

Scientific Session I  
Raymond H. Alexander, MD Resident Paper Competition of the EAST Foundation

January 15, 2014  
Paper 1 8:50 am

**CRYOPRESERVED RED BLOOD CELLS ARE SUPERIOR TO STANDARD  
LIQUID RED BLOOD CELLS**

David A. Hampton, MD, MEng, Connor L. Wiles, BS, Loic J. Fabricant, MD,  
Laszlo N. Kiraly, MD, FACS, Jerome Differding, MPH, Samantha Underwood, MS,  
Dinh Le, MD, Jennifer M. Watters, MD, FACS\*, Martin A. Schreiber, MD, FACS\*  
Oregon Health and Science University

**Presenter:** David A Hampton, MD, MEng

**Discussant:** Levi Procter, MD, University of Kentucky Medical Center

**Objectives:** Liquid preserved packed red blood cell (LPRBC) transfusions are utilized to treat anemia and increase end organ perfusion. Throughout their storage duration, LPRBCs undergo biochemical and structural changes collectively known as the storage lesion. These changes adversely affect perfusion and oxygen off-loading. Cryopreserved RBCs (CPRBC) can be stored for up to 10 years and potentially minimize the associated storage lesion. We hypothesized that CPRBCs maintain a superior biochemical profile compared to LPRBCs.

**Methods:** This was a prospective, randomized, double-blinded study. Adult trauma patients with an injury severity score  $>4$  and an anticipated 1-2 unit transfusion of PRBCs were eligible. Enrolled patients were randomized to receive either CPRBCs or LPRBCs. Serum proteins (haptoglobin, serum amyloid P, and C-reactive protein), pro- and anti-inflammatory cytokines, D-dimer, nitric oxide, and 2,3-DPG concentrations were analyzed. Mann-Whitney U and Wilcoxon Rank Sum tests were utilized to assess significance ( $p < 0.05$ ).

**Results:** Fifty-seven patients were enrolled (CPRBC:n=22, LPRBC:n=35). The LPRBC group's final IL-8, TNF-alpha, and D-dimer concentrations were elevated compared to their pre-transfusion values ( $p < 0.05$ ). After the 2<sup>nd</sup> transfused units, 2,3 DPG was higher in the patients receiving CPRBCs ( $p < 0.05$ ); this difference persisted throughout the study. Finally, serum protein concentrations were decreased in the transfused CPRBC units compared to LPRBC ( $p < 0.01$ ).

**Conclusions:** CPRBC transfusions have a superior biochemical profile: an absent inflammatory response, attenuated fibrinolytic state, and increased 2,3 DPG. A blood banking system utilizing both storage techniques will offer the highest quality products to critically injured patients virtually independent of periodic changes in donor availability and transfusion needs.

## Notes

**Scientific Session I**  
**Raymond H. Alexander, MD Resident Paper Competition of the EAST Foundation**

**January 15, 2014**  
**Paper 2                      9:10 am**

**TEEN TRAUMA WITHOUT THE DRAMA: OHIO ADOLESCENT TRAUMA OUTCOMES**

Ashley E. Walther, MD, Timothy A. Pritts, MD, PhD\*, Richard A. Falcone, Jr., MD, MPH\*,  
Dennis Hanseman, PhD, Bryce R.H. Robinson, MD\*  
University of Cincinnati

**Presenter:** Ashley E. Walther, MD

**Discussant:** Barbara Gaines, MD, Children's Hospital of Pittsburgh

**Objectives:** The optimal treatment facility for adolescent trauma patients is controversial. We sought to investigate risk-adjusted outcomes of adolescents treated at adult-only trauma centers (ATC) vs pediatric-only trauma centers (PTC) in a state system with legislated ACS-verified institutions in order to determine ideal pre-hospital referral patterns.

**Methods:** The Ohio Trauma Registry was queried for 15-19 year olds with a length of stay (LOS) >1 day at ATC (Level 1) or PTC (Level 1 and 2) from 2008-2012. Race, gender, ED vital signs, ISS, and CT imaging were reviewed. Outcomes by mechanism of injury included ventilator days, ICU LOS, hospital LOS, and mortality. Statistical analysis was performed using rank sum or Chi-square testing. Propensity score-based risk adjustment matching was used to compare groups (score within 0.01, ISS within 5).

**Results:** 5,793 adolescent patients were identified (84% blunt, 16% penetrating) with 66% treated at ATC. Unadjusted demographics and vital signs significantly differed between centers ( $p<0.01$ ). For adolescents with blunt injury, more males (71.6% vs 66.3%,  $p<0.01$ ) and non-whites (19.2% vs 15.8%,  $p<0.01$ ) were seen at PTC. In 928 propensity-matched pairs for blunt trauma, no differences were seen in mortality or hospital LOS. ATC were found to have longer ICU LOS (0.3 days,  $p<0.01$ ) and ventilator use (0.2 days,  $p=0.01$ ). For penetrating trauma, more males (88.6% vs 50.8%,  $p<0.01$ ) and non-whites (76.6% vs 68.6%,  $p<0.01$ ) were admitted to ATC. In 115 propensity-matched pairs of penetrating injuries, no differences were seen in outcomes. In both injury patterns, CT imaging was more common at ATC ( $p<0.01$ ).

**Conclusions:** Major outcome differences for injured adolescents do not exist between ATC and PTC, regardless of injury pattern. CT imaging remains more prevalent at ATC. In a state system with mandatory ACS-verified centers, injury patterns need not dictate triage decisions for adolescent patients.

## Notes

Scientific Session I  
Raymond H. Alexander, MD Resident Paper Competition of the EAST Foundation

January 15, 2014  
Paper 3 9:30 am

**IN-VITRO TRANSFUSION OF RED BLOOD CELLS RESULTS IN DECREASED PRODUCTION  
OF IL-8, IL-10, AND TNFA BY HUMAN T CELLS**

Kristin L. Long, MD, Martin Ward, MS, Dennis Williams, MD, Cindy Meier, MS,  
Jerold Woodward, PhD, Andrew C. Bernard, MD\*  
University of Kentucky

**Presenter:** Kristin L Long, MD

**Discussant:** Robert Winfield, MD, Washington University

**Objectives:** Transfusion-related immunomodulation (TRIM) consists of both pro- and anti-inflammatory responses after transfusion of red blood cells. Stored red blood cells (RBCs) suppress human T cell proliferation in-vitro, but the mechanisms remain unknown. We hypothesized that cytokine synthesis by T cells may mediate suppressed proliferation of activated T cells when stored RBCs are present.

**Methods:** Purified human T cells were stimulated to proliferate with anti-CD3/anti-CD28 and then exposed to stored or fresh RBCs. Cells were placed in culture for 5 days. Cell culture supernatants were analyzed for inflammatory cytokines TNF- $\alpha$  and IL-8, as well as anti-inflammatory IL-10 using multi-analyte ELISArray kits.

**Results:** Stimulated T cells proliferated. RBC exposure markedly suppressed this proliferation. TNF- $\alpha$ , IL-8 and IL-10 were increased in response to stimulation but depressed in the presence of stored RBCs. Use of fresh RBCs also resulted in depression of TNF- $\alpha$ , IL-8 and IL-10 when compared to stimulated T cells with no RBCs; however, this depression was slightly less pronounced for IL-10 and TNF- $\alpha$ .

**Conclusions:** T cell activation is associated with both pro- and anti-inflammatory cytokine release, comparable to patterns seen in trauma and acute injury. All of these responses are depressed by exposure to stored red blood cells. Decreased levels of these cytokines after red blood cell transfusion represents a potential contributor to the immunosuppressive complications seen in trauma patients after transfusion. This provides insight for future mechanistic studies to delineate the role of red blood cell transfusion in TRIM.

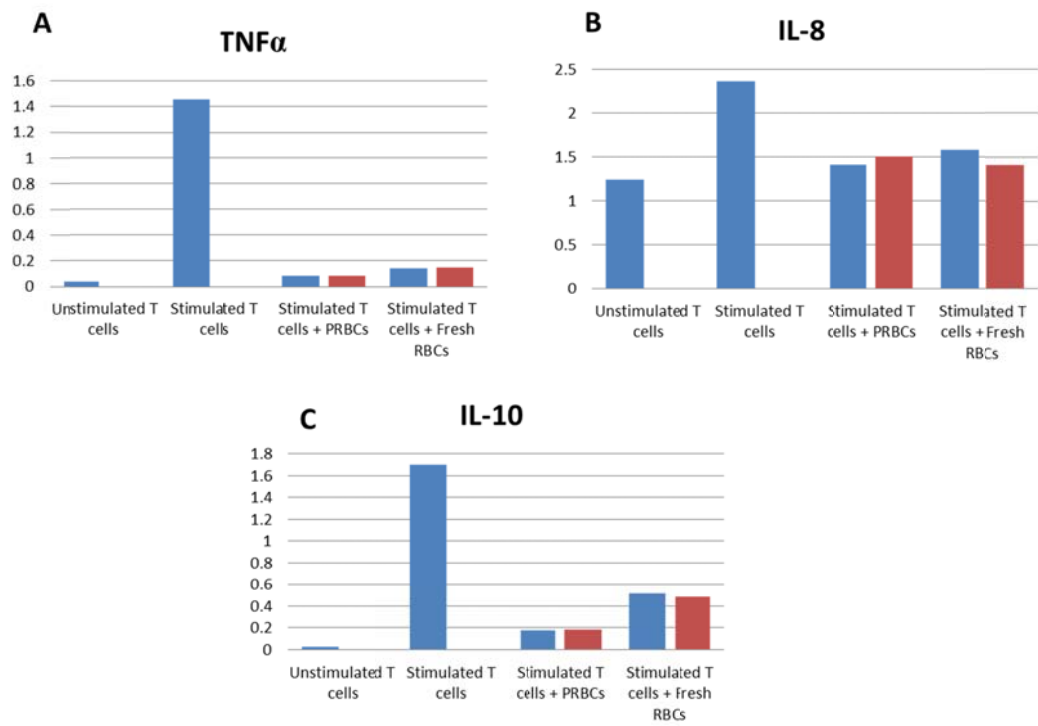


Figure 1: Cytokine production of (a): TNF- $\alpha$ , (b): IL-8, and (c): IL-10 by human T cell after exposure to red blood cells

Scientific Session I  
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January 15, 2014  
Paper 4 9:50 am

**EPIDURAL PLACEMENT DOES NOT RESULT IN AN INCREASED INCIDENCE OF VENOUS THROMBOEMBOLISM (VTE) IN COMBAT-WOUNDED PATIENTS.**

Joseph David Caruso, M.D., Allison B. Weisbrod, MD, MPH, Eric Elster, MD, FACS,  
Carlos J. Rodriguez, DO, MBA, FACS\*  
Walter Reed National Military Medical Center

**Presenter:** Joseph David Caruso, MD

**Discussant:** Donald Jenkins, MD, Mayo Clinic

**Objectives:** Patient-controlled epidural analgesia (PCEA) decreases the amount of systemic opioid required for adequate analgesia and decreases the rate of opioid induced side effects. Given the location of catheters required to deliver analgesics and potential for epidural hematoma, the American Society of Regional Anesthesia and Pain Medicine recommends modification of the standard trauma VTE prophylaxis regimen of enoxaparin 30mg BID to 40mg daily. The objective of this retrospective study was to determine if 40mg daily dosing would increase the incidence of VTE.

**Methods:** With IRB approval, records of all combat casualties admitted to our institution between November 2010 and November 2012 were reviewed for demographics, VTE prophylaxis regimen, PCEA days, and incidence of VTE. Patients who arrived without VTE were the study cohort. Rates of VTE were compared between PCEA and no-PCEA groups. Variables were analyzed with Mann-Whitney U, Pearson's  $\chi^2$ , and Fisher's Exact tests. A p-value  $\leq 0.05$  was considered significant.

**Results:** 565 records were reviewed. 484 met inclusion criteria. 181(37.4%) patients had PCEA for 13(6,25) days. Age and sex were similar between the groups. PCEA patients were more often injured by dismounted IEDs (75.1% vs. 39.3%,  $p < 0.001$ ), had longer hospital stays (38 vs. 17 days,  $p < 0.001$ ), higher ISS (14 vs. 12,  $p = 0.033$ ), and were more likely to have an amputation (66.1% vs. 20.4%,  $p < 0.001$ ). 23(12.7%) PCEA patients developed VTE vs. 32(10.6%) no-PCEA patients ( $p = 0.464$ ). 11(47.8%) VTE events occurred with the catheter in place, while 12(52.2%) occurred 6(2,15) days after removal.

**Conclusions:** Though PCEA catheters were more often placed in patients prone to VTE, there was no difference in incidence of VTE with their use. This data suggests that enoxaparin 40mg daily in patients with PCEA is not inferior to 30mg BID for VTE prophylaxis in combat-wounded patients.

## Notes



Scientific Session I  
Raymond H. Alexander, MD Resident Paper Competition of the EAST Foundation

January 15, 2014  
Paper 5 10:10 am

**SALUTARY EFFECT OF CALCIUM CHANNEL BLOCKADE FOLLOWING  
HYPOXIC AND SEPTIC INSULT**

Abubaker A. Ali, MD, Lawrence N. Diebel, MD\*, David Liberati, MS  
Wayne State University

**Presenter:** Abubaker A. Ali, MD

**Discussant:** George Kasotakis, MD, Massachusetts General Hospital

**Objectives:** Intestinal ischemia and reperfusion (I/R) is a major problem associated with a high morbidity and mortality following trauma and hemorrhagic shock. Apoptosis is the major mode of cell death following reperfusion. The cytoskeleton damage precedes the apoptotic final microscopic features. Calcium plays a central role in apoptosis. Therefore, we studied whether verapamil could preserve the function of the cytoskeleton in an in vitro intestinal model following hypoxia-reoxygenation (H/R). Our goal was to assess mainly the cytoskeleton functions which includes: IgA transport and the cell monolayer barrier integrity.

