure ranged from 90-170s/60-90s throughout the case. The patient received crystalloid 7000mL, albumin 1250mL, pRBCs 18 units, FFP 13 units, platelets 2 units, cryoprecipitate 30 units, and cell saver 3000mL. Total EBL was 5000mL and UOP was 3300mL. With adequate resuscitation, pressors were weaned off prior to transfer to ICU, and the patient was extubated on POD#1.

Discussion: Intra-operative management of paraganglion tumors is challenging because of the potential for catecholamine release during tumor manipulation, and the hemodynamic effects from a sudden decrease in circulating catecholamines. This case was particularly challenging because of the size and location of the tumor and the amount of blood loss encountered. We demonstrated a unique intra-operative protocol using nitroglycerin and mannitol to control blood pressure and maintain intravascular volume.

References:
Debilitating Ischemic Stroke After Total Hip Replacement: A Case Report

Presenter: Eric Steinman, MD, Resident
Virginia Mason

Authors: Eric Steinman, MD
James Helman, MD (Faculty Mentor)

Total hip replacement is a common surgical procedure and stroke in the post-operative period is a well-documented complication, with estimates of incidence up to 0.6%. With the large, and increasing, population of patients undergoing total hip replacement, recognition of this complication and identification of patients at increased risk of stroke should be of prime importance.

In this case report, we present the case of a 65 year old female with a history of hypertension, diabetes, and obstructive sleep apnea, who underwent a general anesthetic technique for a right total hip replacement. Induction of anesthesia was obtained with propofol and fentanyl, and maintained with sevoflurane, air and oxygen. The intra-operative course was uncomplicated. In the PACU, she was noted to be drowsy but met criteria for discharge to the inpatient setting, and following admission to the orthopedic ward, was found to be difficult to arouse. This was initially felt to be residual anesthesia and opioids from the operation. In the early morning of POD1, she was found to have right hemiparesis of face and arm. CT scan demonstrated a left MCA/ACA territory infarct secondary to acute left internal carotid occlusion. Based on her immediate post op status and unclear onset time of her neurologic event, the decision was made to not administer intravenous-tPA.

The Neurology service was consulted, and suggested the most likely etiology of her acute neurologic deficit was left internal carotid artery bifurcation plaque rupture or a single embolus to a chronically narrowed left internal carotid. She was medically managed, and discharged to skilled nursing facility on hospital day 15. At the time of discharge, she remained largely unresponsive, only stirring when pressure was applied to her left hand or foot.

This case highlights the need for prompt recognition of stroke in the post-operative period. With the increasing age and number of comorbidities commonly encountered in patients scheduled to undergo total hip replacement, awareness of, and monitoring for, this potentially devastating complication is becoming increasingly important.
Hypotensive and bradycardic event during open AC joint repair under a general anesthetic and a preoperative interscalene nerve block

Presenter: Harpreet Singh, MD, Resident
University of California, Davis

Authors: Harpreet Singh, MD
Robin Aldwinkle, MD (Faculty Mentor)

We report a case of a 40-year-old female with a history of mild hypertension and smoking ½ pack per day, who underwent a general anesthetic with a preoperative interscalene nerve block for an open repair of an acromioclavicular joint. Patient was positioned in a reclined beach chair position; no epinephrine was used in any irrigation by the surgeon or in the interscalene block solution. The case was uneventful up until the surgeon had started closing skin and at that point the patient had an episode of bradycardia to a heart rate in the 30’s with ST elevation on EKG, hypotension to 60’s/30’s, low CO2, and was accompanied by ventricular arrhythmias (short bursts of 5-6 beats of ventricular tachycardia). Symptoms lasted for about 10 minutes. Patient was positioned in the supine position and was awoken. The patient denied any chest pain and reported feeling well, and her vitals had returned to normal with her pulse being in the 60’s and blood pressure in the 130’s/80’s. Patient was transported from the ambulatory surgery center to the hospital emergency department where a cardiac work up was negative and patient signed out against medical advice and refused to be admitted for observation.

Although hypotension and bradycardic events (HBEs) may be associated with the adverse effects of interscalene nerve block in the sitting position, the underlying mechanisms responsible for HBEs during the course of shoulder surgery are not well understood.

In this report we will overview the physiology of this event, risk factors, prevention and discuss general treatment.
Hardware infection after intravenous regional anesthesia

Presenter: Anna Swenson Schalkwyk, MD, Resident
Stanford University

Authors: Anna Swenson Schalkwyk, MD
Michael Fishman, MD

A 43-year-old man sustained a closed right tibial plateau fracture, initially treated with external fixation due to edema. He developed diffuse numbness and burning pain in the common peroneal nerve distribution, requiring revision of the external fixator. On post-injury day nine he underwent definitive treatment with common peroneal nerve neuroplasty and open reduction internal fixation. One day after discharge, he developed paresthesias, worsening numbness, and warmth in his right leg. He failed to rehabilitate and was readmitted on post-injury day 25 for knee manipulation. At this time Complex Regional Pain Syndrome (CRPS) was diagnosed and initially treated with lumbar epidural and lumbar sympathetic plexus blocks. Intravenous regional anesthesia (IVRA) was performed four months after the initial fracture for CRPS. After chlorhexidine prep, a right foot IV was placed with sterile technique, the limb exsanguinated, and a mixture of 20cc saline, 30cc 1% lidocaine, 70mcg clonidine and 30mg ketorolac was injected with the tourniquet inflated for 30 minutes. The patient was discharged in stable condition. Over the next seven days, he developed dizziness, weakness, body spasms, chills, and erythema, edema, and pain near his proximal tibia incision. Emergency department evaluation revealed an abscess at that site, which was treated with incision, drainage, and hardware removal. Wound cultures grew methicillin sensitive Staphylococcus aureus; blood cultures had no growth. The patient completed a 6 week course of cefazolin. His fracture remained healed by x-ray at 1 month follow up, and he remains in treatment for his CRPS.

While the evidence may be circumstantial, this case illustrates the potential for clinically significant infections after IVRA. Although a PubMed search did not identify similar cases, there may be a role for perioperative antibiotics and strict sterile technique for patients with hardware in the anesthetized limb.
Persistent Fluid Leak after Discontinuation of an Intrathecal Catheter

Presenter: Neena Gupta, MD/DO, Resident
University of Colorado

Authors: Neena Gupta, MD
Adrian Hendrickse, MD (Faculty Mentor)

Introduction

Although leaky catheters are common problems associated with neuraxial anesthesia, persistent fluid leak after the removal of such catheters is a much rarer complication. Here we describe a case of an atypical presentation of persistent fluid leak after discontinuation of an intrathecal catheter and the diagnostic approach used in its evaluation.

Case Report

A 67 year-old woman presented for open sigmoidectomy. For postoperative pain control, a T11-12 catheter was placed intrathecally after several unsuccessful attempts at placement of an epidural. The patient had satisfactory pain control for 2 postoperative days, after which the catheter was discontinued. Hours later, upon standing the patient had a large amount of fluid dripping from her back. She denied headache, fever, or neurologic symptoms. Upon examination, there was no palpable fluid pocket, but there was a steady flow of clear fluid from one of the previous puncture sites. The fluid was collected and analyzed, and found to have glucose 95 mg/dL. With concern for a persistent CSF leak, the patient was placed on bedrest for the next 24 hours. The fluid leak resolved the next morning, and the patient remained asymptomatic.

Discussion

The differential diagnosis for persistent fluid leak includes CSF, interstitial fluid, residual local anesthetic, infectious exudate, and saline if used for loss of resistance. Symptoms of CSF leak include headache, meningism, cranial nerve palsy, or infectious symptoms. Tests that can help diagnose the etiology of fluid leak include glucose, protein and chloride levels. Although the natural history of this complication is not well described, it is thought that many resolve spontaneously. Some describe utilizing the epidural blood patch to treat fluid leak. Anesthesiologists should be aware of persistent fluid leak after neuraxial anesthesia. Consideration of the clinical presentation along with simple bedside tests can help determine the etiology and guide management decisions.
Inadvertent Femoral Nerve Block Following Intraoperative Ilioinguinal Nerve Block for Inguinal Herniorrhaphy

Presenter: Michael Gardner, MD/DO, Resident
University of California, Irvine

Authors: Michael Gardner, MD/DO
Jane Ahn, MD/DO (Faculty Mentor)

Introduction:
Ilioinguinal/iliohypogastric nerve blocks have been used as pain control adjuvants for inguinal herniorrhaphy, orchialgia, cesarean sections and even abdominal hysterectomies. Unexpected complications have been reported including colonic puncture and pelvic hematoma, among others. We present a case of inadvertent femoral nerve block following an intraoperative, landmark guided, ilioinguinal nerve block for an open inguinal hernia repair.

