

IS THE SYMPATHETIC SYSTEM INVOLVED IN SHOCK-INDUCED GUT INJURY?

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Presenter: Gregg Baranski

Discussant: Nicole Fox, MD, MPH - Cooper University Hospital

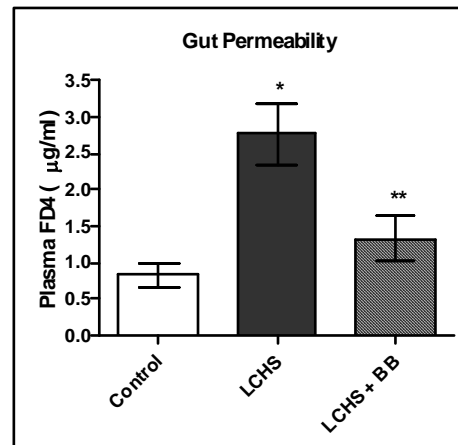
Objective: Beta blockade (BB) has been shown to prevent bone marrow dysfunction following trauma and hemorrhagic shock (HS). The impact of the sympathetic system and the role of BB on shock-induced distant organ injury is not known. This study will determine if BB can diminish gut injury following trauma and HS.

Methods: Male Sprague-Dawley rats were subjected to lung contusion (LC) followed by 45 minute HS. Animals (n=6/group) were then randomized to either receive propranolol (LCHS+BB) immediately after resuscitation or not (LCHS). Gut permeability was evaluated in vivo at 2.5 hours post resuscitation by diffusion of 4-kDa fluorescein dextran (FD4) from an isolated segment of small bowel into peripheral blood. Villous injury was graded histologically by a blinded reader. *p < 0.05 vs control and ** p < 0.05 vs. non-BB counterpart with ANOVA and Tukey-Kramer.

Results: Animals undergoing LCHS had significantly higher plasma levels of FD4 compared to control animals. However, animals receiving BB had a significant reduction in plasma FD4 compared to the LCHS group and were similar to control levels (Figure). Villous injury was higher following LCHS (2.75 ± 1) and with the use of BB villous injury score was similar to control animals (1.5 ± 0.6 vs. 1.4 ± 0.9).

Conclusions: Propranolol can protect against the detrimental effects of trauma and HS on gut permeability and villous injury. This effect is likely due to a blunting of the exaggerated sympathetic response.

Beta blockade's reduction of both bone marrow dysfunction and gut injury further demonstrates the importance of the sympathetic nervous system and its role in potentiating end organ dysfunction following severe trauma.



Session

Paper 2 9:10 AM

INSERTION OF CENTRAL VENOUS CATHETERS INDUCES A HYPERCOAGULABLE STATE

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Presenter: Mark Ryan, MD

Discussant: Babak Sarani, MD - George Washington University School of Medicine

Objective: Pulmonary artery catheters induce a hypercoagulable state in patients or swine for up to 8 hrs (*J Trauma* 2005 Oct;59(4): 853-7). The purpose of this study is to determine whether insertion of a central venous line (CVL) provokes a similar response.

Methods: *Animal:* Healthy, anesthetized swine (n=10) underwent CVL catheterization. Blood was drawn from 7F femoral arterial catheters before and 60 min after CVL catheterization and analyzed by kaolin-activated thromboelastography (TEG) at precisely 2 min. *Human:* An IRB-approved prospective, observational trial was conducted in critically ill patients (n=8) at a Level 1 trauma center. Blood was drawn from arterial catheters before and 60 minutes after CVL catheterization. Samples were stored in sodium citrate for exactly 15 min prior to TEG. Pre- and post catheterization samples were compared using a paired t-test and significance was assessed at the 95% interval.

Results: In both animals and humans, CVL decreased clotting time (R) and clot formation time (K), and accelerated fibrin cross-linking (alpha). Clot strength (MA) was not significantly affected.

	Animal				Human			
	Pre-CVL	Post-CVL	Percent Difference	P	Pre-CVL	Post-CVL	Percent Difference	P
R	13.9±0.1	6.4±1.0	- 55%	0.0001	15.6±1.4	10.9±1.2	- 29%	0.0135
K	5.7±0.9	2.5±0.3	- 41%	0.0026	3.4±0.4	2.1±0.3	- 36%	0.0187
Alpha	44.2±2.8	58.4±4.4	+ 28%	0.0077	53.7±4.6	62.5±3.3	+ 19%	0.0032
MA	68.5±0.9	79.6±2.1	+ 8%	0.0629	66.4±4.6	66.3±3.3	+ 1%	0.9262

Conclusion: In healthy swine as well as critically ill patients, insertion of a CVL initiates and propagates a systemic hypercoagulable state. This may explain why CVLs are associated with an increased risk of venous thromboembolism.

**PREVENTATIVE VENTILATION PRIOR TO LUNG INJURY AVERTS ARDS:
A NOVEL TIMING-BASED STRATEGY OF VENTILATOR THERAPY**

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Presenter: Shreyas Roy, MD, CM

Discussant: Michael Chopko, MD - Department of Surgery, Division of Trauma/ Critical Care at SUNY Buffalo

ARDS affects 200,000 patients annually killing 30-40%. Alveolar instability occurs early in the development of ARDS, prior to clinical signs of lung injury. Mechanical ventilation of unstable lungs causes shear stress exacerbating lung injury. **Hypothesis-** Early application of preventive mechanical ventilation *before* clinical signs of lung injury will avert the development of ARDS by minimizing alveolar instability and shear stress. **Methods -** Yorkshire Pigs (38-45kg) were anaesthetized and subjected to 2-hit injury: **Ischemia-Reperfusion**- the superior mesenteric artery was clamped for 30 min + **Peritoneal Sepsis**- a fecal clot was placed in the peritoneal cavity. Immediately following injury, animals were randomized into 2 Groups: **Early Preventative Ventilation (Airway Pressure Release Ventilation- APRV) n = 3** and **Non-Protective Ventilation (NPV) n = 5** and followed for 48hrs. Both groups received IV anesthesia, monitoring, antibiotics, and fluid/vasopressor therapy per *Surviving Sepsis Campaign* guidelines. **Ventilation:** 1) **NPV Group** - Tidal volume (Vt) - 10cc/kg + PEEP- 5 cm/H₂O in volume-cycled mode, 2) **APRV Group** - Vt of 10-15 cc/kg, APRV parameters (P_{high}, P_{low}, T_{high}, T_{low}) were titrated over the study to maximize alveolar stability.

Histologic analysis of the lung was performed at necropsy. **Results-** All NPV animals developed ARDS (PaO₂/FiO₂ < 200) whereas none of the APRV animals developed ARDS. Quantitative histological scoring showed significant improvements in stigmata of ARDS in the APRV group (p<0.001 vs. NPV). Gross lung pathology corroborated histology (Fig 1). Preliminary cytokine assays showed minimal differences in IL-

1, IL-4, IL-6, IL-8, and NO₃/NO₂ plasma concentrations between groups. **Conclusions-** Early preventive mechanical ventilation with APRV stopped the development of ARDS despite similar systemic inflammation and Vt. Our results could change the clinical paradigm from supportive mechanical ventilation for ARDS to early preventative ventilation strategies for at risk patients.

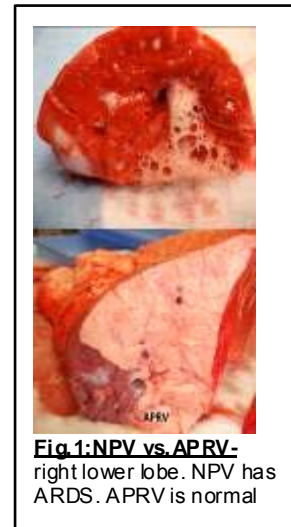


Fig 1: NPV vs. APRV- right lower lobe. NPV has ARDS. APRV is normal

Session

Paper 4 9:50 AM

DEBUNKING THE SURVIVAL BIAS MYTH: CHARACTERIZATION OF MORTALITY OVER THE INITIAL 24 HOURS FOR PATIENTS REQUIRING MASSIVE TRANSFUSION

Joshua B Brown, MD, Andrew B Peitzman, MD, Mitch J Cohen, MD, Eugene E Moore, MD, Ronald V Maier, MD, Micheal A West, MD, PhD, Joseph Cuschieri, MD, Josph P Minei, MD, Timothy R Billiar, MD, Jason L Sperry, MD, MPH, University of Pittsburgh

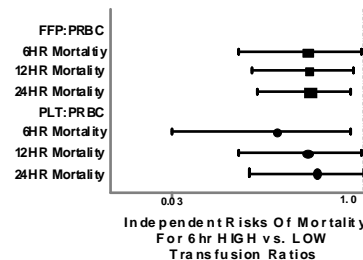
Presenter: Joshua Brown, MD

Discussant: Juan Duchesne, MD - Tulane University School of Medicine

Objectives: Controversy surrounds the optimal ratios of blood (PRBC), plasma (FFP) and platelet (PLT) use in patients requiring massive transfusion (MT) due to possible survival bias in prior studies. We sought to characterize mortality over the first 24hrs while controlling for time-varying effects of transfusion to minimize survival bias. **Methods:** Data were obtained from a multicenter prospective cohort study of blunt injured adults with hemorrhagic shock. MT was defined as $\geq 10u$ PRBC over 24hrs. HIGH FFP:PRBC ($=1:1.5$) and PLT:PRBC ($=1:9$) ratios at 6hr, 12hr, and 24hr were compared to LOW ratio groups. Cox-Hazard regression was used to determine the independent mortality risks at 6hr, 12hr, and 24hrs while controlling for important confounders. FFP:PRBC and PLT:PRBC ratios were also analyzed as time-dependent covariates accounting for fluctuation over time. Mortality > 24 hrs was treated as survival. **Results:** In the MT cohort ($n=604$), base deficit, lactate, and INR were similar across HIGH and LOW ratio groups at presentation and at 6hrs. HIGH 6hr FFP:PRBC and 6hr PLT:PRBC ratios were independently associated with over a 50% reduction in mortality risk at 6hrs, 12hrs and 24hrs. (FIG.) These findings were consistent for 12hr and 24hr ratios. When analyzed as time-dependent covariates, the associated survival benefit remained significant for HIGH FFP:PRBC and PLT:PRBC ratios throughout the 24hr period. Subgroup analysis revealed that a HIGH 1:1 ratio ($=1:1.5$) had a significant survival benefit at 24hr relative to a HIGH 1:2 ($1:1.51-1:2.50$) ratio group (HR 0.25; CI 0.06-0.95, $p=0.04$) suggesting a dose response relationship.

Conclusion: Despite similar degrees of early shock and coagulopathy, HIGH FFP:PRBC and PLT:PRBC ratios are associated with a survival benefit as early as 6hrs and throughout the first 24hrs, even when time dependent fluctuations of component transfusion are accounted for.

