Session 1

Paper 1 7:50 AM

THE TRAUMA QUALITY IMPROVEMENT PROGRAM: PILOT STUDY AND INITIAL DEMONSTRATION OF FEASIBILITY

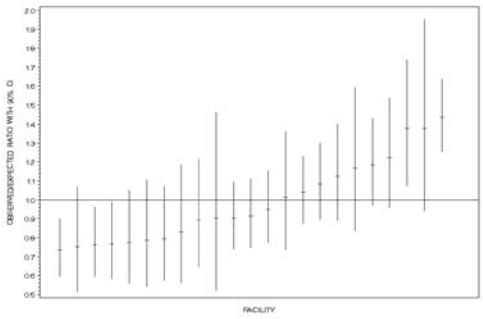
Mark R Hemmila*, MD, Avery B Nathens*, MD PhD, Shahid Shafi*, MD MPH, J Forrest Calland, MD, David E Clark*, MD MPH, H Gill Cryer*, MD PhD, Sandra Goble, MS, Christopher J Hoeft, BS, J Wayne Meredith*, MD, Melanie L Neal, MS, Michael D Pasquale*, MD, Michelle D Pomphrey, RN, John J Fildes*, MD. University of Michigan Medical School.

Invited Discussant: LD Britt

Objective: The ACS COT has created a "Trauma Quality Improvement Program" (TQIP) that utilizes the existing infrastructure of COT programs. As the first step towards full implementation of TQIP, a pilot study was conducted in 23 Level 1 & 2 trauma centers. This study details the feasibility and acceptance of TQIP among the participating centers.

Methods: NTDB data for patients admitted to pilot study hospitals during 2007 was used (15,801 patients). A multivariable logistic regression model was developed to estimate risk-adjusted mortality in aggregate and on 3 pre-specified subgroups (1: blunt multisystem, 2: penetrating truncal, and 3: blunt single system injury). Benchmark reports were developed with each center's risk adjusted mortality (expressed as an observed to expected (O/E) mortality ratio and 90% CI) and crude complication rates available for comparison. Reports were de-identified with only the recipient having access to their performance relative to their peers. Feedback on the reports was collected by survey.

Results: Mortality was 6.8% and in cohorts 1-3 was 18.5, 8.3, and 2.3%, respectively. In the aggregate analysis (Graph), 3 trauma centers were low outliers (O/E and 90% CI < 1) and 2 centers were high outliers (O/E and 90% CI > 1) with the remaining 18 centers demonstrating average mortality. We identified the need for additional work in benchmarking complications as some centers did not submit any complications. 92% of survey respondents found the report clear and understandable, and 90% thought the report was useful. 63% of respondents will be taking action based on the report.



Conclusion: Using NTDB infrastructure to provide risk-adjusted benchmarking of trauma center mortality is feasible and useful. There are differences in O/E ratios across similarly verified centers. Substantial work is required to allow for morbidity benchmarking.

Session 1

Paper 2 8:10 AM

TRAUMA, TRANSFUSIONS, AND RECOMBINANT ACTIVATED FACTOR VII: A MULTI-CENTER ANALYSIS OF 1,041 PATIENTS

M Margaret Knudson, MD*, Mitchell J Cohen, MD, Rosemary Reidy, BA, Sebastian Jaegar, MS, Charles Wade, PhD, John Holcomb, MD*. University of California San Francisco.

Invited Discussant: David Spain

Objectives: Recombinant Factor VIIa (rFVIIa) is widely utilized as an adjunct for hemorrhage control in trauma without clear evidence about efficacy, patient selection, timing, and dosing. We hypothesized that we could identify the setting in which rFVIIa would be most effective.

Methods: Patients from our multi-center rFVIIa case registry were compared to a similar number of patients in a multi-center massive transfusion study (MT, ≥10 units/24 hours) who had **not** received rFVIIa. We compared survival by proportional hazard regression and analyzed "response" to rFVIIa (i.e. survival for 24 hrs. vs. death from hemorrhage) by multivariate logistic regression.

Results: 500 patients from 21 centers received rFVIIa for hemorrhage. Compared to MT patients, the rFVIIa group had significantly higher overall mortality (54.4% vs. 39.5%), ISS, transfusion rates (26 vs.18 units/1st 24hrs.) and higher INR and PTT on admission. 21.4% of the deaths in the MT group were attributable to hemorrhage vs. 29.8% in the rFVIIa study. A poor response to rFVIIa was associated with a pH< 7.2, platelet count< 100k, or blood pressure of < 90 at the time of rFVIIa administration (see table).

Conclusion: rFVIIa is unlikely to be effective as an adjunct to hemorrhage control if given in the presence of persistent shock, acidosis and thrombocytopenia.

Variables	Odds Ratio*	95% CI	p-value
pH < 7.2	0.14	0.07-0.28	<0.0001
Platelets <100k	0.42	0.18-0.99	0.048
BP < 90 systolic	0.12	0.05-0.28	<0.0001

*OR > 1 meaning a good response (survival); OR< 1=poor response

Session 1

Paper 3 8:30 AM

ALL TRAUMA SURGEONS ARE NOT CREATED EQUAL: ASYMMETRIC DISTRIBUTION OF MALPRACTICE CLAIMS RISK

Kaushik Mukherjee, MD, James W Pichert, PhD, M Bernadette Cornett, MA, Ge Yan, MS, Jose J Diaz, MD*. Vanderbilt University Medical Center.

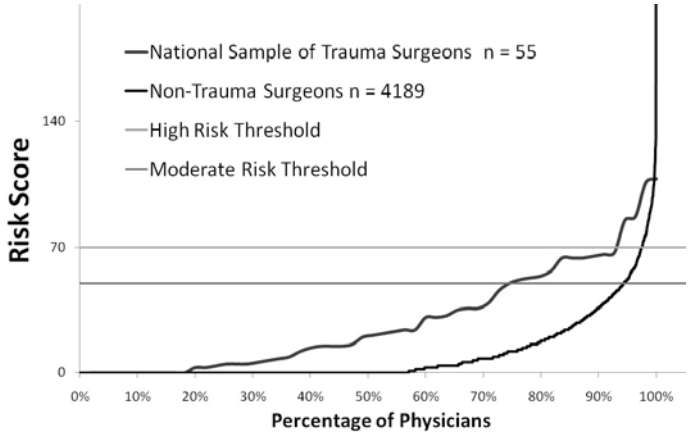
Invited Discussant: Timothy Fabian

Objectives: Trauma is a high risk practice and unsolicited patient complaints (UPC) predict elevated malpractice risk. An *ex ante* analysis of UPC was performed to determine the risk profile for trauma surgeons.

Methods: UPC from 14 health systems over 4 years were retrospectively studied. Surgeons were divided into non-trauma (NTS) and trauma (TS). Inclusive criteria for TS were practice at a level 1 trauma center and surgical critical care certification or AAST, EAST, or WTA membership. Standardized risk scores were generated using a weighted sum algorithm from UPC data. Mann-Whitney U test, chi-square for linear trend, and relative risk analysis was performed.

Results: 16,518 UPC were filed against 4,244 surgeons, including 55 TS. 18% of TS and 57% of NTS had 0 UPC. Mean risk score was higher for TS (29.2 ± 29.0 vs. 10.2 ± 19.5, $p < 0.001$). More TS (20.0% vs. 3.15%) were at moderate (score 50-69) or at high risk (score > 70) (7.27% vs. 2.57%; $p< 0.001$). TS have a relative risk of 6.17 (95% CI 3.36 to 11.33) for score > 50.

Conclusions: TS are at increased risk of UPC, but this risk is largely borne by a minority. Targeted intervention for the highest risk 7% of TS may reduce malpractice claims, benefiting all TS.



Session 1

Paper 4 8:50 AM

ALLOGENEIC RED BLOOD CELLS SUPPRESS T CELL PROLIFERATION WITHOUT CELL CONTACT-HUMAN, ANIMAL AND MECHANISTIC EVIDENCE

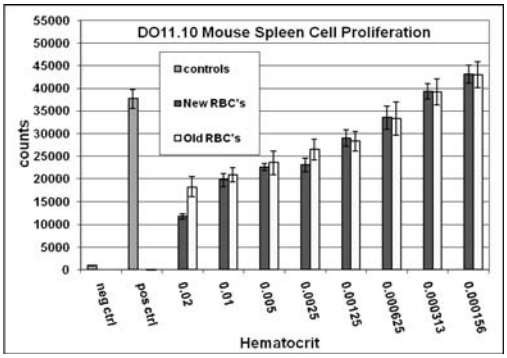
Andrew Bernard, MD*, Marty Ward, MS, Cindy Meier, MS, Levi Procter, MD, Jerry Woodward, PhD. University of Kentucky.

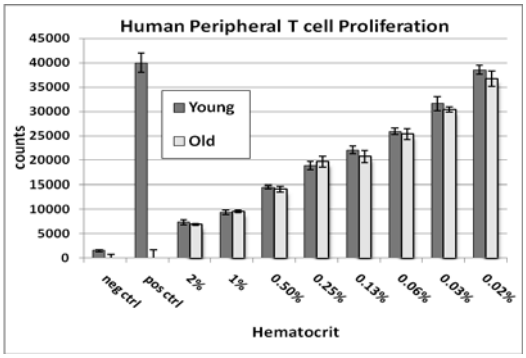
Invited Discussant: Krishan Raghavendran

Introduction: Transfusion related immune suppression remains a clinical problem despite universal leukoreduction. One mechanism may be red blood cell (RBC) effects. RBCs suppress T cell proliferation in an immortal cell line but the mechanism and relevance to normal T cells are unclear. It is hypothesized that low dose RBC exposure suppresses T cell proliferation, that the effect crosses species and is due to soluble factors.

Methods: Fresh human T cells were stimulated (anti-CD3/anti-CD28) and murine transgenic DO11.10 (ovalbumin-specific) splenic T cells were stimulated (ovalbumin) in the presence of allogeneic human RBC [0-7 (new) or 35-42 (old) days, .015-2% hematocrit). In select cultures, T cells and RBC were separated by a porous barrier (trans-well plates). Proliferation was measured by thymidine incorporation analyzed by ANOVA.

Results: Stimulated human T cell proliferation was significantly suppressed by even low-dose RBC exposure ($p<0.001$, Fig 1). RBC age did not affect results. Proliferation of DO11.10 mice T cells were similarly suppressed ($p<0.001$, Fig 2). Trans-well experiments did not abrogate the suppressive effects, indicating that soluble factors are responsible.





Conclusions: These data provide conclusive evidence that RBCs contribute to TRIM by suppressing proliferation of normal T cells. The effect crosses species, making the DO11.10 mouse a powerful animal model of TRIM. RBC:T cell contact is not required for T cell suppression indicating that soluble factors are responsible.

Session 1

Paper 5 9:10 AM

REAL TIME POLYMERASE CHAIN REACTION TEST FOR THE RAPID DIAGNOSTIC TOOL FOR SEPSIS

Asako Matsushima, MD, Osamu Tasaki, MD, Takeshi Shimazu*, MD, Seiji Asari, BS, Katsunori Yanagihara, MD, Yuko Kitagawa, MD, Hisashi Sugimoto*, MD, Yoshinobu Sumiyama, MD, Masaki Kitajima, MD. Department of Trauma, Critical Care Medicine and Burn Center, Social Insurance Chukyo Hospital.

Invited Discussant: Michael West

Introduction: Early diagnosis and proper use of antibiotics is essential to treat sepsis. Blood culture (BC) is the standard technique to detect bacteria in blood, however slow-growing and fastidious bacteria or prior administration of antibiotics can cause delay and false negative of BC results. In this study, we examined a real-time polymerase chain reaction (PCR) method for rapid detection of bacteria in the blood of septic patients.

Method: Prospective observation study was performed in our medical and surgical intensive care unit of emergency department. Patients who diagnosed or suspected sepsis were included. Whole blood sample for PCR test was taken at the same time with BC sample and the results were compared. SeptiFast test was used for whole blood PCR tests. The definition of the society of critical care medicine was referred to diagnose sepsis and severe sepsis in each sample.

Results: Eighty nine samples from 26 patients were taken; 45 samples were taken from sepsis, 20 samples were from severe sepsis and 24 samples were from non-sepsis. The origins of sepsis were pneumonia in 8 patients, necrotizing fascitis in 5 patients and others in 14 patients. The frequency of PCR pathogen detection was 14/45 in sepsis (7/45 for BC) 6/20 in severe sepsis (3/20 for BC) and 0/24 for both PCR and BC in non-sepsis. The frequency of PCR detected contaminated bacteria was 1/89 (2/89 for BC). Thirteen samples of sepsis and severe sepsis were positive only for PCR, which were all taken after empirical antibiotics administration.

Conclusion: In sepsis, PCR detected more bacteria that were not found by BC. PCR test can provide bacterial information more rapidly than BC test which contributes to early and precise diagnose of sepsis even after the empirical antibiotics administration.

Session 1

Paper 6 9:30 AM

EFFERENT VAGAL NERVE SIGNALING IMPROVES INTESTINAL BARRIER INTEGRITY FOLLOWING SEVERE BURN

Todd W Costantini, MD, Vishal Bansal, MD, Carrie Y Peterson, MD, William H Loomis, BS, James G Putnam, BS, Brian P Eliceiri, PhD, Andrew Baird, PhD, Raul Coimbra*, MD, PhD.
University of California, San Diego School of Medicine.

Invited Discussant: Steve Wolf

Introduction: Severe injury can cause intestinal permeability through decreased expression of tight junction proteins, resulting in systemic inflammation. Activation of the parasympathetic nervous system following shock through vagal nerve stimulation is known to have potent anti-inflammatory effects; however, its effects on modulating intestinal barrier function are not fully understood. We postulated that vagal nerve stimulation would improve intestinal barrier integrity following severe burn through an efferent signaling pathway, and would be associated with improved expression and localization of the intestinal tight junction protein occludin.

Methods: Male balb/c mice underwent right cervical vagal nerve stimulation for 10 minutes immediately prior to 30% total body surface area, full-thickness steam burn. Animals also underwent abdominal vagotomy at the gastro-esophageal junction prior to vagal nerve stimulation and burn. Intestinal barrier injury was assessed by permeability to 4 kilodalton FITC-Dextran, histology, and changes in occludin expression using immunoblotting and confocal microscopy.

Results: Cervical vagal nerve stimulation decreased burn-induced intestinal permeability to FITC-Dextran (195 ± 12μg/ml vs. 61 ± 19μg/ml, $p<0.02$), returning intestinal permeability to sham levels (42 ± 19μg/ml). Vagal nerve stimulation prior to burn also improved gut histology and prevented burn-induced changes in occludin protein expression and localization. Abdominal vagotomy abrogated the protective effects of cervical vagal nerve stimulation prior to burn, resulting in gut permeability (177 ± 16μg/ml, $p<0.05$ vs. Vagal stim + burn), histology, and occludin protein expression similar to burn alone.

Conclusion: Vagal nerve stimulation improves intestinal barrier integrity following severe burn through an efferent signaling pathway, and is associated with improved tight junction protein expression.

Session 1

Paper 7 9:50 AM

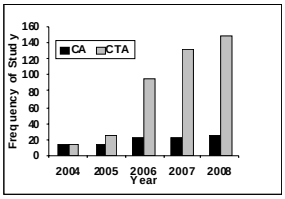
COMPUTED TOMOGRAPHIC ANGIOGRAPHY: FALSE POSITIVES IN THE DIAGNOSIS OF BLUNT CERVICAL VASCULAR INJURIES

Samir M Fakhry, MD*, Tayseer A Aldaghlas, MD , Linda Robinson, RN, MA, MS , Hani Seoudi, MD*, Anne Rizzo, MD*. Inova Regional Trauma Center.

Invited Discussant: Walter Biffl

Introduction: Complications of undetected blunt cervical vascular injuries (BCVI) can lead to serious neurological sequela. This study's objective is to assess false positive rates of 16/64 slice multidetector CTA when compared to the gold standard conventional angiography (CA) in the evaluation of BCVI.

Methods: Retrospective review of all neck CTAs and CAs performed at an ACS COT level 1 trauma center during 2004-08 was performed. Blunt trauma patients with trauma team activation and consults that underwent a CTA and/or CA were selected from the radiology and trauma databases. Patient demographics were obtained from the trauma registry and chart reviews.



Results: There were 11476 blunt trauma patients during the study period. CTA was the predominant screening test for BCVI and its usage increased ten-fold during the study period (fig 1). 448 patients were evaluated for BCVI of whom 415 patients had CTA (19% positive BCVI) and 95 had CA done (48% positive BCVI). Patients with positive neck CTA who were eligible for anticoagulation underwent CA. There were 62 patients who had both tests done with a false positive result of 35% (table 1). The majority (60%) of BCVI were to the vertebral arteries.

Table 1	CA pos	CA neg	Total
CTA pos	31 (65%)	17 (35%)	48
CTA neg	3 (21%)	11 (79%)	14
Total	34	28	62

Conclusion: CTA use for the diagnosis of BCVI has increased significantly Its diagnosic accuracy remains imperfect given the high false positive rate with up to a third of patients subjected to potentially unnecessary anticoagulation and its associated complications. Further investigation of large patient cohorts is needed to validate the use of CTA as a screening tool for BCVI.

Session 1

Paper 8 10:10 AM

1H-NMR BASED METABOLIC SIGNATURES IN TRAUMA PATIENTS: METABOLIC PROFILING BEYOND LACTATE AND BASE DEFICIT.

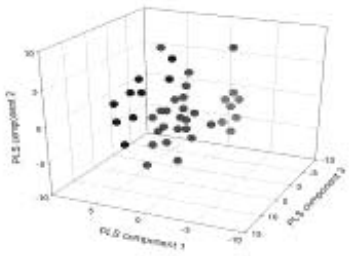
Mitchell Jay Cohen, MD*, Natalie J Serkova, PhD, Jeanine Wiener-Kronish, MD, Jean Francois Pittet, MD, Claus U Niemann, MD. University of California San Francisco.

Invited Discussant: Greg Beilman

Background: Despite advances in resuscitation endpoints and monitoring, the degree of metabolic derangement cannot often be adequately measured resulting in occult hypoperfusion and inadequate understanding of cellular and sub-cellular dysfunction during shock. We therefore hypothesized that advanced NMR metabolomic techniques on blood from injured patients would provide metabolic profiles, superior measurement and better estimates of metabolic dysfunction and unmeasured hypoperfusion after trauma.

Methods: We sampled blood from 32 severely injured trauma patients within 30 minutes of arrival to the emergency department. Blood metabolic profiles were evaluated for metabolic profiles using ^{1}H-NMR spectroscopy,

Results: A total of 43 endogenous metabolites were quantified from each ^{1}H-NMR spectrum of extracted blood. While there was a trend for higher lactate and base excess levels in non-survivors, both markers failed to achieve statistical significance (p=0.11 and p=0.12, respectively). Advanced, quantitative metabolomic analysis was able to detect: higher levels of circulating aromatic amino acids(p=0.02), MUFA (p=0.05) and TAG (p=0.02) in survivors. In contrast, glutamate (p=0.007), tyrosine (p=0.02), glucose (p=0.004) were lower in survivors. The results obtained using PLS-LDA show a clear separation between healthy controls (green), survivors (red) and non-survivors (blue) on the basis of the entire set of metabolic variables (Figure).



Conclusion: Severely injured patients display distinct metabolic profiles after trauma and shock. Through detection, analysis and evaluation of significant perturbations in Krebs cycle, lipid and carbohydrate metabolism, ^{1}H-NMR metabolomics may help to better identify the metabolic perturbations of injury and identify trauma victims at risk for persistent hypoperfusion.

Session 1

Paper 9 10:30 AM

STANDARD PROPHYLACTIC ENOXAPARIN DOSING LEADS TO INADEQUATE ANTI-XA LEVELS AND INCREASED DVT RATES IN CRITICALLY ILL TRAUMA AND SURGICAL PATIENTS

Darren J Malinoski, MD, Anne Herbst, MD, Fariba Jafari, Chris Ardary, Heather Conniff, Mark Baje, PharmD, Allen Kong, MD, Cristobol Barrios, MD, Marianne Cinat*, MD, Matthew Dolich, MD, MIchael Lekawa*, MD, David B Hoyt*, MD. University of California, Irvine.