Case Details:
An otherwise healthy 43-year-old male presented with unilateral, right-sided leg weakness and numbness immediately following an uneventful, right-sided open inguinal hernia repair under general anesthesia with an intraoperative ilioinguinal nerve block by the surgeon using 40 milliliters of 1% lidocaine. A focused physical exam of the patient revealed right-sided quadriceps weakness and numbness of anterior and medial thigh/knee and medial calf. Patient remained in the observation unit for 5-6 hours following the surgery where he regained complete motor strength and full sensation on the affected side. Patient was discharged to home with no further sequelae.

Discussion:
1. Etiology of femoral nerve block following ilioinguinal nerve block is still unclear, though could be explained by the incorrect placement of injection, too high volume of local anesthetic, or a combination of the both.

2. Ultrasound use by an experienced provider could potentially lead to decreased incidence of transient femoral nerve palsy as the various planes, as well as the ilioinguinal nerve itself, may be visualized, allowing more focused deposit of local anesthetic with smaller total volumes.

3. There is a need for more awareness by surgeons, anesthesiologists and PACU nurses of potential complications of ilioinguinal nerve blocks in order to readily recognize and appropriately manage them.
1 = transverse abdominis muscle
2 = internal oblique muscle
3 = external oblique muscle
Baclofen Pump Exchange in a Patient with end-stage Amyotrophic Lateral Sclerosis: A Case Report

Presenter: Iman Hadaya, MD, Resident
University of California, San Francisco

Authors: Iman Hadaya, MD
Matthias Braehler, MD (Faculty Mentor)

Background: Amyotrophic Lateral Sclerosis (ALS) is a progressive neurodegenerative disease that affects upper and lower motor neurons, eventually leading to death from respiratory failure.

Patients with ALS present unique challenges to perioperative management. Special anesthetic considerations include the avoidance of neuromuscular blocking agents and the risk of prolonged mechanical ventilation postoperatively.1,2

Case Description: A 50 year old female with end-stage ALS presented for left abdominal Baclofen pump replacement.

Preoperatively: The patient was extremely debilitated. She was wheelchair bound with no movement of her arms and legs. She was dysphonic and communicated mostly by eye blinking. She required nightly non-invasive positive pressure ventilation (NIPPV). The year prior, she was hospitalized for Influenza A for which she required nearly a week of NIPPV before returning to her baseline.

Intraoperatively: The patient underwent an uneventful left transversus abdominis plane (TAP) block and received 40 ml of Ropivacaine 0.375% (150 mg) to anesthetize the left lower quadrant of the abdomen. No sedatives or analgesics were administered during the surgical procedure. The only other medication administered intraoperatively was Cefazolin.

Postoperatively: The procedure was successfully completed without any complications. At her one-month follow-up appointment, mental status and neurological exam were at baseline.

Discussion: It is prudent to consider anesthetic plans other than general anesthesia in patients with ALS whenever possible, so as to avoid the risk of succinylcholine-induced hyperkalemia and postoperative pulmonary complications. There have been reports of successful neuraxial and regional blocks in these patients.3-5 To the authors’ knowledge, this particular regional block has not been reported in this patient population. This case report demonstrates successful placement of a TAP block in a patient with ALS and offers a safe and useful anesthetic technique that can be utilized by clinical anesthesiologists.

References:

Keywords:
Amyotrophic Lateral Sclerosis (ALS), Transversus Abdominis Plane (TAP) Block
Liposomal Bupivacaine for Pectoral Nerve and Serratus Plane Blocks in Breast Surgery - A Case Series

Presenter: Paul Maliakel, MD/DO, Resident
Naval Hospital

Authors: Paul Maliakel, MD/DO
Ross Glinecki, MD/DO
Brandon DaValle, MD/DO (Faculty Mentor)
Niels Hauff, MD/DO
Brian Terrien, MD/DO

Introduction: We present a series of 15 patients undergoing breast surgery who received pectoral nerve and/or serratus plane blocks using liposomal bupivacaine in the perioperative period with postoperative pain control data through 72 hours after surgery.

Case series: Pecs 1, Pecs 2, and/or serratus plane blocks (depending on staff anesthesiologist preference) were performed on patients undergoing outpatient breast surgery at our institution. Patient’s analgesic usage, subjective pain scores, and their ability to sleep at night were quantified along with any potential complications.

Results: Overall, patients subjectively reported adequate analgesia after receiving the pectoral nerve and/or serratus plane blocks. In the PACU, average pain scores were 4 or less for 11/15 (73%) patients. Furthermore, most required only minimal oral opioids on the same day surgery ward (average 14.9 ME, range 0-63.5 ME). At the 24 hour point, pain scores were again 4 or less for 11/15 (73%). Opioid requirements continued to be very small (average 14.9 ME, range 0-63.5 ME). Additionally, 73% patients were able to sleep through the night without pain.

Discussion: The data from this case series suggests that these blocks provide sustained analgesia with minimal opioid usage through 24-72 hours after surgery when performed with liposomal bupivacaine and may represent a safer alternative to the thoracic epidural or paravertebral block.
Inadvertent intrapleural placement of an intended epidural catheter

Presenter: Christopher Fung, MD, Resident
University of New Mexico

Authors: Christopher Fung, MD
Dmitry Garmaev,
Hrishikesh Modi,
Bryan Brindeiro,

Traumatic rib fractures are common and can cause significant pain and impose severe compromise to normal respiratory function. Thoracic epidurals have long been utilized to provide analgesia for relief of rib fracture pain in hopes of improving respiratory mechanics and preventing subsequent respiratory complications such as atelectasis and pneumonia. Thoracic epidural placement is not an innocuous procedure, however. Infection, bleeding, spinal cord/nerve injury, dural puncture and misplacement are well known complications. Inadvertent intrapleural placement of an intended thoracic epidural catheter is a rare complication that has been described in literature in patients undergoing thoracic surgery, when misplacement was discovered intraoperatively by direct visualization of the catheter by the surgical team.

We present a case of a patient who suffered multiple rib fractures after a motor vehicle accident, who was consulted by our acute pain service to provide an epidural placement for analgesia. After uneventful thoracic epidural placement our patient reported good pain relief, and a continuous infusion of local anesthetic was started. Two days after thoracic epidural placement, a computed tomography (CT) scan was performed at the request of the intensive care unit team to evaluate a worsening right-sided pneumothorax. Interestingly, the radiologist noted that the epidural catheter terminated in the right pleural space at the level of the lung apex. Despite the catheter being located in the right apical pleural space, the patient reported bilateral analgesia after local anesthetic bolus/infusion administration by the acute pain service. Because of the persistent pneumothorax, the decision was made to remove the epidural catheter. A chest tube was placed by the intensive care team and the patient suffered no complications post epidural removal. Our case is unique in that our unilateral intrapleural catheter provided symmetrical analgesia and may have gone unnoticed had a CT scan not been performed by the intensive care team.
Hemidiaphragmatic Paralysis After Ultrasound-guided Supraclavicular Brachial Plexus Block

Presenter: Matthew Brown, MD, Resident
University of California, Irvine

Authors: Kyle Ahn, MD (Faculty Mentor)

Objectives:
Peripheral nerve blocks are useful both as primary anesthetics and for postoperative analgesia for a wide range of surgical procedures. Complications associated with supraclavicular blocks include pneumothorax, hemothorax, phrenic nerve block, recurrent laryngeal nerve block, and stellate ganglion block. Although the incidence of phrenic nerve block is relatively high with nerve-stimulation-guided techniques (53-88%), it is rare under ultrasound-guidance.

We present a case of acute respiratory distress due to hemidiaphragmatic paralysis as a result of phrenic nerve blockade during an ultrasound-guided supraclavicular block.

Case Report:
A 72-year old man with chronic kidney disease was scheduled for dialysis catheter placement and AV fistula creation in his left arm. He was a former smoker, without clinical evidence of respiratory compromise.

