

Scientific Session I - Raymond H. Alexander, MD Resident Paper Competition

Paper #1  
January 15, 2020  
12:30 pm

**TREATMENT OF BLUNT CEREBROVASCULAR INJURIES:  
ANTICOAGULANTS OR ANTIPLATELETS?**

Kamil Hanna, MD, Michael Ditillo, DO, FACS\*, Samer Asmar, MD, Lourdes Castanon, MD\*,  
Mohammad Chehab, MD, Lynn Gries, MD, Andrew L. Tang, MD\*, Bellal Joseph, MD\*  
The University of Arizona

**Presenter:** Kamil Hanna, MD

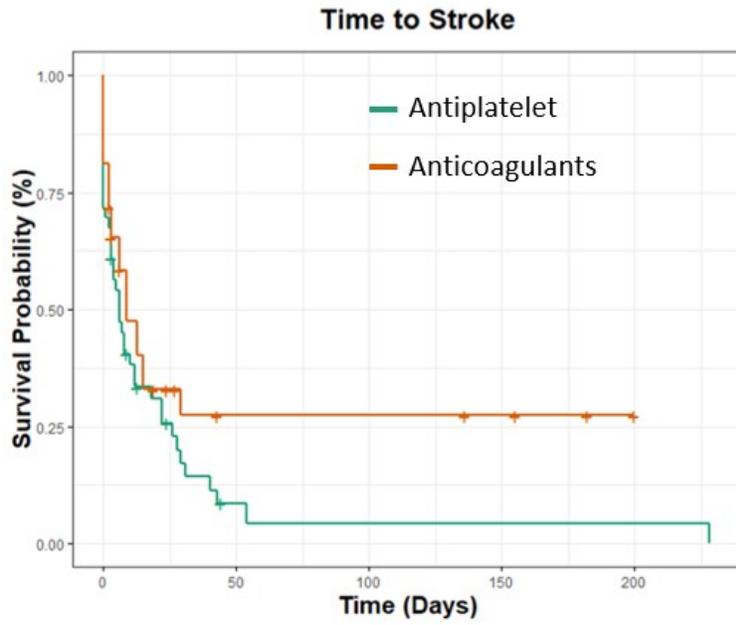
**Discussant:** Laura Kreiner, MD, MetroHealth Medical Center

**Objectives:** Blunt cerebrovascular injury (BCVI) is associated with cerebrovascular accidents (CVA). Early therapy with antiplatelets or anticoagulants is recommended. There is relatively less data comparing the effectiveness of these treatments. The aim of our study was to compare outcomes between BCVI patients who received anticoagulants versus those who received antiplatelets.

**Methods:** We performed a (2011-2015) analysis of the Nationwide Readmission Database and included all adult trauma patients =18y who had an isolated BCVI (other body regions AIS<3). Head injury patients or those who developed a CVA during the index admission were excluded. Patients were stratified into: anticoagulants and antiplatelets. Propensity score matching was performed (1:1 ratio) to control for demographics, comorbidities, BCVI grade, distribution and severity of injuries. Outcomes were readmission with CVA, and mortality within 6 months.

**Results:** A total of 725 BCVI patients were identified. A matched cohort of 370 patients (antiplatelet: 185 anticoagulants: 185) was obtained. Mean age was 50+/-15y, neck-AIS was 3[3-4], and ISS was 12[9-17]. The majority of the patients (69%) had high-grade BCVI (AIS=3). Overall, 6% were readmitted with CVA and 3% died within 6-months. Patients who received anticoagulants had a lower rate of readmission with CVA (9% vs. 26%; p=0.017), and a lower rate of 6-month mortality (1.3% vs. 3.9%; p=0.01). There was no significant difference between the two groups reading the median time to stroke (9 vs. 6 days; p=0.12) **Figure 1.**

**Conclusions:** BCVI patients on CVA prophylaxis for BCVI have a 6% rate of stroke after discharge. Compared to antiplatelets, anticoagulants are associated with lower rates of CVA in the first 6-month post discharge. Further studies are required to identify the optimal agent to prevent CVA in this high-risk subset of trauma patients.



**Figure 1:** Time to stroke Kaplan Meier Analysis

Scientific Session I - Raymond H. Alexander, MD Resident Paper Competition

Paper #2  
January 15, 2020  
12:50 pm

**VISCOELASTIC TESTING IN COMBAT RESUSCITATION: TIME FOR A NEW STANDARD?**

Daniel T. Lammers, MD, Christopher Marengo, MD, Kaitlin Morte, MD,  
John P. Kuckelman, DO, Douglas R. Morte, MD, Jason Bingham, MD,  
Matthew J. Martin, MD, FACS\*, Matthew J. Eckert, MD\*  
Madigan Army Medical Center

**Presenter:** Daniel T. Lammers, MD

**Discussant:** Lucy Kornblith, MD, UCSF-San Francisco General Hospital

**Objectives:** Traumatic hemorrhage and coagulopathy represent major sources of morbidity and mortality on the modern battlefield. Viscoelastic testing (VET) offers the potential for a more personalized approach to resuscitation, although data on superiority to non-VET guided therapy is lacking. Since 2009, VET has been performed at one NATO Role III Hospital in Afghanistan. We sought to evaluate the outcomes of patients who received VET-guided resuscitation compared to standard balanced blood product resuscitation.

**Methods:** Retrospective analysis of the Department of Defense Trauma Registry, 2008-2016, was performed. Multivariate logistic regression analyses of all adults presenting to NATO Role III facilities who required blood products were performed to identify factors associated with VET-guided resuscitation and mortality. A propensity score matched comparison of outcomes in patients treated at VET vs non-VET Role III facilities was performed. P values less than 0.05 were considered significant.

**Results:** 3320 patients predominately male (98%), median age range 25-29 years, ISS  $18.8 \pm 0.2$ , with a penetrating injury (84%) were studied. Overall mortality was 9.7%. 594 patients had VET during their initial resuscitation. After adjusting for demographics, injury type/severity, vital signs, laboratory values, and hospital complications, VET during initial resuscitation was independently associated with decreased mortality in all patients (OR 0.63;  $p=0.04$ ). Propensity analysis confirmed a VET-associated survival advantage with a 57% reduction in mortality (7.3% vs 13.1%;  $p=0.001$ ) for all patients requiring blood products.

**Conclusions:** VET offers the ability for personalized, product-specific resuscitation within critically injured patients in combat trauma. Data from this NATO Role III experience suggest that routine VET use may be superior to non-VET guided resuscitation for combat trauma victims.

|  | Non-VET<br>Guided<br>Resuscitation | VET Guided<br>Resuscitation | P value |
|--|------------------------------------|-----------------------------|---------|
| Average ISS                              | 19.7                               | 19.3                        | 0.582   |
| Overall Mortality (%)                    | 13.1                               | 7.3                         | 0.001   |
| Large Volume Transfusion (4-9U/24hr) (%) | 32.9                               | 33.3                        | 0.476   |
| Massive Transfusion (>9U/24hr) (%)       | 29.3                               | 46.9                        | 0.000   |
| Crystalloid Given in First 24hr (ml)     | 4062                               | 2736                        | 0.000   |
| Whole Blood in First 24hr (U)            | 0.2                                | 0.1                         | 0.276   |
| Packed Red Blood Cells in First 24hr (U) | 8.1                                | 11.6                        | 0.000   |
| Fresh Frozen Plasma in First 24hr (U)    | 7.0                                | 11.8                        | 0.000   |
| Cryoprecipitate Given in First 24hr (U)  | 1.7                                | 1.2                         | 0.041   |
| Platelets Given in First 24hr (U)        | 1.0                                | 2.2                         | 0.000   |
| Total Blood Product in First 24hr (U)    | 18.0                               | 26.9                        | 0.000   |
| Blood Loss at First Surgery (ml)         | 616.9                              | 445.2                       | 0.245   |
| Trauma Induced Coagulopathy (%)          | 7.0                                | 3.3                         | 0.003   |
| Patients with RBC:Plasma $\leq$ 1 (%)    | 55.8                               | 81.1                        | 0.000   |
| Average RBC:Plasma                       | 1.061                              | 0.917                       | 0.000   |

Table 1) Comparison of multiple resuscitation measures and outcomes for non-VET guided versus VET guided resuscitation.

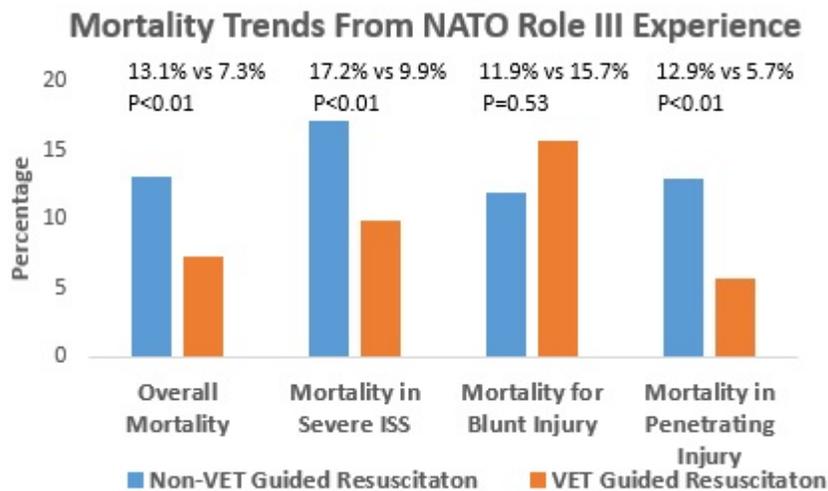


Figure 1) Mortality trends the NATO Role III experience overall and categorized into cohorts based on injury severity and mechanism.

Paper #3  
January 15, 2020  
1:10 pm

**RIB FIXATION IN GERIATRIC TRAUMA: MORTALITY BENEFITS FOR THE MOST VULNERABLE PATIENTS**

Roger C. Zhu, MD, Amory de Roulet, MD MPH\*,  
Chun-Cheng Chen, MD, PHD, Konstantin Khariton, DO\*  
New York Presbyterian-Queens

**Presenter:** Roger C. Zhu, MD

**Discussant:** Jennifer Knight Davis, MD, West Virginia University

**Objectives:** Using a national trauma registry, we assessed the impact of surgical stabilization of rib fractures (SSRF) in patients over the age of 65.

**Methods:** Using data from the 2016 Trauma Quality Improvement Program (TQIP) database, we identified patients  $\geq 65$  years of age admitted with multiple rib fractures and isolated chest wall injury. We developed a multivariate propensity score match to stratify patients that underwent rib fixation based on demographic, injury, and trauma center characteristics. We then compared outcomes including mortality, intensive care unit and hospital lengths of stay, tracheostomy, and pneumonia rates. We performed a subgroup analysis of patients receiving early ( $<48$ hrs) vs late SSRF.

**Results:** Of the 13,842 patients included in the study analysis, 278 (2.0%) underwent surgical rib fixation. (Table 1) Patients undergoing SSRF had higher rates of flail chest, earlier intubation, higher injury severity score, and increased intensive care unit (ICU) admission rates. The 1:1 propensity score match resulted in 220 patients in each group. The in-hospital mortality rate was significantly lower in the group that underwent surgical rib fixation (3.6% vs. 9.5%;  $p=0.01$ ). In the subgroup analysis of patients undergoing early fixation ( $n=75$ ) vs late ( $n=203$ ), we found that early fixation was associated with decreased rates of ventilator-associated pneumonia (VAP) (1.3% vs 7.9%  $p=0.04$ ), shorter ICU lengths of stay (LOS) (6 vs 10 days  $p=0.001$ ), and shorter hospital LOS (9 vs 15 days  $p<0.0001$ ). Our results also trended towards decreased mortality (2.7% vs 4.4%,  $p=0.50$ ) and ventilator days (4 vs 7 days,  $p=0.10$ ) in the early fixation group, however, these results did not reach statistical significance.

**Conclusions:** This study demonstrated a mortality benefit in geriatric trauma patients undergoing SSRF. Subgroup analysis demonstrated decreased VAP, ICU LOS, and hospital LOS in patients undergoing early SSRF.

|  | Pre-match     |            |                   | Post-match  |            |         |
|--|---------------|------------|-------------------|-------------|------------|---------|
|  | No Fixation   | Fixation   | p-value           | No Fixation | Fixation   | p-value |
| <b>Sample Size</b>                             | 13,564        | 278        |                   | 220         | 220        |         |
| <b>Gender (Male)</b>                           | 7,715 56.90%  | 191 68.70% | <b>&lt;0.0001</b> | 147 66.80%  | 144 65.50% | 0.7628  |
| <b>Age</b>                                     | 75 69-81      | 72 68-79   | <b>&lt;0.0001</b> | 73 68 -79   | 72 79.5    | 0.472   |
| <b>Age Group</b>                               |               |            |                   |             |            |         |
| <80  | 9,189 67.70%  | 210 75.50% | <b>0.0062</b>     | 173 78.60%  | 165 75.00% | 0.3039  |
| >= 80  | 4,375 32.30%  | 68 24.50%  |                   | 47 21.40%   | 55 25.00%  |         |
| <b>Race</b>                                    |               |            |                   |             |            |         |
| White  | 11,856 87.40% | 258 92.80% | <b>0.0059</b>     | 204 92.70%  | 204 92.70% | 0.9518  |
| Black  | 587 4.30%     | 3 1.10%    |                   | 2 0.90%     | 3 1.40%    |         |
| Asian Pacific                                  | 330 2.40%     | 4 1.40%    |                   | 4 1.80%     | 3 1.40%    |         |
| Other  | 791 5.80%     | 13 4.70%   |                   | 10 4.50%    | 10 4.50%   |         |
| <b>ACS Level</b>                               |               |            |                   |             |            |         |
| Level I  | 5,764 42.50%  | 136 48.90% | <b>0.0419</b>     | 107 48.60%  | 110 50.00% | 0.9576  |
| Level II                                       | 3,387 25.00%  | 70 25.20%  |                   | 56 25.50%   | 54 24.50%  |         |
| Not Applicable                                 | 4,413 32.50%  | 72 25.90%  |                   | 57 25.90%   | 56 25.50%  |         |
| <b>Teaching Status</b>                         |               |            |                   |             |            |         |
| Community                                      | 5,738 42.30%  | 128 46.00% | 0.1109            | 102 46.40%  | 100 45.50% | 0.9804  |
| Non-Teaching                                   | 1,541 11.40%  | 21 7.60%   |                   | 18 8.20%    | 18 8.20%   |         |
| University                                     | 6,285 46.30%  | 129 46.40% |                   | 100 45.50%  | 102 46.40% |         |
| <b>GCS</b>                                     |               |            |                   |             |            |         |
| GCS 9 -11                                      | 145 1.10%     | 5 1.80%    | 0.2448            | 4 1.80%     | 5 2.30%    | 0.7366  |
| GCS 12-15                                      | 13,419 98.90% | 273 98.20% |                   | 216 98.20%  | 215 97.70% |         |
| <b>SBP &lt;90</b>                              | 279 2.10%     | 10 3.60%   | 0.0754            | 8 3.60%     | 7 3.20%    | 0.793   |
| <b>Intubated at Arrival in ED</b>              | 72 0.50%      | 4 1.40%    | <b>0.0425</b>     | 5 2.30%     | 3 1.40%    | 0.476   |
| <b>Injury Severity Score</b>                   |               |            |                   |             |            |         |
| <15  | 9,370 69.10%  | 120 43.20% | <b>0.0001</b>     | 108 49.10%  | 109 49.50% | 0.2823  |
| 15-24  | 3,755 27.70%  | 122 43.90% |                   | 96 43.60%   | 86 39.10%  |         |
| >25  | 439 3.20%     | 36 12.90%  |                   | 16 7.30%    | 25 11.40%  |         |
| <b>Maximum Non-Chest Trauma Severity Score</b> |               |            |                   |             |            |         |
| 0  | 3,341 24.60%  | 56 20.10%  | <b>0.0051</b>     | 45 20.50%   | 47 21.40%  | 0.7266  |
| 1  | 2,231 16.40%  | 30 10.80%  |                   | 35 15.90%   | 27 12.30%  |         |
| 2  | 5,574 41.10%  | 138 49.60% |                   | 105 47.70%  | 107 48.60% |         |
| 3  | 2,418 17.80%  | 54 19.40%  |                   | 35 15.90%   | 39 17.70%  |         |
| <b>Chest Injury Severity Score</b>             |               |            |                   |             |            |         |
| 3  | 12,818 94.50% | 179 64.40% | <b>0.0001</b>     | 159 72.30%  | 157 71.40% | 0.8892  |
| 4  | 613 4.50%     | 84 30.20%  |                   | 53 24.10%   | 53 24.10%  |         |
| 5  | 133 1.00%     | 15 5.40%   |                   | 8 3.60%     | 10 4.50%   |         |
| <b>Flail Chest</b>                             | 753 5.60%     | 134 48.20% | <b>0.0001</b>     | 77 35.00%   | 80 36.40%  | 0.7655  |
| <b>ED Disposition</b>                          |               |            |                   |             |            |         |
| General Floor                                  | 4,768 35.20%  | 38 13.70%  | <b>0.0001</b>     | 34 15.50%   | 35 15.90%  | 0.8751  |
| Observation Unit                               | 263 1.90%     | 2 0.70%    |                   | 2 0.90%     | 2 0.90%    |         |
| Step Down                                      | 2,233 16.50%  | 35 12.60%  |                   | 32 14.50%   | 31 14.10%  |         |
| SICU   | 5,663 41.80%  | 191 68.70% |                   | 144 65.50%  | 138 62.70% |         |
| Operating Room                                 | 449 3.30%     | 16 5.80%   |                   | 7 3.20%     | 12 5.50%   |         |
| Other  | 188 1.40%     | 2 0.70%    |                   | 1 0.50%     | 2 0.90%    |         |

Demographics and injury characteristics of geriatric patients with isolated chest wall injury pre and post propensity matching.

Paper #4  
January 15, 2020  
1:30 pm

**IMPACT OF MARIJUANA ON VENOUS THROMBOEMBOLIC EVENTS:  
CANNABINOIDS CAUSE CLOTS IN TRAUMA PATIENTS**

Jack Stupinski, MD, Kamil Hanna, MD, Michael Ditillo, DO, FACS\*, Samer Asmar, MD, Lourdes Castanon, MD\*, Lynn Gries, MD, Narong Kulvatunyou, MD\*, Bellal Joseph, MD\*  
The University of Arizona

**Presenter:** Jack Stupinski, MD

**Discussant:** Walt Biffl, MD, Scripps Clinic

**Objectives:** Tetra-hydro-cannabinoids (THC) can modulate the coagulation cascade resulting in hypercoagulability. However, the clinical relevance of these findings has not been investigated. The aim of our study was to evaluate the impact of pre-injury marijuana exposure on thromboembolic complications in trauma patients.

**Methods:** We performed a 2-year (2015-2016) analysis of ACS-TQIP database and included all adult (=18y) trauma patients. Patients were stratified based on pre-injury exposure to Marijuana: THC +ve and THC -ve groups. We performed propensity score matching to control for confounding variables: demographics, comorbidities, injury parameters, hospital course, and thromboprophylaxis use. Outcomes were TEC [deep venous thrombosis (DVT), pulmonary embolism (PE), stroke, myocardial infarction (MI)] and mortality.

**Results:** Of 593,818 trauma patients, 678 patients were matched (THC +ve: 226 vs THC -ve: 452). Mean age was 35 +/- 14 years, ISS was 20[18-34]. There was no difference between the two groups regarding age ( $p=0.24$ ), gender ( $p=0.32$ ), ISS ( $p=0.15$ ), spine-AIS ( $p=0.28$ ), head-AIS ( $p=0.41$ ), extremities-AIS ( $p=0.16$ ), use of thromboprophylaxis ( $p=0.18$ ) and hospital length of stay ( $p=0.36$ ). Overall, the rate of thromboembolic complications was 5% and mortality was 4.1%. Patients in THC +ve group had higher rates of thromboembolic complications compared to those in THC -ve group (9.3% vs 2.8%,  $p=0.01$ ). The rate of DVT (6.6% vs 1.8%,  $p=0.02$ ) and PE (2.2% vs 0.2%,  $p=0.04$ ) was higher in THC +ve group. However, there was no difference regarding the rate of stroke ( $p=0.24$ ), MI ( $p=0.35$ ) and mortality ( $p=0.28$ ) (**Table1**).