Invited Discussant: David Livingston

Background: Deep venous thromboses (DVT) and pulmonary emboli (PE) continue to cause significant morbidity and mortality. Standard prophylaxis for high risk patients includes sequential compression devices and twice-daily dosing with 30 mg enoxaparin. DVT rates still exceed 10-15% in critically ill patients despite these measures. Anti-Xa levels are used to measure the activity of enoxaparin and 12-hour trough levels ? 0.1 IU/mL have been associated with higher rates of DVT in orthopedic patients. We hypothesized that low Anti-Xa levels would be found in critically ill trauma and surgical patients and that low levels would be associated with higher rates of DVT.

Methods: All patients on the surgical ICU service were prospectively followed. In the absence of contraindications, patients were given prophylactic enoxaparin and anti-Xa levels were drawn after the third dose. Trough levels ? 0.1 IU/mL were considered low. Screening duplex exams were obtained within 72 hours of admission and then weekly. CT-angiography for PE was obtained if clinically indicated. Patients were excluded if they did not receive a duplex, if a DVT occurred prior to initiating enoxaparin, or if they lacked correctly timed anti-Xa levels. DVT rates and demographic data were compared between patients with low and normal anti-Xa levels using the Fischer's exact and student's t-test.

Results: Data were complete for 38 patients with a mean age of 43 ± 22 years and 16 ± 10 ICU days. 84% suffered trauma (ISS of 27 ± 12), 74% were male and 3% died. Overall, 18 (47%) patients had low anti-Xa levels. Patients with low anti-Xa levels had significantly more DVTs than those with normal levels (44% vs. 10%, p=0.03), despite similar age, BMI, ISS, creatinine clearance, high risk injury patterns (fractures, head, spine), and ICU/ventilator days. No PEs were documented in the study population.

Conclusion: Standard dosing of enoxaparin leads to inadequate anti-Xa levels in nearly half of surgical ICU patients. Low levels are associated with a significant increase in the risk of DVT. These data support future studies using adjusted-dose enoxaparin.

Session 1

Paper 10 10:50 AM

THE EFFECT OF PREINJURY STATIN USE ON MORTALITY AND SEPSIS IN ELDERLY BURN PATIENTS

Mary D. Fogerty, MD, Naji Abumrad, MD, David Efron*, MD, Jeffrey Guy, MD, Adrian Barbul, MD. Vanderbilt University School of Medicine, Department of Surgery.

Invited Discussant: Basil Pruitt, Jr

Objective: Premorbid statin use has been associated with decreased mortality in both septic and trauma patients. This phenomenon has been ascribed to the pleiotropic, anti-inflammatory effects of HMG-CoA reductase inhibitors. This association has not been investigated in patients with burns, a potent inflammatory injury with a high rate of sepsis.

Methods: A retrospective review of 223 consecutive patients aged ? 55 who were admitted to the Vanderbilt University Burn Service from January 1, 2006 to December 31, 2008 was performed. Multivariate regression analysis was used to determine odds ratios of in-hospital death and sepsis of statin- and non-statin users adjusting for the effect of cardiovascular comorbidities by statin use. Covariates included: history of myocardial infarction, cerebrovascular or peripheral vascular disease, arrhythmia, hypertension, chronic obstructive pulmonary disease, and diabetes mellitus. Sepsis was defined as infection plus temperature ? 38.3 ºC and SBP<90 mmHg.

Results: Of 223 patients, 70 (31.4%) were identified as taking statin medications prior to admission. Mean age [(67.2; 95%CI 65.3-69.2) vs. (67.6; 95%CI 66.1-69.2)] and mean total body surface area burn [(13.6%; 95%CI 8.2-19 %) vs. (13.6%; 95%CI 10.4-16.9%)] were not different between statin- and non-statin users. The odds ratio of in-hospital death was 0.17 [95%CI 0.05-0.6; *P*=.004] for statin users. Stratification by cardiovascular comorbidities did not change the odds ratio of in-hospital mortality. Sepsis developed in 30 patients (13.5%). The odds ratio of sepsis in statin users compared to non-statin users was 0.50 [95%CI 0.2-1.3; *P*=.155].

Conclusion: Pre-injury statin use was associated with an 83% reduction in the odds of death following significant thermal injury. Though the risk of sepsis was decreased by 50%, this did not achieve statistical significance. A prospective study is warranted to investigate the potential benefits of statin therapy in the management of victims of thermal and traumatic injury.

Session 3A

Paper 11 1:30 PM

IMPACT OF PLATELET TRANSFUSION RATIO IN MASSIVELY TRANSFUSED TRAUMA PATIENTS

Kenji Inaba*, MD, Thomas Lustenberger, MD, Peter Rhee*, MD, MPH, Ira Shulman, MD, Janice Nelson, MD, Peep Talving, MD, PhD, Pedro G Teixeira, MD, Demetrios Demetriades*, MD, PhD. LAC+USC.

Invited Discussant: Addison May

Introduction: Aggressive plasma replacement has been demonstrated to improve survival in patients requiring a massive transfusion. However, the optimal ratio of platelets to red blood cells (PLT:RBC) is unknown. The purpose of this study was to analyze the impact of increasing PLT:RBC ratios on survival.

Methods: All trauma patients admitted to a Level I trauma center over a 6-year period ending 12/2005 and requiring a massive transfusion (? 10 RBC in the first 24 hours) were included in a retrospective analysis. During the study period, Apheresis platelets containing ? $3x10^{11}$ platelets per unit were used exclusively. Patients were stratified into 4 groups according to PLT:RBC ratio: Low (<1:20), Medium (?1:20 and <1:15), High (?1:15 and <1:10) and Highest (?1:10).

Results: Of 25,599 trauma patients admitted during the study period, 479 (1.9%) required a massive transfusion. Average age: 34.5 ± 16.4 years, 83.3% male, mean ISS: 29.0 ± 14.9, 57.6% penetrating. The overall mortality was 48.6%. Each group was compared with survival as the primary outcome measure correcting for FFP volume during the first 24 hours, ISS, hypotension (<90mm Hg) and GCS ?8 on admission. Using the Highest ratio group as a reference, the mortality rate increased significantly in a stepwise fashion with decreasing PLT:RBC ratio.

PLT:RBC ratio	Mortality	Adjusted Odds Ratio (95% CI)	Adjusted *p*-value
Highest (≥1:10)	34.30%	1.0	-
High (≥1:15 and <1:10)	47.10%	2.2 (1.2 - 4.1)	0.015
Medium (≥1:20 and <1:15)	68.20%	8.0 (2.4 - 26.2)	0.001
Low (<1:20)	81.30%	10.4 (5.2 - 20.6)	<0.001

Conclusions: For trauma patients requiring a massive transfusion, an increasing platelet to red blood cell ratio improved survival. The optimal ratio of platelets to red blood cells requires further prospective validation.

Session 3A

Paper 12 1:50 PM

INHIBITION OF INTRALUMINAL PANCREATIC ENZYMES WITH NAFAMOSTAT MESILATE IMPROVES CLINICAL OUTCOMES AFTER HEMORRHAGIC SHOCK IN SWINE

Hubert D Kim, MD, Darren J Malinoski, MD, Boris Borazjani, MD, Madhukar S Patel, ScM, Joseph Chen, MD, Johnathan Slone, MD, Earl Steward, David B Hoyt*, MD. University of California, Irvine.

Invited Discussant: Robert Cooney

Introduction: Recent studies suggest that intraluminal pancreatic enzymes play a major role in the initiation of the inflammatory cascade by the gut after hemorrhagic shock. Previous animal models have shown that inhibition of enteral pancreatic enzymes with a serine protease inhibitor, nafamostat mesilate (NM), decreases leukocyte activation and transfusion requirements after hemorrhagic shock, but studies involving clinically relevant outcomes in survival models are lacking. We **hypothesized** that enteroclysis with NM will improve clinical outcomes in swine after hemorrhagic shock and intestinal hypoperfusion.

Methods: 33 male Yucutan minipigs weighing 25-30 kg underwent jugular venous and femoral arterial line insertion, laparotomy, and duodenostomy tube placement. After a controlled hemorrhage of 25 mL/kg over 15 min. and clamping the base of the mesentery for 60 min., animals were allocated to three groups: (1) Shock only (n=15), (2) Shock + enteroclysis with 100 ml/kg GoLYTELY as a carrier (GL, n=11), and (3) Shock + enteroclysis with GL + 0.37 mmol/L nafamostat mesilate (GL+NM, n=7). Shed blood and LR were used to maintain a MAP of 35-40 mm Hg for four hours. Serial lactate measurements were made. Animals were then recovered from anesthesia, observed for three days, and graded on a daily 4-point clinical scoring system. A score of 0 indicated a moribund state or early death and a score of 4 indicated normal behavior.

Results: Weight and lactate clearance were similar between groups. Pigs treated with GL+NM had significantly higher mean postoperative recovery scores (3.8 +/- 0.4, essentially normal behavior with no early deaths) compared to animals within the Shock only and Shock + GL groups (2.1 +/- 1 with 1 early death and 2.2 +/- 1.2 with 2 early deaths, respectively, ANOVA $p<0.003$).

Conclusion: Inhibition of intraluminal pancreatic enzymes using enteroclysis with the serine protease inhibitor nafamostat mesilate after hemorrhagic shock and lactic acidosis significantly improves clinical outcome. Human trials should be considered.

Session 3A

Paper 13 2:10 PM

INTESTINAL MUCUS LAYER PRESERVATION IN FEMALE RATS ATTENUATES GUT INJURY FOLLOWING TRAUMA HEMORRHAGIC SHOCK.

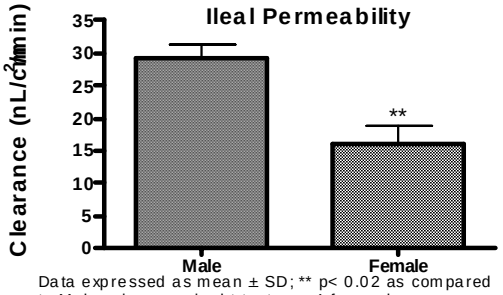
Sharvil U Sheth, MD, Qi Lu, MD, Susan M Sharpe, MD, Xiaofa Qin, MD, PhD, Marlon A Lee, MD, Diego C Reino, MD, Da-Zhong Xu, MD, PhD, Edwin A Deitch*, MD. University of Medicine and Dentistry of New Jersey, New Jersey Medical School.

Invited Discussant: Ernest E Moore

Objective: We tested the hypothesis that proestrous females are more resistant to trauma/hemorrhagic shock (T/HS) induced gut injury than males due to better preservation of the mucus barrier layer.

Methods: Male and proestrous female SD rats underwent a laparotomy (trauma) and 90 min of shock (35mmHg). At 3 hr post reperfusion, terminal ileum was harvested and stained with Carnoy's Alcian Blue for mucus. Counter staining with H/E and Periodic Acid Schiff was done for villus and goblet cell morphology. Villus injury was graded as described by Chiu et al. Terminal ileal permeability was also measured using ex-vivo everted gut sac technique with FD4 in a separate set of animals.

Results: As shown below female rats were more resistant to T/HS induced morphologic gut injury (table) and intestinal permeability (figure) than male rats. The resistance to gut injury was associated with significant preservation of the mucus layer coverage. There was a direct correlation between the loss of mucus layer and the incidence (r^2=0.63; p<0.02) and magnitude (r^2=0.96; p<0.0001) of villus injury.



Data expressed as mean ± SD; ** p< 0.02 as compared to Male using unpaired t test, n = 4 for each group

Conclusion: Proestrous female rats are more resistant to T/HS induced disruption of intestinal mucus layer than male rats, which may protect against shock-induced gut injury and subsequently distant organ injury by limiting the ability of luminal contents such as bacteria and digestive enzymes from coming into direct contact with the epithelium.

Groups	% of villi injured	Grade of injury	% ileal mucus coverage	Goblet cells/villus
Male	22 + 5	2.8 + 0.4	62 + 3	43 + 5
Female	14 ± 3	1 ± 0.1**	86 ± 3***	46 ± 2

Data expressed by mean + SD; ** p<0.001 vs. Male; *** p< 0.0001 vs. Male using unpaired t test

Session 3A

Paper 14 2:30 PM

POINT OF CARE (POC) RAPID THROMBELASTOGRAPHY IMPROVES MANAGEMENT OF LIFE THREATENING POSTINJURY COAGULOPATHY

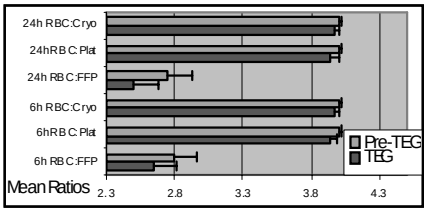
Jeffry L Kashuk, MD*, Ernest E Moore, MD*, Max Wohlauer, MD, Jeffrey LJohnson, MD*, Michael Pezold, BA, Jerry Lawrence, BA, Walter L Biffl, MD*, C Clay Cothren, MD*, Carlton Barnett, MD, Michael Sawyer, MD, Angela Sauaia, MD, PhD. Denver Health Medical Center and University of Colorado Health Sciences Center.

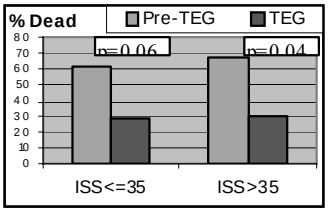
Invited Discussant: John Holcomb

Background: Designing an optimal massive transfusion protocol is currently hindered by a lack of real time assessment of coagulation function. Rapid thrombelastography (r-TEG) provides comprehensive point of care (POC) analysis of clot formation. We **hypothesized** that goal directed therapy via r-TEG would improve early management of coagulopathy and thereby reduce hemorrhage related mortality.

Methods: r-TEG was performed by adding tissue factor to uncitrated whole blood. 34 consecutive patients at risk for postinjury coagulopathy(?6 u RBC /6 hours) admitted to our level 1 trauma center after r-TEG implementation (TEG) were compared to 34 consecutive patients admitted prior to TEG implementation (Pre-TEG). Data are presented as mean±SEM.

Results: ED Pre-TEG vs.TEG shock and coagulation indices were not different: SBP (94mm Hg vs.101 mm Hg), temp (35.3° vs. 35.9°), pH (7.16 vs.7.11), base deficit (-13.0 vs. -14.7), lactate (6.5 vs.8.1) INR (1.59 vs. 1.83). r-TEG, however, appeared to be associated with more effective resuscitation based upon changes (from ED to 6 hr) in lactate (median improvement: Pre-TEG 2% vs. TEG: 44%, p=0.07). RBC:FFP, RBC: platelets, RBC: cryoprecipitate ratios consistently reflected less transfusion in TEG vs. Pre-TEG, albeit not significantly (fig). Of note, INR at 6hrs did not discriminate between survivors and non-survivors (p=0.10), while r-TEG "G" value was significantly associated with survival (p=0.03). Mortality fell from 65% to 29% (p=0.004) after r-TEG algorithm implementation, most striking in patients with ISS>35. (fig).





Conclusion: Our results suggest that goal directed resuscitation guided by POC r-TEG results in more efficient management of postinjury coagulopathy and improved survival.

Session 3A

Paper 15 2:50 PM

JUST ONE DROP: THE SIGNIFICANCE OF A SINGLE HYPOTENSIVE BLOOD PRESSURE READING DURING TRAUMA RESUSCITATIONS

Mark J Seamon, MD, Christina Feather, BS, John P Gaughan, PhD, Heather Kulp, MPH, Paola G Pieri, MD, Kevin M Bradley, MD, Thomas A Santora,* MD, Abhijit S Pathak, MD, Amy J Goldberg,* MD. Temple University School of Medicine.

Invited Discussant: Tammy Kopelman

Introduction: Single, isolated hypotensive blood pressure (BP) measurements are often ignored or considered "erroneous." While their clinical significance remains unknown, we hypothesized that single, isolated hypotensive BP readings during trauma resuscitations signify the presence of life threatening injuries that warrant immediate operation.

Methods: A prospective observational study was performed on all trauma patients admitted during June 2008 to January 2009 at an urban, level-I trauma center. Patients with a single SBP reading <110mmHg during their initial trauma resuscitation (arrival until imaging completion) were evaluated and demographics, hemodynamics, resuscitation (fluids, blood products, duration), operative or endovascular management, and injuries were analyzed. Single and multiple variable logistic regression analyses were performed. Lowest SBP was analyzed with respect to need for immediate operation and a cutpoint analysis performed on all lowest SBPs. A p-value ≤0.05 was considered significant.

Results: Study patients (n=145) were predominantly male (77.2%) but age (mean, 35.1±15.3 years) and injury mechanisms varied (penetrating, 46.2%; blunt, 53.8%). Cutpoint analysis determined a single SBP reading <90 mmHg best predicted the need for urgent operation. These patients were more than six times as likely to undergo immediate operation (RR, 6.6; CI, 2.2-20.0; p<0.001) than those with a single SBP ≥90 mmHg.

	SBP <90 mmHg (n=49)	SBP ≥90 mmHg (n=96)	*p*
Prehospital IVF (mL)	128.1±227.8	92.9±241.2	0.405
Penetrating injury	34 (69.4%)	33 (34.4%)	<0.001
ISS	12.4±9.3	9.8±10.4	0.158
Admission HR	101.2±23.9	98.0±22.7	0.435
ED blood transfusion	8 (16.3%)	4 (4.2%)	0.022
ED IVF (mL)	1645.8±1041.9	1167.1±864.8	0.004
ED time (minutes)	58.0±32.3	51.5±24.6	0.180
Immediate OR	22 (44.9%)	24 (25.0%)	0.023
Immediate IR	4 (8.2%)	1 (1.0%)	0.045

Conclusions: Single, isolated hypotensive BP measurements during trauma resuscitations should not be ignored or considered erroneous. Instead, our results suggest that a single SBP reading of <90 mmHg indicates the presence of critical injuries that often require immediate operative or endovascular treatment.

Session 3A

Paper 16 3:10 PM

INDUCTION OF PROTECTIVE HYPOTHERMIA PRESERVES THE ORGANS BY DOWN REGULATING METABOLIC GENES

Sahar Hashmi, MD, Yongqing Li, MD, PhD, Baoling Liu, MD, Fahad Shuja, MD, Muhammad U Butt, MD, Eugene Fukudome, MD, Robert A Finkelstein, MD, George C Velmahos, MD*, and Hasan B Alam, MD*. Massachusetts General Hospital/Harvard Medical School.

Invited Discussant: Kenji Inaba

Introduction: Induction of profound hypothermia for total body preservation can improve survival after lethal blood loss. Although hypothermia decreases cellular metabolic demands, it remains unknown whether it directly modulates the metabolic pathways. This study was done to measure the effect of hypothermia on metabolic pathways at the level of gene transcription.

Methods: Male Wister-Kyoto rats were subjected to hemorrhage (40% blood volume) over 10 minutes, and assigned to two groups (n=7/group). 1) Profound hypothermic shock: core temperature 15°C (HS), and 2) normothermic shock: core temperature 36-37°C (NS). Cardiopulmonary bypass (CPB) was used to reach the target temperature over 40 minutes, and to maintain a low flow state for 60 minutes. Animals were then resuscitated, re-warmed, and monitored for 3 hours. Sham rats served as controls. Blood samples were collected serially and hepatic tissues were harvested after 3 hours. Affymatrix Rat Gene 1.0 ST Array (27,342 genes, >700,000 probes) were used to determine gene expression (n=3/group), which were further analyzed using GeneSpring (Agilent Technologies) and GenePattern (Broad Institute) programs. Data were further queried using network analysis tools including Gene Ontology, and Ingenuity Pathway Analysis (Ingenuity Systems). Key findings were verified using RT-PCR and Western blots.

Results: Survival rates were 0% in NS animals and 100% in HS animals ($p<0.05$). Microarray analysis showed that genes controlling multiple metabolic pathways were down-regulated. The largest change was in peroxisome proliferator-activated receptor gamma gene that codes for transcriptional coactivator, which in turn controls mitochrondrial biogenesis, gyycerolipd and other metabolic pathways in the liver.

Conclusion: Induction of profound hypothermia significantly improves survival in a rodent model of hemorrhagic shock. In addition to decreasing tissue oxygen consumption, hypothermia directly down regulates metabolic pathways at the level of gene transcription.

