What do you do when you’re called to see someone with:

DYSPNEA

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University of Washington
Overview and Learning Goals

- Mechanisms
- Bedside evaluation
- Emergency care
DYSPNEA: A definition

- An abnormal or uncomfortable sensation of breathing.

- A subjective experience of breathing discomfort that is comprised of qualitatively distinct sensations that vary in intensity.
Patients with Dyspnea

- Type 1 diabetic with nausea & vomiting
- Alcoholic man with acute GI bleed
- Chronic liver failure with ascites
- College student with severe diarrhea
- Elderly woman with CHF
- Medical student with pneumonia
- Hospitalized man with a PE
- Young woman with a pneumothorax
- Senator with COPD

Why do they all have the same symptom?
Pathophysiology

- The respiratory system is designed to maintain homeostasis with respect to gas exchange and acid-base status with the least amount of work possible.

- Derangements in this balance or in the work required to maintain homeostasis can result in dyspnea.
Important Components of the “Respiratory System”

- Brain
- Spinal Cord
- Nerves
- Muscles
- Chest Wall
- Diaphragm
- Pleura
- Airways
- Alveoli
- Heart
- Blood Vessels
- Blood

...even the mighty Mitochondria!
Pathophysiology of Dyspnea

- Increased central drive (dz, meds, psych)
- Excess respiratory muscle work (WOB)
- Poor airflow and lung stretch
- Gas exchange & metabolic demand
  - Oxygenation of the blood (hypoxemia)
  - Oxygen delivery to the tissues (tissue hypoxia)
  - CO$_2$ clearance (hypercapnia)
  - Acid production (metabolic acidosis)

Many conditions have more than one mechanism
Case #1

- You are the Night Medicine intern. The RN calls you at 2:30 AM to report that Ms. Petunia Acco, a 68 yo woman admitted 5 days ago for CAP and a mild COPD flare, has worsening dyspnea. The nurse asks you what you would like to do.

- You check your sign-out.
## Case #1

<table>
<thead>
<tr>
<th>Patient</th>
<th>Problem List/PMH</th>
<th>Meds</th>
<th>Signout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acco, Petunia</td>
<td>Mitral stenosis</td>
<td>IV antibiotics</td>
<td>WBC improving</td>
</tr>
<tr>
<td>68 yo W Code: full NKDA</td>
<td>CAD h/o NSTEMI CHF</td>
<td>Prednisone</td>
<td>BCxs negative</td>
</tr>
<tr>
<td>HD 5 – CAP, mild COPD flare</td>
<td>Hyperlipidemia COPD h/o DVT Osteoarthritis</td>
<td>Albuterol/ipratropium ASA Simvastatin Lisinopril Metoprolol Furosemide KCl</td>
<td>SCx non-specific</td>
</tr>
<tr>
<td>STABLE</td>
<td></td>
<td></td>
<td>R subclavian line placed today</td>
</tr>
</tbody>
</table>

NTD
Case #1 - DDx

- COPD exacerbation
- Progressive pneumonia, ALI/ARDS
- Pneumothorax
- Pulmonary edema, CHF, ?ischemia vs. volume overload
- Pulmonary embolus
What would you do next?

- Order furosemide 40 mg IV x 1
- Order CT angiogram
- Go see her
- Stop her IV fluids
- Activate the cath lab
When Called about Dyspnea: Key First Steps

- On the phone, ask for:
  - Vital signs
  - Oxygen saturation
  - Mental status / distress
  - Background - Did something just happen?
- Think: What do you want prior to your arrival?
  - Oxygen, monitor, IV?
  - Albuterol?
  - ABG, ECG, CXR, etc?
- You must see the patient!
Case #1 - Exam

- In moderate respiratory distress
- T 37.4, HR 108, BP 128/67, RR 24, SpO₂ 91% on 4 lpm NC
- No JVD
- Lungs with right basal crackles, occasional soft wheeze with good airflow
- Bilateral pretibial pitting edema, 1+ on the right, trace on the left

What would you order next?
Please don’t order the CXR as:

- F/U
- F/U SOB
Case # 1 - Data

- CXR - RLL focal opacity unchanged from admission, no evidence of worsening CHF or PTX
- ABG - 7.48/34/62 on 4 lpm NC (baseline on 2 lpm NC was 7.39/43/78)
- ECG: no ST-T wave changes, no ischemic changes, no changes from baseline
- What next??
Three “PILLARS” of Care for Patients with Dyspnea