A left-sided, single-injection, in-plane, ultrasound-guided supraclavicular block was performed to be use as primary anesthesia. Within minutes after the procedure, the patient exhibited dyspnea and labored breathing, necessitating supplemental oxygen. Lung sounds were decreased on the left. Ultrasound imaging of the chest demonstrated “lung-sliding,” indicating intact pleura. CXR showed atelectasis and elevated left hemi-diaphragm without evidence of pneumothorax.

A diagnosis of acute respiratory distress due to hemidiaphragmatic paralysis from incidental phrenic nerve blockade was made. The patient was placed on BiPAP and monitored in ICU. His respiratory symptoms and block concurrently resolved. He was taken to the OR the following day, given an axillary block, and the surgery proceeded uneventfully.

Conclusions:
1) Supraclavicular blocks may be complicated by pneumothorax, hemothorax, phrenic nerve block, and recurrent laryngeal nerve block, regardless of the technique used.

2) A patient exhibiting acute respiratory distress after receiving a supraclavicular block must have each of these complications investigated.

3) Although phrenic nerve blockade is rare after ultrasound-guided supraclavicular block, clinicians must be aware of its potential clinical manifestations and be prepared to intervene.
Effects of through-the-needle vs. through-the-catheter local anesthetic bolus in adductor canal analgesia for knee replacement

Presenter: James Tan, MD, Fellow
Stanford University

Authors: James Tan, MD
Toni Ganaway, BA/BS
T. Edward Kim, MD
Steven K. Howard, MD
Edward R. Mariano, MD (Faculty Mentor)

Background: The optimal technique for administering local anesthetic (LA) during perineural catheter placement is unknown. LA can be injected through the introducer needle (TTN) prior to catheter advancement or through the catheter (TTC) after insertion. To date, TTN and TTC techniques have not been compared for adductor canal catheter analgesia in knee arthroplasty patients. We hypothesized that TTC would result in lower opioid consumption on post-operative day (POD) 1 when compared to TTN.

Methods: With IRB approval and waiver of informed consent, we conducted a retrospective cohort study pooling data from previously published studies involving knee arthroplasty patients with adductor canal catheters. For TTN, catheters were placed according to usual clinical care. For TTC, a standardized protocol restricted injectate volume via the needle to 5 ml of D5W prior to catheter insertion and injection of the local anesthetic bolus via the catheter. The primary outcome was opioid consumption by POD1. Secondary outcomes included ambulation distance, rest pain, and dynamic pain on POD 1.

Results: Data from 116 patients were included in the study (48 TTC and 68 TTN). The TTC group used 52.5 (25.2-105) mg morphine equivalents on POD 1 versus 75 (37.5-139.8) mg in the TTN group (p<0.001). Secondary outcomes are shown in Table 1.

Conclusions: Bolusing LA through the adductor canal catheter for knee replacement patients may have analgesic advantages over the TTN technique. Other factors may have influenced these results, and confirmatory prospective study may be warranted.

References:

Table 1: Secondary outcomes

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<tr>
<th></th>
<th>TTN</th>
<th>TTC</th>
<th>P-Value</th>
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<tbody>
<tr>
<td>Ambulation Distance</td>
<td>(n=68)</td>
<td>(n=48)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>POD 1 Morning (m)</td>
<td>POD 1 Afternoon (m)</td>
<td></td>
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<tr>
<td></td>
<td>14.5 (0.0-45.7)</td>
<td>15.2 (0.0-45.7)</td>
<td>0.575</td>
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<tr>
<td></td>
<td>16.8 (0.0-61.0)</td>
<td>16.8 (0.0-61.0)</td>
<td>0.667</td>
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Rest Pain

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<th></th>
<th>POD 1 Morning (NRS)</th>
<th>POD 1 Afternoon (NRS)</th>
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<tbody>
<tr>
<td></td>
<td>4.5 (0.0-8.0)</td>
<td>2.2 (0.0-7.0)</td>
<td>0.005</td>
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<tr>
<td></td>
<td>4.5 (0.0-8.0)</td>
<td>4.0 (0.0-6.5)</td>
<td>0.486</td>
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Dynamic Pain

<table>
<thead>
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<th></th>
<th>POD 1 Morning (NRS)</th>
<th>POD 1 Afternoon (NRS)</th>
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<tr>
<td></td>
<td>5.2 (1.7-8.0)</td>
<td>4.5 (0.0-8.0)</td>
<td>0.190</td>
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<tr>
<td></td>
<td>5.0 (0.0-8.6)</td>
<td>5.0 (1.2-8.7)</td>
<td>0.547</td>
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*Values are reported as median (10\textsuperscript{th}-90\textsuperscript{th} percentiles); POD: postoperative day; NRS: numeric rating scale (0=no pain at all; 10=worst possible pain)*
Early Recovery Protocol After Total Joint Replacement: Is There A Role For Hypobaric Spinals? A Retrospective Review

Presenter: Daniel Cherkassky, MD, Resident
Cedars-Sinai Medical Center

Authors:
Shawn Coleman, MD
Jonathan Hausman, MD (Faculty Mentor)
Matthew Eng, MD
Kapil Anand, MD
Roya Yumul, MD

There is considerable interest in developing early recovery and mobility protocols for patients undergoing total joint replacement. Studies have suggested that rapid commencement of physical rehabilitation, as early as in the PACU, leads to quicker attainment of functional milestones, decreased length of hospital stay, fewer post-operative complications, and decreased overall cost. Early recovery programs are a multidisciplinary endeavor, requiring close coordination between surgeons, anesthesiologists, physical therapists, and hospital support staff.

Anesthetic management therefore plays a vital role in ensuring the success of an early recovery protocol for patients undergoing total joint replacement. In addition to proper patient selection and avoidance of complications which could delay PACU or hospital discharge such as nausea/vomiting or urinary retention, one of the primary anesthetic goals should be to provide adequate analgesia with minimal motor blockade, which will allow patients to begin participating in physical therapy as soon as possible.

One proposed method to achieve these goals, which we are currently investigating at our institution, features the use of hypobaric spinals with mepivacaine for intra-operative analgesia. Hypobaric spinals may, in theory, decrease the incidence of post-operative urinary retention by avoiding excessive blockade of the sacral nerve roots which innervate the bladder. Mepivacaine’s relatively shorter duration of action compared to bupivacaine allows for motor block to resolve shortly after arrival in the PACU, thereby facilitating immediate initiation of physical therapy. The addition of adductor canal and genicular nerve blockade provides motor-sparing analgesia to further facilitate physical therapy for total knee replacement patients.

Our experience with this technique so far suggests that this may be a viable and effective anesthetic approach for an early recovery protocol after total joint replacement, warranting further study.
**Sonoanatomy of the Adductor Canal: Anatomical Variation of the Femoral Vein**

**Presenter:** Mark Awad, MD/DO, Resident  
Loma Linda University School of Medicine

**Authors:**  
*Mohamed Nour, MD/DO (Faculty Mentor)*  
*Jay Shah, MD/DO*  
*Richard Applegate, MD/DO (Faculty Mentor)*

**Background:**

Ultrasound guided peripheral nerve blocks have become the mainstay technique due to numerous advantages over anatomical landmark or paresthesia techniques. These include the ability to visualize anatomic variation in real time, precise deposit of local anesthetics, lower dose of local anesthetic, fewer needle passes, decreased incidence of vascular punctures, and shortened block performance time.

Adductor Canal Block (ACB) is an alternative method for pain control following total knee arthroplasty. The ACB is performed midway between the inguinal ligament and the patella targeting the saphenous nerve. This observational ultrasound study describes variation in the position of the femoral vein relative to the femoral artery at the adductor canal.

**Methods:**

30 patients consented to ultrasound scanning of bilateral adductor canals. The distance (X) from the inguinal ligament to the proximal border of the patella was measured and recorded. A 2 MHz linear probe was used to scan at the midpoint of distance X (X/2).

**Results:**

60 adductor canal ultrasound scans were reviewed. The femoral vein was found lateral to the femoral artery in 60%, medial in 20% and inferior in 10% of the scans. In 10% of the scans 2 to 3 veins were found at multiple locations. 9/30 (30%) patients had differences in the relative femoral vein position when comparing both legs.

