Session: I: Plenary Papers 1-8
Paper 1: 1:00 - 1:20 PM

THE SPLENIC INJURY OUTCOMES TRIAL: AN AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA MULTI-INSTITUTIONAL STUDY

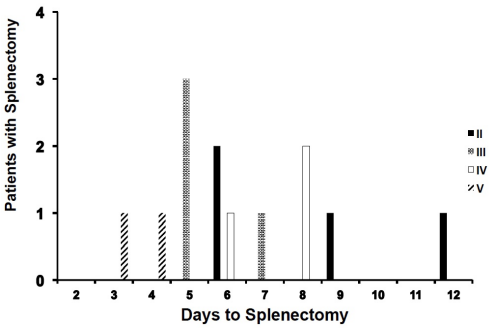
Ben L. Zarzaur* MD,MPH, Rosemary Kozar* MD,Ph.D., John G. Myers* MD, Jeffrey A. Claridge* MD, MS, Thomas M. Scalea* MD, Todd A. Neideen* MD, Adrian A. Maung* MD, Louis Alarcon* MD, Aaron Scifres* MD, Alain Corcos* MD, Andrew Kerwin* MD, Raul Coimbra* MD,Ph.D., AAST Multi-Institutional Trials Committee

Invited Discussant: Andrew Peitzman, MD

Introduction: Delayed splenic rupture resulting in delayed splenectomy (DS) after attempted non-operative (NON-OP) management of blunt splenic injury (BSI) is a feared complication, particularly in the outpatient setting. Significant healthcare resources, including angiography (ANGIO) and follow-up computed tomography (CT), are utilized in an effort to prevent DS. However, no prospective, long-term data exists to determine the actual risk of DS. Understanding the actual risk of DS could help limit resource utilization and radiation exposure. The purpose of this multi-institutional trial was to ascertain the 180-day risk of DR after 24 hours of successful NON-OP management of BSI and to determine factors related to DS.

Methods: 11 Level I trauma centers participated in this prospective study. Adults ≥ 18 with BSI successfully managed NON-OP for 24 hours were eligible. Patients were followed for 180-days. Demographic, physiologic, radiographic and injury related information was obtained. Any spleen related interventions were recorded. Univariate and bivariate analyses were used to determine factors associated with DS.

Results: 383 patients were enrolled. 30, 90, and 180-day follow-up were 95%, 88%, and 87% respectively. 12 patients (3.1%) suffered in-hospital splenectomy between 24 hours and 9 days post-injury. 4 patients died (none were spleen related) and 1 withdrew leaving 366 patients discharged with a spleen. 1 (0.27%) required readmission for splenectomy on post-injury day 12. No Grade I injuries suffered DS. High-grade injuries tended to have earlier DS and lower grade injuries had later DS (Figure). Overall splenectomy rate after NON-OP management for 24 hours was 1.5 per 1000 patient-days. Only extravasation from the spleen (ADMIT-BLUSH) at time of admission was associated with DS (OR 3.6; 95% CI 1.4, 12.4). Of patients with ADMIT-BLUSH (n=49), 17 (34.7%) did not have ANGIO with embolization (EMBO) and 2 of those (11.8%) underwent splenectomy; 32 (65.3%) underwent ANGIO with EMBO and 2 of those (6.3%) required splenectomy.



Conclusions: The need for splenectomy after 24 hours of successful NON-OP management is rare. After the initial 24 hours, no additional interventions are warranted for patients with Grade I injuries. For grade II – V BSI close observation is indicated for 10 – 14 days as this is the time of greatest risk of DS. Extravasation of contrast from the spleen at the time of admission is a strong predictor of DS and may be an area where aggressive use of ANGIO and EMBO is warranted and should be the focus of future prospective studies. Use of CT to follow splenic healing after discharge is not indicated in patients without symptoms.

Session: I: Plenary Papers 1-8
Paper 2: 1:20-1:40 PM

A CONTROLLED RESUSCITATION STRATEGY IS FEASIBLE AND SAFE IN HYPOTENSIVE TRAUMA PATIENTS: RESULTS OF A PROSPECTIVE RANDOMIZED PILOT TRIAL

Martin A. Schreiber* MD, Samuel A. Tisherman* MD, Eric N. Meier MS, Jeffrey Kerby* MD,Ph.D., Craig Newgard MD, Karen Brasel* MD, Debra Egan MPH, MSc, William Witham MD, Carolyn Williams RN, BSN, Jeff Beeson DO, FACEP, Delores Kannas RN, MS, Susanne May Ph.D., Barbara McKnight Ph.D., David B. Hoyt* MD, And The ROC Investigators, Oregon Health & Science University

Invited Discussant: Thomas Scalea, MD

Introduction: Optimal resuscitation of hypotensive trauma patients has not been defined. A prior prospective randomized trial performed in hypotensive patients with penetrating torso wounds showed a survival advantage in patients who received delayed resuscitation. The current trial was performed to determine the feasibility and safety of controlled resuscitation (CR) vs standard resuscitation (SR) in hypotensive patients with blunt and penetrating trauma.

Methods: Patients were enrolled and randomized in the prehospital setting using exception from informed consent. Nine-teen EMS systems and 10 hospitals in 6 regions of the Resuscitation Outcome Consortium participated in the study. Eligible patients suffered blunt or penetrating trauma, were ≥ 15 years old or > 50kg if their age was unknown, had a prehospital systolic blood pressure (SBP) ≤ 90mmHg and were transported to a participating trauma center. EMS units carried blinded boxes containing either two 250cc bags of normal saline (NS) and a 500cc weight (CR) or 1 liter of NS (SR). Patients in the CR group received fluid only if they had no radial pulse or a SBP ≤ 70mmHg. SR group patients received 2 liters initially and additional fluid as needed to maintain a SBP ≥ 110mmHg. Patients could receive blood products as indicated. The crystalloid protocol was maintained until either hemorrhage was controlled or for 2 hours after hospital arrival.

Results: Between March 2012 and April 2013, 192 patients were randomized (97 to CR and 95 to SR). The CR and SR groups were similar at baseline in terms of mean age 42 (20)* vs 42 (19) years, median ISS 9 (2-19) vs 9 (2-24), median initial SBP 82 (72-92) vs 84 (74-94) mmHg and rate of penetrating injury 33% vs 35%, respectively. Average crystalloid resuscitation given during the study period was 1.0 (1.5) liter in the CR group and 2.0 (1.4) liters in the SR group, a difference of 1.0 liter (95% CI: 0.6 to 1.4). Admission mean SBP was 99 (32) mmHg in the CR group and 105 (34) mmHg in the SR group. ICU free days, ventilator free days, renal injury and renal failure did not differ between groups at 28 days. At 24 hours after admission, there were 5 deaths (5%) in the CR group and 14 (15%) in the SR group (adjusted odds ratio 0.39 (95% CI: 0.12, 1.26). Among patients with blunt trauma, there was a significant difference in 24 hour mortality, with rates of 3% (CR) and 18% (SR) and an adjusted OR of 0.17 (0.03, 0.92). There was no difference among patients with penetrating trauma: 9% vs 9%, adjusted OR 1.93 (0.19, 19.17).

Conclusion: Conclusions: Controlled resuscitation is achievable in prehospital and hospital settings and may offer an early survival advantage. A large-scale, Phase III trial to examine its effects on survival and other clinical outcomes is warranted.

*Means are given with their standard deviations and medians are given with their interquartile ranges.

Session: I: Plenary Papers 1-8
Paper 3: 1:40-2:00 PM

GETTING IT RIGHT: ADHERENCE TO AN ESTABLISHED DIAGNOSTIC THRESHOLD FOR VENTILATOR-ASSOCIATED PNEUMONIA CONTRIBUTES TO LOW FALSE-NEGATIVE RATES IN TRAUMA PATIENTS

John P. Sharpe MD, MS, Louis J. Magnotti* MD, Jordan A. Weinberg* MD, Joseph M. Swanson MD, Thomas J. Schroeppel* MD, Timothy C. Fabian* MD, Martin A. Croce* MD, University of Tennessee Health Science Center - Memphis

Invited Discussant: Christopher Michetti, MD

Introduction: For more than two decades, diagnosis of ventilator-associated pneumonia (VAP) in our institution has followed an established diagnostic threshold (DT) of $\geq 10^5$ CFU/mL on bronchoalveolar lavage (BAL) based on our previous experience (PS). Because mortality from VAP is related to treatment delay, some have advocated a lower DT. The purpose of the current study (CS) was to evaluate the impact of adherence to this DT for VAP on false-negative (FN) rates and mortality in trauma patients.

Methods: Consecutive patients over 9 years with VAP (defined as $\geq 10^5$ CFU/mL in the BAL effluent) subsequent to the previous study (PS) were identified. Data regarding timing and frequency of BAL and the colony counts of each organism identified were recorded. A false negative BAL was defined as any patient who had $<10^5$ CFU/mL and developed VAP with the same organism up to 7 days after the previous culture. The CS was then compared to the PS.

Results: Over 9 years, 1679 patients underwent 3202 BALs. Of these, 79% were male, 88% followed blunt injury, and mean age and Injury Severity Score (ISS) were 44 years and 31, respectively. Overall there were 73 FN BALs (2.3%) in the CS compared to 3% in the PS (p=0.09). No FN BALs were identified in patients with $<10^4$ organisms on BAL. In those patients with 10^4 organisms, the FN rate was reduced (7.5% vs 11%, p=0.045) and mortality unchanged (5.4% vs 8.3%, p=0.36) in the CS compared to the PS. Use of $\geq 10^5$ resulted in a cumulative reduction in antibiotic charges of $1.57 million.

Conclusion: Continued adherence to the diagnostic threshold of $\geq 10^5$ for quantitative BAL in trauma patients has maintained a low incidence of FN BALs and reduced patient charges without impacting mortality. The purported benefit of a lower threshold (reducing mortality by shortening treatment delays) is not supported. In addition, the potential sequelae of increased resistant organisms, antibiotic-related complications and costs associated with prolonged unnecessary antibiotic exposure are minimized.

Session: I: Plenary Papers 1-8
Paper 4: 2:00-2:20 PM

REDUCING SECONDARY BRAIN INJURY IN TRAUMA PATIENTS: THE EFFECT OF REMOTE ISCHEMIC CONDITIONING

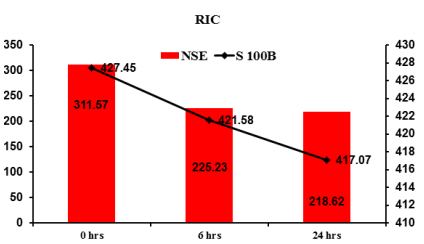
Bellal Joseph* MD, Viraj Pandit MD, Ammar Hashmi MD, Narong Kulvatunyou* MD, Terence O'Keeffe* MD, MBChB, Bardiya Zangbar MD, Andrew Tang MD, Donald J. Green* MD, Lynn Gries MD, Randall S. Friese* MD, Peter Rhee* MD,MPH, University of Arizona - Tucson

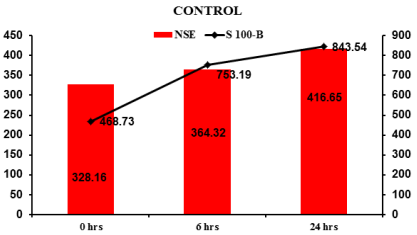
Invited Discussant: Deborah Stein, MD, MPH

Introduction: Management of traumatic brain injury is primarily focused on preventing secondary brain injury. Remote ischemic conditioning (RIC) is an established treatment modality that has been shown to improve patient outcomes secondary to inflammatory insults. The aim of our study was to assess the effects of RIC in trauma patients with severe TBI.

Methods: This prospective consented interventional trial included all TBI patients with an intracranial hemorrhage (ICH) and a Glasgow coma scale (GCS) score of ≤ 8 on admission. In each patient, four cycles of RIC were performed on admission. Each cycle consisted of five minutes of controlled upper limb ischemia followed by five minutes of reperfusion. Serum bio-markers of acute brain injury, S-100B and Neuron specific enolase (NSE) (sensitivity=80%, specificity=73%) were measured at 0 hrs, 6 hrs, and 24-hours. RIC was performed after collection of 0hr serum marker. The established elevated serum levels of NSE and S100B in TBI patients were reconfirmed using patients without RIC (the baseline value of these markers is zero in patients without neuronal injury). Outcome measure was reduction in the level of serum biomarkers post RIC.

Results: A total of 20 patients were enrolled. The mean age was 46.15±18.64 years, median GCS was 8[3-8] and median head abbreviated injury (h-AIS) scale score was 3[3-5]. The mean 0hr S-100B value was 427.45±201.15 pg/ml while mean NSE value was 311.57±146.81 pg/ml. There was a significant reduction in the levels of S-100B (p=0.033) and NSE (p=0.031) at 6hrs and 24hrs in comparison to the 0hr level **(Figure 1)**. The overall mortality was 18.18% (n=4).





Conclusion: This study highlights the novel therapeutic role of RIC for preventing secondary brain insults in TBI patients. There was a significant reduction in the biomarkers of acute brain injury post RIC. Further research assessing the impact of RIC on patient outcomes is warranted.

Session: I: Plenary Papers 1-8
Paper 5: 2:20-2:40 PM

REGIONAL COLLABORATIVE QUALITY IMPROVEMENT FOR TRAUMA REDUCES COMPLICATIONS AND COSTS

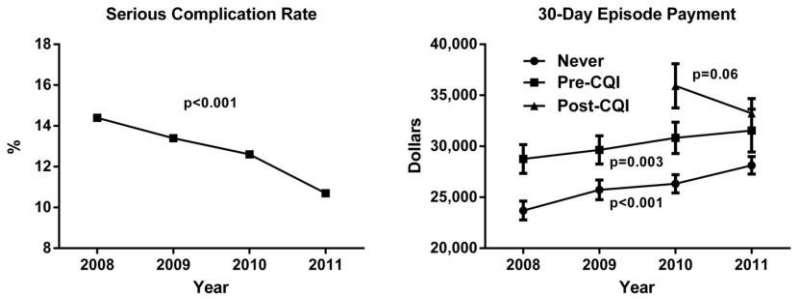
Mark R. Hemmila* MD, Peter C. Jenkins MD, Wendy L. Wahl* MD, Wayne E. Vander Kolk MD, Judy N. Mikhail MSN, Nancy J. Birkmeyer Ph.D., University of Michigan

Invited Discussant: David Hoyt, MD

Introduction: While evidence suggests that quality improvement to reduce complications for trauma patients should decrease costs, studies have not addressed this question directly. In our state, trauma centers and a private payer have created a regional collaborative quality improvement (CQI) program. This CQI program began as a pilot in 2008 and was expanded to a formal program in 2010. We examined the relationship between outcomes and expenditures for trauma patients treated in collaborative participant and non-participant hospitals.

Methods: Payer claims and collaborative registry data (2008-2011) were analyzed for 30-day episode payments and complications in patients admitted with trauma diagnoses. Patients were categorized as treated in hospitals that had different CQI status: 1) never participated (Never), 2) collaborative participant, but patient treated prior to CQI initiation (Pre-CQI), or 3) active collaborative participant (Post-CQI). ICD-9 codes were cross-walked to AIS 2005 codes. Episode payment data were risk adjusted (age, gender, comorbidities, type/severity of injury, and year of treatment) and price standardized. Outcome data was adjusted for risk and reliability. A serious complication consisted of one or more of the following occurrences: abdominal compartment syndrome, acute lung injury/ARDS, acute kidney injury, cardiac arrest with CPR, decubitus ulcer, DVT, enterocutaneous fistula, extremity compartment syndrome, mortality, myocardial infarction, pneumonia, pulmonary embolism, severe sepsis, stroke/CVA, unplanned intubation, or unplanned return to OR.

Results: The risk-adjusted rate of serious complications declined from 15.6% to 12.2% ($p<0.001$) in participating hospitals (Post-CQI; n=23). Average episode payments decreased by $2,697 ($35,927 to $33,230, p=0.06) among patients (n=4,084) treated in Post-CQI centers, whereas patients treated at Pre-CQI (n=9,931) or Never (n=28,777) institutions had a significant year-to-year increase in payments (Figure). A savings of $11 million in total episode payments from 2010 to 2011 was achieved for Post-CQI treated patients.



Conclusion: This study confirms our hypothesis that participation in a regional collaborative quality improvement program improves outcomes and reduces costs for trauma patients.

Session: I: Plenary Papers 1-8
Paper 6: 2:40-3:00 PM

MITOCHONDRIAL DAMPS FROM FRACTURES SUPPRESS PULMONARY IMMUNE RESPONSES VIA FORMYL PEPTIDE RECEPTORS 1 AND 2

Haipeng Li MD, Kiyoshi Itagaki Ph.D., Nicola Sandler MD, David Gallo BS, Elzbieta Kaczmarek Ph.D., Amanda Galenkamp BS, Leo Otterbein Ph.D., Carl J. Hauser* MD, Beth Israel Deaconess Medical Center

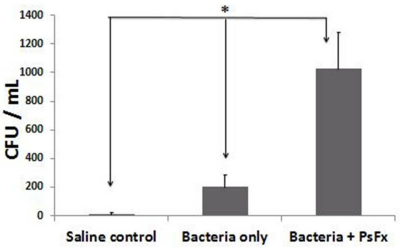
Invited Discussant: Ronald Maier, MD

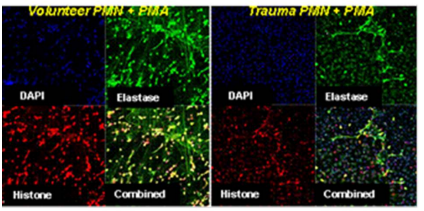
Introduction: Pneumonia (PNA) is a common cause of morbidity & mortality after trauma but no known biologic mechanisms link PNA with tissue injury. Neutrophils (PMN) are the dominant innate immune effector cells that control bacterial growth in the lung. But to clear bacteria from the lung, circulating PMN must get to the alveoli using chemotaxis (CTX) to G-protein coupled chemoattractants and then must kill bacteria in Neutrophil Extracellular Traps (NETs). We previously found that clinical trauma suppresses PMN CTX and predicted trauma might suppress other antimicrobial functions. Mitochondrial damage molecules (DAMPs) from femur reamings alter PMN phenotype. We now hypothesize DAMPs from fracture injury caould predispose to PNA by decreasing PMN traffic to the lung and suppressing the antimicrobial function of PMN once they get there.

Methods: **Expt 1:** Rats (n=10 /condition) were divided into 4 groups; a) naïve controls; b) pulmonary contusion (PC induced by percussion); c) pseudo-fracture (PsFx: injection of the thigh with crushed bone supernatant containing DAMPs), and d) PC plus PsFx. **Expt 2:** Rats were put in three groups: a) controls - saline injection in the thigh; b) intratracheal (*i.t.*) injection of $5x10^4$ *S. aureus*; c) PsFx followed by *S. aureus i.t.* Bronchoalveolar lavage (BAL) was performed 16h after treatment. BAL bacteria and PMN were counted. **Expt 3:** Human clinical trauma PMN were assayed for CTX (in transwells) and NETosis (by fluorescent confocal microscopy).

Results:**: Expt 1:** PC increased and PsFx markedly decreased PMN traffic to the lung ($P<0.01$, ANOVA). **Expt 2:** PsFx markedly suppressed lung bacterial clearance ($P<0.01$, Fig. **Lt**) with BAL bacteria increasing as PMN decreased. DAMPs from human bone activated PMN $[Ca^{2+}]_i$ flux. This response was inhibited by mAbs to formyl peptide receptors (FPR) 1&2. **Expt 3:** Clinical trauma strongly suppressed PMN CTX to IL-8 and LTB4 (not shown) as well as NETosis responses to PMA (Fig. **Rt**).

Conclusion: Fracture DAMPs act via FPR1/2 to decrease PMN traffic to the lung and to decrease their ability to clear bacteria. PNA after injury reflects DAMP mediated decreased PMN traffic to the lung and decreased antimicrobial function once there **.**





Session: I: Plenary Papers 1-8
Paper 7: 3:00-3:20 PM

THE AAST PROSPECTIVE OBSERVATIONAL VASCULAR INJURY TREATMENT (PROOVIT) REGISTRY: MULTICENTER DATA ON MODERN VASCULAR INJURY DIAGNOSIS, MANAGEMENT AND OUTCOMES

Joseph J. DuBose* MD, Stephanie A. Savage* MD, Timothy Fabian* MD, Jay Menaker MD, Thomas Scalea* MD, John Holcomb* MD, Nathaniel Poulin MD, Konstantinos Chouliaras MD, Kenji Inaba* MD, Xian Luo-Owen MD,Ph.D., Thomas A. O'Callaghan* MD, Andreas Larentzakis MD, George Velmahos* MD, George Dulabon MD, Todd E. Rasmussen* MD, University Of Texas Health Science Center - Houston

Invited Discussant: Howard Champion, FRCS

Introduction: There is a need for a prospective registry designed to capture trauma-specific, in-hospital and long-term outcomes related to vascular injury.

Methods: The AAST PROspective Vascular Injury Treatment (PROOVIT) registry was used to collect demographic, diagnostic, treatment and outcome data on vascular injuries.

Results: 542 injuries from 14 centers (13 ACS Level I, 1 ACS Level II) have been captured since February 2013. The majority of patients are male (70.5%); ISS ≥ 15 among 32.1%. Penetrating mechanisms account for 36.5%. Arterial injuries to vessels of the head/neck (26.7%), thorax (10.4%), abdomen/pelvis (7.8%), upper extremity (18.4%) and lower extremity (26.0%) were identified, along with 98 major venous injuries. Hard signs of vascular injury, including hypotension (SBP < 90, 11.8%), were noted in 28.6%. Pre-hospital tourniquet use for extremity injuries occurred in 20.2% (47/233). Diagnostic modalities included exploration (28.8%), CTA (38.9%), duplex US (3.1%) and angiography (10.7%). Arterial injuries included transection (24.3%), occlusion (17.3%), partial transection/flow limiting defect (24.5%), pseudoaneurysm (9.0%) and other injuries including intimal defects (22.7%). Non-op management was undertaken in 276 (50.9%), with failure in 4.0%. Definitive endovascular and open repair were utilized in 40 (7.4%) and 126 (23.2%) patients. Damage control maneuvers were used in 57 (10.5%), including ligation (31, 5.7%) and shunting (14, 2.6%). Re-intervention of initial definitive repair was required in 42 (7.7%). Amputation was performed in 7.7% of extremity vascular injuries and overall hospital mortality was 12.7%. Follow-up ranging from 1-7 months is available for 48 patients via a variety of modalities, with re-intervention required in only 1 patient.

Conclusions: The PROOVIT registry provides a useful contemporary picture of the management of modern vascular injury. This resource promises to provide needed information required to answer questions about optimal diagnosis and management of these patients – including much needed long-term outcome data.

Session: I: Plenary Papers 1-8
Paper 8: 3:20-3:40 PM

INTRACRANIAL PRESSURE MONITORING AND INPATIENT MORTALITY IN SEVERE TRAUMATIC BRAIN INJURY: A PROPENSITY-SCORE MATCHED ANALYSIS

Aaron J. Dawes MD, Greg D. Sacks MD,MPH, H. Gill Cryer* MD,Ph.D., Christy Preston RN, Deidre Gorospe RN, Matt Garrett MD, David McArthur MPH,Ph.D., Melinda Maggard Gibbons MD, MSHS, Marcia M. Russell MD, Clifford Ko MD, MS, MSHS
University of California, Los Angeles
Invited Discussant: Alex Valadka, MD

Background: Despite being recommended as standard of care by the Brain Trauma Foundation, the benefit of intracranial pressure (ICP) monitoring in severe traumatic brain injury (TBI) remains controversial. Moreover, the effect of ICP monitoring on mortality may be overstated if more severely injured patients die without undergoing monitor placement. Our study aim was to examine the impact of ICP monitor placement on in-patient mortality within a regional trauma system, and to attempt to correct for selection bias through propensity-score matching.

Methods: Data were prospectively collected from all severe TBI cases presenting to 14 trauma centers within a single trauma system during the two-year study period (2009-2010). Inclusion criteria were: blunt injury, Glasgow Coma Scale (GCS) ≤ 8 in the emergency room, and at least one intracranial injury on head CT. Patients who died in the emergency department or underwent emergency craniotomy were excluded. A multivariate logistic regression model was used to predict inpatient mortality after controlling for demographics, trauma center, severity of injury, comorbidities, and TBI-specific variables (GCS, pupil reactivity, initial INR, and 10 specific head CT findings). We then calculated both unadjusted and risk-adjusted odds ratios for mortality based on ICP monitor placement. To examine for differences between the treatment and non-treatment groups, we developed a logistic model to predict ICP monitor placement using the variables in our initial multivariate model predicting inpatient mortality. Using observed associations between covariates and the likelihood of undergoing treatment, we then developed a propensity-score matched model to explore the underlying effect of ICP monitoring on in-hospital mortality.

Results: During the two-year study period, 635 patients met inclusion criteria. In-patient mortality was 39.2%, and 38.0% of patients had an ICP monitor placed within the first 72 hours. Both unadjusted and risk-adjusted odds of mortality were significantly lower in the ICP monitoring group (Table). Predicted mortality rates were significantly higher in the non-treated group (42.8% vs. 33.7%, p=0.006), suggesting the possibility of selection bias in ICP monitor placement. Based on our treatment model, ICP monitor placement was positively associated with injury severity score, pupil reactivity, and subarachnoid hemorrhage, and negatively associated with age, GCS, obesity, elevated INR, and compression of basal cisterns on head CT. After adjusting for treatment selection by propensity score matching, ICP monitor placement remained significantly associated with mortality with recipients displaying a 13% reduction in the odds of death compared to those without an ICP monitor (Table).

	Odds of inpatient mortality for ICP monitor placement (vs. not)	95% Confidence Interval
Unadjusted data	0.49	0.35-0.69
Risk-adjusted model	0.37	0.17-0.77
Prospensity-score matched	0.87	0.77-0.98

Conclusions: ICP monitor placement occurred in only 38% of eligible patients, but was significantly associated with decreased mortality after adjusting for baseline risk profile and the propensity to undergo monitor placement. The decreased magnitude of the effect between logistic and propensity-score matched models indicates that significant selection bias exists in the placement of ICP monitors. As individual benefits of ICP monitoring may vary, future efforts should center on determining the appropriate use of invasive monitoring techniques.

