Riyad Karmy-Jones, M.D.

- Indications and Outcome Following Thoractotomy
- Traumatic Aortic Rupture
- Lung Inflammation

AWARDS
Resident Teaching Award

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Zymogenetics

Chest injury is responsible for at least 25% of deaths following trauma, and plays a major factor in a further 25% of deaths. Our research has been focused in three areas: Indications for and outcomes of thoracotomy following trauma; aortic trauma; ischemia-reperfusion injury and lung inflammation.

Indications and Outcome Following Thoracotomy

The timing of thoracotomy following injury has been based on historical data originating during the Vietnam War. Indications have been "1500 cc of blood output on initial placement of chest tube or 200-300 cc/hour of output for several hours." This has been particularly problematic following blunt injury, when thoracotomy has been delayed in hopes that "output is decreasing." We conducted a multi-center retrospective study within the Western Trauma Association. When considering patients who underwent thoracotomy for bleeding (as opposed to specific diagnosis or because of shock), we documented that for each 500 cc of blood loss prior to thoracotomy, mortality increased 60% and that this increased risk of death was independent of mechanism (Figure 1).

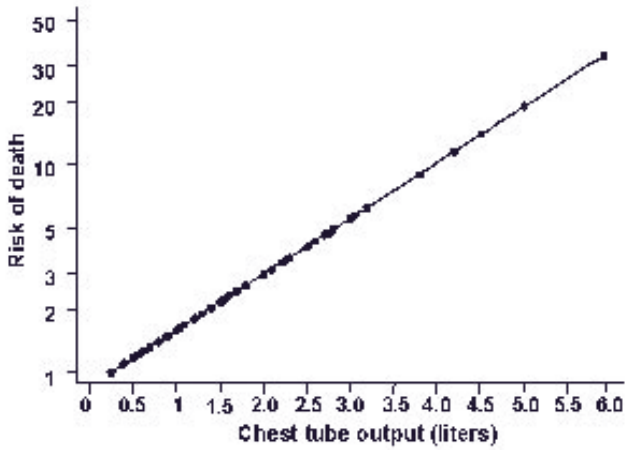

FIGURE 1: Risk of death and volume chest tube output.

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This has prompted a multi-center prospective study, with change in practice so that once 1500 cc has been reached within 24 hours, thoracotomy or thoracoscopy should be considered. Preliminary data suggests a 50% reduction in mortality.

We have also reviewed specific techniques of lung resection following traumatic injury. Considering all mechanisms of injury, there is an incremental risk of death with progressively complex resections (Figure 2). A related review focusing on patients with penetrating injury alone found that anatomic resections were associated with a lower incidence of septic complications compared to "stapled" approaches. The implications of this work are that a) lesser resections are favored, including damage control techniques but b) surgeons must be facile in all possible methods and be ready to progress to more complex operations without delay.

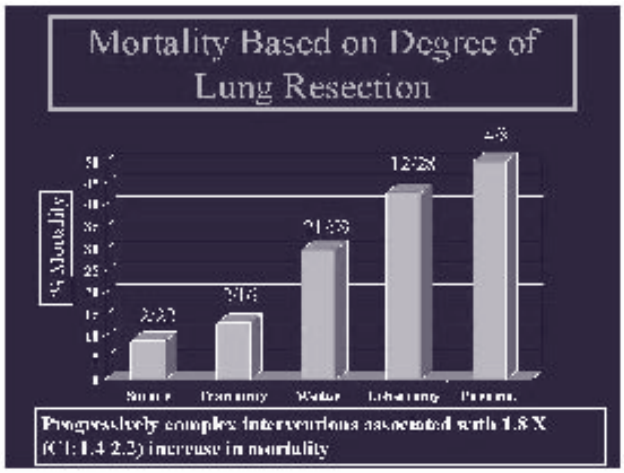

Figure 2: Mortality based on degree of lung resection.

Traumatic Aortic Rupture

Harborview is unique in that it has one of the largest volumes of aortic trauma in the nation. The average trauma center treats on average less than two patients/year with aortic trauma while HMC, on average, treats 15. This volume, coupled with the ability to utilize the trauma database, has allowed us to study a number of questions. An important anatomic detail is the location of the injury relative to the left subclavian artery (LSCA). In 91 cases the exact location of the injury in patients who underwent operative repair could be determined. Forty-one were ≤ 1 cm from the junction of the LSCA and the thoracic aorta, 49 more distal. The more proximal injuries were associated with increased mortality (43% vs. 22%, p=0.04), intra operative rupture (17% vs. 2%, p=0.003) and cross clamp time (39.5±21.9 minutes vs. 28.4±13 minutes, p=0.04). Three ruptures occurred while obtaining proximal control in patients with injuries close to the LSCA. We advocate instituting bypass before attempting proximal control to avoid the risk of rupture before bypass can be instituted.