**Methods:** Confluent HT-29 intestinal monolayers grown in a two-chamber cell culture system were held under hypoxic (5% CO<sub>2</sub>) conditions for 90 minutes followed by normoxia (21% O<sub>2</sub>) (H/R). Cell subsets were exposed to lipopolysaccharide (LPS-10µg/ml) prior to H/R. Verapamil (8µM) was added to HT-29 cell subsets after H/R treatment. Dimeric IgA was added to the basal compartment and apical media was sampled at intervals to quantitate IgA transcytosis using ELISA. HT-29 cells held under normoxic conditions served as controls. HT-29 permeability to FD4 was assessed at the end of each experiment. In a separate experiment, HT29 cells were stained for F actin using rhodamine-labeled phalloidin.

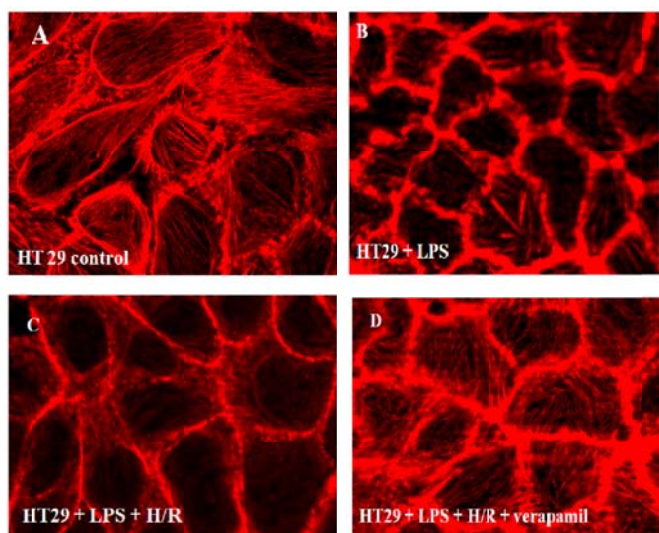
**Results:** Intestinal monolayer permeability was increased following treatment with H/R and/or LPS. Verapamil treatment prevented increased permeability in HT-29 cells and led to an increase IgA transport. Disruption of actin microfilaments was demonstrated following H/R and/or LPS insult but was abrogated by addition of verapamil following H/R and/or LPS insult.

**Conclusions:** Reperfusion can lead to both physical and immune derangement of epithelial cell barrier function. Verapamil may be important in preserving gut barrier function. Additional studies including confirmation in animal shock models are needed to validate these findings

	IgA Transcytosis (pg/ml) 12hr.	FD4 Permeability (nmol·cm <sup>-2</sup> ·hr <sup>-1</sup> )
HT-29 control	12.4 ± 0.5	0.44 ± 0.02
HT-29 + LPS	21.3 ± 1.0*	0.72 ± 0.05*
HT-29 + LPS + H/R	35.1 ± 1.6*	0.81 ± 0.08*
HT-29 + LPS + H/R + Verap.	48.9 ± 1.1*#	0.50 ± 0.04#

Apical chamber sIgA, (mean  $\hat{\pm}$  SD, N = 5)

\*p<0.05 vs. HT-29 control, #p<0.05 vs. same group no Verapamil



Actin staining of HT29 cells + LPS and H/R  $\pm$  verapamil

**Scientific Session II**  
**Raymond H. Alexander, MD Resident Paper Competition**

**January 15, 2014**  
**Paper 6                      10:50 am**

**TRANSFUSION OF STORED RED BLOOD CELLS IN TRAUMA PATIENTS IS NOT ASSOCIATED WITH INCREASED PROCOAGULANT MICROPARTICLES**

Satbir K. Dhillon, MD, Mindy Houck, PA-C, Donald H. Jenkins, MD\*, Jordan Rosedahl, BA, Sarah E Perkins, MSc,  
William Harmsen, MS, Timothy Halling, ASc, Myung Park, MD\*  
Mayo Clinic

**Presenter:** Satbir K. Dhillon, MD

**Discussant:** Timothy Pritts, MD, PhD, University of Cincinnati

**Objectives:** We set out to determine the effects of transfusing stored red cells on the levels of procoagulant MPs in the blood of trauma patients.

**Methods:** Blood was drawn and processed to platelet poor plasma for MP analysis for 409 injured patients seen in the trauma bay from February 2001 to January 2013. Blood from 27 non-injured volunteers was also analyzed. Quantification of platelet derived (PD) and non-platelet derived (non-PD) procoagulant MPs (per  $\mu$ l plasma) utilizing a direct-plasma analysis via flow cytometry was performed. Demographic data, injury severity score (ISS), overall mortality and units of transfused packed red cells was collected. Data are presented as median interquartile range (IQR). Transfusion groups were assessed using t-test or Wilcoxon rank sum test. The alpha level was set as .05 for statistical significance.

**Results:** Median ISS was 12 (5-19), 12% transfused, median age 48 (29-62), 68% Male and overall mortality 3%. Median units transfused 3(2-5). The median number of all procoagulant MPs was greater in trauma patients 758 (405-1627) when compared to our control subjects 232 (125-372),  $p < .0001$ . This difference remained significant after adjusting for age and sex,  $p < .0001$ . Transfused patients had similar ED baseline MPs (PD and non-PD) when compared to non-transfused patients ( $p = .89$ ). After transfusion the procoagulant MP levels did not change ( $p = .07$ ). Patients transfused with blood  $> 14$  days old did not have increased procoagulant MP levels when compared to those that received blood that was  $< 14$  days ( $p = .5$ ). This was also true for those that received blood that was  $> 28$  days old when compared to those that received blood that was  $< 28$  days old ( $p = .84$ ).

**Conclusions:** Early after injury procoagulant MPs are increased even after adjusting for age and sex. We did not observe any change in the levels of procoagulant MPs after transfusion of stored red cells.

## Notes

Scientific Session II  
Raymond H. Alexander, MD Resident Paper Competition

January 15, 2014  
Paper 7 11:10 am

**DECREASED MORTALITY IN TRAUMATIC BRAIN INJURY FOLLOWING REGIONALIZATION  
OF TRAUMA ACROSS HOSPITAL SYSTEMS**

Michael L. Kelly, MD, Aman Banerjee, MD, Michael Nowak, PhD, Michael Steinmetz, MD, Jeffrey Claridge, MD  
MetroHealth Medical Center

**Presenter:** Michael L. Kelly, MD

**Discussant:** Deborah Stein, MD, R Adams Cowley Shock Trauma Center

**Objectives:** The Northern Ohio Trauma System (NOTS) was established to improve outcomes of trauma patients across the region. We hypothesized that mortality in patients with traumatic brain injury (TBI) would improve after regionalization.

**Methods:** All patients >14 years with a TBI were identified from NOTS, a regional trauma system consisting of 2 large healthcare systems and regional EMS providers. Data from 2008 through 2012 were analyzed before and after NOTS formation in 2010. Multivariate regression analysis (RA) was performed to evaluate independent predictors of survival.

**Results:** 11,220 patients were identified with TBI in the NOTS database during the study period; 4507 (40%) before NOTS and 6713 (60%) after NOTS. The percentage of patients presenting to the regional level 1 center post-NOTS increased from 35% to 66% ( $p<.0001$ ). TBIs in the post-NOTS group were older (median age 55 vs. 52,  $p= 0.02$ ) and less likely male ( $p=0.001$ ). Injury severity scores and Abbreviated Injury Scores (AIS) were similar between periods. Post-NOTS TBIs had a lower median ICU stay ( $p=0.001$ ) and were more likely to present via air transport ( $p=0.02$ ). The mortality rate decreased from 6.2% to 4.9% ( $p=0.005$ ) among all TBIs and from 19% to 14% ( $p<.0001$ ) in TBIs with a Head AIS $\geq 3$  ( $N= 2,570$ ). Craniotomy procedures increased from 1.8% to 2.7% ( $p= 0.003$ ) in all TBIs and from 5.9% to 8.1% ( $p= 0.02$ ) in those with Head AIS $\geq 3$ . RA demonstrated an independent effect on survival for post-NOTS period. The OR for TBI patients in the post-NOTS period was 1.3 (95% CI: 1.1-1.6; C-stat= 0.96) and in TBI patients with Head AIS $\geq 3$  was 1.4 (95% CI: 1.1-1.7; C-stat=0.86).

**Conclusions:** Regionalization of an urban trauma system is associated with a reduced mortality rate for patients with TBI, particularly for patients with a Head AIS $\geq 3$ . These findings support regionalization of trauma in a spirit of collaboration across health care systems.

## Notes

Scientific Session II  
Raymond H. Alexander, MD Resident Paper Competition

January 15, 2014  
Paper 8 11:30 am

**PROPRANOLOL PREVENTS HEMATOPOIETIC PROGENITOR CELL MOBILIZATION  
FOLLOWING SEVERE TRAUMATIC INJURY**

Letitia E. Bible, MD, Latha Pasupuleti, MD, Walter Alzate, MS,  
Ziad C. Sifri, MD\*, David H. Livingston, MD\*, Alicia M. Mohr, MD\*  
Rutgers-New Jersey Medical School

**Presenter:** Letitia E. Bible, MD

**Discussant:** Nimit Patel, MD, MetroHealth Medical Center

**Objectives:** Bone marrow (BM) dysfunction is common in severely injured trauma patients resulting from elevation of catecholamines and plasma granulocyte colony stimulating factor (G-CSF), as well as prolonged mobilization of hematopoietic progenitor cells (HPCs) into peripheral blood. We have previously shown that propranolol (BB) reduces HPC mobilization in a rodent model of injury and hemorrhagic shock. We hypothesize that BB would prevent BM dysfunction in humans following severe injury.

**Methods:** Forty six severely injured trauma patients were studied in a prospective randomized pilot trial. Twenty-five patients received BB and twenty-one served as untreated controls. The dose of propranolol was adjusted to decrease the heart rate by 10-20% from each patient's initial mean 24h baseline. Blood was collected at several timepoints for the presence of HPC (BFU-E, CFU-E), and G-CSF levels. Demographic data, injury severity score, and outcome data were obtained. \*p < 0.05 with student's t-test or ANOVA and Tukey-Kramer.

**Results:** The mean age of the study population was 33 years, 87% were male with a mean ISS of 29. There is a significant increase in BFU-E in peripheral blood immediately following traumatic injury and this mobilization persists for thirty days (Figure). The use of BB significantly decreases BFU-E at all time points. A similar trend is seen for CFU-E. G-CSF is significantly elevated in both groups on admission (BB: 1005±159 pg/ml vs. no BB: 1886±248 pg/ml), the use of BB decreases G-CSF levels 51% as compared to 37% for the control group.

**Conclusions:** Following severe trauma, treatment with propranolol during hospitalization decreases HPC mobilization. G-CSF peaks immediately after injury and there is a more rapid decline to baseline with the use of BB. Propranolol may be the first therapeutic agent to improve BM function after severe injury.

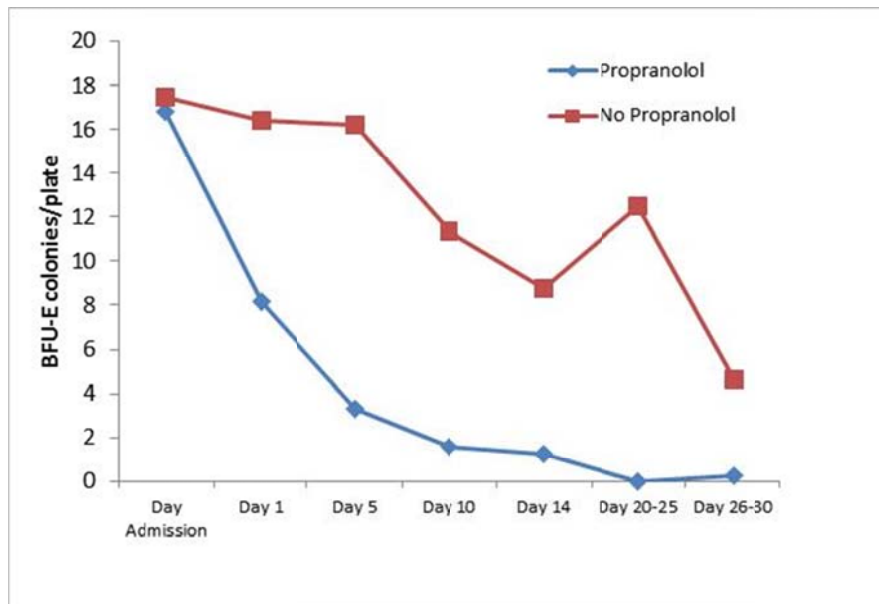


Figure 1. BFU-E growth in peripheral blood is compared in trauma patients with and without propranolol treatment.