This suggests the observed mortality benefit associated with high component transfusion ratios is unlikely due to survivor bias and that early attainment of high transfusion ratios may significantly lower the risk of mortality in MT patients.



Session

Paper 5 10:10 AM

HUMAN MICROPARTICLES GENERATED DURING SEPSIS IN CRITICALLY ILL PATIENTS ARE NEUTROPHIL-DERIVED AND MODULATE THE IMMUNE RESPONSE

Priya Prakash, MD, Charles Caldwell, PhD, Timothy Pritts, MD, PhD, Bryce Robinson, MD, University of Cincinnati Department of Surgery

Presenter: Priya Prakash, MD

Discussant: David Skarupa, MD - East Carolina University

OBJECTIVE: Microparticles (MPs) are 0.3 to 1 μ M vesicles generated after cell activation or apoptosis that may play a role in the pathophysiology of sepsis. We sought to elucidate the role of MPs in critically ill patients and hypothesized that MPs are generated at the site of inflammation and can modulate the immune response. **METHODS:** Critically ill surgical patients with ongoing sepsis were enrolled from the ICU of an urban, level I trauma center from March to June 2011. Abdominal washings and bronchial alveolar lavage (BAL) fluid were collected from sites of inflammation. MPs were isolated using differential centrifugation, then characterized by flow cytometry. Immunological assays were conducted by incubating neutrophil-derived MPs (NDMPs) with a human monocytic cell line (THP-1). A p-value ≤ 0.05 was considered significant. **RESULTS:** MPs were absent in non-inflamed foci in patients while NDMPs were present in locations of inflammation (Fig 1). NDMPs were added to cultured THP-1 cells in order to quantify immunomodulatory effects. THP-1 cells were able to phagocytose NDMPs. Cells that ingested NDMPs demonstrated increased activation as demonstrated by an increase in quantitative fluorescence of cell surface markers (Fig 2). In contrast, bystander THP-1 cells without ingested NDMPs demonstrated decreased activation. **CONCLUSION:** NDMPs are generated at the site of inflammation in critically ill patients during sepsis. They have a divergent impact on the immune response by activating phagocytic cells and deactivating bystander cells. NDMPs may play an important role in regulating the inflammatory response to sepsis in critically ill patients.

Figure 1:

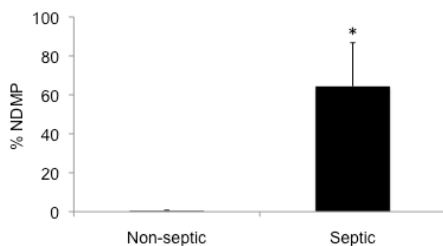
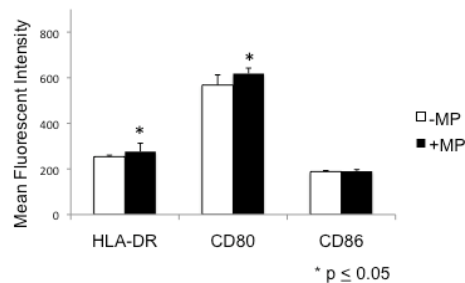


Figure 2:



Session

Paper 6 10:50 AM

STILL MAKING THE CASE FOR "SCOOP AND RUN": A RAT HEMORRHAGIC SHOCK MODEL.

Sharven Taghavi, MD, MPH, MS, Senthil Jayarajan, MD, Jason M. Duran, BS, Gonzalo E. Cruz-Schiavone, BS, Richard E. Milner, BS, John P. Gaughan, PhD, Lars O. Sjöholm, MD, Abhijit Pathak, MD, Thomas A. Santora, MD, Steven R. Houser, PhD, Amy J. Goldberg, MD, Temple University Hospital

Presenter: Sharven Taghavi, MD

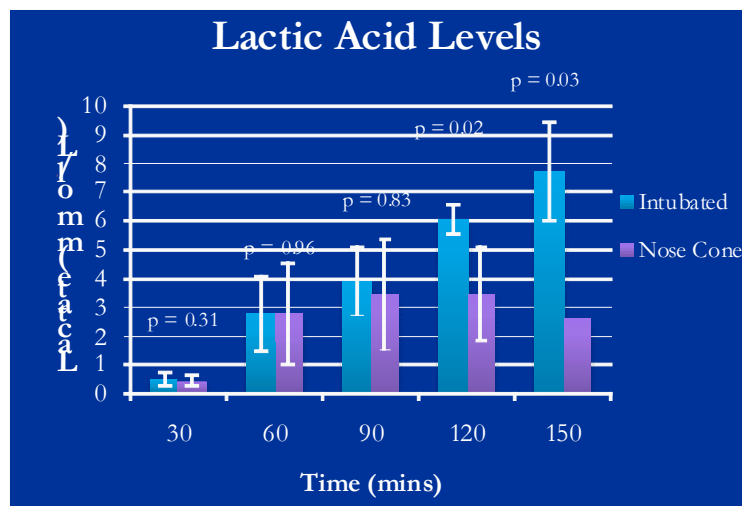
Discussant: Greta Piper, MD - Yale University School of Medicine

Introduction: Pre-hospital intubation does not appear to result in a survival advantage in patients suffering penetrating trauma, yet there is still resistance to the practice of “scoop and run” to speed access to advanced care. An animal model was used to determine whether intubation provides a survival advantage during potentially lethal hemorrhage.

Methods: The carotid arteries of Sprague-Dawley rats were cannulated, and mean arterial pressure (MAP) was measured. One group of animals (n=10) was intubated and placed on a ventilator while the other (n=9) was administered 100% oxygen via nose cone. Rats were exsanguinated to a MAP of 40 mm Hg and then bled periodically to maintain a MAP between 40-45 mm Hg. The primary end-point was time until death. Secondary end-points included lactic acid and base deficit levels measured in blood collected at 30-minute intervals after inducing shock.

Results: There was no significant difference in time until death between the intubated and nose cone groups (85.5 vs. 93.3 mins, p=0.60). Intubated animals had higher lactic acid levels at 120 and 150 minutes after the initiation of shock (see figure). In addition, intubated animals had larger base deficits at 120 minutes (-13.5 vs. -7.9 mmol/L, p=0.04).

Conclusions: Intubation does not result in a survival advantage in this rat model of hemorrhagic shock. Positive pressure ventilation may cause decreased venous return and accentuate end-organ hypoperfusion. Large animal studies are needed to further investigate these findings.



17 β -ESTRADIOL ATTENUATES CYTOKINE-INDUCED NITRIC OXIDE PRODUCTION IN RAT HEPATOCYTE

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Presenter: Ikenna Nweze, MD

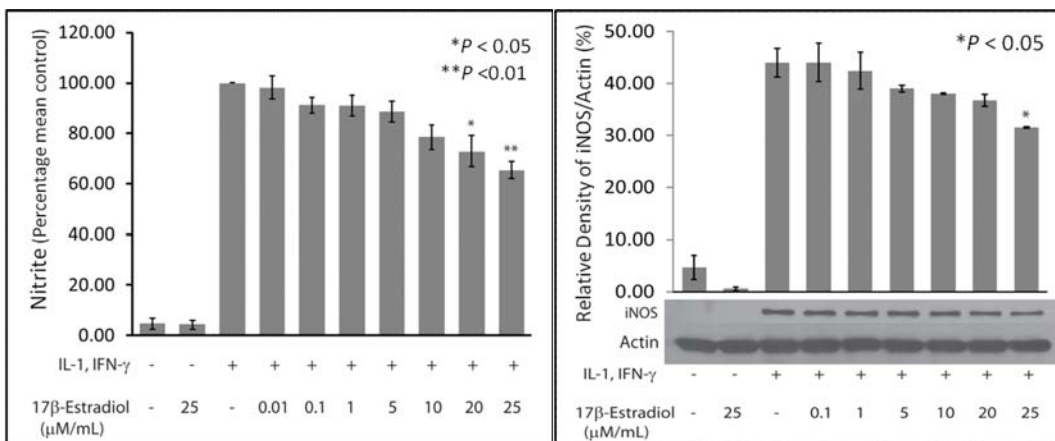
Discussant: Matthew Rosengart, MD, MPH - University of Pittsburgh Medical Center

Objective: Nitric Oxide (NO) regulation during shock and sepsis is complex and NO serves divergent functions. Nitric oxide production by endothelial NO synthase (eNOS) maintains microvascular perfusion and prevents shock-induced organ injury. However, overproduction of NO by inducible NO synthase (iNOS) contributes to liver dysfunction after shock, and is associated with increased tissue damage and mortality. Estrogen improves organ function and outcome after shock and sepsis but the mechanism is unknown. We hypothesized that 17 β -Estradiol would improve organ function by regulating the production of hepatocyte nitric oxide.

Methods: Isolated rat hepatocytes were stimulated in-vitro with pro-inflammatory cytokines to induce NO synthesis with or without estrogen. Nitrite was detected after 24 hours. iNOS protein was determined using western blot.

Results: Cytokine stimulation increased nitrite and iNOS protein in a dose-dependent manner. The cytokine-induced nitrite increase was significantly decreased by estrogen. Inducible nitric oxide synthase expression was also diminished in cultures with the higher doses of estrogen.

Conclusion: 17 β -Estradiol decreases cytokine-stimulated iNOS expression and NO production. Downregulation of iNOS expression may account for the beneficial role of estrogens in models of shock and sepsis.



Session

Paper 8 11:30 AM

"SCIP" PING ANTIBIOTIC PROPHYLAXIS GUIDELINES IN TRAUMA: THE CONSEQUENCES OF NON-COMPLIANCE

Brian P Smith, MD, Nicole Fox, MD, Abdulla Fakhro, MD, Mary LaChant, RN, Abhijit S Pathak, MD, Steven E Ross, MD, Mark J Seamon, MD, Temple University Hospital

Presenter: Brian Smith, MD

Discussant: John Santaniello, MD - Loyola University Medical Center

Objective: The Surgical Care Improvement Project (SCIP) established surgical antibiotic prophylaxis guidelines as part of a national patient safety initiative aimed at reducing surgical complications such as surgical site infection (SSI). While these antibiotic prophylaxis guidelines have become well established in surgical patients, they remain largely unstudied in trauma patients undergoing operative procedures. We sought to determine the role of these antibiotic prophylaxis guidelines in preventing SSI in patients undergoing trauma laparotomy.

Methods: A retrospective review of all patients who underwent emergency trauma laparotomy at two level-I trauma centers (2007-2008) revealed 306 patients who survived >4d after injury. Demographics and clinical risk SSI factors were analyzed and patients compared on the basis of adherence to the following SCIP guidelines: 1) prophylactic antibiotic given, 2) antibiotic received within 1hr prior to incision, 3) correct antibiotic selection, and 4) discontinuation of antibiotic within 24hrs after surgery. The primary study endpoint was the development of SSI.