**Discussion:**

Knowledge of anatomical variations should allow for safer and faster performance of ACBs with decreased likelihood of unintentional vascular puncture and intravascular injection. Knowing the saphenous vein is commonly lateral to the artery and directly below the saphenous nerve can give operators pause when piercing through the neurovascular fascia. In conclusion, this study clearly illustrates sonoanatomical variation of the femoral vein in the adductor canal. The anatomical variation seen in this study supports the utility and necessity of ultrasound guidance in order to more safely perform ACB.
Figure 1 A. Femoral vein (FV) lateral to femoral artery (FA) B. Femoral vein medial to femoral artery C. Femoral vein inferior to femoral artery D. Two veins at multiple locations. Saphenous nerve, SN.

Figure 1E Adductor canal. Percent variation in the location of Femoral Vein (FV) relative to Femoral Artery (FA) and Saphenous Nerve (SN). 10% of ultrasound scans showed more than one FV at multiple locations relative to the FA and SN.
Regional Anesthesia Case Report: Novel Application for Serratus Plane Block with Shoulder Replacement

Presenter: Sara Paquet, MD, Resident
Cedars-Sinai Medical Center

Authors: Sara Paquet, MD
Jennifer Ross, MD
Matthew Eng, MD (Faculty Mentor)

BACKGROUND
Recently, a regional technique has been described which provides perioperative analgesia for patients undergoing thoracic wall surgery, the serratus plane block (SPB). The SPB has been described to reduce pain in breast and thoracic wall surgeries, and more recently for rib fractures. We present yet another potential application of this regional anesthesia technique in patients undergoing shoulder arthroplasty.

CASE REPORT
Two patients undergoing unilateral shoulder arthroplasty at Cedars-Sinai Medical Center reported severe axillary/chest wall pain in the PACU despite receiving interscalene nerve blocks preoperatively. This residual pain was presumably secondary to a number of factors including intraoperative manipulation of the joint, radiating pain from the surgical site, fluid extravasation, and/or intraoperative positioning. We performed an SPB, which resulted in immediate resolution of pain.

To achieve analgesia, ultrasound guidance was used to identify the fifth rib in the midaxillary line, using the thoracodorsal artery as a landmark to aid in identification of the plane superficial to the serratus muscle. The StimuQuik 3.5” needle was then advanced in-plane to the probe. Monitoring the needle location by ultrasound continuously, we then injected 25 cc of 0.5% bupivacaine with 1:200,000 epinephrine. Within thirty minutes after injection, we confirmed that the patients were experiencing decreased or no pain. The SPB provided coverage from T2-T9.

This is the first case series described in the literature of the SPB used in shoulder replacement surgeries. As such, we describe a novel application of SPB for refractory chest wall pain after interscalene blocks in two shoulder arthroplasty patients. Given the analgesic results and low risk profile of the SPB, it should be considered for patients experiencing chest wall pain in shoulder replacement surgeries.
Right breast mastectomy and reconstruction with tissue expander under thoracic paravertebral blocks in a 12 week parturient

Presenters: Shara Cohn, MD, Resident
Stanford University

Authors: Christopher Allen-John Webb, MD
Paul David Weyker, MD
Shara Cohn, MD
Amanda Wheeler, MD
Jennifer Lee, MD (Faculty Mentor)

Paravertebral blocks are becoming increasingly utilized for breast surgery with studies showing improved postoperative pain control, decreased need for opioids, and less nausea and vomiting. We describe the anesthetic management of an otherwise healthy woman who was 12 weeks pregnant presenting for treatment of her breast cancer. For patients undergoing breast mastectomy and reconstruction with tissue expanders, paravertebral blocks offer an anesthetic alternative when general anesthesia is not desired.
**The Paravertebral Block for Hepatobiliary Surgery: A Retrospective Case Series**

**Presenter:** Marissa Bell, MD, Resident  
University of Southern California

**Authors:**  
Sanaz Ghaffari, MD (Faculty Mentor)  
Marisa Bell, MD  
Mojgan Moallempour, MD (Faculty Mentor)

**Background:**

Developed in 1905 for obstetric applications, the paravertebral block (PVB) was not widely used until recently. Advances in ultrasound technology, as well as the safety and reliability of PVB, are contributing to its resurgence in modern anesthetic practice. At Keck Medical Center of USC, we are utilizing thoracic bilateral PVBs as an alternative to epidural blockade for hepatobiliary surgery. This poster will address a retrospective case series of 6 patients.

**Methods:**

During a 1-month period at a tertiary medical center, 7 patients underwent elective hepatobiliary surgery with preoperative placement of bilateral PVB with continuous catheter infusion. A retrospective review was completed to identify: a) patients’ pain scores on postoperative days (POD) 1 through 3, and b) their respective opioid use.

**Results:**

Patients ranged from 38 to 81 years old. There were 2 men and 4 women. The surgeries consisted of: 1 whipple procedure, 1 bypass gastrojejunostomy, and 4 liver resections. All patients had bilateral PVB catheters placed preoperatively. Postoperatively bilateral ON-Q pump infusions were started of Ropivacaine 0.2% at 8ml/hr. On POD #1, pain scores ranged from 0 to 7 at rest, and 2 to 8 with movement. On POD #2, pain scores ranged from 0 to 4 at rest, and 2 to 8 with movement. On POD #3, pain scores ranged from 0 to 2 at rest, and 2 to 4 with movement. In addition to PVB infusion, patients also received Dilaudid patient controlled analgesia. Total Dilaudid consumption ranged from: 0.3 to 4.4 mg on POD #1, 0 to 4.8 mg on POD #2, and 0 to 4.6 mg on POD #3.

**Conclusion:**

The results support the role of using PVB in hepatobiliary surgery for aiding postoperative pain relief. Additional studies comparing PVB with a control group will further validate PVB’s impact on postoperative pain control.

Presenter: Brian Kim, MD, Resident
University of California, San Diego

Authors: Brian Kim, MD
Swapnil Khoche, MD

The incidence of life-threatening complications of thoracic aortic aneurysms (after critical sizes have been reached) is reported to be 31% in ascending lesions greater than 6 cm. In this case report, a 91 year old female patient with a past history of an unresolved 9x7.6 cm dissected ascending aortic aneurysm extending into the coronaries, presented after a mechanical fall with a displaced trochanter fracture, and was scheduled for a hemiarthroplasty. Pertinent medical history consisted of rate-controlled atrial fibrillation and remote pulmonary emboli, not managed with anticoagulation. She also had severe Aortic Stenosis with a valve area of 0.85 cm², and severe pulmonary hypertension by transthoracic echocardiography. She was not a surgical candidate, even in the face of rupture, and wished for minimal necessary intervention. Due to her tenuous status, extremely high risk for complications (including further dissection, rupture, and even death), a subarachnoid block with isobaric bupivacaine was successfully utilized with stable intraoperative hemodynamics. Arterial access was obtained prior to administration of the block. Peri-procedural sedation consisted of alfentanil, and subhypnotic doses of ketamine. This case report highlights the indications for utilizing neuraxial blockade as well as the anesthetic management and complications of critical thoracic aortic aneurysms, but within the context of the holistic perioperative management.
Successful use of fat emulsion therapy in resuscitation of a patient with suspected local anesthetic toxicity from pudendal block

Presenter: Sam Afshar, MD/DO, Resident
University of Arizona

Authors: Sam Afshar, MD/DO
Charles Otto, MD
Courtney Castoro, MD

Background:
Local anesthetic toxicity is a rare and life-threatening event. Dr. Guy Weinberg initially studied fat emulsion therapy as a potential antidote for bupivacaine induced local anesthetic toxicity. Prior to lipid emulsion therapy, the treatment for local anesthetic toxicity was supportive with prolonged ACLS and cardio-pulmonary by-pass.