Session: VI: Plenary Papers 9-12
Paper 9: 8:00-8:20 AM

RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA (REBOA) IS A FEASIBLE ALTERNATIVE TO RESUSCITATIVE THORACOTOMY IN TRAUMA PATIENTS WITH NON-COMPRESSIBLE TRUNCAL HEMORRHAGE AND PROFOUND HEMORRHAGIC SHOCK

Laura J. Moore* MD, Megan Brenner MD, Rosemary A. Kozar* MD,Ph.D., Jason Pasley DO, Charles Wade* Ph.D., Thomas Scalea* MD, John B. Holcomb* MD,
University of Texas Health Science Center-Houston

Invited Discussant: Timothy Fabian, MD

Introduction: Hemorrhage remains the leading cause of death in trauma patients. Proximal aortic occlusion, usually performed by direct aortic cross-clamping via thoracotomy, can provide temporary hemodynamic stability, permitting definitive injury repair. Resuscitative endovascular balloon occlusion of the aorta (REBOA), utilizes a minimally-invasive, trans-femoral balloon catheter which is rapidly inserted retrograde and inflated for aortic occlusion, may control inflow and allow time for hemostasis. We compared resuscitative thoracotomy with aortic cross-clamping (RT) to REBOA in trauma patients in profound hemorrhagic shock.

Methods: Trauma registry data was utilized to compare all patients undergoing RT or REBOA over an 18 month period from two Level one trauma centers. Groups were compared using a t-test, p value <0.05 considered significant.

Results: There was no difference between RT (n=72) and REBOA groups (n=24) in terms of demographics, mechanism of injury, injury severity score (40.6 vs. 31.4, p=0.17), admission base deficit (12.9 vs. 11, p=0.31), or initial blood pressure (70.9 vs. 55.8, p=0.15). REBOA had fewer early deaths (see table) and improved overall survival as compared to RT (37.5% vs. 9.7%, p=0.003).

	Resuscitative Thoracotomy (RT) Deaths (n=65)	**REBOA Deaths (n=15)**	**p value**
Died in ED (%)	69.2%	26.7%	0.002
Died in OR (%)	9.3%	20%	0.234
Died in ICU (%)	21.5%	53.3%	0.013

Conclusions: REBOA is a feasible and controls non-compressible truncal hemorrhage in trauma patients in profound shock. Patients undergoing REBOA have improved overall survival and fewer early deaths as compared to patients undergoing RT.

Session: VI: Plenary Papers 9-12
Paper 10: 8:20-8:40 AM

Evaluation of the Safety and Feasibility of Resuscitative Endovascular Balloon Occlusion of the Aorta in Japan

Nobuyuki Saito MD, Takanori Yagi MD, Hisashi Matsumoto MD,Ph.D., Kunihiro Mashiko* MD,Ph.D., Chiba Hokusoh Hospital, Nippon Medical School

Invited Discussant: Matthew Wall, Jr, MD

Introduction: Resuscitative endovascular balloon occlusion of the aorta (REBOA) is ultimately an invasive procedure for managing severe subphrenic torso injury, but it is less invasive than resuscitative open aortic cross clamping and therefore its clinical application is expected. We retrospectively evaluated the safety and clinical feasibility of REBOA sets (IABO:intra-aortic occlusion balloon; MERA, Tokyo, Japan) using the Seldinger technique.
Methods: Of 5230 trauma patients admitted to our Japanese trauma center between 2007 and 2013, 52 underwent REBOA for first-line resuscitation and 24 who underwent REBOA independently was included in the analysis. The indication for REBOA was a pelvic ring fracture (PRF) or hemoperitoneum with impending cardiac arrest. Emergency hemostasis was performed during REBOA in all patients.
Results: All 24 patients suffered blunt mechanism trauma and median age was 59.5 (interquartile range: 41.5–71) years, median injury severity score was 47.5 (37–52), and 30-day survival rate was 29.2% (n=7). The probability survival rate of this group of all patients was less than 0.5. Indications for REBOA were hemoperitoneum in 15 cases, PRF in 15 cases. In 10 cases of death, the balloon could not be deflated in 5 cases. In 19 cases in which the balloon could be deflated, median duration of aortic occlusion was shorter in surviving cases than in cases of death (21 min vs 35 min, P=0.05). The mean systolic blood pressure was significantly increased by REBOA (53.1±21 mmHg to 98.0±26.6 mmHg, P<0.01). The balloon was inserted within around 20 minutes from arrival in the emergency room. Percutaneous puncture was employed in 23 (95.8%) insertion techniques; surgical cut-down was performed in only 1 case. There were 3 cases of complications (12.5%), 1 of vascular injury and 2 of limb ischemia, in which lower limb amputation was needed in all cases. Acute kidney injury developed in all 3 cases, but the failure was not persistent.
Conclusion: REBOA appears to be feasible for trauma resuscitation and should improve survivorship. There were serious complications of limb ischemia, so it is necessary to improve the safety of REBOA.

Session: VI: Plenary Papers 9-12
Paper 11: 8:40-9:00 AM

THE EARLY EVOLVING SEX HORMONE ENVIRONMENT IS ASSOCIATED WITH SIGNIFICANT CLINICAL OUTCOME AND INFLAMMATORY RESPONSE DIFFERENCES POST-INJURY

Samuel J. Zolin BS, Yoram Vodovotz Ph.D., Raquel M. Forsythe* MD, Rosengart Matthew* MD,MPH, Rami Namas MD, Andrew P. Peitzman* MD, Timothy R. Billiar* MD, Jason L. Sperry* MD,MPH, University of Pittsburgh

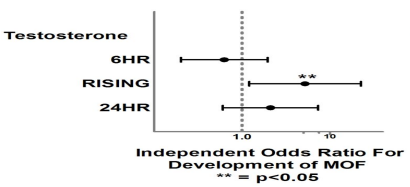
Invited Discussant: Reuven Rabinovici, MD

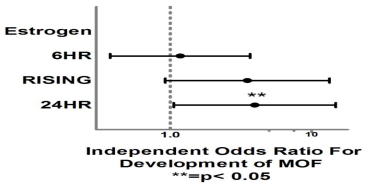
OBJECTIVE(S): Clinical research characterizing the mechanisms responsible for gender based outcome differences post-injury remain conflicting. Currently lacking is an understanding of the early sex-hormone milieu of the injured patient (< 6 hour from injury) and the effects these early hormone differences have on clinical outcomes and the innate immune response following injury. We hypothesized that the early sex-hormone environment would be associated with significant differences in clinical outcomes and the early innate immune response.

METHODS: A prospective cohort study was performed over an 18 month period. Blunt injured patients requiring ICU admission were enrolled while patients with isolated brain and spinal cord injuries were excluded. Blood samples were collected within 6 hours and at 24 hours post-injury and were analyzed for total testosterone (TT) and estradiol (EST) concentrations. Hormone variables were dichotomized into HIGH and LOW groups and into those patients with increasing hormone levels between 6hr and 24hr measurements (RISING). Outcomes of interest included Multiple Organ Failure (MOF, Marshall MODscore > 5), nosocomial infection (NI), mortality and serial cytokine/mediator measurements. Multivariate logistic regression was utilized to determine the independent risks associated with early sex hormone measurements after controlling for differences in demographics, injury characteristics, shock severity and resuscitation requirements.

RESULTS: In 288 prospectively enrolled patients, 68% were male with a median ISS of 16 [IQR 10,21]. Prevalence of MOF, NI and mortality was 12.5% , 29.9% and 4.1%, respectively. After controlling for important confounders, HIGH TT levels at 6hrs were associated with elevated IL-6 levels and cytokine/mediator measurements (22 out of 26 measured). RISING TT levels were significantly associated with over a 5-fold and 2-fold higher independent risk of MOF and NI, respectively (OR 5.2, p=0.02, 95%CI 1.2-22.3, OR 2.1, p= 0.03, 95%CI 1.02-4.2). At 24hrs HIGH TT was no longer associated with poor outcome while HIGH EST was significantly associated with almost a 4-fold higher independent risk of MOF (OR 3.9, p=0.04, 95% CI 1.05-13).

CONCLUSIONS: Early elevations and increasing testosterone levels over the initial 24hrs are associated with an exaggerated inflammatory response and a significantly greater risk of MOF and NI. HIGH Estrogen levels at 24hrs are independently associated with a greater risk of MOF. Inflammation is known to result in the peripheral conversion of androgens to estrogens. The current analysis suggests an early evolving testosterone to estrogen hormonal environment is associated with a significantly higher independent risk of poor outcome following traumatic injury.





Session: VI: Plenary Papers 9-12
Paper 12: 9:00-9:20 AM

SYSTOLIC BLOOD PRESSURE CRITERIA IN THE NATIONAL TRAUMA TRAIGE PROTOCOL FOR GERIATRIC TRAUMA: 110 IS THE NEW 90

Joshua B. Brown MD, Mark L. Gestring* MD, Raquel M. Forsythe* MD, Nicole A. Stassen* MD, Timothy R. Billiar* MD, Andrew B. Peitzman* MD, Jason L. Sperry* MD,MPH, University of Pittsburgh

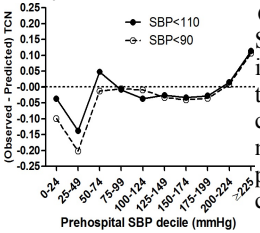
Invited Discussant: Frederick Luchette, MD

Introduction: Under-triage following injury continues to be a concern in the geriatric trauma population. The latest revision of the national trauma triage protocol (NTTP) recognized that a systolic blood pressure (SBP) <110mmHg may represent shock in those over 65 years of age, but this change has not been studied and the current triage trigger remains <90 for all adult age groups. The study objective was to evaluate performance of the NTTP when the current SBP<90 is replaced with <110 for triage.

Methods: Subjects undergoing scene transport in the NTDB (2010-12) were included. NTTP physiologic (Step1) and anatomic (Step2) criteria were determined using prehospital vital signs and ICD-9 diagnosis codes. Imputation was used for missing data. Trauma center need (TCN) was defined as ISS>15, ICU admit, urgent OR, or ED death. Geriatric (age>65) and adult (age 16-65) patients were compared. Test characteristics were calculated to predict TCN. The area under the curve (AUC) was compared between SBP<110 and SBP<90. Logistic regression was used to generate a predicted probability of TCN using SBP<110 or SBP<90, controlling for other NTTP criteria. Observed vs predicted TCN was compared to evaluate calibration. Optimal SBP cutoffs for TCN and mortality were identified as the SBP cutoff maximizing sensitivity and specificity. Logistic regression was also used to determine the effect of geriatric vs adult age group on mortality in patients who would be triaged positive with this change applied (SBP 90-109mmHg).

Results: 1,555,944 subjects were included. Table 1 shows test characteristics for SBP<110 and SBP<90, individually and within the NTTP for the geriatric and adult cohorts. As individual criteria, the AUC was higher for SBP<110 both in the geriatric cohort (p<0.01) and adult cohort (p<0.01). Within the first 2 steps of the NTTP, AUC was still higher using SBP<110 compared to SBP<90 in the geriatric cohort, but slightly lower in the adult cohort (p<0.01). The difference between observed and predicted TCN across SBP deciles for the model using SBP<110 compared to SBP<90 was lower in the geriatric cohort (Figure) than in the adult cohort, indicating better calibration of SBP<110 in geriatric patients than adult patients. The optimal cutoff SBP was 122 for TCN and 118 for mortality in the geriatric cohort, while it was 118 for TCN and 106 for mortality in the adult cohort. In patients with SBP 90-109, geriatric age group was associated with a nearly 10 fold increase in the odds of mortality (OR 9.7; 95%CI 8.7-10.8, p<0.01).

	Sensitivity	Specificity	PPV	NPV	AUC
Geriatric (age>65)					
SBP<110	13%	93%	50%	68%	0.532
SBP<90	5%	99%	66%	67%	0.519
NTTP Step 1+2 using SBP<110	44%	71%	44%	71%	0.575
NTTP Step 1+2 using SBP<90	40%	75%	45%	71%	0.574
Adult (age 16-65)					
SBP<110	23%	90%	63%	61%	0.564
SBP<90	10%	98%	79%	59%	0.539
NTTP Step 1+2 using SBP<110	67%	62%	58%	70%	0.641
NTTP Step 1+2 using SBP<90	62%	67%	59%	69%	0.646



Conclusion: SBP<110 trades specificity for sensitivity. Substituting SBP<110 has better discrimination and calibration in the geriatric cohort. Geriatric patients triaged positive under this change have a nearly 10 fold increased odds of mortality compared to adult patients. This change in SBP criteria appears merited in geriatric patients and may be valuable in all adult patients, warranting further study to consider elevating this change to a step 1 criterion in the NTTP.

Session: VIII: Papers 13-16: Acute Care Surgery
Paper 13: 10:00-10:20 AM

ARTERIOGRAPHY FOR LOWER GI BLEEDING: DOES A PRECEDING ABDOMINAL CT ANGIOGRAM IMPROVE BLEED IDENTIFICATION AND OUTCOME?

Christina L. Jacovides BS, Gregory Nadolski MD, Steven R. Allen MD, Niels D. Martin* MD, Daniel N. Holena* MD, Patrick M. Reilly* MD, Scott O. Trerotola MD, Lewis J. Kaplan* MD, Jose Pascual* MD,Ph.D., FRCSC University of Pennsylvania

Invited Discussant: Leslie Kobayashi, MD

Introduction: The substantial morbidity of lower gastrointestinal hemorrhage (LGIH) can be reduced with timely localization of the bleeding site. Recently, CT angiography (CTA) has been proposed as an adjunct in LGIH localization. We hypothesized that preceding visceral arteriography (VA) with CTA in acute LGIH would increase the rate of identification and embolization of bleeds, but worsen renal function due to a greater total contrast load.

Methods: An institutional policy was enacted in our tertiary academic center in 1/2009 effectively disallowing the use of VA in any LGIH patient without a prior positive imaging study (e.g. CTA, nuclear bleeding scan [NBS]). An Interventional Radiology database was queried to identify all subjects undergoing VA for LGIH (1/2005 to 12/2012). Exclusion criteria included upper GI bleeding and recent unrelated lower GI procedures. Demographics, imaging used (VA, NBS, CTA), arteriography parameters (fluoroscopy time, contrast volume), creatinine, hemoglobin, and interventions were abstracted. Patients were grouped by imaging performed; parametric statistics were used for intergroup comparisons.

Results: 161 patients underwent VA during the study period (78 pre- and 83 post-2009, 48% male, mean age of 70±20 years). 140 underwent imaging prior to VA (NBS: 91, CTA: 35, both: 14), while 21 underwent VA first. Obtaining VA without prior imaging resulted in less frequent identification of bleeding (62 vs. 94%, $p<0.001$) and fewer imaging studies but similar rates of embolization (28%) or surgical intervention (20%). CTA performed before VA resulted in more total intravenous contrast exposure, but a lower creatinine increase and shorter fluoroscopy time (Table). Pre-VA imaging with CTA instead of NBS resulted in fewer imaging studies, increased VA fluoroscopy time, and tended to increase bleed localization and embolization on VA.

Group	Number imaging studies (N)	Bleed found any study (%)	Bleed localized on VA (%)	Embolization at VA (%)	Total contrast (ml)	Fluoroscopy time (min)	Creatinine increase (%)
VA only	1.3±0.7	42.9	42.8	28.6	160±80	32.2±34.9	300±400
CTA before VA	2.5±0.8	91.8	40.8	36.7	230±80	26.3±16.8	170±60
P-value	***<0.0001***	***<0.0001***	1.0	0.6	***0.001***	***0.01***	***0.006***
CTA only before VA	2.1±0.3	94.3	45.7	40.0	220±80	27.8±17.2	160±50
NBS	2.5±0.8	94.5	26.4	23.1	130±70	17.8±14.8	200±300
P-value	***0.01***	1.0	***0.05***	0.07	***<0.0001***	***0.003***	0.1

Conclusion: Performing abdominal CTA prior to arteriography in the management of acute LGIH increases bleed identification while reducing fluoroscopy time. Compared to NBS, CTA prior to angiography reduces the need for repeated imaging and increases the proportion of positive angiographic studies without worsening renal function.

Session: VIII: Papers 13-16: Acute Care Surgery
Paper 14: 10:20-10:40 AM

SAME DAY COMBINED ERCP AND CHOLECYSTECTOMY: ACHIEVABLE AND COST EFFECTIVE

Muhammad J. Younus MD, Mohsen M. Shabahang MD, Denise Torres MD, Kenneth Widom MD, DiAnne Leonard* MD, Joseph Blansfield MD, William Strodel MD, Jeffrey L. Wild MD, Geisinger Health System

Invited Discussant: Michael Chang, MD

Introduction: It is estimated that choledocholithiasis is present in 5-20% of patients at the time of laparoscopic cholecystectomy (LC). Several European studies have found decreased length of stay (LOS) when performing LC and intra-operative endoscopic retrograde cholangio-pancreatography (ERCP) on the same day. In the US, presence of CBD stones is usually managed pre-operatively and often on a separate day than LC. Our aim was to evaluate LOS between same day versus separate day ERCP and cholecystectomy.

Methods: This is a retrospective study of patients undergoing ERCP and cholecystectomy during the same admission for the management of choledocholithiasis from 2010-2014. Group one had ERCP and cholecystectomy performed on the same day under one general anesthesia and group two had ERCP at least 1 day prior to cholecystectomy and underwent two general anesthesias. Primary outcome measured was length of stay.

Results: The study population included 245 patients. Average age in group one was 60.7 years versus 62.4 years in group two. There were 67 patients in group one and 178 patients in group two. Overall LOS for group one was 3.8 days versus 6.6 days in group two ($p < 0.0001$). There was no difference in conversion rates to open cholecystectomy between the two groups (15% within each group). 10% of group one required skilled nursing facility versus 20% in group two ($p = 0.08$).

Conclusions: Combined ERCP and cholecystectomy performed under one anesthesia requires coordination between GI, Anesthesia, and Surgery. ERCP/cholecystectomy under the same anesthesia is feasible. Same day procedures decrease hospital LOS by almost 3 days and patients have a higher probability of being discharged home. Future goals include a multidisciplinary protocol to study outcomes in larger numbers.

ERCP	**Sample Size n**	**Hospital day to surgery (days)**	**LOS (days)**
Separate day	178	3.2	6.6
Same day	67	1.3	3.8

Session: VIII: Papers 13-16: Acute Care Surgery
Paper 15: 10:40-11:00 AM

DEFINING THE ACUTE CARE SURGERY CURRICULUM

Therese M. Duane* MD, Christopher J. Dente* MD, John J. Fildes* MD, Kimberly A. Davis* MBA,MD, Gregory J. Jurkovich* MD, J W. Meredith* MD, L D. Britt* MD,MPH, Virginia Commonwealth University

Invited Discussant: Ronald Stewart, MD

Introduction:The Acute Care Surgery (ACS) case log system was designed to track operative cases performed by ACS trainees to quantify the depth and breadth of the operative experience within the ACS training paradigm. An initial analysis revealed an experience weighted towards general surgery abdominal cases but with wide variability in exposure to the essential and desirable cases of the ACS curriculum. This follow up study was designed to better identify and define the gaps in essential and desirable (E/D) case volumes that may prompt re-evaluation of the ACS curriculum, or restructuring of the training provided.

Methods:Review of the first two years of ACS case log entry (7/11-6/13) was performed. Individual trainee logs were evaluated to determine how often they performed each case on the E/D list. Trainees described cases using CPT codes, which had been previously mapped to the E/D list. Comparisons were made between the first and second year to determine if any differences could be identified.

Results:There were a total of 29 trainees from 15 programs (year 1) and 30 trainees from 13 programs (year 2) who participated in case log entry with some overlap between the years. There were a total of 487 fellow-months of data with an average of 14.6 CPT codes per month and 175.5 per year for cases on the E/D list vs. 12 and 143.5 for cases not on the E/D list, respectively. Overall the most common essential cases were laparotomy for trauma (1463; 705 year 1, 758 year 2), tracheostomy (665; 372 year 1, 293 year 2) and gastrostomy tubes (566; 289 year 1, 277 year 2). There are a total of 73 types of essential operations and 45 types of desirable operations in the current curriculum. There were 16 (13.6%) distinct codes never used of which 6 overlapped with other codes. Based on body region the ten E/D codes never used by any fellow are shown in the table.

Conclusion:The current ACS trainees lack adequate head/neck and pediatric experience as defined by the ACS curriculum. Restructuring rotations at individual institutions and a focus on novel educational modalities may be needed to augment the individual institutional exposure. Finally, re-evaluation of some aspects of the curriculum, particularly as it relates to the management of pediatric injuries and elective neck explorations may be warranted.

Case category	Essential (E) or Desirable (D)	Number of codes not used	Total number of codes in case category	% of total codes not used	Case specifics
Head/Face	D	1	5	20	Lateral canthotomy
Neck	D	5	12	41.7	All related to elective neck dissection
Thoracic	E	1	16	6.25	Vascular trauma to chest
Pediatric	D	3	5	60	Inguinal hernia repair, SBO treatments

Session: VIII: Papers 13-16: Acute Care Surgery
Paper 16: 11:00-11:20 AM

PROTOCOLIZED MANAGEMENT OF ADHESIVE MECHANICAL SMALL BOWEL OBSTRUCTION: MOVING IT ALONG.

Janeen R. Jordan MD, Trina Bala RN, Scott Brakenridge MD, Chasen A. Croft MD, Lawrence Lottenberg* MD, Linda Atteberry* MD, Winston Richards MD, David Mozingo* MD, Alicia Mohr* MD, Frederick A. Moore* MD, University of Florida - Gainesville

Invited Discussant: Clay Cothren Burlew, MD

Introduction:Differentiating between a partial small bowel obstruction (SBO) likely to resolve with medical management and a complete obstruction requiring intervention remains elusive. For quality improvement, we implemented a standardized protocol for management of SBO and the purpose of this study is to evaluate its performance.
Methods:Patients with symptoms and X-ray findings of SBO were admitted for IV fluid resuscitation, bowel rest, nasogastric tube (ngt) decompression and exams every 4 hours. Labs and a CT scan of the abdomen and pelvis with IV contrast only were obtained. Patients with peritonitis or CT imaging findings suggestive of bowel compromise were taken to the operating room (OR) for exploration following resuscitation. All other patients were than given 120mL of diluted 2:1 gastrograffin (GG). KUBs were obtained at 4, 8, 12 and the 24^{h} hour. If contrast did not reach the colon in 24 hours, then the patient was counseled and operative intervention was performed.
Results:Over a year, 101 patients were admitted for SBO. 26 patients went directly to the OR due to imaging or clinical findings suggesting bowel compromise (49% required bowel resection). Seventy-five patients were enrolled in the GG protocol of which 45.3% of patients underwent surgery. The average time to surgery was within 1 day for those not on the protocol and 2 days for those treated with GG

	LOS	Time of GG to colon (min)
GG+no surgery(n=41)	3($p<0.0001$)	300($p<0.0002$)
GG+surgery(n=34)	14($p=1$)	480($p=1$)
no GG+surgery(n=26)	12($p=0.2$)	N/A

Conclusion:Differentiating between patients with a partial bowel obstruction vs. complete obstruction remains arduous. Institution of the GG protocol standardized our management algorithm with the goal to identify those patients with complete obstructions early and intervene more rapidly. The protocol may have led to a more rapid resolution of a partial obstruction. The administration of GG did not comparatively increase the risk of bowel ischemia or significantly increase the rate of bowel resection.

Session: XA: Papers 17-25
Paper 17: 2:00-2:20 PM

NOT ALL BELLIES ARE THE SAME: A COMPARISON OF DAMAGE CONTROL SURGERY FOR INTRA-ABDOMINAL SEPSIS VERSUS TRAUMA

Jason W. Smith* MD,Ph.D., Nick A. Nash MD, Levi Procter MD, Matthew V. Benns MD, Keith R. Miller MD, Glen A. Franklin* MD, J D. Richardson* MD, Andrew C. Bernard* MD, Brian G. Harbrecht* MD, University of Louisville

Invited Discussant: Andre Campbell, MD

Introduction: Damage control surgery (DCS) has found a prominent place in the armamentarium of the acute care surgery. Developed to manage exsanguinating trauma patients it has been applied to the management of peritoneal sepsis and abdominal catastrophes. However, these entities are quite different and yet few manuscripts compare the outcomes of these surgeries on disparate patient populations

Methods: A multi-institutional three group 1:1:1 propensity score matched case cohort study comparing penetrating trauma (PT-DCS), blunt trauma (BT-DCS) and intra-peritoneal sepsis (IPS-DCS) patients treated between 2008-2013 with damage control surgery was performed. Propensity scoring was performed utilizing demographic and presenting physiologic data. Outcome variables were collected and analyzed utilizing univariate and multivariate techniques with a priori significance at $p< 0.05$.

Results: Four hundred and twelve (412) patients were treated with DCS during study period across the two institutions. After propensity matching for presenting physiologic and demographic variables, 80 patients per group were identified for comparison. Neither method of temporary abdominal closure nor institution predicted time to closure or rate of primary fascial closure. Rate of primary fascial closure was lowest in the IPS-DCS patients and highest in the PT-DCS patients which correlated with fewer numbers of operations and an increased time to closure.

Intra-abdominal complication rates (including abscess and EC fistula) were highest in the IPS-DCS group and correlated with an increased time to abdominal closure across all groups. (RR 1.8; 1.3-2.2; $p<0.03$) Mortality at 90 days was highest in the IPS-DCS patients and patients delayed >8 days were at more than twice the risk of death at 90 days across all groups.

(RR: 2.15; 1.2-3.5; $p<0.002$).

Conclusion: Expected outcomes after the use of DCS in trauma and emergency general surgery are very different. Despite these great differences, patients treated with prolonged open abdomens had a higher intra-abdominal complication rate and mortality at 90 days post-surgery. Regardless of etiology, prompt abdominal closure at the earliest possible opportunity affords the best outcome in patients managed via damage control surgery.