Results: The study sample varied by age (32 ± 16 years) and injury mechanism (GSW 44%, SW 27%, blunt 30%). When patients with perioperative antibiotic management complying with the 4 SCIP antibiotic guidelines ($n=151$) were compared to those who did not comply ($n=155$), no difference between age, shock, small bowel or colon resection, damage control procedures, or skin closure was detected ($p > 0.05$). After controlling for ISS, hypotension, blood transfusion, enteric injury, operative duration, and other potential confounding variables in a multivariate analysis, complete adherence to these 4 SCIP antibiotic guidelines independently decreased the risk of SSI (OR 0.43 [0.20-0.94], $p=0.035$). Patients adhering to these guidelines less often developed SSI (17% vs. 33%, $p=0.001$), had shorter overall hospital duration of antibiotics (4 ± 6 vs. 9 ± 11 days, $p < 0.001$) and hospital length of stay (14 ± 13 vs. 19 ± 23 days, $p=0.016$) although no difference in mortality was detected ($p > 0.05$).

Conclusions: Our results suggest that SCIP antibiotic prophylaxis guidelines effectively reduce the risk of SSI in patients undergoing trauma laparotomy. Despite the emergent nature of trauma operative procedures, efforts to adhere to these antibiotic guidelines should be maintained.

Session

Paper 9 11:50 AM

EFFECT OF LOCAL ANESTHETIC ON MICROORGANISMS IN A MURINE MODEL OF SURGICAL SITE INFECTION

Valerie G Sams, MD, MPA, BA, Christy M Lawson, MD, Patricia N Coan, DVM, PhD, DACLAM, David A Bemis, PhD, DACVM, Kim M Newkirk, DVM, PhD, ACVP, Michael D Karlstad, PhD, Jamison Norwood, BS, Patrick B Barlow, BS, Mitchell H Goldman, MD, FACS, Brian J Daley, MD, MBA, FACS, FCCP, CNSC, UTMCK

Presenter: Valerie Sams, MD, MPA

Discussant: Glen Tinkoff, MD - Christiana Care Health Services

Objectives: Surgical site infections remain a concern with incidence of 1.5-5% for all types of surgery. In vitro studies have suggested an antimicrobial effect of local anesthetic. We hypothesized that subcutaneous infiltration of local anesthetic before a surgical incision is made reduces incidence of postoperative wound infection.

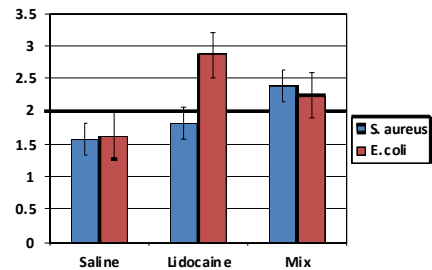
Methods: In a wound infection model using 4-6 week-old outbred female mice (N=52), *S. aureus* (200 µL of 2x10⁵ CFU) and *E. coli* (200 µL of 3x10⁷ CFU) were inoculated in surgical wounds infiltrated and non-infiltrated with local anesthetic. Day 5, tissue was evaluated for bacteria colony counts, presence of bacteria histologically, and degree of inflammation.

Results: There was no statistical difference in the degree of inflammation when comparing mice infiltrated with saline and those infiltrated with local anesthetic in *S. aureus* inoculated group.

Mice inoculated with *E. coli* after infiltration with saline had a significantly lower degree of inflammation as compared with those infiltrated with lidocaine. Infiltrate, whether saline, lidocaine or lidocaine/marcaine mix, did not significantly predict bacterial growth or higher degree of inflammation when controlled for experimental condition of bacterial inoculums.

Inoculum	Infiltrate	Wounded	Number of mice	Average degree of inflammation (Std Dev)	% w/ bacteria seen on histopath	Culture results
None	Saline	Y	2	1.5 (0.7)	50	No growth
None	Saline	N	2	0.5 (0.7)	0	No growth
None	Lidocaine	Y	2	2.75 (0.35)	100	>100 CFU (1)
None	Lidocaine	N	2	0 (0)	0	Broth only (1)
None	Lidocaine/Marcaine	Y	2	2 (0)	100	No growth
None	Lidocaine/Marcaine	N	2	0.25 (0.35)	0	No growth
<i>S. aureus</i>	Saline	Y	6	1.58 (0.66)	66	40-1000 CFU
<i>S. aureus</i>	Lidocaine	Y	6	1.83 (0.68)	66	100-1000 CFU
<i>S. aureus</i>	Lidocaine/Marcaine	Y	5	2.4 (0.82)	40	30-200CFU
<i>E. coli</i>	Saline	Y	8	1.62 (0.51)	37.5	Broth only
<i>E. coli</i>	Lidocaine	Y	7	2.86 (0.38)	28.5	10-40 CFU
<i>E. coli</i>	Lidocaine/Marcaine	Y	8	2.25 (0.88)	62.5	2-50 CFU

Ave Degree of Inflammation



Conclusions:

Subcutaneous infiltration of local anesthetic before a surgical incision is made does not reduce the incidence of postoperative wound infection or influence degree of inflammation.

Session

Paper 10 12:10 PM

THE UTILITY OF PROCALCITONIN IN CRITICALLY ILL TRAUMA PATIENTS

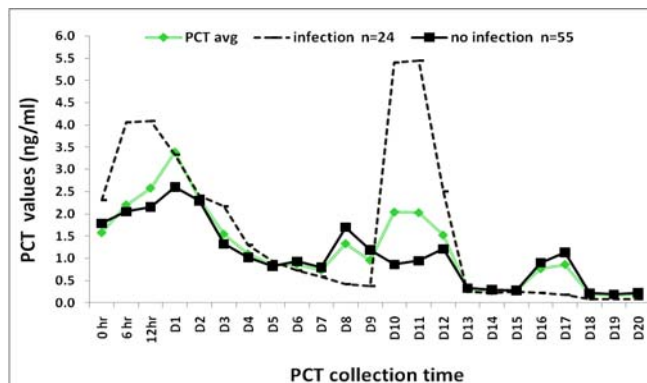
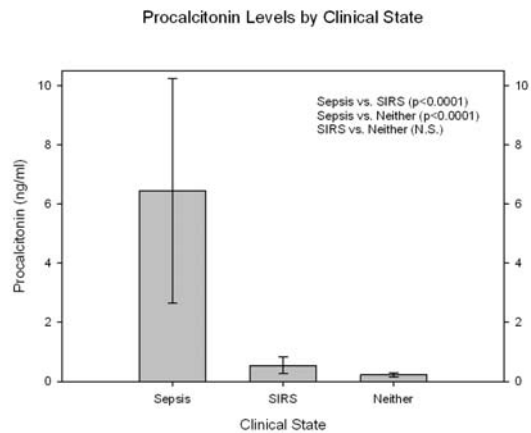
Joseph V Sakran, MD, MPH, Christopher Michetti, MD, FACS, Michael J Sheridan, ScD, FACE, Robyn Pickens, MD, Tarek Waked, MD, Tayseer Aldaghlis, MD, Samir M Fakhry, MD, FACS, University of Pennsylvania

Presenter: Joseph Sakran, MD, MPH
Discussant: William Bowling, MD, MBA - Hurley Medical Center

Objectives: Determine utility of procalcitonin (PCT) as a marker of sepsis vs. SIRS in critically ill trauma patients. Secondary outcome was to determine association of mortality with level of PCT.

Methods: This prospective observational cohort study evaluates PCT concentration in trauma patients. All trauma patients admitted to the Intensive Care Unit (ICU) of a Level I trauma center from June 2009 – June 2010 were screened. Serum PCT assays were done on eligible patients at hours 0 (upon ICU admission), 6, 12, 24, and then daily until discharge from ICU or death.

Results: 856 PCT levels from 102 patients were analyzed. Mean age was 48.5 years, 63% male, 89% blunt trauma, mean ISS 21, hospital mortality 13%. Mean PCT concentrations in patients with sepsis, SIRS and neither were evaluated. Mean PCT levels were higher in patients with sepsis vs. SIRS ($p < 0.0001$, Fig 1). Patients with a PCT concentration of >5 ng/ml had increased mortality, relative risk of 3.5 ($p=0.09$) when compared to those with PCT <5 ng/ml. Fig 2 shows the PCT values over time in patients with and without infection. **Conclusions:** PCT levels were significantly higher in trauma ICU patients with sepsis vs. SIRS, and may help differentiate these entities during critical illness. While a higher PCT level was associated with increased mortality, this was not found to be statistically significant.



Session

Paper 11 8:00 AM

HYPERFIBRINOLYSIS ON ADMISSION IS AN UNCOMMON BUT HIGHLY LETHAL EVENT ASSOCIATED WITH SHOCK AND PRE-HOSPITAL CRYSTALLOID ADMINISTRATION

Bryan A Cotton, MD, MPH, Nena Matijevic, PhD, Kristin Minei, BS, Vadim V Kostousov, MD, Zayde A Radwan, BS, Evan Pivalizza, MD, Charles E Wade, PhD, John B Holcomb, MD, University of Texas Health Science Center

Presenter: Bryan Cotton, MD, MPH

Discussant: Lewis Kaplan, MD - Yale University School of Medicine

Objective: Hyperfibrinolysis (HF) has been reported to occur in a range of 2% to 30% of trauma patients. Using rapid thromboelastography (r-TEG), we hypothesized that HF is (1) rarely present on admission in severely injured patients and (2) associated with crystalloid hemodilution. To further strengthen this hypothesis, we created an *in vitro* hemodilution model to improve our mechanistic understanding of the early HF.

Methods: The trauma registry was queried for patients who were our highest-level trauma activations and admitted directly from the scene (10/09-10/10). HF was defined as >7.5% amplitude reduction 30 minutes after maximal amplitude (LY30). Using r-TEG, we then created an *in vitro* hemodilution model (0.9% NS) with and without tissue injury (addition of tissue factor, TF) to identify the crystalloid volumes and injury needed to achieve specific LY30 values.

Results: Admission r-TEG values were captured on 1225 consecutive admissions. Only 29 (2.4%) patients had HF on admission r-TEG. The groups were similar in demographics. Compared to non-HF patients, the HF group had more pre-hospital crystalloid (1.5 vs. 0.5 L), higher median ISS (25 vs. 16), greater admission base deficit (20 vs. 2) and higher mortality (81% vs. 10%); all $p < 0.001$. Controlling for ISS and base deficit on arrival, pre-hospital fluid was associated with a significant increase in likelihood of HF (Table). In fact, each additional liter of crystalloid was associated with a 15% increased odds of HF. The *in vitro* model found that hemodilution to 30% of baseline and TF were required to achieve an LY30 of 30%.

	Odds ratio	95% confidence interval	p-value
Pre-hospital fluid, liters	1.15	1.009, 1.338	0.045
Base deficit	0.77	0.680, 0.919	0.002
Injury severity score	1.13	0.979, 1.320	0.096

Conclusions: While uncommon immediately after injury, HF is associated with prehospital crystalloid administration and shock on admission, and is highly lethal. Our *in vitro* model confirms that tissue injury and significant crystalloid hemodilution result in severe and immediate hyperfibrinolysis.