Also, the operative outcomes of 120 patients were reviewed relative to presentation. Patients were classified as "unstable" if presenting systolic blood pressure was < 90 mm Hg or if it decreased to < 90 mm Hg after admission. Operative mortality was significantly higher in unstable patients (62%) vs. stable patients (17%,p=0.001), and patients with cardiac ischemia or contusion (71%) vs. those without (24%,p=0.001). Free rupture was the cause of hypotension in only 25% of unstable patients, the remainder being due to other causes. Although the use of mechanical circulatory support (MCS) appeared to reduce the risk of paralysis, (0/59 cases with MCS vs. 8/61 without MCS), logistic regression analysis found that only preoperative instability was a significant independent predictor of paralysis (risk increased 5.5 times, confidence intervals 3.3-10). Currently, patients with closed head injury are not excluded from operative repair, but patients with severe lung injury or depressed cardiac function are managed by alternative means.

One such approach for patients who may not be operative candidates is blood pressure control with *B*-blockers. We were able to review and follow the course of 30 cases managed non-operatively who had serial radiological exams. Three patients exhibited progression of injury size within 5 days of injury, one of whom experienced free rupture (and was not managed with *B*-blockers). Our data demonstrated that *B*-blockers can significantly reduce the risk of rupture, that the risk of rupture is greatest within the first five days of injury, and that psueodoaneurysms that persist greater than two weeks will not resolve and will ultimately follow the pattern of chronic thoracic aneurysms. We are currently leading a multi-center prospective study of non-operative management of aortic trauma.

An exciting option in the management of thoracic vascular diseases is the role of endovascular stent grafts (EVSG). A review of 50 angiograms of patients with aortic rupture identified some key anatomic details with regards to modeling grafts. The mean distance along the lesser curve to the superior aspect of the tear was 5.8 mm, aortic diameter 19 mm and mean degree of curvature 27°. The majority of aortic tears will require the origin of the subclavian to be covered. We have

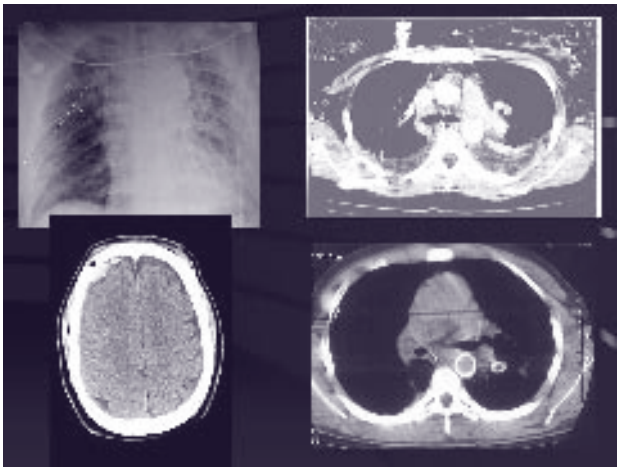

Figure 3: 18 year old female involved with MVC. Patient sustained closed head injury with elevated ICP, severe pulmonary contusion and required splenectomy. Her pelvis was unstable and angiographic embolisation needed for arterial bleeding. EVSG was utilized to control her TRA.

treated 10 patients with this approach (Figure 3) and have made the following observations: Commercially available grafts are superior to "home made ones"; most aortic injuries can be treated by commercially available "cuff-extenders"; tears near the aortic curvature of > 1.5 cm are associated with "telescoping" resulting in increased risk of endoleak. The ideal thoracic grafts are not yet available, but our group is leading a trial with the Talent device which we have used on one occasion and appears to be ideally suited to the thoracic aorta.

Lung Inflammation

Although direct ischemia-reperfusion injury has been an area of great interest to the transplant community, indirect mechanisms of lung injury may be more important following trauma. We used a model of hilar occlusion to demonstrate that ischemia-reperfusion to one lung results in an indirect injury to the contralateral lung with release of NFkB (Figure 4).

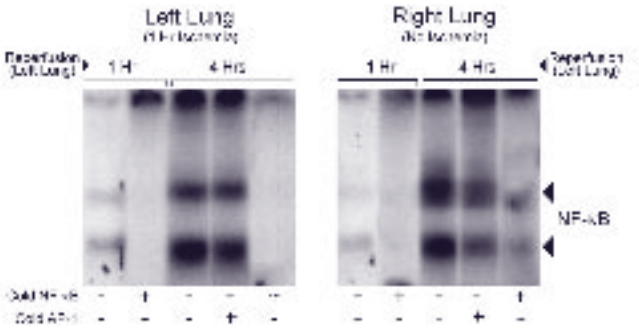

Figure 4: Left lung with ischemia compared to right lung with no ischemia

We are also involved with determining the role of novel cytokines, including Interleukin 20, in parenchymal disorders. Preliminary data suggest that patients with degrees of fibrosis and active inflammation have increased expression, while patients with cancer have much lower expression of this cytokine and its mediators.

Related Publications

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Department Co-Investigators

Gregory Jurkovich, M.D. / **Mark Meissner, M.D.** / **Avery Nathens, M.D., Ph.D., MPH** / **Stephen Nicholls, M.D.**

Other Co-Investigators

Yasmin Chandrasaker Ph.D., Zymogenetics / **Steven Cohn, M.D.,** University of Miami / **Seher Demerer, M.D.,** University of Ankara / **John Holcomb, M.D.,** USAF / **James Holmes IV, M.D.,** Virginia Mason / **David Hoyt, M.D.,** University of San Diego / **Mathew Wall Jr., M.D.,** Ben Taub