**Conclusions:** THC exposure increases the risk of thromboembolic complications in patients with trauma. Early identification and treatment for thromboembolic complications is required to improve outcomes in this high risk subset of trauma patients.

| <b>Outcomes</b>                     | <b>THC +ve<br/>(n=226)</b> | <b>THC -ve<br/>(n=452)</b> | <b>P-value</b> |
|-------------------------------------|----------------------------|----------------------------|----------------|
| Thromboembolic Complications, % (n) | 9.3% (21)                  | 2.8% (13)                  | <b>0.01</b>    |
| DVT                                 | 6.6% (15)                  | 1.8% (8)                   | <b>0.02</b>    |
| PE                                  | 2.2% (5)                   | 0.2% (1)                   | <b>0.04</b>    |
| Stroke                              | 1.3% (3)                   | 0.9% (4)                   | 0.24           |
| MI                                  | 0% (0)                     | 0.2% (1)                   | 0.35           |
| Mortality                           | 3.5% (8)                   | 4.4% (20)                  | 0.28           |

THC=Tetra-hydro-cannabinoids; DVT=Deep Vein Thrombosis; PE=Pulmonary Embolism;  
MI=Myocardial Infarction

Table 1: Outcomes

Scientific Session I - Raymond H. Alexander, MD Resident Paper Competition

Paper #5  
January 15, 2020  
1:50 pm

**HYPERTONIC SALINE RESUSCITATION IN TRAUMA FOLLOWING DAMAGE CONTROL  
LAPAROTOMY: DOES IT ATTENUATE INFLAMMATION**

Patrick M. McCarthy, MD, Ryan Rhie, MD, Michelle Buehner, MD, Xiaoming Shi, MD,  
Christopher Corkins, MD, Kimberly Medellin, BSN, Nicole Shults, BS, James Aden, PhD,  
Allyson Arana, PhD, William Sanns, PhD, Joel Michalek, PhD, Valerie Sams, MD\*  
San Antonio Military Medical Center

**Presenter:** Patrick M. McCarthy, MD

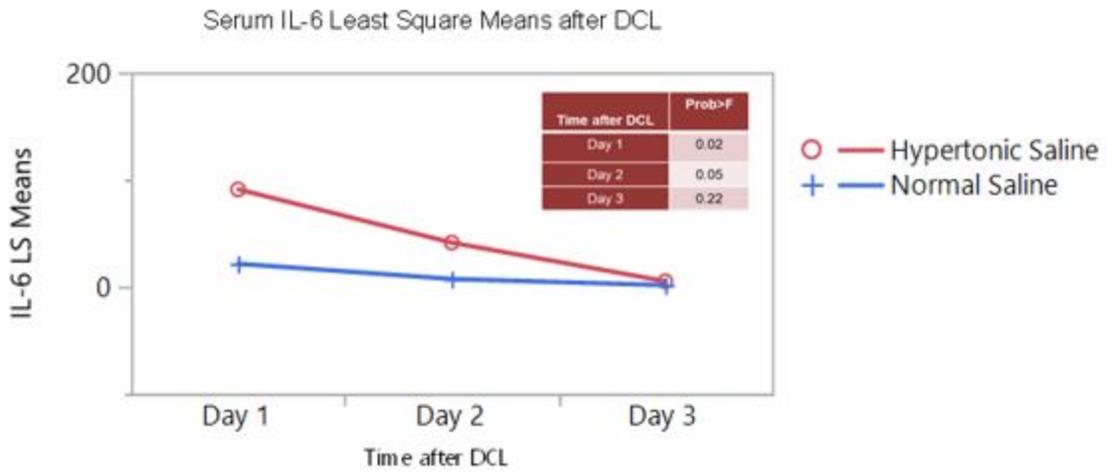
**Discussant:** Joseph Fernandez-Moure, MD, MS, Duke University Medical Center

**Objectives:** This study sought to determine if inflammatory cytokine levels were impacted by hypertonic saline solution (HTS) resuscitation in trauma patients undergoing damage control laparotomy (DCL).

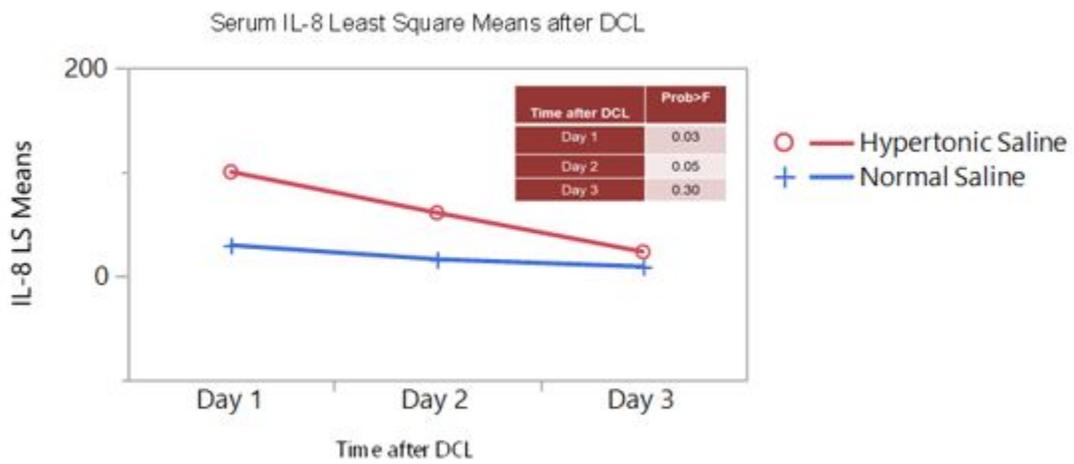
**Methods:** Trauma patients 18 years old or greater requiring a DCL were randomized to receive a standard rate of 3% HTS or 0.9% Normal Saline Solution (NSS) in this double blinded prospective trial. Demographics, laboratory values, IL6 and IL8 levels were compared. Statistical analysis was performed using JMP 13 (SAS, Cary, NC). Fisher's exact test, Mann-Whitney U-test, or Student's t-test were used as appropriate. Statistical significance was set at  $p < 0.05$ .

**Results:** 70 patients met inclusion criteria of which 62 completed the protocol. The HTS and NSS groups were similar in age, sex, and body mass index ( $p > 0.05$ ). Groups had similar injury severity score (ISS), initial Glasgow Coma Scale (GCS), maximum Abbreviated Injury Score (AIS), Trauma Injury Severity Score (TRISS), and Revised Trauma Score (RTS). There were more penetrating traumas in the NSS cohort (64% vs. 36%), but no difference in organ laceration, orthopedic injuries, abdominal trauma, or significant vascular injuries. Mean base deficit and lactate were not significantly different ( $p > 0.05$ ). The geometric means of IL6 and of IL8 concentrations were significantly higher in the HTS group compared to the NSS group in the first 72 hours ( $p = 0.033$ ,  $p = 0.047$ , respectively).

**Conclusions:** This is the largest known human study to date investigating impact of HTS resuscitation in trauma on inflammatory cytokines. Our results found an increase in inflammatory markers with the HTS cohort that does not support previously published studies. This analysis is part of a larger multicenter trial investigating infection rates and organ dysfunction and may necessitate larger studies investigating the effects of inflammatory cytokine levels on trauma patient outcomes.



Comparison of the geometric means of IL-6 concentrations between normal saline and 3% hypertonic saline in the days after damage control laparotomy



Comparison of the geometric means of IL-8 concentrations between normal saline and 3% hypertonic saline in the days after damage control laparotomy

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

Paper #6  
January 15, 2020  
2:30 pm

**SAVE IT – DON'T WASTE IT! MAXIMIZING UTILIZATION OF ERYTHROCYTES FROM PREVIOUSLY STORED WHOLE BLOOD**

Kasiemobi Pulliam, MD, Bernadin Joseph, BS, Rosalie Veile, BS, Amy Makley, MD\*,  
Michael Goodman, MD\*, Timothy A. Pritts, MD, PhD\*  
University of Cincinnati

**Presenter:** Kasiemobi Pulliam, MD

**Discussant:** John R. Taylor, III, MD, University of Arkansas for Medical Sciences

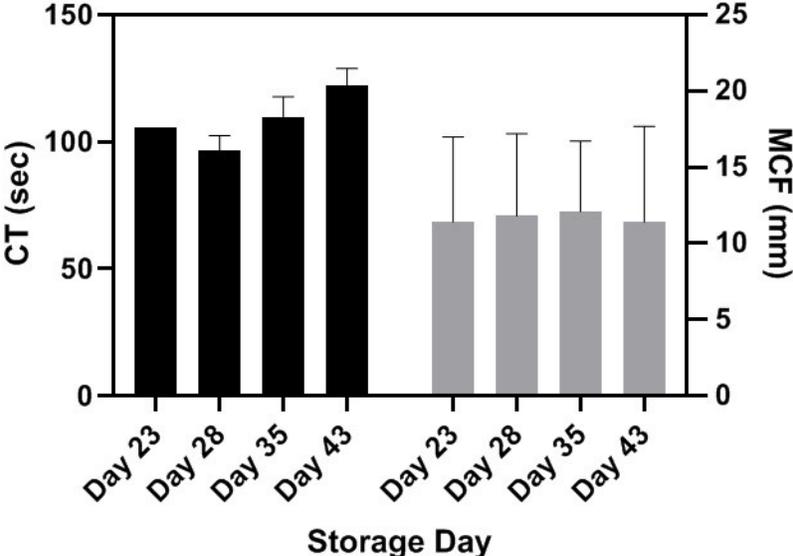
**Objectives:** Recent military and civilian experience suggests that fresh whole blood (WB) may be the preferred initial management of hemorrhagic shock, but its use is limited by its 21-day shelf life. The viability, red blood cell storage lesion, and coagulation status of packed red blood cells (pRBCs) salvaged from expired WB are unknown. We hypothesized that packed red blood cells can be salvaged from previously stored WB.

**Methods:** Cold stored, low-titer, O-positive, non-leukoreduced, WB units were obtained at 21 days. These units underwent centrifugation and erythrocytes were resuspended in AS-3 and stored for 21 additional days (salvaged pRBCs). The red blood cell storage lesion parameters of microvesicles, band-3, free hemoglobin, annexin V, advanced oxidation protein products (AOPP), and erythrocyte osmotic fragility were measured weekly and compared to pRBCs prepared at the time of donation and stored in AS-3 for 42 days (standard pRBCs). Viscoelastic coagulation parameters were analyzed by thromboelastometry to determine innate coagulability in an *in vitro* 1:1 ratio with plasma.

**Results:** There were no significant differences in microvesicle (585.2+181.4 vs. 700.2+317.2 events/ $\mu$ L), cell-free hemoglobin (59.4+13.8 vs. 67.6+17.4 g/dL), and annexin V content (20.8+3.7 vs. 32.2+2.1 %) for salvaged vs. standard pRBCs. The salvaged pRBCs had a significant reduction in AOPP (567.3+8.2 vs. 232.0+4.4  $\mu$ M) but reduced Band-3 (98.3+1.4 vs. 68.4+6.7 %) and greater osmotic fragility. Salvaged pRBCs maintained consistent clotting time, clot formation time, and maximum clot formation as they aged.

**Conclusions:** Salvaged pRBCs from previously stored whole blood accumulate the red blood cell storage lesion in a similar fashion to standard pRBCs and maintain consistent coagulability when reconstituted with plasma. Salvaged pRBCs may be a viable product for potential utilization in the treatment of traumatic hemorrhagic shock.

### Salvaged pRBCs + FFP



Salvaged pRBCs maintained consistent clotting time, clot formation time, and maximum clot formation as they aged.

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

Paper #7  
January 15, 2020  
2:50 pm

**DOXYCYCLINE IMPROVES TRAUMATIC BRAIN INJURY OUTCOMES IN MURINE MODEL**

Adil J. Malek, MD, Bobby Robinson, MD, Angie Hitt, RN,  
Courtney Shaver, MS, Claire Isbell, MD, MSCI\*  
Scott and White Memorial Hospital

**Presenter:** Adil J. Malek, MD

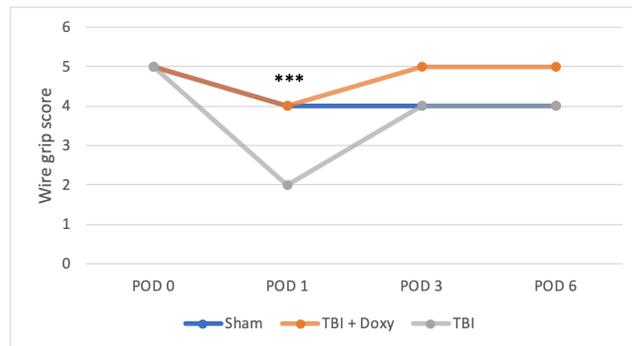
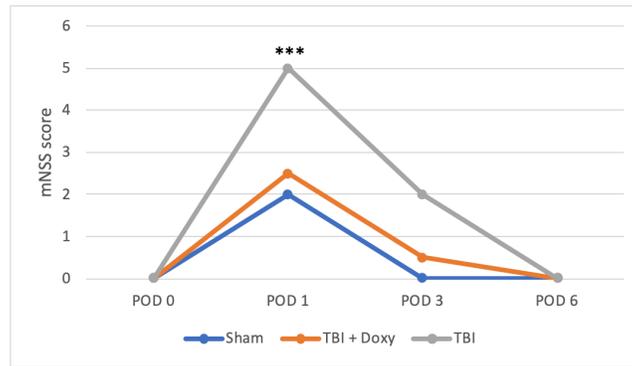
**Discussant:** Jose L. Pascual, MD, PhD, Penn Presbyterian Medical Center

**Objectives:** Cerebral edema after traumatic brain injury (TBI) leads to secondary brain ischemia, herniation, and brain death. The underlying pathophysiology responsible for TBI-induced microvascular “leak” is by loss of the blood-brain barrier (BBB) integrity via the proteolytic enzyme matrix metalloproteinase-9 (MMP-9). Administration of doxycycline has demonstrated preservation of BBB integrity by inhibition of MMP-9 in prior *in vitro* and non-survival murine studies. We sought to determine the effect of doxycycline administration on behavioral and motor function after inducing TBI in a murine survival model.

**Methods:** Adult C57BL/6 mice underwent sham versus TBI with or without doxycycline treatment. TBI was induced using a controlled cortical impactor. The TBI with doxycycline cohort received a dose of doxycycline (20mg/kg) one hour after injury and every 12 hours until postoperative day (POD) 6. All mice underwent preoperative modified neurological severity score (mNSS) testing, wire grip testing, and weighing. Postoperative mNSS, wire grip, weight, and ataxia analysis (Digigait) was performed on POD 1, 3, and 6. Non-parametric testing was used for comparative analysis.

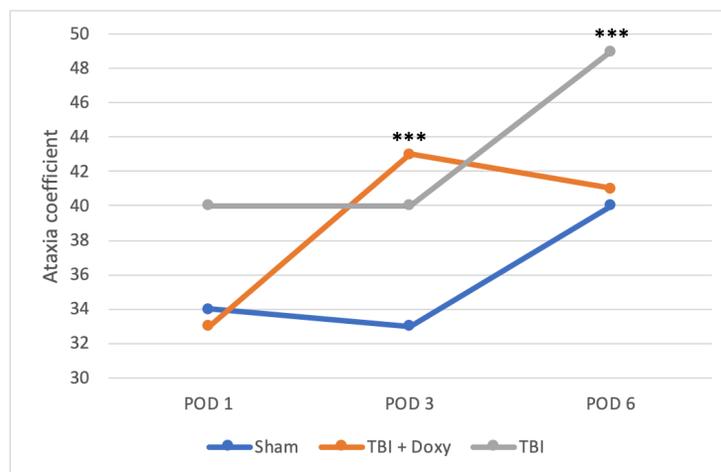
**Results:** 15 sham mice, 15 TBI mice, and 10 TBI with doxycycline mice were studied. Mice treated with doxycycline had significantly improved mNSS and wire grip scores by POD 1 ( $p < 0.05$ , Figure 1). Mice treated with doxycycline had significantly improved ataxia scores by POD 6 ( $p = 0.0006$ , Figure 2). There was no significant difference in rate of weight change between the three groups.

**Conclusions:** Mice treated with doxycycline following TBI had improved behavioral and motor function that approached or exceeded those of sham mice. This study demonstrates the important role of doxycycline in preserving BBB integrity following TBI in a murine model. Further studies exploring the role of doxycycline in adult TBI are warranted.



**Figure 1:** Comparison of postoperative behavioral testing outcomes. Lower mNSS scores and higher wire grip scores indicate improved function. TBI + Doxy mice trend closer to sham mice than mice with TBI alone.

**Abbreviations:** POD-postoperative day; TBI-traumatic brain injury; mNSS-modified neurological severity score; Doxy-doxycycline  
 \*\*\*: Denotes  $p < 0.05$



**Figure 2:** Comparison of postoperative gait analysis utilizing Digigait. Higher ataxia coefficients indicate more severe ataxia.

**Abbreviations:** POD-postoperative day; TBI-traumatic brain injury  
 \*\*\*: Denotes  $p < 0.05$

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

Paper #8  
January 15, 2020  
3:10 pm

**VALIDATION OF A NOVEL PARTIAL REBOA DEVICE IN A SWINE HEMORRHAGIC SHOCK MODEL: FINE TUNING FLOW TO OPTIMIZE BLEEDING CONTROL AND REPERFUSION INJURY**

Dominic M. Forte, MD, Woo S. Do, MD, Jessica Weiss, MD, Rowan Sheldon, MD, John P. Kuckelman, DO, Matthew J. Eckert, MD\*, Matthew J. Martin, MD, FACS\*  
Madigan Army Medical Center

**Presenter:** Dominic M. Forte, MD

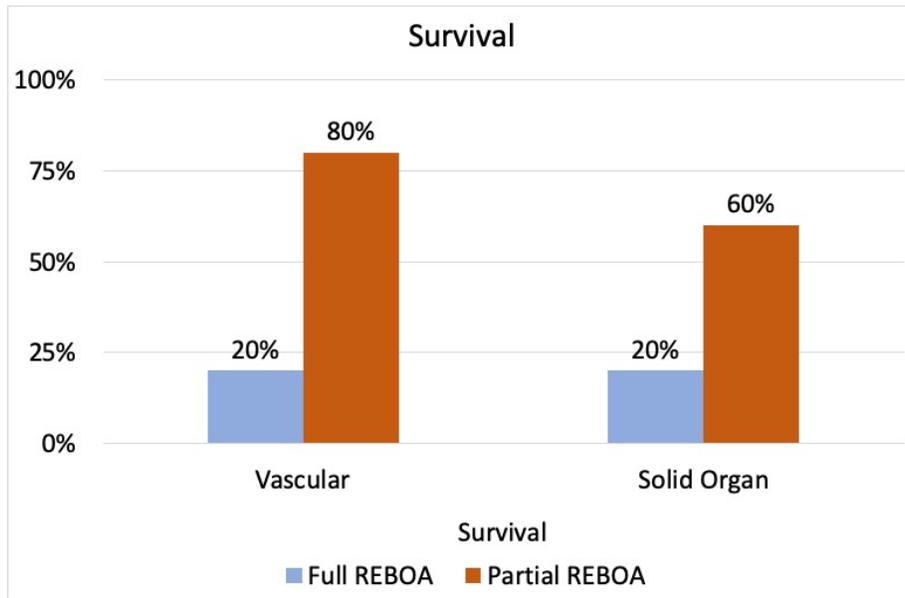
**Discussant:** Letitia Bible, MD, Banner Health

**Objectives:** Partial restoration of aortic flow during REBOA is advocated by some to mitigate distal ischemia, but current devices cannot effectively control partial flow. Our lab has validated the mechanics and optimal partial REBOA flow rates using a prototype device (pREBOA). We sought to test this novel technology against full REBOA (fREBOA) in hemorrhagic shock conditions.

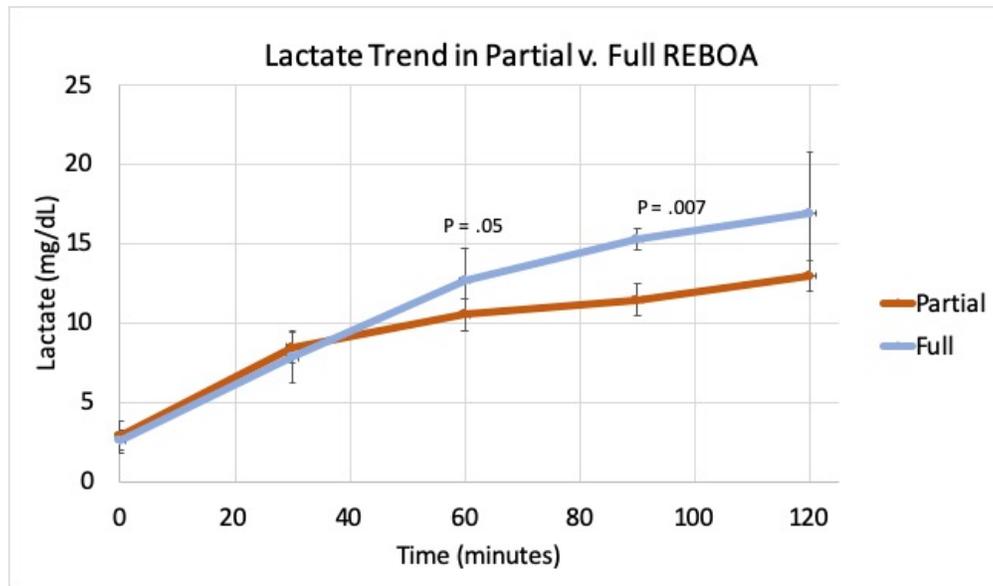
**Methods:** 20 Yorkshire swine underwent placement of aortic flow probes, zone 1 REBOA placement, and 20% blood volume hemorrhage. They were then randomized to either solid organ (SOI) or abdominal vascular (AVI) injury. The pREBOA arm (10 swine) underwent full inflation for 10min, then deflation to a flow rate of (0.5L/min) for 2hr. The fREBOA arm (10 swine) underwent full inflation for 60min, followed by deflation/resuscitation.

**Results:** There was no significant difference in cardiac output (CO), wedge pressures, or systemic vascular resistance between pREBOA and fREBOA arms except for CO at 30min (pREBOA 2.1, fREBOA 2.3,  $p=.03$ ). Hemorrhage was higher in the fREBOA group as measured by intra-abdominal clot weight at conclusion of the experiment (1.1kg v. 0.8kg,  $p=.02$ ). 60% of SOI and 80% of the AVI animals survived to completion of experiment in the pREBOA arm vs 20% SOI and 20% AVI animals in the fREBOA arm (Figure 1). Serum lactate was higher in the fREBOA arm at 60 and 90min (13 v 10, and 15 v 11, both  $p<.05$ , Figure 2). The pREBOA swine were further assessed by survival. Surviving animals had higher calcium at 30 (8.6 v 7.5,  $p=.02$  at 30min, 8.6 v 7.2 at 60min,  $p=.07$ ) and a trend towards lower potassium.

**Conclusions:** Prolonged pREBOA at a moderate distal flow rate provided hemorrhage control, improved survival, and decreased ischemic injury versus fREBOA with prolonged use. Prophylactic aggressive calcium supplementation may be routinely warranted prior to and during the reperfusion phase.