Session

Paper 12 8:20 AM

THE INFLUENCE OF UNIT-BASED NURSE PRACTITIONERS ON HOSPITAL OUTCOMES AND READMISSION RATES FOR TRAUMA PATIENTS

David S Morris, MD, Jeff Rohrbach, MD, Georgianna Telford, CRNP, Seema Sonnad, PhD, Patrick Kim, MD, Patrick Reilly, MD, Carrie Sims, MD, Hospital of the University of Pennsylvania

Presenter: David Morris, MD

Discussant: Lawrence Lottenberg, MD - University of Florida College of Medicine

Objective: To determine if the use of unit-based nurse practitioners (UBNPs) results in improved outcomes and rates of readmission compared to traditional resident-run services (TRRS).

Methods: All trauma admissions between 1/1/04 – 8/31/10 that were discharged alive were identified from our database. Demographics, injury characteristics, comorbidities, complications, and discharge information were extracted from an administrative database. Patients cared for by the UBNPs were compared to those cared for by TRRS. Chi-square, Fisher’s exact, and Student t-tests were used. Multivariate linear regression analysis was then performed on significant variables. P<0.05 =significant.

6	UBNP N (%)	TRRS N (%)	P
N=7 137	4 880 (68.4)	2 257 (31.6)	
Median Age, yrs	39	40	0.11
Readmissions	2 12 (4)	1 07 (5)	0.45
ISS, Mean	12.85	13.74	0.004
Sp. Cord Inj.	1 13 (2)	76 (3)	<0.0001
ICU admission	17 08 (35)	9 01 (40)	<0.0001
Mean LOS, days	6	8	0.001
ARF	93 (2)	65 (3)	<0.0001
Pneumonia	45 (1)	62 (3)	<0.0001
Discharge Status			
Home	33 45 (77)	13 50 (68)	<0.0001
Supervised Setting	10 24 (23)	6 30 (32)	

Results: 7,137 patients were identified, 4,880 (68.4%) of which were discharged from the UBNPs service, and 2,257 (31.6%) from the TRRS (see table). Demographic data and readmission rates were similar. The mean injury severity score (ISS) was higher for the resident run services and more patients with spinal cord injury were admitted to the TRRS. UBNP patients were less likely to have had an ICU stay, pneumonia, or acute renal failure during their hospitalization, and were more likely to have been discharged to home. After controlling for these differences, the difference in mean length of stay for the UBNP service remained significantly lower (6 days vs. 8 days, p =0.001).

Conclusions: Trauma patients discharged from UBNP-run services have equivalent readmission rates as traditional resident-run services, and have a significantly shorter hospital length of stay. UBNPs are a viable alternative care model to compensate for the decreasing resident presence, and may provide a cost savings benefit.

Session

Paper 13 8:40 AM

SCREENING FOR TRAUMATIC STRESS AMONG SURVIVORS OF URBAN TRAUMA

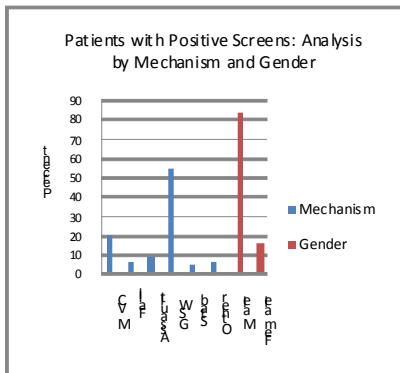
Carol S Reese, MDiv, MSW, Tabitha A Pederson, BA, Susan Avila, BSN, MPH, Kimberly Joseph, MD, Kimberly Nagy, MD, Andrew Dennis, DO, Dorion Wiley, MD, Frederic Starr, MD, Faran Bokhari, MD, John H. Stroger, Jr. Hospital of Cook County, Department of Trauma

Presenter: Carol Reese, MDiv, MSW

Discussant: Kathryn Tchorz, MD - Miami Valley Hospital

Objective: Believing that the incidence of traumatic stress after civilian trauma may be higher than commonly accepted, the objective of this study is to assess the emotional status of direct (patients) and indirect (families) survivors of traumatic injuries.

Methods: Using the Primary Care PTSD screening tool (PC-PTSD) plus one question exploring interest in talking about their experience, patients and family members were assessed for symptoms of Acute Stress Disorder (ASD) and Post Traumatic Stress Disorder (PTSD) in the outpatient clinic of a large urban Level 1 Trauma Center. The survey was distributed by a social work intern and a chaplain over a 10 week period between April and June 2011. The survey was self-administered and participation was voluntary and anonymous. Additional information collected included mechanism and date of injury, gender, age, and zip code.



Results: Of 213 surveys completed, 62 % were patients and 35% were family members. 42% of all respondents had a positive PC-PTSD screen (3 of 4 positive responses). 56% of patients and 57% of family members with a positive screen noted it would be helpful to talk to someone about their trauma experience.

Conclusions: Direct survivors of traumatic injuries experience symptoms of ASD and PTSD at rates higher than reported in previous studies. Male patients and gunshot wound victims report more symptoms of post-traumatic stress relative to other groups. Indirect survivors also report significant levels of traumatic stress. Both patients and family members may benefit from a referral for additional screening and intervention in the early post-trauma period.

Session

Paper 14 9:00 AM

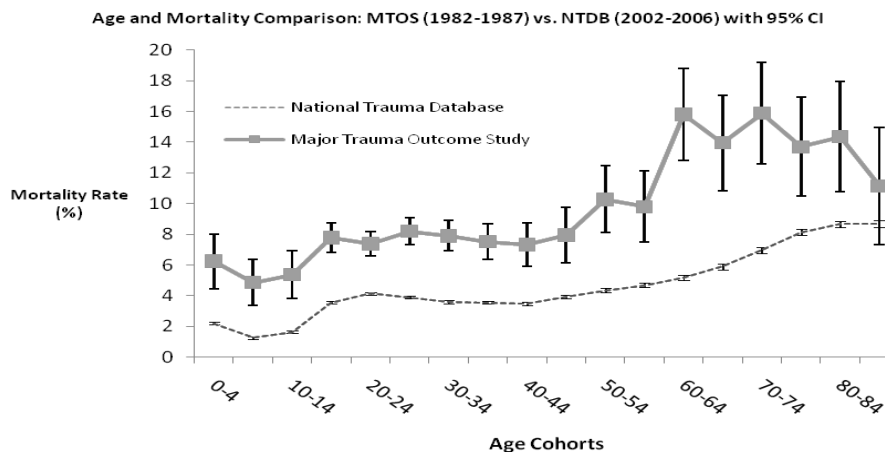
HAS TRISS BECOME AN ANACHRONISM? A COMPARISON OF MORTALITY BETWEEN THE NTDB AND MTOS DATABASES

Frederick B Rogers, MD, MS, FACS, Michael A Horst, PhD, Turner Osler, MD, MS, Margaret D Krasne, Amelia T Rogers, John C Lee, MD, Daniel Wu, DO, Mathew M Edavettal, MD, Tracy L Evans, MD, Eric H Bradburn, DO, FACS, Lancaster General Health

Presenter: Frederick Rogers, MD, MS

Discussant: Avery Nathens, MD, PhD, MPH - St. Michaels Hospital

OBJECTIVES: TRISS has been the mainstay of trauma outcome prediction scoring over the past twenty years. TRISS is so inculcated into our trauma scoring culture that it has been adopted by many commercial registries including TRACS. Unfortunately, its survival statistics are based on a trauma database that was collected in the 1980s. We hypothesized that the improvements in trauma care over the past twenty years would lead to improved survival in a large database, thus making the TRISS scoring system obsolete. **METHODS:** Two databases were compared; the Major Trauma Outcome Study (MTOS) of 1982-1987 includes 80,544 patients, and the National Trauma Database (NTDB) of 2003-2006 contains 1,912,952 patients. Patients were stratified by mortality versus age for both databases. The odds ratios (95%CI) were compared between databases and stratified based upon age groups using the Mantel-Haenszel, **RESULTS:** Overall mortality was 9% for MTOS versus 4.4% for NTDB ($p < 0.001$). When comparing individual age groups, there was a significant difference in mortality for every age group, except the 85-89 age group.



CONCLUSIONS: Overall survival for all ages has improved significantly since 1987 when MTOS was completed. TRISS is now outdated and should be abandoned for a survival prediction model derived from more current mortality rates.

Session

Paper 15 9:20 AM

A MULTI-CENTER PROSPECTIVE ANALYSIS OF PEDIATRIC TRAUMA ACTIVATION CRITERIA ROUTINELY UTILIZED IN ADDITION TO THE AMERICAN COLLEGE OF SURGEON SIX CRITERIA

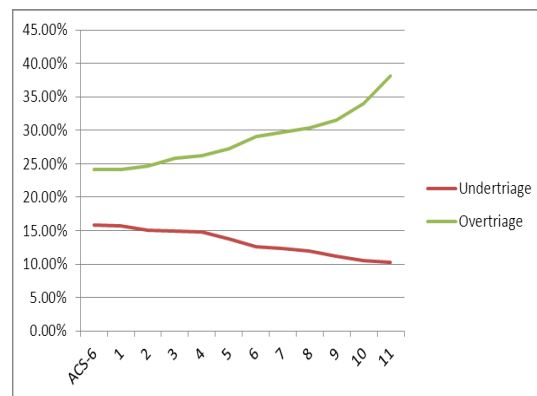
Richard A Falcone, MD, MPH, Lynn Haas, MSN, Suzanne Moody, MS, Eileen King, PhD, Cincinnati Childrens

Presenter: Richard Falcone, MD, MPH
Discussant: David Efron, MD - Johns Hopkins Hospital

Background: The American College of Surgeons has defined six minimum activation criteria (ACS-6) for the highest level of trauma activations at trauma centers. The verification criteria also allow for the inclusion of additional criteria at the institution's discretion. The purpose of this prospective multi-center study was to evaluate the ACS-6 as well as commonly utilized activation criteria to evaluate over and under triage rates for pediatric trauma team activation.

Methods: Data was prospectively collected at 9 pediatric trauma centers to examine 29 commonly utilized activation criteria. Patients meeting any of these criteria were evaluated for the use of high level trauma resuscitation resources according to an expert consensus list. Patients requiring a resource but not meeting any activation criteria were included to evaluate undertriage rates.

Results: Over one year a total of 656 patients were enrolled with a mean age of 8yrs, a mean ISS of 14 and mortality of 11%. Utilizing all criteria 55% of patients would have been over triaged and 9% would have been under-triaged. If only the ACS-6 were utilized 24% of patients would have been over- and 16% would have been under-triaged. Among criteria with more than 10 patients, those most predictive of utilizing a high level resource were a gun-shot to the abdomen (92%), blood given prior to arrival (83%), traumatic arrest (83%), tachycardia/poor perfusion (83%), and age-appropriate hypotension (77%). Sequential addition of criteria to the ACS-6 yield minimal improvements in over/under-triage until at least 4 additional criteria are utilized (**Figure**).