Safety Net
- Oxygen
- IV access
- Monitors

Vital Signs
- Pulse
- BP
- RR
- Temp
- SpO₂ (ABG)
- Mental status

“Dyspnea”
- A
- B
- C
- D
- E
Dyspnea: A – B – C – D – E

- **Airway**
  - Partial Obstruction

- **Breathing (Lung)**
  - Asthma, Atelectasis, COPD, Pleural Effusion, Pneumonia, Pneumothorax, Other Infiltrative Processes

- **Circulation**
  - Anemia, Arrhythmia, CHF, Ischemia, Pericardial Effusion, Shock, PE

- **“Deficits”**
  - Neuro & Musculoskeletal Abnormalities (e.g., Myasthenia gravis, Scoliosis)

- **“Electrolytes/extras”**
  - Abdominal disorders, Acidosis, Sepsis, Anxiety, Over-feeding, Electrolyte Abnormalities (K+, Phosphate)
Dyspnea: A – B – C – D – E

- **Airway**
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Case #1 – What would you do?

- Order a BNP
- Order a D-dimer
- Order a CT pulmonary angiogram
- Order a V/Q scan
- Order an echocardiogram
### Wells Clinical Prediction Model

<table>
<thead>
<tr>
<th>ITEM</th>
<th>POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical signs and sx of DVT</td>
<td>3</td>
</tr>
<tr>
<td>Alternative dx less likely than PE</td>
<td>3</td>
</tr>
<tr>
<td>HR &gt; 100</td>
<td>1.5</td>
</tr>
<tr>
<td>Immobilization or surgery in past 4 weeks</td>
<td>1.5</td>
</tr>
<tr>
<td>Previous PE/DVT</td>
<td>1.5</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>1</td>
</tr>
<tr>
<td>Malignancy (on treatment, treated in last 6 months, or receiving palliative care)</td>
<td>1</td>
</tr>
</tbody>
</table>

Probability: Low < 2 points, Mod 2-6 points, High >6 points

*Wells, et. al. Thromb Haemost 2000;83:416-20*
## Revised Geneva Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk factor</strong></td>
<td></td>
</tr>
<tr>
<td>Age &gt; 65y</td>
<td>1</td>
</tr>
<tr>
<td>Prev. VTE</td>
<td>3</td>
</tr>
<tr>
<td>Recent surgery of Fx</td>
<td>2</td>
</tr>
<tr>
<td>Active malignancy</td>
<td>2</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td></td>
</tr>
<tr>
<td>Unilateral leg pain</td>
<td>3</td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>2</td>
</tr>
<tr>
<td><strong>Clinical signs</strong></td>
<td></td>
</tr>
<tr>
<td>HR 75 - 94 bpm</td>
<td>3</td>
</tr>
<tr>
<td>HR ≥ 95</td>
<td>5</td>
</tr>
<tr>
<td>LE edema and/or pain on palpation of LE</td>
<td>4</td>
</tr>
</tbody>
</table>

**Score**
- Low risk = 0 - 3
- Intermed. = 4 - 10
- High risk = ≥ 11

**Case # 1 = 13**

D-dimer

- Properly used when clinical suspicion is low
  - If negative, no further tests necessary
- If further tests are planned anyway, no need for D-dimer
- Positive result is not diagnostic
- Chance of negative result decreases with age and comorbid disease
- May be unreliable in inpatients
PIOPED II
Why Clinical Scoring is Necessary

Prevalence of PE by Clinical Probability and CTPA Findings

<table>
<thead>
<tr>
<th>Wells Clinical Probability Score</th>
<th>CTA Positive</th>
<th>CTA Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>0.5</td>
<td>38</td>
</tr>
<tr>
<td>Moderate</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>39</td>
<td>99</td>
</tr>
</tbody>
</table>

True Positive
VTE: “Diagnostic Strategy”

- Determine Pre-Test Probability
  - Well’s score, Revised Geneva score
  - Pisa Model, PERC
- Basic Studies: ECG, CXR, ? ABG
- D-Dimer: probably not helpful for inpatients
- Follow a diagnostic algorithm
- V/Q Scan vs. LE Duplex vs. CTPA
- Always ask: should therapy be started?
Case #2

- You are the Night Medicine intern. The RN calls you at 3:30 AM to report that Mr. William Pallor, a 65 yo man admitted early today for an anemia of unclear etiology and COPD has worsening dyspnea. The nurse asks you what you would like to do.