Case Description:
A 38 year-old male with past medical history of: asthma, GERD, obesity, and perianal abscess with subsequent development of perianal fistula presents for fistula closure. After preoperative evaluation, a 20 G IV was placed in the left hand and the patient was taken to the operating room. Patient was connected to standard ASA monitors. He was pre-oxygenated and IV induction was achieved with: lidocaine, fentanyl, and propofol. Patient was paralyzed with succinylcholine. Trachea was intubated with a size 8 ETT. Patient was placed on prone view bed and positioned in standard fashion. Maintenance of anesthesia was achieved with inhaled anesthetic. Near the end of the procedure the surgeon performed bilateral pudendal blocks with 30CCs of 0.5% bupivacaine. Shortly after the block patient became bradycardic (with a junctional rhythm), hypotensive and hypoxic. Operating room staff and surgeons were informed of the changes in vital signs. Patient was bag mask ventilated with FiO2 of 100%. Intravenous Epinephrine was administered. Patient was returned to the supine position. ETT tube position was confirmed and patient was placed on volume control. Central venous catheter was placed and infusions of 20% fat emulsion and epinephrine were started. Patient returned to sinus rhythm and hemodynamic stability was achieved.

Discussion:
Fat emulsion therapy is now a part of American Society of Regional Anesthesia guideline for treatment of local anesthetic toxicity. This is a case report of suspected bupivacaine toxicity with hemodynamic instability and successful resuscitation in a patient whose treatment regiment included fat emulsion therapy.
Regional

Poster # MM17

**Bilateral Thoracic Paravertebral Catheter Placement for Mediastinal Chest Tube Pain: Case Report**

**Presenter:** Stephanie Pan, MD, Resident  
University of Washington

**Authors:**  
*Stephanie Pan, MD*  
*Zachary Fisk, MD (Faculty Mentor)*

**Introduction:**

There is substantial evidence for the effectiveness and safety of paravertebral blocks for post-thoracotomy pain management. To our knowledge, the use of paravertebral blocks for pain associated with mediastinal chest tubes after cardiac surgery has not been described.

**Case report:**

A 66-year-old man (BMI 28, ASA IV) with history of chronic lower back pain treated with twice-a-day Morphine ER 30mg underwent coronary artery bypass grafting (CABG) and aortic valve repair. After an uncomplicated intraoperative course, he was transferred to the surgical intensive care unit with three mediastinal chest tubes present on each side of midline in the vicinity of the xyphoid process. Upon extubation on post-operative day 1, the patient reported unbearable pain (pain score 10/10) at the mediastinal chest tube insertion sites despite receiving his usual Morphine ER, scheduled acetaminophen, and hydromorphone PCA.

Bilateral paravertebral catheters were placed at T7 under ultrasound guidance. Within five minutes of placing the blocks and bolusing each catheter with 15mL of 0.5% ropivacaïne the patient’s pain diminished to 0/10 at rest and 3/10 with deep breathing. Incentive spirometry efforts immediately improved from 250cc to 750cc. The catheters remained in place with an infusion of 1/8% bupivacaine at 6ml/hr each while the chest tubes were present. On each of those subsequent mornings the patient’s pain scores remained between 0 and 4 with deep inspiration. The patient’s PCA usage remained minimal and no opioid related side effects were noted. Incentive spirometry recorded values continued to improve to above 1000cc. He remained hemodynamically stable for the duration of the paravertebral block infusions without requiring any vasopressors.

**Conclusion:**

Thoracic paravertebral blocks offer a unique and effective adjunct for pain control in patients who have undergone cardiac surgery or who have mediastinal chest tubes while decreasing opioid requirements and maintaining hemodynamic stability.
Epidural anesthesia is a key component of the modern anesthetic. The use of the test dose is a critical evaluation tool to determine where the tip of the epidural catheter lies: epidural, intravascular, subdural or intrathecal space. Spinal cord stimulators (SCS) are indicated for CPRS and FBSS and are increasing in popularity. The electrodes of a SCS sit in the epidural space with conducting wire running along the lateral spine to a generator in the gluteal region.

We describe a case of sudden unresponsive after epidural test dose administration at T7/8 for a 73 year old female scheduled for Whipple surgery with an unknown in situ SCS. After confirming negative aspiration, the test dose of lidocaine 45mg plus epinephrine 15ug was given. The patient then became somnolent, bradycardic and hypotensive. Ventilation was supported with intermittent bag mask ventilation, and hemodynamics were supported with atropine and ephedrine. After 5 minutes, spontaneous respirations resumed and the epidural catheter was removed. Closing films revealed a SCS at T9-11. The patient made a complete recovery with normal functioning of her SCS.

Our differential included high spinal, subdural administration, high epidural or vasovagal response. The Tuohy needle may have entered the subdural space with subsequent puncture of the subarachnoid membrane by the catheter. Alternatively, given the acquired spinal stenosis secondary to SCS electrode panel, her symptoms may have been the result of a high epidural. Additionally, sedation in combination with high baseline anxiety may have culminated in a vasovagal response. Importantly, identification of a high block must be treated immediately. SCSs can be placed through small incisions. Every possible mode of therapy for patients with chronic pain must be thoroughly examined.
**A Standardized ICU to OR Handoff Increases Face-to-Face Communication, Patient Readiness and Provider Satisfaction Without Delaying Surgery**

**Presenter:** Stephen Kelleher, MD/DO, Resident  
Stanford University

**Authors:**  
Stephen Kelleher, MD/DO  
Juan Marquez, BA/BS  
Melanie Gipp, MD/DO  
Paul Sharek, MD/DO  
Thomas Caruso, MD/DO (Faculty Mentor)

**Background:**
Transitions of care for Intensive Care Unit (ICU) patients are periods of vulnerability. Many studies have focused on Operating Room (OR) to ICU or OR to Post Anesthesia Care Unit (PACU) handoffs, however the transition from ICU to OR has not been previously studied. The primary aim of this study is to determine if a standardized ICU to OR handoff process increases standardized face-to-face physician handoffs and improves patient readiness. Secondary aims include determining if a standardized ICU to OR handoff improves anesthesiologists’ satisfaction without delaying surgery timeliness.

**Methods:**
We conducted a prospective cohort study at a 311-bed academic pediatric hospital in Northern California. The intervention consisted of (1) development of a handoff process using the I-PASS structure and a nursing checklist to prepare ICU patients for transport to the OR; (2) collection of pre-implementation data on frequency of handoffs, patient readiness, anesthesiologist satisfaction, and first-case on-time start and turnover times; (3) staff education prior to and during implementation of the restructured process; and (4) collection of post-implementation data.

**Results:**
Comparison of pre-implementation and post-implementation data showed that the frequency of ICU physician to anesthesiologist handoffs increased from 25% to 86% (p<.0001), patient readiness increased from 61% to 97% (p=.001), and paired mean total satisfaction scores for anesthesiologists increased from 23 to 32 (p = .002). There was no significant difference in first case-start delays or turnover time when comparing the pre-implementation and post-implementation phases.

**Conclusion:**
A standardized protocol for multidisciplinary ICU to OR handoff prior to patient transport increases the frequency of ICU face-to-face physician to anesthesiologist handoff, improves patient readiness for transport, and increases anesthesiologist satisfaction without contributing to delays in first-case surgery start times or an increase in OR turnover time.
Residents must embrace the quality and safety systems at their different clinical training sites throughout residency. At our primary clinical site, housestaff involvement in incident reporting is well publicized and frequently encouraged. A link to the reporting system, System Quality Improvement System (SQIS), is on the main page of the Health Affairs Intranet. Incidents are reviewed daily by the Critical Events Management Team (CEMT), which includes Graduate Medical Education leadership, who also share the reports entered by housestaff and the Housestaff Safety Officers. Common reporting themes by residents include medication errors (ordered but not given correctly) and policy/procedure gaps.

Similar systems are not as readily available at other sites. For instance, at the Long Beach Veterans Affairs (LBVA), quality management policies and incident reporting systems are in place, but housestaff are not frequently informed of reporting systems, and these access to these resources requires physical presence on the LBVA campus. Reported incidents are both addressed internally and submitted to a national patient safety program; further investigation leads to changes to process or policy.

Accessibility and ease of reporting systems are especially important as physicians are less likely to report incidents than nursing staff (1), and incident reporting systems identify as few as 7% of patient safety incidents (2). For an information reporting system to be successful, it must be easily accessible for all staff as well as produce visible, meaningful results. Learning different systems of incident reporting, as well as how the data collected can be harnessed for meaningful use is an important part of residency training. Such exposure during training results in the production of residents capable of seizing quality improvement opportunities and creating high reliability organizations.
Anesthesia Resident Implementation of a Standardized Intraoperative Handoff Checklist Tool during Surgical Case Handovers.