Conclusions: The ACS-6 provide a reliable over/undertriage rate for pediatric patients. The inclusion of additional criteria should be carefully considered as there is a minimal improvement in undertriage with a resultant steeper increase in overtriage rates.

Session
Paper 16 8:00 AM
**A PROSPECTIVE NOVEL APPROACH TO EVALUATE TRAUMA
RECIDIVISM**

Andrew M McCoy, MD, MS, John J Como, MD, MPH, Gregory Greene, BS, Jeffrey A
Claridge, MD, MS, MetroHealth Medical Center

Presenter: Andrew McCoy, MD
Discussant: Amy Goldberg, MD - Temple University Hospital

Objective: The purpose of this study was to determine the incidence and burden of trauma recidivism at a regional level 1 trauma center by incorporating a novel prospective method of collecting injury history as part of the standard workup.

Methods: All trauma patients who met pre-hospital trauma criteria and activated the trauma team over a 13-month period were asked about their history of injury in the past 5 years. A *recidivist* was defined as a patient presenting more than once for separate severe injuries. A *major recidivist* was defined as a patient admitted to the hospital for their most recent injury while a *minor recidivist* was discharged from the ED. *Recurrent recidivists* were patients who presented multiple times during the study period.

Results: Of the 4,971 trauma activations during the study period, 1,246 (25.2%) were identified as recidivists. Recidivists were 75% male, 62% Caucasian, 36% unemployed, 26% uninsured, and 70% unmarried. Forty-two percent of recidivists were major recidivists and 58% were minor recidivists. The recidivism rate among admitted patients was 23.4%, while among patients discharged from the ED this rate was 29.3%. The highest recidivism rates were noted in patients with penetrating injuries (34.2%) or assaults (36.8%), and in those who reported alcohol (34.9%) or illegal drug (42.4%) use on the day of injury. Those involved in interpersonal violence (IPV), i.e., penetrating mechanism or assault, were more likely to have been involved in IPV at the prior trauma than those with other trauma mechanisms. Of the major recidivists, 45% reported a prior hospitalization for injury. Seventy-three patients (1.5%) were recurrent recidivists representing 157 unique encounters. Key risk factors for recidivism were identified for major subgroups of patients.

Conclusions: This is the highest trauma recidivism rate reported on a large population of all trauma activations at a regional level 1 trauma center. These data illustrate the tremendous burden of recidivism in the modern era, more than previously recognized. Efforts specifically targeting those involved in IPV may reduce recidivism rates.

Session

Paper 17 8:20 AM

IMPACT OF A GRADUATED DRIVERS LICENSE LAW ON YOUNG DRIVER CRASHES IN NEW YORK STATE

Julius D Cheng, MD, MPH, Mark L Gestring, MD, Ayodele T Sangosanya, MD, Nicole A Stassen, MD, Paul E Bankey, MD, PhD, University of Rochester Medical Center

Presenter: Julius Cheng, MD, MPH
Discussant: Thomas Rohs, Jr., MD - Borgess Trauma Services

Introduction: Motor vehicle crashes constitute the greatest risk of injury for young adults. Graduated driver licensing (GDL) laws have been used to reduce injuries and deaths in the young driver population. The New York State GDL law increased young driver supervision, and limited time-of-day driven, and number of passengers. **Objective:** This review examines the impact of a GDL enacted in New York in September, 2003. **Methods:** Retrospective review of New York State administrative databases from 2001 to 2009. The time period includes the implementation date of a state-wide GDL requirement. Database review included all reported crashes to the NYS DMV by cause and driver age, and motor fuel tax receipts by the NY State Comptroller's Office. Motor fuel tax receipts were used as a proxy for overall miles driven. **Results:** Prior to 2003, under-18 drivers were involved in 90 fatal crashes and 10406 personal-injury (PI) crashes, constituting 0.6% and 72.6% of all registered drivers of that age. By 2009, the number of under-18 fatal and PI crashes decreased to 44(0.3%) and 5246(40.0%) respectively. Of note, the number of crashes suffered by the 18-20 year-old age group during this period also declined, from 192(0.6%) and 25407(75.6%) to 135(0.3%) and 18114(43.6%) respectively. Motor fuel use during this period also declined, but to a lesser amount (\$552M, to \$516M, or 6.6%). (see Table

1) **Conclusions:** The use of a GDL law has shown a large decrease in the number of young driver fatalities and PI crashes. The delay in full driver privileges from the GDL did not result in an increase in fatal or PI crashes in the next older age group.

Year	<18 Fatal n/%	<18 PI n/%	18-20 Fatal n/%	18-20 PI n/%	Fuel Tax (\$M)
2001	85(0.5)	9518(55.6)	193(0.5)	24148(57.8)	513
2002	90(0.6)	10406(72.6)	192(0.6)	25407(75.6)	552
2003	75(0.6)	9439(71.6)	162(0.5)	23241(74.1)	543
2004	74(0.6)	8371(70.3)	178(0.6)	21658(72.5)	557
2005	61(0.6)	7336(68.5)	140(0.5)	20111(71.5)	530
2006	53(0.4)	6725(49.8)	168(0.5)	19120(53.6)	517
2007	56(0.4)	6559(41.7)	157(0.4)	18979(43.7)	520
2008	34(0.2)	5760(40.1)	142(0.3)	18366(43.8)	500
2009	44(0.3)	5246(40.0)	135(0.3)	18114(43.6)	516

Session

Paper 18 8:40 AM

**THE DANGERS OF BEING A "WEEKEND WARRIOR:" A NEW CALL FOR
INJURY PREVENTION EFFORTS**

Charles M Psoinos, BS, Jennifer F Tseng, MD, MPH, W. Brian Sweeney, MD, Timothy A Emhoff, MD, Heena P Santry, MD, MS, University of Massachusetts Medical School

Presenter: Charles Psoinos, BS

Discussant: Thomas Esposito, MD - Loyola University Medical Center

Objective: Non-professionals routinely perform high-risk home maintenance activities otherwise regulated by the Occupational Health and Safety Administration (OSHA) when professionals perform the same work. Reducing the risks taken by these “weekend warriors” has not been the focus of injury prevention efforts. This study describes injury patterns and outcomes for non-professionals attempting home roof and tree maintenance.

Methods: We queried our trauma registry for all adult patients (age ≥ 18) with injury codes for “fall-from-height” or “struck-by-tree” (2005-present) and reviewed charts to determine injuries sustained during home roof or tree work. Patients injured during occupational duties (indicated by Workman’s compensation) were excluded. Descriptive statistics were used to determine patient demographics, injury patterns, and outcomes.

Results: 174 patients were injured performing roof and tree maintenance during the study period; 129 (74.1%) were non-professionals. Of these, 90 (69.8%) were “fall-from-height” and 39 (30.2%) were “struck-by-tree.” Mean age was 45 ± 14 years. The majority were male (124, 96.1%) and White (116, 89.9%). Nearly half (59, 46.8%) were privately insured; a quarter (32, 25.4%) had no insurance. Mean Injury Severity Score was 12.7 ± 9.3 . Injury distributions were: 48.8% head injury, 10.1% facial fractures, 3.9% C-spine fractures, 28.1% TLS-spine fractures, 27.1% rib fractures, 22.5% intra-thoracic injuries, 6.2% liver/spleen injuries, 15.6% pelvic fractures, 27.3% upper extremity fractures, and 14.7% lower extremity fractures. 19 patients (14.7%) had one or more regions with AIS >3 . Mean length of stay was 5.3 ± 7.6 days. Except for 2 deaths (1.6%), discharge dispositions were: 64.2% home, 10.1% home with services, 17.8% rehab, and 5.4% skilled nursing.

Conclusion: “Weekend warriors” performing home roof and tree maintenance sustain serious injuries with potential for long-term disability at young ages. Injury prevention efforts should educate the public about the hazards of high-risk home maintenance, possibly encouraging OSHA-regulated protective measures or deferral to trained professionals.

Session

Paper 19 9:00 AM

**CHANGING ATTITUDES TOWARD VIOLENCE: THE EFFECT OF BRIEF
HOSPITAL BASED INTERVENTIONS**

Michel B Aboutanos, MD, MPH, Anne Jordan, MSW, Robin L Foster, MD, Robert Cohen, PhD,
Stephanie C. Smith, BSW, Luke G. Wolfe, BS, Rachel Poindexter, RN, Kimberly Goodman,
PhD, Raquel Halfond, PhD, Bonita Hogue, LCSW, Rao R Ivatury, MD, Virginia Commonwealth
University Medical Center

Presenter: Michel Aboutanos, MD, MPH

Discussant: C. William Schwab, MD - Hospital of the University of Pennsylvania

Background: Currently, there are few data to suggest that hospital-based violence interventions are effective for trauma patients admitted for interpersonal violence. The objective of this study is to assess change in risk behavior and attitudes towards violence, employment, and future aspirations for a cohort of young trauma patients in a prospective, randomized trial comparing brief violence intervention (BVI) with or without community case management services.

Methods: Intentionally-injured patients, aged 10-24 years, admitted to a level 1 trauma center, were randomized to receive a brief in-hospital psycho-educational violence intervention alone (Group I) or in combination with 6 months of wraparound community case management services (Group II). History of recidivism (HOR), attitudes toward violence (ATV), school (ATS), and employment (ATE), triggers for fighting, and future aspirations were assessed at baseline (BsL), 6 weeks (6W) & 6 months (6M) using validated measures.

Results: 75 out of 376 eligible injured patients were randomized into Groups I & II. The 2 groups had similar demographics, injuries, and clinical outcomes. Overall, a 20% HOR was noted (gun shots 65%, stabbings 14%, blunt assaults 21%). In both intervention groups, ATV improved from 76% at BsL to 90% and 89% at 6W ($p=0.0381$) and 6M ($p=0.09$), respectively. ATS also improved from 60% at BsL to 80% at 6W ($p=0.14$) and to 90% at 6M ($p=0.07$). ATE was high (>90%) at all time periods for both groups. Triggers for fighting were transiently decreased (<50%) at 6W and increased back to BsL levels (>50%) at 6M. Hospital experience was associated with a positive change in future aspirations in 70% overall (Group I 65%, Group II 75%) at 6W and 6M. No statistical significance was noted between Group I & II.

Conclusions: This study suggests that BVI alone may be sufficient for changing attitudes toward violence. Longer follow up and greater recruitment is needed to show meaningful difference between BVI alone or in combination with community services.