**Scientific Session II**  
**Raymond H. Alexander, MD Resident Paper Competition**

**January 15, 2014**  
**Paper 9                      11:50 am**

**"PERMISSIVE HYPOVENTILATION" IN A SWINE MODEL OF HEMORRHAGIC SHOCK**

Sharven Taghavi, Lucas Ferrer, MD, Senthil N Jayarajan, MD, Halley Vora, Bachelor of Science,  
Conor McKee, Richard Milner, BS, John Gaughan, Jay E. Dujon, MD\*, Lars Ola Sjöholm, MD\*,  
Abhijit S. Pathak, MD, MSE\*, Joseph Rappold, Thomas A. Santora, MD\*,  
Steven Houser, Amy J. Goldberg, MD\*  
Temple University School of Medicine

**Presenter:** Sharven Taghavi, MD

**Discussant:** Brian Eastridge, MD, UT Health Science Center San Antonio

**Objectives:** Most penetrating trauma patients in severe hemorrhagic shock receive positive pressure ventilation (PPV) upon transport to definitive care, either by intubation (INT) or bag-valve mask (BVM). Using a swine hemorrhagic shock model that simulates penetrating trauma, we proposed that severely injured patients may have better outcomes with "permissive hypoventilation", where manual breaths are not given and oxygen is administered passively via face mask (FM). We hypothesized that PPV is harmful in severe low flow states and that "permissive hypoventilation" would result in better outcomes.

**Methods:** The carotid arteries of Yorkshire pigs were cannulated with a 14-gauge catheter. One group of animals (n=6) was intubated and manually ventilated, a second group received PPV via BVM (n=7), and a third group received 100% oxygen via FM (n=6). After placement of a Swan-Ganz catheter, the carotid catheters were opened and the animals were exsanguinated. The primary end point was time until death. Secondary end points included central venous pressure (CVP), cardiac output, lactate levels, serum creatinine, CO<sub>2</sub> levels, and pH measured in 10 minute intervals.

**Results:** Average survival time in the FM group (50.0 mins) was not different from the INT (51.1 mins) and BVM (48.5 mins) groups; p=0.84. CVP was higher in the FM group as compared to the INT group 10 minutes into the shock phase (8.3 vs. 5.2 mm Hg, p=0.04). Drop in cardiac output (Fig 1) and increase in lactate (Fig 2) was worse in both PPV groups. Creatinine levels were higher in both PPV groups throughout the shock phase; p=0.04. The FM group was more hypercarbic and acidotic than the two PPV groups; p<0.001.

**Conclusions:** Although "permissive hypoventilation" leads to respiratory acidosis, it results in less hemodynamic suppression and better perfusion of vital organs. In severely injured penetrating trauma patients, consideration should be given to immediate transportation without PPV.

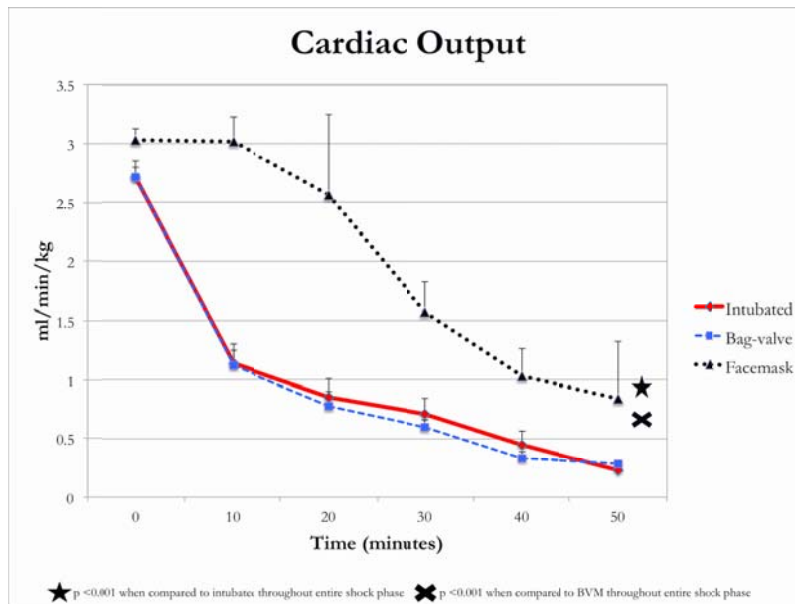


Figure 1 - Decline in cardiac output during the hemorrhagic shock phase.

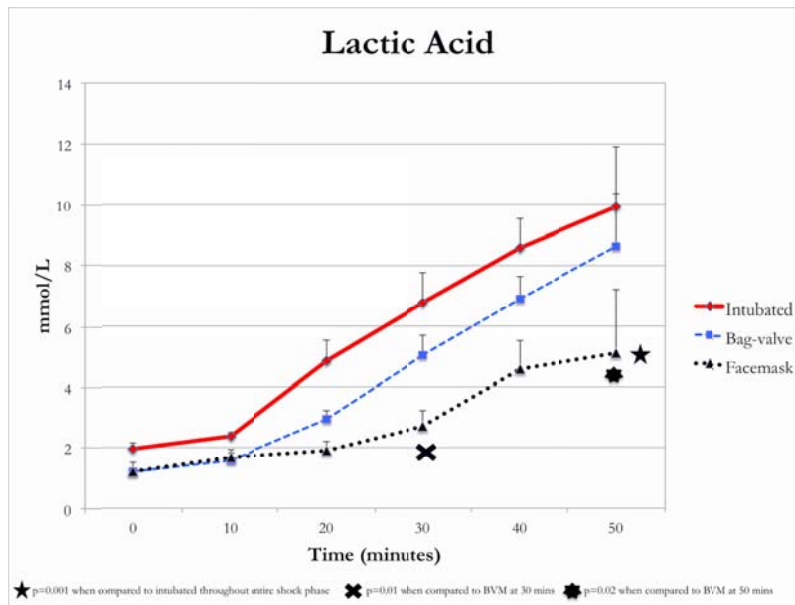


Figure 2 - Increase in lactic acid levels during the hemorrhagic shock phase.

**Scientific Session II**  
**Raymond H. Alexander, MD Resident Paper Competition**

**January 15, 2014**  
**Paper 10      12:10 pm**

**TRAUMATIC BRAIN INJURY IS NOT ASSOCIATED WITH COAGULOPATHY OUT OF PROPORTION TO INJURY IN  
OTHER BODY REGIONS**

Tim H. Lee, MD MS, David A Hampton, MD, MEng, Brian S. Diggs, PhD,  
Sean P. McCully, MD, MS, Matthew Kutcher, MD, Brittney J. Redick, BA,  
Jeanette M. Podbielski, RN BSN, Tim Welch, NREMT-FP-C, Bryan A. Cotton, MD, MPH\*,  
Mitchell J. Cohen, MD, FACS, Martin A. Schreiber, MD, FACS\*  
Oregon Health and Science University

**Presenter:** Tim H. Lee, MD MS

**Discussant:** Tanya Zakrison, MD, FRCSC, Miller School of Medicine

**Objectives:** Coagulopathy following trauma is associated with poor outcomes. Traumatic brain injury (TBI) has been associated with coagulopathy out of proportion to other body regions. We hypothesized that injury severity and shock determine coagulopathy independent of body region injured.

**Methods:** We performed a prospective, multi-center observational study at three level 1 trauma centers. Conventional coagulation tests (CCT) and rapid thrombelastography (rTEG) were used. Admission vital signs, base deficit (BD), CCTs, and rTEG data were collected. The abbreviated injury score (AIS) and injury severity score (ISS) were obtained. Severe injury was defined as AIS $\geq$ 3 for each body region. Patients were grouped according to their dominant AIS region of injury. Dominant region of injury was defined as the single region with the highest AIS score. Patients with two or more regions with the same greatest AIS score and patients without a region with an AIS $\geq$ 3 were excluded. Coagulation parameters were compared between the dominant AIS region. Significant hypoperfusion was defined as BD $\geq$ 6.

**Results:** Of the 795 patients enrolled, 405 had complete admission data and met criteria for grouping by dominant AIS region. Patients were predominantly Caucasian (59%), male (75%), suffered blunt trauma (71%), and had a median ISS of 25 (IQR 14, 29). Patients with BD $\geq$ 6 (n=110) were hypocoagulable by CCT and rTEG compared to patients with BD<6 (n=223). Patients grouped by dominant AIS region showed no significant differences between any rTEG or CCT parameter. Patients with BD $\geq$ 6 demonstrated no difference in any rTEG or CCT parameter between dominant AIS regions.

**Conclusions:** Coagulopathy results from a combination of tissue injury and shock independent of the dominant region of injury. Utilizing AIS as a measure of injury severity, TBI was not independently associated with more profound coagulopathy.

## Notes

Scientific Session III-A  
Clinical Science

January 16, 2014  
Paper 11 8:00 am

**INTRAOSSUEOUS INFUSION RATES UNDER HIGH PRESSURE:  
A CADAVER STUDY OF ANATOMICAL SITE COMPARISONS**

Jason Pasley, DO\*, Catriona Miller, PhD, Kimberly Boswell, MD,  
Chuck Halcome, NREMT-P, BS, Jonathan Casey, MSN, CRNA, Stacy A. Shackelford, MD\*,  
Raymond Fang, MD, FACS\*, Joseph J. DuBose, MD\*, Michael Cotter, Associates in Health Sciences,  
Michael Matsuura, MD, Nathaniel Relph, Julie Bosch, PhD, Nick Tarmey, MBChB FRCA DICM DipIMC  
R Adams Cowley Shock Trauma Center

**Presenter:** Jason Pasley, DO

**Discussant:** Lance Stuke, MD, MPH, Louisiana State University

**Objectives:** Intraosseous (IO) access for emergency resuscitation is recommended when conventional peripheral vascular access is not readily achievable. The aim of this research is to determine which of three possible sites for IO access is the most effective for volume resuscitation, defined in terms of flow volumes achievable for resuscitation fluids. A cadaver model was used, as to date there have been no conclusive studies in human subjects.

**Methods:** Sixteen cadavers were obtained within 72 hours of death in collaboration with the Maryland State Anatomy Board from March 15, 2012 to June 21, 2013. IO infusion devices were placed in the proximal tibia (EZ-IO), humeral head (EZ-IO), and sternum (FAST-1). Sequentially, the volume of 0.9% saline infused into each site under 300 mmHg pressure over five minutes was recorded. Mean infused volumes were compared between the three IO sites. Analysis of variance (ANOVA) was used to determine significance ( $p < 0.05$ ).

**Results:** Analysis of sixteen cadavers (average age 58), Caucasian (14 of 16), and male (13 of 16) found that the mean volume infused at each site was sternum (469 ml), humerus (286 ml), and tibia (154 mls) [ $F(2,47) = 13.025$ ,  $p < 0.001$ ]. The humeral site had the greatest variability in volumes infused, ranging from 30.0 ml to 730 ml. The tibial site had the greatest number of insertion difficulties.

**Conclusions:** This is the first study comparing the rate of flow at various IO sites in an adult human model. Our results show that the sternal site for IO access provides the most consistent and highest flow compared to the humeral and tibial insertion sites. The average volume infused in the sternum was 1.6 and 3.1 times greater than the average volume infused in the humeral and tibial sites.

Site:	Mean	StDEV	SEM	Median	Min	Max	# of Insertion Mishaps
Sternum	469	190	47.4	438	188	770	0
Humerus	286	218	54.5	206	30.0	703	0
Tibia	154	94.0	23.4	155	20.0	292	3

Table 1. Sites and flow volumes

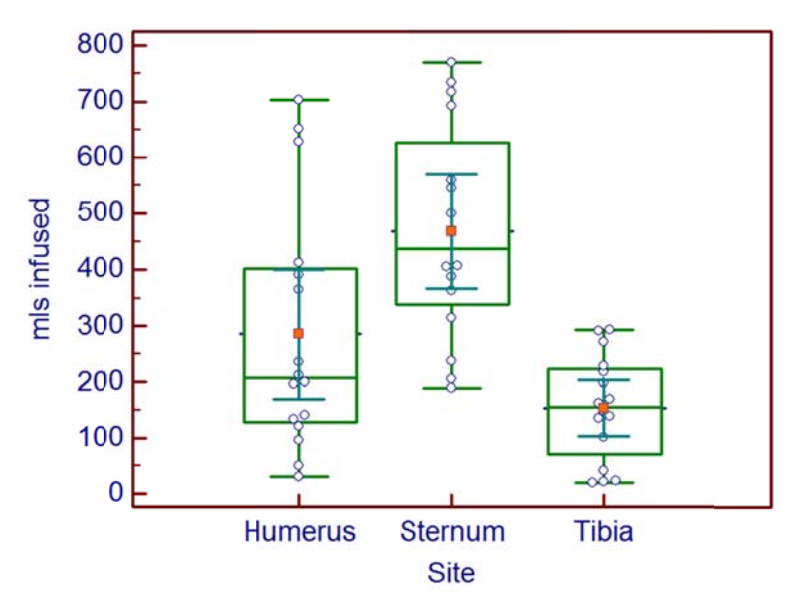


Figure 1 sites and flow volumes

Scientific Session III-A  
Clinical Science

January 16, 2014  
Paper 12 8:20 am

**INFERIOR VENA CAVA SIZE IS NOT ASSOCIATED WITH SHOCK FOLLOWING INJURY**

Michal Radomski, MD, Ritesh Agnihotri, BA, Stephanie Knapp, BS, Daniel Scher, MD, Nadia Khati, MD, Kathleen Brindle, MD, Richard Amdur, PhD, Jonathan Messing, James R. Dunne, MD\*, Babak Sarani, MD\*  
George Washington University

**Presenter:** Michal Radomski, MD

**Discussant:** Paula Ferrada, MD, Virginia Commonwealth University

**Objectives:** The inferior vena cava (IVC) collapses with shock due to absolute or relative hypovolemia but may also be collapsed in volume depleted patients in the absence of shock. Although various serum markers are associated with impending or actual shock, the speed and availability of CT scan or ultrasound make IVC measurement an attractive testing modality for shock. The purpose of this study is to determine if IVC size following injury is associated with shock.