Session 3A

Paper 17 3:30 PM

ADMISSION IONIZED CALCIUM LEVELS PREDICT THE NEED FOR MULTIPLE TRANSFUSIONS: A PROSPECTIVE STUDY OF 591 CRITICALLY-ILL TRAUMA PATIENTS

Louis J Magnotti*, MD, Eric H Bradburn, DO, David L Webb, MD, Stepheny D Berry, MD, Peter E Fischer, MD, Ben L Zarzaur*, MD, Thomas J Schroeppel, MD, Timothy C Fabian*, MD, Martin A Croce*, MD. University of Tennessee Health Science Center.

Invited Discussant: Martin Schreiber

Introduction: Deaths from uncontrolled exsanguinating hemorrhage occur rapidly post-injury. Any successful resuscitation strategy must also occur early, underscoring the importance of rapid identification of patients at risk for multiple transfusions. Previous studies have shown low ionized calcium (iCa) levels to be associated with hypotension and function as a predictor of mortality. We hypothesized that admission iCa levels could potentially predict the need for multiple transfusions in critically-ill trauma patients.
Methods: Admission iCa was collected prospectively on all trauma activations over a 9-month period. Youden's index was used to determine the appropriate cut-point for iCa. Outcomes (mortality, multiple transfusions [≥5 units PRBCs in 24 hours] and massive transfusion [≥10 units PRBCs in 24 hours]) were compared using Wilcoxon rank-sum and chi-square tests where appropriate. Multivariable logistic regression (MLR) was performed to determine whether iCa was an independent predictor of multiple transfusions.
Results: 591 patients were identified: 461 (78%) men and 130 (22%) women. Cut-point was identified as 1.00. iCa was <1.00 (lo-Cal) in 332 patients and ≥1.00 (hi-Cal) in 259 patients. Mortality was significantly increased in the lo-Cal group (15.5% vs. 8.7%, p = .036). In addition, both multiple transfusions (17.1% vs. 7.1%, p = .005) as well as massive transfusion (8.2% vs. 2.2%, p = .017) were significantly increased in the lo-Cal group. MLR analysis identified iCa <1.00 as an independent predictor of the need for multiple transfusions after adjusting for age and injury severity (OR=2.294, 95%CI=1.053-4.996).
Conclusions: Low iCa levels at admission were associated with increased mortality as well as an increased need for both multiple and massive transfusion. Multivariable logistic regression analysis identified low iCa levels as an independent predictor of multiple transfusions. Admission iCa levels may facilitate the rapid identification of patients requiring massive transfusion, allowing for earlier preparation and administration of appropriate blood products.

Session 3A

Paper 18 3:50 PM

DAMAGE CONTROL RESUSCITATION IN COMBINATION WITH DAMAGE CONTROL LAPAROTOMY: A SURVIVAL ADVANTAGE AND NOT A SELECTION BIAS

Juan C Duchesne MD,, Ryan Jacobs MD,, John P Hunt, MD MPH*, Alan B Marr MD,, Georgia Wahl MD, NREMT-P,, James M Barbeau MD,, Christopher C Baker MD*,, Norman E McSwain, Jr,MD*. Tulane University School of Medicine.

Invited Discussant: Frederick Moore

Objective: Damage control laparotomy (DCL) improves outcomes when used in patients with severe hemorrhage. Correction of coagulopathy, with close ratio resuscitation while limiting crystalloid, forms a new methodology known as damage control resuscitation (DCR). We hypothesize a survival advantage in DCL patients managed with DCR when compared to DCL patients managed with conventional resuscitation efforts (CRE).

Methods: This study is a 4 year retrospective review of trauma patients requiring greater than 10 units of packed red blood cells (PRBC) during DCL surgery. A 2 year period after institution of DCR was compared to the preceding 2 year. Univariate analysis of continuous data was done with Students t-test followed by multiple logistic regression.

Results: One-hundred twenty-four and seventy-two patients were managed during the DCL&CRE and DCL&DCR time periods respectively. Baseline patient characteristics of age, ISS, % penetrating, BP, hemoglobin, base deficit, and INR were similar between groups. DCL&DCR conveyed a survival benefit (OR; 95% CI: 0.19 (0.05-0.33), p=0.005).

Outcomes	DCL & CRE (n=124)	DCL & DCR (n=72)	*p* value
Intra-operative Crystalloids	14.2	4.7	0.009
Intra-operative PRBC	21.7	25.5	0.53
Intra-operative FFP	6.4	18.2	0.002
Intra-operative PLT	6.1	13.8	0.01
Intra-operative FFP:PRBC Ratio's	1:4.2	1:1.2	0.002
Intra-operative PLT:PRBC Ratio's	1:5.9	1:2.3	0.002
Mean TICU LOS	20	11	0.01
30-day Survival	55%	73.7%	0.009

Conclusion: This is the first civilian study that analyses the survival advantage of Damage Control Resuscitation in patients managed with Damage Control Laparotomy. During the DCL & DCR study period more PRBC, FFP and Platelets with less crystalloid solution was used intra-operatively. DCL & DCR was associated with a survival advantage and shorter TICU LOS in patients with severe hemorrhage when compared to DCL & CRE.

Session 3A

Paper 19 4:10 PM

ASSOCIATION OF 6% HETASTARCH RESUSCITATION WITH ADVERSE OUTCOMES IN CRITICALLY ILL TRAUMA PATIENTS

Matthew Lissauer, MD, Albert Chi, MD, Betsy Kramer, RN, Steven Johnson*, MD, Thomas Scalea*, MD. R Adams Cowley Shock Trauma Center, University of Maryland Medical Center.

Invited Discussant: Lewis Kaplan

Introduction: 6% Hetastarch (6% HS) is often used as a volume expander in traumatic hypovolemia. Studies have shown an increase in renal failure and mortality with hetastarch use in septic patients. This study evaluated trauma patients resuscitated with 6% HS and subsequent organ dysfunction and mortality.

Hypothesis: The use of 6% HS increases mortality and renal failure in trauma patients compared to other resuscitation fluids.

Methods: A retrospective review was performed of all primary trauma patients over age 18 admitted to an ICU for > 24 hours from July 1, 2003 through June 30, 2008. Patient's demographics, injury severity, injury mechanism, initial labs, and outcomes were recorded. Patients were divided into 2 groups: 1) HESP: patients who received 6% HS during their first 24 hours of admission and 2) NON-HESP: patients did not receive 6% HS in the first 24 hours. Students T-test was used for continuous variables, Fischer exact for categorical. A multivariate logistic regression model was used for all significant variables.

Results: 2953 patients were identified of which 503 (17%) received 6% HS in the 1st 24 hours. Mean age was 45 ± 20 yrs. There were 2260 males (76.5%). There were no differences between groups in age, gender, or mechanism (blunt vs. penetrating). Initial lactate, hematocrit and creatinine were not statistically different between groups. ISS was different between groups: HESP 29.1±13.2 vs. NON-HESP 27.2 ± 12.9, ($p < 0.01$). Renal failure developed in 51 (10.1%) HESP patients versus 157 (6.4%) NON-HESP patients (RR 1.61, 95% CI 1.17-2.13, $p<0.01$). Mortality in the HESP group was 20.0% versus NON-HESP 12.3% (RR 1.63, 95% CI 1.33-2.00, $p<0.01$). Multivariate logistic regression model demonstrated ISS and 6% HS use as independent predictors of both renal failure (6% HS OR 1.6, 95% CI 1.1 - 2.2) and death (6% HS OR 1.8, 95% CI 1.4 -2.2)

Conclusions: Because of the detrimental association with renal failure and mortality, 6% Hetastarch should be avoided in the initial resuscitation of trauma patients.

Session 3A

Paper 20 4:30 PM

HEPCIDIN IN TRAUMA: LINKING INJURY, INFLAMMATION, AND ANEMIA

Kristen C Sihler MD, MS; Mark Westerman PhD; Wen Ye PhD; Lena M Napolitano* MD.
University of Michigan.

Invited Discussant: George Velmahos

Introduction: Hepcidin is liver-derived peptide that is a negative regulator of iron stores via its inhibition of intestinal iron absorption and iron recycling from senescent red cells. Hepcidin is also up-regulated by IL-6. Hepcidin has been shown to have an important role in the anemia of chronic inflammatory diseases, but has not been previously studied in acute inflammatory states. We sought to define the link between traumatic injury, hepcidin, and inflammation.

Methods: 129 sequential trauma patients admitted to the intensive care unit were prospectively enrolled in the study. Urine for hepcidin measurement was collected on admission and at regular time points thereafter. Serum was collected for cytokines and anemia measures, including soluble transferrin receptor levels. Information regarding demographics, nature and severity of injury, laboratory values, operations, complications, and transfusions were extracted from the medical record.

Results: The study population was 72.5% male. Mean age was 46 years (SD 20), with a median ISS of 27 (SD 14). The mean lactate level was 2.7 mmol/L (SD 1.7) and mean hemoglobin was 12.0 g/dL (SD 2.2). Urinary hepcidin levels were among the highest ever recorded and had a rightward skew. Log hepcidin values were positively correlated with ISS (correlation coefficient 0.34, $p<0.0001$). There was a trend towards a negative correlation with lactate (-0.21, $p=0.066$). In multivariate analysis only ISS remained significantly associated with urinary hepcidin. Every increase in ISS by 10 was associated with a 40% increase in hepcidin. IFN-γ levels were also found to be positively associated with hepcidin (0.57, $p=0.0025$). No other cytokines or anemia measures were significantly correlated with hepcidin levels.

Conclusion: Hepcidin levels rise to extremely high but variable levels after trauma and are positively correlated with injury severity and IFN-γ levels. Hepcidin is likely a key factor in the impaired erythropoiesis seen in critically injured trauma patients.

Session 3B

Paper 21 1:30 PM

DELAY IN DIAGNOSIS AND TREATMENT OF BLUNT INTESTINAL PERFORATION DOES NOT ADVERSELY AFFECT PROGNOSIS IN THE PEDIATRIC TRAUMA PATIENT

Robert W Letton, MD, David W Tuggle*, MD, Veronical Worrell, PhD, The American Pediatric Surgical Association Committee on Trauma Blunt Intestinal Study Group. Oklahoma University Health Sciences Center.

Invited Discussant: Edward Cornwell III

Objective: Blunt intestinal injury (BII) requiring surgical intervention in the pediatric trauma population remains difficult to diagnose. We sought to determine whether delay in treatment in the event of perforation had an adverse affect on patient outcome

Methods: A multi-institutional retrospective chart review utilizing the American Pediatric Surgical Association Committee on Trauma was initiated after IRB approval was obtained at each of the 18 institutions. All children ≤ 15 years of age diagnosed with a BII were identified and only those with BII noted during surgery or autopsy from January, 2002 through December, 2007 were included.

Results: 358 patients were accrued into the study. 214 patients had sufficient data to determine the interval between injury and operation. These were divided into 8 groups (<6 hours, 6-12 hours, 12-24 hours, > 24 hours) based on time from injury to intervention and whether they had intestinal perforation or not. Early and late complications as well as hospital days, ISS, and time to full feeds were compared in each group.

	PTS	NPO	DAYS	ISS	EARLY (%)	LATE (%)	DEATHS (%)
0 to 6	49	7.6 + 5.3	9.0 + 6.5	19.3 + 13.9	9 (18.4)	3 (6.1)	7 (14.3)
0 to 6 Perf	33	10.1 + 7.7	12.2 + 9.9	24.1 + 15.5	5 (15.2)	2 (6.1)	4 (12.1)
6 to 12	33	7.4 + 5.5	9.7 + 8.4	15.8 + 11.7	4 (12.1)	1 (3.0)	1 (3.0)
6 to 12 Perf	32	8.6 + 7.4	10.6 + 8.2	12.5 + 7.5*#	6 (18.7)	4 (12.5)	
12 to 24	20	8.7 + 9.4	11.1 + 12.8	13.7 + 10.9*	2 (10)	1 (5)	
12 to 24 Perf	33	8.4 + 6.4	11.8 + 11.5	12.4 + 5.9#	8 (24.2)	2 (6.1)	
> 24	7	7.7 + 6.6	10.0 + 8.9	12.7 + 8.1		1 (14.3)	
> 24 Perf	7	19 + 18.5	30.1 + 32.5	20.2 + 6.8	3 (43)	1 (14.3)	

Statistically different from *0 to 6 and #0 to 6 Perf at p <0.005

Conclusion: These data suggest that delay in operative intervention does not have a significant effect on prognosis after pediatric blunt intestinal perforation. Appropriate observation and serial examination rather than urgent exploration would appear adequate when the diagnosis is in question.

Session 3B

Paper 22 1:50 PM

WHAT IS THE OPTIMAL TIME FOR REMOVAL OF PACKING IN PATIENTS MANAGED WITH DAMAGE CONTROL AFTER SEVERE PENETRATING ABDOMINAL TRAUMA ?

Carlos Ordoñez, MD, Luis Pino, MD, Marisol Badiel, MD, Alberto García, MD, Marcela Granados, MD, Gustavo Ospina, MD, Andrew Peitzman, MD, Juan Carlos Puyana, MD*.
Universidad del Valle.

Invited Discussant: H Leon Pachter

Objective: Intra-abdominal packing (IAP) in damage control (DC) laparotomy is a lifesaving technique for controlling hemorrhage in severely injured patients. However, the impact of the duration of abdominal packing on outcome, specifically on the rate of rebleeding and intrabdominal infections (IAI) in penetrating abdominal trauma, is unknown. The objectives of this study are to evaluate the incidence of complications related to the duration of IAP and to determine the optimal time for packing removal.

Methods: Adult patients admitted over a 6-year period with penetrating abdominal trauma and DC were identified from our trauma registry. Only patients who survived to reoperation were included. Age, ATI, ISS, duration of packing, survival, presence of IAI and incidence of recurrent hemorrhage were analyzed. Rebleeding and infections rates according to duration of packing were calculated.

Results Of 214 patients with penetrating abdominal trauma, 33.2% (n=71) underwent DC and IAP. Mean age for the DC group was 32.3±10.0 years, ATI was 34.8±17.3, ISS 25.0±9.4 and 30 day mortality was 21.1%.

Packing time (hr)	Abdominal Infections rate (%)	Re-bleeding rate (%)
24	4.8	42.9
48	22.2	14.8
72	31.6	10.5
96	67	0
120	100	0
144	100	0

The liver was packed in 23 patients, retroperitoneum in 40, pelvis in 6 and post- splenectomy left upper quadrant in 6. Colon and small bowel injuries ocurred in 37 and 35 patients, respectively.

Conclusion: These data provide strong rationale for removing IAP at 72 hours. At this time, not only is the rate of re-bleeding reasonably low, but further delays in packing removal result in a steady rise in the incidence of IAI. .

Session 3B

Paper 23 2:10 PM

A CONTEMPORARY COMPARISON OF OPERATION AND ANGIOGRAPHY IN THE TREATMENT OF BLUNT RENAL INJURY

Babak Sarani, MD*, Joseph Taddeo, MD, Elizabeth Powell, BS, Brendan Carr, MS, MD, Mark Seamon, MD, Jessica Wobb, BS, Amy J Goldberg, MD*, C William Schwab, MD*. University of Pennsylvania.

Invited Discussant: Louis Magnotti

Introduction: Operative treatment of high grade renal injury is associated with a high nephrectomy rate. There is only 1 prior report of angioembolization as a means to arrest hemorrhage in this population. The purpose of this study is to evaluate the efficacy and morbidity associated with angiography (IR) for high grade blunt renal injury.

Methods: A retrospective analysis of the trauma registry from 1998-2008 at two high volume, level I trauma centers was used to identify patients with renal injury following blunt trauma. High grade renal injury was defined as grade III or higher using the American Association for the Surgery of Trauma classification. Patients who underwent surgery were compared to those treated by IR using chi-square test, student's t-test, and the Wilcoxon Rank Sum test. Multivariate analysis was used to adjust for age, injury severity score (ISS), blood transfusion, number of comorbidities, grade of injury, hypotension, tachycardia, and number of concomitant injuries.

Results: A total of 246 patients were identified. Of the patients with high grade renal injury (n=69), 28 had contrast extravasation on CT scan, 17 underwent operation and 23 underwent IR. Patients in the IR group were significantly older (47±5 v 32±3 years, $p=0.02$), had a lower ISS (24±3 v 40±3, $p<0.001$), lower serum creatinine value at discharge (0.86 mg/dL v 1.3 mg/dL, $p=0.05$), and shorter ICU stay (6.1±1.5 v 13.8±4.6 days, $p=0.05$). None of the patients in the IR group died, whereas 5 died following surgery ($p=0.009$). No patients in the IR group had significant recurrent hemorrhage, rendering a 100% efficacy. Multivariate analysis found no difference between groups in renal function, length of stay, need for transfusion, post-discharge disposition, or mortality.

Conclusion: We present the largest study to date examining the use of IR in high grade blunt renal trauma. We found that IR may be useful in avoiding operation in this patient cohort. Angiography does not appear to have a negative impact on renal function in this setting.

Session 3B

Paper 24 2:30 PM

DAMAGE CONTROL LAPAROTOMY: A VITAL TOOL ONCE OVER UTILIZED

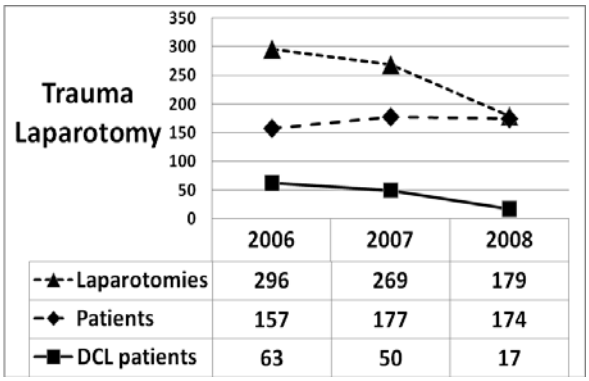
Guillermo Higa, MD, Randal Friese, MD, Terrance O'Keeffe, MD, Julie Wynne, MD, Michelle Ziemba, MRN, Rifat Latifi, MD*, Peter Rhee, MD*, MPH. University of Arizona.

Invited Discussant: Michael Rotondo

Introduction: Trauma surgery is constantly evolving. The purpose of this study was to report the change in the use of damage control laparotomy (DCL) over time.

Methods: The trauma registry from a level I trauma center identified trauma laparotomies performed over a three year (2006-2008) period. All operative reports were reviewed. Laparotomy was defined as DCL when fascia was not closed at the first operation.

Results: There were 14,534 trauma patients evaluated and 744 laparotomies were performed on 508 patients during the study period. There were 450 open laparotomies and 58 laparoscopies. The number of patients undergoing DCL decreased 73% during the study period which directly equated to a 40% reduction in the total number of laparotomies being performed during the last year. The number of laparotomies per patient decreased from 2.2 to 1.15. The mortality rate for patients requiring open laparotomies for trauma significantly decreased during the three year period from 24.6% to 15.4% ($p<0.05$) despite no change in demographics, mechanism of injury or injury severity. The survival rate for those undergoing DCL did not change significantly over the study period and averaged 45%. This resulted in a 28% reduction in hospital costs and charges ($2.0 mil and $5.7 mil respectively).



Conclusion: Trauma laparotomies and specifically DCL decreased significantly over time in this institution. DCL was performed one third less often than before. This has resulted in improved survival for patients requiring laparotomies following trauma and significant reduction in health care utilization. While damage control laparotomy is a vital aspect of trauma surgery, it can be utilized more selectively with improved outcome.

Session 3B

Paper 25 2:50 PM

DO "TRAUMA SCANS" REDUCE MISSED INJURIES?

Christy M Lawson, MD, Christine B Ormsby, MD, Brian J Daley, MD*. University of Tennessee Medical Center at Knoxville.

Invited Discussant: Tiffany Bee

Background: A rapid CT technique or "Trauma Scan" (TS) provides high resolution studies of the head, cervical spine, chest, abdomen, and pelvis. We sought to determine if widespread use of TS has decreased missed injuries. A previous study before TS had a 3% missed rate for head and torso injuries which would be included in the TS.

Methods: After IRB approval, trauma patients at a Level 1 center from January 2000 through December 2008 were reviewed for delayed diagnosis of an injury (DD) of the head, cervical spine, chest, abdomen, or pelvis. Missed extremity injuries were excluded. ISS, hospital length of stay, type of injury missed, outcomes resulting from the missed injury, and days of detection were captured.