Session

Paper 20 9:20 AM

**A TARGETED ARSON PREVENTION PROGRAM GREATLY REDUCES
RECIDIVISM**

Jason W Smith, MD, Theresa Baker, RN, Brian G Harbrecht, MD, Glen A Franklin, MD,
University of Louisville

Presenter: Jason Smith, MD

Discussant: James Holmes, IV, MD - Wake Forest University School of Medicine

Objectives: Risk-taking behavior is common amongst adolescents and frequently leads to injury. Arson and firesetting are two forms of this type of behavior with recidivism rates reported up to 72%. More than 50% of those arrested for arson in the USA are less than 18 yrs old. We reviewed the long-term results of our adolescent arson prevention program and its success in preventing recidivism.

Methods: We utilized a 1-day educational prevention program targeted at youths focused on the medical, legal and social consequences of fireplay and burn injury. The program was hospital based, with trained educational leaders and involvement of the juvenile court system and fire department arson unit. Parental participation was required.

Results: There were 201 participants in the program from 2005-2010 with an average age of 13.3 ± 2.0 yrs. Most were male (89%), Caucasian (65%) and from single parent homes (67%). Referrals to the program were from juvenile court (76%), child psychiatry (12%) and the fire department (7%). Arson events outnumbered firesetting 2:1, with 19 participants coming from juvenile detention and 11 from home incarceration. 25% of the adolescents had known mood disorders with ADHD being the most common. Most participants (87%) were from lower income areas with an average income <\$50K and 28% were below the federal poverty level. Follow-up surveys were obtained from parents and participants with high satisfaction ratings of 4.8/5.0 on a standard scale. Recidivism was tracked throughout the study period with an average follow-up of 2.5 yrs (range 10 months to 5 yrs). Only one participant had a repeat offense and one other ultimately committed suicide secondary to a psychiatric disorder.

Conclusions: Arson and firesetting remain juvenile behavior problems. Using a targeted education program we were able to provide a community-wide prevention program assisting the court system. Program participants' demographics were typical of this behavior type and program satisfaction was high. Recidivism was reduced to 0.5% with long-term follow-up. Our results demonstrate that prevention programs of this type are successful and can have long lasting effects with obvious community benefits.

CHEMICAL VENOUS THROMBOEMBOLIC PROPHYLAXIS IS SAFE AND EFFECTIVE IN PATIENTS WITH TRAUMATIC INTRACRANIAL HEMORRHAGE WHEN STARTED 24 HOURS AFTER ABSENCE OF PROGRESSION OF HEMORRHAGE ON BRAIN CT

Yamaan Saadeh, BS, Penny Stevens, BSN, PhD, Chet Morrison, MD, Benjamin Mosher, MD, Paul Schneider, MD, John P Kepros, MD, Michigan State University

Presenter: Yamaan Saadeh, MD

Discussant: Douglas Schuerer, MD - Washington University School of Medicine

Objectives: Venous thromboembolic disease (VTE) is an important complication in trauma patients including patients with intracranial hemorrhage. We implemented a protocol starting chemical prophylaxis 24 hours after absence of progression of hemorrhage on CT to increase consistency with the use of chemical VTE prophylaxis in this population.

Methods: Patients with traumatic intracranial hemorrhage admitted to a level 1 trauma center over an 18-month period were reviewed. Patients with a hospital length of stay <3 days were excluded in the analysis. Time to chemical prophylaxis in relation to absence of progression on brain CT was examined as well as the subsequent risk of progression of hemorrhage and risk of VTE events. The overall rate of VTE was compared to matched historical controls.

Results: All patients received mechanical prophylaxis in the form of sequential compression devices. Of the 205 patients reviewed, 261 intracranial hemorrhages were identified with 101 subdural hematomas, 8 epidural hematomas, 86 subarachnoid hemorrhages and 66 intraparenchymal hemorrhages. Emergent craniotomy was required in 6.3% and 4.9% required other emergent surgery. Follow-up CT was performed the day after admission in 86.3% of patients and of these 12.2% showed progression. Of the patients who did not have progression of hemorrhage on follow-up CT, 60.4% received chemical prophylaxis during their hospital admission. Of the patients who received chemical prophylaxis, 35.8% had chemical prophylaxis given within 36 hours of the follow-up CT, 43.2% within 48 hours, 60.5% within 72 hours, and 71.6% within 96 hours. No patients in this sample had progression of intracranial hemorrhage after initiation of chemical VTE prophylaxis and no patients developed VTE. The overall rate of VTE in all trauma patients decreased from 0.99% to 0.04% over the same time period. No other complications related to chemical VTE prophylaxis were identified.

Conclusions: A protocol based on early use of chemical VTE prophylaxis after absence of progression of traumatic intracranial hemorrhage does not result in increased progression of intracranial hemorrhage and reduced the rate of VTE in our institution. There is still, however, room for increased compliance.

Session

Paper 22 8:20 AM

**EVALUATION FOR INTRA-ABDOMINAL INJURY IN CHILDREN
FOLLOWING BLUNT TORSO TRAUMA. CAN WE REDUCE UNNECESSARY
ABDOMINAL CT BY UTILIZING A CLINICAL PREDICTION MODEL?**

Brent M Jewett, MD, William S Russell, MD, Peter S Gutierrez, MD, Amy H Wahlquist,
Christian J Streck, MD

Presenter: Brent Jewett, MD

Discussant: Patrick Kim, MD - Hospital of the University of Pennsylvania

Objectives: Injury is the leading cause of morbidity and mortality in children with blunt mechanisms accounting for the majority of these traumas. Despite increased awareness of the potential for radiation-induced malignancy, increased cost, limited sensitivity for the detection of small bowel injury and the low incidence of injury requiring operative intervention, CT for evaluation of abdominal trauma in hemodynamically stable children remains common. Previous studies have suggested that a clinical model using exam and laboratory data may help predict children with intra-abdominal injuries and potentially limit unnecessary CT scans.

Methods: Following institutional IRB approval, a retrospective chart review of all patients <16 years of age in the trauma registry who were evaluated as "Trauma Alerts" following blunt mechanism in an 18 month period was performed at a Level 1 trauma center. Previously defined "high-risk" clinical factors for prediction of blunt abdominal injury (hypotension, abnormal abdominal exam, elevated AST, elevated amylase, low hematocrit and heme-positive urinalysis) and potential limitations in performing reliable abdominal exam (GCS<8, age<2) were reviewed.

Results: 125 "alert" patients sustained blunt trauma during the study period and 97 underwent abdominal CT, with only 15 identifying intra-abdominal injury (IAA). Applying our prediction rule, IAA would have been identified in 16/17 patients (Se=94%) and missed in only one patient, a grade I spleen laceration which did not require surgery (npv=99%). Of the 83 patients with no risk factors for IAA, 54 patients underwent a negative abdominal CT (8 others demonstrated pelvic fracture with no associated IAA). Of the 54 patients with normal CT, 22 had a potential limitation to a reliable abdominal exam with at least 32 patients (33% of scanned patients) undergoing an "avoidable" abdominal CT scan

Conclusions: Utilization of a clinical prediction model based on six "high-risk" variables for IAA in patients with no limitation to abdominal examination may decrease cost and radiation exposure from potentially avoidable abdominal CT scans in children. Based on these findings, we have implemented clinical practice guidelines utilizing our prediction rule to avoid unnecessary abdominal CT in our institution and are evaluating the rule prospectively.

Session

Paper 23 8:40 AM

**EMERGENCY SURGERY SERVICE CONCENTRATES CRITICAL RESIDENT
TRAINING EXPOSURE IN GENERAL SURGICAL PROCEDURES**

HESHAM M AHMED, MD, AARON BERGSMAN, MD, VICENTE H GRACIAS , MD,
FACS, FCCP, FCCM, ROBERT WOOD JOHNSON UNIVERSITY HOSPITAL

Presenter: Hesham Ahmed, MD

Discussant: Jeanette Capella, MD, Med - Altoona Regional Medical Center

Introduction Emergency surgical services (ESS) are becoming an increasing presence in academic institutions. The ACGME requires a certain number of operations to be completed by general surgery residents in predetermined categories. We hypothesize that residents rotating on ESS will be able to accumulate needed operative experience in a concentrated period of time. In addition, ESS can aid in broadening the scope of general surgical exposure; ranging from routine operations to more complex procedures, such as gastrectomies and pancreatectomies.

Method Retrospective data review of a prospectively accrued data base for the ESS was queried from January to December 2010. The ACGME required operations were then tabulated. ACGME requirements were compared to actual surgical cases performed.

Results During a one year period, more than 500 ESS operations were performed. The most common operations were laparoscopic cholecystectomy and laparoscopic appendectomy, which consisted of 92 and 90 operations respectively. 60 operations are needed to complete the ACGME laparoscopic basic category. Each month on the ESS provides 25% of this categorical experience. A diversity of more than 70 other types of general surgical operations was recorded. This included complex laparoscopic and multi-specialty approaches. Procedures included: intraoperative consult, re-operation / revision, delayed closure, urgent surgical air way management and seldom performed operations such as vagotomy.

Conclusion An ESS rotation is becoming essential in large teaching hospitals. It provides emergent general surgical skills and serves as a vehicle to obtain ACGME requirements in an efficient manner.

GERIATRIC HIGH RISK PROTOCOL: IMPROVING MORTALITY IN THE ELDERLY

Eric H Bradburn, DO, FACS, Frederick B Rogers, MD, MS, FACS, Margaret D Krasne, Amelia T Rogers, Daniel Wu, DO, John C Lee, MD, FACS, Mathew M Edavettal, MD, Tracy L Evans, MD, Michael Horst, PhD, Matthew J. Beelen, MD, Lancaster General Health

Presenter: Eric Bradburn, DO

Discussant: Carl Schulman, MD, MSPH - Miller School of Medicine

OBJECTIVES: Injured geriatric patients pose unique challenges to the trauma team because of their abnormal responses to shock and injury. We have developed the geriatric high risk protocol (GP) which seeks to identify high-risk geriatric patients. We hypothesized that a high-risk geriatric protocol would improve outcome in this select group of patients. **METHODS:** Patients from 2000 to 2010 were included. Patients > 65 years old who met high risk GP based on co-morbidities and/or physiologic parameters were compared to those patients prior to 2006, when GP was implemented. This protocol includes a geriatric consult as well as a lactate, arterial blood gas, and echo to assess for occult shock. Age, trauma activation, preexisting conditions, injury severity score (ISS), RTS, and mortality were reviewed. Univariate and multivariate analyses were conducted to identify factors predictive of mortality. **RESULTS:** A total of 3902 patients were evaluated. In our multivariate model (ROC = 0.84), all analyzed variables demonstrated a deleterious effect on mortality except GP, which significantly improved mortality. There also seems to be a dramatic increase in mortality for those patients over the age of 75.