**Methods:** Following IRB approval, a retrospective study was performed at an adult trauma center from January 1 to December 31, 2012. Only patients who met highest level activation criteria and underwent abdominal CT scan during their initial resuscitation were included. All images were reviewed by 3 independent radiologists and concordance assessed using the Pearson coefficient and Bland-Altman plots. The transverse (T) and anteroposterior (AP) diameters were measured to calculate a T-AP ratio. ANOVA and chi-square were used to assess the relationship between this ratio and various indices of shock.

**Results:** 276 cases were examined, 75% of whom were male. Average age and ISS were  $50 \pm 21$  years and  $15 \pm 10$ , respectively. 92% of patients had a blunt mechanism of injury and overall mortality rate was 5.4%. Pearson coefficients were 0.83-0.86. The IVC was nearly round in 58 (21%) patients and collapsed in 73 (26%). There was no significant association between various IVC sizes and shock index, blood pressure, lactate, hemoglobin, need for urgent operation or angiography, or length of stay (table 1). Similarly, there was no association between IVC size and need for emergency transfusion ( $p=0.26$ ) or death ( $p=0.16$ ).

**Conclusions:** There is no correlation between various degrees of IVC collapse and shock or death following blunt injury. Imaging is not a reliable modality for detection of impending or actual shock following blunt injury.

Table 1: Relationship Between IVC Size, Various Endpoints of Shock, and Length of Stay

Outcome (Average $\pm$ Standard Deviation)	Mean IVC Ratio of Transverse to AP:				P
	Least collapsed  1.0-1.33  (N=58)	Slight narrowing  1.34 - 1.58  (N=66)	Moderate narrowing  1.59 - 1.99  (N=79)	Collapsed  $\geq 1.99$  (N=73)	
Shock Index	0.66 $\pm$ 0.19	0.66 $\pm$ 0.22	0.65 $\pm$ 0.19	0.71 $\pm$ 0.32	0.47
Mean Arterial Pressure (mm Hg)	97.8 $\pm$ 17.6	98.8 $\pm$ 20.4	97.3 $\pm$ 16.6	93.2 $\pm$ 19.0	0.30
Lactate	3.7 $\pm$ 4.1	2.7 $\pm$ 1.7	3.9 $\pm$ 2.6	3.5 $\pm$ 3.0	0.59
Hemoglobin	13.3 $\pm$ 1.9	13.3 $\pm$ 2.1	13.8 $\pm$ 1.8	13.3 $\pm$ 2.2	0.32
Operation within 24 hours of arrival	22%	24%	20%	15%	0.57
Interventional radiology within 24 hours of arrival	3.4%	1.5%	5.1%	6.8%	0.46
Hospital days <sup>1</sup>	5.2 $\pm$ 6.1	8.5 $\pm$ 11.4	7.9 $\pm$ 10.4	7.7 $\pm$ 9.3	0.19
ICU days <sup>1</sup>	2.8 $\pm$ 3.8	4.4 $\pm$ 7.3	4.7 $\pm$ 6.5	4.1 $\pm$ 6.3	0.30

1. Two outliers with twice as many Hospital days as the next closest subject were removed



Scientific Session III-A  
Clinical Science

January 16, 2014  
Paper 13 8:40 am

**IS FULL SPINE IMAGING NECESSARY IN THE ELDERLY, FALL FROM STANDING TRAUMA PATIENT  
WITH A CERVICAL FRACTURE?**

George Koenig, DO, MS\*, Neils Martin, MD, FACS, Muhammad Zubair, MBBS,  
Kris R. Kaulback, MD\*, Gary A. Lindenbaum, MD, FACS, FCCP\*, Alec Beekley, MD  
Thomas Jefferson University

**Presenter:** George Koenig, DO, MS

**Discussant:** Jamie J. Coleman, MD, Indiana University

**Objectives:** The incidence of non-contiguous (NC) spinal column fractures approaches 20%. Current practice in the evaluation of patients that sustain cervical spine fractures often involves full spine imaging using computed tomography (CT) to identify concomitant thoraco-lumbar spinal column fractures. We hypothesize that the incidence and clinical relevance of these fractures in elderly patients that fall from standing is low and question if routine CT imaging of the entire spine is necessary.

**Methods:** We performed a retrospective analysis of patients, older than 65, who fell from standing and sustained a cervical spine fracture in the Pennsylvania Trauma Outcome Study (PTOS) registry. Demographics, frequency of NC spinal fractures, and management were analyzed. Stepwise logistic regression controlled for GCS, ISS, gender, rib fractures, and visceral injuries was used to determine factors associated with NC vertebral fractures.

**Results:** In total, 14,502 patients met the inclusion criteria of age greater than 65 with the mechanism fall from standing. The incidence of cervical fracture was 7.6%. There was no neurologic deficit in 1083 (98.7%) patients. Within this cohort, 74 (6.8%) were diagnosed with a cervical spine fracture and other spinal column fractures. Three patients required surgery on their thoraco-lumbar spine. The presence of rib fracture was associated with a 2.83 (95% CI:1.46-5.46) increased risk of NC vertebral fracture.

**Conclusions:** The incidence of NC spinal column fractures is substantially less in elderly that fall from standing than previously reported in other more heterogeneous series of trauma patients. Neither physical exam nor the presence of other injuries reliably predicts who should undergo radiographic screening of their entire spine. Routine screening for concomitant thoraco-lumbar spinal fractures should not be abandoned especially in patients with associated rib fractures.

## Notes

Scientific Session III-A  
Clinical Science

January 16, 2014  
Paper 14 9:00 am

**NEGATIVE PLEURAL SUCTION IN THORACIC TRAUMA PATIENTS: A RANDOMIZED CONTROLLED TRIAL**

Camila Mejia, MD, Luis Alberto Roldan, General Surgeon, Carlos H. Morales, MSc General Surgeon,  
Maria Fernanda Saldarriaga, Medical Student, Andres Felipe Duque, Medical Student,  
Saint Vincent's Hospital

**Presenter:** Camila Mejia, MD

**Discussant:** Kristan Staudenmayer, MD, MS, Stanford University School of Medicine

**Objectives:** Identify the benefits of negative pleural suction compared to water seal in patients with thoracic trauma treated with tube thoracostomy.

**Methods:** Patients with tube thoracostomy secondary to traumatic pneumothorax, hemothorax or hemopneumothorax, were randomly assigned to either group one (tube thoracostomy connected to negative pleural suction -20 cm H<sub>2</sub>O), or group two (tube thoracostomy connected to water seal). We excluded patients submitted to mechanical ventilation, emergency surgery (thoracoscopy or open thoracotomy), those with history of chronic pulmonary condition, and patients with severe Traumatic Brain Injury (Glasgow coma scale equal or less than 8/15). Our outcomes of interest were persistent air leak, coagulated hemothorax, empyema and length of hospital stay.

**Results:** 110 patients were included: 56 were assigned to the negative pleural suction group, and 54 to water seal. There were no significant differences in the demographic characteristics between groups. We did not find differences between the length of hospital stay ( $p=0.22$ ), days with tube thoracostomy ( $p=0.35$ ) (three days in each group), or in the incidence of complications related to thoracostomy placement. The probability for persistent air leak was greater in the group submitted to negative pleural suction, compared to water seal alone ( $p=0.023$ ).

**Conclusions:** The use of negative pleural suction in tube thoracostomy has no advantages over water seal in patients with traumatic pneumothorax, hemothorax, or pneumohemothorax.

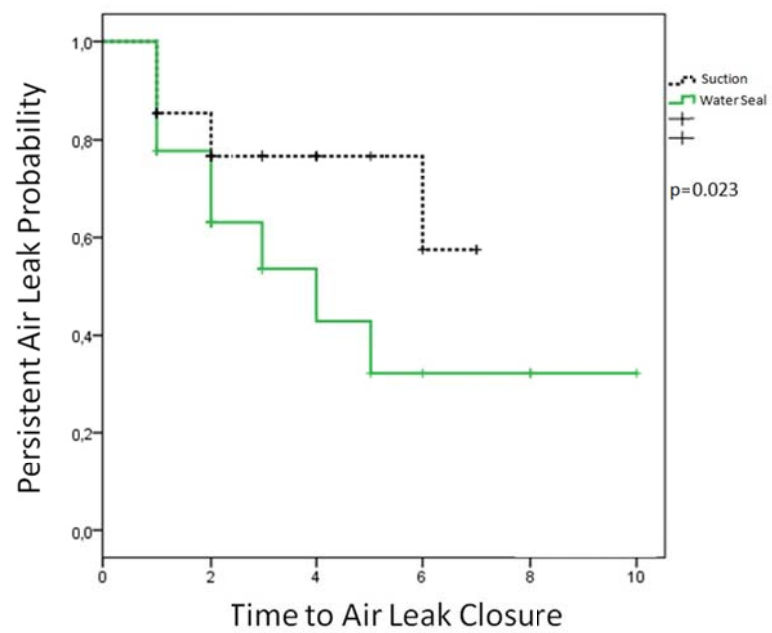


Figure 1. Kaplan-Meier plot of time to Air Leak Closure

Kaplan-Meier plot of time to Air Leak Closure

Scientific Session III-A  
Clinical Science

January 16, 2014  
Paper 15 9:20 am

**INTRACRANIAL PRESSURE RESPONSE AFTER PHARMACOLOGIC TREATMENT  
OF INTRACRANIAL HYPERTENSION**

Katharine R. Colton, Shiming Yang, PhD, Peter Hu, PhD, Hegang Chen, PhD,  
Thomas M. Scalea, MD, FACS, FCCM\*, Deborah M. Stein, MD\*,  
R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine

**Presenter:** Katharine R. Colton

**Discussant:** Mayur B. Patel, MD, MPH, Vanderbilt University Medical Center

**Objectives:** Accepted treatment of increased intracranial pressure (ICP) in patients suffering from severe traumatic brain injury (TBI) is multimodal and algorithmic, obscuring individual effects of treatment. We used automated and manual data collection to determine ICP response to individual therapy.

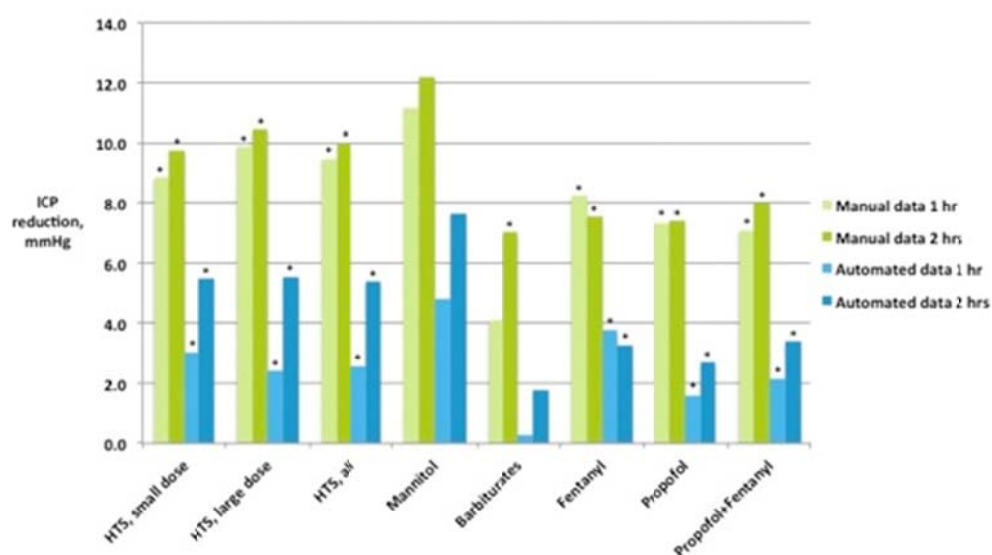
**Methods:** Patients >17 years old, admitted and requiring ICP monitoring between 2008-2010 at a single large urban tertiary care facility were retrospectively enrolled. Timing and dose of ICP-directed therapy were recorded from paper and electronic medical records. ICP data was collected automatically at 6-second intervals and from manual charts. A statistical mixed model was applied to all data to account for multiple sampling.

**Results:** 98 patients with 664 treatment instances were identified. Patient characteristics are in Table 1. Pharmacologic treatments identified include 'small' ( $\leq$ dose equivalent of 250 ml 3%) or 'large' ( $>$ 250 ml 3%) doses of hypertonic saline (HTS), mannitol, single dose barbiturates, and a dose escalation of propofol or fentanyl infusion. Fig. 1 shows the average ICP reduction at 1 or 2 hours after treatment administration as calculated from automated or manual data collection. The average ICP in the hour before medication administration was higher for barbiturates (27 mmHg) and mannitol (32 mmHg) than for the other interventions (18-19 mmHg).

**Conclusions:** All treatments resulted in an average ICP reduction over the two hours following administration. While the average ICP after administration of HTS, mannitol, or barbiturates showed continued improvement after two hours, the shorter-acting agents propofol and fentanyl did not show significant improvement after the initial effect in the first hour. Manually recorded data consistently overestimated treatment effectiveness, suggesting that automated data collection gives a more accurate assessment of patient status and responsiveness to treatment.

**Table 1. Patient and Injury Characteristics**

No. participants (males/females)	98 (78/20)
Age (y), mean (SD)	39.41 (17.64)
Post-resuscitation score Glasgow coma score, mean (SD)	6.70 (2.40)
Marshall score, mean (SD)	2.56 (0.85)
Mortality (%)	19.39

**Figure 1. Reduction in intracranial pressure (ICP) after drug administration.**

\* Indicates  $p < 0.05$ .