Results: Of 26,264 patients reviewed, 30 patients had DD to the head, cervical spine, chest, abdomen or pelvis, an incidence of 0.11%. DD most commonly presented on day 2, (range 1-29 median = 5.4 days). Injuries included: 10 bowel, 5 diaphragm, 4 spleen, 2 intracranial bleeding, 2 spine, and 1 each of pancreas, mesentery, liver, pelvis, skull, common bile duct, and mandible. DD resulted in 1 death, 6 prolonged stays, and 19 operative interventions.

Conclusion: Trauma scan is an effective and highly sensitive way of evaluating trauma patients for intracranial, cervical spine, chest, abdomen, and pelvic injuries that have the potential to significantly impact morbidity and mortality. The incidence of injuries missed in these crucial areas has been reduced significantly at our institution by the increased use of this radiographic modality. Unfortunately, the most common missed torso injury remains to the bowel, so a high index of suspicion and the tertiary survey must remain a mainstay of therapy even after TS.

Session 3B

Paper 26 3:10 PM

HARNESSING THE CENTRAL NERVOUS SYSTEM TO PREVENT INTESTINAL DYSFUNCTION FOLLOWING TRAUMATIC BRAIN INJURY

Vishal Bansal, MD; Todd Costantini, MD, Carrie Peterson, MD; William Loomis, BA; Jim Putnam, BA; Brian Elicieri, PhD; Andrew Baird, PhD; Raul Coimbra*, MD, PhD. University of California San Diego.

Invited Discussant: Rosemary Kozar

Introduction: Intestinal barrier breakdown following traumatic brain injury (TBI) is characterized by increased intestinal permeability, which may lead to bacterial/endotoxin translocation, sepsis and multi system organ failure. The mechanisms by which intestinal barrier breakdown occurs following TBI are unclear. We hypothesized that regulation of the intestinal barrier may involve the central nervous system and its connections to the intestinal mucosa via the enteric glia.

Methods: A weight drop model was used to create severe TBI in Balb/c mice. Animals were divided into three groups. Group TBI: animals underwent TBI only; Group VNS: animals underwent electrical stimulation of the right cervical vagus nerve prior to TBI; and SHAM: opening of the skull but no TBI or VNS. Intestinal permeability to 4.4 kDa FITC-Dextran was measured 6 hours following injury. Segments of terminal ileum were harvested at two hour time intervals following TBI and glial fibrillary acidic protein (GFAP), a marker of glial activity, was measured by qPCR.

Results: Intestinal permeability was markedly increased in TBI compared to SHAM 6 hours following injury (104.5 ± 32.2 μg/ml vs. 24.7 ±11.4 μg/ml; $p< 0.01$). VNS prevented TBI induced intestinal permeability (50.7 ± 4.2 μg/ml vs.104.5 ± 32.2 μg/ml; $p<0.02$). In TBI animals, intestinal GFAP was not higher than SHAM at 2 hours nor at 4 hours following injury. However, VNS animals had a marked increase in intestinal GFAP at 2h (3.1 fold increase) and 4h (14.9 fold increase) compared to TBI and SHAM ($p<.05$). Levels of GFAP in all groups were equal at 6 hours.

Conclusions: In a mouse model of TBI, vagal nerve stimulation prevented TBI induced intestinal permeability. Furthermore, vagal nerve stimulation increased enteric glial activity and may represent the pathway for central nervous system regulation of intestinal barrier dysfunction.

Session 3B

Paper 27 3:30 PM

OPTIMAL TIMING OF PHARMACOLOGIC THROMBOPROPHYLAXIS FOLLOWING TRAUMATIC BRAIN INJURY

A Stewart Levy, MD, Kristin Salottolo, MPH, Raphael Bar-Or, BS, Charles W Mains, MD, Patrick Offner*, MD, David Bar-Or, MD. St. Anthony Central Hospital.

Invited Discussant: M Margaret Knudson

Introduction: Early administration of pharmacologic thromboprophylaxis (PTP) has been shown to reduce deep venous thrombosis and pulmonary embolism (VTE) after trauma, but may exacerbate intracranial hemorrhage (ICH) in patients with traumatic brain injury (TBI). The purpose of this study was to determine the optimal timing of PTP in order to reduce VTE while minimizing the risk of increased ICH following TBI.

Methods: Over a one year period, patients admitted to our Level I trauma center with blunt TBI were identified. Data regarding patient demographics, admission GCS, injury severity, timing of PTP, occurrence of VTE and increased ICH (based on radiologic findings) were tabulated. Early and late PTP were defined in two ways: < 48 hours and < 72 hours, and ? 48 hours and ? 72 hours after admission, respectively. Patients who received no PTP were also included. Timing of PTP was analyzed as an independent risk factor for VTE and ICH using multiple logistic regression. Separate logistic regression models were developed for each definition of early/late PTP.

Results: 156 TBI patients were identified, and 17.3% (n=27) developed a clinical complication: VTE (n=10), increased ICH (n=19), or both (n=2). Early PTP defined as < 48 hours was associated with a significant reduction in VTE (OR: 0.25, p=0.05), and a trend towards an increase in ICH (OR: 1.84, p=0.17). When early PTP was defined as < 72 hours, a large, non-significant reduction in VTE was observed (OR: 0.34, p=0.10), with no apparent risk of increased ICH (OR: 1.20, p=0.56). Younger age and higher admission GCS were also associated with decreased VTE, independent of PTP. The risk of increased ICH was greater with more severe TBI (greater head AIS score), independent of PTP.

Conclusion: These findings suggest that the optimal time to initiate PTP is within 72 hours of admission. Moreover, earlier initiation of PTP in certain subgroups of patients with TBI may be more effective and safe. We are currently conducting a larger multi-center study to better define the optimal timing for PTP in patients with TBI.

Session 3B

Paper 28 3:50 PM

PRESSURE-TIME DOSE OF AUTOMATED ICP AND CPP DATA PREDICTS OUTCOMES IN SEVERE TBI

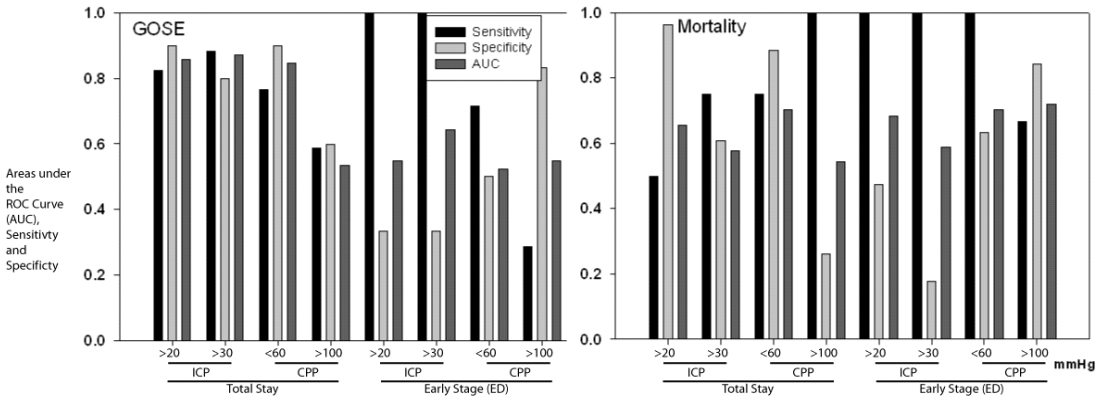
Sibel Kahraman,MD, Peter Hu, MS , Yan Xiao, PhD, Richard P Dutton*, MD, Bizhan Aarabi*, MD, Deborah M Stein*, MD, Thomas M Scalea*, MD. University of Maryland School of Medicine.

Invited Discussant: Lena Napolitano

Objective: Intracranial pressure (ICP) and cerebral perfusion pressure (CPP) measurements are the primary basis for the care of the severe traumatic brain injury (TBI) patients. We tested the accuracy of a pressure-time dose (PTD: mmHg*h) based on automated ICP and CPP data in predicting outcomes of severe TBI patients.

Methods: ICP and CPP data for 30 severe TBI patients were collected automatically at 6 sec intervals. PTDs of ICP and CPP over or under two different thresholds were calculated for early stage (Emergency Department stay: 3.4=/- 2.8 h) and total stay (4.6 +/- 2.6 d). Four outcomes (mortality, 3-month Extended Glasgow Outcome Scale -GOSE, discharge GCS and decompressive craniectomy) were used in assessing prediction value of PTDs.

Results: Total stay PTDs were strong predictors of GOSE and mortality (Fig.). In particular, early stage PTDs for ICP thresholds had 100% sensitivity but low specificity (17-47%). Total stay PTD of ICP>20mmHg correlated with discharge GCS (r=-0.44,p=0.016), and PTD of ICP>30mmHg correlated with the need for decompressive craniectomy (r=0.40, p=0.03).



Conclusion: Dose-based scoring of continuous automated ICP and CPP recordings seems to be a strong predictor of outcomes in TBI. Direct management of dose-based scoring at early stages might be valuable in therapeutic decisions. *Supported by W81XWH-07-2-0118*

Session 3B

Paper 29 4:10 PM

BETA-ADRENERGIC BLOCKADE AND TRAUMATIC BRAIN INJURY: PROTECTIVE?

Thomas J Schroeppel, MD, Ben L Zarzaur*, MD, MPH, Peter E Fischer, MD, Louis J Magnotti*, MD, L Paige Clement, PharmD, Martin A Croce*, MD, Timothy C Fabian*, MD.
University of Tennessee Health Science Center.

Invited Discussant: Kimberly Davis

Background: Catecholamine surge following traumatic brain injury (TBI) is associated with infectious morbidity and potentially preventable mortality. Previous studies have supported the protective effect of beta-adrenergic blockade in patients with TBI. We hypothesize that suppression of the catecholamine surge in multiply injured TBI patients with *beta*-adrenergic blockade decreases mortality.

Methods: The trauma registry at an urban level-one trauma center was queried for blunt TBI from 1/1/05 to 12/31/06. Patients who received more than one dose of *beta*-blockers (BB) were identified by a review of the hospital pharmacy order database. Chi-square and students t-tests were used where appropriate. After adjusting for age, injury severity score (ISS), admission Glasgow Coma Score (ADM GCS), and transfusions multivariable logistic regression was performed to determine whether receiving BB was protective in patients sustaining TBI.

Results: 2070 patients were admitted with blunt TBI during the study period. 443 (21%) received BB. Despite higher age (50 vs. 38 yrs, $p<0.001$) and more severe head injury (Head AIS 4.09 vs. 3.78, $p<0.001$), there was no difference in mortality (15.6 vs. 16.4%). Multivariable logistic regression identified BB as protective in patients sustaining head injury (OR 0.416, CI 0.306-0.597), when compared to those who did not receive BB, reducing mortality by 42%.

	Adjusted OR	CI	*p*
BB	0.416	0.289-0.598	<0.001
Age	1.042	1.033-1.051	<0.001
ISS	1.047	1.033-1.061	<0.001
ADM GCS	0.801	0.775-0.828	<0.001
Transfusions	2.711	1.955-3.758	<0.001

Conclusions: BB are associated with significantly reduced mortality in patients with TBI. This simple, inexpensive intervention may have a profound effect on mortality in this population of injured patients and requires further prospective study.

Session 3B

Paper 30 4:30 PM

"NEVER BE WRONG: THE COMPLICATION BURDEN OF NEGATIVE AND DELAYED LAPAROTOMIES IN BLUNT ABDOMINAL TRAUMA"

Bruce Crookes*, MD, Steven Shackford*, MD, Tuner Osler*, MD, Jennifer Gratton, RN, John Ratliff, JD, Meesha Khaleel, MD. University of Vermont.

Invited Discussant: Susan Brundage

Objective: To investigate the 30-day morbidity of a negative or non-therapeutic (NEG) laparotomy (LAP) in patients (pts) with blunt abdominal trauma (BAT). No previous work has examined exclusively BAT pts, utilized a control group, or determined complication burden.

Materials and Methods: This was a retrospective cohort study. Records of 662 BAT pts admitted to a Level I center from 8/97 to 8/07 were queried. Demographics, ISS, abdominal ISS, TRISS, LOS, mortality, and findings at LAP were analyzed and pts were assigned to 4 groups based on treatment and findings: NEGLAP (n=28), positive LAP (POSLAP, n=109), delay to LAP (DELAY, n=18), and no LAP (NOLAP, n=427). Complications (CXS) that occurred during hospitalization and for 30 days post discharge were extracted from our Surgical Activity Tracking System (SATS), and adjusted for severity through a weighted complication scoring system (Complication Impact Score, CIS). SATS is a validated CXS database using data gathered concurrent with care. The LAP groups were compared to NOLAP using Analysis of Covariance (ANCOVA) to compare the burden of CXS, while controlling for TRISS and LOS.

Results: The average number of CXS per patient ranged from 1.81 (DELAY) to 0.38 (NOLAP), and the average CIS per patient ranged from 7.29 (NEGLAP) to 1.62 (NOLAP). However, when controlled for injury severity and LOS, NEGLAP did not significantly increase the CIS compared to NOLAP while POSLAP and DELAY each had a significantly increased CIS compared to NOLAP ($p<0.000$ and $p<0.011$, respectively).

Conclusions: When controlled for injury severity and LOS, a NEGLAP does not increase the complication burden when compared to NOLAP. CXS in patients undergoing NEGLAP are due primarily to associated injuries and not to the LAP itself. When confronted with equivocal findings in pts with BAT, an operation for diagnosis does not appear to add significantly to the complication burden.

Session 5

Paper 31 7:45 AM

TRAUMA SURGERY TO ACUTE CARE SURGERY: DEFINING THE PARADIGM SHIFT

Joseph M Galante, MD, Ho Phan, MD, David H Wisner*, MD. University of California, Davis Medical Center.

Invited Discussant: Gregory Jurkovich

Introduction: Trauma surgery is in many locales gradually evolving into acute care surgery (ACS). We sought to better define this evolution and, using work relative value unit (wRVU) and billing data, to characterize the current practice of acute care surgery.

Methods: We used fiscal year 2007-2008 data from the UHC-AAMC Family Practice Solutions Center (FPSC) database, which is comprised of coding/billing data downloaded from over 100 participating institutions. We compared averages for practices designated as trauma surgery with general surgery, surgical oncology, and vascular surgery.

Results: The key wRVU and CPT data for the 4 different practice types are shown below:

	Trauma	General	Surg Onc	Vascular
% wRVU's Procedural	43%	75%	74%	86%
Top wRVU Generator	Critical Care, 1st Hour	Lap Gastric Bypass	Outpt. Visit, Est.	Rechannel Artery
Total Procedure CPT's	660	715	713	835
% Top 20 Proc. That were "Bedside"	20%	0%	10%	5%
Cholecystectomy wRVU	388 (77% Lap)	452 (73% Lap)	140 (39% Lap)	0%
Appendectomy wRVU's	180 (63% Lap)	128 (69% Lap)	34 (53% Lap)	0%

The top 5 wRVU generating CPT codes for trauma were all E&M codes, with "Critical Care, 1st Hour" accounting for fully 25% of all of the wRVU's.

Conclusion: Trauma surgeons remain distinctly different from their colleagues, with a greater emphasis on "cognitive" work, especially in the ICU. The number of procedures performed by trauma surgeons is comparable to other disciplines, but there is a somewhat greater emphasis on "bedside" procedures. Trauma surgeons' higher appendectomy volumes with similar cholecystecomy volumes compared to general surgeons is a likely reflection of the gradual transition in many institutions to an ACS model. The characterization of trauma surgery as nonoperative and ICU-based is in part substantiated by this study but there are indications of a gradual paradigm shift.

Session 5

Paper 32 8:05 AM

IN-HOUSE TRAUMA ATTENDINGS: A NEW FINANCIAL BENEFIT FOR HOSPITALS

Linda Ann Dultz, MD, MPH, Ronald Simon, MD*. Bellevue Hospital Center New York University.

Invited Discussant: Lenworth Jacobs, Jr

Introduction: There is an intuitive belief that in-house trauma attendings benefit outcome for trauma patients, though multiple studies have failed to prove this. There are no studies, however, investigating the financial advantage for hospitals by having the in-house attendings also perform urgent general surgery cases (GSC) during nights and weekends. The purpose of this study is to identify how an in-house attending program was utilized for urgent GSC and to see if it provided a financial benefit to the hospital.

Methods: An in-house attending program was implemented in Oct 2007. A retrospective study reviewed all cholecystectomies performed from Oct 2006-Sept 2007 and Oct 2007-Sept 2008. Total length of stay (LOS) was calculated for each group. Total LOS for each group was then multiplied by the daily cost for a med-surg bed ($2,530.00). The cost difference was calculated for the pre-policy implementation group vs post-policy group.

Results: 264 urgent cholecystectomies were performed before instituting an in-house attending compared to 291 cases in the period after; a 9% increase. The number of cases performed on nights and weekends rose from 9 to 35. Total LOS for cholecystectomies performed before was 6.4 days translating to $16,192.00 in room costs versus a total LOS of 5.24 days after and $13,257.20 in room costs. This translated to a savings of $2,934.80 per patient when instituting an in-house trauma attending who performed urgent GCS on nights and weekends.

Conclusion: In-house attendings are beneficial in decreasing overall LOS for urgent GSC. As there were 291 cholecystectomies performed over the last 12 months, the reduced LOS resulted in a cost savings of $854,026.80. This subsidized the full cost of the in-house attending program. This study demonstrates that in-house trauma surgeons can perform urgent GSCs and realize a cost savings for a hospital that can be used to fully subsidize the cost of the program.

Session 5

Paper 33 8:25 AM

COMPARISON OF HEMODYNAMIC MEASUREMENTS DURING EARLY RESUSCITATION FROM INVASIVE AND NON-INVASIVE MONITORING

Kathryn M Tchorz*, MD, Mukul Chandra, MD, Ronald J Markert, PhD, Michael Healy, BS, Kathleen M Dominguez, MD, Mary C McCarthy*, MD. Wright State University- Boonshoft School of Medicine.

Invited Discussant: Joseph Cushieri

Introduction: In the critically ill and injured, the use of the Pulmonary Artery Catheter (PAC) has become standard practice for monitoring resuscitation efforts. However, the PAC measurements only estimate left-sided cardiac preload conditions. The purpose of this study was to compare serially obtained PAC and Transthoracic Echocardiography (TTE) measurements during the initial ICU resuscitation period.

Methods: Over an 18- month period, 23 critically ill and injured patients admitted to a Level I Adult Trauma Center were enrolled in this initial 48-hr ICU study. Serial PAC and TTE measurements were obtained every 12 hours, for a total of 5 measurement points/patient. Protocols for resuscitation and ventilator management were utilized (www.gluegrant.org) and serial PAC and TTE measurements of SV and CO were obtained.

Results: The study group was 65.2% male, with a mean age of 49.3 ± 20 years and 26% mortality. Of these, 91% were trauma patients with a mean ISS of 23.4 ± 11. Using Pearson correlation, PAC and TTE measurements of CO and SV were significant for the first 36 hrs of resuscitation but Intra-class Correlations (ICC) were not satisfactory for agreement (ICC<.80).

Time	Pearson CO PAC vs TTE	ICC	Pearson SV PAC vs TTE	ICC
Initial	.56 (p=.007)	.68 (p=.003)	.53 (p=.012)	.60 (p=.01)
12 hrs	.55 (p=.007)	.67 (p=.003)	.45 (p=.031)	.55 (p=.02)
24 hrs	.64 (p=.001)	.73 (p<.001)	.45 (p=.032)	.54 (p=.02)
36 hrs	.70 (p< .001)	.73 (p<.001)	.49 (p<0.19)	.54 (p=.01)
48 hrs	-.02 (p=.92)	-.02 (p=.52)	.31 (p=.15)	.41 (p=.08)

Conclusion: Although both PAC and ECHO measurements of CO and SV correlate during the initial resuscitation period, PAC measurements may overestimate actual values.