Survival with Full v Partial REBOA



Lactate Trends in Partial v Full REBOA

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

Paper #9  
January 15, 2020  
3:50 pm

**INJURY AND SHOCK DRIVEN EFFECTS ON PLATELET AGGREGOMETRY:  
A CAUTIONARY TALE OF PHENOTYPING**

Nichole E. Starr, MD, MPH, Zachary Matthay, MD, Matthew E. Kutcher, MD\*,  
Alexander Fields, PhD, Brenda Nunez-Garcia, BA, Rachael A. Callcut, MD, MSPH, FACS\*,  
Mitchell J. Cohen, MD, FACS, Lucy Z. Kornblith, MD\*  
University of California San Francisco

**Presenter:** Nichole E. Starr, MD, MPH

**Discussant:** Niels Martin, MD, University of Pennsylvania

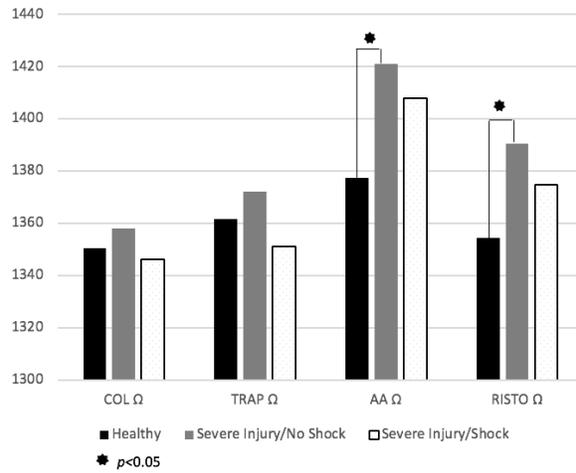
**Objectives:** Platelet behavior in trauma-induced coagulopathy (TIC) is poorly understood. Injured patients show impaired platelet aggregation (“dysfunction”) to *in vitro* agonist stimulation assessed by impedance aggregometry (*PA*). However, *PA* detects only the response of unstimulated platelets capable of responding to agonists. We hypothesize that severe injury itself stimulates platelets, curtailing their ability to respond to agonism, and thus over-identifies platelet “dysfunction” by *PA*.

**Methods:** Blood from 227 pre-resuscitation trauma patients and 27 healthy donors was collected for *PA*. Pre-agonist impedance(O) and platelet aggregation(area under the curve [AUC]) in response to collagen(COL), thrombin receptor-activating peptide-6(TRAP), arachidonic acid(AA), and ristocetin(RISTO) were measured. The effects of severe injury(ISS>25) and shock(base excess<-6) on pre-agonist impedance and stimulated platelet aggregation were assessed by stratification and multivariable regression.

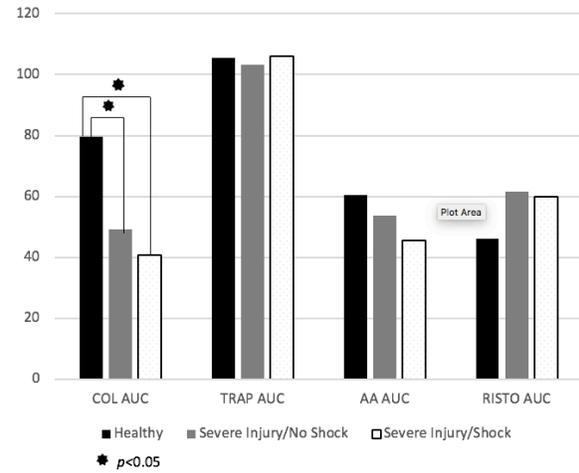
**Results:** The patients had a median ISS of 21, with 23% in shock. Isolated severe injury was associated with a “functional” platelet phenotype: elevated pre-agonist impedance (AA and RISTO,  $p<0.01$ ;PanelA), yet impaired aggregation to COL ( $p<0.01$ ;PanelB). Combined injury/shock was associated with a “dysfunctional” phenotype: no significant effect on pre-agonist impedance, but similar impaired aggregation responses (COL,  $p<0.01$ ). Isolated severe injury was associated with adjusted increases in pre-agonist impedance (COL21O,  $p=0.03$ ), not seen in combined injury/shock (all  $p>0.05$ ).

**Conclusions:** Injury and shock confer differential patterns of platelet aggregation and are required in combination to drive platelet “dysfunction.” This supports that combined tissue injury and shock are necessary to induce coagulopathic responses and is consequential in improving phenotyping of post-injury platelet behavior and for guiding platelet-based therapeutics.

Pre-agonist Impedance in  
Healthy, Isolated Severe Injury,  
and Combined Severe Injury and Shock



Stimulated Aggregation in  
Healthy, Isolated Severe Injury,  
and Combined Severe Injury and Shock



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

Paper #10  
January 15, 2020  
4:10 pm

**ACTIN IS ASSOCIATED WITH TISSUE INJURY IN TRAUMA PATIENTS AND PRODUCES A HYPERCOAGULABLE PROFILE IN VITRO**

Julia R. Coleman, MD, MPH, Ernest Eugene Moore, MD\*, Kalev Freeman, MD,  
Christopher Silliman, MD, PhD, Mitchell J. Cohen, MD, FACS,  
Angela Sauaia, MD, PhD, Jason Samuels, MD, Kirk Hansen, PhD  
University of Colorado, Aurora

**Presenter:** Julia R. Coleman, MD, MPH

**Discussant:** Vanessa Nomellini, MD, PhD, University of Cincinnati

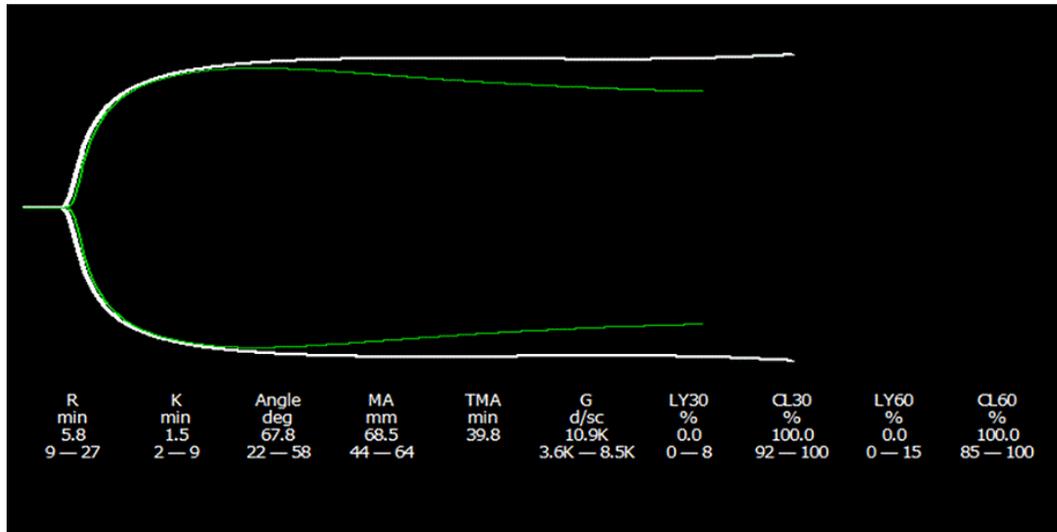
**Objectives:** While tissue injury provokes fibrinolysis shutdown in trauma, the mechanism remains elusive. Cellular death causes release of structural proteins, specifically cytoskeletal and skeletal muscle actin and myosin, which may interact with clot formation and structure. We hypothesize that tissue injury is associated with high circulating actin and that actin produces a hypercoagulable profile *in vitro*.

**Methods:** First, blood was collected from trauma activation patients at a single level-1 trauma center. Proteomic analyses were performed through targeted liquid-chromatography coupled with mass-spectrometry using isotope labeled standards for quantification. Second, we added physiologic concentrations of actin to whole blood from healthy volunteers and analyzed changes in coagulation by thrombelastography, as well as to plasma of healthy volunteers and examined clot architecture via confocal microscopy of fluorescent fibrinogen.

**Results:** Overall, 108 trauma patients were included: majority(71%) male, median age 32.7, 66% blunt mechanism, median new injury severity score(NISS) of 41. Compared to patients without severe tissue injury(NISS<15, n=10), patients with severe tissue injury(NISS>15, n=98) had higher levels of circulating actin:gelsolin (0.2355 vs 0.1539, p=0.02). Overall, 10 healthy volunteers were included in the *in vitro* experiments (50% male, median age 31.3). Actin significantly increased angle(40.0° to 52.9°, p=0.002) and decreased fibrinolysis(LY30 of 4.0% to 1.6%, p=0.002), provoking fibrinolytic shutdown in three patients(Table 1, Figure 1). Additionally, actin impacted fibrin thickness and fibrin cross-linking.

**Conclusions:** Actin increases clot propagation and provokes fibrinolysis shutdown *in vitro*, and high circulating levels of actin are present in patients with severe tissue injury, suggesting release of actin in the setting of tissue injury contributes to fibrinolysis shutdown.

**Figure 1. Citrated native thrombelastography tracing in absence (green) and presence (white) of actin.**



**Table 1. Changes in thrombelastography in the presence of actin, presented as median and interquartile ranges (IQR).**

|                  | Whole blood      | Whole blood + actin | p value |
|------------------|------------------|---------------------|---------|
| <b>R (min)</b>   | 8.3 (8.0-10.1)   | 7.6 (5.7-9.6)       | 0.22    |
| <b>Angle (o)</b> | 40.0 (37.0-49.0) | 52.9 (42.4-61.0)    | 0.002   |
| <b>MA (mm)</b>   | 63.5 (60.4-67.5) | 63.5 (53.0-69.1)    | 0.52    |
| <b>LY30 (%)</b>  | 4.0 (3.2-7.0)    | 1.6 (0.2-3.7)       | 0.002   |

R=reaction time, MA=maximum amplitude, LY30=fibrinolysis 30 minutes after MA

## Scientific Session III-A - EAST Multicenter Trials

Paper #11  
January 16, 2020  
1:45 pm

### COLORECTAL RESECTION IN EGS: AN EAST MCT

Brittany Aicher, MD\*, Alejandro Betancourt-Ramirez, MD, FACS\*, Michael D. Grossman, MD\*, Holly Heise, MSN, Thomas J. Schroepel, MD\*, Matthew C. Hernandez, MD, Martin D. Zielinski, MD, FACS\*, Napaporn Kongkaewpaisan, MD, Haytham Kaafarani, MD, MPH\*, Afton Wagner, Daniel J. Grabo, MD, FACS\*, Michael T. Scott, MD, Gregory L. Peck, DO\*, Gloria Chang, Kazuhide Matsushima, MD\*, Laura M. Cullinane, Daniel C. Cullinane, MD\*, Benjamin W. Stocker, BS, Joseph Posluszny, MD\*, Ursula J. Simonoski, BS, Richard D. Catalano, MD\*, Georgia Vasileiou, D. Dante Yeh, MD, FACS, FCCM\*, Vaidehi Agrawal, PhD, Michael Truitt, MD\*, MaryAnne Pickett, MD, Linda Dultz, MD, MPH\*, Alison Muller, Adrian W. Ong, MD\*, Janika L. San Roman, MPH, Oliver Fackelmayer, MD, Catherine Velopulos, MD, MHS, FACS\*, Cheralyn Hendrix, MD, Jordan Estroff, MD\*, Sahil Gambhir, Kokila Jeyamurugan, Nikolay Bugaev, MD\*, Victor Portillo, MD, FACS\*, Matthew M. Carrick, MD\*, Lindsay O'Meara, CRNP\*, Joseph A. Kufera, MA, Brandon R. Bruns, MD, FACS\*  
University of Maryland

**Presenter:** Brittany Aicher, MD

**Discussant:** Amy Rushing, MD, Ohio State University

**Objectives:** Evidence for stoma (STM) or anastomosis (ANST) after urgent/emergent colorectal resection is limited. This study examined outcomes after colorectal resection in emergency general surgery patients.

**Methods:** This was an EAST-sponsored prospective observational multicenter study of patients undergoing urgent/emergent colorectal resection. 21 centers enrolled patients over 11-months. Preoperative, intraoperative and postoperative variables were recorded. Chi-square, Mann-Whitney U-test, and multivariable logistic regression models were used to describe outcomes and risk factors for surgical complication or mortality.

**Results:** 439 patients were enrolled (184 ANST, 255 STM). Median (IQR) age was 62 (53-71), median Charlson Comorbidity Index (CCI) was 4 (1-6). The most common indication for surgery was diverticulitis (28%). STM group was older, had a higher CCI and more likely to be immunosuppressed. Preoperatively STM patients were more likely to be intubated, on vasopressors, have pneumoperitoneum, leukocytosis or elevated lactate. Overall mortality was 13%, which was higher in STM patients (18 vs. 8%,  $p=0.02$ ). 35% of STM patients developed a surgical complication vs. 25% of ANST patients ( $p=0.02$ ) (Table 1). On multivariable analysis, management with an open abdomen, intraoperative blood transfusion and larger hospital size were associated with development of a surgical complication while CCI, preoperative vasopressor use, steroid use, open abdomen and intraoperative blood transfusion were independently associated with mortality (Table 2).

**Conclusions:** This study highlights a tendency to perform fecal diversion in patients that are acutely ill at presentation. The morbidity/mortality rate is higher in STM patients. Independent predictors of mortality include CCI, preoperative vasopressor use, steroid use, open abdomen and intraoperative blood transfusion. Following adjustment by clinical factors, method of colon management was not associated with surgical complication or mortality.

**Table 1:** Preoperative, intraoperative, and postoperative patient variables.

|  | All<br>439       | Anastomosis <sup>1</sup><br>184 (41.9) | Stoma <sup>2</sup><br>255 (58.1) | p value*            |
|--|------------------|--|----------------------------------|---------------------|
| <b>Demographics, comorbidities</b>                     |                  |  |                                  |                     |
| Female sex   | 210 (47.8)       | 80 (43.5)                              | 130 (51.0)                       | 0.12                |
| Age, y <sup>†</sup>                                    | 62 (53-71)       | 58 (46-69)                             | 64 (56-73)                       | <0.001 <sup>‡</sup> |
| Charlson Comorbidity Index                             |                  |  |                                  |                     |
| 0  | 60 (13.7)        | 39 (21.2)                              | 21 (8.2)                         |                     |
| 1  | 53 (12.1)        | 28 (15.2)                              | 25 (9.8)                         |                     |
| 2  | 64 (14.6)        | 32 (17.4)                              | 32 (12.5)                        |                     |
| 3  | 36 (8.2)         | 13 (7.1)                               | 23 (9.0)                         |                     |
| 4  | 68 (15.5)        | 17 (9.2)                               | 51 (20.0)                        |                     |
| 5 or more  | 158 (36.0)       | 55 (29.9)                              | 103 (40.4)                       | <0.001              |
| Steroids   | 51 (11.6)        | 10 (5.4)                               | 41 (16.1)                        | <0.001              |
| Other immunosuppressant                                | 25 (5.7)         | 4 (2.2)                                | 21 (8.2)                         | 0.007               |
| <b>Preoperative exam and laboratory value</b>          |                  |  |                                  |                     |
| Continuous vasopressor infusion                        | 74 (16.9)        | 13 (7.1)                               | 61 (23.9)                        | <0.001              |
| Intubated  | 72 (16.4)        | 15 (8.2)                               | 57 (22.4)                        | <0.001              |
| Pneumoperitoneum                                       | 172 (39.2)       | 41 (22.3)                              | 131 (51.4)                       | <0.001              |
| Lactate >1.5 (n=131,214)                               | 216 (62.6)       | 67 (51.2)                              | 149 (69.6)                       | <0.001              |
| Hgb, g/dL <sup>†</sup> (n=184,254)                     | 12.3 (10.0-14.2) | 12.8 (10.9-14.7)                       | 11.9 (9.5-14.0)                  | 0.002 <sup>‡</sup>  |
| WBC count, /μL <sup>†</sup> (n=184,254)                | 12.4 (8.8-18.1)  | 11.9 (9.0-17.0)                        | 13.1 (8.4-18.7)                  | 0.37 <sup>‡</sup>   |
| <b>Surgical complications</b>                          |                  |  |                                  |                     |
| Surgical site infection                                |                  |  |                                  |                     |
| Superficial  | 34 (7.7)         | 18 (9.8)                               | 16 (6.3)                         | 0.17                |
| Deep   | 17 (3.9)         | 5 (2.7)                                | 12 (4.7)                         | 0.29                |
| Organ  | 62 (14.1)        | 13 (7.1)                               | 49 (19.2)                        | <0.001              |
| Anastomotic dehiscence                                 | 28 (6.4)         | 21 (11.4)                              | 7 (2.7)                          | <0.001              |
| Enterocutaneous or atmospheric fistula                 | 8 (1.8)          | 5 (2.7)                                | 3 (1.2)                          | 0.29                |
| Bowel obstruction requiring surgery                    | 1 (0.2)          | 0 (0.0)                                | 1 (0.4)                          | 1.00                |
| Stoma complication requiring surgery                   | 16 (3.6)         | 0 (0.0)                                | 16 (6.3)                         | <0.001              |
| Fascial dehiscence                                     | 22 (5.0)         | 6 (3.3)                                | 16 (6.3)                         | 0.16                |
| ≥1 of the above complications                          | 133 (30.3)       | 45 (24.5)                              | 88 (34.5)                        | 0.02                |
| Need for unplanned intervention for above complication | 97 (22.1)        | 30 (16.3)                              | 67 (26.3)                        | 0.01                |
| Surgical drain   |                  |  |                                  |                     |
| Surgical   | 41 (9.3)         | 17 (9.2)                               | 24 (9.4)                         | 0.71                |
| Percutaneous drain                                     | 22 (5.0)         | 2 (1.1)                                | 20 (7.8)                         | 0.001               |
| Surgical and percutaneous drain                        | 34 (7.7)         | 11 (6.0)                               | 23 (9.0)                         | 0.24                |
| <b>Discharge</b>                                       |                  |  |                                  |                     |
| Hospital length of stay                                | 13 (8-22)        | 10 (6-16)                              | 15 (10-25)                       | <0.001 <sup>‡</sup> |
| Deceased   | 59 (13.4)        | 14 (7.6)                               | 45 (17.6)                        | <0.001              |

<sup>1</sup>Anastomosis: bowel resection with primary anastomosis; <sup>2</sup>Stoma: bowel resection with an end ostomy  
 Data presented as n (%), unless otherwise indicated. (n=x,y), indicates the number of variables available for analysis in each group if other than 184, 255. NSAID, non-steroidal anti-inflammatory drug; Other immunosuppressant includes tacrolimus, methotrexate, highly-active antiretroviral therapy, azathioprine, mycophenolic acid, keflunomide, hydroxychloroquine, and azathioprine; bpm, beats per minute; Cr, creatinine; Hgb, hemoglobin; WBC, white blood cell. \*  $\chi^2$  tests were used unless otherwise indicated. † Values are median (IQR). ‡ Mann-Whitney U test.

**Table 2:** Multivariable logistic regression model for at least one surgical complication and mortality in patients undergoing urgent or emergent colorectal resection

|                                  | At least one surgical complication* |           |         | Mortality  |           |         |
|----------------------------------|-------------------------------------|-----------|---------|------------|-----------|---------|
|                                  | Odds Ratio                          | 95% CI    | P value | Odds Ratio | 95% CI    | P value |
| Stoma (vs. anastomosis)          | 1.28                                | 0.79-2.08 | 0.32    | 1.42       | 0.67-3.03 | 0.36    |
| CCI                              | 0.97                                | 0.88-1.08 | 0.62    | 1.46       | 1.06-2.02 | 0.02    |
| Preoperative vasopressor         | 1.22                                | 0.62-2.41 | 0.57    | 3.07       | 1.35-6.97 | 0.007   |
| Preoperative respiratory failure | 0.64                                | 0.31-1.31 | 0.22    | 1.32       | 0.54-3.20 | 0.54    |
| Pneumoperitoneum                 | 1.25                                | 0.77-2.03 | 0.36    | 0.66       | 0.32-1.34 | 0.25    |
| Open abdomen                     | 2.07                                | 1.24-3.46 | 0.006   | 2.62       | 1.30-5.29 | 0.007   |
| Steroid use                      | 0.77                                | 0.39-1.51 | 0.44    | 3.02       | 1.26-7.20 | 0.01    |
| Intraoperative PRBC transfusion  | 2.03                                | 1.20-3.42 | 0.008   | 2.29       | 1.17-4.47 | 0.02    |
| Diverticulitis                   | 1.40                                | 0.82-2.41 | 0.22    | 0.42       | 0.15-1.18 | 0.10    |
| Hospital size                    | 1.82                                | 1.11-2.96 | 0.02    | 0.60       | 0.28-1.25 | 0.17    |

\*Surgical complications include: surgical site infection, anastomotic dehiscence, enterocutaneous or atmospheric fistula, bowel obstruction requiring surgery, stoma complication requiring surgery, and fascial dehiscence.

CI: confidence interval, CCI: Charlson comorbidity index, PRBC: packed red blood cell

Hosmer-Lemeshow test: Complication -  $\chi^2 = 7.29$ ,  $df = 8$ ,  $p = 0.51$ ; Mortality -  $\chi^2 = 6.53$ ,  $df = 8$ ,  $p = 0.59$

Scientific Session III-A - EAST Multicenter Trials

Paper #12  
January 16, 2020  
2:05 pm

TEMPORARY INTRAVASCULAR SHUNTS AFTER CIVILIAN ARTERIAL INJURY: A  
PROSPECTIVE, MULTICENTER EAST STUDY

Lily Tung, MD\*, Jennifer Leonard, MD, PhD\*, Ryan A. Lawless, MD\*,  
Alexis Cralley, MD, Richard Betzold, MD\*, Jason D. Pasley, DO, FACS\*, Kenji Inaba, MD,  
Jennie S. Kim, MD, Dennis Y. Kim, MD, FRCSC, FACS, FCCP\*, Kwang Kim,  
Brad Dennis, MD, FACS\*, Michael C. Smith, MD\*, Margaret Moore, MD\*,  
Christina Tran, Joshua P. Hazelton, DO, FACS\*, Atlee Melillo, MD,  
Tejal S. Brahmhatt, MD, FACS\*, Stephanie Talutis, MD, MPH,  
Noelle Saillant, MD\*, Jae Moo Lee, BS, Mark J. Seamon, MD, FACS\*  
University of Pennsylvania

**Presenter:** Lily Tung, MD

**Discussant:** David Skarupa, MD, UFCOM & UF Health Jacksonville

**Objectives:** Prior civilian temporary intravascular shunt (TIVS) reports have provided limited, conflicting, retrospective data regarding the shunt dwell time (SDT) and shunt outcomes relationship. We sought to definitively determine the impact of SDT on shunt related outcomes after major arterial injuries.