Table1: Selected outcome variables of patients treated using DCS

	PT- DCS (n=80)	BT- DCS (n=80)	IPS-DCS (n=80)
Time to closure(days)	**4.3 ± 1.9**	**6.9 ± 2.7 ***	**8.3 ±4.1‡†**
# of operations	**3 ± 2**	**5 ± 2 ***	**5 ± 5 ‡**
Primary fascial closure	**61 (79%)**	**49 (64%) ***	**40 (50%)‡†**
Abdominal complications	**18 (23%)**	**33 (41%) ***	**36 (45%)‡**
90 day Mortality	**10 (13%)**	**13 (16%)**	**21 (26%)‡†**

‡ denotes $p<0.05$ between IPS-DCS and PT-DCS †$p<0.05$ between IPS-DCs and BT-DCS, * denotes $p<0.05$ between PT-DCs and BT-DCS

Session: XA: Papers 17-25
Paper 18: 2:20-2:40 PM

THE IMPACT OF TRANEXAMIC ACID ON MORTALITY IN INJURED PATEINTS WITH HYPERFIBRINOLYSIS

JOHN A. HARVIN MD, MARK M. MIMS BS, JESSICA HUDSON MD, JEANETTE PODBIELSKI RN, CHARLES E. WADE Ph.D., JOHN B. HOLCOMB* MD, BRYAN A. COTTON* MD,MPH, University of Texas Health Science Center-Houston

Invited Discussant: Ernest Moore, MD

Introduction:Tranexamic acid has been shown in a randomized trial to improve survival among trauma patients if given in the first three hours after injury. However, given the numerous issues and concerns surrounding the design and results of that study, the indications for its use remain uncertain. Supported by data from two separate trauma centers, we implemented a protocol to administer TXA in trauma patients with evidence of hyperfibrinolysis on admission. The purpose of this study was to examine whether the use of TXA in patients with fibrinolysis >3.0% by admission thrombelastography (TEG) was associated with improved survival.

Methods: Following IRB approval, we evaluated all trauma patients >15 years of age admitted to our center between 09/09 and 09/13. We excluded patients with admission fibrinolysis <3.0%, determined by TEG LY-30. Our protocol for TXA with LY30>3% was implemented in 09/11. The patients were then divided into those who received TXA (TXA group) in the emergency department and those who did not receive TXA (no TXA group). In addition to admission rapid TEG values, we evaluated follow-up rapid TEG values obtained within the first 6 hours. Univariate and multivariate analyses were performed. A logistic regression model was developed *a priori* to evaluate to evaluate the impact of TXA on in-hospital mortality (controlling for age, gender, ISS, arrival physiology, and base deficit).

Results: 1032 patients met study criteria. 98 (10%) of patients received TXA and 934 (90%) did not. TXA patients were younger (median 37 vs. 32, p=0.018), more severely injured (median ISS 29 vs. 14, p<0.001), more hypotensive (arrival SBP 103 vs. 125, p<0.001) and were more likely to be in shock (BE -5 vs. -2, p<0.001). Al arrival rapid TEG values were more hypocoagulable on admission (ACT 128 vs 113, alpha 69 vs. 71, mA 57 vs. 63, and LY30 5.3 vs 4.3, all p<0.001). However, with the exception of ACT (136 vs. 121, p=0.047) there were no differences in repeat rapid TEG values obtained in the first 6 hours (all p>0.05). Only 6% of TXA patients had LY30>3% on repeat rapid TEG (vs. 0% in the no TXA group, p<0.001). With respect to outcomes, mortality was significantly higher in the TXA group (40% vs. 17%, p<0.001) while there were no differences in venous thromboembolic events (3.3% vs. 3.8%). Controlling for age, gender, injury severity, shock, and hypotension, regression analysis failed to find a difference in mortality among those receiving TXA upon admission (odds ratio 1.74, 95% C.I. 0.38-1.40). Consistent with the implementation of our protocol in 09/11, use of TXA increased over the study period from 3% in the first to years to 21% in the last year. However, when evaluating outcomes by year and increasing TXA compliance, there were no mortality differences observed by univariate (23% vs 22%) or multivariate analyses (odds ratio 1.35, 95% C.I. 0.42-4.26).

Conclusion: In the current study, use of TXA upon arrival resulted in correction of hyperfibrinolysis in 94% of patients. However, this correction did not translate into a reduction in mortality. Depsite a protocol in place, trauma faculty chose not to administer TXA to 90% of patients. Further studies are needed to better define who will benefit (and who might be harmed) by administration of TXA.

Session: XA: Papers 17-25
Paper 19: 2:40-3:00 PM

OVERWHELMING TPA RELEASE, NOT PAI-1 DEGRADATION, IS RESPONSIBLE FOR HYPERFIBRINOLYSIS IN MASSIVELY TRANSFUSED TRAUMA PATIENTS

Michael P. Chapman MD, Ernest E. Moore* MD, Eduardo Gonzalez MD, Hunter B. Moore MD, Theresa L. Chin MD, Arsen Ghasabyan MPH, CCRC, Fabia Gamboni Ph.D., Sanchayita Mitra MS, Anirban Banerjee Ph.D., Angela Sauaia MD,Ph.D., Christopher C. Silliman MD,Ph.D., Denver Health Medical Center

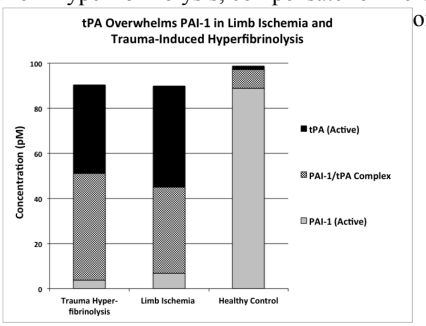
Invited Discussant: Yasuhiro Otomo, MD

Introduction: Hyperfibrinolysis is a highly lethal component of trauma-induced coagulopathy (TIC), but its mechanism is poorly understood. Plasminogen activator inhibitor-1 (PAI-1) and tissue plasminogen activator (tPA) are mutually inhibitory, existing in equilibrium with an inactive covalent complex. Degradation of PAI-1 by activated protein C (aPC) has been proposed as the initiator of hyperfibrinolysis in TIC. However, we have observed increased resistance to exogenous tPA in most trauma patients. Thus, we hypothesized that the normal reaction to traumatic injury is a protective elevation of PAI-1 and that cases of hyperfibrinolysis in TIC are caused by an overwhelming release of tPA from ischemic tissues.

Methods: Consecutive trauma patients activating our massive transfusion protocol (MTP, n=22) had blood collected on admission. Functional ELISAs for active tPA and PAI-1 as well as the inactive PAI-1/tPA complex were performed. Hyperfibrinolysis was defined as a tranexamic acid-reversible clot lysis after 30 minutes ≥3% by thrombelastography. Trauma patients were compared to healthy volunteers (n=3) before and after 45 minutes of upper extremity ischemia.

Results: 41% of MTP patients (median ISS 34, IQR 25-41), had hyperfibrinolysis. Total and free tPA were dramatically elevated in these patients compared to controls: total 86.8±20.0 vs. 9.9±1.2 picomolar (pM); (p= 0.024, t-test) and free 39.4±5.2 pM vs. 1.7±0.6 pM; (p=0.001). Total PAI-1 levels did not change significantly. Instead, the PAI-1 population shifted from 91% free PAI-1 to 7% in hyperfibrinolysis, the remainder complexed to tPA. The same pattern was observed after limb ischemia. In non-fibrinolytic trauma patients, total tPA was still markedly elevated, but was compensated for by a 20-fold increase in total PAI-1.

Conclusion: Hyperfibrinolysis in trauma with hemorrhagic shock is driven by a massive increase in tPA levels. Excess tPA inactivates PAI-1 by driving formation of the covalent PAI-1/tPA complex. Enzymatic degradation of active PAI-1 is not a significant feature of trauma-induced hyperfibrinolysis. Severely injured trauma patients who do not suffer from hyperfibrinolysis, compensate for increased tPA levels with a massive upregulation of PAI-1, which suppresses tPA activity.



Session: XA: Papers 17-25
Paper 20: 3:00-3:20 PM

Lung Protective Ventilation (ARDSNet) Versus APRV: Ventilatory Management of a Combined Model of Acute Lung and Brain Injury

Stephen W. Davies MD,MPH, Kenji L. Leonard MD, Randall K. Falls Jr., MD, Ronald P. Mageau MD, Joseph P. Hollowell BA, Wayne E. Trainer II, BS, Hilal A. Kanaan MD, Robert C. Hickner Ph.D., Robert G. Sawyer MD, Nathaniel R. Poulin MD, Brett H. Waibel* MD, Eric A. Toschlog* MD, Brody School of Medicine at East Carolina University

Invited Discussant: Orlando Kirton, MD

Introduction: Each year, over 300 thousand Americans suffer concomitant traumatic brain and lung injury resulting in significant morbidity and mortality. Lung protective ventilation (ARDSNet) has become the standard for managing acute respiratory distress syndrome (ARDS); however, the resulting permissive hypercapnea may compound traumatic brain injury. Airway pressure release ventilation (APRV) offers an alternative strategy for managment of this patient population. The purpose of this study was to evaluate the effects of APRV compared to ARDSNet protocol on a swine model with concomitant lung and brain injury.
Methods: Yorkshire swine were randomized to either ARDSNet or APRV. Lung injury was induced using 0.1N hydrochloric acid (4cc/kg) via the endotracheal tube. Intracranial hypertension (brain injury) was induced by inflating an intracranially placed, catheter to an intracranial pressure (ICP) between 30-40mmHg. Ventilatory settings and pulmonary parameters, vitals, arterial and venous blood gases, quantitative histopathology, and cerebral microdialysis were compared between groups.
Results: 22 swine (17male, 5female), weighing 24.2±5.6kg, were randomized to APRV (n=9), ARDSNet (n=12), or sham (n=1). Baseline characteristics (while on pressure support) were similar between groups. Following lung and brain injury, static compliance (APRV 11.7±1.1L/cmH_2O versus ARDS Net 10.9±4.7L/cmH_2O), P/F ratio (165±66 versus 181±52), and cerebral perfusion pressure (CPP)(65±14 versus 78±21mmHg) dropped significantly, while ICP (40±19 versus 31±6mmHg) increased significantly compared with baseline. Peak inspiratory pressure was significantly greater among ARDSNet recipients; however, static complicance, P/F ratio, CPP, and ICP were not significantly different between groups throughout the duration of the study. Additionally, preliminary review of histopathology and cerebral microdialysis did not differ significantly between groups; however, cerebral biomarkers glucose, glycerol, pyruvate, and lactate/pyruvate ratio trends suggest reduced cerebral ischemia with ARDSNet (Table).
Conclusion: Previous studies have not evaluated the effects of APRV in this population. While macroscopic parameters did not observe a significant difference between groups, microdialysis data suggest a trend toward cerebral ischemia associated with APRV. Additional and future studies should focus on extending the time interval for observation to deliniate differences between groups.

Table: Cerebral Microdialysis Biomarkers

	Mode	Baseline	1.5hr	2.5hr	3.5hr	4.5hr	5.5hr	6.5hr
Glucose (mmol/L)	APRV ARDSNet	1.0±0.79	0.84±0.65 1.4±1.2	0.23±0.071 1.7±1.3	ND 2.2±2.0	ND 3.1±2.2	ND 1.8±1.1	ND 1.6±1.0
Lactate (mmol/L)	APRV ARDSNet	4.0±4.3	5.6±2.9 5.1±2.5	6.9±1.9 7.3±4.9	6.5±1.4 7.4±4.8	6.2±0.60 4.7±2.6	6.5±1.1 5.2±2.4	6.6±1.2 7.3±3.9
Glycerol (µmol/L)	APRV ARDSNet	112±131	63±26 118±79	102±118 122±72	156±254 122±66	185±292 95±73	355±454 90±73	262±403 145±145
Pyruvate (µmol/L)	APRV ARDSNet	237±426	130±70 128±46	102±110 255±236	147±148 126±84	126±153 128±87	68±38 149±90	96±56 183±147
Lac/Pyr	APRV ARDSNet	23±10	58±44 38±14	174±132 40±18	106±82 86±99	145±115 67±70	124±69 62±59	93±52 68±78

Session: XA: Papers 17-25
Paper 21: 3:20-3:40 PM

RECONSTITUTION FLUID TYPE DOES NOT AFFECT PULMONARY INFLAMMATION OR DNA DAMAGE FOLLOWING INFUSION OF LYOPHILIZED PLASMA

Sean P. McCully MD, MS, Tim H. Lee MD, MS, Belinda H. McCully Ph.D., Elizabeth A. Rick BS, Nathan W. Anderson BS, David A. Hampton MD, MEng, Scott G. Louis MD, Martin A. Schreiber* MD, FACS Oregon Health & Science University

Invited Discussant: Frederick Moore, MD

Introduction: Dysfunctional inflammation following severe trauma and hemorrhagic shock can lead to multiple organ failure, and death. Compared to lyophilized plasma (LP) buffered with other acids, LP reconstituted in sterile water with ascorbic acid (AA) in our polytrama swine model restores hemostasis, suppresses systemic inflammation, and attenuates DNA damage. It is unknown whether the inflammatory response is affected by the type of fluid used to reconstitute LP. We hypothesize that commonly used reconstitution fluids: sterile water (SW), lactated Ringers (LR), normal saline (NS), or Hextend (HX) will yield similar profiles of pulmonary and systemic inflammation, and DNA damage following resuscitation with LP.

Methods: This was a randomized, prospective, blinded animal study. Donor plasma was collected from swine and lyophilized. LP was reconstituted to 50% of original volume with SW, LR, NS, or HX buffered with 15mM AA. Forty swine were subjected to a validated model of polytrauma, hemorrhagic shock, Grade V liver injury, and resuscitated with LP. Physiologic data was collected. Serum IL-6, IL-10 and plasma 8-hydroxy-2-deoxyguanosine concentrations were assessed for systemic inflammation and DNA damage at baseline, 2 and 4 hours following liver injury. Lung inflammation was evaluated by RT-PCR.

Results: Physiologic parameters and degrees of shock were not different between groups. The pH of reconstituted LP prior to resuscitation was similar between all groups. In all groups, serum IL-6 and IL-10 increased at 2- and 4-hours compared to baseline ($p \leq 0.05$), with no difference between groups. Serum IL-10 peaked between 1 and 4 hours following liver injury. In animals resuscitated with LP reconstituted with NS, LR and SW, DNA damage (Figure 1) increased from baseline to 2 hour, baseline to 4 hour and 2 to 4 hours, $p \leq 0.05$ (*). In animals resuscitated with LP reconstituted with HX, increased DNA damage occurred only at 4 hours versus baseline, $p \leq 0.05$ (Ψ). DNA damage was not different between groups at any time point. Lung tissue inflammation was similar between groups.

Conclusions: Reconstitution fluid type does not affect inflammatory cytokine profiles or DNA damage. Based on these findings and its universal availability, sterile water appears to be the fluid of choice for reconstitution of LP.

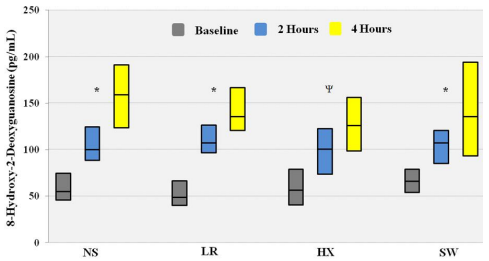


Figure 1: Plasma 8-Hydroxy-2-Deoxyguanosine concentration. Medians (IQR) are provided for each fluid group across time.

Session: XA: Papers 17-25
Paper 22: 3:40-4:00 PM

CLEARLY DEFINING PEDIATRIC MASSIVE TRANSFUSION: CUTTING THROUGH THE FOG AND FRICTION WITH COMBAT DATA

Lucas P. Neff MD, Jeremy W. Cannon* MD, Jonathan J. Morrison MB, Philip C. Spinella MD, Matthew A. Borgman MD, San Antonio Military Medical Center

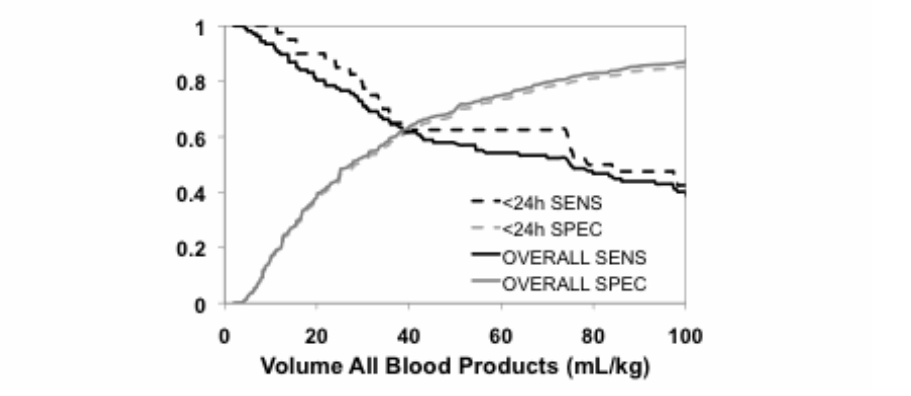
Invited Discussant: Michael Nance, MD

Introduction: Massive transfusion (MT) in pediatric patients remains poorly defined. Using the largest existing collection of transfused pediatric patients, we sought to identify an MT threshold which serves as an accurate surrogate for risk of death from trauma.

Methods: The Department of Defense Trauma Registry (DoDTR) was queried from 2001-2013 for pediatric trauma patients (<18 years). Burns, drowning, isolated head trauma, and missing injury severity score (ISS) were excluded. MT was evaluated as a weight-based volume of *all* blood products given at any time in the first 24 hours including packed red blood cells, whole blood, plasma, platelets, and cryoprecipitate. Mortality at 24 hours and in-hospital was calculated for increasing transfusion volumes. Sensitivity and specificity curves for predicting mortality were used to identify an optimal MT threshold. Patients above and below this threshold (+MT and –MT, respectively) were compared.

Results: The DoDTR yielded 4,990 combat-injured pediatric trauma patients of whom 1,340 were excluded. An additional 2,536 were not transfused. The remaining 1,114 transfused patients comprised the study cohort. Sensitivity and specificity for 24-hour and in-hospital mortality were optimal at 40.4 mL/kg and 38.8 mL/kg total blood products in the first 24 hours, respectively (Figure). Using a pragmatic threshold of 40 mL/kg, patients were divided into +MT (n=436) and –MT (n=678). On univariate analysis, +MT patients were more often in shock (68.1% vs. 47.3%, $p<0.0001$), hypothermic (12.9% vs. 3.6%, $p<0.0001$), coagulopathic (44.2% vs. 30.2%, $p=0.0002$), and thrombocytopenic (10.9% vs. 5.0%, $p=0.0008$) on presentation. +MT patients also had a higher ISS, longer ICU and hospital length of stay, more mechanical ventilator days, and a higher 24-hour (5.7% vs. 2.2%, $p=0.002$) and in-hospital mortality (15.1% vs. 6.0%, $p<0.0001$).

Conclusion: Based on this large cohort of transfused combat-injured pediatric patients, a threshold of 40 mL/kg of *all* blood products given at any time in the first 24 hours reliably identifies critically injured children at high risk of early and in-hospital death. This evidenced-based definition will provide a consistent framework for future research and protocol development in pediatric resuscitation.



Session: XA: Papers 17-25
Paper 23: 4:00-4:20 PM

ANGIOTENSIN INHIBITION DECREASES MULTIPLE ORGAN FAILURE IN OBESE TRAUMA PATIENTS

Robert D. Winfield MD, Robert E. Southard MD, Anja Fuchs Ph.D., Kelly Bochicchio MSN, Bradley D. Freeman MD, Douglas J. Schuerer* MD, Grant V. Bochicchio* MD,MPH, Washington University School of Medicine

Invited Discussant: Robert Cooney, MD

Introduction: Obese patients fare poorly following severe blunt injury, and are more likely to develop multiple organ failure (MOF) than lean patients. The pathophysiology of obesity includes an overactive, adipose tissue-derived, renin-angiotensin-aldosterone system (RAAS); this affects inflammatory responses via leukocyte angiotensin receptors. We hypothesized that obese patients taking pre-injury ACE Inhibitors (ACE-I) or angiotensin receptor blockers (ARB) would show a decrease in multiple organ failure and differences in immune cell frequencies.

Methods: We analyzed data contained within the "Inflammation and the Host Response to Injury" trauma related database. Patients taking pre-injury ACE-I and ARB were characterized as obese (BMI $\geq$30) or nonobese (BMI<30). Groups were then age, gender, and ISS matched against patients in the database who were not taking ACE-I or ARB. Patients were compared on the basis of demographic information, two MOF scores (Marshall Multiple Organ Dysfunction Score and Denver-2 Postinjury MOF Score), and leukocyte surface markers on T cells and monocytes as measured by flow cytometry.

Results: 1,932 patients were evaluated. Of these, 110 took pre-injury ACE-I (n=80) and/or ARB (n=31) with 94 patients (55 obese, 39 non-obese) having data available to calculate BMI. These patients were compared to patients not taking ACE-I or ARB (102 obese, 75 nonobese). Obese patients taking ACE-I/ARB showed maximum Marshall (5.83 ± 2.87) and Denver-2 (2.45 ± 2.32) scores similar to nonobese patients taking or not taking ACE-I/ARB, while obese patients not taking ACE-I/ARB had significantly higher Marshall (6.49 ± 2.57, $p=0.009$) and Denver-2 (3.33 ± 2.21, $p=0.006$) scores. Leukocyte analysis demonstrated multiple differences, most notably lower frequencies of GITR ($p<0.001$) and CD328 ($p<0.001$) positive T cells in obese patients taking ACE-I/ARB when compared to obese not taking these medications.

Conclusions: Obese patients taking pre-injury ACE-I/ARB show post-injury organ failure scores similar to nonobese patients, while obese patients not taking these medications show significantly greater post-injury organ failure. Leukocyte analysis demonstrates differences in T cell and monocyte surface marker expression, and this may indicate improved regulation of the immune system. Further study is needed to investigate the connection between these findings, and to clarify the role of angiotensin and adipose RAAS in post-injury immune dysfunction.

Session: XA: Papers 17-25
Paper 24: 4:20-4:40 PM

TIME FOR CLOSURE: A DEDICATED TRAUMA ICU IS ASSOCIATED WITH LOWER POST INJURY COMPLICATION RATES AND DEATH AFTER MAJOR COMPLICATIONS

Marko Bukur* MD, Ivan Puente MD, Joe Catino MD, MIchael Parra MD, Margaret Crawford RN, MSN,CCRN,CEN, Robyn Farrington MBA,RN, BSN, Fahim Habib MD,MPH, Delray Medical Center

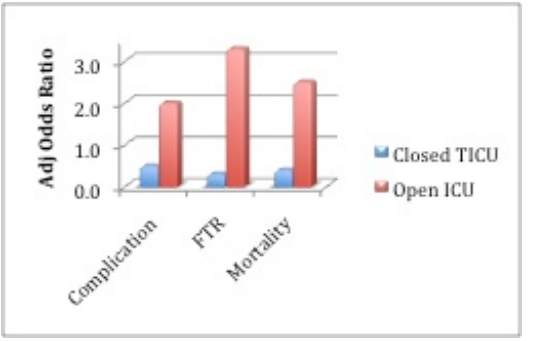
Invited Discussant: Charles Adams, Jr., MD

Introduction: Recent data suggests that injured patients admitted to a dedicated trauma intensive care unit (TICU) have better outcomes than those admitted to mixed ICUs. The cause for this apparent discrepancy has not been well established. We hypothesized that trauma patients admitted to a dedicated TICU would have a lower frequency of post injury complications, as well as, death after major complication (failure to rescue [FTR]).

Methods: We performed a retrospective review of patients admitted to the respective ICUs of two Level I trauma centers covered by the same group of trauma and surgical intensivists over the past 5 years. One center has a dedicated TICU, while the other has a mixed, open ICU. Patients were excluded if they had non-survivable injuries or an ICU stay of less than 48 hours. Relevant demographic and clinical characteristics were abstracted and stratified into TICU and ICU groups for comparison. The primary outcomes were overall post-injury complication rate and FTR between the respective ICU models. Multivariate regression was used to derive factors associated with complication rate(s) and FTR.

Results: During the 5 year study period, 2,567 patients were admitted to the TICU and 1,266 to the mixed ICU respectively. TICU patients were older (Mean Age 57.8 vs. 47.0, $p<0.0001$), had more co-morbidities (Charlson score 2 vs. 1, $p=0.001$), were more likely to be admitted with severe head injuries (Head AIS $\geq$ 3, 50.0% vs. 37.5%, $p<0.0001$), and have a greater overall injury burden (ISS>16 49.6% vs. 38.6%, $p<0.0001$) than those admitted to the mixed ICU. Need for operative intervention was similar between the two groups (18.0% vs. 17.6%, $p=0.788$). Complications were significantly higher in trauma patients admitted to the mixed ICU (27.5% vs. 17.0%, $p<0.0001$), as well as, FTR (3.7% vs. 1.8%, $p<0.0001$). After adjusting for confounding factors, trauma patients admitted to a dedicated TICU had a significantly lower chance of developing a post-injury complication (AOR 0.5, 95%CI [0.4,0.6], $p<0.0001$), FTR (AOR 0.3, 95%CI [0.2,0.5], $p<0.0001$), and overall mortality (AOR 0.4, 95%CI [0.3,0.5], $p<0.0001$).

Conclusion: Admission of critically ill trauma patients to a dedicated TICU staffed by a surgical intensivist is associated with a significantly lower risk of developing p ost-injury complications and death after major complication. Factors such as trauma nursing experience, education, and unit structure should be further explored to elucidate the observed improved outcomes.



Session: XA: Papers 17-25
Paper 25: 4:40-5:00 PM

FACTOR VIIA ADMINISTRATION IN TRAUMATIC BRAIN INJURY: AN AAST-MITC PROPENSITY SCORE ANALYSIS

Sarah Lombardo MD, MSc, Tom H. Greene Ph.D., Molly L. McFadden MS, Thomas M. Scalea* MD, Gregory J. Jurkovich* MD, Jason Sperry* MD,MPH, Iman Feiz-Erfan* MD, Patrick O'Neill* MD,Ph.D., Raul Coimbra* MD,Ph.D., Raminder Nirula* MD,MPH, University of Utah

Invited Discussant: M. Margaret Knudson, MD

Introduction: Recombinant Factor VIIa (rFVIIa) is FDA-approved for treatment of uncontrolled bleeding in patients with hemophilia. There are numerous accounts of off-label rFVIIa use as an adjunct in the reversal of warfarin therapy and management of hemorrhage in the setting of trauma. Only a handful of these reports are rigorous studies, from which results regarding safety and effectiveness have been mixed. There remains no clear consensus as to the role of rFVIIa in traumatic brain injury.

Methods: Eleven Level 1 trauma centers provided clinical data and head CT scans of patients with a GCS<=13 and radiographic evidence of TBI. CTs were blindly graded according to the Marshall classification. A propensity score (PS) to receive rFVIIa in those surviving 2 days or greater was calculated for each patient based upon patient demographics, comorbidities, physiology, injury severity score (ISS), admission GCS, and treatment center. Patients who actually received rFVIIa within 24hr hours of admission were matched to patients who did not receive rFVIIa for outcomes assessment.