Session 5

Paper 34 8:45 AM

PRESERVATION OF SPLENIC IMMUNO-COMPETENCE FOLLOWING SPLENIC ARTERY ANGIO-EMBOLIZATION FOR BLUNT SPLENIC INJURY

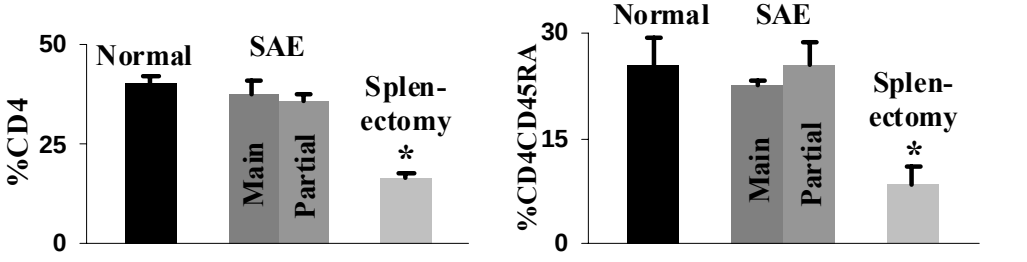
Ajai K Malhotra*,MD, Richard Carter, MD, Deborah Lebman, PhD, Dawn Carter, PhD, Omer J Riaz, MD, Michel B Aboutanos*, MD, Therese M Duane*, MD, Rao R Ivatury*, MD. Medical College of Virginia, Virginia Commonwealth University.

Invited Discussant: Brian Harbrecht

Background: Splenic artery embolization (SAE) is increasingly being utilized as an adjunct to non-operative management for stable patients with blunt splenic injury (BSI). However, little is known about splenic immuno-competence following SAE. The current study aims at assessing splenic immuno-competence following SAE for BSI.

Methods: Peripheral blood was obtained from BSI patients (n=8) who had SAE. Splenic immuno-competence was assessed by isolating mononuclear cells and incubating with $CD4^+$ and $CD4^+CD45RA^+$ antibody. $CD4^+CD45RA^+$ cells are a subset of $CD4^+$ cells generated ***only*** when an immuno-competent spleen is present. Cells were counted by fluorescence activated cell sorting, and compared to trauma patients that had splenectomy for BSI (n=4: negative controls) and normal healthy volunteers (n=4: positive controls).

Results: The test was discriminatory for the asplenic state. $\%CD4^+$ cells were significantly lower in splenectomized patients (16 ± 1) vs normal (40 ± 2) – $p<0.05$. This was due to significant decrease (8 ± 2 vs 26 ± 4 – $p<0.05$) in $\%CD4^+CD45RA^+$ cells. SAE patients had values ($CD4^+$ – 36+2, and $CD4^+CD45RA^+$ – 24+2) comparable to normal ($p>0.05$) and significantly higher than splenectomized patients ($p<0.05$). When the SAE group was subdivided into main (n=4) and branch vessel (partial: n=4) SAE, results were the same for both types of embolization (Fig.).



***p<0.05 splenectomy vs normal and splenectomy vs embolization (Main or partial)**

Conclusions: Splenic immune function, measured by T cell subset, generated ***only*** in the presence of an immuno-competent spleen, is preserved after SAE for BSI – main or partial.

Session 5

Paper 35 9:05 AM

REDUCING NEUTROPHIL TRAFFICKING PRESERVES HEPATIC FUNCTION AFTER SEPSIS

Toan Huynh*, MD, Nhat Nguyen, MS, Steven Keller, MS, Min Shin, PhD, Iain McKillop, PhD.
F.H. Sammy Ross Jr. Trauma Center.

Invited Discussant: Raul Coimbra

Introduction: Neutrophil trafficking may induce hepatic dysfunction in sepsis. Herein, we hypothesize that reduction in neutrophil adhesion and hence leukocyte-endothelial interaction by activated protein C (aPC) may preserve hepatic function after sepsis.

Methods: Two groups of *Sprague-Dawley* rats underwent sham or cecal ligation and puncture (CLP), followed by either saline or aPC (1mg/kg, i.v.) infusion, twice daily for 4 days. Thereafter, hepatic IL-6 levels were determined by ELISA. Liver injury was assessed by plasma AST, and hepatic function quantified by bile production. In separate experiments, neutrophils were labeled with Rhodamine 6G (0.05mg/mL), and leukocyte trafficking was determined by cell motion tracking using *in vivo* intravital microscopy.

Results: Septic animals showed increased hepatic neutrophil adhesion with reduced neutrophil velocity. Sepsis also induced elevated IL-6 and AST levels; while decreased bile production. Conversely, treatment with aPC reduced leukocyte infiltration, attenuated IL-6 levels, and preserved hepatocellular function (see Table).

Group	WBC Adhesion (cells/image)	WBC Velocity (μm/sec)	IL-6 (pg/mL)	AST (IU/L)	Bile (mcg/kg/hr)
Sham+NS	14.8 ± 3.8	22.3 ± 2.4	824 ± 437	51±7	2357 ± 147
Sham+aPC	25.7 ± 3.4	17.7 ± 1.8	124 ± 118	34±5	2773 ± 307
CLP+NS	42.7 ± 7.3*	10.5± 2.2**	2133 ± 641*	227±14*	436 ± 247*
CLP+aPC	4.3 ± 1.2	11.8 ± 2.7	379 ± 127	85±7	2356 ± 878

* $p<0.01$ vs. sham & aPC-treated counterparts, **$p<0.05$ vs. sham; n = 5 animals/group.

Conclusion: Our data showed sepsis induces hepatic dysfunction by augmenting leukocyte recruitment and adhesion. Treatment with aPC attenuated leukocyte trafficking and, in doing so, preserved hepatic function. Collectively, these data suggest an important role for leukocyte-endothelial interaction in sepsis.

Session 5

Paper 36 9:25 AM

DISPARATE EFFECTS OF BACTERIA AND TOLL-LIKE RECEPTOR DEPENDANT BACTERIAL LIGAND STIMULATION ON IGA TRANSCYTOSIS

Lawrence N Diebel*, MD, David M Liberati, MS. Wayne State University.

Invited Discussant: Timothy Billiar

Introduction: Recent studies have indicated that epithelial cells of the gut and other mucosal surfaces play an important role in orchestrating host responses to luminal microbes. Intestinal epithelial cells (IEC) also play an important role in the transport of dimeric secretory immunoglobulin A (dIgA) via the polyimmunoglobulin receptor (pIgR). The end product is secretory IgA (sIgA) which contains a cleaved portion of the pIgR, called secretory component. Transcytosis of dIgA may be responsive to various stimuli. We studied the effect of gram negative (G-) or gram positive bacteria (G+) and Toll-Like Receptor (TLR) bacterial ligand pathways on IgA transcytosis *in vitro*.

Methods: Polarized HT-29 cells, a human IEC line, were grown to confluence in a two-chamber cell culture system. Rat dIgA was added to the basal chamber of HT-29 monolayers at 4°C to allow maximal binding. Cells were then stimulated with either heat killed *Escherichia coli* (Δ *E. coli*), lipopolysacchiride (LPS) (TLR-4 pathway ligand), heat killed Staphylococcus aureus (Δ*S. aureus*), or peptidoglycan (PGN) (TLR-2 pathway ligand). HT-29 cell monolayer integrity was monitored by serial measurement of transepithelial electrical resistance (TEER). Samples were obtained from the apical chamber at timed intervals and assayed for sIgA by ELISA.

Results: Apical chamber sIgA (mean ± SD, ng/ml, N = 4 in each group)

	3 hr.	12 hr.	TEER (ohm.cm^{-2}) T=0	T=End
Control	2.6 ± 0.3	14.5 ± 0.7	302±25	302±12
Δ *E. coli*	3.8 ± 0.4	28.7 ± 0.4*	304±21	291±23
LPS	5.3 ± 0.8	34.1 ± 2.5*	309±19	299±18
Δ S. aureus	4.7 ± 1.0	15.9 ± 1.2	309±11	298±14
PGN	4.4 ± 1.4	15.7 ± 0.7	306±11	295±10

TEER measurements remained stable throughout the experiment. *$p<0.001$ vs. Control

Conclusion: Stimulation by G- bacteria or the TLR-4 bacterial ligand LPS led to increased IgA transcytosis in this model. The disparate effects between different bacteria and TLR-4 vs. TLR-2 pathways may have implications in host responses at mucosal surfaces.

Session 5

Paper 37 9:45 AM

IMPACT OF THE SURGICAL HOSPITALIST: IMPROVED OUTCOMES PRODUCES DECREASED COSTS

Michael S O'Mara, MD, Leon J Owens*, MD. Sutter Medical Center, Sacramento.

Invited Discussant: Grace Rozycki

Introduction: The surgical hospitalist model is a way to improve efficiency and reduce complications and length of stay. We hypothesized that 24-hour in-house general surgeon coverage for urgent and emergent surgical consultation would improve safety, enhance quality, increase satisfaction, and lower costs.

Methods: We reviewed our program after one year and compared it to surgery performed in the previous year. Before this program, in 2007, the general surgeons performed 767 emergent cases; in 2008, the surgical hospitalists performed 711. Most commonly performed were: lap cholecystectomy, lap appendectomy, open appendectomy, and exploratory laparotomy. This amounted to, in 2007, 560 procedures, of which 558 had complete data. Complete data from 2008 was available for 376 of the 551 performed.

Results: There was a reduction in length of stay with the surgical hospitalists for lap appendectomies (2.5 to 1.7 days, $p<0.0001$) and for all appendectomies (2.8 to 1.9 days, $p<0.0001$). Charges and revenue per case remained constant for the most common procedures. For appendectomies and cholecystectomies, there was a significant reduction in total cost. There was no documented reduction in cost for exploratory laparotomy.

Procedure, Category	2007 (Before)	2008 (Surgical Hospitalists)	p
Lap Appendectomy, Total Cost	$10,600 ± 5300 (N=146)	$8000 ± 3400 (N=125)	<0.0001
Open Appendectomy, Total Cost	$11,000 ± 8000 (N=48)	$7200 ± 5100 (N=32)	0.007
All Appendectomies, Total Cost	$10,700 ± 6000 (N=194)	$7800 ± 3800 (N = 157)	<0.0001
Lap Cholecystectomy, Total Cost	$14,500 ± 10, 500 (N=206)	$12, 300 ± 7400 (N=176)	0.022
Exploratory Laparotomy, Total Cost	$30,100 ± 24, 600 (N=158)	$32, 500 ± 30, 500 (N=43)	0.81

Conclusion: The surgical hospitalist model improves physician satisfaction, improves timeliness of patient care, and provides a safe and effective means of caring for emergency surgical patients. We saw a reduction in costs that changed emergency surgery from a losing proposition to one that produced a potential profit for the facility.

Session 5

Paper 38 10:05 AM

TH17 (IFNγ- IL17+) CD4+ T CELLS GENERATED AFTER BURN INJURY MAY BE A NOVEL CELLULAR MECHANISM FOR POST-BURN IMMUNOSUPPRESSION.

Crystal J Neely, BS, Robert Maile, PhD, Ming-jin Wang, BS, Sivaram Vadlamudi, PhD, Anthony A Meyer*, PhD,MD, Bruce A Cairns*, MD. University of North Carolina at Chapel Hill.

Invited Discussant: Matthew Rosengart

Introduction: The mechanism responsible for initiating and controlling the immunosuppressive response following burn injury remains unknown. IL17-secreting Th17 (IFNγ- IL17+) cells are a novel subset of CD4+ T cells associated with a weak, pro-inflammatory response that antagonizes the pro-inflammatory Th1 (IFNγ+IL17-) response. Given that TGFβ and IL6 mediate Th17 cell development, we hypothesized that burn injury may generate Th17 cells that could mediate post-burn immunosuppression.

Methods: Following a 20% TBSA burn in female C57BL/6 mice, wound-draining lymph nodes were harvested 3, 7, or 14 days after injury. CD4+ T cells were enriched by magnetic selection and flow cytometry was used to identify intracellular IL17 and IFNγ in CD3+CD4+ T cells. Additional purified CD3+CD4+ T cells were cultured with Th17-polarizing IL6 and TGFβ for four days and flow cytometry was again used to identify intracellular IL17 and IFNγ in CD4+ T cells.

Results: The number and percentage of pre-formed Th17 cells was significantly greater in burn mice compared to sham at all time points (Day 3, $p<0.05$; Day 7, $p<0.05$; Day 14 $p<0.05$- see figure representative of all time points). In addition, the ratio of Th17 cells to Th1 cells was always significantly higher in burn mice compared to sham ($p<0.05$). These differences were eliminated in Th17 polarizing conditions in vitro. CD4+ T cells never generated both IL17 and IFNγ.

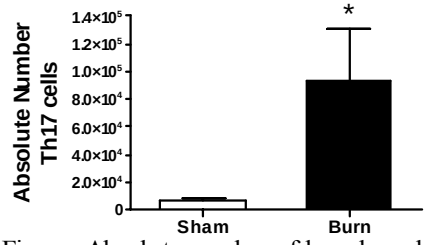


Figure: Absolute number of lymph-node Th17 cells is significantly (*, $p<0.05$, t test) greater following burn injury 14 days post burn (n=5 mice per group).

Conclusion: These results demonstrate for the first time that Th17 cells (IFNγ-IL17+) are spontaneously generated after burn injury. Given that Th17 cells (IFNγ-IL17+) are antagonistic to Th1 (IFNγ+IL17-) cells, these results suggest a novel mechanism for initiating and controlling post-burn immunosuppression that deserves further investigation.

Session 7A

Paper 39 10:25 AM

GOAL ORIENTED SHOCK RESUSCITATION IS ASSOCIATED WITH IMPROVED OUTCOMES FOLLOWING SEVERE BLUNT INJURY

David Zonies, MD MPH, Mitchell Cohen, MD, Grant O'Keefe*, MD MPH, Heather Evans, MD MS, Jason Sperry, MD , Joseph Minei*, MD, Ernest Moore*, MD , Ronald Maier*, MD , Joseph Cuschieri*, MD. Harborview Medical Center.

Invited Discussant: Michael Chang

Introduction: Because resuscitation protocols vary, there is a need to better define their effects on blunt injury. Outcomes were evaluated in a cohort of severely blunt injured patients who either achieved or failed to meet a goal oriented resuscitation protocol that limited central venous pressure (CVP) to $\leq$15 within the first 24 hours of admission.

Methods: A multi-institution observational study of severe blunt injured patients, treated by a volume-oriented protocol, was performed from 2001-2007. Patients with suspected cardiac dysfunction (defined as initial CVP>15) were excluded. Maximal CVP was recorded during initial resuscitation (0-6 hours) and at 24 hours after volume loading. Patients who exceeded a loading goal (CVP>15) were compared to those who met the protocol goal. Univariate analysis and logistic regression was used to assess differences in outcome.

Results: 181 patients were stratified by resuscitation goal at 24 hours (138 CVP <15, 43 CVP>15). There were no group differences by age, gender, ISS, or the development of ARDS, DVT and PE. Protocol violation was associated with more fluid delivery, prolonged ventilator support, longer ICU stay, multiple organ failure (MOF), and pneumonia (VAP). Adjusting for massive transfusion, the odds of developing VAP was 2.2 (95%CI 1.1-4.6, p=0.03). With further adjustment by vasopressor use, the odds of developing MOF was 5.3 (95%CI 2.5-12.4, p<0.001).

Variable	CVP <15 (n=138)	CVP >15 (n=43)	p-value
24h total blood (L)	2.7 ± 0.2	3.9 ± 0.5	0.02
24h total crystalloid (L)	14.8 + 0.8	19.4 + 0.2	<0.01
24h total fluids (L)	19.2 ± 1.0	25.8 ± 2.0	<0.01
Ventilator time (days)	10.2 + 0.7	16.8 + 2.2	<0.01
ICU stay (days)	14.1 ± 0.9	19.6 ± 2.2	<0.01
Hospital stay (days)	24.4 + 1.6	28.5 + 3.4	0.25
Multiple organ failure (%)	30%	74%	<0.01
Pneumonia (%)	28%	47%	0.03

Conclusions: Goal-orientated resuscitation is associated with reduction in organ failure, VAP, and ICU stay. Despite lack of difference in other complications, our results suggest that inability to adhere to goal-oriented shock resuscitation should prompt the provider to seek adjunctive modalities to investigate the underlying inadequacy of resuscitation.

Session 7A

Paper 40 1:30 PM

NORMAL PRESENTING VITAL SIGNS ARE UNRELIABLE IN GERIATRIC BLUNT TRAUMA VICTIMS

Daithi S Heffernan, MD, Rajan Thakkar, MD, Radhika Ravindran, BA, Charles A Adams, MD, Matthew Kozloff, MD, Shea Gregg, MD, William G Cioffi*, MD. Brown University Warren Alpert Medical School.

Invited Discussant: A Britton Christmas

Background: It is a commonly held belief that tachycardia and hypotension are associated with worse outcomes in trauma patients, and this believed to even more so in geriatric patients.

Methods: A Level 1 Trauma center retrospective chart review of vital signs on presentation (Pulse and BP) in young (17-35 year old) and geriatric (>/=65 year old) blunt trauma victims from September 2003 to September 2008 as a predictor of mortality. Stepwise, multiple logistic regressions were used to model mortality in samples of young and geriatric patients. Age, gender, Pulse, Systolic Blood Pressure, and all interactions were eligible for inclusion. Factors with $p<0.10$ were permitted to enter and be retained. Optimized thresholds were determined for each equation maximizing sensitivity and specificity at their point of intersection.

Results: There were 2,194 geriatric and 2,081 young patients. 251 (11.4%) geriatric and 49 (2.4%) young patients died. Age and pulse were significantly predictive of mortality in each model ($p<.05$). Blood pressure was significantly predictive in male and female young patients ($p<.05$), but was only predictive in female geriatric patients ($p<.05$). Gender was retained in the model for geriatric patients, but was not statistically significant. The sensitivities and specificities of the optimized models were significantly lower for geriatric patients at 62.2% (Sens. 95%CI 59.2%-65.1%; Spec. 95%CI 60.7%-62.8%) relative to younger at 71.5% (Sens. 95%CI 65.7%-77.1%; Spec. 95%CI 70.2%-72.0%).

Conclusions: Vital signs on presentation are less predictive of mortality in geriatric blunt trauma victims, especially so in older male victims Accordingly, geriatric blunt trauma patients warrant increased vigilance despite normal vital signs on presentation.

Session 7A

Paper 41 1:50 PM

THE SIGNIFICANCE OF A SERUM CREATININE IN DEFINING RENAL FUNCTION IN SERIOUSLY INJURED PATIENTS

Michael White*, MD, Lawrence Diebel*, MD, Anna M Ledgerwood*, MD, Charles E Lucas*, MD. Wayne State University.

Invited Discussant: Martin Croce

Introduction Most current analyses of multiple organ failure (MOF) after injury use the serum creatinine (S_{Cr}) as a surrogate for defining renal insufficiency (RI) or renal failure (RF). This study correlates S_{Cr} with glomerular filtration rate (GFR) as measured by the clearances of inulin (C_{In}), the gold standard in man, and creatinine (C_{Cr}).

Methods 144 injured hypotensive (shock time average of 45 minutes) patients requiring an average of 14.1 blood transfusions during resuscitation and operation underwent sophisticated renal function studies which included S_{Cr}, C_{In}, C_{Cr}, and C_{PAH}. The first comprehensive study was performed when the patient stabilized during ongoing postoperative resuscitation. All clearance studies followed the classic methodologies described by Homer Smith, including weight guided loading dose, steady state serum levels, and urine collections made exactly 15 minutes after serum collections.

Results The average S_{Cr} at study time was 1.7 mg/dl (Range: 0.4 to 10.8 mg/dl); the average C_{In} was 75 ml/min (Range: 3 to 232 ml/min); the average C_{Cr} was 68 ml/min (Range : 5-271 ml/min). The C_{In} correlated in a highly significant manner ($p<0.0005$) with C_{Cr} between the values of 0.8 and 1.7 mg/dl; the C_{Cr} correlated with S_{Cr} ($p=<0.0005$) when the S_{Cr} was ranged from 0.8 to 1.7 mg/dl. The GFR as determined by C_{In} and C_{Cr} always exceeded 30 ml/min when S_{Cr} was less than 2.5 mg/dl. The GFR was less than 15 ml/min when the S_{Cr} was greater than 3.2 mg/dl.

Discussion Based upon these findings, one can recommend that when data are extracted from large trauma registries, the definition of renal insufficiency should be inferred when the S_{Cr} exceeds 2.5 mg/dl and non-oliguric renal failure should be diagnosed when the S_{Cr} exceeds 3.2 mg/dl. The percent reductions in renal plasma flow (C_{PAH}) are always greater than the reductions in C_{In} and C_{Cr}.