Presenter: Janice Man, MD, Resident
University of California, San Francisco

Authors: Janice Man, MD
Janine Ajalat, MD
Alex Edwards, MD
Shin-e Lin, MD
Rondall Lane, MD (Faculty Mentor)

Background:
Intraoperative patient handovers are prone to communication errors, and with the increasing number of intraoperative patient handovers due to work-hour restrictions, this can negatively impact patient safety. We implemented an intraoperative handoff protocol and checklist, the Anesthesia Resident Checklist for Handoffs (ARCH) tool, which standardized communication of critical perioperative patient information during transfer of patient care involving a resident during a surgical case at the end of the day.

Methods:
We measured compliance with the handoff tool amongst residents by auditing surgical cases handovers and tracking the performance and documentation of the intraoperative handoff checklist within anesthesia charts. We also collected quantitative and qualitative information from anesthesia providers pre-implementation, mid-implementation, and post-implementation of the standardized intraoperative handoff checklist.

Results: Overall residents had a cumulative compliance rate of 86% with the handoff tool for the entire academic year of 2013-2014. Providers had an increase from 42% to 85% with their satisfaction of receiving intraoperative handoff information from another anesthesia provider after implementing the ARCH tool. Providers had an increase from 65% to 87% with their satisfaction of being able to communicate intraoperative handoff information to another provider confidently after implementing the ARCH tool. Providers had an increase from 65% to 80% when surveyed about their confidence in their intraoperative and postoperative management of patients after receiving a handoff from another anesthesia provider after implementing the ARCH tool.

Discussion:
Current literature on handover of care from the operating room to post-anesthesia or intensive care units recommend and support the standardization of the handover process through the use of checklists and protocols, and demonstrate an association between poor-quality handovers and adverse events. We have demonstrated not only successful provider utilization of a standardized checklist but also an increase in overall provider satisfaction with intraoperative handoffs after implementation of the ARCH tool.
UCSF ARCH

Preoperative Patient Information
- Name/Age/Weight
- Diagnosis & Procedure
- Allergies and reactions
- Preop Vitals
- Pertinent PMH/PSH/Prior anesthetic complications
- Chronic pain history
- Pertinent home meds

Intraoperative Anesthetic Information
- Preop Regional/Neuraxial anesthesia
- Airway assessment, Technique used
- Ventilator settings
- Type of anesthesia and anesthetic course/events
- Access and lines
- Intraoperative medications/Antibiotics including dose and time
- Current labs, planned labs
- Fluids/EBL/UOP

Surgical Information
- Surgery attending name and team members name (scrub, circulator, resident, neuromonitoring, etc)
- Surgical course, time until completion, anastomoses, bypass/circulatory arrest
- Drains/packing/tourniquet

Assessment & Care Plan
- Current Vitals
- Available blood products
- Anticipatory Guidance: fluid management, pain management
- Post-op destination (PACU/ICU)
- Most important thing I’m concerned about is: ____________
Evaluation of Surgery Cancellations at Cedars Sinai Medical Center during a One Year Period

Presenter: Yelena Neyman, MD/DO, Resident
Cedars-Sinai Medical Center

Authors: Yelena Neyman, MD
Roya Yumul, MD (Faculty Mentor)
Xiao Zhang, PhD
Pardes Seleh,

Last minute cancellations of surgical procedures cause patient stress, anxiety, and dissatisfaction with medical care as well as significant economic losses to the hospital. Studies performed at other major medical centers revealed major causes to be administrative and change in clinical status and/or inadequate optimization of medical comorbidities. This is a retrospective study, aimed to identify the most common cause of same day cancellations at Cedars Sinai Medical Center in order to streamline perioperative care with the goal of improving patient satisfaction, clinical outcomes, and to reduce economic loss.
**Prolonged PACU stay following outpatient ophthalmologic surgery**

Presenter: Rachel Steckelberg, MD, Resident  
University of California, Los Angeles

Authors:  
Rachel Steckelberg, MD  
Theodora Wingert, MD  
Mary Keyes, MD  
Wendy Ren, MD (Faculty Mentor)  
Zhuang Fang, MD (Faculty Mentor)

Background: Ophthalmic surgeries are considered low-risk procedures, especially for outpatient procedures performed under Monitoring Anesthesia Care (MAC). The incidence of serious systemic postoperative complications leading to a prolonged stay in the Post Anesthesia Care Unite (PACU) following outpatient eye surgery is not well defined. Furthermore, these complications may have significant medical and economic impact to the ambulatory surgery center.

Objective: To determine the incidence of prolonged post-anesthesia care unit (PACU) stay following outpatient ophthalmic surgery at a major outpatient ophthalmologic surgery center and the associated factors.

Hypotheses: The identification of factors associated with prolonged PACU stay following outpatient ophthalmic surgery will help to target therapies and early interventions.

Methods: All adult patients with prolonged PACU stays following outpatient ophthalmologic surgery were identified. The details of the PACU stay, demographic data, duration of surgery, type of anesthesia, and medications administered were recorded. All patients enrolled in the study were optimized for the proposed surgery. Risk factors (including the risk incurred by general/MAC anesthesia) for prolonged PACU stay were noted. Data analysis consisted of a simple, descriptive analysis.

Results: From March 2013 to January 2015, there were 58 patients with prolonged PACU stay. The overall incidence was 0.6%. Of these, 59% (n=34) were due to hypotension, while 45% patients had profound bradycardia (n=26). The majority of patients with postoperative bradycardia and/or hypotension received MAC anesthesia with IV fluid administration. The average PACU stay was 4 hours.

Conclusion: Although prolonged PACU stay is not a common occurrence following outpatient ophthalmologic surgery, it is important to identify factors that put patients at increased risk for this adverse outcome. Our study provides evidence that even MAC anesthesia is not without risk and post-op complications may still occur. Further data is needed to better define the associated factors with prolonged PACU stay following outpatient ophthalmic surgery.
**EFFECTS OF INTRAVENOUS FLUID RESTRICTION AND MULTIMODAL PAIN MANAGEMENT AS PART OF THE ENHANCED RECOVERY AFTER SURGERY PROTOCOL ON RENAL FUNCTION**

**Presenter:** Evan Franke, MD, Resident
Mayo Clinic

**Authors:**
- Evan Franke, MD
- Andrew Gorlin, MD (Faculty Mentor)
- Efrain Cubillo, MD
- Awais Ashfaq, MD
- Tonia Young-Fadok, MD

1. Purpose

Enhanced Recovery After Surgery (ERAS) is a multi-disciplinary, evidence based approach to perioperative care that aims to facilitate recovery through multimodal pain control with limited opioids, early feeding and ambulation, and avoiding fluid overload perioperatively. Though euvolemia was the protocol’s stated goal, there was some concern that fluid restriction might increase the use of vasopressors and/or result in renal insufficiency. The purpose of this study is two-fold: 1. To evaluate whether the goals of the anesthesia ERAS protocol are being met, and 2. To determine the impact of fluid restriction on intraoperative vasopressor usage and postoperative renal function.

2. Methods

This IRB approved (14-000790) retrospective case-control study utilized an ongoing database of patients undergoing laparoscopic colon resection pre- and post-ERAS implementation.

3. Results

Patients in the ERAS (n=39) and pre-ERAS (n=32) groups were similar in terms of demographics. Fluid restriction guidelines were followed appropriately with pre-ERAS and ERAS patient receiving an average of 721ml/hr vs 542ml/hr of IV fluids, respectively (P=0.0006). Hydromorphone use was reduced with an average dose of 0.96mg vs 0.49mg in pre-ERAS and ERAS patients, respectively (P=0.01). The pre-ERAS and ERAS groups did not show a statistically significant change in renal function. Intraoperative vasopressors usage also did not differ significantly. Ephedrine was used in 41% of pre-ERAS cases and 54% of ERAS cases with an average dose of 7.73mg vs 7.56mg, respectively (P=0.95). Phenylephrine was used in 31% of pre-ERAS cases and 36% of ERAS cases with an average dose of 165mcg vs 143mcg, respectively (P=0.79).