**Scientific Session III-B**  
**Cox-Templeton Injury Prevention Paper Competition of the EAST Foundation**

**January 16, 2014**  
**Paper 16      8:00 am**

**A PROSPECTIVE, MULTI-INSTITUTIONAL STUDY OF PEDIATRIC  
ALL-TERRAIN VEHICLE CRASHES**

Ioanna G Mazotas, MD, Megan Toal, MD, Kevin Borrup, JD, MPA, Hassan Saleheen, MBBS, MPH,  
Allison Hester, MSN, Paul D. Danielson, MD\*, Daniel Copeland, MD,  
Anthony L DeRoss, MD\*, Garry Lapidus, Brendan T. Campbell, MD, MPH\*  
Connecticut Children's Medical Center

**Presenter:** Ioanna G. Mazotas, MD

**Discussant:** Terence O'Keeffe, MD, MSPH, University of Arizona

**Objectives:** Pediatric all-terrain vehicle (ATV) injuries have been increasing annually for more than a decade. The purpose of this study is to prospectively evaluate crash circumstances and clinical outcomes resulting from pediatric ATV crashes.

**Methods:** Three pediatric trauma centers prospectively collected data from patients during their hospitalization for injuries sustained in ATV crashes from July 2007 through June 2012. Patients completed a 35-item questionnaire describing the crash circumstances (ATV engine size, safety equipment use, training/experience). Clinical data (injuries, surgical procedures, etc.) were collected for each patient.

**Results:** Eighty-four patients were enrolled with a mean age of  $13.0 \pm 3.1$  years and were predominantly male ( $n=56$ , 67%). Injuries were musculoskeletal (42%), central nervous system (39%), abdominal (20%), thoracic (16%), and genitourinary (4%). Multisystem injuries were prevalent (27%), and two patients died. Thirty patients (36%) required operative intervention. Most children were riding for recreation (96%), and ignored ATV manufacturers' recommendation that children <16 years ride ATV's with smaller ( $\leq 90$ cc) engines (71%). Dangerous riding practices were widespread: no helmet (69%), no adult supervision (57%), double riding (50%), riding on paved roads (22%), and nighttime riding (16%). Lack of helmet use was significantly associated with head injury (53% vs. 25%,  $p=0.03$ ). Rollover crashes were most common (42%), followed by collision with a stationary object (26%) or another vehicle (12%). Half (51%) of children said they would ride an ATV again.

**Conclusions:** These data demonstrate a relationship between dangerous ATV-riding behaviors and severe injuries in children who crash. Children less than 16 years of age should not operate ATV's, and legislation that effectively restricts ATV use in children is urgently needed.

## Notes



Scientific Session III-B  
Cox-Templeton Injury Prevention Paper Competition of the EAST Foundation

January 16, 2014  
Paper 17 8:20 am

**VIOLENCE PREVENTION PROGRAMS ARE EFFECTIVE WHEN INTERVENTION IS INITIATED DURING THE INITIAL WORKUP OF VIOLENTLY INJURED PATIENTS IN A URBAN LEVEL 1 TRAUMA CENTER**

Steven L. Salzman, DO\*, Sheila C. Regan, BS, Elena Quintana, PhD,  
Elise Wisnieski, MA, Charles F. Mack, Hospital Responder,  
LeVon Stone, Sr., BA, Barbara Giloth, DrPH  
Advocate Christ Medical Center

**Presenter:** Steven L. Salzman, DO

**Discussant:** Michel Aboutanos, MD, Virginia Commonwealth University

**Objectives:** This study represents the first attempt at evaluating the ability of the CeaseFire hospital-situated intervention program to disrupt the pattern of violent reinjury. It seeks to compare the reinjury rates among gunshot wound patients who received services from CeaseFire with those gunshot wound patients who did not. We hypothesize that patients who received intervention are less likely to return to Advocate Christ Medical Center (ACMC) with violent injuries than patients who did not have any intervention in the 48 months following their injury.

**Methods:** The treatment group consisted of African-American male patients who presented to the ACMC with a gunshot wound and received CeaseFire hospital intervention at the bedside between 2005 and 2007. The mean age of the treatment group was 23.9 years. The same inclusion criteria were used in establishing a post-hoc control group who did not receive intervention for comparison using hospital records from 2003 to 2005. The mean age of the non-treatment group was 23.9 years.

**Results:** 6 percent (n=18) of subjects in the CeaseFire treatment group and 11 percent (n=33) of subjects in the non-intervention group returned to ACMC with a new violent injury (Figure 1), yielding a total reinjury rate of 8.5 percent. Most individuals returned to ACMC only once with another violent injury (Table 1). We computed an Odds Ratio to estimate the relative risk of returning with a violent injury during the evaluation period. Results suggest that CeaseFire had a protective effect for violently injured patients who received services within the hospital. Individuals who *did not have* CeaseFire services were nearly twice as likely as the treatment group to be shot again.

**Conclusions:** The hospital based violence prevention program Cease Fire positively effected at risk patients and prevented reinjury.

		Recidivism Rates Across Groups		
Outcome	Returned with a violent injury	Treatment 18 (6%)	Non-treatment 33 (11%)	Total 51 (8.5%)
	Did not return with a violent injury	282 (94%)	267 (89%)	549 (91.5%)
Total		300 (100%)	300 (100%)	300 (100%)

Recidivism Rates Across Groups

	Treatment Group	Non-Treatment Group	All Repeat Patients
Total no. of hospital visits (including initial visit) for violent trauma	37 (34.3%)	71 (65.7%)	108
Mean total no. of hospital visits for violent trauma	2.06	2.18	2.14
Mean age at initial injury	23.5	21.97	22.51
Mean age at second injury	25.33	23.91	24.41
Mean years between first and second injury	1.83	1.94	3.9
% injured in same zip code at second injury	9 (50.0%)	16 (48.5%)	25 (49%)
% died as a result of repeat violent injury	1 (5.5%)	3 (9.0%)	4 (7.8%)

Characteristics of Repeat Patients

Scientific Session III-B  
Cox-Templeton Injury Prevention Paper Competition of the EAST Foundation

January 16, 2014  
Paper 18 8:40 am

INPATIENT HOSPITALIZATION AND INTIMATE PARTNER VIOLENCE:  
WHO ARE WE TREATING?

Mican I. DeBoer, BSN, RN, CEN, Amy Koestner, BSN, MSN\*, Catherine Kothari, MA,  
Rashmi U. Kothari, MD, Thomas J. Rohs, Jr., MD\*  
Borgess Medical Center

**Presenter:** Mican I. DeBoer, BSN, RN, CEN

**Discussant:** Jose Pascual Lopez MD, PhD, University of Pennsylvania

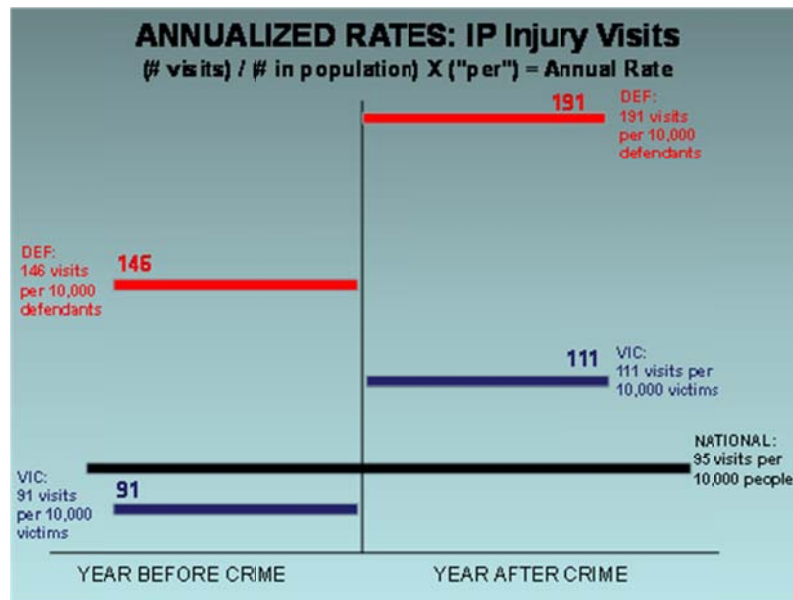
**Objectives:** To determine the annualized rates of inpatient injury-related hospitalization amongst not only victims, but also defendants in intimate partner violence (IPV).

**Methods:** This was an analysis study linking data from two Level 1 Trauma Centers and the county prosecutor's office, from 2000-2010 in Kalamazoo County, Michigan: (1) Hospital data included inpatient (IP) injury-related admissions (ICD-9 codes 800-959.9), (2) Prosecutor data contained all charging requests for crimes between intimate partners. Annualized rates were calculated for the year prior to the IPV crime and for the year after, using the following algorithm:  $(\#hospitalizations)/(\#population) \times ("per"10,000)$ . Confidence intervals (CI) and two-sided statistical significance were calculated at the 95% confidence level.

**Results:** During the study period 21,179 IPV-crimes were committed, involving 12,913 individual defendants and 14,797 victims. During this period, there were 30,301 injury-related hospitalizations. Compared to national hospitalization rates of 95.0 per 10,000 people for injury/poisoning (ICD-9 800-999) [1], IPV-victim rates were 90.6 (CI 83.3,98.7) the year before the crime and 110.8 (CI 102.6,119.4) the year after. Defendant hospitalization rates were 145.6 per 10,000 people (CI 135.5,156.5) the year before the crime and 191.3 (CI 179.2,202.8) the year after. Victim and defendant hospitalization rates were significantly different from each other ( $p < .05$ ), both pre- and post-crime.

[1] Hall, Margaret; DeFrances, Carol; Williams, Sonja; Golosinskiy, Aleksandr; Schwartzman, Alexander. *National Hospital Discharge Survey: 2007 Summary*. National Health Statistics Reports. No. 29. 2010.

**Conclusions:** The access to criminal justice data and hospital data in this study provides unique insight to opportunities for intervention and prevention involving both victims and defendants.



IPV In-Patient Injury Visits

**Scientific Session III-B**  
**Cox-Templeton Injury Prevention Paper Competition of the EAST Foundation**

**January 16, 2014**  
**Paper 19      9:00 am**

**TAKING ATV INJURY PREVENTION TO THE HILLS:  
AN EFFECTIVE WAY TO REACH RIDERS**

Karen Lommel, DO, MHA, MS\*, Daniel Davenport, PhD, Andrew C. Bernard, MD\*  
University of Kentucky

**Presenter:** Karen Lommel, DO, MHA, MS

**Discussant:** Brian L. Brewer, MD, Sinai Hospital

**Objectives:** The object of this study was to determine the effectiveness of a community-based all-terrain vehicle (ATV) injury prevention intervention in rural areas of a state where ATV injuries rank among the highest in the nation. The statewide trauma registry was used to identify counties of greatest concern.

**Methods:** This study was conducted within 2 large community festivals and 1 ATV-specific festival. The intervention consisted of a 20 square foot booth with 3 stations; survey collection, interactive education and a prize station. Surveys were completed pre- and 2 months post-intervention. We aggregated safety themes (ETOH, Helmet, Safety Course, Risky Behaviors, Child-Sized ATV) by taking the average of the 3 stages of response. The survey was based on the Theory of Planned Behavior. Paired t-tests and Spearman's Rho Correlations were used to analyze the data.

**Results:** We collected 498 pre- and 227 post-intervention surveys. We excluded matched pairs if the reported age differed by more than 4 years or gender difference between 2 surveys leaving 225 matched pairs. Demographics are outlined in Table 1. All aspects of risky behavior assessment improved significantly between pre- and post-intervention ( $p < .001$  to  $p = .011$ ). There was no significant difference in actual safety practices of wearing a helmet, taking an ATV safety course and drinking while driving. However, the correlations validated our survey. As outlined in Table 3, risky behaviors negatively correlated with ETOH consumption ( $- .209$ ) and ETOH consumption correlated with not wearing a helmet. Taking an ATV safety course correlated with wearing a helmet and choosing a child-sized ATV (.393 and .407 respectively all reported here to be at significance of 0.01 level).

**Conclusions:** Our intervention decreased risky behaviors and attitudes. Future interventions should focus on more direct ways to link risky behaviors and attitudes to direct ATV safety practices.

**Table 1 Pre- and Post-Intervention Respondent Characteristics**

Variable	Pre-Intervention (%)	Post-Intervention (%)
Number of Surveys (actual number)	498	227
Festival Attended		
Crockettsville Charity ATV Concert	11.3	8.8
Black Gold Festival	32.0	38.5
World Chicken Festival	56.7	52.7
Mean age $\pm$ SD (actual number)	40.6 $\pm$ 14.8	40.8 $\pm$ 15.2
Female	63.7	60.2
Children in the home	52.1	47.8
Children in the home who ride ATVs	60.2	54.2
Own an ATV	68.0	66.2
Driven an ATV	81.1	86.3
Been a passenger	85.8	88.5
Hurt on an ATV	22.8	23.3
Been to a clinic for an ATV accident	11.6	10.1
Been to the ER for an ATV accident	11.4	10.1

**Table 3 Spearman's Rho Correlations Between Attitudes at Baseline (n=495)**

5 Safety Constructs	Risky Behavior	Helmet	ETOH	Safety Course	Child-Sized ATV
Risky Behavior	1.000		-.209**		
Helmet		1.000	.250**	.407**	.229**
ETOH	-.209**	.250**	1.000		
Safety Course		.407**		1.000	.393**
Child-Sized ATV		.229**		.393**	1.000

\*\* Correlation is significant at the 0.01 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

**Scientific Session III-B**  
**Cox-Templeton Injury Prevention Paper Competition of the EAST Foundation**

**January 16, 2014**  
**Paper 20      9:20 am**

**OPERATION CEASEFIRE-NEW ORLEANS: A MODEL FOR ADDRESSING RECIDIVISM FROM PENETRATING TRAUMA**

Erin H. McVey, MD, Juan C. Duchesne, MD, FACS, FCCP, FCCM\*, Siavash Sarlati, MD, Michael O'Neal, MD,  
Kelly Johnson, MD, Jennifer Avegno, MD  
Louisiana State University School of Medicine

**Presenter:** Erin H. McVey, MD

**Discussant:** Adil H. Haider, MD, MPH, Johns Hopkins School of Medicine

**Objectives:** CeaseFire, using an infectious disease approach, addresses violence by partnering hospital resources with the community by providing violence interruption and community-based services for an area roughly composed of a single city zip code (70113). Community-based violence interrupters start in the trauma center from the moment penetrating trauma occurs, through hospital stay, and in the community after release. This study interprets statistics from this pilot program, begun May 2012. We hypothesize a decrease in penetrating trauma rates in the target area compared to others after program implementation.