Session 7A

Paper 42 2:10 PM

ACUTE DEFINITIVE INTERNAL FIXATION OF PELVIC FRACTURES IN POLYTRAUMA PATIENTS: A FEASIBLE OPTION.

Zsolt J Balogh*, MD, PhD, Natalie Enninghorst, MD, Laszlo Toth, MD, Kate L King, RN, Julie A Evans, RN, Stuart Mackenzie, MD. Department of Traumatology, John Hunter Hospital, University of Newcastle.

Invited Discussant: David Hoyt

Background: Staged skeletal stabilization [early ex-fix or C-clamp and later definitive internal fixation (ORIF)] is recommended for high energy pelvic ring fractures (PRF). *Purpose:* to evaluate the safety and efficacy of acute definitive pelvic ORIF (A-ORIF) by comparing its short term outcomes with those who underwent staged surgery (S-ORIF).

Methods: 45-month retrospective review of the prospective PRF database of a Level-1 trauma center was performed. All consecutive polytrauma patients with PRF who were manageable with minimally invasive ORIF were included. Patients were categorized as A-ORIF (<24 hrs) or S-ORIF (>24 hrs). Demographics, Injury Severity Score (ISS), pelvic Abbreviated Injury Scale (AIS), 24 hr pack red blood cell (PRBC) transfusions, physiological parameters [Base Deficit (BD), systolic blood pressure (SBP), Lactate], time to OR, angiography requirement, LOS and mortality were compared. Data are presented as mean±SEM or %. *Denotes $p<0.05$ based on univariate analysis.

Results: Forty-six patients met inclusion criteria, 17 patients had definitive A-ORIF and 29 had S-ORIF. Acute and staged ORIF patients had statistically not different demographics, injury severity, injury pattern, fracture type, angiography requirement and 24hrs transfusion. Initial shock parameters were significantly worse in the acute ORIF group. There was no difference in mortality, complications, hospital LOS and ICU LOS.

	N	Time to ORIF	Age (yrs)	Male %	ISS	Pelvic AIS	PRBC (U)
A-ORIF	17	*5.5±2 hrs	48±5	82	30±4	3.7±0.2	4.7±1
S-ORIF	29	5.2±1 days	40±3	79	24±2	3.4±0.2	6.6±1

	N	SBP (mmHg)	BD	Lactate	Angio	LOS	ICU LOS	Mortality
A-ORIF	17	*SBP 69±2	*7.4±1	*6.7±1	18%	25±6	2.9±0.5	0%
S-ORIF	29	108±4	4.9±0.2	2.5±0.2	21%	37±6	3.7±1	3%

Conclusion: Acute definitive minimally invasive ORIF of unstable PRF could be performed within 6 hours of admission even in shocked polytrauma patients. The outcomes are similar or better than with those of staged operative approach. A-ORIF did not lead to increased ICU LOS; it potentially could decrease the hospital LOS and transfusions.

Session 7A

Paper 43 2:30 PM

IS MANDATED FDA SAFETY EVALUATION FOR HEMOSTATIC DEVICES (HD) INADEQUATE? OBSERVATIONS WITH WOUNDSTAT

Bijan S Kheirabadi, PhD, James E Mace, MD, Irasema B Terrazas, MS, Chriselda G Fedyk, MS, J Scot Estep, DVM, Michael A Dubick, PhD, Lorne Blackbourne*, MD. US Army Institute of Surgical Research.

Invited Discussant: Charles A Adams

Background: In 2007, WoundStat (WS, smectite granules) received FDA clearance as a safe and effective hemostatic device for temporary treatment of external hemorrhage. Our previous study revealed microscopic WS residues in injured vessels treated with WS after wound debridement. Hence, thromboembolic risk of WS treatment as compared with gauze products to control external hemorrhage was investigated in a swine vascular injury model.
Methods: Anesthetized pigs (37 kg) were instrumented, and their right carotid arteries and jugular veins were isolated and injured (50% transection). After 30 sec free bleeding, neck wounds were packed with WS, Combat Gauze (CG, a kaolin-coated surgical gauze), or regular gauze (Kerlix) and compressed sequentially until hemostasis achieved (n=8/grp). Hextend (~500 ml) was administered to normalize blood pressure. After 2 hrs, wounds were debrided extensively and vascular injuries were primary repaired with suturing. Blood flow was restored after infusing 1L LR (no heparin) and wounds were closed. Two hrs later, CT angiography was performed and wounds were reopened to harvest the vessels. Brains and lungs were recovered for gross and microscopic examination after euthanasia.
Results: No difference was found at baselines. TEG tests showed equal hypercoagulability in final blood samples of all groups which was not detected by standard tests (PT, aPTT). Vessels treated with Kerlix and CG were all patent and had no thrombus or blood clot in their lumen. In contrast, 7 out of 8 carotid arteries and 6 out of 8 jugular veins treated with WS developed large occlusive red thrombi and had no flow. Small clots and WS residues were also found in two lungs. Microscopically, significant endothelial and transmural damages were seen in WS treated vessels with luminal thrombi and embedded granules.
Conclusion: WS granules caused severe endothelial injury and significant transmural damage to the vessels that render them useless for surgical repair. The granules may enter systemic circulation and cause distal thrombosis. More relevant in vitro and in vivo vascular injury tests should be employed for evaluating safety of HD.

Session 7A

Paper 44 2:50 PM

USE OF RECOMBINANT FACTOR VIIA (RFVIIA) IN US MILITARY CASUALITIES OVER THE PAST FIVE YEARS

Charles E Wade*, PhD, Brian J Eastridge*, MD , John A Jones, BS, Susan A West, RN, Philip C Spinella MD, Jeremy G Perkins, MD, Michael A Dubick, PhD, Lorne H Blackborne*, MD, John B Holcomb*, MD. US Army Institute for Surgical Research.

Invited Discussant: Wayne Meredith

Introduction: Two prospective randomized trauma trials have shown rFVIIa to be safe and decrease transfusion requirements. rFVIIa is presently used in 22% of massively transfused (MT) civilian trauma patients. The US Military has used rFVIIa in combat trauma patients for five years, and in two small studies of MT patients described an association with improved outcomes. The present study was undertaken to assess how deployed physicians are using rFVIIa, and casualty outcomes.

Methods: US combat casualties (n=2099) receiving any blood transfusion over 5 years were reviewed to compare patients receiving rFVIIa (n=511) to those who did not (n=1588). Propensity-score matching (primary analysis) and multivariable logistic regression were used to compare outcomes. Differences were determined at $p<0.05$.

Results: Twenty four percent of patients received rFVIIa. (See Table for unadjusted comparisons.) For propensity-score matching factors associated with death were used: ISS, GCS, HR, SBP, DBP, Hgb and total PBRC. A total of 271 patients per group were matched; 53% of the rFVIIa group. For this comparison there were no differences in the any of the demographics, including incidence of massive transfusion (51% vs. 51%). There was no difference in the rate of complications (20% vs. 23%) or mortality (17% vs. 19%) for patients not treated or receiving rFVIIa respectively.

*p<0.05	SBP mmHg	HR beat/min	BD	Hgb mg/dl	GCS	ISS	MT %	Died %
No rFVIIa	113	99	-5	12.0	12	19	26	14
rFVIIa	110*	109*	-8*	11.5*	11*	26*	66*	24*

Conclusion: In military casualties rFVIIa is used in the most severely injured patients, but in a matched subpopulation is not associated with improved outcomes. Funding agencies must undertake studies validating predictive algorithms that identify patients that could potentially benefit from drugs, such as rFVIIa. This must be accomplished before efficacy studies can be undertaken.

Session 7A

Paper 45 3:10 PM

FRESH WHOLE BLOOD RESUSCITATION ATTENUATES THE INFLAMMATORY CYTOKINE RESPONSE TO HEMORRHAGE

Amy T. Makley, MD, Michael D Goodman, MD, Lou Ann W Friend, Rebecca M Schuster, Jay A Johannigman*, MD, Warren C Dorlac*, MD, Alex B Lentsch, PhD, Timothy A Pritts, MD PhD. University of Cincinnati.

Invited Discussant: Mitchell Cohen

Objective: Hemorrhagic shock induces systemic inflammatory responses that may result in significant morbidity. The effect of resuscitation strategies on the inflammatory response to hemorrhage is not well understood. We hypothesized that fresh whole blood would decrease cytokine production as compared to crystalloid resuscitation.

Methods: Mice underwent a pressure-clamp model of hemorrhagic shock with femoral artery cannulation, then withdrawal of blood to a SBP of 25mmHg for 1 hour. Mice were resuscitated to a SBP of 80 mm Hg with either Lactated Ringers (LR) or fresh whole blood (FWB) from donor animals. Sham mice were cannulated but not hemorrhaged. At intervals, mice were sacrificed and serum samples were collected for ELISA analysis.

Results: Mice resuscitated with LR demonstrated increased serum levels of the cytokines IL-6, KC, and MIP-1α as compared to sham animals (Figure). Resuscitation with FWB resulted in decreased levels of these cytokines 30 minutes after resuscitation (Figure).

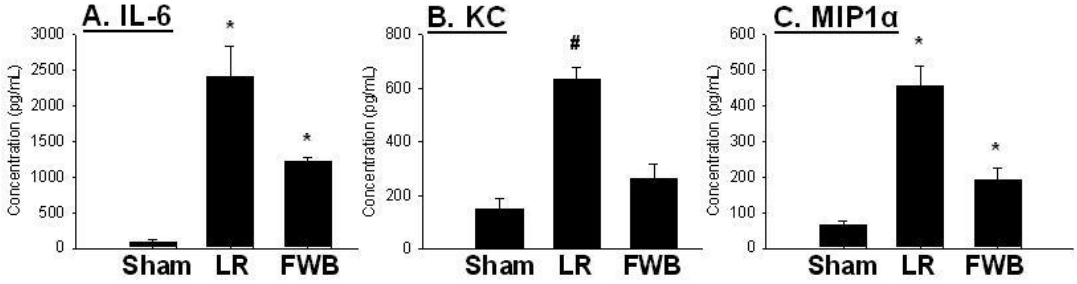


Figure: Serum levels of IL-6 (A), KC (B), and MIP-1α (C) in mice 30 minutes after hemorrhagic shock and resuscitation with LR or FWB. *$p<0.05$ vs. other groups; #$p<0.05$ vs. sham and FWB

Conclusions: Resuscitation with FWB results in a decreased systemic inflammatory response to hemorrhagic shock as compared to resuscitation with LR. These findings suggest that non-crystalloid resuscitation may reduce systemic inflammation following hemorrhagic shock.

Session 7A

Paper 46 3:30 PM

END-TIDAL CAPNOGRAPHY PREDICTS COMPENSATED SHOCK AND NEED FOR EMERGENT BLOOD TRANSFUSION

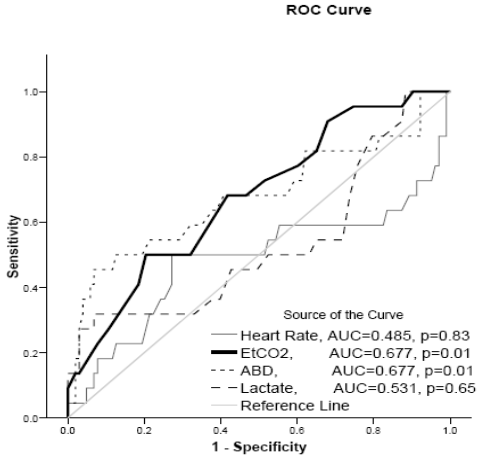
Keir J Warner, BS, Eileen M Bulger*, MD, David Carlbom, MD, Heather Evans, MD, Michael K Copass*, MD, Gregory J Jurkovich*, MD, Joseph Cuschieri*, MD. University of Washington.

Invited Discussant: Carol Schermer

Background: Early recognition of compensated traumatic shock (CS) is difficult, and relies on physical exam and invasive measures, including arterial base deficit (ABD) and lactate, to determine. End-tidal capnography (EtCO2) has been proposed as a continuous measure to determine shock, but has not been evaluated in CS. Thus, we set out to determine if EtCO2 can determine CS requiring emergent blood transfusion.

Methods: A single institutional prospective observational trial was conducted from 1/1/2007 to 12/31/2007. Patients were considered to have potential CS if the SBP was greater than 90mmHg. Patient demographics and injury characteristics were obtained. Presenting heart rate (HR), EtCO2, ABD, and lactate were recorded and a ROC was developed for area under the curve (AUC) for need for emergent blood. Additionally, tachycardia (HR>100), AB >6, lactate>4, and EtCO2<25 were evaluated for positive and negative predictive values (PPV/NPV) for requirement of emergent blood.

Results: A total of 180 of patients were evaluated. 42 patients had a SBP<90 mmHg and were excluded, leaving 138 patients with potential CS. CS patients were 76% male, median age of 35(IQR 23-48), and ISS of 24(IQR 13-35). ROC demonstrated similar AUC of EtCO2 to both ABD and lactate(Figure). PPV/NPV for non-invasive measures were (16%/82%) for HR>100 and (40%/85%) for EtCO2<24, while invasive measures were (39%/88%) for ABD>6 and (27%/85%) for lactate >4.



Conclusion: EtCO2 allows for non-invasive measure that predicts need for emergent blood transfusion. Although further prospective validation is required, it appears that EtCO2 can be used as a continuous non-invasive measure to determine shock.

Session 7A

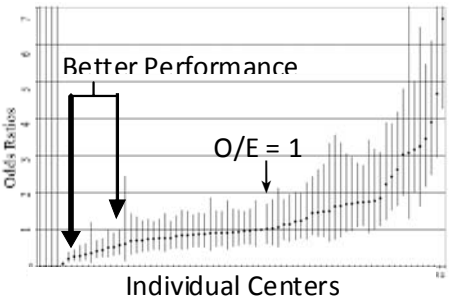
Paper 47 3:50 PM

BURN-CENTER QUALITY IMPROVEMENT PROJECT

Tjasa Hranjec, MD, Florence E Turrentine, RN, PhD, Michelle T Pomphrey, RN, George J Stukenborg, PhD, Robert G Sawyer, MD, James F Calland*, MD. University of Virginia.

Invited Discussant: Richard Kagan

Introduction: Advances in the science and delivery processes of burn care have led to substantial decreases in burn-related mortality over the past 20 years. However, little is known about variance between burn center mortality outcomes. This project seeks to compare burn-center mortality outcomes using National Surgical Quality Improvement Program data from the National Burn Repository. **Methods:** De-identified data from 306,304 acute burn observations obtained from the National Burn Repository from January 1, 1996 to Jan 30, 2006, was used to estimate a multivariable logistic regression model with three predictors of mortality risk was created: age in years, inhalational injury and the total burn size (%BSA). Complete data was available for 219,778 observations. **Results:** The model achieved excellent discrimination (ROC area 0.81) for predicting mortality and each of the three covariates (age, inhalation injury, %BSA) were highly statistically significant predictors of this outcome(p-value <0.0001). The observed number of deaths for each individual center was compared to the expected numbers that were predicted by the model. The enclosed caterpillar plot depicts odds ratios and their 95% confidence intervals (for mortality) for each facility compared to the reference facility, where observed to expected ratio of mortality were approximately equal (O/E = 1).



Conclusions: It is possible to generate useful risk-adjusted analyses of the outcomes of individual burn centers using National Burn Repository (NBR) data. In order to enhance burn care, future work should focus on improving the quality of NBR, and assessing the effects of providing reports of risk-adjusted outcome reports to the individual burn centers.

Session 7B

Paper 48 1:30 PM

TRAUMA ICU SURVIVAL: HOW GOOD IS AN EDUCATED GUESS?

Claudia E Goettler, MD FACS, Brett H Waibel, MD FACS, Joel Goodwin, MD FACS, Frank Watkins, RN, Eric A Toschlog, MD FACS*, Scott G Sagraves, MD FACS*, Paul J Schenarts, MD FACS*, Michael R Bard, MD FACS*, Mark A Newell, MD FACS, Michael F Rotondo, MD FACS*. East Carolina University, Brody School of Medicine.

Invited Discussant: Thomas Scalea

Introduction: In trauma systems, great resources are expended on individuals in hopes of a "great save." Additionally, families request estimated outcomes to choose the best course of care. We studied the ability of the healthcare team to predict patient outcome.

Methods: Over 38 months, (7/05-8/08) an observational study of adult trauma patients was undertaken. These patients are managed by a multidisciplinary team: Trauma/Surgical Critical Care attending, surgical ICU fellow, residents & medical students, advanced practitioners (AP), and bedside ICU nurses. Team members independently completed an outcome survey tool on hospital days 1 & 3. Data was concurrently collected & retrospectively analyzed to determine the accuracy of the survival assessment. Statistical analysis was via Student's T-test between provider accuracy and by chance accuracy which would be obtained by random chance with statistical significance set at $p<0.05$*.

Results: 223 patients had 326 observations. Day 3 accuracy improved, but did not improve with observer experience. In all groups, accuracy was found to be significantly better than by chance accuracy. As the majority of patients were survivors, sensitivity and positive predictive value (PPV) of the observer's ability to predict death was also evaluated.

	Accuracy—Correct categorization of survival or death (by chance accuracy)		Sensitivity- Died who were predicted to die		PPV-death was predicted, did die	
Observer:	Day 1 (n=159)	Day 3 (n=167)	Day 1	Day 3	Day 1	Day 3
Attending	84.9%*(68.1%)	86.5%*(73.8%)	51.7%	43.5%	65.2%	58.8%
Fellow	91.3%*(66.0%)	90.0%*(65.5%)	60.0%	70.0%	100%	87.5%
Sr Resident	85.7%*(65.9%)	88.3%*(72.1%)	69.2%	55.0%	66.7%	68.8%
Jr Resident	80.9%*(72.8%)	88.4%*(75.9%)	40.9%	52.9%	40.9%	60%
Med Student	80.9%*(71.1%)	89.8%*(70.3%)	64.7%	60.9%	78.6%	77.8%
AP	82.5%*(67.5%)	88.6%*(68.8%)	57.1%	52.9%	57.1%	81.8%
Nurse	82.1%*(69.6%)	89.8%*(80.6%)	34.8%	50.0%	53.3%	53.8%

Conclusions: While significantly better than chance, the ICU team's ability to predict individual survival of trauma patients remains inaccurate. Care must be taken when describing likely outcomes to patient family members, particularly early in the course.

Session 7B

Paper 49 1:50 PM

INJURY SEVERITY: WHOSE PERSPECTIVE IS IMPORTANT?

Karen J Brasel, MD, MPH*, Terri deRoon-Cassini, PhD, Ciaran T Bradley, MD. Medical College of Wisconsin.

Invited Discussant: Howard Champion

Background: Ambiguity exists about factors that predict post-injury quality of life (QOL). We hypothesized that patient-perceived injury severity, not Injury Severity Score (ISS), and severity of post-traumatic stress disorder (PTSD) would be correlated with QOL.

Methods: 333 trauma patients admitted to a Level I trauma center completed a questionnaire during inpatient stay and 6 months following injury. The questionnaire assessed physical (PCS) and mental (MCS) quality of life with the SF-36, PTSD severity using the PCL checklist, and used a 4-point rating of perceived injury severity. ISS and demographic information were obtained from the trauma registry. Statistical analysis was done with Pearson's correlation and multiple regressions.

Results: ISS was not significantly correlated with perceived injury severity, PTSD symptom severity, PCS or MCS. Correlation coefficients are listed in the table.

	Perceived injury severity	PTSD	PCS	MCS
Perceived injury severity	--			
PTSD	.218**	--		
PCS	-.519**	-.381**	--	
MCS	-.481**	-.505**	.371*	--
ISS	.073	-.095	-.060	.040

An increase in PTSD symptom severity and perceived injury severity significantly predicted both decreased physical and mental QOL at 6 months.

Variables	*B*	SE *B*	β	*R*	*Adj.R*^{2}	*F*
Regression 1: PCS				0.65	0.38	9.92**
PTSD Severity	-0.34	0.13	-.40**			
Perceived ISS	-7.00	2.40	-.44**			
Regression 2: MCS				0.70	0.44	12.77**
PTSD Severity	-0.46	0.13	-.52**			
Perceived ISS	-6.25	2.35	-.38**			

* = $p < .05$; ** = $p < .01$.