- You check your sign-out.
# Case #2

<table>
<thead>
<tr>
<th>Patient</th>
<th>Problem List/PMH</th>
<th>Meds</th>
<th>Signout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pallor, William</td>
<td>Anemia, HCT 22% COPD, GOLD stage 3</td>
<td>Prednisone, Albuterol/ipratropium s/q heparin</td>
<td>Anemia work-up ongoing. Does not appear to be GI source.</td>
</tr>
<tr>
<td>65 yo M</td>
<td>Med Flr rm 2 Code: full NKDA</td>
<td></td>
<td>NTD</td>
</tr>
<tr>
<td>HD 1 – anemia of unclear etiology, mild COPD flare</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case # 2 - DDx

- A – 
- B – Worsening COPD, Pneumonia, Aspiration of gastric contents
- C – Worsening anemia, CHF, ACS
- D – 
- E – Sepsis
What would you do next?

- Order furosemide 40 mg IV x 1
- Order 2 u PRBC stat
- Order a direct/indirect Coomb’s test
- Activate the cath lab
- Go see him
CASE #2

- EXAM: older, ill, overweight male, AOx3.
- VS: P 110, BP 160/105, RR 22, T 38.1 C, SpO2 89% on RA
- Respiratory distress, diaphoretic, wheezes and rhonchi with scattered crackles and prolonged expiratory phase. No JVD, distant heart sounds, no peripheral edema.

- How would you care for him now?
What would you *not* order now?

- Bedside spirometry
- ABG
- Repeat HCT
- CXR
- Oxygen

- ABG 7.29/54/58/27
- HCT 21%
- CXR – changes c/w hyperinflation but no new opacities or edema
COPD: Acute Therapy

- Oxygen
- Albuterol / Atrovent
- Corticosteroids: for non-ICU, start 40 mg PO prednisone or IV methylprednisolone
- Limited-spectrum antibiotics
- ? Diuretics – *dry lungs are happy lungs!*
- Non-Invasive Ventilation
  - NPPV, BiPAP®
- Intubation & mechanical ventilation
Other Considerations: COPD

- Bedside spirometry usually not helpful
- ABG usually needed
- CXR & ECG usually needed
- Consider: MI, PE, pneumonia, CHF, pneumothorax,
Oxygen Saturation Goals

- Most patients with hypoxemia
  - $\text{SpO2} \approx 92 - 96\%$
- Severe anemia
  - $\text{SpO2} \geq 96\%$
- COPD patients (with exacerbation)
  - at risk for $\text{CO}_2$ retention
  - What’s their baseline?
  - $\text{SpO2} 88 - 92\%$
  - Both over- and under-oxygenation are bad!
Case # 3

- 82 yo man with a PMH of dementia
- Admitted with fever and a decubitus ulcer over his sacrum, receiving wound care, piperacillin/tazobactam and enteral nutrition
- You are called to come see him for dyspnea
- DDx?
Case # 3 - DDx

- A – Mucus plug
- B – Pneumonia, Aspiration of gastric contents
- C – Volume overload, Pulmonary embolus
- D – Respiratory muscle fatigue
- E – Sepsis, Overfeeding
Case # 3 - Exam

- Somnolent but awake, in moderate respiratory distress
- T 38.8, HR 110, BP 95/67, RR 38, SpO₂ 97% on 4 lpm O₂ via NC
- No JVD
- Lungs with a few bibasilar rhonchi, no crackles, no wheezing
- Bilateral trace pretibial pitting edema
Case # 3 - Data

- CXR – low lung volumes, clear
- ECG: ST, no ischemic changes, no changes from baseline
- *What next??*
Case # 3 - Data

- ABG – 7.47 / 25 / 89 (RA)
- *What next??*
- Basic metabolic panel

<table>
<thead>
<tr>
<th>Value</th>
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<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>106</td>
<td>38</td>
<td>168</td>
</tr>
<tr>
<td>3.2</td>
<td>18</td>
<td>1.7</td>
<td></td>
</tr>
</tbody>
</table>