**Methods:** This was a three-year prospective data collection of trauma registry from May 2010-May 2013. All intentional, target area, penetrating trauma treated at our Level I trauma center received immediate activation of CF personnel. Incidences of violent trauma, and rates of change, by zip code, were compared with the same time period for two years pre-implementation.

**Results:** During this period, the yearly incidence of penetrating trauma in Orleans Parish increased. Three of the highest rates were found in adjacent zip codes: 70112, 70113, and 70119. Average rates per 100,000 were 722.7, 523.6, and 286.4, respectively. These socioeconomically similar areas represent 3 of the 6 zip codes city-wide that saw year-to-year increases in violent trauma over this period. However, 70113 saw a lower rate of rise in trauma than 70112 and 70119 ( $p < 0.02$  and  $p = 0.38$ , respectively).

**Conclusions:** Hospital-based intervention programs that partner with culturally appropriate personnel and resources outside the institution walls have potential to have meaningful impact over the long-term. While few conclusions of the effect of such a program can be drawn in a 12-month period, we anticipate long term changes in the numbers of penetrating traumas in the target area and in the rest of the city as this program expands.

## Notes



Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 21 8:00 am

COMPARISON OF CRITICAL CARE PROCEDURAL COMPLICATION RATES BETWEEN RESIDENT PHYSICIANS AND  
ADVANCED CLINICAL PROVIDERS

Massanu Sirleaf, ACNP-BC, A. Britton Christmas, MD, FACS\*, Brian Jefferson, ACNP, Ronald F. Sing, DO\*,  
Michael H. Thomason, MD\*, Toan T. Huynh, MD, FACS, FCCM\*  
Carolinas Medical Center

**Presenter:** Massanu Sirleaf, ACNP-BC

**Discussant:** Jeffrey Claridge, MD, MS, MetroHealth Medical Center

**Objectives:** The limitation of surgical resident work hours led many teaching hospitals to incorporate Advanced Clinical Practitioners (ACPs) as integral partners in the care of critically ill patients. ACPs are increasingly performing invasive procedures that were previously delegated only to residents (RPs) and attending physicians. We undertook this study to assess the complication rates for invasive procedures performed by RPs vs. ACPs in the critical care setting.

**Methods:** We conducted a retrospective review of procedures performed from January to December, 2011 in our Trauma and Surgical ICUs. Procedures consisted of arterial lines, central venous lines, bronchoalveolar lavage, thoracostomy tubes, percutaneous endoscopic gastrostomy and tracheostomy. Under attending supervision, ACPs performed invasive procedures for surgical critical care patients while RPs performed respective procedures for trauma patients. Data included demographics, APACHE III scores, complications, and outcomes. Complications were assessed by post procedure radiography, operative notes and post procedure notes.

**Results:** Overall, 1575 procedures were performed during the study period. Resident physicians performed 1020 procedures with 21 identified complications, while ACPs performed 555 procedures with 11 complications yielding a similar complication rate of 2%. We observed no difference in the ICU (RP  $3.9 \pm 0.2$  vs. ACP  $3.7 \pm 0.1$ ) or hospital (RP  $12.2 \pm 0.4$  vs. ACP  $13.3 \pm 0.3$ ) mean length of stay. The mortality rates for those patients treated by the RPs (11%) vs. the ACPs (9.7%) were comparable despite significantly higher APACHE III scores for the ACP group (RP  $40.8 \pm 0.9$  vs. ACP  $47.7 \pm 0.7$ ,  $p < 0.05$ ). See Tables.

**Conclusions:** ACPs can perform invasive procedures in the ICU with similar competence to RPs. ACP responsibilities may be effectively expanded to include invasive procedures in the critical care setting.

# Demographics

Group	Patients	Age	APACHE III	ICU LOS	HOSPITAL LOS	MORTALITY
Residents	980	49.9 ± 0.6	40.8 ± 0.9	3.9 ± 0.2	12.2 ± 0.4	11%
AP's	624	54.5 ± 0.5	47.7 ± 0.7	3.7 ± 0.1	13.3 ± 0.3	9.7%

Data are mean ± standard errors; n = number of patients; LOS: length of stay.

# Procedures

Group	Procedures	CL	A-line	BAL	TT	Trach	PEG	Complications
Residents	1020	220	164	233	176	153	74	21 (2%)
AP's	555	148	89	142	31	102	43	11 (2%)

CL: central line

A-line: arterial line

BAL: brocheoalveolar lavage

TT: thoracostomy tube

Trach: tracheostomy

PEG: percutaneous endoscopic gastrostomy

Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 22 8:20 am

**SELF-EXPANDING POLYURETHANE FOAM IMPROVES SURVIVAL IN A LARGE ANIMAL MODEL OF  
EXSANGUINATION FROM ILIAC ARTERY TRANSECTION**

David King, MD\*, John O. Hwabejire, MD, MPH, Miroslav P. Peev, MD,  
Michael Duggan, DVM, George Velmahos, MD, PhD, MEd, Marc A. deMoya, MD\*,  
John Beagle, BS, Adam P. Rago, MS, John Marini, BS, Upma Sharma, PhD  
Massachusetts General Hospital

**Presenter:** David King, MD

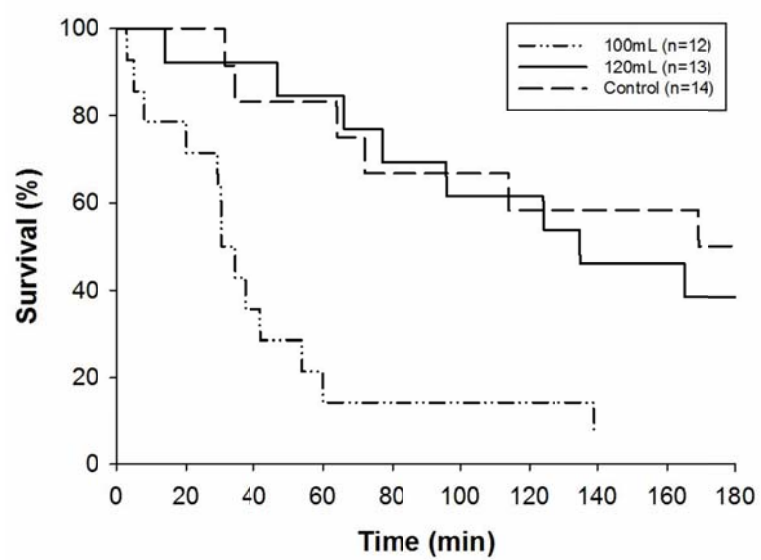
**Discussant:** Joseph DuBose, MD, University of Texas-Houston

**Objectives:** We have previously demonstrated the effectiveness of a self-expanding poly(urea)urethane foam in reducing mortality from a lethal hepato-portal injury. The utility of this therapy in a noncompressible large arterial injury model remains unknown. We hypothesized that foam therapy would improve survival following iliac artery transection.

**Methods:** Swine underwent transection of the right intra-peritonealized external iliac artery in a closed abdominal cavity, resulting in rapid exsanguination. After injury, animals were randomized to either: control group (n=14), treatment group 1 (120mL foam dose, n=13), or treatment group 2 (100mL foam dose, n=12). Animals were monitored for three hours. Main outcome measures included survival duration, overall percent survival, and hemorrhage rate.

**Results:** One hour after injury, survival was higher in group 1 than controls (85% vs. 14%,  $p<0.001$ ) and in group 2 compared to controls (82% vs. 14%,  $p=0.001$ ). Both foam treatment groups had significantly longer survival times compared to controls (group 1:  $125\pm59$  minutes, group 2:  $130\pm63$  minutes vs. controls:  $42\pm37$  minutes, all  $p<0.001$ ). In group 1, the volume of blood loss ( $33\pm13$  ml vs.  $46\pm8$  ml in controls,  $p=0.004$ ) and the rate of hemorrhage ( $0.55\pm0.85$  ml/minute vs.  $3.19\pm4.36$  ml/minute in controls,  $p=0.042$ ) were reduced. Similarly, in group 2, the volume ( $35\pm15$  ml vs.  $46\pm8$  ml in controls,  $p=0.03$ ) and rate ( $0.50\pm0.59$  ml/minute vs.  $3.19\pm4.36$  ml/minute in controls,  $p=0.045$ ) of bleeding were reduced.

**Conclusions:** This study establishes efficacy of foam treatment in a large vessel, high pressure, arterial injury. These findings, combined with our previous work, demonstrate the potential of foam to treat exsanguinating, noncompressible, venous, portal, and arterial injuries in the pre-hospital environment as a bridge to definitive surgical intervention.



Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 23 8:40 am

**ARE PEDIATRIC CONCUSSION PATIENTS COMPLIANT  
WITH DISCHARGE INSTRUCTIONS?**

Vivian Hwang, MD, Amber W. Trickey, PhD, MS, Christy Lormel, MPH,  
Anna Bradford, PhD, MSW, Margaret M. Griffen, MD\*, Cheryl Lawrence, BS,  
Charles F. Sturek, BA, MS, Elizabeth A. Stacey, MSN, John Howell, MD  
Inova Fairfax Hospital

**Presenter:** Vivian Hwang, MD

**Discussant:** Michael Pasquale, MD, FACS, FCCM, LeHigh Valley Health Network

**Objectives:** The objective was to evaluate compliance with Emergency Department (ED) post-discharge guidelines for concussion management.

**Methods:** A prospective cohort study was conducted from Nov 2011-Nov 2012 in a Pediatric Emergency Department at a regional level 1 trauma center, serving 35,000 pediatric patients/year. Subjects were age 8-17 yrs, discharged from the ED with diagnosis of concussion. Exclusion criteria included: recent (past 3 mo.) diagnosis of head injury, hospital admission, intracranial injury, skull fracture, suspected accidental trauma, or preexisting neurologic condition. Subjects were administered a baseline survey in the ED and given standardized instructions for concussion by the treating physician. Telephone follow-up surveys were conducted at 2 and 4 wks post-ED visit.

**Results:** A total of 150 patients were enrolled. Demographics and follow-up characteristics are presented in Table 1. The majority (67%) of concussions were sports-related. Among sports concussions, soccer (30%), football (11%), lacrosse (8%) and basketball (8%) injuries were most common. Over one-third (39%) reported returning to play on the day of injury. Physician follow-up was equivalent for sport and non-sport concussions (2 wks: 58%, 4 wks: 64%). Sports concussion patients were more likely to follow-up with a trainer (2 wks: 25% v. 10%,  $p=0.06$ ; 4 wks: 29% v. 8%,  $p<0.01$ ). Of patients who had returned to play or normal activities at 2 wks (44%), over one-third (35%) were symptomatic, and most (58%) did not receive medical clearance (Table 2). Of patients who had returned to activities at 4 wks (64%), less than one-quarter (23%) were symptomatic, and most (54%) received medical clearance (Table 2).

**Conclusions:** Pediatric patients discharged from the ED are mostly compliant with concussion instructions. However, a significant number of patients return to play on the day of injury, while experiencing symptoms or without medical clearance.

**Table 1: Demographics and Follow-Up Characteristics.**

	Mean (SD) or N (%)
Total, N	150
Age, mean (SD)	13 (2.5)
8-13 yrs, N (%)	83 (55)
14-17 yrs, N (%)	67 (45)
Male, N (%)	95 (63)
Insurance:	
Private, N (%)	124 (85)
Medicaid, N (%)	14 (10)
Self pay, N (%)	8 (5)
Hospital County, N (%)	110 (72)
2-week Follow-Up, N (%)	125 (83)
4-week Follow-Up, N (%)	116 (77)

**Table 2: Compliance with Discharge Instructions.**

	2 Weeks N (%)	4 Weeks N (%)
Return to Play / Normal Activities	55 (44)	74 (64)
With Symptoms	19 (35)	17 (23)
After Symptoms Resolved	36 (65)	57 (77)
With Medical Clearance	23 (42)	40 (54)
Without Medical Clearance	32 (58)	34 (46)
Reported Rehabilitation Stages	120 (96)	108 (93)
Completed Appropriate Stages	105 (87)	94 (87)
Skipped Stages	15 (13)	14 (13)

Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 24 9:00 am

NEVER-FROZEN LIQUID PLASMA BLOCKS ENDOTHELIAL PERMEABILITY AS EFFECTIVELY AS  
THAWED FRESH FROZEN PLASMA

Anahita Dua, MD\*, Yanna Cao, Nena Matijevic, PharmD, PhD,  
Yao-Wei Wang, MD, Shibani Pati, MD PhD, Charles E. Wade, PhD,  
Tien C. Ko, MD, John B. Holcomb, MD\*

Center for Translational Injury Research, Department of Surgery, University of Texas-Houston

**Presenter:** Anahita Dua, MD

**Discussant:** Herb A. Phelan, III, MD, UT Southwestern Medical Center

**Objectives:** Thawed fresh frozen plasma (TP) is the preferred plasma product for resuscitation, but can only be utilized for up to 5 days post thawing. Never-frozen, liquid plasma (LQP) is approved for up to 26 days when stored at 1-6°C. We have previously shown that TP repairs human endothelial cells (EC) TNF-alpha induced permeability. We hypothesized that stored LQP decreased permeability as effectively as TP.