Results: There were 4284 patient observations; 129 (3.3%) received rFVIIa within 24 hours of admission. Those receiving rFVIIa tended to be older, male, have more comorbidities, on warfarin therapy, and had higher ISS and head AIS scores. Groups were comparable after matching. No differences in mortality or morbidity were seen in association with rFVIIa. GCS at discharge was significantly lower among those receiving rFVIIa in the setting of polytrauma (-1.40, 95% CI: -2.572, -0.221), and a trend towards decreased GCS was seen among primary head injury patients receiving rFVIIa (-1.00, 95% CI: -2.934, 0.934).

Conclusion: Use of rFVIIa in early management of the traumatic brain injured patient is not associated with a decreased risk of mortality or morbidity, and may negatively impact recovery and functional status at discharge.

	Pre-matching		**Post-matching, all comers**		**Post-matching, primary head injury**	
	OR/coef	*95% CI*	*OR/coef*	*95% CI*	*OR/coef*	*95% CI*
Mortality	3.45	2.416, 4.931	1.57	0.731, 3.379	0.56	0.161, 1.919
Morbidity	0.61	0.367, 1.006	0.66	0.298, 1.475	1.84	0.387, 8.767
VAP	0.61	0.307, 1.207	1.00	0.330, 3.035	--	--
ARDS	0.56	0.176, 1.781	3.10	0.314, 30.608	--	--
DVT	0.48	0.118, 1.973	0.48	0.085, 2.741	--	--
CRBSI	0.34	0.047, 2.460	--	--	--	--
Abscess	6.68	1.429, 31.244	--	--	--	--
Meningitis	1.06	0.143, 7.853	1	0.061, 16.342	--	--
GCS at discharge	-1.39	-2.076, -0.703	-1.40	-2.572, -0.221	-1.00	-2.934, 0.934

Session: XB: Papers: 26-34
Paper 26: 2:00-2:20 PM

OBESITY AND CLOTTING: BMI INDEPENDENTLY CONTRIBUTES TO HYPERCOAGULABILITY AFTER INJURY

Lucy Kornblith MD, Benjamin Howard MD,MPH, Ryan Kunitake BA, Brittney Redick BA, Mary Nelson RN, MPA, Mitchell Cohen* MD, Rachael Callcut* MD, MSPH University of California, San Francisco

Invited Discussant: Hasan Alam, MD

Introduction: The role of obesity as a mediator in coagulation after injury remains unknown. However, obese patients exhibit chronic low-grade inflammation and have high rates of thrombosis after injury. We hypothesized that BMI is independently associated with increased measures of hypercoagulability longitudinally after injury.

Methods: Demographics, outcomes, and laboratory measures were prospectively collected on arrival and up to 28 days for 377 consecutive highest-level trauma activation patients with a body mass index (BMI) ≥ 18.5, not anti-coagulated, and without liver failure at a single Level 1 Trauma Center. Standard coagulation measures, citrated kaolin and functional fibrinogen thromboelastography (TEG), and an extensive panel of clotting factors were measured at 0, 6, 12, 24, 48, 72, 96, and 120h. Multiple linear regression was used at each time point to examine the relationship of BMI with clotting measures. Multiple logistic regression was used to define predictors of thromboembolic complications. BMI categories were defined by standard cutoffs: normal weight (BMI 18.5-24.99 kg/m^2), overweight (BMI 25-29.99 kg/m^2), and obese (BMI ≥ 30 kg/m^2).

Results/progress: The 377 patients were mostly male (81%) and bluntly injured (61%), with a median BMI of 25.8 kg/m^2. 42% were normal weight (median BMI 22.5 kg/m^2), 32% were overweight (median BMI 27.1 kg/m^2), and 26% were obese (median BMI 33.0 kg/m^2). There were no differences in age, gender, ISS or base deficit between groups, but the obese patients had lower rates of blunt injury and head injury than the normal weight patients (blunt injury rate 54.6% vs. 71.5%p=0.007; median AIS-head 0 vs. 2, p=0.008). There were no differences in admission INR/PTT or factors II, V, VII, VIII, X, ATIII, or protein C across BMI groups. However, obese patients had significantly higher admission platelet counts (302.69 vs. 268.58 x 10^9/L, p=0.004), factor IX (134 vs. 119 % activity, p=0.04), and lower D-dimer (1.88 vs. 4.00 ug/mL, p=0.004) than normal weight patients. Measured by TEG, clot strength (MA) and functional fibrinogen level (FLEV) were also higher on admission for obese patients (MA 65.7 vs. 63.4 mm,p=0.016; FLEV 406.53 vs. 350.73 mg/dL, p=0.008). In multiple linear regression, the relationship of BMI to clot strength, FLEV, and FIX persisted through 24h (Table). Similarly, the relationship of BMI and platelet count persisted through 120h (all$p$<0.05). In multiple logistic regression, for every 5kg/m^2 increase in BMI, there was an 85% increase in odds of developing a thromboembolic complication (OR 1.85, CI 1.13-3.08, p=0.017).

Conclusions: Following injury, obese patients are hypercoagulable compared to their similarly injured normal weight counterparts. This hypercoagulability persists to at least 24h after injury as demonstrated by relative thrombocytosis, stronger clot, increased FIX activity, and increased functional fibrinogen levels with increasing BMI. The clinical significance of this hypercoagulability needs to be elucidated to guide management of anticoagulation in this at-risk group.

Table. Multiple linear regression for each 5kg/m2 increase in BMI from 0-24h

	0h	6h	12h	24h
MA (mm)	1.01 (p=0.002)	1.24 (p=0.004)	1.17 (p=0.005)	0.95 *($p=0.032$)*
FLEV (mg/dL)	23.20 (p=0.001)	19.92 (p=0.047)	19.85 (p=0.016)	15.96 (p=0.049)
Factor IX (% act)	7.79 (p=0.015)	13.88 (p=0.003)	9.30 (p=0.016)	7.83 (p=0.133)
Platelet (x10^9/L)	10.94 (p=0.013)	23.30 (p=0.020)	33.33 (p<0.001)	10.57 (p=0.002)

Session: XB: Papers: 26-34
Paper 27: 2:20-2:40 PM

THE NEW METRIC TO IDENTIFY LARGE-VOLUME HEMORRHAGE: RESULTS OF A PROSECTIVE STUDY OF THE CRITICAL ADMINISTRATION THREHSOLD

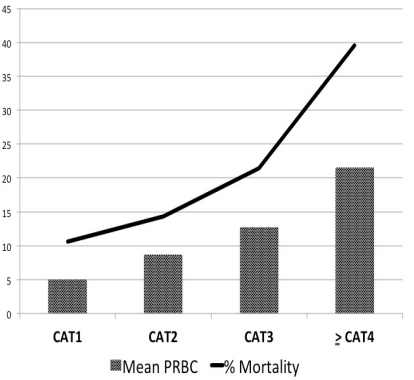
Stephanie Savage* MD, MS, Joshua J. Sumislawski BS, Ben L. Zarzaur* MD,MPH, Wesley P. Dutton BS, Martin A. Croce* MD, Timothy C. Fabian* MD, University of Tennessee Health Science Center - Memphis

Invited Discussant: John Holcomb, MD

Introduction: The current definition of massive transfusion (MT, $\geq$ 10 units PRBC in 24 hours) focuses on a static volume over fixed time and is a crude estimate of acute hemorrhage. This arbitrary volume-definition leads to survival bias and fails to identify the 'massively' transfused patient. In prior retrospective work, the critical administration threshold (CAT) was created to incorporate both rate and volume of transfusion; CAT proved a superior predictor of mortality compared to traditional MT (*J Trauma Acute Care Surg, 2013*). The purpose of this study is to prospectively validate CAT in a larger population of trauma patients. We hypothesize that CAT is a highly sensitive method to identify actively bleeding patients.

Methods: Patients receiving at least one unit of blood within the first 24 hours of admission were identified prospectively from June 2012 to May 2013. Patients with isolated head injury or cardiac arrest upon arrival were excluded. Administration time of each blood unit was recorded in minutes from time of injury. CAT status, defined as receipt of at least 3 units of blood in a 60-minute period, was identified for each hour of the first 24 hours. CAT+ patients were further quantified by number of times CAT+ was reached: once (CAT1), twice (CAT2), three times (CAT3) or 4 or more times (CAT4). A multivariable Cox Proportional Hazard model with a time-varying covariate was used to quantify risk of death with increasing CAT status.

Results: 432 patients were prospectively identified. 308 met inclusion criteria, 163 were CAT+. 76% were male with mean age of 38 years, 46% penetrating injury, mean injury severity score (ISS) of 18.6 and 21% mortality. CAT+ showed a 3-fold increased risk of death (HR 3.099, 95% CI 1.187, 8.091), and multiplicative increases in mortality risk with each CAT+.



Subdividing CAT+ patients by number of events showed a consistent increase in gross mortality (*Figure*). 95 patients were CAT+ and received less than 10 units of blood, thereby failing to meet criteria for MT (CAT+/MT-). CAT+/MT- had significant injury patterns with a mean ISS of 18.1 (blunt ISS 22, penetrating ISS 13.3) and 11% mortality. Mean time to initial CAT+ in the CAT+/MT- group was 236 minutes.

Conclusion: The prospective nature of CAT allows early identification of injured patients at greatest risk of death. Encompassing both rate and volume, CAT is a more sensitive tool than common massive transfusion definitions. Further, CAT allows identification of hemorrhaging patients excluded by static definitions of MT. Studies examining large-volume blood transfusions should utilize CAT, not traditional MT definitions, to accurately identify cohorts of interest.

Session: XB: Papers: 26-34
Paper 28: 2:40-3:00 PM

A PHARMACOLOGIC APPROACH TO VAGAL NERVE STIMULATION PREVENTS MESENTERIC LYMPH TOXICITY AFTER HEMORRHAGIC SHOCK

Koji Morishita MD,Ph.D., Akinori Ueno Ph.D., Brian Eliceiri Ph.D., Todd W. Costantini MD, Raul Coimbra* MD,Ph.D., University of California, San Diego

Invited Discussant: William Cioffi, MD

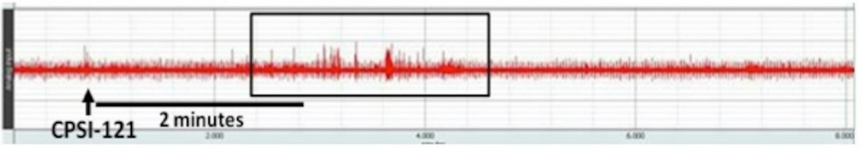
Introduction: Electrical stimulation of the vagus nerve (VN) prevents gut inflammation and mesenteric lymph (ML) toxicity in animal models of injury. While electrical stimulation of the VN currently has limited translational applicability, a pharmacologic approach to stimulating the VN could easily be administered to injured patients. We have previously shown that treatment with CPSI-121, a guanylhydrazone-derived compound, prevents gut barrier failure after burn injury. While the structure of CPSI-121 predicts that it will activate parasympathetic signaling, its ability to stimulate the VN is unknown. The aims of this study were to 1) measure the ability of CPSI-121 to induce VN activity, 2) determine whether CPSI-121 causes significant hemodynamic effects, and 3) further define the potential for CPSI-121 to limit the systemic inflammatory response to injury.

Methods: Male Sprague Dawley rats were given 1 mg/kg of CPSI-121 intravenously while blood pressure, heart rate, and efferent VN electrical activity was recorded. Rats also underwent cannulation of the mesenteric lymph duct prior to trauma/hemorrhagic shock (T/HS, 60 min at a mean arterial pressure of 35 mmHg). Following T/HS, animals were resuscitated with shed blood and normal saline. A separate cohort of animals received CPSI-121 after the HS phase. Gut tissue was harvested at 2 hours after injury for histologic analysis. The ability of mesenteric lymph to prime neutrophils was assessed by measuring in vitro oxidative burst using flow cytometry.

Results: Blood pressure was not altered after treatment with CPSI-121, while heart rate decreased only slighty. Recording of efferent VN electrical activity revealed an increase in discharge rate starting at 2 minutes after administration of CPSI-121 that lasted for several minutes (See Figure). T/HS caused histologic gut injury which was prevented in animals treated with CPSI-121 ($p < 0.05$). Treatment with CPSI-121 following T/HS attenuated neutrophil priming after exposure to ML, with decreased neutrophil oxidative burst compared to T/HS alone ($p < 0.05$).

Conclusion: CPSI-121 causes efferent vagus nerve output and limits gut injury and ML toxicity after T/HS. CPSI-121 is a candidate pharmacologic approach to vagus nerve stimulation aimed at limiting the inflammatory response in patients following severe injury.

Figure: CPSI-121 increases efferent vagus nerve activity



Session: XB: Papers: 26-34
Paper 29: 3:00-3:20 PM

FIBRINOGEN CONCENTRATE ADMINISTRATION INHIBITS ENDOGENOUS FIBRINOGEN SYNTHESIS IN PIGS AFTER TRAUMATIC HEMORRHAGE

Wenjun Z. Martini Ph.D., Michael Dubick* Ph.D., US Army Institute of Surgical Research

Invited Discussant: Peter Rhee, MD, MPH

Introduction:
Fibrinogen plays a central role in coagulation and has been shown to fall to critical levels early after trauma. Administration of fibrinogen concentrate (FC) to improve hemostasis after bleeding under various pre-clinical and clinical conditions seems beneficial, but it is unclear whether its use introduces overly abundant fibrinogen with potential risk of thrombosis. This study investigated changes of endogenous fibrinogen metabolism from FC administration following traumatic hemorrhage in pigs.

Methods:
Anesthetized, instrumented pigs were randomized into LR and FC groups (n=7 each). Femur fracture was induced using the captive bolt stunner at mid shaft of the pigs' left legs, followed by hemorrhage of 60% total blood volume and resuscitated with LR (3x bled volume, LR group) or LR plus FC at 250 mg/kg in the FC group. Afterwards, a primed constant infusion of stable isotope 1- ^{13}C-phenylalanine (phe, 6h) and d_5-phe (3h) was performed with hourly blood sampling and subsequent gas chromatography and mass spectrometry analysis to quantify fibrinogen synthesis and breakdown rates, respectively. Hemodynamics was continuously monitored. Blood samples were taken at phases for blood and coagulation measurements using Thrombelastograph ®. Animals were euthanized at the end of the 6 h isotope period.

Results:
MAP decreased from baseline (BL) 75 ± 3 mmHg to 37 ± 2 mmHg by the hemorrhage but returned to near BL within 1h after resuscitation in both groups. Hemorrhage and LR resuscitation reduced total protein, Hct, fibrinogen and platelets to 50% of BL; decreased fibrinogen concentration from 207 ± 6 mg/dL to 132 ± 7 mg/dL and clot strength from 72 ± 2 mm to 63 ± 2 mm in both groups (both $p<0.05$). FC administration in the FC group recovered plasma fibrinogen concentration and restored clot strength within 15 min, while no changes observed in LR group. Fibrinogen synthesis rate in FC was reduced to 1.3 ± 0.2 mg/kg/h, compared to 3.1 ± 0.5 mg/kg/h in LR ($p<0.05$). Fibrinogen breakdown rates were similar between FC and LR.

Conclusion:
In addition to acute recoveries of fibrinogen concentration and clotting strength, administration of FC after traumatic hemorrhage inhibited fibrinogen synthesis without affecting fibrinogen breakdown. These data suggest a feedback mechanism in regulating host fibrinogen availability and an unlikely risk of thrombosis from FC administration.

Session: XB: Papers: 26-34
Paper 30: 3:20-3:40 PM

ARE WE MEASURING THE RIGHT THING? CARDIAC DYSFUNCTION, NOT CARDIAC OUTPUT, IS PREDICTIVE OF OUTCOME IN CRITICALLY ILL SURGICAL PATIENTS

Sarah B. Murthi* MD, Samuel M. Galvagno DO,Ph.D., Jacob J. Glaser MD, Thomas M. Scalea* MD, University of Maryland Medical Center

Invited Discussant: Paula Ferrada, MD

Introduction: Hemodynamic monitors use cardiac output (CO) as the sole assessment of cardiac function. We sought to determine the *i*) accuracy of CO in detecting cardiac dysfunction (CDF) and *ii*) the association between CDF and outcome.

Methods: The Focused Rapid Echocardiographic Evaluation (FREE) assesses CO by CI and stoke volume index (SVI). The functional assessments are; left ventricular (LV) ejection fraction (EF), LV diastolic function, and right ventricular (RV) function. The area under the Receiver-Operator Characteristic (AUROC (95% CI)) was used to determine the accuracy of CO (CI and SVI) in detecting moderate and severe CDF (EF <30%, diastolic dysfunction (DD), and RV dysfunction (RVD)). In addition we determined the association of CI, EF, DD and RVF on mortality and other measures of outcome.

Results: From 9/2009-3/2013, 1059 patients had a FREE performed for clinical indications. The average age was 60 yrs (±) 18, 60% were male and, 52% had undergone surgery. The overall prevalence of dysfunction (EF <55%, DD and RVD) was 24%, 32% and 15%. The prevalence of moderate and severe dysfunction was, 12% for EF<30%, 19% for DD, and 9% for RVD. Both CI and SVI were inaccurate detectors of all forms of moderate to severe dysfunction. Using a CI of 2.2 L/min/M ^{2} as a threshold value, the AUROC was 0.66 (0.62 -0.71), 0.60 (0.56-0.63) and 0.59 (0.55-0.63) for EF, DD and RVD. In addition, using a threshold value of 33 ml/M^2/beat for SVI it was 0.53 (0.50-0.55), 0.50 (0.49-0.52) and 0.52 (0.50-0.54). Furthermore, the associated risk of death was higher with each form of moderate to severe CDF; 1.43 (CI 0.97-2.1, P=0.07) for EF <30%, 1.52 (1.10-2.11, P=0.01) for DD and 1.28 (0.9-1.8, P=0.2) for RVD.

Conclusion: Cardiac output is a poor measure of EF, DD and RVD. Patients with DD have a significantly increased risk of mortality, which has not been previously demonstrated. If cardiac dysfunction is suspected, an echo should be performed. Further studies are needed to determine if function-based treatment, directed by echo, is superior to catheter based care.

Session: XB: Papers: 26-34
Paper 31: 3:40-4:00 PM

POST-RESUSCITATIVE HYPERCHLOREMIC METABOLIC ACIDOSIS IS ASSOCIATED WITH ACUTE KIDNEY INJURY

Dennis Y. Kim MD, Kyle Mock MD, Brian Nguyen MD, James Cunningham MD, Allison Forbes RN, Amy Kaji MD,Ph.D., Scott Bricker MD, Fred Bongard* MD, Angela Neville* MD, Brant Putnam* MD, David Plurad* MD, Harbor-UCLA Medical Center

Invited Discussant: Lena Napolitano, MD

Introduction: Hyperchloremic metabolic acidosis (HMA) is a common finding following the acute resuscitation of trauma patients. The clinical consequences of this metabolic abnormality are questionable. Recent data suggest an association between HMA and adverse outcomes including acute kidney injury (AKI). We hypothesized that HMA would be associated with an increased risk for early AKI in trauma patients.

Methods: We performed a 4 year retrospective analysis of all adult patients with an injury severity score (ISS) >15 admitted to the surgical intensive care unit for >48 hours at our Level 1 trauma center. Records were reviewed for arterial blood gases, serum chemistry, 24 hour admission fluid and blood product composition, volumes, and balance. AKI was defined according to the Acute Kidney Injury Network criteria. Patients with an HMA (pH <7.35; chloride >110; normal adjusted anion gap) were compared to patients without an acidosis. The primary outcome of interest was early AKI (developing ≤48 hours of admission). Multivariable logistic regression analysis was performed to identify independent predictors of AKI.

Results: Of 494 patients, 208 (42%) developed an HMA. Patients with an HMA had a higher ISS (28 ± 10 vs. 23 ± 8, $p<0.0002$), received more fluids in the first 24 hours (4L [IQR=3L-7L] vs. 2L [1L-3L], $p<0.0001$), and required an emergent operation (41% vs. 30%, $p=0.009$) and massive transfusion (7% vs. 3%, $p=0.04$) more frequently than patients without an acidosis. The overall incidence of AKI was 18%, which occurred more commonly in patients with an HMA (26% vs. 8% [OR=4.0; 95% CI 2.3-7.1, $p<0.0001$]). On multivariate logistic regression analysis, after controlling for confounding variables and known risk factors for AKI, HMA was found to be the only independent predictor of early AKI (OR=3.9; 95% CI=2.2-6.9, $p<0.0001$).

Conclusion: Post-resuscitative hyperchloremic metabolic acidosis is independently associated with the development of early AKI. Efforts to minimize the administration of chloride rich crystalloids may potentially reduce the incidence of AKI among critically injured patients.

Session: XB: Papers: 26-34
Paper 32: 4:00-4:20 PM

NATIONAL ESTIMATES OF PREDICTORS OF OUTCOMES FOR EMERGENCY GENERAL SURGERY

Adil A. Shah MD, Adil H. Haider* MD,MPH, Diane A. Schwartz MD, Elliott R. Haut* MD, Syed N. Zafar MD,MPH, Zain G. Hashmi
MD, Eric B. Schneider Ph.D., Catherine G. Velopulos MD, Shahid Shafi* MD,MPH, Hasnain Zafar MBBS, FRCS, David T. Efron*MD, Johns Hopkins School of Medicine

Invited Discussant: Kristan Staudenmayer, MD

Introduction: Identification of predictors of complications and mortality have enabled improvements in outcomes for a variety of surgical conditions. However, similar work has yet to be done to identify factors affecting outcomes following emergency general surgery (EGS). Our objective was to determine the predictors of in-hospital complications and mortality among EGS patients.

Methods: The Nationwide Inpatient Sample (2003–2011) was queried for patients with conditions encompassing EGS as determined by the American Association for Surgery of Trauma (AAST) and categorized into the 24 defined EGS groups using ICD9 codes. Our primary outcomes of interest were the incidence of a major complication (defined as pneumonia, pulmonary emboli, urinary tract infections, myocardial infarction, sepsis or septic shock) and in-hospital mortality. Separate multivariate logistic regression analyses for complications and mortality were performed, to identify risk-factors of either outcome from the following domains: patient demographics (age, sex, insurance type, race, and income quartile), comorbidities, and hospital characteristics (location, teaching status and bed size).

Results: We analyzed 6,836,764 visits for EGS conditions. The average age was 58 years with a slight female preponderance (55%). Uninsured patients were more likely to die (OR[95% CI]:1.24[1.19- 1.29]), whereas patients in the highest income quartile had the least likelihood of mortality(OR[95% CI]:0.85[0.84-0.87]). Old age was an independent predictor of mortality for all EGS sub-diagnoses (table). The overall mortality rate was 1.8%. The overall complication rate was 15%. Of the patients who died, 62% suffered at least one major complication. Risk adjusted mortality rates were highest for patients requiring resuscitation for sepsis & shock. Patients with septic shock had a (OR[95%CI]:71.6[69.9-73.4]) had markedly high odds of death compared to those with no complications.

Table: Odds likelihood of mortality for the top 5 EGS conditions

	Odds Likelihood of Mortality [95% Confidence Interval]				
	Soft tissue pathologies	**Biliary pathology**	**Gastrointestinal bleeding**	**Colorectal pathology**	**Intestinal Obstruction**
Female	0.94 [0.89-0.98]	0.94 [0.89-0.98]	0.85 [0.83-0.88]	0.94 [0.89-1.01]	1.01 [0.98 -1.05]
Age Categories (years) (Referent: 16-25)					
• 66 - 75	12.0 [8.1-17.9]	9.1 [5.4-15.2]	3.6 [2.4-5.3]	7.1 [3.5-14.4]	3.2 [2.4-4.3]
• 76-85	18.2 [12.2-27.1	15.8 [9.4-26.5]	4.8 [3.2-7.2]	11.1 [5.5-22.5]	5.3 [4.0-7.1]
• >85	28.0 [18.8-41.7]	29.9 [17.8-51.1]	8.0 [5.4-11.8]	20.2 [10.1-41.0]	10.6 [7.9-14.2]
Race (Referent: White)					
• Black	1.09 [1.01-1.18]	1.01 [0.90-1.13]	0.84 [0.79-0.88]	0.89 [0.78-1.01]	1.05 [0.98-1.11]
• Hispanic	0.96 [0.87-1.05]	0.82 [0.73-0.91]	0.90 [0.84-0.96]	0.79 [0.69-0.92]	0.93 [0.85-1.01]
• Others/Unknown	1.10 [0.97-1.24]	1.07 [0.99-1.16]	0.96 [0.93-1.01]	0.94 [0.87-1.04]	1.06 [1.01-1.11]
Insurance Type (Referent: Private)					
• Government	1.15 [1.07-1.25]	1.34 [1.21-1.48]	1.01 [0.96-1.07]	1.45 [1.30-1.61]	1.10 [1.03-1.16]
• Uninsured	1.07[0.92-1.25]	1.17 [0.95-1.44]	1.24 [1.13-1.37]	1.05 [0.80-1.37]	1.19 [1.02-1.40]
Income Quartile (Referent: Lowest)					
• Highest	0.84 [0.78-0.90]	0.78 [0.71-0.86]	0.85 [0.81-0.89]	0.84 [0.80-0.97]	0.85 [0.80-0.89]
Teaching Hospital	0.94 [0.89-0.99]	1.00 [0.94-1.07]	1.00 [0.97-1.03]	1.00 [0.93-1.07]	1.04 [1.00-1.09]
Urban location	1.11 [1.03-1.19]	1.02 [0.94-1.11]	0.92 [0.88-0.96]	0.91 [0.82-1.00]	0.91 [0.86-0.96]

Conclusion: EGS patients have death patterns that can be discerned using administrative datasets. Understanding patterns of mortality and complications would allow for hospital benchmarking on similar lines to trauma surgery.

Session: XB: Papers: 26-34
Paper 33: 4:20-4:40 PM

IMPLEMENTATION OF AN ACUTE CARE SURGERY SERVICE IN A COMMUNITY HOSPITAL: IMPACT ON HOSPITAL EFFICIENCY AND PATIENT OUTCOMES

Michael Kalina DO, Steven A. Johnson MD, Capital Health

Invited Discussant: Lewis Kaplan, MD

Introduction: Incorporating an acute care surgery service led by acute care surgeons into the management of critically ill surgical, emergency general surgery, and trauma patients has resulted in improved efficiency and patient outcomes at university hospitals and Level 1 trauma centers. Our goal was to determine if implementing an acute care surgery service led by acute care surgeons, entitled the Surgical Trauma and Acute Resuscitative Service (STARS), in a community hospital improved hospital efficiency and patient outcomes.