**Methods:** A prospective, multicenter study (11 centers) of trauma patients undergoing TIVS following arterial injury was undertaken (2017-2019). Exclusion criteria included age <15yrs, TIVS distal to popliteal/brachial arteries and death before TIVS removal. Clinical variables and outcomes were compared by SDT. The primary endpoint was TIVS complications (thrombosis, migration, distal ischemia). Power analysis based on our prior retrospective data (=6hrs SDT 0% vs >6hrs SDT 30% shunt complications) demonstrated 56 study patients yields 90% power ( $p=0.05$ ).

**Results:** The 67 patients who underwent TIVS were primarily young (med[IQR] 30[22-36] yrs), males (85%), severely injured (ISS 19[10-25]) by penetrating means (60%) and had Argyle (58%) TIVS for extremity (82%) injuries. Compared by SDT (=6hrs [n=42] vs >6hrs [n=25]), there were no differences in age, mechanism, injury location, tourniquet use, extremity AIS, MESS, fractures or surgeon specialty between groups (all  $p>0.05$ ). >6hrs (900[600-1440] min) TIVS patients had more severe injuries (ISS 25 vs 14, SBP 102 vs 129, GCS 10 vs 15, associated vein 76% vs 36%; all  $p<0.05$ ) and more frequent shunt complication predictors (**Table**) than =6hrs (120[57-181] min) patients, yet prolonged SDT did *not* correlate with TIVS complications (**Figure**). Shunt complication patients (9%) were discharged home less often (33% vs 64%;  $p=0.003$ ) but all survived.

**Conclusions:** Prolonged SDT did not lead to shunt complications in this prospective, multicenter study. Our results suggest that SDT should be determined by overall clinical condition rather than concern for shunt complications.

**Table: Clinical Variables Typically Associated with TIVS Complications**

|                                 | SDT ≤6hrs<br>(n=42) | SDT >6hrs<br>(n=25) | <i>p</i> value |
|---------------------------------|---------------------|---------------------|----------------|
| Shunt size (Fr)                 | 9 (8-12)            | 12 (10-14)          | <0.001         |
| Hypotension during SDT          | 5%                  | 48%                 | <0.001         |
| Vasopressors during SDT         | 21%                 | 60%                 | 0.003          |
| CPR during SDT                  | 7%                  | 20%                 | 0.138          |
| Compartment syndrome during SDT | 10%                 | 8%                  | 1.00           |
| Anticoagulation during SDT      | 55%                 | 16%                 | 0.002          |

TIVS = temporary intravascular shunts; SDT = shunt dwell time; median (IQR)

Table: Clinical Variables Typically Associated with TIVS Complications

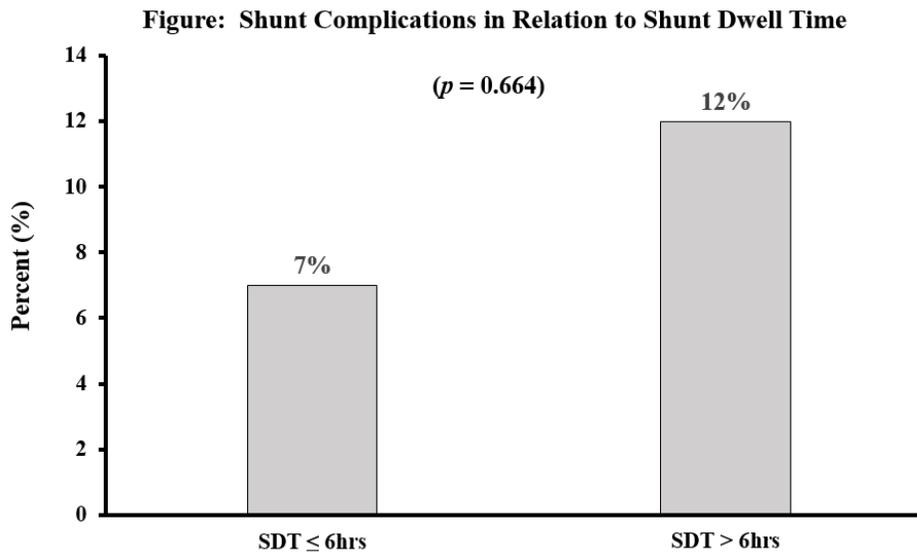


Figure: Shunt Complications in Relation to Shunt Dwell Time

Scientific Session III-A - EAST Multicenter Trials

Paper #13  
January 16, 2020  
2:25 pm

**ASSOCIATION OF TXA WITH VENOUS THROMBOEMBOLISM IN BLEEDING TRAUMA PATIENTS: AN EAST MULTICENTER STUDY**

Lisbi Rivas, MD\*, Babak Sarani, MD, FACS, FCCM\*, Jordan Estroff, MD\*, Andrew Sparks, MS, Kristen Carter, MD, Matthew E. Kutcher, MD\*, Areg Grigorian, MD, Jeffrey Nahmias, MD, MHPE, FACS\*, Spencer Albertson, MD, Juan Quispe, MD, Xian Luo-Owen, PhD, David Turay, MD, PhD\*, Michael Vella, MD\*, Gabriella Tortorello, MD, Jose L. Pascual, MD, PhD, FRCS(C), FACS, FCCM\*, McKell Quattrone, BS, Andrew C. Bernard, MD, FACS\*, Alice Lee, DO, Danielle Tamburrini, DO, Asanthi Ratnasekera, DO, FACOS\*, Kelly Harrell, BS, Carlos J. Rodriguez, DO, MBA, FACS\*, Kokila Jeyamurugan, Nikolay Bugaev, MD\*, Jason Weinberger, DO\*, Anne Warner, MD\*, Joshua P. Hazelton, DO, FACS\*, Miriam Selevany, BS, Janika L. San Roman, MPH, Franklin Lee Wright, MD\*, Shane Urban, RN, Alexandra Kovar, MD, Amy Hamrick, MSN, Michael G. Mount, DO\*, Matthew M. Carrick, MD\*, Daniel C. Cullinane, MD\*, Grace Chang, MD\*, Gary Jain, MD, M. Chance Spalding, DO, PhD\*  
George Washington University

**Presenter:** Lisbi Rivas, MD

**Discussant:** Mark Hoofnagle, MD, PhD, Washington University School of Medicine

**Objectives:** Tranexamic acid (TXA) is an anti-fibrinolytic agent that lowers mortality in bleeding trauma patients. There are conflicting results reported regarding the association between TXA administration for hemorrhagic shock and subsequent venous thromboembolism (VTE). We hypothesized that TXA is not associated with VTE.

**Methods:** A retrospective study was performed in 15 hospitals. Inclusion criteria were: age > 18 years old and need for > 5 units of blood (PRBC) within 24 hours of injury. Exclusion criteria included: death within 24 hours, pregnancy, interfacility transfer, pre-injury use of anticoagulants, TXA administration > 3 hours after injury, and asymptomatic duplex VTE surveillance. Patients were divided into 2 cohorts based on receiving TXA. Incidence of VTE was the primary outcome. Secondary outcomes included myocardial infarction (MI), stroke (CVA), length of stay (LOS), and death. Univariate analysis was performed using Chi-Square, Fisher's exact test, independent samples t-test, and Mann-Whitney U test. Resulting comparisons with  $P < 0.2$  were entered into a multivariable model. A power analysis using expected VTE rates found that 830 patients were needed.

**Results:** 1,333 patients were enrolled; 887 (67%) received TXA. Patients who received TXA were more likely to be female, sustain blunt force injury, have a lower injury severity score, and to receive VTE prophylaxis (table 1). There were no clinically significant differences in coagulation profile. The TXA cohort had significantly lower mortality (17% v 34%) and required less blood product transfusion (table 2). VTE rate was lower in the TXA group (10% v 16%,  $p = 0.001$ ), but no difference was noted on multivariate analysis ( $p = 0.21$ ). There was no difference in incidence of CVA or MI.

**Conclusions:** There is no association between TXA and VTE but use of TXA is associated with decreased transfusion need and lower mortality following injury.

**Table 1 Patient Demographics**

| Variable              | No TXA (n=446) | TXA (n=887) | p-value |
|-----------------------|----------------|-------------|---------|
| Age                   | 40.3 ± 18.2    | 41.0 ± 18.1 | 0.3823  |
| Female                | 85 (19.1)      | 407 (45.9)  | <0.0001 |
| Blunt Injury          | 254 (57%)      | 654 (74%)   | <0.0001 |
| Injury severity score | 27 (17, 38)    | 25 (16, 34) | <0.0001 |
| VTE prophylaxis given | 266 (60%)      | 713 (80%)   | <0.0001 |

Reported as # (%), mean ± standard deviation, or median (interquartile range)

**Table 2 Multivariate Adjusted Outcomes**

| Variable                       | No TXA (n=446) | TXA (n=887) | Adjusted Odds Ratio (95% Confidence Interval) | p-value |
|--------------------------------|----------------|-------------|---|---------|
| VTE                            | 70 (16%)       | 86 (10%)    | 0.78 (0.53 – 1.15)                            | 0.2105  |
| Mortality                      | 150 (34%)      | 153 (17%)   | 0.67 (0.45 – 0.98)                            | 0.0365  |
| MI                             | 4 (0.9%)       | 7 (0.8%)    | 1.11 (0.31 – 3.94)                            | 0.8772  |
| CVA                            | 11 (2.5%)      | 13 (1.5%)   | 0.76 (0.31 – 1.91)                            | 0.5649  |
| Packed Red Blood Cells (units) | 11 (7, 16)     | 8 (2, 17)   | N/A   | <0.0001 |
| Plasma (units)                 | 7 (3, 12)      | 4 (0, 11)   | N/A   | <0.0001 |
| Platelets (units)              | 2 (1, 3)       | 1 (0, 3)    | N/A   | 0.0011  |

Reported as # (%) or median (interquartile range); aOR=Adjusted Odds Ratio; N/A=Not Applicable for continuous outcome. Adjusted for: gender, heart rate, mechanism, ISS, VTE prophylaxis, missed doses, co-morbid conditions

## Scientific Session III-A – EAST Multicenter Trials

Paper #14  
January 16, 2020  
2:45 pm

### TIMING AND VOLUME OF CRYSTALLOID AND BLOOD PRODUCTS IN PEDIATRIC TRAUMA: AN EAST PROSPECTIVE MULTICENTER STUDY

Stephanie F. Polites, MD, MPH, Suzanne Moody, MPA, Regan Williams, MD, MSE\*, Mark L. Kayton, MD\*, Thomas J. Schroepel, MD\*, William Rothstein, MD, Joanne Baerg, MD, FACS, Rachel M. Nygaard, PhD, Cynthia Greenwell, BSN, RN, Alicia Waters, MD, Jeffrey Pence, MD, FACS, Matthew Santore, MD, FACS, FAAP, John Petty, MD\*, Brian K. Yorkgitis, DO, FACS\*, Eric M. Campion, MD\*, Denise Garcia, MD, MEd, Taleen MacArthur, MD, Christa Black, MPH, Shawn Safford, MD, MAS\*, Jessica Rae, MD, Bethany Farr, MD, Anna Goldenberg-Sandau, DO\*, Emily Alberto, MD, Bavana Ketha, MD, Carrie Laituri, MD\*, Megan Cunningham, MD, Todd Jenkins, PhD, Richard A. Falcone, Jr., MD, MPH\*  
Cincinnati Children's Hospital Medical Center

**Presenter:** Stephanie F. Polites, MD, MPH

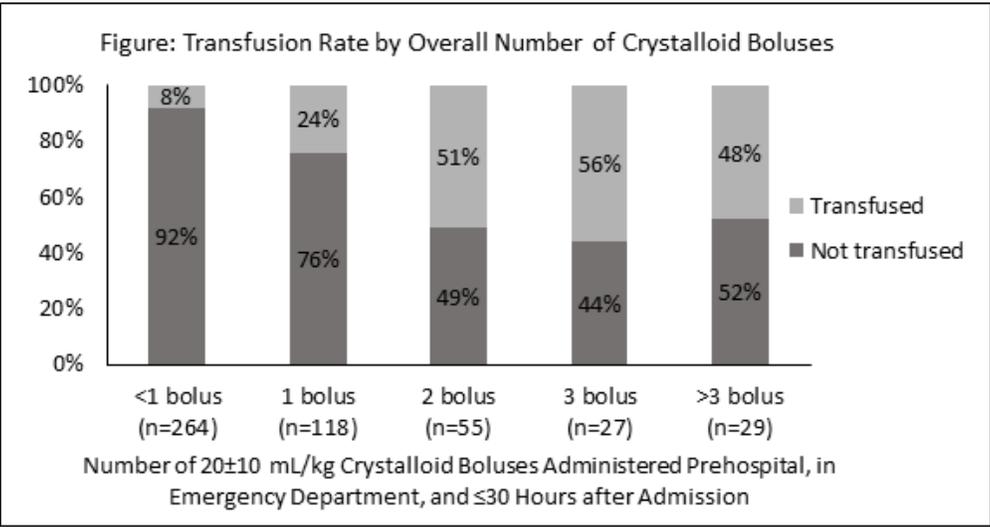
**Discussant:** Terri Elsbernd, MS, RN, CEN, CPEN, Mayo Clinic

**Objectives:** The purpose of this study was to determine the relationship between timing and volume of resuscitative fluids and mortality in pediatric trauma, hypothesizing that earlier transfusion and decreased crystalloid would be associated with improved outcomes.

**Methods:** A prospective observational study of patients <18 years who presented with elevated age-adjusted shock index from scene of injury was performed 3/2018-6/2019. Prehospital, ED, and initial admission resuscitation was assessed including calculation of  $20 \pm 10$  mL/kg crystalloid boluses. Factors significant on univariate analyses were included in multivariable cox proportional hazards and logistic regression models for hospital mortality and extended intensive care, ventilator, and hospital days ( $\geq 90$ th percentile).

**Results:** In 493 children at 25 trauma centers, median (IQR) age was 7 (2-13) years, ISS 9 (2-22), and mortality 6%. Of 229 (47%) patients who received  $\geq 1$  crystalloid bolus, 102 (21%) received blood including 52 (11%) with massive transfusion activation. The transfusion rate plateaued after the first bolus (Figure). Patients who received blood first had shorter median time to transfusion (15 vs 79 minutes,  $p < .001$ ) and less total crystalloid (19 vs 37 mL/kg,  $p = .012$ ) than those who received crystalloid first ( $n = 67$ ) despite similar ISS (median 25 vs 26,  $p = .29$ ). On multivariable analysis there was no association of resuscitation characteristics with mortality however  $< 1$  crystalloid bolus prior to transfusion had decreased odds of extended ventilator and hospital days (Table).

**Conclusions:** Resuscitation with  $> 1$  crystalloid bolus was not associated with decreased transfusion or improved outcomes but rather increased ventilator duration and hospital stay in this study. These data support a crystalloid-sparing, early transfusion approach for injured children who require resuscitation though low event rates necessitate further study.



**Table: Cox Proportional Hazards and Logistic Regression Analysis of Key Outcomes**

| Factor Significant on Univariate Analysis (p<.05)                    | Mortality                        | Extended (>4) Ventilator Days<br>R <sup>2</sup> =0.85 | Extended (>9) ICU Days<br>R <sup>2</sup> =0.92 | Extended Hospital Days (<14)<br>R <sup>2</sup> =0.76 |                                   |
|--|----------------------------------|---|--|--|-----------------------------------|
| <b>Blunt vs penetrating injury</b>                                   | HR=0.77<br>(0.20-2.93)<br>P=.70  | OR=2.13<br>(0.30-15.40)<br>P=.45                      | OR=18.02<br>(1.00-324.05)<br>P=.049            | OR=2.57<br>(0.68-9.90)<br>P=.17                      |                                   |
| <b>ISS (per unit increase)</b>                                       | HR=1.04<br>(1.00-1.08)<br>p=.040 | OR=1.09<br>(1.01-1.17)<br>P=.014                      | OR=1.14<br>(1.03-1.25)<br>P=.002               | OR=1.03<br>(0.99-1.07)<br>P=.45                      |                                   |
| <b>Number of crystalloid boluses prior to transfusion (vs &lt;1)</b> | <b>1</b>                         | HR=0.72<br>(0.19-2.73)<br>P=.63                       | OR=2.88<br>(0.35-23.65)<br>P=.32               | OR=1.06<br>(0.12-9.06)<br>P=.96                      | OR=2.09<br>(0.49-8.84)<br>P=.32   |
|  | <b>2</b>                         | HR=0.31<br>(0.4-2.58)<br>P=.28                        | OR=10.22<br>(1.42-73.37)<br>P=.021             | OR=3.63<br>(0.42-31.46)<br>P=.24                     | OR=5.34<br>(1.17-24.41)<br>P=.031 |
|  | <b>3</b>                         | *   | OR=1.82<br>(0.09-35.15)<br>P=.69               | *  | OR=4.08<br>(0.29-57.52)<br>P=.30  |
|  | <b>&gt;3</b>                     | HR=2.14<br>(0.20-22.84)<br>P=.53                      | OR=14.96<br>(0.30-756.41)<br>P=.18             | OR=129.17<br>(0.73-22699.41)<br>P=.07                | OR=7.00<br>(0.37-131.59)<br>P=.19 |

Preexisting comorbidity, time from injury to hospital arrival, and time from hospital arrival to transfusion were independent variables in all four models and p>.05 for all outcomes. \*Few (n=18) patients received 3 crystalloid boluses prior to transfusion.

## Scientific Session III-A – EAST Multicenter Trials

Paper #15  
January 16, 2020  
3:05 pm

### PROSPECTIVE VALIDATION OF THE EMERGENCY SURGERY SCORE (ESS) IN EMERGENCY GENERAL SURGERY: AN EAST MULTICENTER STUDY

Haytham Kaafarani, MD, MPH\*, Napaporn Kongkaewpaisan, M.D., Brittany Aicher, MD\*, Jose J. Diaz, MD\*, Lindsay O'Meara, CRNP\*, Cassandra Decker, BA, Jennifer Rodriguez, CRC, Thomas J. Schroepfel, MD\*, Rishi Rattan, MD\*, Georgia Vasileiou, D. Dante Yeh, MD, FACS, FCCM\*, Ursula J. Simonoski, BS, David Turay, MD, PhD\*, Daniel C. Cullinane, MD\*, Emmert Cory, DO, Marta McCrum, MD, MPH\*, Natalie Wall, BS, Jeremy Badach, MD, Anna Goldenberg-Sandau, DO\*, Heather E. Carmichael, MD, Catherine Velopulos, MD, MHS, FACS\*, Rachel L. Choron, MD\*, Joseph V. Sakran, MD, MPH, MPA, FACS\*, Khaldoun Bekdache, MD\*, George Black, MD, Thomas Shoultz, MD\*, Zachary Chadnick, MD, Vasilii Sim, MD\*, Firas G. Madbak, MD, FACS\*, Daniel A. Steadman, DO, Maraya N. Camazine, BS, Martin D. Zielinski, MD, FACS\*, Claire Hardman, BSN, Mbaga S. Walusimbi, MD\*, Mirhee Kim, BA, Simon Rodier, MD, Vasileios N. Papadopoulos, MD, Georgios Tsoulfas, MD, J. Martin Perez, MD\*, George Velmahos, MD, PhD, MEd  
Massachusetts General Hospital

**Presenter:** Haytham Kaafarani, MD, MPH

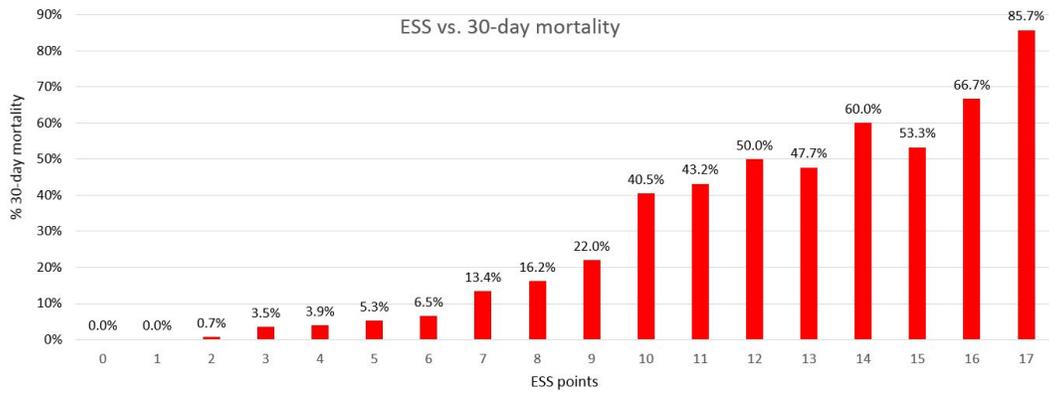
**Discussant:** Linda Dultz, MD, MPH, UTSW Parkland Hospital

**Objectives:** The Emergency Surgery Score (ESS) was recently created and retrospectively validated as an accurate mortality risk calculator for Emergency General Surgery (EGS). We sought to *prospectively* validate ESS, specifically in the high-risk emergency laparotomy (EL) patient.

**Methods:** This is an EAST multicenter prospective observational study. Between April 2018 and May 2019, 19 centers enrolled all patients older than 18 undergoing EL. Preoperative, intraoperative and postoperative variables were prospectively and systematically collected. ESS was calculated for each patient. ESS was validated using the c-statistic methodology by correlating it with three 30-day postoperative outcomes: 1) mortality, 2) complications (e.g. respiratory/renal failure, infection), and 3) ICU admission.