**Methods:** Three single-donor plasma units were pooled. Aliquots were frozen and samples thawed on day 0 (TP0) then stored for 5 days (TP5). The remaining LQP was kept refrigerated for 28 days and aliquots analyzed every 7 days. The EC monolayer was stimulated with TNF-alpha (10ng/ml), inducing permeability, followed by treatment with TP0, TP5, or LQP aged 0, 7, 14, 21, and 28 days. Permeability was measured by leakage of FITC-Dextran through the monolayer. Hemostatic profiles of samples were evaluated by thrombogram and thrombelastogram. Statistical analysis was performed using two-way ANOVA with  $p < 0.05$  deemed significant.

**Results:** TNF-alpha increased permeability of the EC monolayer 2-fold compared to medium control. LQP repaired TNF-alpha-induced permeability at all time points ( $p < 0.001$ ) and as effectively as TP0 and TP5 ( $p = 0.07$ ). Stored LQP retained the capacity to generate thrombin and form a clot.

**Conclusions:** LQP repairs TNF-alpha-induced EC permeability and preserves hemostatic potential after 28 days of storage, similar to TP stored for 5 days. The significant logistical benefit (five-fold) of prolonged LQP storage improves the immediate availability of plasma as a primary resuscitative fluid for bleeding patients.

	TP0	TP5	LQP
EC Permeability (Mean of fold $\pm$ SE)	1.00 $\pm$ 0.12	1.44 $\pm$ 0.19	1.03 $\pm$ 0.12
Endogenous Thrombin Potential (ETP, nM x min)	1537 $\pm$ 48	1585 $\pm$ 58	1574 $\pm$ 37
TEG maximum amplitude (MA, mm)	31 $\pm$ 3	32 $\pm$ 2	33 $\pm$ 3

Permeability and hemostatic profile comparing TP0, TP5 and LQP



Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 25 9:20 am

**UNVEILING POST-TRAUMATIC STRESS DISORDER IN TRAUMA SURGEONS:  
A NATIONAL SURVEY**

Bellal Joseph, MD\*, Viraj Pandit, MD, George Hadeed, MPH, Julie L. Wynne, MD, MPH\*, Andrew L. Tang, MD\*,  
Narong Kulvatunyou, MD\*, Terence O'Keeffe, MD, MSPH\*,  
Donald Green, MD, Randall S. Fries, MD\*, Peter Rhee, MD, MPH\*  
The University of Arizona

**Presenter:** Bellal Joseph, MD

**Discussant:** Karen Lommel, DO, MHA, MS, University of Kentucky

**Objectives:** The significance of Post-Traumatic Stress Disorder (PTSD) in trauma patients is well recognized. The impact trauma surgeons endure in managing critical trauma cases is unknown. The aim of our study was to screen and identify risk factors for the development of PTSD symptoms and diagnosis of PTSD among trauma surgeons.

**Methods:** We surveyed all members of the American Association for Surgery of Trauma (AAST) and the Eastern Association for Surgery of Trauma (EAST) using an established PTSD screening test (PTSD Checklist Specific- PCL-S). A PCL-S score of  $\geq 35$  (sensitivity  $\geq 85\%$ ) was used as the cut off for development of PTSD symptoms and a PCL-S score  $\geq 44$  for the diagnosis of PTSD. Step wise forward multivariate logistic regression was used to determine independent risk factors for developing PTSD symptoms and diagnosis of PTSD.

**Results:** There were 453 respondents with a 41% response rate. The majority practiced in an urban (90%), Level I (71%), academic center (80%), with 24 hour resident coverage (83%). PTSD symptoms were present in 40% (n=181) of trauma surgeons and 15% (n=68) of trauma surgeons met the diagnostic criteria for PTSD. Salary, years of clinical practice, and previous military experience were neither predictive for the development of PTSD symptoms nor the diagnosis of PTSD.

**Conclusions:** Both symptoms and the diagnosis of Post-Traumatic Stress Disorder are common among trauma surgeons. Defining the factors that predispose trauma surgeons to PTSD may be of benefit to the patients and the profession. The data from this survey will be useful to major national trauma surgery associations for developing targeted interventions.

<b>Factors predicting PTSD symptoms and diagnosis</b>		
Variables	OR	95%CI
<b><u>PTSD symptoms</u></b>		
<4 hour relaxation per day	7	1.4 – 35
>15 operative cases per month	3	1.2 – 8
24 hour resident coverage	2.8	1.2 – 7
>7 Call duties per month	2.6	1.2 – 6
Male	2	1.2 - 3.1
<2 week vacation per year	2	1.2 – 10
<b><u>PTSD diagnosis</u></b>		
>5 critical cases per call	7	1.1 – 8
PTSD- Post traumatic stress disorder		

Multivariate Regression Analysis for Factors Predicting PTSD Symptoms and Diagnosis

Scientific Session IV-A  
Education and Basic Science

January 17, 2014  
Paper 26 9:40 am

UNCONSCIOUS RACE AND CLASS BIAS AND ITS ASSOCIATION WITH DECISION MAKING BY TRAUMA AND  
ACUTE CARE SURGEONS

Adil H. Haider, MD, MPH\*, Eric B Schneider, N. Sriram, PhD, Valerie K. Scott, MSPH,  
Sandra Swoboda, RN, Lia Losonczy, MD, MPH, Elliott R. Haut, MD, FACS\*,  
David T. Efron, MD\*, Peter Pronovost, MD, PhD, Julie Freischlag, MD,  
Pamela Lipsett, MD, MHPE, Ellen J. Mackenzie, PhD\*,  
Lisa Cooper, MD, MPH, Edward E. Cornwell III, MD\*  
Johns Hopkins School of Medicine

**Presenter:** Adil H. Haider, MD, MPH

**Discussant:** Alexander L. Eastman, MD, MPH, UT Southwestern Medical Center

**Objectives:** Recent studies demonstrate the presence of unconscious or implicit race biases among medical doctors (internists) that impact their decision making. Our objective was to evaluate the presence of similar unconscious race and class bias among surgical providers and to determine if these are associated with surgical decision-making.

**Methods:** Prospective Web-based survey of active members of one of the largest professional organizations for Trauma/ Acute Care Surgeons in the US. Participants completed 9 clinical vignettes with 3 questions each on the management of trauma/ acute care surgery, followed by the Race Implicit Association Test (IAT) and the Social Class IAT, which are validated measures of unconscious race and social class bias. Multivariable, ordered logistic regression was used to determine whether implicit bias was associated with vignette responses. Apriori calculated sample size = 186 participants and surgeons were offered a \$50 Gift Card for their time.

**Results:** Of the 248 surgeon respondents, 79% explicitly stated that they had no race and 55% stated they had no social class preferences. However, 73.5% had IAT scores demonstrating an unconscious preference towards white persons and 90.7% had an implicit preference towards upper social class. Only 3 of the 27 decisions surgeons made on clinical vignettes demonstrated a relationship between race/ social class on univariate analyses. Multivariable analyses revealed no relationship between IAT scores and vignette based clinical assessments. Tests for interactions and race/class stratified subset analyses demonstrated no association between unconscious bias and surgical decisions.

**Conclusions:** Unconscious preferences for white and upper class persons are prevalent among surgical providers. However, these biases are not associated with clinical decisions. This dichotomy between physicians and surgeons needs to be further explored.

## Notes

**Scientific Session IV-B**  
**Trauma Systems and Performance Improvement**

**January 17, 2014**  
**Paper 27      8:00 am**

**HIGHER SURGICAL CRITICAL CARE STAFFING LEVELS ARE ASSOCIATED WITH IMPROVED  
NSQIP QUALITY MEASURES**

Christopher R. Reed, Sandy L. Fogel, MD FACS, Eric H. Bradburn, DO MS FACS\*,  
Bryan R. Collier, DO FACS\*, Christopher C. Baker, MD FACS, Mark E. Hamill, MD, FACS\*  
Virginia Tech Carilion School of Medicine

**Presenter:** Christopher R. Reed

**Discussant:** Chad Wilson, MD, New York University Medical School

**Objectives:** The changing face of American health care demands careful scrutiny of resource allocation. The impact of the surgical intensivist model on general surgical quality measures has not been studied. Our objective was to investigate the relationship between surgical critical care staffing and indicators of general surgical quality as measured by the National Surgical Quality Improvement Program (NSQIP).

**Methods:** We retrospectively examined the number of attending surgical intensivists at our tertiary care center biannually from January 2008 through December 2012. Risk-adjusted indicators of general surgical quality were captured and reported semiannually by NSQIP. Mortality, morbidity, ventilator >48 hours, unplanned intubations, and venous thromboembolism (VTE) were included. Student's t-test was used to compare the staffing levels and associated NSQIP odds-ratios of a 3-year control period of full staffing with a 2-year period following significant provider attrition.

**Results:** The number of full-time surgical intensivists ranged from 2 to 8, with a period of rapid decline in late 2010 – early 2011 followed by slow recovery. There was a mean of 6.6 surgical intensivists during the 3 years prior to the decline, and a mean of 4 in the 2 years post-decline and recovery ( $p < 0.005$ , Figure 1). This period of decline was associated with a significant increase in the odds-ratio of ventilation >48 hours (pre 0.936, post 1.87;  $p = 0.0086$ ) and of VTE (pre 0.844, post 1.43;  $p = 0.0268$ ). A trend in increased unplanned intubations was also observed. Overall morbidity and mortality were not affected. Notably, quality indicators appeared to rapidly approach baseline levels as new surgical intensivists were recruited (Figure 2).

**Conclusions:** Institutional commitment to recruitment and retention of a surgical critical care team leads to improved NSQIP general surgery quality measures.

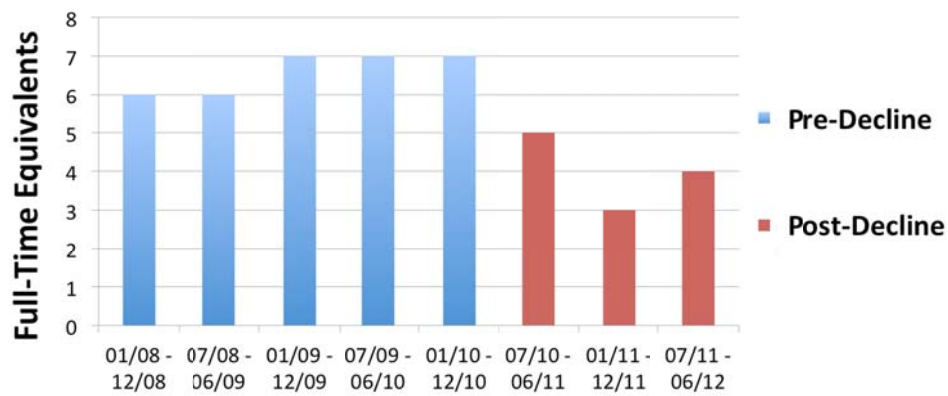


Figure 1 - Surgical Intensivist Staffing Levels

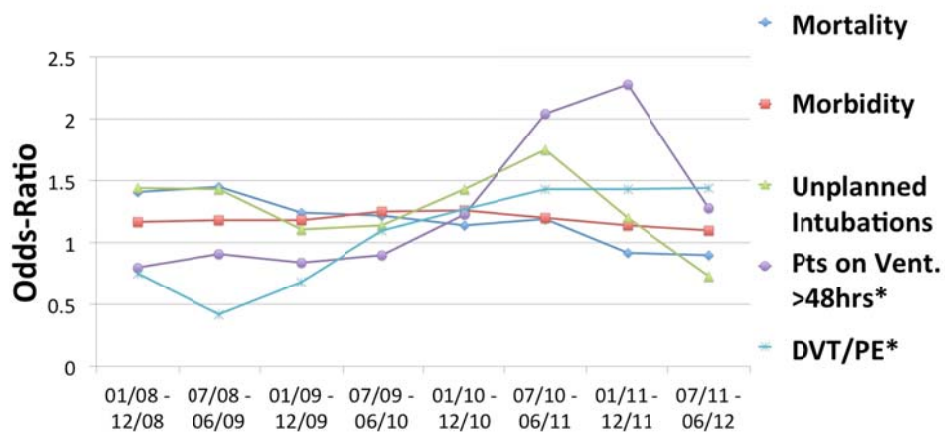


Figure 2 - NSQIP Odds-Ratios of General Surgery Quality Indicators

**Scientific Session IV-B**  
**Trauma Systems and Performance Improvement**

**January 17, 2014**  
**Paper 28      8:20 am**

**MAGNET DESIGNATION OF HOSPITALS IS ASSOCIATED WITH HIGHER  
SURVIVAL RATES FOR TRAUMA**

Tracy Evans, MD, FACS, Frederick Rogers, MD, MS, FACS\*, Turner Osler, MD, MSc, FACS, Amelia Rogers, BS,  
Jo Ann Miller, RN, BSN, CCRN, Christina Martin, MSN, RN, Michael Horst, PhD  
Lancaster General Health

**Presenter:** Tracy Evans, MD, FACS

**Discussant:** Karen Doyle, MBA, MS, RN, NEA-BC, University of Maryland Medical Center

**Objectives:** Little is known about the impact of nursing care on trauma outcomes. The Magnet Recognition Program recognizes hospitals for quality patient care and nursing excellence based on objective standards. We hypothesized that Magnet-designated trauma centers would have improved survival over their non-Magnet counterparts.