Methods: After IRB approval was obtained, 492 patient charts were retrospectively reviewed, 230 prior to implementation of the STARS, from August 2012 to March 2013, (pre-STARS or control group) as compared to 262 after implementation, from April 2013 to December 2013, (post-STARS or study group). Demographic data included age, gender, APACHE 2 score, and medical co-morbidities including diabetes (DM), hypertension (HTN), coronary artery disease (CAD), pulmonary disease (PD), liver failure (LF), and renal failure (RF). Hospital efficiency data included emergency department length of stay (ED-LOS), surgical intensive care unit length of stay (SICU-LOS), and hospital length of stay (H-LOS). Patient outcome data included mortality. Data were analyzed using Student's t-test, Chi-square, and multivariate logistic and linear regression analyses with bootstrapping. Statistical significance was denoted by $p \leq 0.05$.

Results: Of 492 patients, the average age was 64.1 ± 16.4 years, range of 18–98 years. 255 were males (51.83%) and 237 were females (48.17%). The average APACHE 2 score was 11.9 ± 5.8. There were no significant differences in age, APACHE 2 score, DM, CAD, PD, LF or RF. There was a significant difference with respect to HTN and gender ($p=0.02$, $p=0.001$ respectively). Mean ED-LOS was 9.7 ± 9.6 hrs, pre-STARS vs. 6.6 ± 4.5hrs, post-STARS. Mean SICU-LOS was 5.3 ± 9.6 days, pre-STARS vs. 3.5 ± 4.8 days, post-STARS. Mean H-LOS was 12.4 ± 12.7 days, pre-STARS vs. 11.4 ± 11.3 days, post-STARS. Mortality was 8.7%, pre-STARS vs. 4.9%, post–STARS. Adjusting for confounders revealed an average decrease in ED-LOS of 2.9 hours ($p=0.17$; 95% CI: -7.0, 1.2), an average decrease in SICU-LOS of 6.3 days ($p<0.001$; 95% CI: -9.3, -3.2), and an average decrease of H-LOS of 7.6 days ($p=0.001$; 95% CI: -12.1, -3.1) in the post-STARS group. Adjusting for confounders revealed that patients in the post-STARS group had an odds of survival that was 3.4 times greater than those in the pre-STARS group ($p=0.04$; 95% CI: 1.1, 10.7).

Conclusions: Implementation of the Surgical Trauma and Acute Resuscitative Service resulted in statistically significant decreases in surgical intensive care unit and hospital length of stay and increases in the odds of survival. Therefore, implementation of an acute care surgery service led by acute care surgeons in a community hospital improved hospital efficiency and improved patient outcomes.

Session: XB: Papers: 26-34
Paper 34: 4:40-5:00 PM

COMPARISON OF ATRIOCAVAL SHUNTING WITH PERIHEPATIC PACKING VS PERIHEPATIC PACKING ALONE FOR RETROHEPATIC VENA CAVA INJURIES IN A SWINE MODEL

Joshua P. Hazelton DO, Rachel L. Choron MD, Gregory M. Dodson DO, Jeffrey A. Gerritsen MD, Sophia Khan MD, Kathryn E. VanOrden MD, Lisa M. Capano-Wehrle MPH, Ludmil V. Mitrev MD, Marc C. Torjman Ph.D., Roy D. Goldfarb Ph.D., Steven E. Ross* MD, Mark J. Seamon* MD, Cooper University Hospital

Invited Discussant: David Feliciano, MD

Introduction: Retrohepatic vena cava (RVC) injuries are technically challenging and often lethal. Atriocaval shunting has been promoted as a modality to control hemorrhage from RVC injuries, but evidence supporting its benefit is lacking. We hypothesized that atriocaval shunting with perihepatic packing (ACS) is more effective than perihepatic packing alone (PPA) in controlling hemorrhage after RVC injury.

Methods: After a survivable atriocaval shunting model was refined in 4 swine without RVC injury, 13 additional female Yorkshire swine were randomized into either ACS (n=7) or PPA (n=6) treatment arms following the creation of a standardized, 1.5 cm stab RVC injury. Hemodynamic parameters, intravenous fluid, and blood loss were recorded until mortality or euthanization after 4 hours. Data were analyzed using one-way ANOVA with repeated measures, the Student's t-test, and Mann-Whitney U test to compare differences between the 2 groups. A $p<0.05$ was set for statistical significance.

Results: Immediately before and after RVC injury, no difference in temperature, heart rate, mean arterial pressure, or cardiac output was detected (all $p>0.05$) between ACS and PPA groups. Although the RVC injury did affect measured parameters in PPA swine over time (Figure 1), hemodynamic compromise (Figure 1) and blood loss (Figure 2) were significantly greater in ACS than PPA swine. After a 45% greater mean blood loss, all ACS swine died (0% survival; mean survival time, 20 ± 34 min) while all 6 PPA swine survived (100%, $p=0.001$) the entire 4 hour study period.

Figure 1
Measured Parameters Over Time

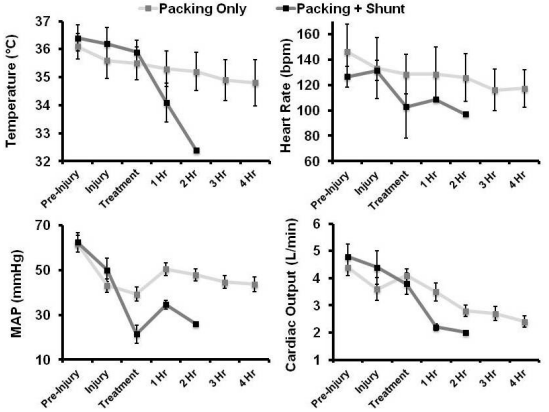
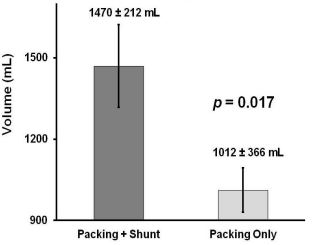


Figure 2
Blood Loss by Intervention



Conclusion: Our results indicate that atriocaval shunting with perihepatic packing is ineffective compared to perihepatic packing alone in controlling hemorrhage after RVC injury. Further study is warranted to compare perihepatic packing to other surgical strategies for the intraoperative management of RVC injuries.

Session: XIVA: Papers 35-44
Paper 35: 1:30-1:50 PM

CORRELATION OF CEREBRAL OXYGEN DYNAMICS AND METABOLIC CRISIS IN PATIENTS WITH SEVERE TRAUMATIC BRAIN INJURY (sTBI)

Michael Stiefel MD, Christy Stoller MD, Nicole Eiden MD, Corrado P. Marini* MD,
Westchester Medical Center

Invited Discussant: Jose Pascual Lopez, MD

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction:Despite successful maintenance of cerebral oxygen dynamics (COD) a percentage of patients with sTBI will have metabolic derangements as detected by cerebral microdialysis (CMD). This study evaluates possible factors contributing to metabolic crisis (MC) in the presence of maintenance of COD.
Methods:Prospective monitoring of 12 sTBI patients with retrospective data analysis. Minimum of three consecutive days multimodality monitoring and targeted therapy to maintain intracranial pressure (ICP) ≤ 20 mmHg, cerebral perfusion pressure (CPP) ≥ 60 mmHg, cerebral partial pressure of oxygen ($PbtO_2$) ≥ 20 mmHg and cerebral oxygen content ≥ 55% measured by bi-frontal Near-infra red spectroscopy (NIRS). CMD was done via dual lumen catheter to sample the interstitial fluid of the brain; it measured glucose (mmol/L), lactate (mmol/L), pyruvate (µmol/L), glutatmate (µmol/L), glycerol (µmol/L), and Lactate:Pyruvate ratio. CMD measurements were averaged hourly. MC was defined as ischemic if L/P 25 with pyruvate < 120 or secondary to mitochondrial dysfunction (MD), if L/P 25 with pyruvate > 120. The multimodality recorded minutes (MRM) and CMD were combined in excel according to time of the measurements. Statistical analysis was done with student t-test and chi-square as applicable. Data are presented as mean ± SD. Significance was accepted to correspond to a $p < 0.05$.

Results:There were a total of 34,907 consecutive MRM. Of these minutes, 5 (0.01%) had CPP < 60 with NIRS < 55 (MRM1), 780 (2.23) had CPP < 60 with PbtO2 < 20 (MRM2), and 234 (0.67) had PbtO2 < 20 with NIRS < 55 (MRM3) for a total abnormal MRM of 1019/34,907 (2.92%). MRM stratified by survival status showed 614/17,808 (3.4%) MRM of the cerebral oxygen dynamics to be abnormal in non-survivors (n=4) compared to 405/37603 (1.1%) in survivors (n=8), $p < 0.05$. 474/951 (49.8%) of the CMD samples collected simultaneously with the multimodality monitoring had L/P > 25; of these 389/474 (82%) had MC from MD in contrast to 85/474 (18%) from ischemia. There were only 16 events of MC occurring simultaneously with abnormal cerebral oxygen dynamics:1/16 with MRM1, 9 with MRM2 and 6 with MRM3 physiologic pattern.

Conclusion: Based on the results of this study we conclude: 1. MC can occur despite the achievement of endpoints of targeted therapy in patients with sTBI; 2.COD events are associated with increased mortality;3. The majority of the MC events are due to mitochondrial dysfunction not to ischemia.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

Session: XIVA: Papers 35-44
Paper 36: 1:50-2:10 PM

A COST ANALYSIS OF SURGICAL STABILIZATION VERSUS CONVENTIONAL MANAGEMENT OF SEVERE RIB FRACTURES

Sarah Majercik* MBA,MD, Scott Gardner PA-C, Steven R. Granger MD, Donald H. Van Boerum MD, Emily Wilson MS, Justin Dickerson MBA,Ph.D., Thomas W. White MD, Intermountain Medical Center

Invited Discussant: Suresh Agarwal, MD

Introduction: Rib fractures are common, and contribute significantly to healthcare costs and socioeconomic burden. Surgical stabilization of rib fractures (SSRF) is increasingly used for flail chest and severely displaced fractures. One factor that has precluded the wide adoption of SSRF is the perception that it is too expensive to surgically fix an injury that will eventually heal without intervention. The purpose of this study was to compare hospital and professional charges for 137 patients with SSRF to a series of propensity-matched, non-operatively managed rib fracture patients (NON-OP) at a single Level One Trauma Center.

Methods: All patients who were admitted to the hospital with rib fractures between January 2009 and June 2013 were identified. Patient demographics, injury mechanism, injury severity score (ISS), chest acute injury severity (AIS), hospital length of stay (LOS), ICU LOS, and charge data were collected for each patient. Propensity score matching was used to identify NON-OP patients whose rib injuries were similar to the SSRF patients. The 2:1 match was based on propensity scores from a model including age, sex, chest AIS, and hospital LOS. Using the matched dataset, zero-inflated negative binomial regression was conducted to assess the relationship between SSRF and ICU LOS. A subset of charge codes relevant to the medical care provided for the thoracic injury was identified. Charge information for each group was compared using Wilcoxon rank sum tests.

Results: 411 patients (137 SSRF, 274 NON-OP) were included in the analysis. As expected, SSRF and NON-OP patients were not significantly different with regard to age, sex, ISS, or chest AIS. By binomial regression, ICU LOS was 1.65 days less for SSRF patients as compared to NON-OP. SSRF had less ventilator days than NON-OP(1.7 vs 3.6 $p=0.01$). NON-OP patients accrued less total relevant hospital and professional charges than SSRF patients. ($112,606 vs $132,232, $p<0.001$).

Conclusion: Overall relevant hospital and professional charges for SSRF patients are higher than for similarly injured NON-OP patients. SSRF patients have shorter ICU LOS and less ventilator days, but similar hospital LOS as compared to NON-OP. Further cost-effectiveness research in this patient population will determine whether improved quality of life and ability to return to meaningful activity sooner outweighs the increased costs of the acute care episode for SSRF patients.

Session: XIVA: Papers 35-44
Paper 37: 2:10-2:30 pm

CAN WE EVER STOP WORRYING ABOUT VENOUS THROMBOEMBOLISM AFTER TRAUMA?

Laura N. Godat MD, Leslie Kobayashi MD, David C. Chang MBA,MPH,Ph.D., Raul Coimbra* MD,Ph.D., University of California, San Diego

Invited Discussant: Ali Salim, MD

Introduction: Trauma patients with pelvic fractures, vertebral fractures and spinal cord injury are known to be at increased risk for venous thromboembolism (VTE). However, the risk of developing VTE may change over time following injury. Determining the time period in which patients are at increased risk of developing VTE may have an impact on prophylaxis, cost and quality of care.

Methods: The California Office of Statewide Health Planning and Development (OSHPD) hospital discharge database was searched between 1995-2009 for all patients admitted with ICD-9 diagnosis codes for traumatic pelvic fractures and vertebral fractures with and without associated spinal cord injury. Those patients were then searched for the ICD-9 diagnosis codes for pulmonary embolism or deep vein thrombosis. Kaplan-Meier and Cox Proportional Hazards analyses were used to assess the timing of VTE events and their association with mortality. Factors studied included; age, gender, race, insurance status, injury type, Survival Risk Ratio, Charlson co-morbidity index, and hospital type.

Results: During the study period 267,743 trauma patients met the injury criteria, of those 10,633 or 3.97% developed VTE. The occurrence of VTE was a significant predictor of mortality, (HR 1.18, $p<0.001$). Compared to pelvic fractures, patients with spine fractures without cord injury were less likely to develop PE or DVT (HR 0.85, $p=0.002$). However, patients with spine fractures and cord injury were more likely to develop VTE (HR 3.18, $p<0.001$); this remained true when in combination with a pelvic fracture (HR 2.12, $p=0.001$). Patients with spine fractures and cord injury at the cervical or thoracic level were significantly more likely to develop VTE, (HR 1.53, $p=0.028$ and HR 1.88, $p=0.001$ respectively), compared to those with lumbar injury.

In the first 3 months after injury the incidence of VTE is 10.3%. This rate drops to 0.5% by the end of 6 months post injury. Subsequently, the rate falls to 0.2% at one year, 0.14% at 18 months and remains low at 0.12%, at 2 years.

Conclusions: The cumulative incidence of VTE is 3.97% in this subset of patients; the highest risk is during the first three months after injury. Between 18 and 21 months the rate returns to that of the general population at 0.1%. These results may guide management strategies such as duration of VTE prophylaxis and removal of IVC filters, which may have an impact on quality of care.

Session: XIVA: Papers 35-44
Paper 38: 2:30-2:50 PM

VARIATIONS IN IMPLEMENTATION OF ACUTE CARE SURGERY: RESULTS FROM A NATIONAL SURVEY OF UNIVERSITY-AFFILIATED HOSPITALS

Heena P. Santry* MD, Courtney E. Collins MD, Didem Ayturk MS, Timothy A. Emhoff* MD, George C. Velmahos* MD,Ph.D., MSEd, L D. Britt* MD,MPH,
Catarina I. Kiefe MD,Ph.D., University of Massachusetts

Invited Discussant: John Fildes, MD

Introduction: Acute Care Surgery (ACS) was espoused as a surgical subspecialty over a decade ago to re-invigorate interest in trauma and critical care and improve access to care for general surgery emergencies. Since then many institutions have implemented ACS. We undertook a national survey to determine predictors of ACS implementation and variations emergency general surgery (EGS) processes of care.

Methods: We surveyed surgeons responsible for EGS coverage at University HealthSystems Consortium hospitals (representing >90% of our nation's academic medical centers and their affiliates) using an 8-page postal/email questionnaire querying respondents on attitudes toward EGS coverage, clinical vignettes, hospital resources and infrastructure, and EGS processes of care. Survey responses were analyzed using descriptive statistics, univariate comparisons, and multivariable logistic regression models.

Results: 258 of 319 potential respondents completed surveys (81% response rate). 81 hospitals (31%) had implemented ACS while 134 (52%) had a traditional general surgeon on-call model (GSOC). 38 (15%) hospitals had another model (Other). The table compares hospitals by their reported characteristics. In multivariable modeling, hospital type, setting, and trauma center verification were predictors of ACS implementation. EGS processes of care varied with 28% GSOC having EGS block time vs 67% ACS (p<0.0001); 45% GSOC critically ill patients cared for in a surgical specialty ICU vs 93% ACS patients (p<0.0001); GSOC sharing call among 5.7 (+/- 3.2) surgeons vs 7.9 (+/-2.3) ACS surgeons (p<0.0001); and 13% GSOC taking in-house EGS call vs 75% ACS (p<0.0001). Among ACS hospitals there were variations in patient cohorting (25% EGS patients alone; 21% EGS+trauma; 17% EGS+elective; 30% EGS+trauma+elective), data collection (only 26% had prospective EGS registries), and patient handoffs (only 56% had attending surgeon presence). ACS surgeons took 4.8 (+/- 1.3) calls per month with 60% providing extra call stipend and 40% freeing overnight surgeons from clinical responsibility the following day.

Conclusions: ACS has been adopted by nearly 1/3 of our nation's university-affiliated hospitals with the model more prevalent among urban, university-based level-1 trauma centers. Thus, the potential of the new specialty on the national crisis in access to EGS care is not fully met. Furthermore, variations in EGS processes of care among adopters of ACS suggest that standardized criteria for ACS implementation, much like trauma center verification criteria, may be beneficial.

Table. Hospital Characteristics by Patient Care Model*

	General Surgeon on Call (N=134)	Acute Care Surgery (N=81)	Other (N=38)	Univariate p-value†	OR for ACS Implementation¥ (95% CI)
Hospital Type N (%)					
University-based	**18 (13)**	**55 (68)**	**23 (61)**	**<0.0001**	**Ref**
Community-based	**96 (72)**	**6 (7.4)**	**9 (24)**		**0.24 (0.06, 0.99)**
State/County/City/Public	**8 (6)**	**16 (20)**	**2 (5.2)**		**1.9 (0.55, 6.6)**
Other	**2 (1.5)**	**2 (2.5)**	**1 (2.6)**		**4.2 (0.09, 189)**
Setting N (%)					
Urban	**35 (26)**	**65 (80)**	**19 (50)**	**<0.0001**	**Ref**
Suburban	**52 (39)**	**7 (8.6)**	**10 (26)**		**0.24 (0.08, 0.76)**
Rural	**37 (28)**	**7 (8.6)**	**6 (16)**		**0.53 (0.16, 1.8)**
Teaching Status N (%)					
Teaching	**68 (51)**	**78 (97)**	**31 (82)**	**<0.0001**	**Ref**
Non-teaching	**56 (42)**	**1 (1.2)**	**4 (11)**		**0.41(0.03, 5.4)**
Trauma Center Verification N (%)					
Level 1	**14 (10)**	**71 (88)**	**21 (55)**	**<0.0001**	**Ref**
Level 2	**15 (11)**	**2 (2.5)**	**5 (13)**		**0.11(0.02, 0.59)**
Level 3	**20 (15)**	**2 (2.5)**	**1 (2.6)**		**0.09 (0.01, 1.5)**
Non-designated	**75 (56)**	**3 (3.7)**	**7 (18)**		**0.03 (0.00, 0.21)**
Inpatient Bed Capacity N (%)					
>500	**14 (10)**	**46 (57)**	**16 (42)**	**<0.0001**	**Ref**
401-500	**8 (6)**	**12 (15)**	**4 (11)**		**13.1(0.97, 176)**
301-400	**17 (13)**	**12 (15)**	**6 (16)**		**0.52 (0.11, 2.5)**
201-300	**24 (18)**	**5 (6.2)**	**4 (11)**		**0.50 (0.16, 1.5)**
101-200	**25 (19)**	**4 (5)**	**0**		**0.59 (0.18, 1.9)**
< 100	**36 (27)**	**0**	**5 (13)**		--

'Row category' percentages may not equal 100 due to missing responses. †Pearson Chi² test (or Fisher exact test for cell sizes <5). ¥Logistic regression model for outcome "ACS implementation" adjusted for all other hospital characteristics.

Session: XIVA: Papers 35-44
Paper 39: 2:50-3:10 PM

IS IT A MYTH THAT THE WHOLE-BODY COMPUTED TOMOGRAPHY IMPROVES THE OUTCOME FOR POLY-TRAUMA PATIENTS WITH AN ISS 16 AND OVER ? : A PROPENSITY-ADJUSTED ANALYSIS

Takashi Fujita* MD, Taichiro Tsunoyama MD, Yasuyuki Uchida MD, Maki Kitamura MD, Kahoko Nakazawa MD, Hideki Ishikawa MD, Ichiro Kaneko MD, Yasuhiko Ajimi MD, Hiroto Ikeda MD, Tetsuya Sakamoto MD, Teikyo University School of Medicine

Invited Discussant: H. Gill Cryer, MD, PhD

Introduction:

The efficacy of whole-body computed tomography (WBCT) has recently been reported for patients with an injury severity score (ISS) of 16 or over. However, the precise prediction of the injury severity is impossible, and we frequently order WBCT as part of a conservative and self-defensive practical behavior. The objective of this study was to evaluate the outcomes of WBCT for blunt-injured adults.

Methods:

We used the datasets from the Japan Trauma Data Bank (JTDB) 2004-13 to obtain data for injured adult patients with blunt trauma with an ISS of 16 and over who were transported directly to the hospital, who did not lack any data related to their vital signs on admission or their outcome at discharge. The patients' demographic data and outcomes on discharge were compared between the WBCT group (WG) and non-WBCT group (nWG). A propensity-adjusted regression analysis was used to determine the association of these factors with the survival discharge for the two groups.

Results:

Of the 25,326 patients evaluated, 10,109 (40%) were evaluated using WBCT (WG), while and 15,195 (60%) were not (nWG). The mean age (95%CI) was 57(56-57) in the nWG versus 54(53-54) in the WG ($p<0.001$). The mean ISS was 24.6(24.5-24.8) vs. 26.8(26.6-27.0) ($p<0.001$), respectively. The mean RTS was 6.88(6.85-6.90) vs. 6.82(6.80-6.85) ($p=0.006$), respectively for the WG and nWG. The crude survival rate was 0.82(0.81-0.82) vs. 0.83(0.82-0.84) ($p=0.002$). The propensity-adjusted odds ratio for the survival discharge rate between the WG and nWG was 1.037(95%C.I., 0.972-1.106; $p=0.275$).

Conclusion:

We failed to demonstrate a significant increase in the survival discharge rate due to the use of WBCT in this study. This result is in contrast to the previous reports about the use of WBCT for patients with an ISS of 16 and over, and suggests that further prospective studies should be performed with strict indication protocols.

Session: XIVA: Papers 35-44
Paper 40: 3:10-3:30 PM

THE ANATOMIC SEVERITY OF CHEST WALL INJURIES DOES NOT PREDICT POST-RECOVERY PULMONARY SYMPTOMS: A PROSPECTIVE COHORT STUDY

Tejveer S. Dhillon MD, Joseph M. Galante* MD, Edgardo S. Salcedo MD, Garth H. Utter* MD MSc University of California, Davis

Invited Discussant: Raminder Nirula, MD, MPH

Introduction: Although thoracic trauma is common, little is known about which factors lead to poor long-term functional outcomes. We sought to determine whether the anatomic severity of the chest wall injury predicts post-recovery pulmonary symptoms.

Methods: We conducted a prospective cohort study of patients with thoracic injuries who participated in a single-center randomized trial involving chest tube management. At 60 days after injury, a blinded member of our team conducted standardized interviews to assess: dyspnea severity (visual analog scale, score 0-10); dyspnea frequency (score 0-4); Modified Medical Research Council dyspnea scale (MMRC) (score 0-4); St. George's Respiratory Questionnaire (SGRQ) (score 0-100); and Medical Outcomes Study Short Form 36 physical component score (SF-36 PCS) (normalized score 0-100). To account for both the severity and frequency of dyspnea, we calculated a measure of "dyspnea burden" by multiplying the severity by the frequency. We evaluated the severity of the chest wall injury [number of rib fractures, presence of flail chest, and chest Abbreviated Injury Scale (AIS) score] as a predictor of pulmonary symptoms using linear regression, adjusting for potential confounding factors.

Results: At 60 days after injury, of 244 patients with chest wall injuries who participated in the parent trial, 21 had died, 18 were lost to follow up, 13 were unable to communicate, and 3 declined to be interviewed. Among the remaining 189 evaluated patients, the mean age was 42 ± 18 years and 77% sustained blunt trauma. Prior to injury, 41% were current smokers, 13% had asthma, and 4% had chronic obstructive pulmonary disease (COPD). The mean Injury Severity Score (ISS) was 26 ± 13, chest AIS score was 3.5 ± 0.9, and number of radiographically apparent rib fractures was 5 ± 4. At 60 days, 23% of patients reported dyspnea ≥5 on a 0-10 scale, and 28% experienced dyspnea within the past 24 hours.

Patient-reported outcomes 60 days after chest wall injury*

	Dyspnea Burden (range 0-40, worst=40)	MMRC (range 0-4, worst=4)	SGRQ (range 0-100, worst=100)	SF-36 PCS (range 0-100, worst=0)
Change per additional rib fracture	0.0 (-0.4 to +0.3)	0.0 (0.0 to +0.1)^	+0.1 (-0.7 to +1.0)	-0.5 (-1.0 to 0.0)†
Change associated with flail chest	+1.4 (-2.8 to +5.6)	+0.4 (-0.3 to +1.0)	+10.0 (-0.3 to +20.3)	-6.4 (-12.3 to -0.4)
Change per unit of chest AIS score	+0.2 (-1.4 to +1.8)	0.0 (-0.3 to +0.2)	+1.6 (-2.3 to +5.4)	+0.9 (-1.3 to +3.1)

* Mean change in scores after adjusting for age, sex, cigarette pack-years, asthma, COPD, mechanism of injury, and ISS.
^ 95% CI contains 0.
† 95% CI does not contain 0 but the upper bound is indicated as 0 purely due to rounding.

Conclusion: The anatomic severity of chest wall injuries does not predict worse dyspnea symptoms 60 days post-injury, but it does predict impaired patient-reported overall physical health. The lack of association with pulmonary symptoms suggests that treatment targeted at restoring anatomy (e.g., plating of rib fractures) thus may not address the salient consequences of such injuries.