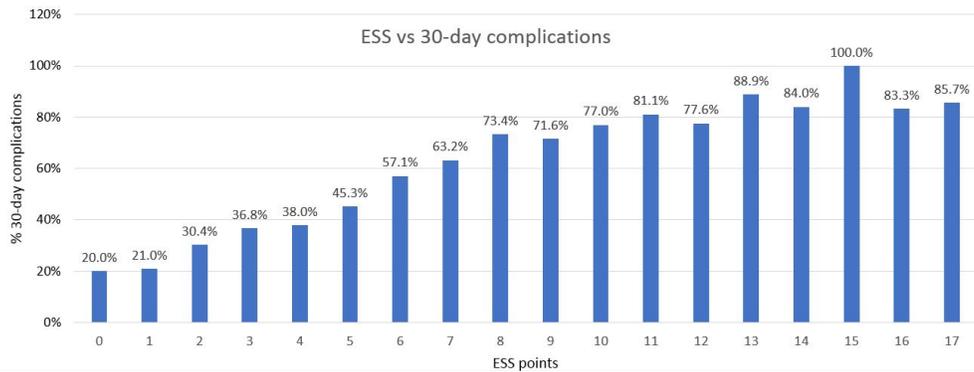
**Results:** A total of 1,646 patients were included. The mean age was 60.5 years, 50.3% were female, and 71.4% were white. The mean and median ESS were 6, and the most common indication for EL was hollow viscus perforation (29.5%). The 30-day mortality, complication and ICU admission rates were 14.8%, 53.3% and 57.0%, respectively. ESS gradually and accurately predicted 30-day mortality; 3.5%, 50.0% and 85.7% of patients with an ESS of 3, 12 and 17 died after surgery, respectively (Figure 1, c-statistic 0.85). Similarly, ESS gradually and accurately predicted complications; 21.0%, 57.1% and 88.9% of patients with an ESS of 1, 6 and 13 developed postoperative complications, respectively (Figure 2, c-statistic 0.74). ESS also accurately predicted which patients required ICU admission (c-statistic 0.80).

**Conclusions:** This is the first prospective multicenter study to validate ESS as an accurate predictor of outcome in the EL patient. ESS can prove useful for 1) perioperative patient and family counseling, 2) triaging patients to the ICU and 3) benchmarking the quality of EGS care.



**ESS Points:**  
 Age>60 years...2 Albumin<3.0...1 Alkaline phosphatase>125...1 Ascites...1 Body mass index<20...1 BUN>40...1 History of COPD...1 Creatinine>1.2...2 Disseminated cancer...3 Dyspnea...1  
 Functional dependence...1 Hypertension...1 INR>1.5...1 Platelets<150...1 SGOT>40...1 Sodium>145...1 Steroid use...1 Transfer from outside ED or acute care hospital...1 Ventilator requirement  
 48 hours pre-operatively...3 WBC<4,500 or 15,000-25,000...1 WBC>25,000...2 White race...1 >10% weight loss in last 6 months...1

Figure1: ESS vs. 30-day mortality



**ESS Points:**  
 Age>60 years...2 Albumin<3.0...1 Alkaline phosphatase>125...1 Ascites...1 Body mass index<20...1 BUN>40...1 History of COPD...1 Creatinine>1.2...2 Disseminated cancer...3 Dyspnea...1  
 Functional dependence...1 Hypertension...1 INR>1.5...1 Platelets<150...1 SGOT>40...1 Sodium>145...1 Steroid use...1 Transfer from outside ED or acute care hospital...1 Ventilator requirement  
 48 hours pre-operatively...3 WBC<4,500 or 15,000-25,000...1 WBC>25,000...2 White race...1 >10% weight loss in last 6 months...1

Figure2: ESS vs. 30-day complications

## Scientific Session III-A – EAST Multicenter Trials

Paper #16  
January 16, 2020  
3:25 pm

### **DELIRIUM AND USE OF REGIONAL ANALGESIA TECHNIQUES IN OLDER ADULTS WITH MULTIPLE RIB FRACTURES: AN EAST MULTICENTER STUDY**

Kathleen M. O'Connell, MD\*, Kushang Patel, PhD, MPH, Elisabeth Powelson, MD, MSc, Bryce R.H. Robinson, MD, MS, FACS, FCCM\*, Marta McCrum, MD, MPH\*, Jacob Peschman, MD\*, Kelly Boyle, MD, Jessica Ballou, MD, Joshua Judge, MD\*, Justin Leavitt, Shannon Greenberg, MD, Ethan Blocher-Smith, MS, DO, Kaushik Mukherjee, MD MSCI FACS\*, Lewis E. Jacobson, MD, FACS\*, Karen Brasel, MD, Monica Vavilala, MD, Frederick Rivara, MD, MPH, Saman Arbabi, MD, MPH\*  
University of Washington

**Presenter:** Kathleen M. O'Connell, MD

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

**Objectives:** Single center data demonstrated that regional analgesia (RA) techniques reduce risk of delirium in older patients with multiple rib fractures. We sought to investigate this association in a multicenter patient population.

**Methods:** Data from 7 Level-I trauma centers were collected for patients  $\geq 65$  years old, admitted to an ICU, with  $\geq 3$  rib fractures from 1/2012-12/2016. Those with a head and/or spine injury AIS  $\geq 3$ , or a history of dementia were excluded. Delirium was defined as one positive Confusion Assessment Method for the ICU score in the first 7 days of ICU care. Poisson regression with robust standard errors was used to determine the association of RA (thoracic epidural or paravertebral catheter) with delirium incidence.

**Results:** Data of 602 patients were analyzed with the median age= $75$  years [IQR= $69-83$ ], ISS= $14$  [11-19], and ICU LOS= $3$  days [2-6]. 38.7% of patients were women, 15.6% were non-white, and 32.7% required a chest tube. RA was used in 23.4% patients. Patient characteristics did not differ by RA use, however, ICU LOS was longer ( $P < 0.001$ ) and chest tube placement was more common ( $P < 0.001$ ) in those who had RA. Delirium was more common in patients who had RA (32.1% vs. 23.4% without,  $P = 0.04$ ); however, RA use was not associated with delirium after adjusting for age, ISS, ICU LOS, and chest tube placement (IRR= $1.15$ ; 95% CI: 0.81-1.65). RA use was not associated with mortality, ICU readmission, or respiratory complications. Multivariable adjustment and propensity score matching models (RA vs. no RA) yielded similar results.

**Conclusions:** In this multicenter cohort of injured older adults with multiple rib fractures, regional analgesia use was not associated with lower risk of delirium or other short-term adverse outcomes. Further studies are needed to standardize protocols for optimal pain management and prevention of delirium in older adults with severe thoracic injury.

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #17  
January 16, 2020  
1:45 pm

**SURVIVORS OF GUN VIOLENCE AND THE EXPERIENCE OF RECOVERY: UNDERSERVED, UNDERDIAGNOSED, AND UNDERTREATED COMMUNITIES**

Kathleen O'Neill, MD, Leonard Jahad, BA, Cecilio Vega, AD,  
Pina Violano, PhD, MSPH, RN-BC, CCRN, CPS-T\*, Sidney Saint-Hilaire,  
Marjorie Rosenthal, MD, MPH, Adrian A. Maung, MD, FACS, FCCM\*,  
Robert D. Becher, MD, MS, James Dodington, MD  
Yale-New Haven Hospital

**Presenter:** Kathleen O'Neill, MD

**Discussant:** Sarah Mattocks, MSN, FNP-C, UPMC Hamot

**Objectives:** Survivors of gun violence may develop significant mental health disorders and are at high risk for re-injury through repeat violence. Despite this, survivors of violent crimes often return to the community without evaluation of their mental health and with little support during recovery. We sought to understand and assess the post-hospitalization recovery experience of gunshot survivors.

**Methods:** We used a qualitative research study design and a community-based participatory research approach. Partnering with a community-based organization, we developed a semi-structured interview guide for in-depth one-on-one interviews. We used the snowball sampling method for recruitment. Using the constant comparison method of qualitative analysis, we catalogued interview transcript data by assigning conceptual codes and organizing them into a consensus list of themes. We presented the themes back to participants and community members for confirmation.

**Results:** We conducted 20 interviews with survivors of gun violence; all were Black males, aged 20 to 51 years. Five recurring themes emerged: (1) Isolation: physical and social restriction due to fear of their surroundings; (2) Protection: a disrupted sense of safety leading to maladaptive behaviors including carrying an illegal firearm; (3) Aggression: consideration of retaliation and willingness to use a firearm; (4) Normalization: no reaction at all because gun violence is normal; and 5) Barriers: participants noted barriers to accessing mental health treatment, including distrust of providers.

**Conclusions:** Survivors of gun violence describe a disrupted sense of safety following their injury. They experience isolation, increased need to carry or use a firearm, normalization of gun violence and barriers to mental health treatment. These maladaptive reactions suggest a mechanism for the violent recidivism seen among survivors of gun violence.

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #18  
January 16, 2020  
2:05 pm

**DUSK TO DAWN: EVALUATING THE EFFECT OF A HOSPITAL BASED YOUTH VIOLENCE PREVENTION PROGRAM ON YOUTHS' PERCEPTION OF RISK**

Brooke Snyder, BA, Ashley Farrens, MSN, MBA, RN, Melissa Tibbits, PhD,  
Jenny Burt, PhD, LP, Zachary M. Bauman, DO, MHA\*  
University of Nebraska Medical Center

**Presenter:** Brooke Snyder, BA

**Discussant:** Krista Haines, DO, Duke University

**Objectives:** Historically, youth violence prevention strategies used deterrence-based programming with limited success. We developed a youth violence prevention program, Dusk to Dawn (D2D), intended to improve youths' recognition of high risk situations and teach new skills in conflict resolution. The aim of this study was to evaluate the effect of D2D on youths' perceptions of personal risk factors and high risk situations.

**Methods:** Youth ages 12-18 were referred to D2D by community based organizations, probation, or youth detention center. Youth completed a self-report survey before and after participating in D2D.

**Results:** 108 youth participated in D2D. Pre and posttest results for self-reported personal risk factors and high risk situations for violence are presented in Table 1. For Personal Risk Factors, a statistically significant increase in the perception that family ( $p < .01$ ) and other issues ( $p < .05$ ), and a decrease in the perception that school problems ( $< .05$ ) were seen as important personal risk factors. For High Risk Situations, increases in the perception that peer violence and substance use as high risk situations were seen as significant at the trend level ( $p < .10$ ). Of the 60% of participants who answered questions regarding satisfaction with D2D, 83.3% agreed or strongly agreed that D2D helped them to better understand violence and 83.3% would recommend D2D to others.

**Conclusions:** Youth violence prevention programming including an explicit discussion of how violence is learned and the role of family, friends, school and a community in shaping youths' attitudes towards violence can effectively raise awareness of one's own risk factors. Risk factors for youth violence are often preventable or modifiable, making awareness of one's own risk factors a realistic target for youth violence prevention programs.

|  | Pretest percentage | Posttest percentage | P value |
|--|--------------------|---------------------|---------|
| <b>Personal Risk Factors</b>                           |                    |                     |         |
| Peer violence/friends                                  | 47                 | 57                  |         |
| Environment  | 30                 | 33                  |         |
| Family   | 20                 | 35                  | <.01    |
| Emotions   | 28                 | 23                  | <.05    |
| Other issues (money, witnessing death, violent sports) | 3                  | 11                  |         |
| Problems at school                                     | 25                 | 15                  | <.05    |
| <b>High Risk Situations</b>                            |                    |                     |         |
| Peer violence/friends                                  | 44                 | 54                  | <.10    |
| Weapons  | 28                 | 26                  |         |
| Substance use  | 26                 | 36                  | <.10    |

Table 1: Percentage of Participants Who Identified Specific Risk Factors and High Risk Situations at Pre and Posttest

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #19  
January 16, 2020  
2:25 pm

**IDENTIFYING PARTICIPANTS FOR INCLUSION IN HOSPITAL BASED VIOLENCE INTERVENTION: AN ANALYSIS OF 18 YEARS OF URBAN FIREARM RECIDIVISM**

Stephanie Bonne, MD\*, Zachary Coles, BA, Nina Glass, MD\*,  
Anastasia Kunac, MD\*, David H. Livingston, MD\*  
Rutgers-New Jersey Medical School

**Presenter:** Stephanie Bonne, MD

**Discussant:** Randi Smith, MD, MPH, Emory University School of Medicine

**Objectives:** Hospital Based Violence Intervention Programs (HVIP) may prevent violent injury recidivism. However, programs are intensive and expensive. To maximize efficacy of HVIPs identification of high risk individuals is needed. The purpose of this study was to describe the characteristics of GSW recidivists to identify the the highest risk population.

**Methods:** Retrospective analysis was done on all patients sustaining GSW that presented to a single urban level 1 trauma center from January 2000 to September 2017, along with all countywide murders. Recidivists were any patient presenting twice or presenting once and subsequently dying by firearm. Subgroup analysis was performed on future recidivists compared to all firearm injury patients.

**Results:** 7,717 GSW cases were reviewed, 299 died, leaving 7,418 at risk of recidivism. 509 (6.9%) became recidivists. 58% of index GSWs were treated and released (T&R) from the ED. African Americans represent 86% of GSWs but 97% of recidivists ( $p<0.05$ ).

At index visit, future recidivists were younger (22 vs, 26,  $P<0.05$ ), with a bimodal age distribution and 100% male. Median time between incidents was 2.5 years but was significantly higher for recidivists who died at the second incident (861 vs 1261 days,  $p<0.05$ ). Future recidivists had lower ISS on index hospitalization.

135 recidivists died at second incident, 17 at later incidents. Mortality at second incident is higher than all-first injuries (27% vs 4%,  $p<0.05$ ). 110 (22%) recidivists required inpatient hospitalization at their second injury. Second hospitalizations are more costly (\$50,238 vs. \$80,091,  $p<0.05$ ).

**Conclusions:** Our HVIP offers greatest benefit to young black men. HVIP services are needed in the ED, as many patients are T&R at initial injury. Recidivists are more likely to be severely injured, die, or have costly hospitalizations, thus, the investment in HVIPs is justified.

# RECIDIVISTS BY RACE

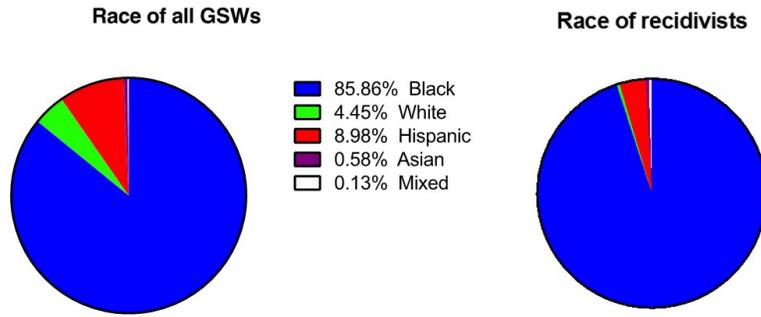


Figure 1: Recidivists by race: Race of future recidivists is mostly African American or Hispanic.

## AGE OF FUTURE RECIDIVISTS ARE MOSTLY 18-22

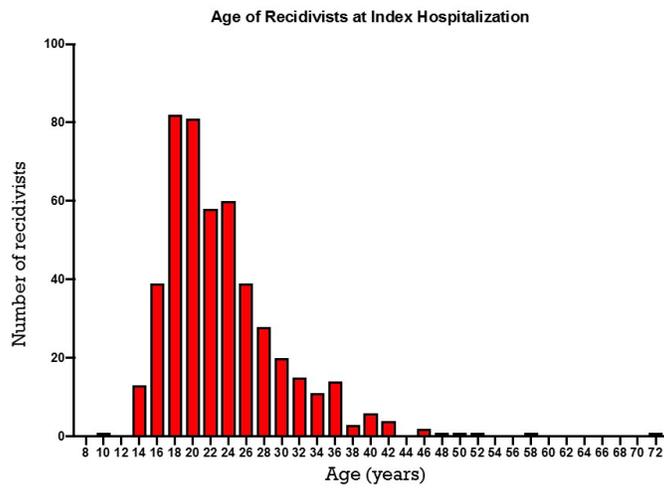


Figure 2: Recidivists by Age: Future recidivists had a slightly bimodal age distribution but are typically age 18-22 at their index hospitalization

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #20  
January 16, 2020  
2:45 pm

**HEROES IN CRISIS: TRAUMA CENTERS SHOULD BE SCREENING FOR AND INTERVENING ON POST-TRAUMATIC STRESS IN OUR EMERGENCY RESPONDERS**

Leah C. Tatebe, MD, FACS\*, Nandini Rajaram Siva, MBBS, Christina Brown, BS, Andrew Wheeler, LCSW, Carol Reese, Caroline Butler, MD\*, Matthew Kaminsky, MD\*, Thomas A. Messer, MD\*, Victoria Schlanser, DO\*, Frederic L. Starr, MD\*, Faran Bokhari, MD, MBA, FACS, FACP\*, Andrew J. Dennis, DO, FACS, FACOS\*  
Stroger Cook County Hospital

**Presenter:** Leah C. Tatebe, MD, FACS

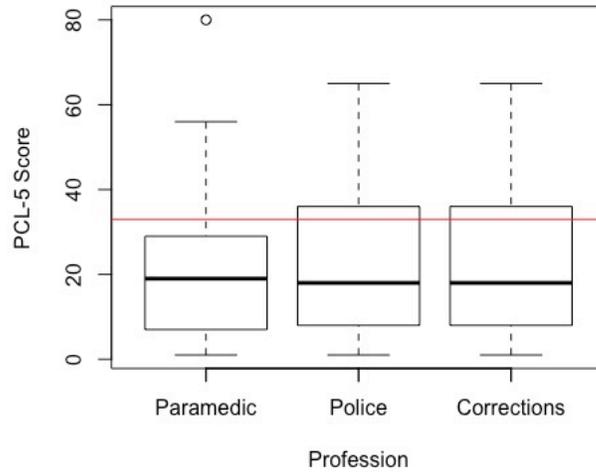
**Discussant:** Jennifer Hartwell, MD, Indiana University Methodist Hospital

**Objectives:** Rising suicide rates is a crisis facing emergency responders, and many resist seeking help due to stigma surrounding mental health. We sought to evaluate the feasibility of an urban trauma center to screen for Post-Traumatic Stress (PTS) and provide mental health services to emergency responders.

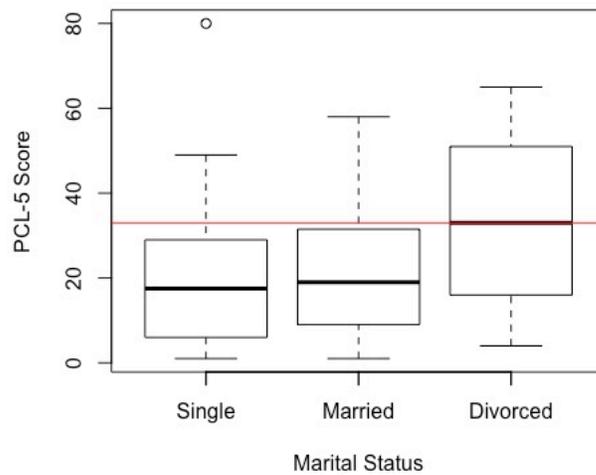
**Methods:** Paramedics, firefighters, law enforcement, and corrections officers involved with victims of trauma in the trauma unit were asked to complete the Post-Traumatic Checklist for DSM-5 (PCL-5). Additional factors known to affect PTS were correlated: occupation, age, gender, years of service, marital status, children, and pets. Willingness and barriers to seeking interventions for PTS were evaluated.

**Results:** A total of 221 responded: 42% paramedics, 40% law enforcement officers, 13% corrections officers, 1% firefighters, and 4% held multiple positions. Responders had a mean of 13.2 years of service (SD 9.6). Overall, 24.5% had diagnostic PTS Disorder with no difference seen in rates between professions (Figure 1). Of these, 78.8% had not sought care. Barriers included that they were not concerned (43.9%), did not recognize symptoms (25.4%), and were worried about consequences (19.5%). Concern over career advancement or losing one's job was the greatest barrier cited for seeking care for all responders. 46% of police were concerned that they would lose their ability to carry a firearm if they sought care for PTS. Divorce was the only factor examined that correlated with increased PCL-5 score (Figure 2). 83.2% overall and 73.1% of those with diagnostic PTS felt the trauma center was the right place to screen and intervene upon PTS.

**Conclusions:** Trauma centers can be an ideal safe place to both screen for PTS and offer mental health assistance. Comprehensive trauma-informed care by hospital-based intervention programs must expand to include emergency responders.



PCL-5 score by profession with a score over 33 (red line) highly indicative of Post-Traumatic Stress Disorder (PTSD), median and IQR are shown.



PCL-5 score by marital status with a score over 33 (red line) highly indicative of Post-Traumatic Stress Disorder (PTSD), median and IQR are shown. PTSD rates were significantly higher in divorced responders compared to married ( $p = 0.04$ ) and single ( $p = 0.02$ ) responders.

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #21  
January 16, 2020  
3:05 pm

**THE HOMELESS PEDESTRIAN: A NEW CATEGORY OF VULNERABLE ROAD USER**

Rebecca E. Plevin, MD, Megan Wier, MPH, Shamsi Soltani, MPH,  
Adaobi Nwabuo, MBBS, MPH, Mimi Tam, BA, Devan Morris, BS,  
Rachael A. Callcut, MD, MSPH, FACS\*, Catherine Juillard, MD, MPH  
University of California San Francisco

**Presenter:** Rebecca E. Plevin, MD

**Discussant:** Laurie J. Punch, MD, Washington University School of Medicine

**Objectives:** Homeless individuals in the United States are at increased risk of traumatic injury. There is little research characterizing the burden of motor vehicle traffic-related mortality in the homeless. We hypothesize that people without housing are disproportionately represented in traffic-related deaths and seek to identify high-risk locations for these fatalities.