**Methods:** All 2009-2011 admissions to any of 30 trauma centers in the state of Pennsylvania (of which 13 were Magnet hospitals) were extracted from the Pennsylvania Trauma Systems Foundation State Registry. A logistic regression model with death as the dependent variable included the following variables: Magnet status, age, gender, logit transformation of the probability of death predicted by the TMPM model (TMPM-ais), systolic blood pressure (SBP), mechanism of injury (MOI), and GCSm from 1 to 6.

**Results:** There were 97,459 patients admitted to trauma centers over the two-year time period. The Magnet and Non-Magnet hospital groups were similar in level of designation, medical school association, surgical residency programs, in-house surgeons, and urban locations (Fischer's exact). Those patients admitted to a Magnet Hospital had a significantly decreased odds of dying when compared to their Non-Magnet counterparts (OR 0.825; 95% CI 0.69-0.98;  $p < 0.03$ ), when controlling for age, gender, TMPM-ais, SBP, MOI, and GCSm. Overall the model has outstanding discrimination with an ROC of 0.93.

**Conclusions:** Admission to a Magnet hospital is associated with a 17% reduction in mortality. We believe that the Magnet program's attention to nursing competence has important consequences for trauma patients, as reflected in the improved survival rates in trauma patients admitted to Magnet hospitals.

## Notes



Scientific Session IV-B  
Trauma Systems and Performance Improvement

January 17, 2014  
Paper 29 8:40 am

EVIDENCE BASED IMPROVEMENT OF THE NATIONAL TRAUMA TRIAGE PROTOCOL:  
GCS VERSUS GCS MOTOR

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

**Presenter:** Joshua B. Brown, MD

**Discussant:** Peter Fischer, MD, MS, Carolinas Medical Center

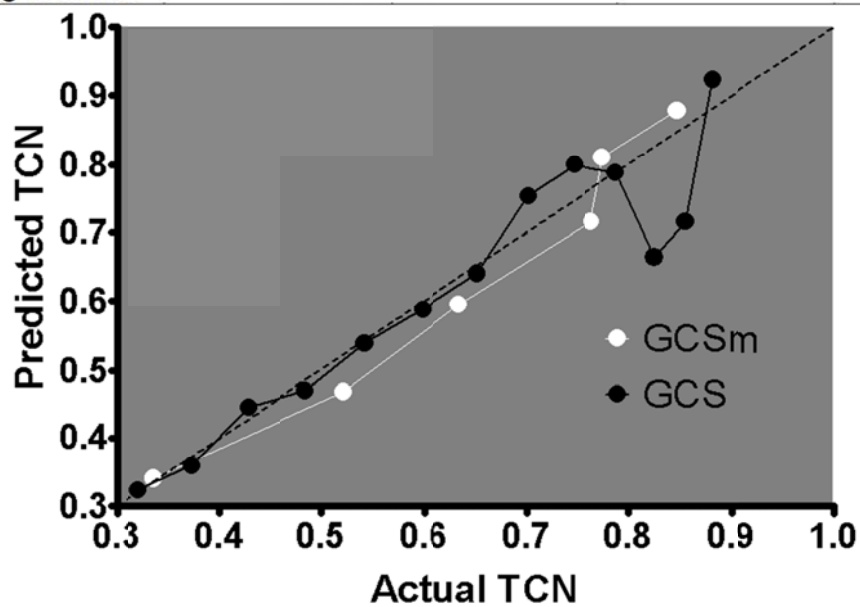
**Objectives:** Ideal triage uses simple criteria to identify severely injured patients. GCS motor (GCSm) may be easier for field use and was considered at the last revision of the National Trauma Triage Protocol (NTTP) but evidence was lacking. This study sought to evaluate performance of the NTTP if GCSm is substituted for the current  $GCS \leq 13$  criterion.

**Methods:** Subjects in the NTDB (2007-08) transported from the scene were included. Presence of NTTP physiologic (Step1) and anatomic (Step2) criteria was determined using prehospital vital signs and ICD-9 diagnosis codes.  $GCSm \leq 5$  was defined as a positive triage criterion. Imputation was used for missing data. Trauma center need (TCN) was defined as ISS > 15, ICU admit, urgent OR, or ED death. Test characteristics were calculated to predict TCN. The area under the curve (AUC) was compared between GCSm and GCS, individually and within the stepwise NTTP. Logistic regression was used to determine the association of  $GCSm \leq 5$  and  $GCS \leq 13$  with TCN after controlling for other NTTP criteria and generated a predicted probability of TCN. Predicted vs actual TCN was compared to evaluate calibration.

**Results:** There were 811,143 subjects included. Table 1 shows test characteristics for  $GCSm \leq 5$ ,  $GCS \leq 13$  and NTTP steps 1+2 using each criterion. There was no difference in AUC between  $GCSm \leq 5$  and  $GCS \leq 13$  when incorporated in the first two steps of the NTTP ( $p=0.10$ ).  $GCSm \leq 5$  had a stronger association with TCN (OR 3.37; 95%CI 3.27-3.48,  $p<0.01$ ) than  $GCS \leq 13$  (3.03; 2.94-3.13,  $p<0.01$ ). GCSm had a better fit of predicted vs actual TCN at the higher end of the scale (Fig).

**Conclusions:**  $GCSm \leq 5$  increases specificity at the expense of sensitivity compared to  $GCS \leq 13$ . When applied within the NTTP there is no difference in discrimination between GCSm and GCS.  $GCSm \leq 5$  is more strongly associated with TCN, and better calibrated to predict TCN. Further study is warranted to explore replacing  $GCS \leq 13$  with  $GCSm \leq 5$  in the NTTP.

	Sensitivity (%)	Specificity (%)	Accuracy (%)	AUC
GCSm≤5	27	95	66	0.609
GCS≤13	30	93	66	0.617
NTTP Step 1+2 using GCSm≤5	60	67	64	0.637
NTTP Step 1+2 using GCS≤13	62	66	64	0.639



Scientific Session IV-B  
Trauma Systems and Performance Improvement

January 17, 2014  
Paper 30 9:00 am

**USING THE ROTHMAN INDEX TO PREVENT UNPLANNED SICU READMISSIONS**

Greta L. Piper, MD\*, Lewis J. Kaplan, MD, FACS, FCCM, FCCP\*, Adrian A Maung, MD\*, Felix Y. Lui, MD, FACS\*,  
Kimberly Barre, RN\*, Kimberly A. Davis, MD, MBA, FACS, FCCM\*  
Yale University School of Medicine

**Presenter:** Greta L. Piper, MD

**Discussant:** R. Shayn Martin, MD, Wake Forest School of Medicine

**Objectives:** The Rothman Index (RI) is a numerical score calculated hourly from 26 data points in the electronic medical record by a commercial software package. A low score is associated with poor clinical status. Although it is purported to serve as an indicator of change in a patient's condition, it has not been extensively evaluated in the literature. Our objective was to determine whether the RI can be used to predict unplanned SICU readmissions.

**Methods:** Single institution, retrospective 12-month period review of all patients transferred from the SICU to the ward. Patients readmitted within 48 hours were compared to patients who did not require readmission during this time (control). Demographics and continuous RI scores were collected at admission, 24 hours prior to SICU transfer, and for the first 48 hours on the ward or until readmission to the SICU. Student's *t*-test and Chi-square analyses were used.

**Results:** 1152 SICU patients were transferred to the ward; 27 patients were readmitted within 48 hours of transfer. Age, gender, and need for surgery were similar in both groups. The mean SICU length of stay was longer in the readmission group ( $4.7 \pm 8.1$  vs.  $16.5 \pm 15.2$ ,  $p < 0.001$ ). The RI immediately prior to SICU transfer was higher in the control group ( $70.4 \pm 20.3$  vs.  $49.1 \pm 20.9$ ,  $p < 0.001$ ) and was uniformly improved from the RI at the initial admission. In comparison, readmitted patients had more labile RI scores from admission to SICU transfer (mean  $\Delta = 6.51$ ; range  $-54.10 - 48.6$ ), and 40.74% of readmitted patients actually had a decreased RI score on transfer. No patient with a RI score  $> 82.90$  was readmitted within 48 hours.

**Conclusions:** An increased RI score or a score  $> 82.90$  correlates with appropriateness for SICU transfer to the ward. A decreased RI score is strongly associated with SICU readmission within 48 hours and should be explored as a potential quality metric.

## Notes

**Scientific Session IV-B  
Trauma Systems and Performance Improvement**

**January 17, 2014  
Paper 31      9:20 am**

**LEAN METHODOLOGY FOR PERFORMANCE IMPROVEMENT IN THE TRAUMA DISCHARGE PROCESS**

Michael Shay O'Mara, MD, MBA, FACS\*, Vickie Graymire, RN, MS, CNS, Aliaksandr Ramaniuk, BS - Finance  
Grant Medical Center

**Presenter:** Michael Shay O'Mara, MD, MBA, FACS

**Discussant:** Heena Santry, MD, MS, University of Massachusetts

**Objectives:** High-volume, complex services such as trauma and acute care surgery are at risk for inefficiency. Lean process improvement can reduce healthcare waste. Lean allows a structured look at processes not easily amenable to analysis. We applied lean methodology to the current state of communication and discharge planning on a urban trauma service, citing areas for improvement.

**Methods:** A lean process mapping event was held. The process map was used to identify areas for immediate analysis and intervention – defining metrics for the stakeholders. After intervention, new performance was assessed by direct data evaluation. The process was completed with an analysis of effect, and plans made for addressing future focus areas.

**Results:** The primary area of concern identified was inter-service communication. Changes centering on a standardized morning report structure reduced the number of consult questions unanswered 67% to 34% ( $p=0.0021$ ). Physical therapy rework was reduced 35% to 19% ( $p=0.016$ ). Patients admitted to units not designated to the trauma service had 1.6 times longer lengths of stay (LOS) ( $p<0.0001$ ). The lean process lasted eight months, and three areas for new improvement were identified: 1) the off-unit patients; 2) patients with LOS more than 15 days contribute disproportionately to LOS; and 3) miscommunication exists around patient education at discharge.

**Conclusions:** Lean process improvement is a viable means of healthcare analysis. When applied to a trauma service with 4,000 admits annually, lean identifies areas ripe for improvement. Our inefficiencies surrounded communication and patient localization. Strategies arising from the input of all stakeholders led to real solutions for communication through a face-to-face morning report, and identified areas for ongoing improvement. This improves resource utilization and identifies areas for improvement of throughput and patient care.

## Notes

Scientific Session IV-B  
Trauma Systems and Performance Improvement

January 17, 2014  
Paper 32 9:40 am

GERIATRIC OUTCOMES FOR TRAUMA PATIENTS IN THE STATE OF FLORIDA AFTER THE ADVENT OF  
A LARGE TRAUMA NETWORK

Darwin Ang, MD\*, Scott H. Norwood, MD\*, Mark G. McKenney, MD\*,  
Erik S. Barquist, MD, FACS\*, Stanley J. Kurek Jr., DO, FACS\*, Brian J. Kimbrell, MD\*, Alejandro J Garcia, MD\*,  
Charles Walsh, MD, Huazhi Liu, MS, Michele K. Ziglar, MSN, RN\*, James M. Hurst, MD\*  
University of South Florida

**Presenter:** Darwin Ang, MD

**Discussant:** Lewis Somberg, MD, Medical College of Wisconsin

**Objectives:** The State of Florida has one of the largest geriatric populations in the U.S. However, geriatric trauma patients are the least served by designated trauma centers (TC). In 2011, one existing trauma center and four provisional level 2 TC were combined to create a large scale trauma network (TN). The new TC were placed in areas with the lowest ratio of TC to residents. The aim of this study is to measure the TN impact on the population of geriatric trauma patients.

**Methods:** Data from the Florida State Agency for Health Care Administration was used to determine mortality, length of stay, and complication rates for geriatric trauma patients ( $\geq 65$ ). The potential effect of the TN was measured by comparing outcomes before and after the initiation of the TN. A total of 116,154 geriatric patients were evaluated. The TN was also compared to the rest of the designated TCs. Multivariate regression methods were used to match for age, injury status (penetrating vs. non-penetrating), gender, race, and Injury severity.

**Results:** The TN treated 9.4% of geriatric trauma patients in Florida during the first three quarters of 2012. There was a temporal association with a decrease in both mortality aOR 0.87 (95% CI 0.79, 0.95) and length of stay for geriatric patients (6.3 vs. 6.1 days p-value=0.001) since the advent of the TN. When comparing the TN with the rest of the TCs, the TN case-mix of patients had a higher frequency of geriatric patients 40% vs. 35%. There were no significant differences in mortality when comparing TN to all other TCs, 4.6% vs. 5.2%, p-value 0.12. However there was a significant shorter LOS (5.6 vs. 6.5 days, p-value 0.001) and complication rate (30.2% vs. 33.1%, p-value 0.01).

**Conclusions:** The temporal improvement in outcomes may be associated with the increased proportion of patients now being treated in state designated trauma centers as a result of the addition of the TN.

## Notes