Session: XIVA: Papers 35-44
Paper 41: 3:30-3:50 PM

A GERIATRIC SPECIFIC RIB FRACTURE PROTOCOL SIGNIFICANTLY IMPROVES MORTALITY

Sean F. Monagahan MD, Charles A. Adams* MD, Michael D. Connolly MD, Andrew H. Stephen MD, Stephanie N. Lueckel MD, David T. Harrington* MD, William G. Cioffi* MD, Daithi S. Heffernan MD, Brown University Rhode Island Hospital

Invited Discussant: Ronald Gross, MD

Introduction:The trauma population of the United States continues to age rapidly. Minor injuries, normally well tolerated by younger patients, often prove fatal among the geriatric trauma population. Despite an apparently minor anatomic impact, two rib fractures carry tremendous associated morbidity and mortality among geriatric patients. Protocols and management strategies specific to these older patients must be developed. To this end, we adopted a geriatric specific standardized rib fracture protocol.
Methods:All admitted geriatric (>/=65 years old) trauma patients who sustained rib fractures over the 10 year period 2004-2013 were reviewed. The protocol was started in 2009 and consisted of 1)immediate ICU admission for every geriatric patient whose injuries included at least 2 rib fractures and 2)prophylactic analgesics including epidural analgesia and frequent pulmonary toilet. Patients were divided into pre-protocol (2004-2008) and post-protocol (2009-2013). Demographics, injuries, hospital course and outcome data were collected. Categorical data was assessed using Fisher's exact test and continuous data was compared using a t-test. Alpha was set to 0.05.
Results:Over the ten-year period a total of 619 geriatric patients with at least 2 rib fractures were admitted, 121 in the pre-protocol and 498 patients in the post-protocol phase. Groups were equal with respect to age (79 vs 79 yrs;p=0.9), gender, bunt mechanism, (fall being the most frequent mechanism), and ISS (10.4 vs 11.6;p=0.07). Following 2009, rib fracture protocol patients were more likely admitted directly to the ICU from the ED (64.4% vs 24.8%; p<0.001), resulting in shorter ICU length of stay (5.5 vs 8 days), and fewer patients requiring mechanical ventilation (14% vs 43%;p<0.001). Despite similar probability of survival (92% vs 91%;p=0.9), mortality was significantly lower in rib fracture protocol patients (9% vs 24%;p=0.01).
Conclusion: With the aging trauma population it is critical that we understand the unique burden minor trauma imposes upon an often fragile physiology. We noted that using an aggressive standardized protocol with a large emphasis on prophylactic pain control, pulmonary toilet and a willingness to utilize scarce resources, resulted in significantly lowering the mortality associated with rib fractures. Adherence to geriatric specific protocols across a spectrum of injuries will continue to improve outcomes of geriatric trauma patients.

Session: XIVA: Papers 35-44
Paper 42: 3:50-4:10 PM

INTRODUCTION OF A MOBILE DEVICE BASED TERTIARY SURVEY APPLICATION REDUCES MISSED INJURIES: A MULTI-CENTER PROSPECTIVE STUDY

Bradley Moffat MD, Kenji Inaba* MD, Neil G. Parry* MD, Daryl K. Gray MD, Richard Malthaner MD, Christopher Martin MD, Demetrios Demetriades* MD,Ph.D., Kelly N. Vogt MD, London Health Sciences Center

Invited Discussant: Leopoldo Cancio, MD

Introduction: Missed injuries during the initial assessment are a major cause of morbidity after trauma. Though the tertiary survey is designed to capture missed injuries, there is wide variation in how the tertiary survey is applied and documented. We designed a novel mobile device application (Physician Assist Trauma Software [PATS]) to standardize performance and documentation of the tertiary survey. The PATS program facilitates the documentation of a complete head to toe examination, the consolidation of investigations, and prompts the user to take action based on tertiary survey findings. This study was undertaken to assess the feasibility of introducing PATS into routine clinical practice, as well as its capacity to reduce missed injuries at two distinct level I trauma centers.

Methods: Prior to implementation of PATS, the missed injury rates at a higher-volume (5000 annual admissions) and a lower-volume (500 annual admissions) level I trauma center were assessed. Missed injuries were defined as those identified after the completion of the tertiary survey and prior to hospital discharge. The PATS program was implemented simultaneously at both centers. Clinical house staff responsible for completing the tertiary survey were trained on the use of the new app, and a one-month acclimatization period allowed before data collection began. Missed injuries were then prospectively tracked during the study period. Compliance and tertiary survey completion rates were evaluated as a marker of feasibility.

Results: A total of 503 and 104 patients were admitted at the higher- and lower-volume centers respectively during the study period. At the higher-volume trauma center, the missed injury rated decreased from 1% to 0% with the introduction of the PATS program ($p = 0.04$). At the lower-volume trauma center, the missed injury rate decreased from 9% to 2% ($p = 0.01$). Prior to implementation of PATS, 68% of patients at the higher-volume center had a complete tertiary survey documented. After implementation of PATS, the compliance rate increased to 100%. At the lower-volume center, prior to implementation, no formal tertiary survey was documented; after implementation documentation of a tertiary survey increased to 60%.

Conclusions: The implementation of a mobile tertiary survey app significantly reduced missed injuries at both a higher- and lower-volume trauma center. The use of this app resulted in a significant improvement in compliance with documentation of the tertiary survey.

Session: XIVA: Papers 35-44
Paper 43: 4:10-4:30 PM

PRIORITIZING QUALITY IMPROVEMENT IN ACUTE CARE SURGERY

Christopher C. McCoy MD, Brian Englum MD, Jeffrey Keenan MD, Steven N. Vaslef* MD,Ph.D., Mark L. Shapiro* MD, John E. Scarborough MD, Duke University

Invited Discussant: David Harrington, MD

Introduction: The relative contribution of emergency surgery to overall surgical mortality and the impact of specific postoperative complications on mortality after emergency operations have not been previously described. Identifying specific contributors to postoperative mortality following acute care surgery will allow for significant improvement in the care of these patients.

Methods: Patients from the 2005-2011 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database who underwent an emergency operation for one of eight common general surgical diagnoses (acute appendicitis, gallbladder disease, gastroduodenal ulcer disease, intestinal ischemia, intestinal obstruction, intestinal perforation, diverticulitis, and abdominal wall hernia) were included for analysis. Postoperative complications were chosen based upon surgical outcome measures monitored by national quality improvement initiatives and national regulatory bodies. Regression techniques were used to determine the independent association between five specific postoperative complications and subsequent 30-day mortality, after adjustment for a robust array of patient- and procedure-related variables and surgical diagnosis. To account for possible survivor bias, the association between specific complications and postoperative mortality was also determined for patients who died on or after postoperative day 7.

Results: Emergency operations accounted for only 14.9% of the approximately 1.2 million general surgery procedures that are included in ACS-NSQIP, but for over 53.5% of the 19,094 postoperative deaths. 100,829 emergency general surgery patients were included in our analysis. The incidences of five specific postoperative complications are shown in the Table. Of these complications, only pneumonia and myocardial infarction were significantly associated with subsequent mortality.

Complication	# (%) With Complication	# (%) Died	AOR (95% CI) Any Death	AOR (95%CI) Late Death*
Incisional SSI (superficial or deep)	4,209 (4.2%)	117 (2.8%)	0.39 (0.31,0.49) p<0.001	0.67 (0.54,0.84) p<0.001
Pneumonia	2,751 (2.7%)	544 (19.8%)	1.61 (1.41,1.84) p<0.001	2.75 (2.39,3.17) p<0.001
Urinary Tract Infection	1,519 (1.5%)	115 (7.6%)	0.52 (0.41,0.65) p<0.001	0.85 (0.67,1.08) p=0.19
DVT/PE	1,198 (1.2%)	129 (10.8%)	0.71 (0.56,0.89) p=0.003	1.10 (0.87,1.40) p=0.44
Myocardial Infarction	450 (0.5%)	143 (31.8%)	2.96 (2.27,3.86) p<0.001	2.80 (2.07,3.80) p<0.001

***Excludes patients who died before postoperative day 7.**

Conclusion: Given its disproportionate contribution to overall surgical mortality, emergency surgery represents an ideal focus for quality improvement initiatives. Of the specific postoperative complications that are typically targeted by such initiatives, only pneumonia and myocardial infarction have an independent association with subsequent mortality. These complications should therefore receive priority as targets for surgical quality improvement initiatives.

Session: XIVA: Papers 35-44
Paper 44: 4:30-4:50 PM

DOES RESUSCITATION WITH PLASMA INCREASE THE RISK OF VENOUS THROMBOEMBOLISM?

Ashley Zander DO, Erik Olson MD, Jan-Michael Van Gent DO, Jesse Bandle MD, Richard Calvo Ph.D. (c), Steven Shackford* MD, Kimberly Peck* MD, Beth Sise RN, Michael Sise* MD, Scripps Mercy Hospital Trauma Service

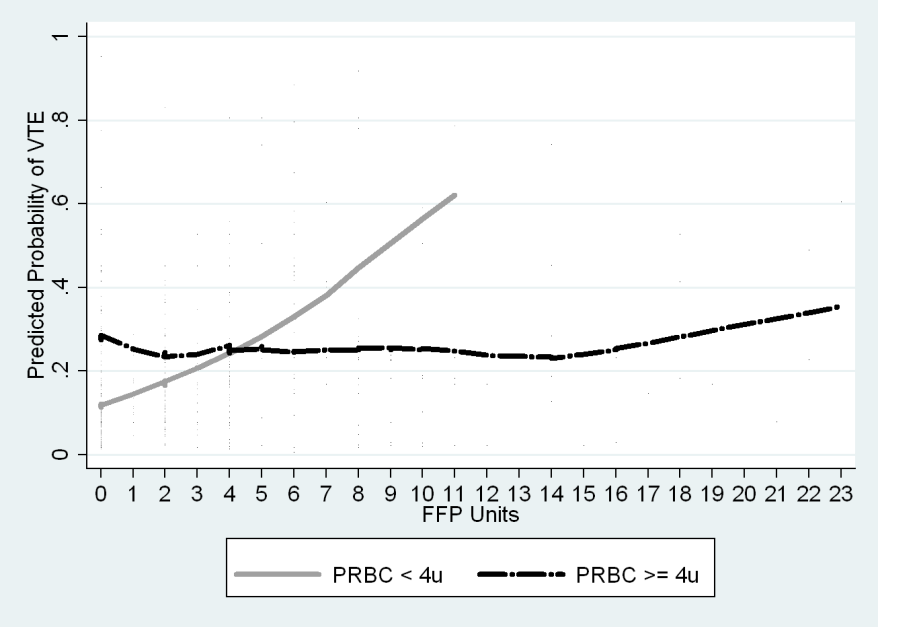
Invited Discussant: Heidi Frankel, MD

Introduction: Resuscitation with blood products improves survival in patients with traumatic hemorrhage. However, the risk of venous thromboembolic (VTE) complications associated with fresh frozen plasma (FFP) administration is unknown. We hypothesized that a higher ratio of FFP to packed red blood cells (PRBCs) given during acute resuscitation increases the risk of VTE independent of severity of injury and shock.

Methods: The records of patients admitted between 4/2007-12/2011 who had surveillance lower extremity duplex ultrasounds were retrospectively reviewed. Patients who received at least 1 unit of PRBCs within 24 hours of admission were included. Patients who died without VTE were excluded. The relationship between FFP and VTE was evaluated using logistic regression.

Results: 387 patients met inclusion criteria, of whom 74 (19%) developed VTE. In patients who required <4 units of PRBCs, increasing units of FFP were associated with an increasing risk for VTE, with each unit of FFP having an adjusted OR=1.25 (95%CI 1.03-1.52, p=0.027) (Fig.). Conversely, in patients who required ≥4 units of PRBCs, FFP in equal or greater ratios than PRBCs was negatively associated with VTE (PRBC=FFP aOR=0.25, 95%CI 0.07-0.90, p=0.035 and PRBCFFP as the reference).

Conclusion: Each unit of FFP increased VTE risk by 25% in patients who required <4 units of PRBCs. In patients who required ≥4 units of PRBCs, FFP administration conferred no increased risk of VTE. This suggests that FFP should be used cautiously when early hemodynamic stability can be achieved with <4 units of PRBCs.



Session: XIVB: Papers 45-54
Paper 45: 1:30-2:10

USING A VIDEO DECISION-SUPPORT TOOL TO INFORM SURROGATE DECISIONS IN THE SURGICAL INTENISIVE CARE UNIT

Zara Cooper* MD, MSc., Rae M. Allain MD, Rebecca Kallman MD, Elizabeth C. Williams MD, Stephanie Whitener MD, Yuchiao Chang Ph.D., Angelo Volandes MD,MPH, Brigham and Womens Hospital

Invited Discussant: David Livingston, MD

Introduction: Effective communication with surrogates in the surgical ICU (SICU) can be particularly challenging given the complexities of formulating prognosis for high-risk surgical patients and the multidisciplinary nature of the providers involved. Videos are innovative tools to standardize communication and improve knowledge among surrogates making difficult medical decisions. In this pilot randomized controlled trial, we investigated the impact of a video decision support tool on knowledge of routine treatments in the SICU among surrogates of critically ill surgical patients.

Methods: We used a convenience sample of English-speaking surrogates of patients $\geq$ 50 years old who were admitted to the SICU from the acute care surgery service of a major tertiary hospital, and who were expected to stay in the SICU for more than 48 hours. Proximate to SICU admission, physicians used a universal consent form to obtain permission to perform 8 procedures which could be routinely performed during the SICU including: tracheal intubation and mechanical ventilation, arterial line, central venous line, pulmonary artery catheterization, bronchoscopy, blood product transfusion, and tube thoracostomy. In the standard care (SC) arm, physicians provided verbal explanations of the procedures, and their risks and benefits during the consent process. Alternatively, in the intervention (video) arm, surrogates received a verbal explanation and viewed a 12 minute video decision-support tool including images and a voice-over describing these same procedures and their risks and benefits during consent. Surrogate and patient demographic data were obtained through chart review and survey questionnaires. Surrogates in each arm completed a 24-question knowledge test (score range of 0 to 24, with higher score indicating more knowledge) after receiving verbal explanation or viewing the video. Surrogates in the video arm also completed questions about the perceived value of the video. We used two-sample t-tests, wilcoxon rank sum tests or Fisher's exact tests as appropriate.

Results: We enrolled 24 surrogates, 10 in the video arm and 14 in the SC arm. There were no significant differences in patient or surrogate characteristics between groups. Out of a possible 24 points on our knowledge test, surrogates in the video arm scored 22.3 points (SD $\pm$ 1.1) and surrogates in the SC arm scored 19.1 points (SD $\pm$ 3.4), p= 0.005. Eight of 10 surrogates found the video very helpful, and all 10 surrogates would recommend the video to others. There was no difference in consent rates for treatments between groups.
Conclusion: Surrogates who viewed the video had higher knowledge scores, found the video helpful, and would recommend it to others. Those who viewed the video were equally likely to give consent for treatment. Video has the potential to improve the informed consent process for surrogates making complex decisions for critically ill surgical patients.

Session: XIVB: Papers 45-54
Paper 46: 1:50-2:10 PM

LETHAL NOW OR LETHAL LATER: THE NATURAL HISTORY OF GRADE IV BLUNT CEREBROVASCULAR INJURY

Margaret H. Lauerman MD, Timothy Feeney BS, MS, Clint W. Sliker MD, Nitima Saksobhavivat MD, Brandon R. Bruns MD, Adriana Laser MD, Ronald Tesoriero MD, Megan Brenner MD, Thomas M. Scalea* MD, Deborah M. Stein* MD,MPH, R Adams Cowley Shock Trauma Center

Invited Discussant: Martin Croce, MD

Introduction: Treatment of Grade IV blunt cerebrovascular injury (BCVI4), complete occlusion of the internal carotid (ICA) and/or vertebral artery (VA), by preventing thrombus propagation and encouraging dissolution with antiplatelet agents and anticoagulation optimizes outcomes. We sought to describe the natural history of BCVI4 with regards to stroke and outcomes.

Methods: We retrospectively reviewed patients with ICA or VA BCVI4 from July 2009 to August 2013. Demographic, clinical, and admission and subsequent radiographic information was collected. Rates of BCVI4-related stroke and stroke-related mortality were calculated.

Results: Eighty-two patients sustained BCVI4 (13 ICA and 69 VA). In patients with ICA BCVI4 surviving to repeat imaging, the stroke rate was 70%, with stroke present on initial imaging in 30%, repeat imaging in 40%, and a 20% stroke-related mortality. All patients with ICA BCVI4 developing a BCVI4-related stroke after admission had evidence of cerebral embolus and new BCVI4 recanalization on peri-stroke imaging, with 50% of recanalizations present at stroke diagnosis and 50% of recanalizations present on the first cervical follow-up imaging after stroke. VA BCVI4 was associated with a 2.9% BCVI4-related stroke rate and no stroke-related mortality. Both patients with VA BCVI4 who developed a BCVI4-related stroke had new VA recanalization present at stroke diagnosis, and one patient had evidence of cerebral embolus. BCVI4-related stroke often presented early in the hospital course, with VA and ICA BCVI4-related stroke occurring between 8.5-9 hours and 2-120 hours after admission, respectively.

Conclusion: BCVI4 are not static, frequently recanalize, often soon after injury, and are associated with BCVI4-related stroke. Emergent endovascular vessel occlusion should be considered to prevent recanalization in patients with contraindications to antiplatelet agents or anticoagulation.

Session: XIVB: Papers 45-54
Paper 47: 2:10-2:30 PM

THE VALIDITY OF ABDOMINAL EXAMINATION IN BLUNT TRAUMA PATIENTS WITH DISTRACTING INJURIES

Jack Rostas MD, Benjamin Cason Jon Simmons MD, Mohammad Frotan MD, Sidney Brevard MD, Richard Gonzalez* MD, University of South Alabama

Invited Discussant: Andrew Kirkpatrick, MD, CD, MHSc

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction:Physicians who care for blunt trauma patients often disregard abdominal clinical examination in the presence of extra-abdominal distracting injuries. Furthermore, many trauma centers mandate a computed tomography (CT) scan of the abdomen in these patients. Ignoring the clinical examination in this patient population may incur undue expense and radiation exposure. The purpose of this study was to assess the efficacy of abdominal clinical examination in patients with distracting injuries.

Methods:During a 1 year period, all awake and alert blunt trauma patients with GCS of 14 or 15 were entered into a prospective study at a Level 1 Trauma Center. Abdominal clinical examination was performed and documented prospectively on all patients entered. Abdominal clinical examination consisted of subjectively questioning the patient for the presence of abdominal pain and physical examination of the abdomen. Physical examination included a four-quadrant anterior abdominal palpation, flank palpation, lower thoracic palpation, pelvis examination, and palpation of and lumbar spine. Following documentation of the clinical examination, all patients underwent CT scan of the abdomen with IV contrast.

Results: Eight hundred and three patients were enrolled during the study period. Four hundred and fifty-one patients had distracting injuries, and 352 patients had no distracting injuries. Of the 352 patients without distracting injuries, one (0.3%) patient was found to have free intra-abdominal fluid that did not require surgical intervention. Of the 451 patients with distracting injuries, 232 patients had a positive abdominal examination, 62 (26.7%) of whom had an intra-abdominal injury diagnosed by CT scan. Of the 219 patients with negative abdominal examination and distracting injuries, 7 (3.2%) were diagnosed with an intra-abdominal injury. All of the seven missed injuries were solid organ injuries, none of which required surgical intervention or blood transfusion. The sensitivity and negative predictive value of abdominal clinical examination for patients with distracting injuries was 89.9% and 96.8%, respectively. The sensitivity and negative predictive value of abdominal examination for surgically significant and transfusion requiring injuries were both 100%.

Conclusion:Distracting injuries do not diminish the efficacy of clinical abdominal examination in the diagnosis of clinically significant abdominal injury. Clinical examination of the abdomen is valid in awake and alert blunt trauma patients, regardless of the presence of other injuries.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

Session: XIVB: Papers 45-54
Paper 48: 2:30-2:50 PM

SURGEON PERFORMED ULTRASOUND (SPUS) IN PREDICTING WOUND INFECTIONS: NO COLLECTION, NO INFECTION.

Christopher D. Barrett MD, Arthur Celestin MD,MPH, Emily Fish MD, Alok Gupta MD, Carl J. Hauser* MD, Beth Israel Deaconess Medical Center

Invited Discussant: Nicole Stassen, MD

Introduction: Surgical wound infections (SWI) after emergency abdominal surgery are an important source of morbidity and are highly associated with sepsis and hospital readmission. Primary wound closure is desireable but increases SWI risk. Thus closing high-risk wounds mandates careful observation. Nonetheless, early signs of SWI are commonly missed even by experienced observers and delayed discovery can lead to wound sepsis, dehiscence, prolonged admissions, expensive outpatient wound care, readmissions and late hernia formation. We hypothesized surgeon-performed ultrasound (SPUS) done at the bedside would detect wound fluid collections and that the presence of a wound collection on SPUS would predict SWI better even than careful clinical examination. If so, SPUS might alter early management and improve outcomes.

Methods: A prospective, single-institution study was conducted on adult patients undergoing high-risk open abdominal surgery. After informed consent, SPUS was performed on post-op day (POD) 2-4, then prior to hospital discharge (or on POD 30). Images were obtained by a Surgery PGY1 or 2 who received only one day of training on a smartphone based US system (MobiUS SP-1, Mobisante, Inc.). The primary surgical team was blinded to SPUS results and delivered standard wound care. SWI was diagnosed if patients were begun on antibiotics for the wound, if the wound was opened or had drains placed, if there was any intervention for SWI at the request of the treating physicians or if patients had SWI adjudicated at POD 30 by NSQIP wound-care nurse review. Results were compared by chi-square test with significance set at a $P< 0.05$.

Results: Fifty-four patients were studied. Twenty patients had detectable ($\gtrsim$ 1cm) incisional collections found on SPUS at POD 2-4. Nine went on to develop a clinical SWI. In 34 patients no collection was seen: only 3 of these developed an infection. SWI was clearly associated with early fluid collections on SPUS ($p = 0.002$). The relative risk of SWI in those with a collection was 5.1 (1.5 - 22.3) compared to those with no collection. The negative predictive value of SPUS was 91.2% (0.81-0.98).

Conclusion: SPUS is a highly effective screening tool for detection of SWI in post-op patients. Using current technology and with minimal training, PG1-2 residents detected early collections better than far more experienced examiners. About half of patients with a collection will go on to develop SWI and in the absence of a collection progression to SWI is very unlikely. In effect, without a collection there is little concern for infection. Also, assuming that early management ('formal' imaging or wound interventions) can resonably be based on this data, the number needed to treat (NNT) would only be 2.8 (1.9-11.4). Given the high morbidity and costs associated with delayed diagnosis and treatment, SPUS may be a useful and cost-effective modality for determining the need for early therapy in post-operative patients at risk of developing SWI. Further study with larger sample sizes, advancing technology and greater expertise will evaluate the characteristics of wound collections in more detail and undoubtedly improve accuracy. Randomized interventional studies are also warranted to validate the results of this preliminary study and definitively determine the clinical utility of SPUS in guiding early wound interventions.

Session: XIVB: Papers 45-54
Paper 49: 2:50-3:10 PM

AN ANALYSIS OF THE EFFECTIVENESS OF A STATE TRAUMA SYSTEM: TREATMENT AT DESIGNATED TRAUMA CENTERS IS ASSOCIATED WITH AN INCREASED PROBABILITY OF SURVIVAL

Dennis W. Ashley* MD, Etienne E. Pracht Ph.D., Regina S. Medeiros DNP,MHSA, RN, Elizabeth Atkins RN, A R. Bayakly Ph.D., Jeffrey M. Nicholas* MD, Medical Center of Central Georgia/Mercer University School of Medicine

Invited Discussant: Joseph Tepas, III, MD

Introduction: States struggle to continue support for recruitment, funding and development of designated trauma centers. The purpose of this study was to evaluate the probability of survival for severely injured patients treated at designated trauma centers (DTC) versus non-trauma centers (NTC).

Methods: We reviewed 188,348 patients from the state's hospital discharge database and identified 14,612 severely injured patients admitted to either DTC or NTC between 2008-2012. ICD-9 Injury Severity Scores (ICISS), an accepted indicator of injury severity, was assigned to each patient. Severe injury was defined as an ICISS < 0.85 (indicating $\geq$ 15% probability of mortality). Three sub-groups of the severely injured patients were defined as most critical, intermediate critical and least critical. A full information maximum likelihood bivariate probit model was used to determine the differences in the probability of survival for matched cohorts.

Results: After controlling for injury severity, injury type, patient demographics, comorbidities, and insurance type and status, severely injured patients treated at a DTC have a 9.5 percent increased probability of survival. The largest improvement was seen in the intermediate subgroup.

	Improvement in probability of survival when treated at a DTC versus NTC	**P-Value**
All severe trauma (ICISS < 0.85)	**9.5%**	**<0.01**
Most critical (ICISS < 0.25)	**16.5%**	**<0.01**
Intermediate critical (0.25 ≤ ICISS < 0.5)	**22.0%**	**<0.01**
Least critical (0.5 ≤ ICISS < 0.85)	**8.3%**	**<0.01**

Conclusion: Treatment of severely injured patients at a DTC is associated with an improved probability of survival. This argues for continued resources in support of designated trauma centers within a defined statewide network.

Session: XIVB: Papers 45-54
Paper 50: 3:10-3:30 PM

A REASSESSMENT OF THE IMPACT OF TRAUMA SYSTEMS CONSULTATION ON REGIONAL TRAUMA SYSTEM DEVELOPMENT

Robert J. Winchell* MD, Nels Sanddal Ph.D., REMT, Jane Ball RN, DrPH, Holly Michaels BA, Chrisoph R. Kaufmann* MD,MPH, Rajan Gupta* MD, Thomas J. Esposito* MD,MPH, Haris Subacius MA Trauma Systems Evaluation And Planning Committee, American College Of Surgeons Committee On Trauma

Invited Discussant: Richard Mullins, MD

Introduction: Many prior studies have shown that trauma systems decrease morbidity and mortality after injury, but progress in system development has been slow and inconsistent. The Trauma Systems Evaluation and Planning Committee (TSEPC) of the American College of Surgeons Committee on Trauma has developed a process to provide expert consultation to facilitate regional trauma system development, and has conducted consultative visits to 35 regions (commonly states) since 1999. This study evaluated the progress in regional system development that occurred after a consultative visit conducted by the TSEPC in 20 state or regional systems, expanding upon a previous study that demonstrated significant progress in six regional systems following consultations done between 2004 and 2006.