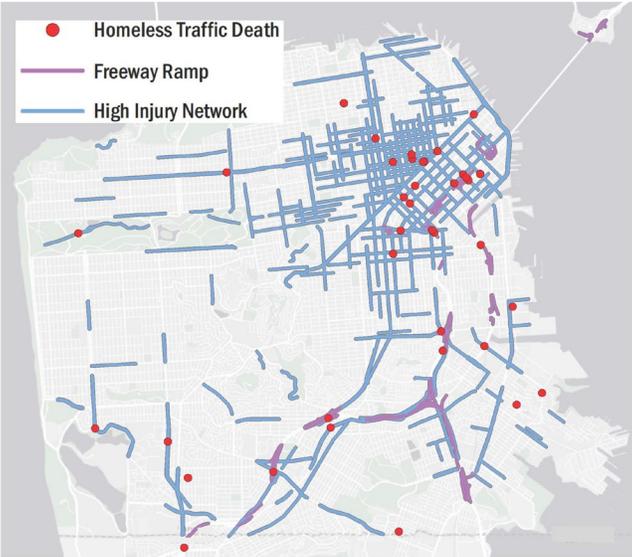
**Methods:** We performed a retrospective review of 2012-2018 mortality data obtained from our city medical examiner. We analyzed all traffic injury-related mortalities in patients without a fixed home address as a conservative proxy for homelessness. Mortality location data were overlaid onto a map of city freeways and the Vision Zero High-injury Network (HIN), a network of 13% of streets where 75% of severe & fatal traffic injuries occur.

**Results:** 12% of fatalities were in people without a fixed home address, who comprise <1% of our city's population. The mean victim age was 44.5 years, and 91% were male (Table 1). The majority of the deaths (63%) were due to automobile vs. pedestrian injuries. The remainder were due to motor vehicle collisions (MVC) or motorcycle collisions (MCC), trains vs. pedestrians (14%), and bicycles/skateboards vs. motor vehicles (9%). Additionally, 72% of the deaths occurred at night and 28% occurred on freeways, including 9/27 auto vs. pedestrian fatalities. Figure 1 overlays the fatality locations onto a map of the city's freeways and the HIN. 79% (34/43) of fatalities occurred on a freeway or one of the streets within the HIN.

**Conclusions:** A significant proportion of traffic-related fatalities in the homeless population occurred at night and while walking on freeways or using streets within the HIN. By characterizing disproportionate representation of the homeless in traffic-related deaths, we call attention to the need for deeper coordination between health care, public health, transportation, and housing disciplines to address this public health crisis in an acutely vulnerable population.

|                          | Number of patients (%) |
|--------------------------|------------------------|
| <b>Age, mean</b>         | 44.5                   |
| <b>Gender</b>            |                        |
| Male                     | 39 (91)                |
| Female                   | 4 (9)                  |
| <b>Injury Mechanism</b>  |                        |
| Auto vs. Pedestrian      | 27 (63)                |
| MVC/MCC                  | 6 (14)                 |
| Train vs. Pedestrian     | 6 (14)                 |
| Auto vs. Bike/skateboard | 4 (9)                  |
| <b>Injury on freeway</b> |                        |
| Yes                      | 12 (28)                |
| No                       | 31 (72)                |
| <b>Time of Injury</b>    |                        |
| Day (06:00 - 18:00)      | 12 (28)                |
| Night (18:00 - 06:00)    | 31 (72)                |

**Table 1**



**Figure 1**

Scientific Session III-B - Cox-Templeton Injury Prevention Paper Competition

Paper #22  
January 16, 2020  
3:25 pm

**DO RIDE SHARING SERVICES AFFECT THE INCIDENCE OF  
ALCOHOL-RELATED MOTOR VEHICLE COLLISIONS?**

Vera Hendrix, MD, Jessica Friedman, MD, Judy Fustok, MS, Tara Reza, BS,  
Scott Mayer, MD, Prathima Madda, BS, Patrick Greiffenstein, MD\*  
Juan C. Duchesne, MD, FACS, FCCP, FCCM\*, Rebecca W. Schroll, MD, FACS\*  
Tulane University School of Medicine

**Presenter:** Vera Hendrix, MD

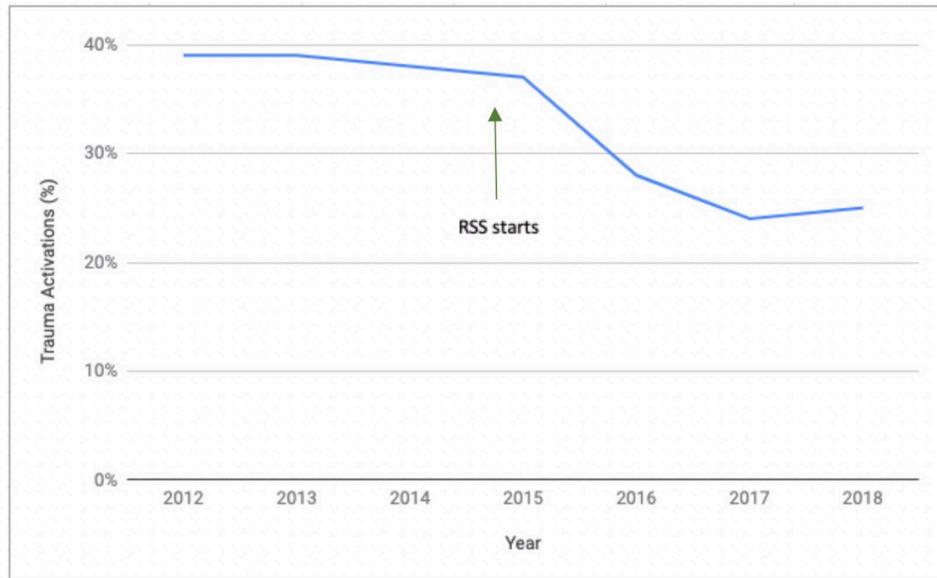
**Discussant:** Jon Dorfman, MD, UMass Memorial

**Objectives:** Alcohol-related motor vehicle collisions (AR-MVCs) account for ~30% of all U.S. traffic fatalities. Ride-sharing services (RSS) have existed since 2010, but few studies to date have investigated their impact on AR-MVCs. We hypothesized that the availability of RSS would be correlated with a decrease in AR-MVCs at an urban level 1 trauma center.

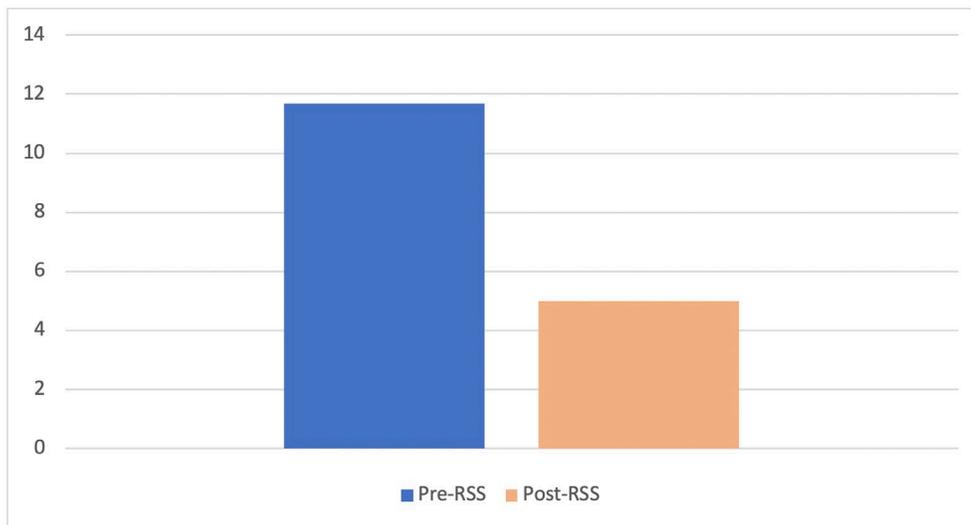
**Methods:** A retrospective chart review was conducted of all AR-MVC trauma activations at a Level 1 trauma center from 2012-2018. Additional data were gathered from regional traffic databases including crash incidence, fatalities, blood alcohol content (BAC) and demographics. Data were compared pre-and post-RSS and analyzed using an unpaired t-test with  $p < 0.05$  considered significant.

**Results:** There were 1474 patients in AR-MVCs during the study period. There was a significant decrease in the annual average proportion of MVCs that were AR-MVCs pre- vs post-RSS (39% vs. 29%,  $p=0.04$ ) as well as a decrease in the average annual incidence of fatal AR-MVCs (11.6 vs 5,  $p=0.02$ ). We found a similar decrease in the incidence of regional AR-MVCs post-RSS by 18%. Post-RSS, AR-MVC incidence decreased in the 21 to 24-year-old age group (14.3 vs 10,  $p=0.04$ ), but there were no significant differences in other age groups, or by race or gender. There was no difference in average BAC for AR-MVC patients pre- vs post-RSS.

**Conclusions:** We found that the incidence of both total AR-MVCs and fatal AR-MVCs presenting to our trauma center decreased after the introduction of RSS, particularly in young adults. RSS may play a role in preventing AR-MVCs. Further research is needed to correlate AR-MVC incidence with granular proprietary RSS usage data and to account for any confounding factors. Future studies may identify ways to better utilize RSS availability as a targeted intervention for certain demographic groups to prevent AR-MVCs.



Incidence of alcohol-related motor vehicle collisions (AR-MVCs) over time



Average annual incidence of fatal alcohol-related motor vehicle collisions (AR-MVCs) pre- vs post- ride sharing service (RSS) availability.

Scientific Session IV-A – Resuscitation and Transfusion

Paper #23  
January 17, 2020  
7:45 am

**BLOOD-BASED BIOMARKERS FOR PREDICTION OF INTRACRANIAL HEMORRHAGE AND OUTCOME IN PATIENTS WITH MODERATE OR SEVERE TRAUMATIC BRAIN INJURY**

Taylor Anderson, BS, Jun Hwang, MS, Barbara McKnight, PhD, Myrna Munar, PharmD,  
Linda Papa, MD, Holly E. Hinson, MD, MCR, Susan E. Rowell, MD, MCR\*  
Duke University Medical Center

**Presenter:** Taylor Anderson, BS

**Discussant:** Michael Goodman, MD, University of Cincinnati Medical Center

**Objectives:** Early identification of traumatic intracranial hemorrhage (ICH) has implications for triage and intervention. Blood-based biomarkers were recently FDA approved for prediction of ICH in patients with mild traumatic brain injury (TBI). We sought to determine if these biomarkers measured early after injury improve prediction of ICH, mortality, and neurologic outcome over Glasgow Coma Scale score (GCS) alone in patients with moderate or severe TBI.

**Methods:** We measured glial-fibrillary-acidic-protein (GFAP), ubiquitin-C-terminal-hydrolase-L1 (UCH-L1), and microtubule-associated-protein-2 (MAP-2) on ED arrival in patients with TBI enrolled in the placebo arm of the Prehospital TXA for TBI Trial (GCS 3-12, SPB > 90). Biomarkers were modeled individually and together with prehospital predictor variables [PH] (GCS, age, gender). Data were divided into a training dataset for model derivation and testing dataset for model evaluation. Models were evaluated for prediction of ICH, mortality, and long-term neurologic outcome. AUC was evaluated for PH alone, PH+individual biomarkers, and PH+3 biomarkers.

**Results:** Of 243 patients with baseline samples (obtained a median 84 min after injury), prehospital GCS was 8 (IQR 5,10), 55% had ICH, and 48-hr and 28-day mortality was 7 and 13%. Poor neurologic outcome at 6 months was observed in 34% based on a Glasgow Outcome Scale-Extended (GOSE)  $\leq 4$ , and 24% based on a Disability Rating Scale (DRS) score  $> 7$ . Addition of each biomarker to PH improved AUC in the majority of predictive models. GFAP+PH compared to PH alone significantly improved AUC in all models [ICH: 0.82 vs 0.64; 48-hour mortality 0.84 vs 0.71; 28-day mortality: 0.84 vs 0.66; GOSE: 0.78 vs 0.69; DRS 0.84 vs 0.81, all  $p < 0.001$ ].

**Conclusions:** Blood-based biomarkers may improve prediction of ICH and outcome in patients with moderate or severe TBI over prehospital characteristics alone. GFAP appears to be the most promising. Future evaluation in the prehospital setting is warranted.

Scientific Session IV-A – Resuscitation and Transfusion

Paper #24  
January 17, 2020  
8:05 am

**PLATELET TRANSFUSIONS DO NOT CORRECT TRAUMA  
INDUCED PLATELET DYSFUNCTION**

Julie S. Kim, BS, Madhu Subramanian, MD\*, Lily Tung, MD\*, Sanjna Surya, BS,  
Andrew Hu, BS, Antonio Davila, PhD, Carrie A. Sims, MD\*  
Hospital of the University of Pennsylvania

**Presenter:** Madhu Subramanian, MD

**Discussant:** Nicole Krumrei, MD, Robert Wood Johnson University Hospital

**Objectives:** Platelets play an integral role in hemostasis with abnormal function implicated in trauma-induced coagulopathy (TIC). The impact of platelet transfusion (PLTs) on correcting platelet dysfunction (PD) during traumatic hemorrhage; however, remains unclear. The aim of this study was to determine whether PLTs effectively correct PD during hemostatic resuscitation.

**Methods:** Blood samples and clinical data were prospectively collected from adult trauma patients admitted to our Level I urban trauma center from March 2017 to May 2019 who required ICU admission. Samples were taken on arrival and serially at 3h, 6h, 12h, and 24h. In addition to standard clinical labs, samples were analyzed by thromboelastography with platelet mapping (TEG-PM). Patients with PD ( $MA_{ADP} < 40mm$ ) transfused with PLTs were compared to those not transfused using Chi-Square and Mann-Whitney U tests. Additionally, in patients receiving PLTs, TEG-PM values were compared pre and post transfusion using paired t-tests.  $P < 0.05$  was considered significant.

**Results:** Of the 93 patients, PD was seen in 56.5% on admission. Admission PD was associated with a higher injury severity score, penetrating trauma, and an increased mortality at 24h and 30d. However, mortality rate was similar in patients with PD despite PLT transfusion. Paradoxically, PLT transfusion did not increase platelet counts in patients with PD. At all timepoints, platelet hypofunction to ADP stimulation were similar in patients with PD regardless of PLT transfusion status. Moreover, PLT dysfunction persisted with no significant differences in pre and post transfusion TEG-PM values.

**Conclusions:** PD is common in trauma patients and current hemostatic resuscitation strategies do not appear to restore platelet function. Further research is needed to determine if the persistent PD observed is secondary to platelet storage lesion, insufficient transfusion strategies, or the result of ongoing TIC.

|                                  | <b>T0</b>        | <b>T3</b>        | <b>T6</b>        | <b>T12</b>       | <b>T24</b>       |                                |
|----------------------------------|------------------|------------------|------------------|------------------|------------------|--------------------------------|
| Platelet count                   | 199 (166-223)    | 99 (89-137)      | 131 (85-145)     | 90 (76-110)      | 116 (81-132)     | <b>Platelets Transfused</b>    |
| Platelets transfused             | ...              | 2 (1-2)          | 1 (1-2.3)        | 2 (1-2.8)        | 1.5 (1-3)        |                                |
| MA <sub>ADP</sub>                | 20.4 (6.9-27.0)  | 17.2 (2.6-29.2)  | 6.2 (4.2-20.6)   | 31 (7.3-43.1)    | 48 (37.9-56.9)   |                                |
| % ADP inhibition                 | 71.7 (55.4-79.2) | 74.8 (46.8-94.5) | 91.4 (59.1-95.7) | 53.4 (38.9-95.4) | 45.9 (29.9-55.4) | <b>No Platelets Transfused</b> |
| Platelet count                   | 197 (178-278)    | 155 (132-172)    | 127 (104-172)    | 131 (99-165)     | 119 (79-146)     |                                |
| MA <sub>ADP</sub>                | 8.3 (3.6-20.4)   | 13.4 (7.2-35.6)  | 16.4 (7.2-21.2)  | 20.2 (7-29.5)    | 38.4 (16.5-53.3) |                                |
| % ADP inhibition                 | 93 (57.3-99.6)   | 78.7 (40.9-93.5) | 81.8 (62.7-93.5) | 75.2 (50.9-93.7) | 47.3 (22.3-94.3) | <b>P - values</b>              |
| Platelet count <b>P-value</b>    | 0.58             | 0.06             | 0.44             | <b>0.02</b>      | 0.76             |                                |
| MA <sub>ADP</sub> <b>P-value</b> | 0.12             | 0.31             | 0.11             | 0.49             | 0.21             |                                |
| % ADP inhibition <b>P-value</b>  | 0.18             | 0.76             | 0.27             | 0.56             | 0.67             |                                |

T0 & T3 (PLTs n = 39, no PLTs n = 20), T6 (PLTs n = 14, no PLTs = 44), T12 (PLTs n = 14, no PLTs = 42), T24 (PLTs n = 10, no PLTs n = 46)  
Values in parentheses are interquartile ranges for continuous variables. P-values compare PLT's transfused versus no PLT's transfused (Mann-Whitney U test or Fisher's exact test).  
Coagulopathy defined if MAADP < 40 mm, % ADP inhibition > 60; MA = maximum amplitude, ADP = adenosine phosphate

**Table 1. Changes in TEG-PM Parameters at All Timepoints in Patients with Platelet Dysfunction Transfused with and without Platelets**

Scientific Session IV-A – Resuscitation and Transfusion

Paper #25  
January 17, 2020  
8:25 am

**HEMOSTATIC POTENTIAL OF COLD-STORED WHOLE BLOOD OVER TIME: AN ASSESSMENT OF PLATELET FUNCTION AND THROMBIN GENERATION FOR OPTIMAL SHELF-LIFE**

Scott Assen, MD, Jessica Cardenas, PhD, Mitchell George, MD, Yao-Wei Wang, PhD, Charles E. Wade, PhD, David Meyer, MD, MS\*, Bryan A. Cotton, MD, MPH  
University of Texas Health Science Center at Houston

**Presenter:** Scott Assen, MD

**Discussant:** David Morris, MD, Intermountain Medical Center

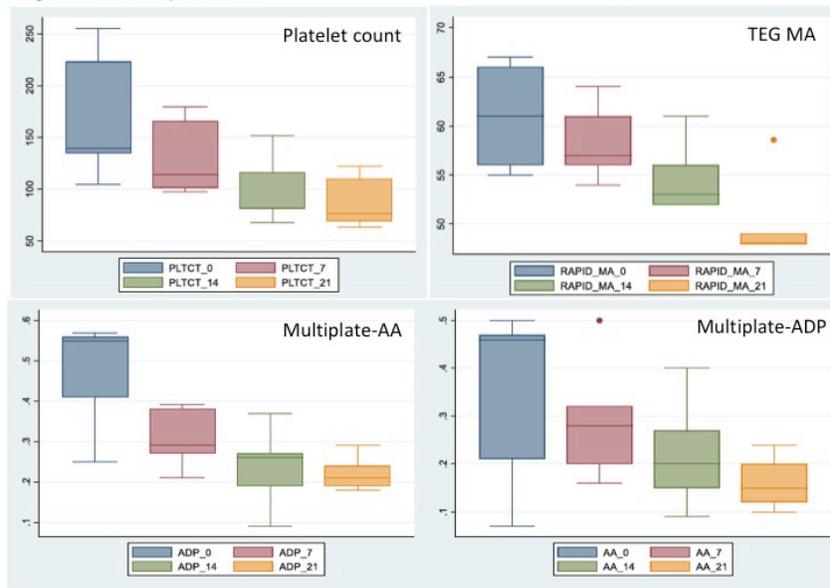
**Objectives:** Cold-stored low-titer whole blood (WB) is becoming increasingly used as the preferred product for initial hemorrhagic shock resuscitation. The purpose of this study was to identify whether the current 21-day shelf-life is the optimal duration for storage of WB, maintaining hemostatic efficacy.

**Methods:** Five units of fresh low-titer group O WB (non-leukoreduced) were acquired from our regional blood center. These units were stored at 4° C for up to 21 days as per current clinical storage guidelines in our emergency department. Hemostatic parameters were measured *in vitro* at 0, 7, 14, and 21 days. Assessments of hemostatic potential included cell count, rapid (r-TEG) and kaolin thrombelastography (TEG), Multiplate impedance aggregometry, and calibrated automated thrombogram (CAT). Univariate analysis, including one-way ANOVA with repeated measures, was performed (STATA 12.1).

**Results:** Compared to baseline product (0 days), both platelet count and platelet function of WB showed sharp decreases at 7 days and again at 14 days. Platelet function deterioration was noted by r-TEG maximal amplitude (MA), TEG-MA, and Multiplate AA and ADP (Figure 1); all  $p < 0.001$ . With respect to clot initiation, r-TEG ACT and TEG R-time were similar over the 21 day shelf-life;  $p = 0.058$  and  $p = 0.620$ , respectively. Thrombin generation assessed by CAT demonstrated stable endogenous thrombin potential (ETP) over the course of storage ( $p = 0.162$ ), but improved peak thrombin generation and quicker time to peak generation after 7 days (Figure 2).