Conclusions: Trauma programs should consider early screening of patients for perception of injury severity and PTSD symptoms to determine which patients may need psychological intervention to improve long-term QOL.

Session 7B

Paper 50 2:10 PM

CRASH TEST RATINGS AND REAL-WORLD CRASH OUTCOMES: A CIREN STUDY

Gabriel E Ryb, MD, MPH*, Tim Kerns, MS , Cinthia Burch, MPH, Patricia C Dischinger, PhD, Shiu Ho, MS. National Study Center for Trauma and EMS and Program in Trauma - University of Maryland.

Invited Discussant: Michael Shapiro

Objective: to evaluate whether the Insurance Institute for Highway Safety (IIHS) frontal crash test ratings predict mortality during vehicular crashes. Our hypothesis was that occupants of vehicles with higher crash test ratings will experience lower mortality.

Methods: The study used Crash Injury Research Engineering Network (CIREN) cases with case occupants over the age of 15 who were involved in frontal crashes. CIREN is a convenience sample of persons injured in crashes with at least one maximum abbreviated injury scale (MAIS) 3+ injury or two MAIS 2+ injuries who were either treated at a Level 1 trauma center or died. Cases with incomplete occupant or crash data were excluded. Cases were grouped by IIHS crash test ratings as: good (G), acceptable (A), marginal (M) and poor (P). The ratings-based groups were compared in relation to the occurrence of death using the Mantel-Haenszel Chi square test. Confounders previously found to be associated with mortality were also analyzed. In order to adjust for confounders, multiple logistic regression models were built to explore the association of frontal IIHS ratings with death. Covariates included age, BMI, delta v, and seatbelt use.

Results: A total of 533 cases were distributed within G (32%), A (34%), M (10%) and P (24%) groups. Mortality was not significantly associated with the IIHS rating (G 8%, A 11%, M 6% and P 13%) in the univariate analyses. Age, seatbelt use, delta v and high BMI were significantly associated with mortality. A multivariate analysis for the prediction of death, including confounding factors, revealed a protective effect of a "G" rating when compared with "P" [odds ratio (OR) 0.42(0.17-0.99)]. Effect of "A" and "M" ratings did not reach statistical significance.

Conclusion: After adjusting for occupant and crash variables, occupants of vehicles rated "Good" by the IIHS experienced a lower risk of death after frontal crashes. This study used real-world injury information to validate the parameters and results of crash tests results. This shows IIHS ratings to be a good measure of safety for consumers.

Session 7B

Paper 51 2:30 PM

SWALLOWING DYSFUNCTION AFTER MECHANICAL VENTILATION IN TRAUMA PATIENTS

Carlos VR Brown*, MD, Kelli Hejl, MSc, Amy D Mandaville, MA, Paul E Chaney, MD, Guy Stevenson, RN, Charlotte Smith, MD. University Medical Center Brackenridge.

Invited Discussant: David Harrington

Background: Swallowing dysfunction (SD) can occur after mechanical ventilation (MV) leading to complications such as aspiration and pneumonia. After MV, authors have recommended evaluating patients with contrast studies or endoscopy to identify patients at risk for SD and aspiration. The purpose of the study was to determine if a bedside swallowing evaluation (BSE) can identify patients with SD after MV.

Methods: One-year (2008) prospective study of all adult trauma patients admitted to the ICU requiring mechanical ventilation. Upon separation from MV, all patients received a BSE. The BSE used mental status, facial symmetry, swallow reflex, and oral ice chips and water to identify SD. Patients who passed BSE were advanced to oral intake per physician orders, while patients who failed BSE were allowed nothing by mouth.

Results: A total of 345 patients were included, 54 died prior to separation from MV and were excluded. The remaining 291 patients underwent BSE after separation from MV, with 143(49%) passing and 148(51%) failing. All patients extubated within 72 hours passed the BSE. All patients who passed BSE were discharged from the hospital without a clinical aspiration event. Independent risk factors for failure of BSE included:

	Odds Ratio (95% CI)	p-value
Tracheostomy	20.5 (4.2 – 100.6)	< 0.001
Age > 70 years	12.3 (3.1 – 48.7)	< 0.001
Intubated > 72 hours	4.8 (2.4 – 9.9)	< 0.001
Delirium Tremens	5.9 (1.8 – 19)	0.003
Traumatic Brain Injury	3.2 (1.5 – 6.5)	0.003
Spine Fracture	3.0 (1.4 – 6.5)	0.007

Three (2%) patients who failed BSE had a clinical aspiration event despite taking nothing by mouth.

Conclusions: A simple BSE can be used to identify patients at risk for SD after MV. More importantly BSE can safely clear patients without swallowing dysfunction, avoiding costly and time-consuming contrast studies or endoscopic evaluation.

Session 7B

Paper 52 2:50 PM

AN INITIATIVE BY MID-LEVEL PROVIDERS TO CONDUCT TERTIARY SURVEYS AT A LEVEL-I TRAUMA CENTER

Toan Huynh*, MD , Angela Blackburn, FNP, Darlene McMiddleton-Nyatui, ACNP, Kelly Moran, ACNP, Michael H Thomason*, MD, David G Jacobs*, MD. F.H. Sammy Ross Jr. Trauma Center.

Invited Discussant: Samir Fakhry

Introduction: Increased patient volume and residents' work hour restrictions have escalated the workload at trauma centers. Since tertiary surveys are integral to care; mid-level providers (MLP) can help streamline this time consuming process. Herein, we implemented a care plan where MLP's conduct all tertiary surveys, initiate appropriate consultations, and offload residents' work hours.

Methods: From January 2007 to December 2008, we conducted a prospective evaluation of an initiative wherein MLP's performed all tertiary surveys within 48 hours of admission. A tertiary survey consisted of a complete history & physical, follow-up of radiologic interpretations, and appropriate consultations. Data included patient demographics, incidence of additional diagnoses noted during tertiary surveys, and reduction in residents' work hours. Data are presented as mean ± SE.

Results: During the 2-year period, there were 5143 patients admitted to the trauma service. The mean age was 36±4.8 years, and mean ISS was 14.2±4.2. Overall mortality was 5%. Blunt mechanisms accounted for 85% and penetrating mechanisms resulted in 14% of injuries. MLP's conducted tertiary surveys in 56% of patients during the first year, and 76% in the second year. In 80 patients (mean age 44±7.1 yrs, ISS 21.7±2.8; $p<0.05$ vs. entire cohort), tertiary surveys revealed additional injuries; for an incidence of 1.5%. The majority of these diagnoses were of "minor" orthopedic and plastic types, half requiring consultations. Residents' workload was reduced by 1802 hours.

Conclusion: Implementation of an MLP initiative to conduct tertiary surveys in trauma patients can achieve a consistent and comprehensive work-up, while offsetting residents' workload and helping to ensure compliance with the 80-hour resident work policy.

Session 7B

Paper 53 3:10 PM

GERIATRIC MOTOR VEHICLE CRASH SURVIVAL: THE ROLE OF INSTITUTIONAL TRAUMA VOLUME

Samir R Pandya, MD, Jay A Yelon*, DO, Don A Risucci, PhD, Tom Sullivan, BS. New York Medical College.

Invited Discussant: Thomas Esposito

Introduction: Links between trauma center volumes and outcomes have been inconsistent in previous studies. This study examines the role of institutional trauma volume parameters in geriatric motor vehicle crash (MVC) survival.

Methods: The New York Statewide Planning and Research Cooperative Systems (SPARCS) database was analyzed for all trauma admissions to state-designated Level 1 and 2 trauma centers from 1996 - 2003. For each center the volume of patients was calculated in each of the following 4 categories: Young adult (17 – 64) MVC and non-MVC, and Geriatric (≥ 65) MVC and non-MVC. Logistic regression analysis was used to predict patient survival to hospital discharge based on the four volume parameters of the center at which they were treated, age, gender, ICISS score, year of admission and type of center (Level 1, 2).

Results: 5365 geriatric MVC victims were admitted to Level 1 (n = 3541) or Level 2 (n = 1824) centers in New York State excluding New York City. 4898 (91%) patients were discharged alive. Volume of Geriatric MVC at the center at which the patient was treated was an independently significant predictor of survival (Odds Ratio (OR); 95% Confidence Interval; OR = 9.0; 1.9 - 42.0; p = 0.005) as was younger age, female gender, decreased ICISS score and more recent year of admission. In contrast, Young Adult Non-MVC volume was an independently significant predictor of non-survival of geriatric patients (OR = 0.85; 0.74 – 0.97; p = 0.017). Type of center was unrelated to outcome.

Conclusions: There may be a risk-adjusted survival advantage for geriatric MVC patients treated at trauma centers with relatively higher volumes of geriatric MVC trauma and relatively lower volumes of young adult non-MVC trauma. For every increase of 100 geriatric MVC cases, there was a 9-fold increase observed in the odds ratio associated with survival. These results support consideration of age in trauma center transfer criteria.

Session 7B

Paper 54 3:30 PM

PHYSICAL AND PSYCHOLOGICAL FUNCTIONING OF POLYTRAUMA PATIENTS WITH TRAUMATIC BRAIN INJURY AT 10+ YEARS FOLLOW-UP

Jennifer Steel, PhD, Juliana Ramirez, MA, Justin Lazaroff, BS, Michael Youseff, Christian Probst MD, Christian Krettek, MD, Nicola Sittaro, MD, Hans Christoph Pape, MD*. University of Pittsburgh School of Medicine.

Invited Discussant: Fred Luchette

Background: The aims of present study were to examine the long-term physical and psychological consequences of multiple blunt forced trauma at 10+ years follow-up.

Methods: A total of 637 polytrauma patients were assessed with Medical Outcomes Study-Short Form-12, the Hannover Score for Poly-trauma Outcome (HASPOC) as well as physical re-examination at 10+ years follow-up. Injury-related characteristics were collected through medical record review. Chi-square, Analysis of Variance, linear and logistic regression were performed to test differences between groups and predictors of physical and psychological functioning at 10+ years follow-up.

Results: Polytrauma patients, who sustained a TBI (n=405), when compared to those without TBI (n=222), were more likely to be male (p=0.001), younger age at the time of injury (p=0.02), had higher Injury Severity Scores (p=0.001), longer hospital stays (p=0.001), and greater number of upper extremity injuries (p=0.02). Patients with TBI reported poorer psychological functioning (p=0.02), chronic pain (p=0.01), and more frequent use of medical aids (p=0.002) at 10+ years follow-up when compared to patients without TBI. In patients with TBI, significant predictors of physical and psychological functioning at 10+ years follow-up included age at the time of injury (physical; p=0.001), paraplegia (physical p=0.007 and psychological p=0.005), satisfaction with rehabilitation (physical p=0.001 and psychological p=0.001), disability (physical p=0.04 and psychological p=0.03), and use of medical aids (physical p=0.02).

Conclusions: Polytrauma patients with TBI had more severe injuries and poorer physical and psychological functioning at 10+ years follow-up when compared to other polytrauma patients. Factors at the time of injury as well as rehabilitation success predicted quality of life 10+ years follow-up.

Session 7B

Paper 55 3:50 PM

MORE OPERATIONS, MORE DEATHS? RELATIONSHIP BETWEEN OPERATIVE INTERVENTION RATES AND RISK-ADJUSTED MORTALITY AT TRAUMA CENTERS

Shahid Shafi*, MD, Jennier Parks, MPH, Chul Ahn, PhD, Larry M Gentilello*, MD, Avery B Nathens*, MD. University of Texas Southwestern Medical School.

Invited Discussant: Karen Brasel

Introduction: The Trauma Quality Improvement Project (TQIP) has demonstrated significant variations in risk-adjusted mortality rates across designated trauma centers. It is not known if outcome differences are related to provider level clinical decision-making. We hypothesized that centers with good outcomes undertake critical operative interventions aggressively, thereby avoiding complications and deaths.

Methods: The previously validated TQIP risk-adjustment algorithm was used to measure Observed-to-Expected mortality rates (O/E with 90% CI) for 152 Level 1 and 2 trauma centers participating in the National Trauma Data Bank (7.0). Adult patients (? 16 years) with at least one severe injury (AIS ? 3) were included (n=135,654). Operative intervention rates for solid organ injuries (Spleen, Liver, Kidney) were compared between centers classified as high mortality (O/E with CI > 1, n=35 centers) vs. low mortality (O/E with CI < 1, n=37 centers) using non-parametric tests.

Results: Low and high mortality trauma centers were similar in designation level, hospital and ICU beds, teaching status, and number of trauma, orthopedic, and neurosurgeons. Despite a similar incidence of solid organ injuries, low mortality centers were less likely to undertake operative interventions (Table).

Rates (Median, IQR)	High Mortality N=35	Low Mortality N=37	p-value
Spleen injury rate	6% (5–8)	6% (4–9)	0.5
Spleen procedures (All injuries)	36% (26–44)	26% (16–36%)	.004*
Spleen procedures (AIS ? 4 injuries)	25% (19–27)	20% (12–24)	.02*
Liver injury rate	8% (5–10)	7% (5–10)	0.6
Liver procedures (all injuries)	19% (13–25)	13% (9–17)	.03*
Liver procedures (AIS ? 4 injuries)	20% (13–25)	13% (10–17)	.01*
Kidney injury rate	3% (2–4)	3% (2–5)	0.33
Kidney procedures (all injuries)	10% (0–21)	4% (0–10)	.06
Kidney procedures (AIS ? 4 injuries)	8% (4–13%)	3% (0–8)	.01*

Conclusions: Lower rates of operative interventions for solid organ injuries are associated with improved risk-adjusted mortality at trauma centers. Hence, trauma center outcomes may be improved by identifying and disseminating institutional characteristics, medical decision-making, and processes of care factors that are associated with successful non-operative management of these injuries.

Session 8

Paper 56 8:00 AM

DECREASING REGIONAL NEUROSURGICAL WORKFORCE- A BLUEPRINT FOR DISASTER

Brian G Harbrecht*, MD, Jason W Smith, MD, Glen A Franklin*, MD, Frank B Miller*, MD, J David Richardson*, MD. University of Louisville.

Invited Discussant: Alex Valadka

Objective: Traumatic brain injuries (TBI) are a frequent cause of death substantial source of morbidity in injured patients. Neurosurgeons (NS) experienced in the management of TBI are essential to minimize morbidity from both primary and secondary brain injuries. However, NS willing to care for injured patients have become increasingly scarce. While many institutions have been individually affected by shortages of NS providing care to injured patients, data on regional changes in NS availability for trauma patients is limited.
Methods: We queried a statewide database for all traumatic intracranial hemorrhages (ICH) from 2004-2007 by ICD-9-CM codes (851.00-853.19). Institutions were categorized by those that admitted > 30 or < 30 patients per year. The state medical society provided the number of licensed NS practicing in the state per year.
Results: The number of NS has decreased on a yearly basis. The number of patients with significant ICH has increased (Table). The number of facilities admitting <30 pts/year has decreased and the proportion of patients cared for in these institutions has declined (Table).
Conclusion: In this state, increasing numbers of patients with ICH are being concentrated in a small number of centers while the number of NS available to care for them has dramatically decreased. Shortages in NS care for patients with traumatic ICH have the potential for catastrophic consequences on a regional basis if effective solutions to this manpower issue are not created.

Year	# NS	Total pts	Hosp	Patients		Hosp	Patients	
	N	N	>30/Yr	N	%	<30/Yr	N	%
2004	87	1234	11	968	78.4	51	266	21.6
2005	60	1292	11	1007	77.9	50	285	22.1
2006	57	1478	10	1180	79.8	47	298	20.1
2007	56	1590	11	1326	83.4	44	264	16.6

Session 8

Paper 57 8:20 AM

HEMATOPOIETIC PROGENITOR CELL MOBILIZATION IS MEDIATED THROUGH BETA-2 AND BETA-3 RECEPTORS FOLLOWING INJURY

Keith A Beiermeister, MD, Brett M Keck, MD, Ziad C Sifri*, MD, Walter Alzate, David H Livingston*, MD, Alicia M Mohr*, MD. UMDNJ - New Jersey Medical School.

Invited Discussant: Saman Arbabi

Introduction: Previous work has demonstrated that hematopoietic progenitor cells (HPCs) are mobilized into the peripheral blood (PB) and then sequestered in injured tissue following trauma. Non-specific beta blockade (BB) has been shown to cause a decrease in mobilization of HPCs to the periphery and to injured tissue. Given the vast physiological effects of non-specific BB the aim of this study is to delineate the role of specific BB in HPC growth and mobilization.

Methods: Male Sprague-Dawley rats underwent daily IP injections of propranolol (Prop), atenolol (B1), butoxamine (B2) or SR59230A (B3) for 3 days to induce BB. All groups then underwent lung contusion (LC). HPC presence was assessed by GEMM, BFU-E and CFU-E colony growth both in injured lung and bone marrow (BM). Flow cytometry, using c-kit and CD71, was used to determine mobilization into PB. *$p < 0.05$ compared to LC.

Results: BB with Prop, B2 and B3 resulted in less suppression of growth in BM as compared to LC alone (Fig 1, dashed line represents control). Prop, B2 and B3 resulted in a reduction of HPC mobilization to PB (Fig 2) and homing to contused lung (data not shown) in contrast to B1 which demonstrated results comparable to LC alone.

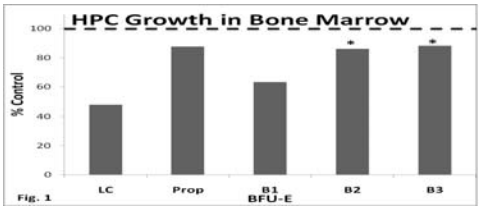


Fig. 1

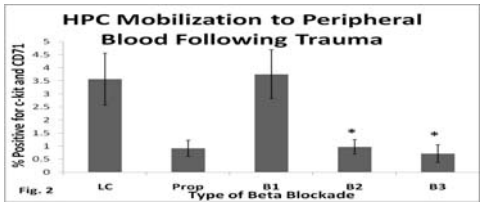


Fig. 2

Conclusions: Non-specific BB reduced suppression of HPC growth in BM following injury and prevented the mobilization and subsequent homing of HPCs to injured tissue. Our data has shown that this effect is mediated through the B2 and B3 receptors. Therefore, in trauma patients treatment with specific BB may attenuate the BM response to tissue injury.

Session 8

Paper 58 8:40 AM

THE COST EFFECTIVENESS OF TRAUMA CENTER CARE

Ellen J MacKenzie*, PhD, Sharada Weir, PhD, Frederick P Rivara*, PhD MPH, Gregory J Jurkovich *, MD, Avery B Nathens*, MD,PhD,MPH, Weiwei Wang, PhD, Daniel O Scharfstein, ScD, David S Salkever, PhD. Johns Hopkins Bloomberg School of Public Health.

Invited Discussant: Robert Mackersie

Objective: To determine the cost-effectiveness of treating major trauma at a level I trauma center (TC) compared to a non-trauma center hospital (NTC).

Methods: Estimates of cost-effectiveness were derived using data on 5,043 major trauma patients enrolled in a large prospective cohort study of severely injured adult patients cared for in 69 hospitals in 14 states. Data on costs were derived from multiple sources including claims data from the Centers for Medicare and Medicaid Services (CMS), UB92 hospital bills, and patient interviews. Cost-effectiveness was estimated as the ratio of the difference in costs (for treatment at a TC vs. NTC) divided by the difference in life years gained (and lives saved) between the two groups. We also measured cost effectiveness per quality adjusted life year (QALY) gained where quality of life was measured using the SF-6D. We used propensity score weighting to adjust for observable differences between patients treated at TCs and NTCs.

Results: The added cost for treatment at a TC vs. NTC was $36,319 per life-year gained ($790,931 per life saved) and $36,961 per QALY gained. These results compare favorably to widely accepted benchmarks used to judge the cost effectiveness of new treatments (ranging between $50,000 and $100,000 per life year or QALY gained). Cost-effectiveness was more favorable for patients with injuries of higher versus lower severity and for younger versus older patients (see table).

	Cost per Per Life-Year Gained if Treated at a TC vs. NTC
Total	$36,319
Max AIS	
<=3	$86,294
4	$44,820
5-6	$14,931
Age	
<55	$25,123
>=55	$174,818

Conclusion: Despite the increased cost of care at a trauma center vs. non-trauma center, the care at a trauma center is cost-effective when compared to other health care interventions of known and acceptable value.