Methods: The study group consisted of regional trauma systems that had consultative visits by expert teams from the TSEPC conducted between 2004 and 2010. System status was assessed using a set of 16 objective indicators. Six systems visited between 2004 and 2006 had baseline scoring done retrospectively as part of the prior study, while the 14 regions visited after 2006 had baseline scores calculated by the consult team as part of the visit. Post-consultation status was assessed during facilitated teleconferences, conducted by members of the original consultation team and current key representatives from each system. Progress was assessed by comparing changes in both aggregate and individual indicator scores.

Results: This study showed a statistically significant increase in aggregate indicator scores following consultation. When each of the sixteen indicators was analyzed individually, significant improvements were seen in fourteen of the sixteen indicators. Indicators showing the greatest gain included those related to trauma system standards, improved linkages with public health, data systems, performance improvement, and prehospital triage criteria. This represented a change from the original study, in which the largest gains were in system planning and quality assurance. As was found in the original study the two indicators related to financing for the trauma system showed no improvement, and showed deterioration in several cases. There was a trend toward better overall improvement in regions with stable funding. In contrast to the initial study, system improvement did not continue to increase with time, but showed a tendency toward deterioration as the length of time after consultation increased.

Conclusions: The TSEPC trauma system consultation process continues to be associated with improvements in regional trauma system development. Gains may not be self-sustaining as there was a trend toward deterioration of aggregate score over time, suggesting that a repeat consultation may be beneficial. A trend showing greater progress in regions with established funding was found. As demonstrated in the original study there was no statistically significant progress area of system funding, and system funding was the area most likely to suffer setbacks over the study period. The ongoing lack of stable trauma system funding may be an even more critical given the indentified trend linking funding and system development.

Session: XIVB: Papers 45-54
Paper 51: 3:30-3:50 PM

INTIMATE PARTNER VIOLENCE – RISKS GO BEYOND THE VIOLENCE: ASSOCIATION OF INTIMATE PARTNER VIOLENCE WITH MENTAL ILLNESS AND SUBSTANCE ABUSE AMONG FEMALES ADMITTED TO A RURAL LEVEL-I TRAUMA CENTER

Ashley B. Hink MD,MPH, Eric A. Toschlog* MD, Brett Waibel MD, Michael Bard* MD, Brody School of Medicine at East Carolina University

Invited Discussant: James Davis, MD

Introduction: Intimate partner violence (IPV) is a major public health problem and significant contributor to intentional injuries and homicides among women. Despite this, it remains under-recognized in the trauma surgery setting and its association to other risk factors for both intentional and unintentional injuries remains poorly defined. This study aims to assess the prevalence of IPV and its association with alcohol abuse (AA), illicit substance use (ISU), selected mental illnesses (MI) and other risk factors for injury among females admitted to a Level-I trauma center.

Methods: This is a prospective study enrolling adult female patients at a rural, Level-I trauma center over a seven-month period in 2013 to participate in face-to-face structured interviews utilizing a formal survey instrument. Lifetime IPV (LIPV) was identified with self-report items, and past-year or current IPV was identified with the Partner Violence Screen (PVS) and the Woman Abuse Screening Tool (WAST). Self-report items and validated instruments assessed AA, ISU and MI. Other collected data include demographics, insurance status, access to primary care, previous injuries, past IPV screening, possession of firearms, and presenting mechanism of injury (MOI). Bivariate analyses were performed with Chi-square, Mantel-Haenszel odds ratios, and independent-samples t-tests. Multivariate analysis was performed with binary logistic regression.

Results: 107 patients met the inclusion criteria and 81 (76%) were enrolled. 41 (50.6%) reported LIPV and 25 (30.9%) reported past-year IPV. Women with LIPV and past-year IPV were more likely to be under the age of 50, in a current relationship, uninsured, and report previous IPV screening compared to those who have not experienced IPV. Participants with a past-year history of IPV were more likely to have a significant other possessing a firearm (OR 4.6, 40% vs. 12.5%, $p=0.005$). Although it did not reach statistical significance, the odds of having a MOI of assault or self-inflicted injury among those with a history of LIPV was 3.4 times higher than those without (15.8% vs. 5.3%, $p=0.13$). Suicidal ideation was significantly associated with LIPV (OR 9.5, $p = 0.015$). LIPV and past-year IPV were significantly associated with self-reported MI and positive detection of MI (Table 1). LIPV was significantly associated with ISU (OR 4.2, 31.7% vs. 10%, $p=0.016$), and past-year IPV was significantly associated with AA (OR 5, 28% vs. 7.1%, $p=0.011$). These associations remained significant when controlling for relationship status, although the associations between IPV, ISU and AA were significant only among women under the age of 50. On further bivariate analysis, MI was not associated with ISU, AA, firearm access or suicidality. Logistic regression models identified that partner possession of a firearm, lifetime IPV exposure, self-reported MI and AA were significant predictors of past-year IPV.

Table 1. Associations Between IPV, Mental Illness and Substance Abuse

	LIPV (n=41)	No LIPV (n=40)	*p*-value OR (95% CI)	Past-Year IPV (n=25)	No Past-Year IPV (n=56)	*p*-value OR (95% CI)
Self-Report Past-Year MI (n=23)	16 (39%)	7 (17.5%)	*0.032** *OR = 3 (1.1 – 8.4)*	12 (48%)	11 (19.6%)	*0.009** *OR = 3.8 (1.4 – 10.5)*
Positive MI MINI (n=26)	20 (48.8%)	6 (15%)	*0.001** *OR = 5.4 (1.9-15.6)*	13 (52%)	13 (23.2%)	*0.01** *OR = 3.6 (1.3 – 9.7)*
Alcohol Abuse AUDIT > 8 (n=11)	7 (17.1%)	4 (10%)	*0.35* *OR = 1.9 (0.5-6.9)*	7 (28%)	4 (7.1%)	*0.011** *OR = 5 (1.3 – 19.3)*
Past-Year Illicit Substance Use (n=17)	13 (31.7%)	4 (10%)	*0.016** *OR = 4.2 (1.2-14.2)*	8 (32%)	9 (16.1%)	*0.104* *OR = 2.4 (0.8 – 7.3)*
Past-Year Illicit SA DAST > 5 (n=8)	6 (14.6%)	2 (5%)	*0.15* *OR = 3.3 (0.6 – 17.2)*	4 (16%)	4 (7.1%)	*0.2* *OR = 2.5 (0.6 – 10.8)*

*Significance defined as $p < 0.05$. MI = Mental Illness, MINI = MINI International Neuropsychiatric Interview, AUDIT = Alcohol Use Disorder Identification Test, SA = Substance Abuse, DAST = Drug Abuse Screening Test

Discussion: The prevalence of IPV among women admitted to a Level-I, rural trauma center was significantly higher than the reported lifetime prevalence of 20-30% in the general population, and IPV was significantly associated with MI, ISU and AA in addition to high-risk scenarios for intentional injury including suicidal ideation and concurrent IPV and firearm ownership by a significant other. These findings further inform the potential value of IPV screening in the inpatient trauma setting, and suggest that IPV, MI, and substance abuse should be considered as associated entities in secondary prevention and recidivism reduction efforts in the female trauma population.

Session: XIVB: Papers 45-54
Paper 52: 3:50-4:10 PM

IS TRAUMATIC VIOLENCE GETTING BETTER OR WORSE? NON-FATAL GUN VIOLENCE AT AN URBAN TRAUMA CENTER

Vincent E. Chong MD, MS, Wayne Lee MD, Gregory P. Victorino* MD, University of California San Francisco - East Bay

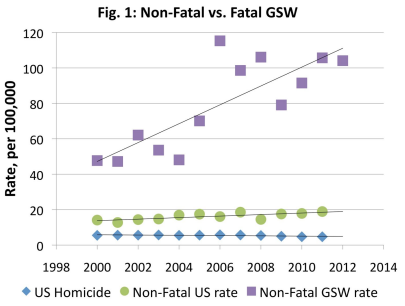
Invited Discussant: Lenworth Jacobs, Jr., MD, MPH

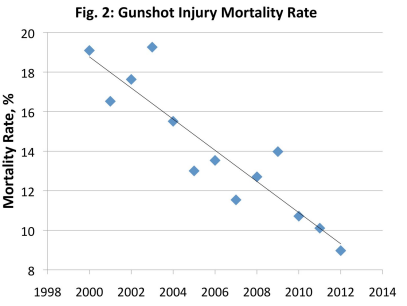
Introduction: National homicide trends suggest violence is getting better. Local data is less clear. Homicide rates in major American cities have diverged in the past decade, with some cities worsening while others improve. Rates of non-fatal firearm injury complicate the picture, suggesting that gun violence is becoming more prevalent, but with varying severity. We hypothesized that non-fatal gunshot injuries were increasing in extent and severity at our urban trauma center.

Methods: We identified patients in our trauma registry who presented as a result of interpersonal violence from 2000-2012. Demographic information and variables of interest (ISS, # of non-fatal gunshot injuries, mortality rate) were trended by year. Non-fatal gunshot injury rates were calculated using population estimates from the FBI Uniform Crime Reporting Program (UCR) and correlated to local municipal police agency data.

Results: We treated 10,082 patients due to interpersonal violence. Of these, 43% (N=4,376) were due to firearms. Rates of non-fatal gunshot injuries rose from 47.7 to 105.7 per 100,000 population ($p<0.001$; Fig. 1). These rates calculated from our registry correlated with rates from the local municipal police agency ($R^2=0.92$; $p<0.001$). Interestingly, the proportion of patients with non-fatal injuries who presented with a severe injury (ISS>25) decreased from 19% to 12% ($p=0.02$) and our gunshot injury mortality rate decreased from 19% to 9% ($p<0.001$).

Conclusion: Homicide rates do not tell the whole story. At our trauma center, non-fatal gunshot injuries are becoming more common, but less lethal. This contrasts with data from other American cities, which show gun violence becoming more prevalent and more lethal. The rate of increase in our non-fatal firearm injury rate outpaced the national trend. Comparison among other major American cities is needed to better understand firearm violence trends in the United States.





Session: XIVB: Papers 45-54
Paper 53: 4:10-4:30 PM

TRAUMA PATIENT READMISSIONS: WHY DO THEY COME BACK FOR MORE?

Laura B. Petrey MD, FACS, Alan D. Cook MD, FACS, Richard Gilder RN, MS, Monica Bennett Ph.D., Megan C. Reynolds MS, Jo Weddle MD, Michael L. Foreman* MD, FACS, Ann Marie Warren Ph.D., Baylor University Medical Center

Invited Discussant: Mark Malangoni, MD

Introduction: Unplanned hospital readmissions are a significant focus of healthcare reform. There is speculation that rates of readmission following a traumatic injury will be publically disclosed and penalties will incur. We hypothesize identifying reasons for readmission will help develop targeted patient interventions directed toward high-risk patients to reduce their hospital utilization and healthcare spending.

Methods: Retrospectively, data was collected for 2027 unique trauma patients admitted to a Level I ACS-certified trauma center over a year, with readmissions identified following one year from the index admission. A regional database encompassing 15,000 square miles including 75 hospitals was queried for readmissions. Outcomes of all readmission encounters were analyzed using a binary logistic regression model including demographic, diagnosis, ISS, procedure, Elixhauser comorbidity, insurance, and disposition data. The Regional Enterprise Master Patient Index (REMPI) was also included in the model and is a probabilistic tool that matches patient encounters across hospitals and allows identification and analysis of patient activity regardless of encounter location or payer. Subset analysis of 174 encounters that had 3 or more readmissions was also performed to look for different patterns in the frequent fliers.

Results: 474 (23%) patients were readmitted during the study period. There were 821 re-admit encounters, (range 1-21) averaging 2.03 re-encounters, with a median of one re-encounter. Of the 474, 88 patients were readmitted for a trauma specific related diagnosis. The trimmed model includes significant "independently predictive" variables with a receiver operating characteristic curve of 0.770, which is characteristic of a strong model.

Independent Predictors for 3 or More Readmissions (above 75th percentile)	Odds Ratio	Beta value	p value
Septicemia with extreme risk of mortality	5.147	1.639	0.001
Elixhauser diabetes mellitus complicated or uncomplicated	2.824	1.038	0.000
Medicaid	2.446	0.894	0.002
Congestive heart failure	1.954	0.670	0.006
Elixhauser weight loss	1.864	0.623	0.008
Elixhauser psychosis	1.724	0.545	0.040
REMPI sequence > 14	2.970	1.088	0.000
Increasing age	0.998	-0.012	0.036

Conclusion: In our study, race, ethnicity, sex, and socioeconomic status were not found to be significant factors for readmission. Septicemia was found to be the most significant risk factor (515%) for readmission. Increasing age was actually found to slightly decrease the risk of readmission. Readmissions occur more frequently in patients with comorbidities such as diabetes and congestive heart failure. Having Medicaid funding increased the risk of readmission by 245%. Weight loss and psychosis were also found to increase the risk of readmission. The REMPI sequence above 14 carries a 297% risk of readmission. Multi-disciplinary discharge planning, patient and family discharge education, and arranging outpatient follow-up has been shown to reduce readmissions. Identification of population factors for readmission following injury may allow trauma centers to target risk factors preemptively and hopefully minimize readmission. This is the first step for developing interventions for the reduction of resource utilization and healthcare cost.

Session: XIVB: Papers 45-54
Paper 54: 4:30-4:50 PM

MINIMALLY INVASIVE IS MAXIMALLY EFFECTIVE: THERAPEUTIC AND DIAGNOSTIC LAPAROSCOPY FOR PENETRATING ABDOMINAL INJURIES

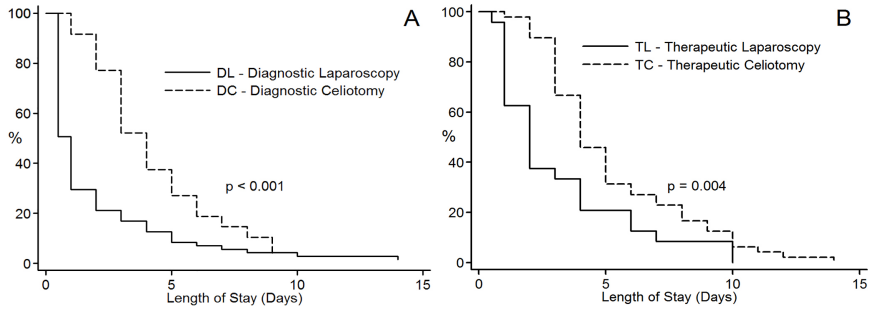
Paul J. Chestovich MD, Timothy D. Browder* MD, Shawna L. Morrissey DO, Douglas R. Fraser MD, Nichole K. Ingalls MD, John J. Fildes* MD, University of Nevada School of Medicine

Invited Discussant: Rao Ivatury, MD

Introduction: Minimally invasive techniques and equipment have evolved allowing increased operative capabilities within most subspecialties of general surgery. There remains limited evidence supporting laparoscopic techniques in managing the injured patient. We hypothesized that laparoscopy is effective for the diagnosis and treatment of penetrating abdominal injuries.

Methods: We retrospectively reviewed all patients undergoing abdominal exploration following penetrating trauma at our Level 1 trauma center over a 6-year period from 1/1/08 to 12/31/13. Demographic and resuscitation data were obtained from our trauma center patient registry. Charts were reviewed for operative details, hospital course and complications. Hospital length of stay (LOS) and complications were primary endpoints. Patients were classified as having non-therapeutic diagnostic laparoscopy (DL), non-therapeutic diagnostic celiotomy (DC), therapeutic laparoscopy (TL), or therapeutic celiotomy (TC). TL patients were matched 1:2 with TC patients having similar intra-abdominal injuries.

Results: 518 patients, including 281 (55%) stab wounds (SW) and 237 (45%) gunshot wounds (GSW) were identified. Celiotomy was performed in 379 (73%) patients, laparoscopy in 139 (27%), with 44 (32%) of those converted to celiotomy. The initial comparison group were non-therapeutic explorations with 119 patients (23%) including 71 DL and 48 DC with similar injury severity (ISS 5.31 vs. 3.83, p=NS). LOS was shorter in DL compared to DC (Fig A, p<0.001). There were no missed injuries. Wound infections (8% vs. 0%, p=0.013) and ileus (10% vs. 0%, p=0.005) were more common after DC than DL. The therapeutic comparison group consisted of 399 (77%) patients, including 375 (72%) with celiotomy, and 24 (4.6%) with laparoscopy (TL). Laparoscopic repairs included liver, stomach, small and large intestine, diaphragm, bladder, minor hemorrhage and abdominal wall defects. The TC included 48 patients with similar injuries and ISS (8.85 vs. 7.95, p=NS). LOS was shorter in the TL group than TC (Fig B, p=0.004). There were no missed injuries. Wound infections were more common in TC than TL (15% vs. 0%, p=0.049).



Conclusion: We have demonstrated the safety of laparoscopy following penetrating abdominal trauma. The use of laparoscopy resulted in shorter hospitalization, fewer wound complications and no missed injuries. Laparoscopy should be the initial procedure of choice in stable patients with penetrating abdominal injuries.

Session: XV: Papers 55-66
Paper 55: 8:00-8:20 AM

TWO ARE BETTER THAN ONE: SYNERGY OF BETA-BLOCKADE AND STATIN THERAPY ON SURVIVAL IN SEPSIS

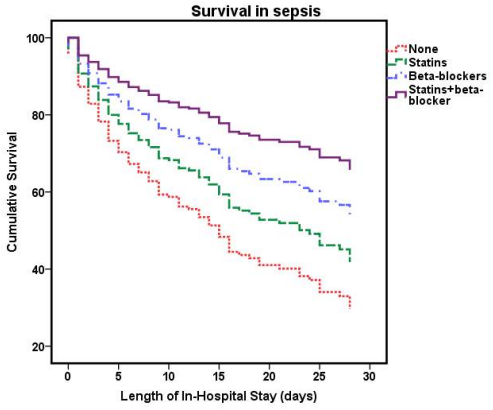
Irada Ibrahim-zada MD,Ph.D., Peter Rhee* MD,MPH, John Santoro Jr., Irina Maskaykina BS, Lynn Gries MD, Terence O'Keeffe* MD, Randall Friese* MD, University of Arizona - Tucson

Invited Discussant: Carl Hauser, MD

Introduction:Current evidence suggests the importance of immunomodulatory therapy in sepsis. Recent clinical trials have demonstrated survival benefits of statins and beta-blocker therapies in sepsis via anti-inflammatory mechanisms. The aim of the study is to evaluate the effect of synchronous administration of beta-blockade and statin therapy in sepsis. We hypothesize that combined administration is associated with increased survival in patients with sepsis.
Methods: This is a single-institution retrospective cohort study on patients with sepsis hospitalized in the ICU at our urban tertiary referral center from 1/1/2008 through 3/31/2011. Records were cross-referenced with pharmacy database to identify patients on beta-blockers (BB), statins (ST), both (BB+ST), and none. Primary outcome is in-hospital 28-day mortality. Kaplan-Meier and Cox-regression analyses were utilized to identify survival benefits adjusted by gender and APACHE II scores.
Results: 304 patients were identified in our database. 101(33%) patients received BB only, 14(5%) received ST only, and 36(12%) patients had BB+ST. Mean APACHE II score was 19.45±7.5 with no difference between groups(p=0.5). Mean survival was 15, 18, 20 and 22 days in groups with none, ST, BB, and BB+ST, respectively. Cox-regression analysis showed that synchronous administration of BB and ST during ICU stay improved in-hospital survival in patients (HR=0.35, 95%CI 0.18 to 0.67, p=0.002) compared to patients without therapy whereas BB only group had HR of 0.51 (p=0.001).

Therapy	p value	HR	95%CI
None	1.0 (REFERENCE)		
Statins	.488	.72	0.29; 1.80
Beta-blockers	.001	.51	0.35; 0.76
Statins+beta-blockers	.002	.35	0.18; 0.67
APACHE II	.000	1.11	1.08; 1.14
Gender	.027	.67	0.47; 0.96

Conclusion:Beta-blockade combined with statin therapy during ICU stay has additive effect and is associated with a further 1.5-fold reduction in mortality in septic patients. Randomized clinical trials are warranted to evaluate their synergistic benefits on survival and explore immunomodulatory mechanisms.



Session: XV: Papers 55-66
Paper 56: 8:20-8:40 AM

SAVING LIVES AND SAVING MONEY: HOSPITAL-BASED VIOLENCE PREVENTION IS COST-EFFECTIVE

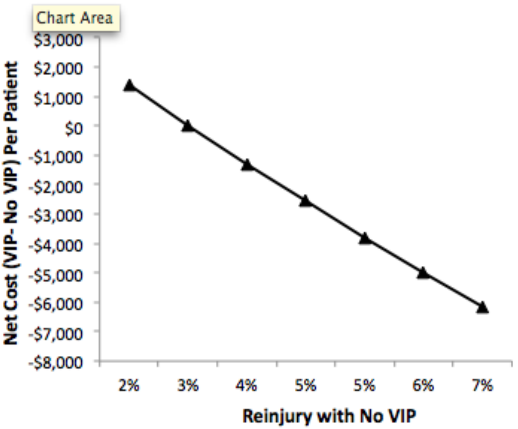
Catherine Juillard MD,MPH, Nancy Anaya MS, Randi Smith MD,MPH, Arturo Garcia MD, James G. Kahn MD,MPH, Rochelle A. Dicker* MD, San Francisco General Hospital

Invited Discussant: Carnell Cooper, MD

Introduction: Victims of violence are at significant risk for injury recidivism and 20% risk of future fatality. We previously demonstrated that our hospital-based violence intervention program (VIP) resulted in four-fold reduction in injury recidivism; trauma care costs $41,000 per patient. Given limited trauma center resources, VIP cost-effectiveness is fundamental when evaluating exportability of these programs to other institutions. This study aims to determine the cost-effectiveness of a hospital-based VIP using a cost utility analysis.

Methods: We used Markov methodology to analyze cost-utility for a hypothetical cohort of violently injured subjects, comparing VIP versus not having VIP at a trauma center. Quality adjusted life-years (QALYs) were calculated using health state utilities based on literature data. Cost of care, cost of VIP, and risk of recidivism with and without VIP were obtained from institutional data. Outcomes were based on QALYs gained and cost of VIP and trauma care over a 5-year horizon. Sensitivity analyses were done using variable values for costs and recidivism rates to predict outcomes over a range of values.

Results: VIP results in 25.6 average QALYs saved and average costs (program cost and cost of care for recidivists) of $5,892 per patient. This is less than the cost of care associated with recidivism for no VIP ($5,923), demonstrating that the reduction in recidivism offsets the cost of VIP. In the sensitivity analysis, net QALYs gained with VIP nearly triple when the injury recidivism rate without VIP is highest. When analyzed over extreme values of injury cost, the cost of having no VIP increases to $85,691 at the highest recorded institutional cost of care. The graph represents potential cost or savings of VIP at our institution's VIP-associated annual injury recidivism rate of 0.9% over a range of recidivism rates with no VIP, at fixed injury cost. Cost-effectiveness remained robust over a range of values; $6,000 net cost savings occur when 5-year recidivism rate without VIP is at 7%.



Conclusion: VIP costs less than having no VIP with significant improvement in QALYs gained. Having no VIP has the most economic consequence when injury recidivism is high. Across a range of plausible values at which VIP would be least cost-effective (lower injury recidivism, cost of injury, and program effectiveness), VIP still results in acceptable cost per health outcome gained. VIP is effective and cost-effective and should be considered in any trauma center that takes care of violently injured patients. This analysis can be used by other trauma centers to determine VIP feasiblity in their setting.

Session: XV: Papers 55-66
Paper 57: 8:40-9:00 AM

PROSPECTIVE, MULTICENTER DERIVATION OF A CLINICAL DECISION RULE FOR THORACIC AND LUMBAR SPINE EVALUATION AFTER BLUNT TRAUMA

Kenji Inaba* MD, Lauren Nosanov BA, Jay Menaker* MD, Patrick Bosarge MD, David Turay MD, Riad Cachecho* MD, Marc DeMoya* MD, Marko Bukur* MD, Jordan Carl BS, Leslie Kobayashi* MD, Stephen Kaminski MD, Alec Beekley MD, Mario Gomez DO, Dimitra Skiada MD, And The TL-Spine Multicenter Study Group LAC+USC Medical Center

Invited Discussant: Carrie Sims, MD

Introduction: Unlike the C-Spine, where NEXUS/Canadian C-Spine Rules can be used, evidence based TL-spine clearance guidelines do not exist. The aim of this study was to develop a clinical decision rule for evaluating the injured TL-spine.

Methods: Adult (≥15yo) blunt trauma patients were prospectively enrolled at 13 US trauma centers (01/12-01/14). Exclusion criteria: C-Spine injury with neurologic deficit, pre-existing paraplegia/tetraplegia, unevaluable examination. The remaining evaluable patients underwent TL-Spine imaging and were followed to discharge. The primary endpoint was a clinically significant TL-Spine injury requiring TL-Spine Orthoses/surgical stabilization. Regression techniques were used to develop a clinical decision rule. Decision rule performance in identifying clinically significant fractures was tested.

Results: Of 12,479 patients screened, 3,068 (24.6%) met inclusion criteria [age 43.5+/-19.8 years (15-103), ISS 8.8+/-7.5, male gender 66.3%]. The majority underwent CT (93.3%), 6.3% only plain films and 0.2% MRI exclusively. TL-Spine injury was identified in 502 patients (16.4%), of which 268 (8.7%) were clinically significant. The most common clinically significant injury was compression fracture (67.4%) followed by a burst fracture (17.2%) and a fracture dislocation (5.0%). The predictive ability of clinical examination (midline tenderness, step-off or neurologic deficit), age and mechanism were examined. A positive clinical examination resulted in a sensitivity of 78.4% and specificity of 72.9%. Addition of age ≥ 60 and a high risk mechanism (MVC with ejection or rollover, pedestrian struck by auto, fall from height, torso crush, jump from moving vehicle, non-enclosed vehicle crash) increased the sensitivity to 98.5% with a specificity of 29.0%.

Conclusion: Clinical examination alone is insufficient for determining need for imaging in evaluable patients at risk of TL-Spine injury. Addition of age and high risk mechanism results in a clinical decision making rule with a sensitivity of 98.5% for clinically significant injuries. Utilization of this clinical decision rule will significantly lower the negative imaging rate.