4. Conclusions

Following implementation of an intraoperative ERAS protocol, laparoscopic colorectal surgical patients received significantly less intraoperative fluid and long acting opioids. Fluid restriction did not lead to an increase in vasopressor usage or a decline in postoperative renal function when compared to pre-ERAS protocol patients undergoing similar procedures.
THE SHIFT IN ANESTHESIOLOGIST PRACTICE PATTERNS DURING A DRUG SHORTAGE

Presenter: Thomas Engar, MD, Resident
Virginia Mason

Authors: Thomas Engar, MD
April Slee, MS/MA/MPH
Robert Hsiung, MD (Faculty Mentor)

Introduction: Drug shortages frequently challenge anesthesiologists. We examined how a moratorium on propofol use for sedation during a severe drug shortage affected anesthesiologists' choice of anesthetic for lower extremity total joint replacement surgery. Our theories were that providers would choose an alternative agent for sedation during a propofol shortage and that the rate of general anesthetics would increase.

Methods: This study included all patients scheduled for elective hip and knee joint replacement surgery from December 1st, 2012, to February 15th, 2013. Retrospective review of the EMR was used to analyze the perioperative data to determine the primary anesthetic modality.

Results: 286 total patients were identified according to anesthetic modality at the time of incision: 199 in the spinal with propofol sedation group, 24 in the spinal with dexmedetomidine sedation group, and 63 in the general anesthesia group. The propofol shortage occurred from January 7th, 2013, through January 16th, 2013. During this time some providers continued to use propofol for sedation despite repeated requests to stop use, others elected to use dexmedetomidine for sedation, while others utilized general anesthesia (figure 1). The rate of general anesthetic use remained stable during and after the shortage.

Conclusion: Anesthesiologists utilized dexmedetomidine for sedation under spinal anesthesia during a propofol shortage. Despite the critically low supply, other providers elected to continue propofol use. General anesthesia utilization remained unchanged. The use of dexmedetomidine did not continue after the shortage, possibly due to bradycardia, longer PACU stays, and less familiarity with the drug. While dexmedetomidine is a sedation alternative for total joint replacement surgery under spinal anesthesia, it is unlikely to be widely used in the future compared to propofol, except in times of drug shortage.
Figure 1: Anesthetic Type from 12/1/12 to 2/15/13

- Spinal with Propofol
- Spinal With Dexmedetomidine
- General

Percent of Anesthetics Performed

Week
Early Perioperative Outcomes After implementation of an Enhanced Recovery After Surgery Pathway for Colorectal Surgery

Presenter: Jonathan Cheah, MD/DO, Resident
University of California, San Francisco

Authors: Jonathan Cheah, MD/DO
Candance Shavit, MD/DO
Spencer Yost, MD/DO (Faculty Mentor)
Ramana Naidu, MD/DO (Faculty Mentor)
Lee-lyn Chen, MD/DO (Faculty Mentor)

Introduction: Enhanced Recovery After Surgery (ERAS) represents a multidisciplinary approach guided by evidence based medicine to standardize perioperative care and improve patient outcomes. After development and initiation of a colorectal surgery ERAS pathway at a tertiary care center, we analyzed perioperative patient data, LOS, pain visual analog scores (VAS), readmission rates, and adherence to the ERAS pathway.

Methods: A retrospective analysis was conducted for 67 patients undergoing laparoscopic resections of the colon and/or rectum (ileocolectomy, perineal resection of the rectum, colectomy, lower anterior resection of the rectum, proctectomy) by four colorectal surgeons from Oct 2013 to Sept 2014. The control cohort consisted of 164 historical patients from one year prior to the implementation of the pathway. We evaluated both cohorts for perioperative data, postoperative nausea/vomiting, and adherence to the ERAS pathway.

Results: Both groups had similar ASA status, age, total intraoperative resuscitation, EBL, and urine output. In the post-ERAS group there was a significant increase in epidural catheter placement, decrease in total time of epidural catheter use, faster advancement to a non-NPO diet, and reduced LOS and readmission rates. Epidural catheter use, PONV prophylaxis, and multimodal analgesics with gabapentin and acetaminophen had a high level of adherence. Patients in the ERAS pathway experienced a significant decrease in VAS pain scores postoperatively from the PACU through postoperative day 1 (Table 1).

Discussion:
The positive benefits of the ERAS pathway supports short and long term improvements for patients having major laparoscopic colorectal surgery. Patients experienced improved postoperative pain scores, faster advancement of enteral nutrition, and increased epidural catheter usage with a high adherence to the ERAS pathway’s multimodal analgesia medications. Long term benefits included a shorter LOS and reduced readmission rates.

### Table 1: Data for Laparoscopic Colorectal Procedures

<table>
<thead>
<tr>
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<th>Pre-ERAS (164)</th>
<th>Post-ERAS (67)</th>
<th>P-value</th>
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</thead>
<tbody>
<tr>
<td>ASA</td>
<td>2.34</td>
<td>2.28</td>
<td>0.3948</td>
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<td>Gender % Male</td>
<td>62.19%</td>
<td>24%</td>
<td>&lt;0.05</td>
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<td>Age</td>
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<td>52.5</td>
<td>0.751</td>
</tr>
<tr>
<td>Epidural Usage %</td>
<td>45.70%</td>
<td>97%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Measure</td>
<td>Value 1</td>
<td>Value 2</td>
<td>P-value</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Hour Use of Epidural</td>
<td>70.7</td>
<td>56.97</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Crystalloid ml</td>
<td>1851.5</td>
<td>2371.3</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Colloid ml</td>
<td>248.5</td>
<td>147.8</td>
<td>0.217</td>
</tr>
<tr>
<td>pRBC Units</td>
<td>0.146</td>
<td>0.05882</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>EBL ml</td>
<td>168.5</td>
<td>191.5</td>
<td>0.562</td>
</tr>
<tr>
<td>Urine ml</td>
<td>320.4</td>
<td>303.9</td>
<td>0.79</td>
</tr>
<tr>
<td>PACU BP High mmHg</td>
<td>133/71</td>
<td>124/67</td>
<td>&lt;0.05 /0.81</td>
</tr>
<tr>
<td>PACU BP Low mmHg</td>
<td>110/61</td>
<td>101/56</td>
<td>&lt;0.05/&lt;0.05</td>
</tr>
<tr>
<td>Readmission %</td>
<td>25.60%</td>
<td>7.30%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Length of Stay Hours</td>
<td>246.90</td>
<td>150.55</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>PONV Treatment</td>
<td>46.95%</td>
<td>59.70%</td>
<td>0.084</td>
</tr>
<tr>
<td>Non-NPO Diet POD 0</td>
<td>9.81%</td>
<td>50.74%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Non- NPO Diet POD 1</td>
<td>30.67%</td>
<td>86.57%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Non- NPO Diet POD 2</td>
<td>68.09%</td>
<td>95.52%</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>VAS Preop</td>
<td>1.31</td>
<td>0.50</td>
<td>0.125</td>
</tr>
<tr>
<td>VAS PACU</td>
<td>3.25</td>
<td>2.22</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>VAS POD 0</td>
<td>3.12</td>
<td>1.62</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>VAS POD 1</td>
<td>2.99</td>
<td>1.92</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>VAS POD 2</td>
<td>2.77</td>
<td>2.49</td>
<td>0.2754</td>
</tr>
<tr>
<td>Adherence Epidural Use</td>
<td>97%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence Scopalamine Preop/POD 2</td>
<td>25%/16.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence Gabapentin Preop/POD 2</td>
<td>100%/83.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence Acetaminophen Preop/POD2</td>
<td>99%/82%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence Diclofenac Preop/POD 2</td>
<td>50%/25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adherence Zofran Intraop</td>
<td>91.1%</td>
<td></td>
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</tr>
</tbody>
</table>
Implementation of the Perioperative Surgical Home At UC Irvine: Creating a Collaborative and Multidisciplinary Postoperative Team

Presenter: Vishal Khemlani, MD, Resident
University of California, Irvine

Authors: Vishal Khemlani, MD
Navid Alem, MD (Faculty Mentor)
Maxime Cannesson, MD
Zeev Kain, MD

Intro:
An escalation in the cost of perioperative health care delivery that has not been paralleled by enhanced patient outcomes has rendered an opportunity to search for innovative practice models that stress provider cohesion throughout the perioperative continuum. The Perioperative Surgical Home (PSH) has emerged as one practice model that seeks to remedy this disparity. However, the challenge remains as to how to tangibly implement a system that is accentuated by extended anesthesiologist led perioperative care.