Primary respiratory alkalosis
Anion gap metabolic acidosis
Case # 4

- You are on long-call and get paged to the ED at 10:58 PM to admit Kristi Leeds
- 37 yo W with SLE, Evan’s syndrome (AIHA + thrombocytopenia) with recent flares of her AIHA requiring aggressive immunosuppression (MMF, Cytoxan, Rituxan, steroids)
- Baseline HCT 18 – 21%
- Came in with severe progressive dyspnea on exertion a/w chest heaviness & lightheadedness
- In ED, HCT = 19%. You’re called to admit.
Case # 4 - Exam

- Meds: MMF, Prednisone, Dapsone, Folate
- Awake and alert, slightly increased WOB
- T 37.1, HR 106, BP 130/84, RR 20, SpO$_2$ 89-91% on 2 – 5 lpm NC
- No JVD
- Lungs: clear
- 2/6 SEM but no gallop
- Extremities: no cyanosis or edema
Case # 4 – Initial data

- CXR – clear
- ECG – sinus tach, no acute changes
- HCT 19%
- Basic metabolic panel
  
<table>
<thead>
<tr>
<th>138</th>
<th>102</th>
<th>4</th>
<th>85</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>18</td>
<td>0.6</td>
<td></td>
</tr>
</tbody>
</table>

- ABG – 7.37 / 31 / 92 (2 lpm NC) [SpO₂ 90%]
- What next?
Case # 4: What would you do next?

- CT pulmonary angiogram
- Transfuse 2 u PRBC
- Intubate for impending hypoxemic respiratory failure
- Order a repeat blood gas with a co-oximetry panel
- Order blood cultures and broad-spectrum antibiotics
Case # 4

- Methemoglobin level = 19.6% !!!
- Methylene blue 50 mg IV given
- Dapsone discontinued
Non-Cardiopulmonary Causes
Don’t forget ‘em!

- Metabolic acidosis
- Sepsis
- Anemia
  - Absolute
  - Relative (e.g., methemoglobinemia)
- Ascites
- Neuromuscular disease
- Anxiety
Summary

- Mechanisms
- Bedside evaluation
- Emergency care
Three “PILLARS” of Care for Patients with Dyspnea

**Safety Net**
- Oxygen
- IV access
- Monitors

**Vital Signs**
- Pulse
- BP
- RR
- Temp
- SpO₂ (ABG)
- Mental status

**Survey**
- A
- B
- C
- D
- E
Dyspnea: A – B – C – D – E

- **Airway**
  - Partial Obstruction

- **Breathing**
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  - Abdominal disorders, Acidosis, Sepsis, Anxiety, Over-feeding, Electrolyte Abnormalities (K+, Phosphate)
Case # 5

- 48 yo man with a PMH of C3 HIV
- Admitted for severe PJP, was intubated for 12 days, extubated 4 hours ago
- You are called for worsening dyspnea
- DDx?
Case # 5 - DDx

- Pneumothorax
- Recurrent PCP
- Volume overload
- Pulmonary embolus
- Aspiration of gastric contents
- Mucus plug
- Respiratory muscle fatigue
Case # 5 - DDx

- A – Mucus plug, UAO/stridor
- B – Pneumothorax, Aspiration of gastric contents, Worsening PJP
- C – Volume overload, Pulmonary embolus
- D – Respiratory muscle fatigue
- E – Sepsis
Case # 5 - Exam

- Somnolent but awake, in moderate respiratory distress
- T 36.8, HR 110, BP 155/97, RR 38, SpO2 87% on 50% Venti-mask
- No JVD
- Lungs with bibasilar rhonchi and crackles, no wheezing
- Bilateral trace pretibial pitting edema
Case # 5 - Data

- CXR - bilateral patchy opacities
- ABG - 7.26/64/56 on 50% Venti-mask
- ECG: ST, no ischemic changes, no changes from baseline

What next??

Can we use NPPV?
Post-Extubation Respiratory Failure

- Upper airway obstruction
  - Subglottic and/or laryngeal edema
- Pulmonary edema secondary to increased venous return
- Respiratory muscle fatigue
  - Excess work of breathing
- Aspiration or mucus plugging

Almost always requires reintubation!
Thank you!