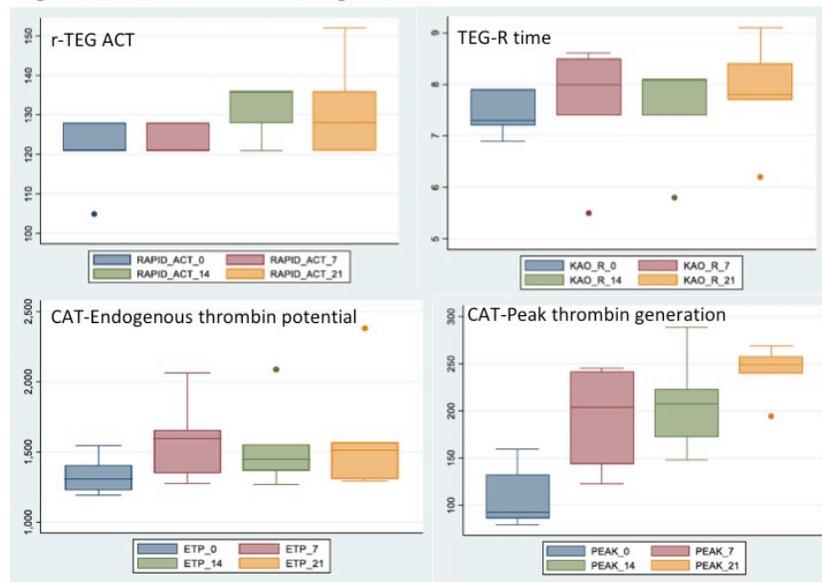
**Conclusions:** While the platelet function of WB degrades significantly at 7 days (and again at 14-days), clot initiation remains stable over time and thrombin generation appears to be improved at 7 days. This study supports a current storage limit for cold-stored, low-titer WB of 14-days.

Figure 1. Platelet parameters



### Platelet parameters of cold-stored whole blood over time

Figure 2. Clot initiation and thrombin generation



### Clot initiation and thrombin generation of cold-stored whole blood over time

Scientific Session IV-A – Resuscitation and Transfusion

Paper #26  
January 17, 2020  
8:45 am

**OVERTRANSFUSION COMES AT A SIGNIFICANT COST: THE DOSE-DEPENDENT  
RELATIONSHIP BETWEEN BLOOD TRANSFUSIONS AND  
INFECTIONS AFTER MAJOR TRAUMA**

Charlie Nederpelt, BSc, Majed el Hechi, MD, Alexander Bonde, BSc,  
Nikos Kokoroskos, MD, April E. Mendoza, MD, MPH\*, Martin Rosenthal, MD,  
Noelle Saillant, MD\*, Peter Fagenholz, MD, David King, MD,  
George Velmahos, MD, PhD, MEd, Haytham Kaafarani, MD, MPH\*  
Massachusetts General Hospital

**Presenter:** Charlie Nederpelt, BSc

**Discussant:** Mark Seamon, MD, University of Pennsylvania

**Objectives:** We sought to quantify the cumulative and independent impact of transfusion within the first 24 hours of admission on the risk of infection in trauma patients.

**Methods:** Using the Trauma Quality Improvement Program 2013-2016 database, we included all patients who received blood transfusion in the first 4 hours. Patients who died within 48 hours, were transferred from another hospital, or had incomplete information on transfusion volume were excluded. Patients were divided into 20 cohorts based on the total blood product volume transfused in the first 24 hours. A composite infection variable (INF) was created (e.g. surgical site infection, pneumonia, sepsis). Univariate and stepwise multivariable logistic regression analyses were performed to study the relationship between blood transfusion and INF, controlling for demographics (e.g. age, gender), comorbidities (e.g. cirrhosis, diabetes, steroid use), injury severity [e.g. vital signs, mechanism, injury severity scale (ISS)], and operative and angiographic interventions.

**Results:** Of 1,002,595 patients, 40,829 met inclusion criteria. The mean age was 42+19 years, 75% were males, 68% had blunt trauma, and the mean ISS was 25 [17-34]. The figure shows the multivariable analyses describing the independent relationship between total blood product transfusion volume and INF. The odds ratio of INF increased incrementally from 1.23 (95% CI: 1.11-1.37) for 2 units transfused to 4.89 (95% CI: 2.72-8.80) for 40 units transfused. Each additional unit increased the odds of INF by 4.9%.

**Conclusions:** Controlling for relevant confounders, transfusion of the bleeding trauma patient comes at the expense of a dose dependent increased risk of infectious complications. Trauma surgeons and anesthesiologists should resuscitate the trauma patient until prompt hemorrhage control while avoiding overtransfusion.

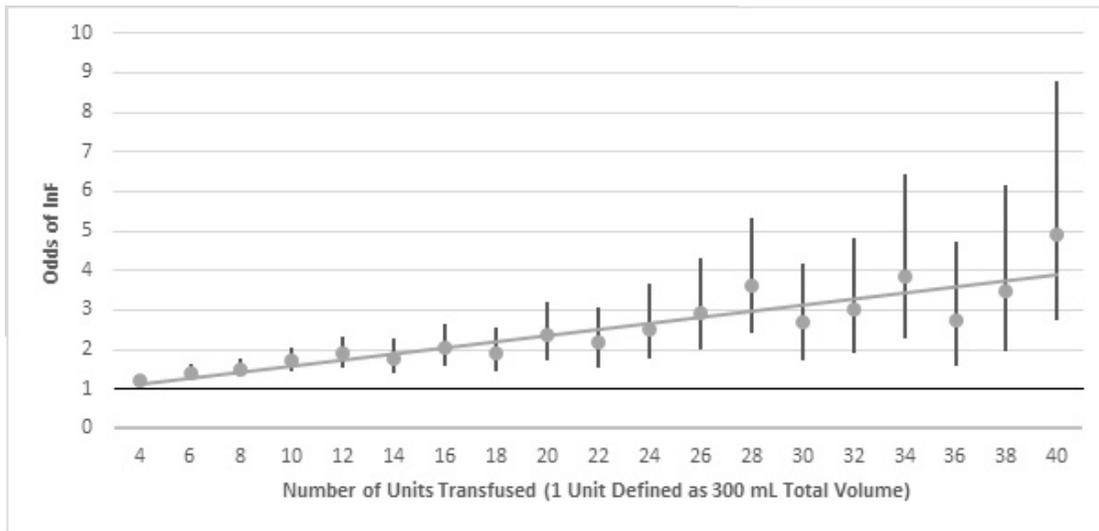


Figure: The relationship between blood transfused and infectious complications.

## Scientific Session IV-A – Resuscitation and Transfusion

Paper #27  
January 17, 2020  
9:05 am

### MASSIVE TRANSFUSION AND THE RESPONSE TO PREHOSPITAL PLASMA: IT IS ALL IN HOW YOU DEFINE IT

Edward Sim, BS, Frank Guyette, MD, MPH, Mark Yazer, MD, Joshua B. Brown, MD, MSc\*,  
Matthew Neal, MD, Brian Zuckerbraun, MD, Brian J. Daley, MD, MBA\*,  
Richard S. Miller, MD\*, Jeffrey A. Claridge, MD, MS, FACS\*,  
Herb A. Phelan III, MD, FACS\*, Brian G. Harbrecht, MD\*  
University of Pittsburgh Medical Center

**Presenter:** Edward Sim, BS

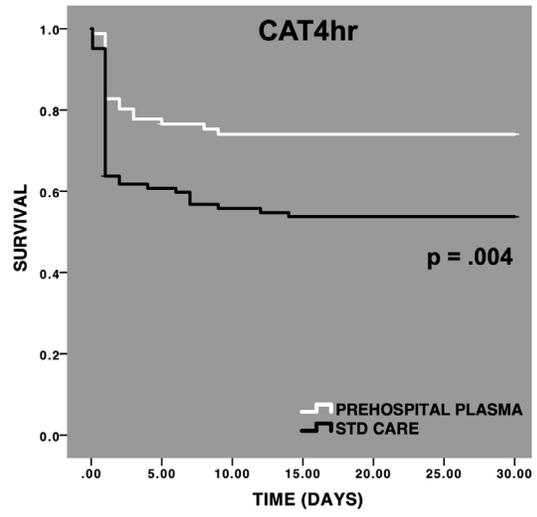
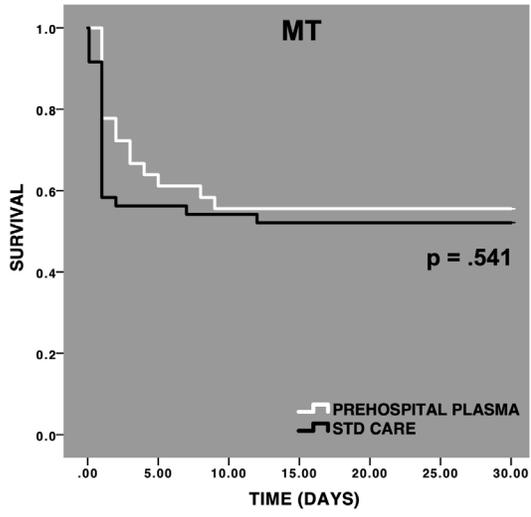
**Discussant:** John Harvin, MD, McGovern Medical School at UT Health

**Objectives:** The definition of massive transfusion following traumatic injury has evolved over time to minimize bias and predict those at highest risk of death. We sought to characterize different definitions of massive transfusion, their associated mortality risks and the response to prehospital plasma.

**Methods:** A secondary analysis was performed using data from a recent prehospital plasma trial. Patients transferred directly from the scene were characterized. We defined historical massive transfusion (hMT) using  $\geq 10$  units red cells/24 hours and critical administration threshold (CAT) as  $\geq 3$  u/hour in the first hour (CAT1hr) or in the first 4 hours (CAT4hr) from arrival. The primary outcome was 30-day mortality. Kaplan-Meier analysis and Cox hazard regression were used to characterize the survival benefit of prehospital plasma for each MT definition.

**Results:** A total of 384 enrolled patients were transferred from the scene and represent the study cohort. Overall, 30-day mortality was 30% with a median ISS of 22. Twenty-two%, 33% and 48% of patients met hMT, CAT1hr and CAT4hr definitions, respectively. Of those who died, 77 patients (26%), 65 patients (25%) and 47 patients (24%) never reached hMT, CAT1hr and CAT4hr thresholds, respectively. CAT4hr had superior sensitivity and specificity and minimized survival bias. Kaplan-Meier survival analysis demonstrated a survival benefit in the patients who were CAT4hr positive with no benefit found for CAT1hr or hMT patients. (Figure) Cox hazard regression verified that for CAT4hr patients, prehospital plasma was associated with an independent survival benefit (HR 0.562, 95% CI 0.322-0.980 p=0.042) after adjusting for confounders.

**Conclusions:** The current analysis demonstrates the superior utility of the CAT4hr definition with optimization of survival bias while conserving mortality risk prediction. This definition was associated with a prehospital plasma survival benefit and may be the most appropriate definition of MT for studies which focus on hemorrhage shock.



## Scientific Session IV-A – Resuscitation and Transfusion

Paper #28  
January 17, 2020  
9:25 am

### VITAMIN C IS ASSOCIATED WITH LACTATE CLEARANCE AND SURVIVAL IN SEPSIS

Saskya Byerly, MD\*, Joshua Parreco, MD\*, Hahn Soe-Lin, MD, MS\*, Jonathan Parks, MD\*,  
Eugenia Lee, MD, MPH\*, Ilya Shnaydman, MD\*, Alejandro Mantero, PhD,  
D. Dante Yeh, MD, FACS, FCCM\*, Nicholas Namias, MBA, MD\*, Rishi Rattan, MD\*  
Ryder Trauma Center, University of Miami Miller School of Medicine

**Presenter:** Saskya Byerly, MD

**Discussant:** Tanya Anand, MD, University of Arizona Tuscon

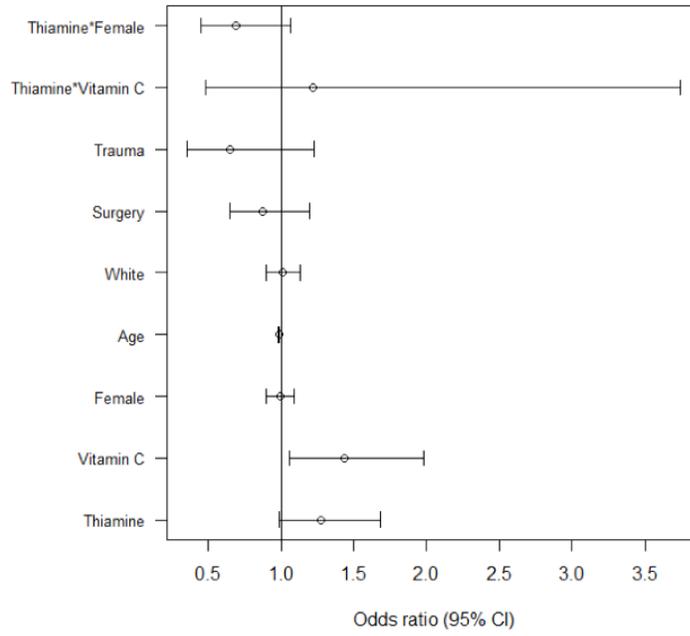
**Objectives:** The efficacy of vitamin C (vitC) and thiamine (thia) in patients admitted to the intensive care unit (ICU) with septic shock is unclear. The purpose of this study was to evaluate the effect of vitC and thia on mortality and lactate clearance in ICU patients.

**Methods:** The Philips eICU database version 2.0 was queried for patients admitted to the ICU in 2014-2015 for  $\geq 48$  hours and patients with sepsis and an elevated lactate  $\geq 2.0$  mmol/L. Subjects were categorized according to the receipt of vitC, thia, both, or neither. The primary outcome was in-hospital mortality. Secondary outcome was lactate clearance defined as lactate  $< 2.0$  mmol/L achieved after maximum lactate. Univariable comparisons included age, gender, race, Acute Physiology Score III, APACHE IVa score, surgical ICU admission status, intubation status, hospital region, vitC and thia orders. Kaplan-Meier estimators and multivariable logistic regression models were constructed.

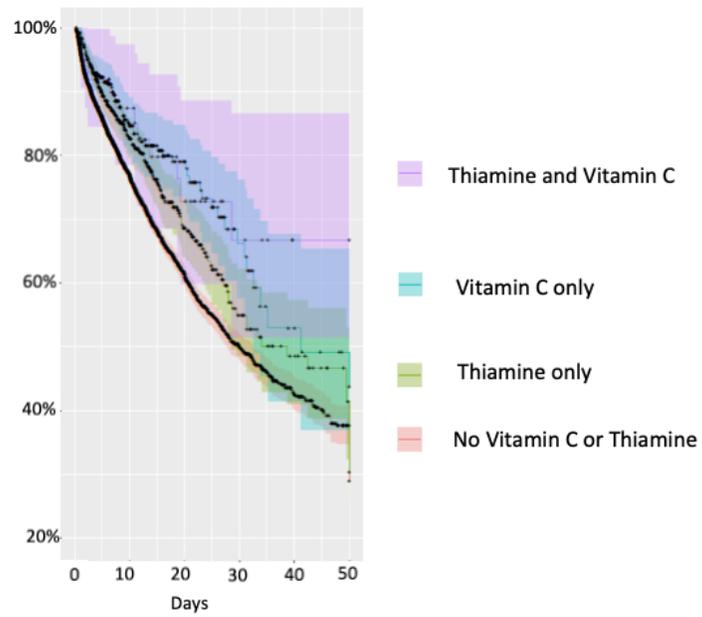
**Results:** Of 146,687 patients from 186 hospitals, 7.7% (n=11,330) were included. Overall mortality was 25.9% (n=2,930) and vitC mortality was 19.6% (n=67, p<0.001). Evidence in favor of an association between vitC and/or thia administration and survival was found on log rank test (all p<0.001). After controlling for confounding factors, vitC was independently associated with decreased mortality (AOR:0.69[0.52-0.90], p=0.007) and lactate clearance (AOR:1.43[1.06-1.98], p=0.023). Older age was also an independent predictor of mortality (AOR:1.02[1.01-1.02], p=0.007) while thia (AOR:1.06[0.85-1.32], p=0.584) and thia\*vitC (AOR:1.28 [0.59-2.60], p=0.511) were not. Younger age was an independent predictor of lactate clearance (AOR:0.99[0.98-0.99], p<0.001) while thia (AOR:1.28[0.98-1.68], p=0.074) and thia\*vitC (AOR:1.22[0.48-3.74], p=0.698) did not reach significance.

**Conclusions:** VitC is associated with lactate clearance and increased survival in septic ICU patients. Randomized, multicenter trials are needed to better understand the effect of vitC on outcomes.

## Predictors of Lactate Clearance



## Kaplan-Meier Estimator



## Scientific Session IV-B – Acute Care Surgery

Paper #29  
January 17, 2020  
7:45 am

### **DIAPHRAGM ULTRASOUND: A NOVEL APPROACH TO ASSESSING PULMONARY RESERVE**

Sean J. Randazzo, BS, Danielle O'Hara, BS, Sahar Ahmad, MD, Erin Taub, Emily Huang, MS,  
David Pasternak, BA, James A. Vosswinkel, MD\*, Randeep S. Jawa, MD\*  
Stony Brook University Medical Center

**Presenter:** Sean J. Randazzo, BS

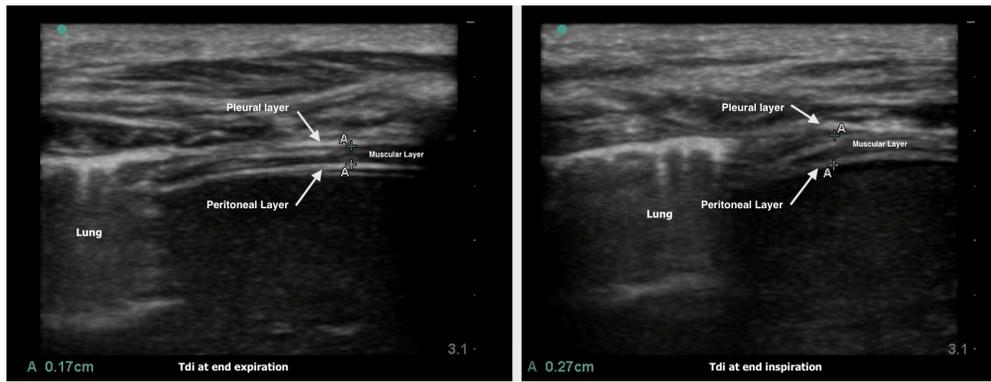
**Discussant:** Charity Evans, MD, University of Nebraska Medical Center

**Objectives:** Rib fractures following blunt trauma are a major cause of morbidity. Various factors have been used for risk stratification. In medical patients, ultrasound (US) measurements of diaphragm thickening fraction (TF) have been used to evaluate the diaphragm, i.e. to predict extubation success. However, TF has not been used to assess pulmonary reserve in non-intubated rib fracture patients. Our study aims to measure TF and inspiratory capacity (IC) in the trauma setting to elucidate the association between acute rib fractures and respiratory function.

**Methods:** This prospective study enrolled adults with acute traumatic rib fractures within 48 hours of admission to a level 1 trauma center. Patients requiring a chest tube or mechanical ventilation were excluded. TF was determined by bedside US measurement of minimum and maximum diaphragm thickness (Tdi) during tidal breathing (Figure 1) and the TF was calculated ( $TF = [Tdi_{max} - Tdi_{min}] / Tdi_{min}$ ). IC was determined via incentive spirometry. Univariate and multivariate analyses were performed.

**Results:** A total of 42 subjects were enrolled. Subject demographics are outlined in Figure 2. Diaphragm US demonstrated a median TF of 0.30 (IQR 0.24-0.45). Median IC was 1750mL (IQR 1250-2000). Multivariate analysis revealed a significant inverse association between TF and median IC. Neither rib fracture laterality nor level of fracture (ribs 1-6 vs 7-12) was correlated with TF. IC, but not TF, was significantly different (750 vs 1750mL) in those discharged to home vs subacute rehab.

**Conclusions:** To our knowledge, this is the first report of TF in rib fracture patients. The significant inverse association between TF and IC, and lack of association with discharge disposition, is surprising. The data would argue that in the setting of chest trauma, it is not the diaphragm, but rather other muscles (accessory/chest wall, abdominal muscles) that are the prime determinants of outcome.



Bedside ultrasound of the diaphragm at the zone of apposition

$$TF = (Tdi_{max} - Tdi_{min}) / Tdi_{min} = (0.27 - 0.17) / 0.17 = 0.59$$

| Characteristic                      | (n = 42)     |
|-------------------------------------|--------------|
| Age (years), median (IQR)           | 63 (52-76)   |
| Male sex, n (%)                     | 25 (60)      |
| Injury Severity Score, median (IQR) | 11.5 (10-14) |
| Rib Fractures, n (%)                |              |
| Right                               | 22 (52)      |
| Left                                | 17 (40)      |
| Both                                | 3 (7)        |
| Pulmonary Contusions, n (%)         | 6 (14)       |
| Comorbidities, n (%)                |              |
| Lung Disease (COPD)                 | 1 (2%)       |
| Current smoker                      | 10 (24%)     |

Patient demographics

Scientific Session IV-B – Acute Care Surgery

Paper #30  
January 17, 2020  
8:05 am

**INFECTIOUS COMPLICATIONS AFTER EMERGENCY GENERAL SURGERY:  
A STATE-WIDE COLLABORATIVE EXPERIENCE & ASSOCIATION  
WITH PATIENT CARE MODELS**

Kathleen To, MD\*, Neil Kamdar, MA, Preethi Patil, MPH, Cathrin Ring, RC,  
Stacey Collins, MA, Elizabeth Seese, MS, CCRC, Greta Krapohl, PhD, RN,  
Darrell (Skip) Campbell, Jr., MD, FACS, Michael Englesbe, MD, FACS,  
Mark R. Hemmila, MD\*, Lena M. Napolitano, MD\*  
University of Michigan

**Presenter:** Kathleen To, MD

**Discussant:** Vanessa Ho, MD, MPH, University Hospitals Case Medical Center

**Objectives:** Emergency General Surgery (EGS) cases are associated with higher morbidity than their elective general surgery counterparts. In the intestinal resection (EGS-IR) cohort, morbidity rate was upwards of 40% in a state-wide Surgical Quality Collaborative (SQC). We performed a comprehensive analysis of patient, hospital & patient care model (PCM) effects on postoperative infectious complications in this high-risk population.