Predictor	Mortality Rate (%)	Adjusted OR (95% CI) for Mortality	P-value	
GP	7.4	0.63(0.39-0.99)	0.045	
Trauma Activation	9.7	1.42(1.04-1.96)	0.030	
ISS Score	Moderate (10-16)	3.2	1.44(0.85-2.41)	0.172
	Severe (17-25)	14.5	6.45(4.22-9.86)	<0.001
	Probable Death (26+)	32.1	15.93(10.39-24.43)	<0.001
Age	75-84	7.2	2.72(1.74-4.25)	<0.001
	85+	9.6	4.62(2.92-7.30)	<0.001
RTS score < 7	41.9	8.22(5.76-11.73)	<0.001	
Co-morbidities	7.7	1.63(1.18-2.25)	0.004	

CONCLUSIONS: The GP significantly reduced mortality in our patient population. Thus, this study confirms the overall effectiveness of our GP, which is hallmarked by prompt identification of those patients with occult shock and a multidisciplinary care of the aged population.

Session

Paper 25 9:20 AM

EARLY AUTOMATED DETECTION OF RESPIRATORY DECOMPENSATION AND INTUBATION EVENTS IN SURGICAL AND TRAUMA PATIENTS: RESULTS FROM THE PREDICTIVE MONITORING IN PATIENTS WITH TRAUMA (PreMPT) STUDY GROUP

Amani D Politano, MD, MS, Lin M Riccio, MD, Doug E Lake, PhD, Lauren E Guin, BS, Craig G Rusin, PhD, J RANDALL Moorman, MD, Jeffrey S Young, MD, Robert G Sawyer, MD, James FORREST Calland, MD, University of Virginia

Presenter: Amani Politano, MD, MS

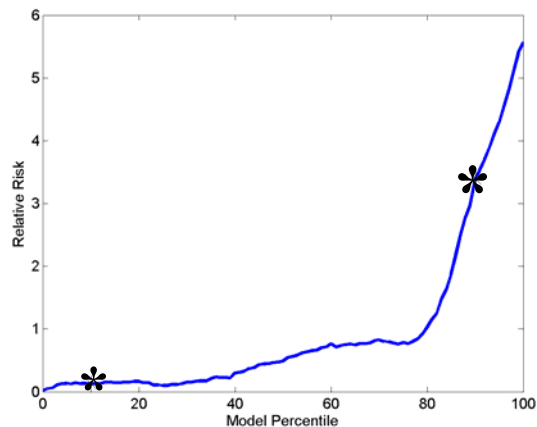
Discussant: Vicente Gracias - UMDNJ/Robert Wood Johnson Medical School

Objectives: Analysis and modeling of vital sign waveform data in surgical or trauma intensive care unit (STICU) patients may allow for early identification and treatment of patients with evolving respiratory failure.

Methods: A total of 854 days of vital sign and waveform data were collected from 149 STICU patients from March through June, 2011. Multivariate predictive models were developed using every-15-minute calculations (n=82,043) based on heart rate (HR), respiratory rate (RR), and pulse oxygen level (SPO₂). Specific measures calculated included mean, standard deviation (SD), median, and 10th and 90th percentile for both the vital sign and vital sign differences. A binary logistic regression model was created using the period <24 compared to ≥24 hours prior to the unplanned intubation. Optimal models were obtained with a simple stepwise procedure based on maximizing the ROC area. A p-value of <0.05 was considered significant.

Results: We identified 23 unplanned intubations in 18 patients. The optimal ROC area of 0.82 was obtained (p<0.001) using the median HR, 90th percentile of RR, and 90th percentile of HR difference. The relative risks of intubation in the next 24 hours for the lowest and highest quintile were 0.13 and 3.39 respectively (>26 fold increase, Figure) with a baseline risk of 0.7%.

Conclusions: In surgical and trauma ICU patients, a multivariate model predicted a significant increase in the risk of intubation based on calculations of vital sign data in the 24 hours prior to urgent intubation. Further refinement of this clinical approach could allow for earlier detection of respiratory decompensation and intervention to reduce preventable morbidity and mortality in surgical and trauma patients.



Relative risk urgent intubation by percentile of multivariate model. The lowest quintile and highest quintiles are marked with asterisks.

Session

Paper 26 9:40 AM

IDENTIFICATION OF DELAYED INTRACRANIAL HEMORRHAGE IN ELDERLY TRAUMA PATIENTS ON WARFARIN THERAPY: WARFARIN PROTOCOL

Jennifer D Bishop, MD, Kevin M Dwyer, MD, Stamford Hospital

Presenter: Jennifer Bishop, MD

Discussant: Michael Pasquale, MD - Lehigh Valley Hospital

Objectives: Warfarin increases the extent and risk of intracranial hemorrhage (ICH), even in minor head trauma. Patients on Warfarin may develop delayed ICH despite a normal initial head CT with a high mortality if unrecognized. This has led some to develop a protocol to repeat the head CT at a set time interval. Our Warfarin protocol initiated in July 2008 automatically obtains a repeat head CT scan six hours after the first scan in trauma patients using warfarin, even in the absence of hemorrhage on the first CT. The object of this study is to analyze the effectiveness of that protocol in a large cohort of elderly trauma patients and to identify an INR "cut off" for repeat head CT.

Method(s): The trauma registry at our Level II trauma center identified 377 patients over the age of 65 who had a head CT for trauma from July 2008 to April 2011. Retrospective chart review identified the use of warfarin, admission INR, results of the two head CTs, the use of blood products, as well as outcomes.

Results: 171 patients taking coumadin were admitted under the protocol and received 2 head CTs. 23 patients had ICH, but only 19 had ICH on the first scan, and 4 developed ICH on the 2nd scan (17% of the patients with ICH). All 4 patients survived to discharge and did not require operative intervention. There were 7 deaths, 2 related to ICH. Of the 19 with ICH on the original scan, 6 got worse with 2 requiring craniotomy. Their average INR was 2.9. All 4 patients who developed a delayed ICH had INRs > 2 and required FFP and/or vitamin K for treatment.

Conclusion(s): 17% of our anticoagulated elderly patients with ICH from head trauma were found on a second CT scan by protocol. All patients with delayed ICH had INR > 2. These results support our protocol for delayed head CT. These results also suggest that we could refine our protocol for repeat head CT after a negative head CT to high risk patients with an initial INR > 2.

Session

Paper 27 8:00 AM

**DOES TREATMENT OF SPLIT-THICKNESS SKIN GRAFTS WITH
NEGATIVE PRESSURE WOUND THERAPY IMPROVE TISSUE MARKERS
OF WOUND HEALING IN A PORCINE EXPERIMENTAL MODEL?**

Christopher Ward, MD, David L. Ciraulo, DO, FACS, MPH, Lucy Liaw, PhD, Steven Desjardin,
RT, Maine Medical Center

Presenter: Christopher Ward, MD

Discussant: Susan Evans, MD, MS - Carolinas Medical Center

Introduction: Negative Pressure Wound Therapy (NPWT) has been used for more than 15 years in the treatment of wounds. More recently, the technique has been used to secure split-thickness skin grafts, and this has become a common practice. However, data is scarce to support this use of NPWT. The actual mechanism by which NPWT speeds healing is also not entirely known. The purpose of this project was to assess whether NPWT improved angiogenesis, wound healing, and graft survival when compared to traditional bolster dressings securing split-thickness skin grafts in a porcine model.

Methods: We performed 2 split-thickness skin grafts on each of eight 30 kg Yorkshire pigs. We took graft biopsies on post-operative days 2, 4, 6, 8, and 10 and submitted the samples for immunohistochemical (IHC) staining, as well as standard H and E staining. We measured the degree of vascular in-growth via IHC staining with von Willenbrand's Factor to better delineate blood vessel epithelium. We determined the mean cross-sectional area of blood vessels present for each representative specimen, and then compared the bolster and NPWT samples. We also assessed each graft for incorporation and survival at post-operative day 10.

Results: Our analysis of the data revealed that there was no statistically significant difference in the degree of vascular in-growth as measured by mean cross-sectional capillary area ($p=.23$).

We did not note any difference in graft survival or apparent incorporation on a macroscopic level, though standard H and E staining indicated that microscopically, there seemed to be better graft incorporation in the NPWT samples.

Conclusion: We were unable to demonstrate a significant difference in vessel in-growth when comparing NPWT and traditional bolster methods for split-thickness skin graft fixation.

Therefore, the cost of NPWT may not show benefit to standard less expensive approaches to post op management of split thickness skin graft sites.

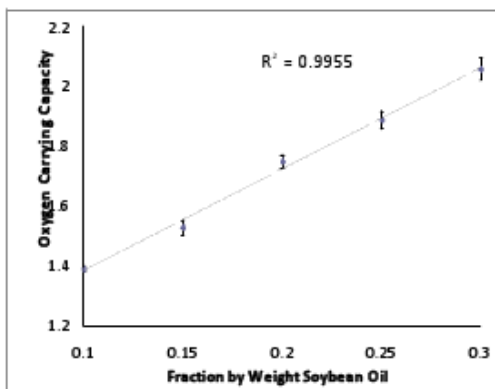
LIPID MICELLES AS COLLOIDS FOR HEMORRHAGIC SHOCK

Michael E Armbruster, BS, Kyriakos D Papadopoulos, PhD, Everett Grimley, Juan R Rodriguez, PhD, Cuthbert O Simpkins, MD, Department of Chemical and Biomolecular Engineering, Tulane University and University of Florida School of Medicine

Presenter: Michael Armbruster, BS

Discussant: Jeffrey Kerby, MD, PhD - University of Alabama at Birmingham

OBJECTIVE: Our laboratory previously demonstrated resuscitation with emulsions containing 20% (w/v) soybean oil micelles (SOM) to be superior to LR or 5% albumin in mice in severe hemorrhagic shock. We attribute this quality to the colloidal and NO absorbing properties of SOM. Furthermore, we believe 20% w/v SOM to be capable of carrying and offloading an amount of O₂ comparable to that offloaded by blood with a hemoglobin concentration of 7.0 gm/dl. More highly concentrated SOM could carry more O₂ and lead to improved outcomes in shock. Thus, we determined whether stable SOM of higher concentration could be prepared and whether SOM of higher concentrations would be capable of carrying larger quantities of dissolved O₂. **METHODS:**



SOM of 10-40% w/v were prepared using homogenization with microfluidization (H&M). SOM O₂ content was determined using mass spectrometric detection. SOM were stored at 4°C for 30 days and stability was assessed by observation for phase separation. SOM droplet diameter was estimated using light scattering. **RESULTS:** SOM up to 40% w/v were stable within the observation period, and had an average diameter of 1.2 μm, far

less than that of the microvasculature. O₂ content was linearly related to SOM concentration from 10-30% (expressed in graph as a multiple of the oxygen solubility of water). Interestingly, 30% w/v SOM would be expected to offload an amount of O₂ similar to blood with a hemoglobin concentration of 11.1 gm/dl. **CONCLUSION:** Stable SOM up to 40% w/v are possible and the solubility of O₂ in these emulsions follows Henry's law. Thus, SOM have potential use as colloids for fluid resuscitation for patients in shock.