Session: XV: Papers 55-66
Paper 58: 9:00-9:20 AM

THE EVIL OF GOOD IS BETTER: MAKING THE CASE FOR BASIC LIFE SUPPORT TRANSPORT OF PENETRATING TRAUMA VICTIMS IN AN URBAN ENVIRONMENT

Joseph F. Rappold* MD, Kathryn A. Hollenbach Ph.D., Thomas Santora* MD, Dania Beadle BS, Elizabeth Dauer MD, Lars Sjoholm MD, Pathak Abhijit* MD, Amy Goldberg* MD, Temple University School Of Medicine Department Of Surgery

Invited Discussant: Norman McSwain, Jr., MD

Introduction: Controversy remains over the ideal way to transport penetrating trauma victims in an urban environment. Both advanced (ALS) and basic life support (BLS) transport are utilized in most urban environments depending on availability and proximity to the victim.

Methods: A retrospective cohort study was conducted at an urban Level I Trauma Center utilizing the Pennsylvania Trauma Outcomes Study Data Registry. Information on all trauma admissions from January 2008 through November 2013 with penetrating injuries that were transported by ALS, BLS or police were included. Standard demographics and injury related variables were abstracted. Patient survival by mode of transport was analyzed using logistic regression to control for confounding effects. A secondary analysis was conducted by level of care provided (ALS vs. BLS).

Results: During the study period, 1490 penetrating trauma patients were transported to our institution via ALS (44.8%), BLS (15.6%), or police (39.6%) personnel. The majority of injuries were gunshot wounds (72.9% for ALS; 66.8% for BLS; 90% for police) and occurred most frequently in males (91%). Mean transport minutes were significantly longer for ALS (17.0±7.9) than for BLS (15.7±6.7) transports ($p < 0.05$).

Descriptive Characteristics of Penetrating Trauma admissions, January 2008 – November 2013

	ALS (n = 668)		BLS (n = 232)		Police (n = 590)	
	n	**%**	**n**	**%**	**n**	**%**
ISS 0-15	362	54.2	140	60.3	268	45.4
16-30	194	29.0	64	27.6	208	35.3
31-45	48	7.2	11	4.7	53	9.0
46-60	5	0.8	1	0.4	7	1.2
61-75	59	8.8	16	6.9	54	9.2
Care: BLS	64	9.7	232	100.0	590	100.0
ALS	596	90.3	0		0	
Died prior to discharge	174	26.1	38	16.4	196	39.6
Died in ED	119	17.8	27	11.6	125	21.2
Overall Death Rate		43.9		28.0		60.8

After adjusting for transport time, among victims with an ISS of 0-30, there was a 2.3 fold increased odds of death (95% CI = 1.3, 4.1) if transported by ALS as compared to BLS. With ISS >30, this relationship did not exist (OR = 0.9; 95% CI = 0.3, 2.5). Similar relationships were observed when comparing police to BLS transport (OR = 3.4; 95% CI = 2.0, 5.9) for ISS 0-30 and OR=0.9 (95% CI = 0.3, 2.3) for ISS >30. When ALS and BLS transports were evaluated by type of care provided, patients with ISS 0-30, who received ALS support were 3.6 times more likely to die than those who received BLS support (95% CI = 2.0, 6.3). Among those with ISS >30, this relationship was not significant (OR = 1.3; 95%CI = 0.5, 3.3).

Conclusion: In an urban environment our data demonstrate that ALS care offers no survival benefit for victims of penetrating trauma regardless of severity and may lead to harm in those with moderate injury. A prospective, randomized study is warranted.

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MORTALITY FOLLOWING EMERGENCY SURGERY CONTINUES TO RISE AFTER DISCHARGE IN THE ELDERLY

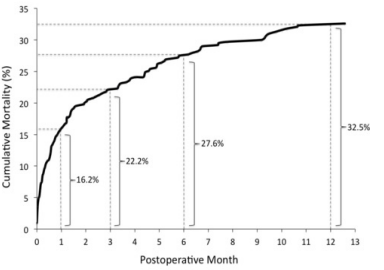
Erika L. Rangel MD, M.S., Gifty Kwakye MD, Christopher Calahan BS, Zara Cooper* MD, M.Sc., Ali Salim* MD, Mohammad Sarhan MD, Joseph Hanna MD,Ph.D.,
Brigham and Womens Hospital

Invited Discussant: George Velmahos, MD, PhD

INTRODUCTION: It is well known that the need for emergency surgery in the elderly is associated with high short term mortality. Longer term outcomes, which would be helpful for counseling patients, are not well described. For elderly patients undergoing emergency operations, we hypothesized that 30-day mortality may underestimate the true burden of operative mortality. The purpose of this study was to characterize cumulative postoperative mortality rates extending to one year following emergency abdominal surgery. In addition, we sought to identify independent preoperative predictors of one year mortality.

METHODS:This is a retrospective study of all elderly patients (age≥70) who underwent emergency general surgery for an acute abdominal condition between 2006-2011 at a major teaching hospital. Medical records were reviewed for demographic characteristics, functional status, preoperative vital signs, body mass index (BMI), laboratory values, Charlson scores, comorbid conditions, ASA classification, type of operation, transfusion, and duration of surgery. In-hospital death was determined from medical records and post-discharge death determined from the Social Security Death Index. Multivariate logistic regression analysis with stepwise selection was used to determine independent predictors of one-year mortality. The area under the receiver operator characteristic (ROC) curve was calculated to assess model performance.

RESULTS: 390 patients met our inclusion criteria. The mean age was 78.8 ± 6.1 years and 44% were men. Postoperative mortality was 16.2% at 30 days, 22.2% at 3 months ($p<0.0001$), 27.6% at 6 months ($p<0.0001$), and 32.5% at one year ($p<0.0001$), reflecting a doubling of mortality between 30 days and one year. Independent preoperative predictors of one year mortality were: Charlson score (OR 1.40; 95% CI 1.18-1.67), serum albumin (OR per unit increase in albumin: 0.51, 95% CI 0.34-0.77), BMI <18.5 (OR 4.45, 95% CI 1.06-18.78), high ASA grade (III:OR 3.18, 95% CI 1.12-9.03, IV:OR 10.74, 95% CI 3.28-35.20), immunosuppression (OR 2.49, 95% CI 1.18-5.24), and acute kidney injury (OR 3.19, 95% CI 1.50-6.78). Our composite model with these variables had excellent predictive value with an area under the ROC curve of 0.87 (95% CI 0.83-0.90).



CONCLUSION: Thirty-day mortality in the elderly emergency surgery population is an inadequate measure of postoperative outcome, as it markedly underestimates the mortality burden suffered by this cohort during the first postoperative year. We identified a constellation of preoperative clinical markers that were highly predictive of one year mortality. Further efforts are needed to explore the causes of late term mortality in the context of these variables. Future studies will develop a clinical scoring tool that can be applied at the bedside to allow more effective and pragmatic perioperative counseling for this high risk cohort.

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Paper 60: 9:40-10:00 AM

PREVENTING MOTOR VEHICLE CRASHES THROUGH GRADUATED DRIVING LICENSING LAWS IN MASSACHUSETTS: A POPULATION-BASED STUDY

Haytham Kaafarani MD,MPH, Catrina Cropano BS, Yuchiao Chang Ph.D., Jarone Lee MD,MPH, Toby Raybould MS, Alice Gervasini Ph.D.,RN, Laurie Petrovick CPHQ, MSc, Christopher DePesa RN, MS, George Velmahos* MD,Ph.D., Peter Masiakos MD, Massachusetts General Hospital

Invited Discussant: Barbara Gaines, MD

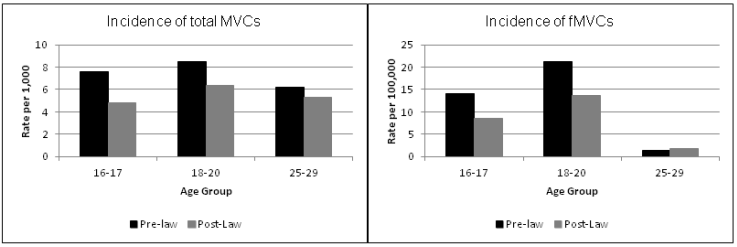
Introduction: Graduated Driving Licensing (GDL) programs phase in driving privileges for teenagers. We aimed to evaluate the effect of the 2007 GDL law on the incidence of motor vehicle crashes (MVCs) and fatal MVCs (fMVCs) among teenagers in Massachusetts.

Methods: The Fatality Analysis and Reporting System, the Missouri Census Data Center and the Massachusetts Department of Transportation databases were all used to create and compare the incidence of MVCs and fMVCs pre- (2002-2006) and post- (2007-2011) law. Three driver age groups were studied: 16-17 (evaluating the law effect), 18-20 (evaluating the sustainability of the effect), and 25-29 (control group) years old. As a sensitivity analysis, we compared the incidence rates per population and per licenses issued.

Results: MVCs decreased following the law for all three age groups (16-17: 7.6 to 4.8 per 1,000 people, $p<0.0001$; 18-20: 8.5 to 6.4 per 1,000 people, $p<0.0001$; 25-29: 6.2 to 5.2 per 1,000 people, $p<0.0001$) [Figure 1]. The subset of fMVCs decreased in the 16-17 (14.0 to 8.6 per 100,000 people, $p=0.0006$) and 18-20 (21.2 to 13.7 per 100,000 people, $p<0.0001$) age groups [Figure 1], but remained unchanged in the control group. All the results were confirmed in sensitivity analyses.

Conclusions: The 2007 Massachusetts GDL was effective in decreasing the incidence of teenager MVCs including fatal MVCs; the effect was sustainable. This study provides further support to develop, implement, enforce and maintain GDL programs aimed at preventing MVCs and their related mortality in the young novice driver population.

Figure 1. The incidence of total and fatal MVCs for the study populations pre- and post-law.



Session: XV: Papers 55-66
Paper 61: 10:00-10:20 AM

THE EFFECT OF TISSUE DAMAGE VOLUME ON SYSTEMIC INFLAMMATION AND ORGAN FAILURE

Travis L. Frantz MS4, Scott D. Steenburg MD, Greg E. Gaski MD, Timothy Pohlman* MD, Todd O. Mckinley MD, Robert L. Reed* MD, Indiana Univesity School of Medicine

Invited Discussant: Basil Pruitt, Jr., MD

Introduction:The Systemic Inflammatory Response Syndrome (SIRS) can lead to organ failure and death in multiply injured patients (MIPs). SIRS results primarily from an immune response to endogenous molecules, Damage Associated Molecular Patterns (DAMPs) felt to be liberated from damaged tissue. However, it is not known how the magnitude of tissue damage affects the subsequent inflammatory response and organ dysfunction. This purpose of this study was to quantify how the volume of tissue damage affected the magnitude of inflammation and organ dysfunction in MIPs.

Methods:Data from 36 MIPs (ISS $\geq$ 18), admitted to the ICU for a minimum of 6 days, were used to calculate daily SIRS scores (0 to 4) and daily Sequential Organ Functional Assessment scores (SOFA; 0 - 24). A novel radiographic index, the Tissue Damage Volume Score (TDVS), was calculated by making volumetric measurements of every injury in each patient detected on admission CT scans and plain X-rays. Individual injury volumes were summed to generate a total body TDVS for each patient. Regression analyses evaluated correlations between TDVS and both inflammatory and organ dysfunction scores.

Results: Two distinct patient populations were identified comparing TDVS to organ dysfunction and SIRS. High-risk patients: SOFA = 0.0043 TDVS + 3.72; Cumulative SIRS = 0.031TDVS + 22. Low-risk patients: SOFA = 0.0006 TDVS + 2.68; Cumulative SIRS = 0.014TDVS - 6.1. SOFA vs. TDVS slope was 7.2X higher in high-risk patients ($p = 0.0007$) and SOFA vs. Cumulative SIRS slope was 2.2X higher in high-risk patients ($p = 0.002$) compared to low-risk patients.

Conclusion: These results demonstrate a dichotomous response of how MIPs tolerate tissue damage. High-risk patients developed over twice the magnitude of inflammation per tissue damage volume compared to low-risk patients. The accentuated inflammatory repsonse extrapolated into a 7X increase in the amount of organ dysfunction per tissue damage volume. Further investigations are required to elucidate the underlying pathomechanistic pathways on how tissue damage causes inflammation and organ dysfunction.

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DOES SIZE MATTER, OR IS EXPERIENCE WHAT REALLY COUNTS? ANNUAL CLINICAL EXPERIENCE (PER SURGEON) IS ASSOCIATED WITH IMPROVED SURVIVAL

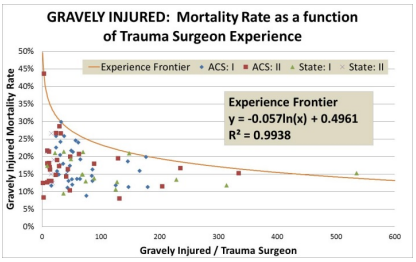
Richard W. Doty Jeffrey S. Young* MD, James F. Calland* MD, University of Virginia

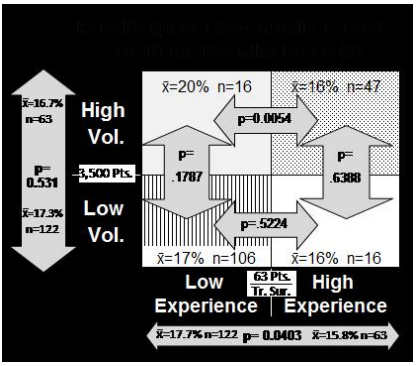
Invited Discussant: Joseph Minei, MD

Introduction: Severely injured trauma patients derive a clear mortality benefit from treatment at trauma centers, but the relationship between trauma center volume and outcome is less well understood. This study seeks to discern the relationship between trauma center volume and trauma surgeon "experience" in patients with varying severity of anatomic injury.

Methods: Patient outcomes for all adult blunt-trauma patients 16-64 years old in the combined 2011 and 2012 NSP Datasets (n=1,200,439 admissions) were cross-tabulated against facility size, verification status, trauma surgeon experience (patients treated per surgeon / year stratified by injury severity score level), and injury severity score (ISS). Data were evaluated and analyzed using two-tailed Student's t-tests and r2 tests of correlation using Microsoft excel.

Results: Trauma centers in which surgeons were annually responsible for > 63 ISS25+ patients per year tended to demonstrate mortality rates that were 12% lower (15.8% vs. 17.7%, $p<0.05$) than centers with surgeons that have a diluted annual "experience" of <63 patients per year. In low volume centers (<3,500 admissions per year) low "experience" did not seem to influence the mortality of ISS25+ patients (16% vs. 17%, $p=0.52$). In high volume centers, however (>3,500 patients treated annually) high experience seemed to result in a 20% lower annual relative observed mortality rate (20% vs. 16%, $p<0.01$). At high experience, increasing facility volume seemed to exert no influence on mortality (16% vs 16%, $P=0.31$).





Conclusions: Trauma surgeon annual "experience" may positively influence the mortality risk of gravely injured patients. Increasing annual center volume, on the other hand, does not improve performance. High "experience" centers seem to produce unexpected survivors, especially in high volume centers that admit >3,500 patients per year.

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The clinical significance of solubule RAGE in patients with severe sepsis

Hisatake Matsumoto MD, Naoya Matsumoto Ph.D., Hiroshi Ogura* Ph.D., Junya Shimazaki Ph.D., Kazuma Yamakawa MD, Takashi Muroya MD, Junichiro Nakagawa MD, Tomoki Yamada MD, Takeshi Shimazu* Ph.D., Department Of Traumatology And Acute Critical Medicine, Osaka University Graduate School Of Medicine

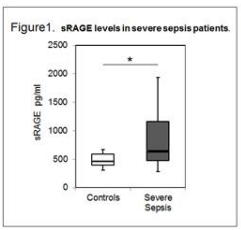
Invited Discussant: Eileen Bulger, MD

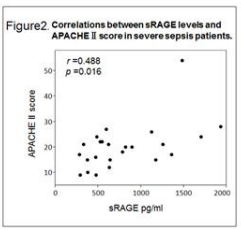
Introduction: Severe sepsis is a major clinical challenge, especially to clinicians working in intensive care units. The receptor for advanced glycation end products (RAGE) is a pattern- recognition receptor, which is involved in the pathogenesis of several inflammatory disease. RAGE has secretory isoforms referred to as soluble RAGE (sRAGE). The role of sRAGE has not been thoroughly clarified in the pathogenesis of critically ill patients. The objective of this study was to investigate circulating sRAGE in patients with sepsis.

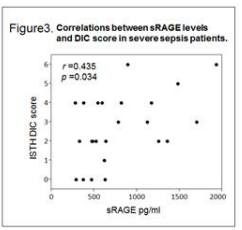
Methods: This prospective observational study was conducted from November 2012 to September 2013. The criteria for inclusion were patients with severe sepsis and age greater than 18 years. Blood samples were collected from patients within 24 hours after the diagnosis of sepsis and from healthy volunteers. sRAGE, high-mobility group box 1 (HMGB1), interleukin 6 (IL-6), and Plasminogen activator inhibitor-1 (PAI-1) were measured with an enzyme-linked immunosorbent assay kit. APACHE II score and SOFA score were assessed at the enrollment time of sepsis patients. We used ISTH overt DIC diagnostic criteria algorithm for assessing DIC.

Results: During the study, 24 sepsis patients and 12 healty volunteers were included. Sepsis patients and controls were similar with respect to age and sex. In the overall analysis of participants, sRAGE levels in the serum were significantly increased in sepsis patients compared with healthy controls ($p<0.05$) (Figure.1). Significant correlations were found between sRAGE levels and APACHE II score (Figure.2) ($p<0.05$), as well as between sRAGE levels and SOFA score ($p<0.05$). sRAGE levels showed significant dependency on ISTH DIC score (Figure.3) ($p<0.05$). Significant correlations were found between sRAGE levels and IL6 levels, as well as between sRAGE levels and PAI-1 levels ($p<0.05$). sRAGE levels also had a tendency to correlate with HMGB-1 levels.

Conclusion: We demonstrated for the first time that sRAGE increased with the progression of DIC in the sepsis patiants, suggesting that sRAGE may reflect the severity of coagulative activity. We also found that sRAGE showed a correlation with APACHE II and SOFA score, suggesting the possibility that sRAGE may play a role as a new sepsis marker.







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The Pediatric Trauma Center and the Inclusive Trauma System: Impact on Splenectomy Rates

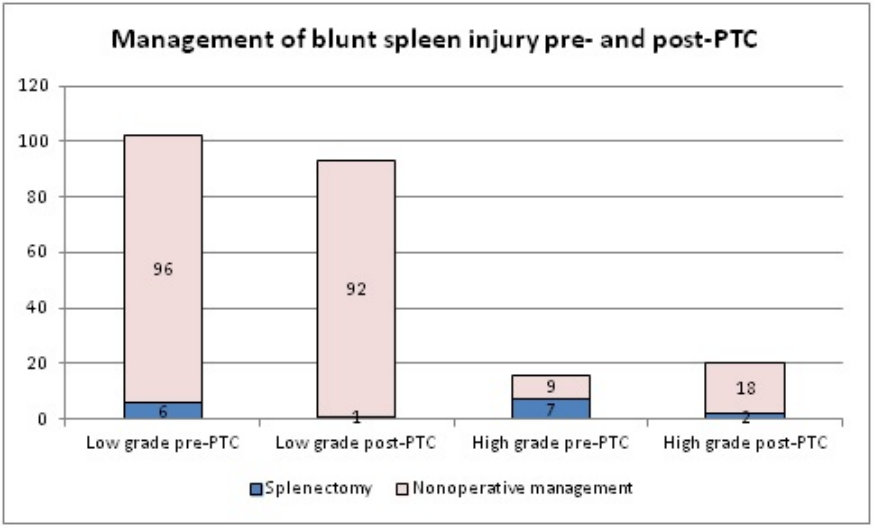
Emily E. Murphy MD, Stephen G. Murphy MD, Mark D. Cipolle* MD,Ph.D., Glen H. Tinkoff* MD, Christianacare Health Services

Invited Discussant: Mary Fallat, MD

Introduction: Prior to 2006, the Delaware Trauma System (DTS) did not include a designated pediatric trauma center (PTC). In 2006, AI DuPont Hospital for Children, a free-standing children's hospital, was designated by the DTS and verified by the ACS Committee on Trauma verification/ consultation program as a PTC. We sought to assess the impact of the addition of this PTC into the pre-existing trauma system on splenectomy rates.

Methods: The DTS trauma registry was queried for all children younger than 16 years of age with spleen injury (ICD9 diagnoses codes 865.0-865.5) from January 1998 through December 2012. This cohort was categorized into two groups, pre-PTC (1998-2005) and post-PTC (2006-2012). Penetrating injuries were excluded. These groups were compared for age, gender, length of stay, organ specific injury grade, injury severity score, incidence of polytrauma, splenectomy rate, and admitting hospital. Management, operative versus nonoperative, of low grade (OIS 1-3) and high-grade (OIS 4-5) were also compared. Pearson's chi-square analysis was performed for categorical variables. Continuous variables were reported as mean +/- standard deviation and compared by Student's t-test for independent normally distributed samples. Mann-Whitney U test was used for non-normally distributed variables. A p value of <0.05 was considered significant.

Results: Of the 231 pediatric spleen injuries, 118 occurred pre-PTC and 113 occurred post-PTC. There were no significant differences in age, gender, length of stay, ISS, OIS grade and incidence of polytrauma. Splenectomy rate decreased from 11% pre-PTC to 2.7% post-PTC (13 vs. 3, p=0.014).



Conclusion: The addition of an ACS-verified PTC within an inclusive trauma system that was previously without one was associated with a significant reduction in the rate of blunt-trauma-related splenectomy. Integration of a verified PTC is an influential factor in achieving spleen-preservation rates equivalent to published APSA benchmarks within a trauma system.

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EMERGENCY GENERAL SURGERY OUTCOMES IN TEACHING VERSUS NON-TEACHING HOSPITALS

Adil A. Shah MD, Syed N. Zafar MD,MPH, David T. Efron* MD, Zain G. Hashmi MD, Elliott R. Haut* MD, Eric B. Schneider Ph.D., Diane Schwartz MD, Catherine G. Velopulos* MD, Adil H. Haider* MD,MPH, Johns Hopkins School of Medicine

Invited Discussant: Gregory J. Jurkovich, MD

Introduction: Prior analyses demonstrate teaching hospitals to have worse outcomes and higher costs, raising concerns for quality of care. The purpose of this study is to compare outcomes between teaching and non-teaching hospitals for emergency surgical conditions in a national sample.

Methods: The Nationwide Inpatient Sample (2005–2011) was queried for patients with conditions encompassing EGS as determined by the American Association for Surgery of Trauma (AAST) Committee on Severity Assessment and Patient Outcomes in 2011 and grouped into the 24 different EGS categories. Outcomes of in-hospital mortality, length of stay and cost of care were compared between patients presenting to teaching versus non-teaching hospitals. Both groups were matched on age, gender, clinical diagnosis, comorbidities, disease diagnosis, disease severity, payer status and insurance utilizing propensity scores. Multivariate regression analyses were performed further adjusting for hospital level factors including EGS volume.

Results: A total of 3,707,465 patient were included. 41% (n=1,520,358) of patients were treated at teaching hospitals. After propensity matching and adjustment, there were no significant differences in the overall mortality, LOS and cost between teaching and non-teaching hospitals (Table). Similar results were observed for rural and urban healthcare facilities.

	Overall	Urban Hospitals	Rural Hospitals
	Mortality (OR [95% CI])		
Teaching Hospitals (Non-teaching as referent)	1.04 (1.02-1.06)	1.04 (1.02-1.06)	1.08 (0.99-1.16)
	Length of Stay (Days with 95%CI)		
Teaching Hospitals	5.03 [4.98-5.09]	5.14 [5.08-5.21]	4.37 [4.3-4.44]
Non-teaching Hospitals	5.22 [5.16-5.29]	5.31 [5.26-5.38]	4.87 [4.59-5.16]
	Cost ($ with 95% CI)		
Teaching Hospitals	12,304 [12,290-12318]	12,507 [12,492-12,523]	11,004 [10,974-11,034]
Non-teaching Hospitals	12,846 [12,827-12,865]	13,078 [13,059-13,098]	11,237 [11,135-11,340]

[OR; Odds Ratio, CI; Confidence Intervals]

Conclusion: National estimates of outcomes for EGS conditions demonstrate comparable results between teaching and non-teaching hospitals. Concerns regarding quality of care and health care costs at teaching hospitals are unfounded.

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Paper 66: 11:40-12;00 PM

PNEUMOMEDIASTINUM FOLLOWING BLUNT TRAUMA: WORTH WHILE A WORKUP?

Konstantinos Chouliaras MD, Elias Bench BS, Peep Talving* MD,Ph.D., Aaron Strumwasser MD, Elizabeth Benjamin MD,Ph.D., Lydia Lam* MD, Kenji Inaba* MD, Demetrios Demetriades* MD,Ph.D., LAC+USC Medical Center

Invited Discussant: Oscar Guillamondegui, MD

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Introduction: Pneumomediastinum is a common radiological finding following blunt upper torso injury, however, its clinical significance is poorly defined. The purpose of this study was to define the incidence of aerodigestive injuries in patients with pneumomediastinum after blunt upper torso injury.

Methods: After IRB approval, a retrospective review of all blunt chest and neck trauma patients admitted to Level I urban trauma center between 1/2007 and 12/2012 was performed. All patients with pneumomediastinum on radiological investigations were enrolled. Data accrued included demographics, admission clinical data, injury severity patterns, incidence of aerodigestive injuries, operative findings, morbidity, mortality, and ICU and hospital lengths of stay.

Results: A total of 9,946 patients were studied. Overall, 258 patients (2.6%) had a pneumomediastinum, 65 (25%) and 193 (75%) diagnosed on a chest x-ray or on a computed tomography (CT) scan, respectively. Almost half of the patients (49%) were injured in motor vehicle collisions with 76% being male. A total of 21 patients (8.1%) had a workup including bronchoscopy, esophagogram or esophagoscopy. Overall, 4 aerodigestive lesions (1.6%) were diagnosed. Three tracheobronchial injuries were identified on CT scan, and one esophageal injury was diagnosed on an esophagogram. Two of the tracheobronchial injuries required surgery while the remaining aerodigestive lesions were managed conservatively. The overall mortality in this cohort was 10.9%. After adjusting for significant confounders age, Injury Severity Score, and Glasgow Coma Scale Score were found to be independent predictors of mortality.

Conclusion: Pneumomediastinum is a poor predictor of aerodigestive injury following blunt trauma. Selective workup in this clinical setting is warranted.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.