Session 8

Paper 59 9:00 AM

TRAUMA CENTER DESIGNATION CORRELATES WITH FUNCTIONAL INDEPENDENCE FOLLOWING SEVERE BUT NOT MODERATE TRAUMATIC BRAIN INJURY

Joshua B Brown, BA, Nicole A Stassen, MD, Julius D Cheng*, MD, Ayodele T Sangosanya, MD, Paul E Bankey*, MD, PhD, Mark L Gestring*, MD. University of Rochester.

Invited Discussant: Ellen MacKenzie

Introduction: Outcomes after traumatic brain injury (TBI) have been correlated with many factors. The objective of this study was to determine if functional independence (FI) at discharge following TBI was influenced by the level of ACS trauma center designation.

Methods: Survivors of TBI treated at ACS Level I and Level II centers were identified using the NTDB® (2002-2006). FI at discharge from Level I and Level II centers was compared following both moderate (GCS 9-12) and severe (GCS ? 8) TBI. FI was defined as a total FIM score of 12, indicating complete independent functioning in locomotion, expression, and feeding. Univariate analysis identified covariates associated with FI, which were then entered into logistic regression to determine predictors of FI at discharge.

Results: 25,170 subjects were identified (28% moderate TBI; 72% severe TBI). Level I and Level II trauma center outcomes and neurosurgical interventions were compared (see table). The Level I patient population consisted of more severe TBI patients. Univariate analysis identified age, gender, race, ISS, mechanism, hypotension, severe non-head injuries, neurosurgery, and prior stroke as covariates. After logistic regression, predictors included all covariates except hypotension after moderate TBI, and all covariates except severe non-head injuries after severe TBI. ACS level I trauma center designation correlated with improved FI after severe TBI (OR 1.09; CI 1.05-1.14, p<0.01), but not after moderate TBI (OR 1.02; CI 0.96-1.08, p=0.5).

	Level I center (n=17,469)	Level II Center (n=7,701)
Moderate TBI*	4,594 (26.3%)	2,350 (30.5%)
Severe TBI*	12,875 (73.7%)	5,351 (69.5%)
FI at discharge	8,759 (50.1%)	3,588 (46.6%)
Moderate TBI	2,643 (57.5%)	1,301 (55.4%)
Severe TBI*	6,116 (47.5%)	2,287 (42.7%)
Neurosurgical Intervention	2,358 (13.5%)	1,059 (13.8%)

* $p < 0.05$ for Level I vs. Level II center

Conclusions: Treatment at an ACS Level I trauma center is more likely to result in FI at discharge following severe TBI. ACS designation did not correlate with FI after moderate TBI. Further prospective study is recommended to clarify this discrepancy.

Session 8

Paper 60 9:20 AM

THE BENEFITS OF A TRAUMA INTENSIVIST MODEL AS APPLIED TO A LEVEL II COMMUNITY HOSPITAL TRAUMA PROGRAM

John C Lee, MD, Frederick B Rogers*, MD, Lanyce Horn, RN, Tracy L Evans, MD, Carla Leed, RN. Lancaster General Hospital.

Invited Discussant: Bruce Bennett

Background: Critical care trained trauma surgeons are the ideal care provider for the severely injured patients. This "Captain of the Ship" (COS) assumes complete responsibility of the patient, from initial resuscitation to eventual discharge. Unlike ACS-verified level I centers, many community hospitals/non-academic trauma centers employ a more fragmented approach, with care in the ICU delegated to a committee of multiple specialists. We hypothesized that dedicated trauma surgeon/intensivists as COS would improve ICU outcome in a community base, non-academic trauma center.

Method: Beginning 9/2005, dedicated fulltime trauma intensivists, without any resident coverage, assumed primary responsibility of all trauma patients admitted to a level II Pennsylvania state verified trauma center. The ICU care was uninterrupted 24/7, 365 days a year. Subspecialty consultations, for recommendations in care only, were selectively obtained as clinically indicated. We compared the three years prior to the implementation of the COS model (PRE: 2003-2005) to the three years following the model (POST: 2006-2008). P ? 0.05 was considered significant.

Results: Mean (±SEM)

	PRE	POST	ρ
N	1541	1627	n/a
ISS	16.1 (0.28)	16.7 (0.26)	0.01
Ventilator days	8 (0.56)	6 (0.34)	0.002
ICU days	4.9 (0.19)	4.4 (0.17)	0.001
# consults	684	558	0.001

The number of consults decreased by 19% in the (POST) group, while ventilator days showed a 25% decrease during the same time period.

Conclusion: A trauma/intensivist driven model can be successfully adopted in a non-academic community trauma program, without the need for a residency program. Care by committee in the ICU fragments care, diminishes the role of the trauma service, decreases the overall throughput of trauma patients, and may impact outcome.

Session 8

Paper 61 9:40 AM

TITLE: EFFECTS OF ETHANOL INTOXICATION AND GENDER ON BLOOD COAGULATION

Nicholas Spoerke, MD, Chitra Sambasivan, MD, Phil Van, MD, Samantha Underwood, MS, Jerome Differding, MPH, David Shapiro, MD, Martin Schreiber*, MD. Oregon Health and Science University.

Invited Discussant: Mariane Cinat

Background: Ethanol intoxication is a common contributor to traumatic injury. It is unknown whether ethanol consumption contributes to the coagulation differences seen between males and females after trauma. Our aim was to examine the combined effect of ethanol intoxication and gender on coagulation measured by thrombelastography (TEG).

Methods: 58 healthy subjects participated and chose to enter into a control group (CG, n=20; 10 male, 10 female) or drinking group (DG, n=38; 20 male, 18 female). Venous blood samples for kaolin-activated TEG were drawn at the beginning of the study. Subjects then interacted in a social atmosphere for at least 2 hours, eating and consuming alcoholic (DG) or non-alcoholic beverages (CG). After 2 hours, blood alcohol status was determined and a second TEG was performed.

Results: Demographics were similar between groups except for age (36.7 yrs CG vs 29.9 yrs DG; p=0.009). All baseline TEG measurements were similar between the CG and DG. Blood alcohol levels (BAL) in the DG were similar between genders at the end of study (191 mg/dl females vs. 189 mg/dl males, p=NS). At the end of study, mean R values in the male DG were higher than the other groups (male DG 9.5min; normal R 4-8min). Changes in TEG values from baseline (base) to post-imbibition (post) in the male DG were consistent with the development of a coagulopathic state (see table). There were no significant changes in any TEG parameters from baseline to post-imbibition in the female DG compared to the female CG.

TEG parameter	Male CG	Male DG	p
Δ R (min) [post-base]	-1.2 [7.8-9.1min]	0.5 [9.5-8.9min]	0.018
Δ K (min) [post-base]	-0.1 [2.3-2.5min]	0.8 [3.2-2.4min]	0.026
Δ LY30 (%) [post-base]	0.5 [1.1-0.5min]	-0.6 [0.3-0.9min]	0.014

Conclusions: Consumption of commonly ingested quantities of alcohol correlated with the development of a hypococagulable state in males but had no effect on coagulation status in females. This phenomenon may contribute to differences in post trauma coagulation status previously noted between genders.

Session 8

Paper 62 10:00 AM

IMPROVED TRAUMA SYSTEM MULTI-CASUALTY INCIDENT RESPONSE: COMPARISON OF 2 TRAIN CRASH DISASTERS

Henry M Cryer MD, PhD*, Demetrios Demetriades MD, PhD*, Daniel Margulies MD*, Brant Putman MD, Donald J Gaspard MD*, Rambir Singh MD, Shawki Saad MD, Christopher Samuels MD, Jeffrey S Upperman MD*, Cathy Chidister. UCLA.

Invited Discussant: Rick Frykberg

Background: Two train crash mass casualty incidents (MCI) occurred in our trauma system (TS). A post crash analysis of the first MCI determined that most victims went to local community hospitals (CH) with underutilization of trauma centers (level I and II TC) resulting in changes to our disaster plan. To determine if our TS MCI response improved, we analyzed the distribution of patients from the scene to TCs and CHs in the recent 2008 MCI compared to the 2005 MCI.

Methods: Data from EMS and trauma center records were interrogated to compare patients triaged as critical, moderately, or minor injury in the field, the type of transport and the destination in the 2008 MCI to the 2005 MCI.

Results: The field triage status was known for 91 transported patients in the 2008 MCI and 106 in the 2005 MCI. The distribution of patients from the scene were:

	Level I 05	Level I 08	Level II05	Level II 08	CH 05	CH 08
Critical	7/25(28%)	16/33(49%)*	4/25(16%)	11/33(33%)*	14/25(56%)	6/33(18%)*
total	21/106(19%)	30/91(33%)*	6/106(6%)	31/91(34%)*	79/106(75%)	30/91(33%)*

*=P<.05 2008 vs. 2005

In 2008 more TCs were utilized (8 vs. 3) and more patients were transported by air (45 vs. 2). In 2008 the most severely injured victims (median ISS 16, range 1-43, and 12 of 15 patients requiring emergent operation) were distributed to 4 level I TCs, the moderately injured victims (median ISS 10, range 1-22) to 4 level II TCs and the majority of minor injuries to CHs. Emergent operations performed included, 6 laparotomies, ORIF of 6 open fractures, 1 craniotomy, 1 thoracotomy, and 1 facial scalp repair.

Conclusions: A trauma system performance improvement program allowed us significantly improve our response to MCIs with improved utilization of trauma centers and improved distribution of victims according to injury severity and needs.

Session 8

Paper 63 10:20 AM

RISK OF DEATH AND TIMING OF FEMUR FRACTURE FIXATION: IS THERE REALLY A CRITICAL TIME WINDOW?

D Griffin MD, J Sperry MD MPH and R Nirula* MD, MPH. University of Utah Department of Surgery.

Invited Discussant: Hasan Alam

Background Femur fracture fixation 3-5 days post injury is associated with increased mortality in several small studies which lack adjustment for confounders such as age and comorbidities. We hypothesized that fixation during this critical window is not associated with worse outcomes when there is adequate adjustment for confounders.

Methods Multivariate regression analyses were undertaken using the 2007 NTDB dataset from 2002 to 2006. Mortality, resource utilization and complications were assessed in relation to timing of fixation while controlling for patient demographics, physiology, comorbidities and other injuries. Timing of fixation was stratified into four groups: within 24 hours, 24-48 hours, 3-5 days, and > 5 days.

Results There were 101,226 femur fracture fixation patients with 68% repaired within 24 hrs. The risk of mortality increased as the interval between admission and fixation lengthened in all patients (figure 1). In more severely injured patients (ISS >15), there was a 55% increase in mortality observed when fixation occurred during the critical 3-5 day period (figure 2). Early fixation was associated with the lowest use of resources (charges, ICU days and vent days) and improved functional outcomes.

Fig 1: Mortality OR's by fixation time

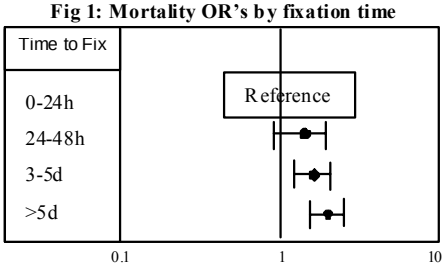
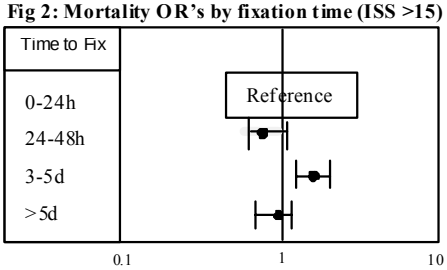


Fig 2: Mortality OR's by fixation time (ISS >15)



Conclusions There is an increased risk of mortality during the critical 3-5 day period in polytrauma patients. Furthermore, resource utilization and functional outcome are superior for early fixation. Timing of fracture fixation may, therefore, be an important benchmark for trauma center verification.

Session 8

Paper 64 10:40 AM

SHOULD AGE BE A FACTOR TO CHANGE FROM A LEVEL II TO A LEVEL I TRAUMA ACTIVATION?

Vanessa K Shifflette, MD, Manuel Lorenzo, MD *, Alicia J Mangram, MD, Michael S Truitt, MD, J Darryl Amos, MD, Ernest L Dunn, MD *. Methodist Hospital.

Invited Discussant: Roxie Albrecht

Background: Elderly trauma patients have a higher incidence of medical co-morbidities when compared to their younger cohorts. Currently, the minimally accepted criteria established by the Committee on Trauma for the highest level of trauma activation (Level I) does not include age as a factor. Should patients older than 60 years of age with polytrauma and/or a significant mechanism of injury be considered as part of the criteria for Level I activation? Would these patients benefit from a higher level of activation?

Methods: The National Trauma Data Bank (NTDB) was queried for the period of January 1, 1999 to December 31, 2008, for all trauma patients and associated injury severity score (ISS). The data abstracted was based on age and ISS.

Results: For the period of review, the NTDB contained 802,211 trauma patients. Seventy-nine percent were younger than 60 years old, and 21% were older than 60.

ISS Category	% Morbidity		% Mortality		P value	
	Age ? 60	Age > 60	Age ? 60	Age > 60	Morbidity	Mortality
Minor (0-9)	1.5	5.0	0.6	3.3	0.001	0.001
Major (10-15)	4.8	10.4	1.4	5.9	0.001	0.001
Severe (16-24)	10.9	16.4	4.3	12.0	0.001	0.001
Critical (> 24)	27.3	28.0	27.9	41.3	0.0495	0.001

Conclusion: Our analysis shows that in all levels of injury, patients older than 60 y/o have an increased risk for morbidity and mortality. A significant difference was found among the minor and major ISS patients. We found a 3-fold increase in morbidity and a 5-fold increase in mortality among the older (age >60) population with a minor ISS. Additionally, the patients older than 60 with a major ISS demonstrated a 2-fold increase in morbidity and a 4-fold increase in mortality. Patients with an ISS between 0-15 are often triaged to Level II activation. Our data would suggest that patients with age > 60 should be a criterion for the highest level of trauma activation.

Session 8

Paper 65 11:00 AM

DELAWARE'S INCLUSIVE TRAUMA SYSTEM: IMPACT ON MORTALITY

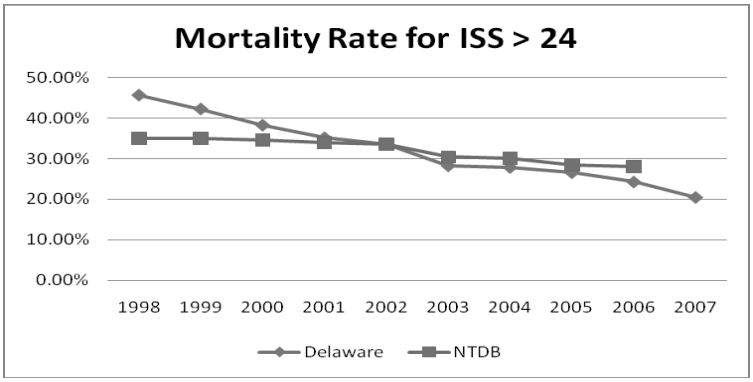
Glen Tinkoff MD*, Ross Megargel DO, Mary Sue Jones RN, MS, James Reed PhD, Edward Alexander MD. Christiana Care Health System.

Invited Discussant: Marc Shapiro

Introduction: The impact of implementing an inclusive state trauma system on injury-related mortality for patient's with life threatening injuries was assessed.

Methods: Using the state trauma registry, trauma patients evaluated in all of Delaware's acute care hospitals from 1998 to 2007 were identified. These patients were categorized by ISS groups (1-9, 10-15, 16-24, and >24). Each category was analyzed by mortality and interfacility transfer rate to the level 1 trauma center for each year. An analysis of the NTDB for these ISS groups and mortality was performed to provide a comparative benchmark. Chi square and ANOVA were used were appropriate with p ? 0.05.

Results: 41,615 entries were identified within the state trauma registry for the 10 yr study period. Mortality rates did not significantly differ for the ISS categories except for ISS > 24 group. For this group, mortality incrementally decreased from 45.7% (1998) to 20.4% (2007) (p ? 0.0005). This rate of decrease in mortality was significantly greater than that displayed in the NTDB. The rate for the aggregate of all interfacility transfers, but not for the individual ISS groups, significantly increased over the same period.



Conclusion: Since it's inception, Delaware's trauma system, in which all of the acute care hospitals participate, has been associated with an incremental and significant decrease in the mortality of the most critically injured patients. This decrease is more substantial than that experienced nationally as depicted within the NTDB. These findings and our evolving experience support the concept and benefits of the "Inclusive" Trauma System.

Session 8

Paper 66 11:20 AM

POINT-OF-CARE USE OF VISENSIA (BIOSIGN) INDEX SCORE PREDICTS POOR OUTCOMES AND MAY BENEFIT PRE-HOSPITAL TRAUMA TRIAGE

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Invited Discussant: Grant Bochicchio

Background: Triage criteria rely on physiologic, anatomic, and mechanistic indicators of injury to minimize over-triage and under-triage, which remain persistently high. The Visensia(Biosign)Index Score (VIS) is a proprietary algorithm based on a bedside monitor that integrates 5 vital signs (VS): heart rate, respiratory rate, blood pressure, pulse oximetry & temperature (OBS Medical, IN).[1] It calculates a score ranging from 1 (no abnormality) to 5 (severe abnormalities). We aim to explore the utility of VIS in identifying trauma patients likely to have a poor prognosis on arrival to the emergency departments (ED)

Methods: After IRB approval, the trauma registry was used to review 117 patients admitted to our level 1 trauma center over a 6 month period. VS were obtained from the pre-hospital run-sheets and upon arrival to the ED. An initial pre-hospital VIS and a mean ED VIS (based on multiple ED VS in the first 30 minutes after arrival) was calculated. We used chi-square test to compare outcomes in five different clusters (Visensia score 1 to 5) and multi-variate regression to assess its association with ICU length of stay and overall hospital days.

Results: Two major clusters were identified. Pre-hospital VIS and ED VIS Scores >3 increased risk of mortality as compared to those with scores <3; Odds Ratios 2.9[1.06-7.8; $p<0.001$) and 3.3 [1.04-10.3; $p<0.001$) respectively. There was no association with length of ICU stay, hospital days or Injury Severity Scores (ISS) in the multi-variate analysis.

Conclusions: Visensia Index Score identified trauma patients likely to have a poorer prognosis in our study population. This may improve pre-hospital triage and prove more valuable to the practicing clinician than retrospectively computed trauma scores (ISS, TRISS).

Reference: **1.** Tarassenko L, Hann A, Young D. Integrated monitoring and analysis for early warning of patient deterioration.Br J Anaesth. 2006 Jul;97(1):64-8.

Session 8

Paper 67 11:40 AM

INCIDENTAL FINDINGS ON THE TRAUMA CT ARE NOT FOLLOWED UP: ARE WE FAILING OUR PATIENTS?

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Invited Discussant: Toan Huynh

Background: Because of the liberal use of CT for trauma, incidental findings (IF) are discovered with increasing frequency. An emphasis on patient safety protocols with full integration of electronic medical records in our hospital provides the ideal environment to capture and follow-up trauma patients, regarding their IF. Our objective is to evaluate if IF are managed adequately after trauma discharge.

Patients: Trauma patients evaluated by CT from January to December 2006 were included. The follow-up of any IF was assessed over the next two years (up to December 2008). IF were classified as Category I (commonly found in asymptomatic patients and frequently related to age), Category II (requiring further evaluation but not urgently), or Category III (requiring urgent evaluation).

Results: Of 746 patients with CT, 501 (67%) had 902 IF, including 169 (23%) with 200 Category III findings: 16 on CT head, 57 on CT c-spine, 73 on CT chest, and 54 on CT abdomen. Only 32 of these 169 patients (19%) had orders on the discharge note to follow-up the IF. More so, 112 of them had a primary care physician from our hospital but only 18 (16%) had IF-related orders on discharge and only 9 (8%) had evidence of IF management over the next 2 years.

Conclusions: IF are very common on trauma CT and require urgent evaluation in approximately one quarter of the patients. However, follow-up is extremely poor after discharge, raising significant ethical and legal concerns. Systems must be created specific to the management of IF.