MID-LEVEL PRACTITIONERS CAN SAFELY PLACE INTRACRANIAL PRESSURE MONITORS

Pamela Young, PA-C, William M Bowling, MD, MBA, Hurley Medical Center

Presenter: Pamela Young, PA-C

Discussant: Ernest Block, MD, MBA, EMT-P - Holmes Regional Medical Center

Objectives Neurosurgical coverage is a challenge for many trauma centers. Mid-level practitioners (MLPs) can extend coverage by sharing the workload. Our objective was to determine whether the complication rates for intracranial pressure monitor placement were similar between neurosurgeons and MLPs.

Methods After obtaining IRB approval, the trauma registry at a Level I trauma center was searched for all ICP monitors placed between 6/05 and 3/10. Complications were classified as major or minor. The study was designed as a non-inferiority trial with a 5% absolute difference in major complications defined as acceptable, *a priori*. Time to monitor placement was a secondary outcome and was analyzed by Wilcoxon rank-sum and multiple linear regression.

Results One hundred seventeen patients were identified. Fifteen cases were excluded (inserted by trauma surgeon or MLP under direct supervision, ventricular drain or inserted at outside facility). Of the remaining 92, 22 were inserted by neurosurgeons and 70 by MLPs. There was one major complication (CSF leak) in a monitor placed by a MLP. The difference in complication rates was significantly less than 5% (1.4% vs. 0%, $p=0.0135$). The minor complication rate was higher for MLPs (20.0% vs. 13.6%, $p=0.989$) On univariate analysis, placement by a MLP, coagulopathy and no craniotomy were associated with longer times to monitor placement; on multivariable analysis, only no craniotomy and coagulopathy were associated with longer times to monitor placement. Nine monitors were inserted at the time of craniotomy, eight of them by the neurosurgeon.

Conclusions ICP monitors can be safely placed by mid-level practitioners with major complication rates not different from neurosurgeons. Monitors placed by neurosurgeons tend to be placed sooner because they are placed at the time of craniotomy which should be within 4 hours of injury. Monitors placed by MLPs are relatively delayed by the time required to communicate with the neurosurgeon and for the neurosurgeon to remotely view the CT scan. Technological and procedural advances which shorten this decision loop may lead to better outcomes.

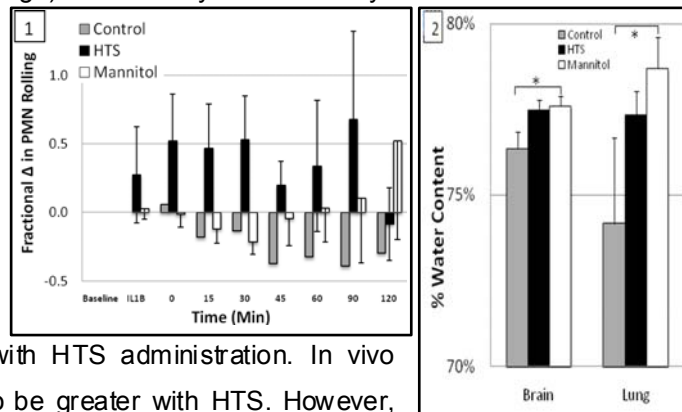
**IN VIVO INFLAMMATION OF THE BLOOD BRAIN BARRIER
MICROCIRCULATION AFTER TBI: HTS IS NOT SUPERIOR TO MANNITOL**

Joshua A. Marks, MD, Shenghui Li, MD, Wanfeng Gong, MD, Paymon Sanati, Rachel Eisenstadt, Carrie Sims, MD, MS, Babak Sarani, MD, Jose L. Pascual, MD, PhD, University of Pennsylvania

Presenter: Joshua Marks, MD

Discussant: Andrew Kerwin, MD - University of Florida Health Science Center

Objectives: Equipose exists on the superiority of mannitol (MTL) or hypertonic saline (HTS) in the treatment of intracranial hypertension following traumatic brain injury (TBI). It is unknown, however, if either treatment exerts anti-inflammatory effects in the microcirculation of the blood-brain-barrier (BBB) as HTS is known to do in other systemic vascular beds. We hypothesized that HTS would reduce brain polymorphonuclear neutrophil (PMN)-endothelial cell (EC) interactions thereby reducing inflammation and cerebral/systemic edema after TBI. **Methods:** CD1 male mice (25-30g) underwent craniotomy-covered window placement for observation of in vivo PMN-EC interactions in brain pial vessels using intravital video microscopy (IVM). TBI was simulated through interleukin-1 β (IL1 β) suffusion of the brain surface. A single, equiosmolar, intravenous dose of either 20% MTL or 5% HTS was administered 15 minutes post IL1 β suffusion. Live microcirculatory video was obtained every 15 minutes for 2 hours. PMN rolling/adhesion to EC and micro-vascular permeability (leakage) were analyzed offline by a blinded observer and correlated to post-mortem brain/lung edema assessed by wet-to-dry ratios. Paired/un-paired t-tests were used to determine significance ($p < 0.05$). **Results:** 14 animals were analyzed: HTS(6), MTL(5), control(3). PMN rolling (FIG.1) and adhesion were not reduced, but rather trended higher with HTS administration. In vivo vessel permeability similarly tended to be greater with HTS. However, ex vivo brain and lung edema were greater in MTL than HTS as compared to controls ($*p = 0.05$, FIG.2). **Conclusion:** Contrary to published findings in other systemic micro-vascular beds, HTS may not reduce in-vivo PMN-EC interactions in the brain and may worsen BBB inflammation as compared to MTL. Studies employing mechanical traumatic injury to the brain are needed to determine true microcirculatory anti-inflammatory effects of each osmotherapy in TBI.



VAGAL NERVE STIMULATION MODULATES GUT INJURY AND LUNG PERMEABILITY IN TRAUMA HEMORRHAGIC SHOCK

Gal Levy, MD, Jordan Fishman, MD, Benjamin Chandler, MD, Da-Jong Xu, MD, PhD, Wei Dong, MD, Dave Palange, MS, Gergely Vida, MD, Luis Ulloa, PhD, Alicia Mohr, MD, Edwin Deitch, MD, UMDNJ

Presenter: Gal Levy, MD, MD, MPH
Discussant: Lawrence Diebel, MD - Wayne State University

Objective: To observe if neuromodulation via cervical vagus nerve stimulation (VNS) shows a protective effect on gut injury and lung permeability in Trauma – Hemorrhagic shock (T/HS).

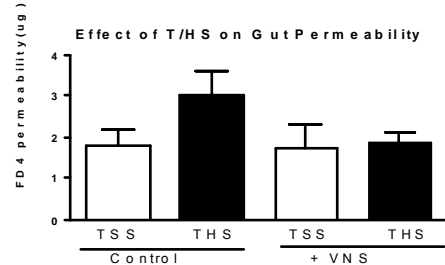
Methods: Male Sprague-Dawley rats were subjected to left cervical vagus nerve stimulation with Biopac MP150 system at 5V continuous stimulation for 10 minutes. The right internal jugular and the right femoral artery were cannulated for blood withdrawal and blood pressure monitoring respectively. Blood was withdrawn into a syringe anticoagulated with arixtra until a MAP between 30-35mmHg was reached. This MAP was sustained for 90 minutes. Blood was then reinfused and the animal was observed for 3 hours. To assess gut permeability, at completion of the observation period a 10cm segment of ileum proximal to the cecum was ligated and injected with 1mL of FD-4 (25mg/mL) for 30 minutes. Later plasma FD4 levels were assayed. One mL 2% Evans-Blue dye was then injected into the animal for lung permeability measurements via BAL, while lung tissue myeloperoxidase (MPO) levels were measured as a marker of PMN sequestration.

Group	Lung Permeability % of Evans blue dye	MPO Activity Units/g tissue
T/SS + VS	2.18 + 0.60	8.18 + 2.57
T/SS + Sham VS	2.82 ± 0.77	8.16 ± 1.67
T/HS + VS	4.87 + 0.78	12.83 + 1.16
T/HS + Sham VS	8.46 ± 0.36* 19	.39 ± 1.01*

Results: Trauma hemorrhagic shock induced lung injury and PMN sequestration is decreased by VNS (Table 1). Likewise, T/HS induced gut permeability was reduced to sham-shock levels by VNS (Figure 1).

Conclusion: Neuromodulation

decreases injury in THS model as evidenced by decreased gut injury and permeability as well as decreased lung injury and neutrophil sequestration in trauma – hemorrhagic shock rat model.



Session

Paper 32 9:40 AM

**COMPUTATIONAL GENE-MAPPING TO ANALYZE CONTINUOUS
AUTOMATED PHYSIOLOGIC MONITORING DATA IN NEURO-TRAUMA
INTENSIVE CARE**

Deborah M Stein, MD, MPH, Lynn G Stansbury, MD, MPH, Peter Hu, Hegang Chen, Thomas M. Scalea, MD

Presenter: Deborah Stein, MD, MPH

Discussant: Stephen Gale, MD - UMDNJ/Robert Wood Johnson Medical School

Objectives: Neuro-trauma (NT) ICU-monitor electronic signal data can be processed into sequences analogous to amino acid sequences in genes. We asked whether high-information-throughput applications used in micro-array gene profiling can assess critical thresholds in large-volume collections of continuous electronic automated physiologic monitoring data, with the eventual goal of establishing critical thresholds specifically relevant to the individual patient.

Methods: We used Class Prediction Analysis, a structured learning technique, to predict binary outcomes (survival, yes/no; 14-day hospital or ICU Length of Stay [LOS]; good/bad Extended Glasgow Outcome Score [GOSE] at 3 months) based on data accrued over 12, 24, 48, and 72 h after admission to the NT ICU. We then used univariate analysis 'feature selection' to identify discriminator 'genes' in each individual's data set. Prediction models using each individual's 'featured' genes were then constructed using 7 different statistical modeling techniques to predict outcome for other individuals in the sample cohort based on the selected 'features' of each individual, using 'leave one out' methodology.

Results: Sixty patients with severe traumatic brain injury (TBI) provided 56 sets of 588 'genes' for each of the 4 periods and outcomes. Mean number (SD) of 'featured' genes ranged from 96(14) predicting 14-day hospital stay by 12 h to 5(1) predicting 3-month GOSE by 12 h. 'Genes' predicting mortality ranged progressively from 13(1) at 12 hours to 51(5) at 72 h. Cerebral and blood pressures over time (e.g. intracranial pressure >20 mmHg for 20 min) provided the best discrimination for outcome, with blood pressure indicators more prominent at 12 and 24 hours and cerebral pressure indicators, sometimes for as little as 10 min, more prominent at 48 and 72 hours. Four of the 7 modeling techniques constructed models that correctly identified outcomes =75% of the time. Over all, modeling performed best for mortality and worst for GOSE at 3 months.

Conclusion: Our results suggest that valid prediction models after severe TBI can be constructed using 'gene mapping' techniques to analyze large datasets from conventional electronic monitoring data, but that this methodology needs validation in larger data sets.