**Methods:** The state-wide SQC maintains a prospectively collected comprehensive database of patient demographics & 30d outcomes. Thirty-four hospitals in the SQC also provided data on PCM, hospital resources, and surgeon practice patterns. Patient outcomes were examined by surgery type, as well as by PCM (ACS=dedicated Acute Care Surgery team; GSS=General Surgeons covering both elective general surgery & EGS patient care; hybrid=EGS call is shared between the ACS & GSS surgeons). Hierarchical multivariable logistic regression analysis was used to determine risk & reliability adjusted outcomes for postoperative infectious complications.

**Results:** Between 1/1/08-12/31/16 there were 126,494 general surgery cases performed at these 34 sites (EGS=39,023; EGS-IR=10,431). Overall EGS 30d infectious complications in our SQC cohort was 15.2% (EGS-IR=9.5%). The ACS model was associated with statistically significant decreased infectious complications in the EGS-IR subgroup ( $P<0.05$ ) [Fig 1-2].

**Conclusions:** We report for postoperative infectious complication rates for the most common EGS procedures in this prospectively collected, research-quality EGS Surgical Quality Collaborative database. EGS-IR patients had the highest rate of complications. We have confirmed that the ACS model is associated with a significant reduction of postoperative infectious complications in the EGS-IR cohort. This represents an area for process of care measures to optimize quality care.

|                                     | All Abdominal Procedures<br>N=39,023 (%) | Appendectomy<br>N=14,092 (%) | Cholecystectomy<br>N=10,151 (%) | Gastrectomy<br>N=256 (%) | EGS-IR<br>N=10,431 (%) |
|-------------------------------------|--|------------------------------|---------------------------------|--------------------------|------------------------|
| <b>SSI - superficial</b>            | <b>904 (2.3)</b>                         | <b>158 (1.1)</b>             | <b>63 (0.6)</b>                 | <b>27 (2.4)</b>          | <b>586 (5.6)</b>       |
| <b>SSI - deep</b>                   | <b>285 (0.7)</b>                         | <b>50 (0.4)</b>              | <b>13 (0.1)</b>                 | <b>14 (1.3)</b>          | <b>178 (1.7)</b>       |
| <b>SSI - organ space</b>            | <b>795 (2.0)</b>                         | <b>210 (1.5)</b>             | <b>81 (0.8)</b>                 | <b>46 (4.1)</b>          | <b>417 (4.0)</b>       |
| <b>Pneumonia</b>                    | <b>1,191 (3.0)</b>                       | <b>79 (0.6)</b>              | <b>105 (1.0)</b>                | <b>114 (10.2)</b>        | <b>770 (7.4)</b>       |
| <b>Sepsis</b>                       | <b>1,092 (2.8)</b>                       | <b>177 (1.3)</b>             | <b>102 (1.0)</b>                | <b>82 (7.3)</b>          | <b>643 (6.2)</b>       |
| <b>Severe Sepsis</b>                | <b>1,110 (2.8)</b>                       | <b>67 (0.5)</b>              | <b>84 (0.8)</b>                 | <b>83 (7.4)</b>          | <b>782 (7.5)</b>       |
| <b>UTI</b>                          | <b>332 (0.9)</b>                         | <b>27 (0.2)</b>              | <b>70 (0.7)</b>                 | <b>17 (1.5)</b>          | <b>186 (1.8)</b>       |
| <b>C Diff</b>                       | <b>230 (0.6)</b>                         | <b>30 (0.2)</b>              | <b>35 (0.3)</b>                 | <b>10 (0.9)</b>          | <b>127 (1.2)</b>       |
| <b>All Infectious Complications</b> | <b>5,939 (15.2)</b>                      | <b>798 (2.0)</b>             | <b>553 (1.4)</b>                | <b>393 (1.0)</b>         | <b>3,689 (9.5)</b>     |

Fig 1. Emergency General Surgery top procedure categories and infectious complication rates

(EGS-IR = Emergency General Surgery Intestinal Resections; SSI = Surgical Site Infection; UTI = Urinary Tract Infection)

|                          | EGS-IR Cohort<br>N=10,431 (%) | ACS model<br>N=1,984 (%) | Hybrid Model<br>N= 1,969 (%) | GSS model<br>N=6,478 (%) | p-value          |
|--------------------------|-------------------------------|--------------------------|------------------------------|--------------------------|------------------|
| <b>SSI - superficial</b> | <b>586 (5.6)</b>              | <b>124 (6.3)</b>         | <b>87 (4.4)</b>              | <b>375 (5.8)</b>         | <b>0.03</b>      |
| <b>SSI - deep</b>        | <b>178 (1.7)</b>              | <b>15 (0.8)</b>          | <b>58 (3.0)</b>              | <b>105 (1.6)</b>         | <b>&lt;.0001</b> |
| <b>SSI - organ space</b> | <b>417 (4.0)</b>              | <b>76 (3.8)</b>          | <b>54 (2.7)</b>              | <b>287 (4.4)</b>         | <b>0.003</b>     |
| <b>Sepsis</b>            | <b>643 (6.2)</b>              | <b>91 (4.6)</b>          | <b>194 (9.9)</b>             | <b>358 (5.5)</b>         | <b>&lt;.0001</b> |
| <b>Severe Sepsis</b>     | <b>782 (7.5)</b>              | <b>142 (7.2)</b>         | <b>155 (7.9)</b>             | <b>485 (7.5)</b>         | <b>NS</b>        |
| <b>Pneumonia</b>         | <b>770 (7.4)</b>              | <b>121 (6.1)</b>         | <b>189 (9.6)</b>             | <b>460 (7.1)</b>         | <b>&lt;.0001</b> |
| <b>UTI</b>               | <b>186 (1.8)</b>              | <b>39 (2.0)</b>          | <b>34 (2.0)</b>              | <b>113 (1.7)</b>         | <b>NS</b>        |
| <b>C diff</b>            | <b>127 (1.2)</b>              | <b>29 (1.5)</b>          | <b>17 (0.9)</b>              | <b>81 (1.3)</b>          | <b>NS</b>        |

Fig 2. Emergency General Surgery Intestinal Resection (EGS-IR) cohort, **bivariate** analysis for outcomes of major infectious complications

(ACS = Acute Care Surgery; GSS = General Surgery Service; SSI = Surgical Site Infection; UTI = Urinary Tract Infection)

Scientific Session IV-B – Acute Care Surgery

Paper #31  
January 17, 2020  
8:25 am

**OBESITY STARTS EARLY AFTER COMBAT AMPUTATION AND COMES WITH THE RISK OF  
MULTIPLE CO-MORBIDITIES**

Robert Conrad, MD, Kelli Ishihara, MD, Dylan Russell, MD, Robert Lim, MD  
Tripler Army Medical Center

**Presenter:** Robert Conrad, MD

**Discussant:** Stephanie Streit, MD, United States Air Force

**Objectives:** The Joint Trauma System (JTS) estimates up to 1500 individuals have sustained a combat-related amputation during the Global War on Terror. Anecdotal data shows they may develop obesity and cardiovascular disease, but the incidence of obesity and associated comorbidities in this population is unknown. We sought to determine the prevalence of obesity and obesity related diseases in the military amputee population and to compare this to the general population.

**Methods:** Retrospective review of the JTS database of 964 combat-related amputation (2001-2015). Data included height, weight, and comorbidities pre and post injuries. Prevalence of obesity and comorbid conditions were determined and compared against the published rates of the United States (RD=rate difference). Kaplan-Meier curves were generated to illustrate onset of obesity and associated comorbidities.

**Results:** The prevalence of obesity was higher in amputees compared to the general population (55.6% vs. 39.8%). Half of amputees were obese at 6.3 years post-amputation with the majority of these patients having developed obesity at 1.1 years post-amputation. 385 patients were analyzed to determine the prevalence of certain co-morbid conditions. HTN (25% vs 8%; RD 9% to 25%;  $p < 0.01$ ), HLD (36% vs 14%; RD 13% to 31.1%;  $p = < 0.0001$ ), and OSA (23% vs 8.%; RD 7.1% to 22.%;  $p < 0.01$ ) were significantly higher in the obese amputee population. The rates of T2DM, CKD, MDD, and PTSD were not significantly different.

**Conclusions:** There is an increased prevalence of obesity in the amputee population with median onset of 13 months post injury. HTN, HLP, and OSA exist at a higher rate among obese amputees compared to non-obese amputees. This suggests early aggressive intervention to prevent obesity may also reduce rates of chronic co-morbid medical conditions in the amputee population. Weight gain appears independent of psychiatric disorders. Further analysis of this population may provide insight into the disease of obesity.

Scientific Session IV-B – Acute Care Surgery

Paper #32  
January 17, 2020  
8:45 am

**USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) SOFTWARE TO MAP HOTSPOTS FOR PENETRATING INJURIES AND IMPROVE LOCATION SELECTION FOR STOP THE BLEED INTERVENTIONS**

Chase Knickerbocker, MD, MHP, Jose Lozada, MD, MS\*,  
Mario F. Gomez, DO\*, Eli Levitt, MS, Ivan Puente, MD\*  
Broward Health Medical Center

**Presenter:** Chase Knickerbocker, MD, MHP

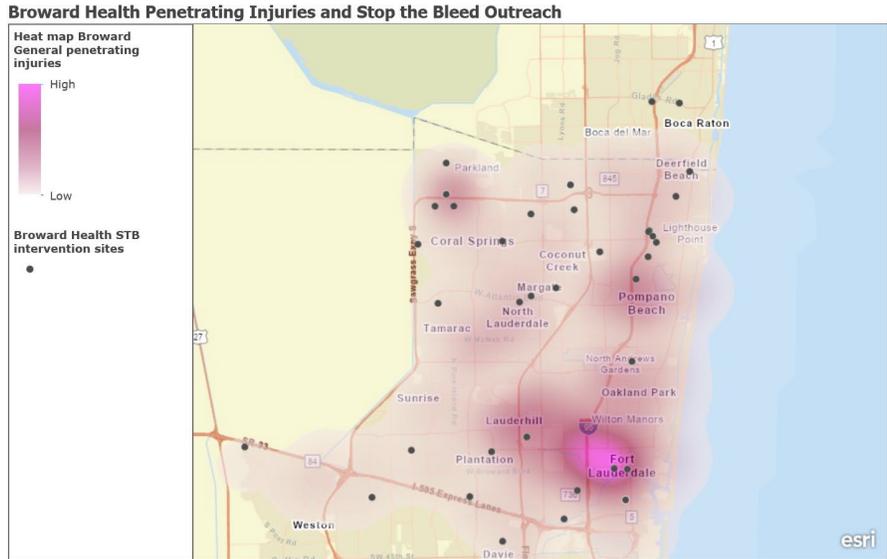
**Discussant:** Evan Wong, MD, MPH, McGill University

**Objectives:** The Broward Health Trauma System (BHTS) saw 395 penetrating injuries in 2018, the majority of which were gunshot wounds. BHTS has hosted 105 Stop the Bleed (STB) campaign interventions in 2018. Our goal is to ascertain whether this information is being disseminated effectively by mapping out hotspots for penetrating trauma and cross referencing these with the locations of STB interventions over the same time period.

**Methods:** All penetrating traumas received by the BHTS in 2018 were mapped based on location of incident. These included gunshot wounds, stabbings, bites, and limb severing traumas. Geographic Information Systems (GIS) software was used to create heat maps highlighting areas with the highest concentration of penetrating injuries both with and without a local civilian mass shooting event. STB locations were also mapped out and these maps were superimposed on one another using the software. Buffer and distance analysis of locations were also performed.

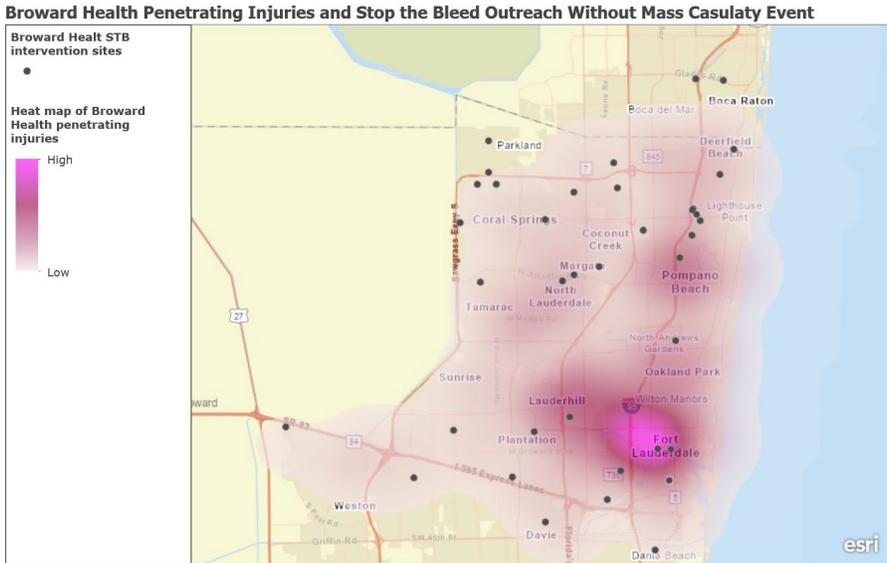
**Results:** Several areas on Map 1 were identified as hot spot. These hot spots were then compared to the locations of STB interventions. After eliminating data from the mass shooting at Stoneman Douglass High School, only 16 of the 105 STB interventions fell within designated hotspots as seen on Map 2. This was defined as interventions within medium intensity areas or higher.

**Conclusions:** GIS software is a powerful public health tool that can be used to quickly and efficiently map data and perform a variety of statistical analyses. Although over 100 STB interventions were performed by BHTS in 2018, there are clearly areas of increased need within the community that may benefit from more targeted interventions. From this information and the use of statistical analysis, we have identified centralized locations within the hot spots that can act as hosts for future Stop the Bleed interventions.



FDEP, Esri, HERE, Garmin, METI/NASA, USGS, EPA, NPS, USDA

Map 1. Heat map of penetrating injuries received by the Broward Health Trauma System in 2018. Superimposed map of Stop the Bleed intervention sites within the same year.



FDEP, Esri, HERE, Garmin, METI/NASA, USGS, EPA, NPS, USDA

Map 2. Heat map of penetrating injuries received by the Broward Health Trauma System in 2018 without those injured in the 2018 Marjory Stoneman Douglas High School civilian mass shooting event. Superimposed map of Stop the Bleed intervention sites within the same year.

Scientific Session IV-B – Acute Care Surgery

Paper #33  
January 17, 2020  
9:05 am

**DO EARLY NON-STEROIDAL ANTI-INFLAMMATORY DRUGS FOR ANALGESIA WORSEN ACUTE KIDNEY INJURY AFTER SEVERE TRAUMA? A PROPENSITY SCORE ANALYSIS**

Gabrielle E. Hatton, MD, Cynthia Bell, MS, Shuyan Wei, MD,  
Charles E. Wade, PhD, Lillian Kao, MD MS, John A. Harvin, MD\*  
University of Texas Health Science Center at Houston

**Presenter:** Gabrielle E. Hatton, MD

**Discussant:** Zaffer Qasim, MBBS, Perelman School of Medicine at the Univ. of Pennsylvania

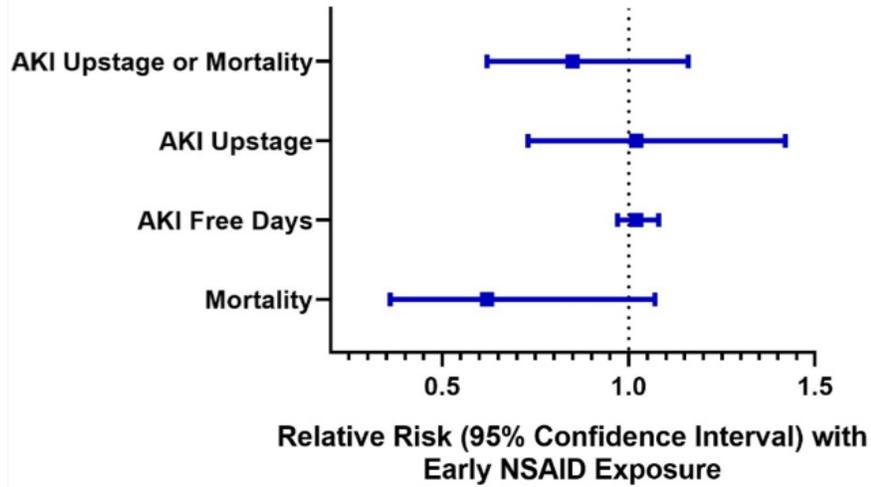
**Objectives:** Non-steroidal anti-inflammatory drugs (NSAIDs) are a class of opioid-sparing analgesics used in multimodal pain regimens. However, they may worsen acute kidney injury (AKI) given concomitant risk factors such as hypovolemia. We aimed to determine if early NSAID exposure is associated with worsened AKI after severe trauma.

**Methods:** A cohort study of adult (=16 years) trauma intensive care unit patients with =1 rib fractures and surviving >24 hours between 2010 and 2017 was performed. Early NSAID exposure was defined as receipt of =1 dose within 48 hours of admission. The primary outcome was AKI upstage or death within 7 days; AKI upstage was defined as an increase in AKI stage as defined by the KDIGO guidelines. Secondary outcomes were AKI upstage, AKI-free days, and death. Propensity for early NSAIDs was calculated by logistic regression and nearest neighbor matching was performed in a 1:4 ratio (early NSAIDs: controls). Frequentist and Bayesian analyses were performed, including sensitivity analyses utilizing NSAID doses in lieu of exposure.

**Results:** Of 2,490 patients, 271 administered early NSAIDs were matched to 1,084 controls. Most patients were male (72%) with a median injury severity score of 22 and a median age of 46 years. The control group had a higher incidence of the primary outcome (20% vs 15%,  $p=0.08$ ) and death (10% vs 4%,  $p=0.01$ ), but AKI upstage was similar between groups (15% vs 14%,  $p=0.80$ ). On frequentist analyses, neither early NSAID exposure nor number of NSAID doses were associated with primary or secondary outcomes (**Figure**). Early NSAIDs were associated with a lower mortality on Bayesian analyses (**Table**).

**Conclusions:** In this study, early NSAID exposure was not associated with AKI upstage or fewer AKI-free days. This finding must be further investigated as selection bias was possible, given the mortality discrepancy between the two groups.

### Relative Risk of Primary and Secondary Outcomes With Early NSAID Exposure



**Figure:** Frequentist Analyses Results

|                      | Relative Risk with Early NSAID Exposure (95% Credible Interval) | Posterior Probability that Early NSAIDs Increases Outcome |
|----------------------|---|---|
| Upstage or Mortality | 0.77 (0.56-1.05)  | 5%  |
| AKI Upstage          | 0.94 (0.67-1.28)  | 35%   |
| AKI Free Days        | 1.00 (0.94-1.05)  | 45%   |
| Mortality            | 0.54 (0.28-0.89)  | <1%   |

**Table:** Bayesian Analyses Results

Scientific Session IV-B – Acute Care Surgery

Paper #34  
January 17, 2020  
9:25 am

**SIMULATION-BASED OBJECTIVE STRUCTURED CLINICAL EXAMINATION (OSCE) FOR THE EVALUATION AND TRAINING OF ADVANCED SURGICAL SKILLS IN TRAUMA**

Pablo Achurra, MD, Juan Pablo Ramos, MD, Rolando Rebolledo, MD, PhD,  
Martin Inzunza, MD, Jose Quezada, MD, Rodrigo Tejos, MD,  
Pablo Ottolino, MD, Julian Varas, MD  
Pontificia Universidad Catolica de Chile

**Presenter:** Pablo Achurra, MD

**Discussant:** Hee Soo Jung, MD, University of Wisconsin

**Objectives:** To describe and validate a novel objective structured clinical examination (OSCE) for the training and evaluation of advanced surgical skills in trauma.

**Methods:** We developed an OSCE with 6 stations for the evaluation and training of basic and advanced surgical skills based on simulation, all stations used real animal tissue. 1. Basic knots and sutures; 2. Bowel resection and anastomosis (bovine bowel); 3. Vascular end-to-end anastomosis (5mm perfused blood vessels); 4. Lung injury repair (ventilated ex-vivo porcine model) 5. Cardiac injury repair (porcine ex-vivo perfused and pumping heart model); 6. Laparoscopic suturing of bowel injury.

Participants had 20 min in each station to complete the procedure objectives. All procedures were video recorded and later blindly evaluated by experts using validated general and specific rating scales (OSATS). Participants were helped by a passive assistant in each station. OSATS max. score was 25 for each station (150 for the complete OSCE).

**Results:** Eight postgraduate year 2 (PY-2); 8 recently graduated surgeons (RGS) and 3 experts were assessed in each station.

Significant differences were identified between groups. Average OSATS were 82 for PY2, 113 for RGS and 147 for experts ( $p < 0.01$ ). Average procedure time was 98 minutes for PY2, 79 minutes for RGS and 53 minutes for expert surgeons ( $p < 0.01$ ).

Minor differences were identified in basic knots and sutures station but mayor differences were identified in the vascular and cardiac injury stations. Average OSATS in vascular anastomosis were 12 (range: 10-15); 18 (12-20) and 24 (24-25) for PY-2, RGS and experts respectively. In cardiac injury, average OSATS were 10 (8-15); 20 (18-22) and 25 respectively.

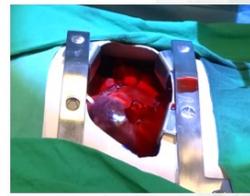
**Conclusions:** Advanced surgical trauma skills can be efficiently evaluated through a standardized OSCE using ex-vivo tissue based simulation stations.



Knots and Sutures



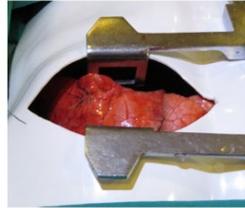
Laparoscopic Suturing



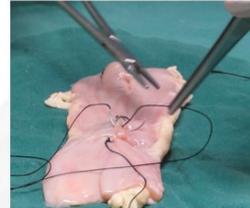
Cardiac Injury



Vascular anastomosis



Lung injury



Bowel injury

## OSCE stations