Discussion:
Transitions or “handoffs” are susceptible periods that may expose patients to gaps in quality and safety. The PSH practice model aims to reduce variability and avoid fragmented clinical care by stressing continuity of care. As such, at UC Irvine, an innovative perioperative team was created by the Anesthesiology Department. The intraoperative anesthesiology team will contact the perioperative team after every case as a means to readily review relevant patient history, intraoperative care, and immediate postoperative goals. The PSH collaborative between the departments of anesthesiology and surgery allows this dedicated team to provide fulltime medical coverage for all enrolled patients post-operatively. In this model, an anesthesiology team comprised of an attending, fellow, nurse practitioner and resident coordinate multidisciplinary resources including physical therapy, pharmacy, social work, case-management and nutrition specialists to augment postoperative care. In effect, the team shepherds patients until the day of discharge and beyond, ensuring that all evidence based milestones are met as outlined by established clinical pathways that guide enhanced recovery.

Conclusion:
As Health Care continues to dynamically evolve to parallel the contemporary needs of both our patients and healthcare systems, it is essential that as a specialty we share with each other our successes and failures. As outlined in this abstract, implementation of the UC Irvine Perioperative Team is one manifestation of the innovative PSH model.

References:
1) Mackey D: Can we finally conquer the problem of medical quality? The systems-based opportunities of data registries and medical teamwork. Anesthesiology 2012; 117 (2): 225–6.
The PSH fellow must be called by the Intraoperative Anesthesiology Attending at 714-456-CURE at the conclusion of the case to give a report.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Pain Management Plan</th>
<th>Post Op Pathway:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Name</td>
<td>Age</td>
<td>Surgeon</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

**Background**
- Major Medical Co-morbidities
- Intraoperative clinical pathway followed/not followed
- Significant intraoperative events
- Most recent Hemoglobin/Labs are
- Fluid Status
- Foley yes/no
- NG Tube yes/no
- Drains yes/no
- Hemodynamic stability
- The patient (is/is not) opioid tolerant (*Opioid tolerant is 60 mg PO morphine/daily or equivalent*)

**Assessment**
- Patient is at high risk for the following perioperative events
- Risk reduction strategies employed
- Patient disposition plan

**Recommendations**
- Perioperative recommendations for risk reduction and optimization include

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Figure 1: Serving as a reference guide, this table prioritizes the essential information necessary for the intraoperative team to efficaciously communicate to the perioperative surgical home team at the conclusion of every case.
A Fast-Track Anesthesia Pathway for Video-Assisted Thoracoscopic Surgery

Presenter: Andrew Hollister, MD, Resident  
Virginia Mason

Authors: Andrew Hollister, MD  
Grete Porteous, MD (Faculty Mentor)

BACKGROUND: Video-Assisted Thoracoscopic Surgery (VATS) is increasingly common, and the optimal approach to fast-track patient recovery has not been described.

METHODS: A combined surgical and anesthetic pathway to standardize perioperative management of patients undergoing VATS was implemented at our institution. The anesthetic aspect of the pathway involved the use of multimodal analgesics, regional anesthesia (paravertebral blocks or thoracic epidurals), minimizing use of arterial lines, restricting intraoperative fluids, and using lung protective ventilation techniques. Following IRB approval, we retrospectively reviewed the charts of patients who had VATS performed by a single surgeon in a two month period before and a two month period after implementation of the pathway. The primary outcomes measured were length of stay in the post-anesthesia care unit (PACU) and 24-hour morphine consumption after surgery. Secondary outcomes were measures of adherence to the new pathway and hospital length of stay.

RESULTS: The charts of 54 patients were reviewed: 28 who had operations before the pathway was implemented, and 26 after. Mean (± SD) PACU time to discharge readiness declined modestly from 97 ± 49 minutes to 85 ± 40. Median 24 hour intravenous morphine consumption declined slightly (36 mg [IQR 19-59] before vs. 25 mg [IQR 17-42] after). Use of regional anesthetic techniques increased from 47 to 88%. Use of multimodal analgesics increased similarly, and arterial line placement decreased from 61 to 39%. In combination with changes in surgical postoperative management, hospital length of stay decreased from a median of 3.5 to 2 days.

CONCLUSION: Implementation of a perioperative anesthetic pathway for VATS surgery was associated with a small decrease in PACU length of stay and immediate postoperative opioid consumption. Clinician adherence to the pathway was very good. In combination with changes in surgical management, hospital length of stay was reduced.
Table 1

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before (n=28)</th>
<th>After (n=26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital LOS (median, IQR)</td>
<td>3.5 (2.0-5.3)</td>
<td>2 (1.0-3.0)</td>
</tr>
<tr>
<td>Same day admit (%yes)</td>
<td>96</td>
<td>85</td>
</tr>
<tr>
<td>Convert to thoracotomy (%yes)</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Age (mean± SD)</td>
<td>66 ± 14</td>
<td>62 ± 15</td>
</tr>
<tr>
<td>Male (%)</td>
<td>68</td>
<td>39</td>
</tr>
<tr>
<td>BMI (mean± SD)</td>
<td>28 ± 4.6</td>
<td>27 ± 6.2</td>
</tr>
<tr>
<td>Regional Anesthetic (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>53</td>
<td>12</td>
</tr>
<tr>
<td>Thoracic epidural</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>Paravertebral block</td>
<td>29</td>
<td>76</td>
</tr>
<tr>
<td>ASA Classification (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>II</td>
<td>25</td>
<td>54</td>
</tr>
<tr>
<td>III</td>
<td>64</td>
<td>31</td>
</tr>
<tr>
<td>IV</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Arterial line (%yes)</td>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>Intraoperative IV fluids mL (mean± SD)</td>
<td>1300 ± 750</td>
<td>990 ± 350</td>
</tr>
<tr>
<td>Any preoperative multimodals (%yes)</td>
<td>11</td>
<td>81</td>
</tr>
<tr>
<td>Intraoperative dexamethasone (%yes)</td>
<td>71</td>
<td>77</td>
</tr>
<tr>
<td>PACU time to discharge readiness (min) (mean ± SD)</td>
<td>97 ± 49</td>
<td>85 ± 40</td>
</tr>
<tr>
<td>24 hour IV morphine equivalents in patients without epidurals (mg) (median, IQR)</td>
<td>36 (19-58)</td>
<td>25 (17-42)</td>
</tr>
</tbody>
</table>
Association between preoperative measures of cardiac function/perfusion and postoperative rates of ICU admission, cardiac events, mortality, and LOS

Presenter: Otto Thomas, MD, Resident
Cedars-Sinai Medical Center

Authors:
Otto Thomas, MD
Roya Yumul, MD (Faculty Mentor)
Ronald Wender, MD

A retrospective review of 60 subjects who had preoperative cardiac function and perfusion studies and underwent an anesthetic at the Cedars-Sinai Medical Center between 1/1/2010 and 12/31/2011 was performed. Age, sex, ASA physical status, preoperative cardiac function and perfusion indices-in addition to postoperative outcomes such as subsequent 30-day ICU admission rate, 30-day cardiac event rate, 30-day mortality rate, ICU LOS, and total hospital LOS, were recorded. SPECT was used to quantify the above preoperative cardiac function indices, specifically LVEF and EDVI, and the cardiac perfusion index of percent myocardial ischemia. Wilcoxon rank-sum tests were used to compare preoperative cardiac function and perfusion indices between subjects who did and did not subsequently receive care in an ICU, have a cardiac event, or have a fatal cardiac arrest. Pearson correlation coefficients were calculated to evaluate the association between the above indices and both ICU LOS and total hospital LOS.

Preoperative cardiac function indices were not found to have a significant correlation with rates of postoperative ICU admission, cardiac events, mortality, ICU LOS, or total hospital LOS. However, these are results of an interim analysis and the current number of subjects reviewed leaves the analysis underpowered. The cardiac perfusion index, preoperative percent myocardial ischemia, was also not found to have a statistically significant correlation with the above outcomes; however, the association between percent myocardial ischemia and EDVI showed a trend toward significance (r=0.2267, p=0.0842). Although preoperative cardiac function and perfusion values were not shown to be significantly associated with the above outcomes in this interim analysis, certain associations showed a trend toward significance, which is promising for subsequent analyses.