Scientific Papers

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

Paper #1
January 11, 2017
8:00 am

EVERY MINUTE COUNTS: TIME TO DELIVERY OF INITIAL MASSIVE TRANSFUSION COOLER AND ITS IMPACT ON MORTALITY

David Meyer, MD, Laura Vincent, Erin Fox, Terence O'Keeffe, MD, MSPH*, Martin A. Schreiber, MD, FACS*, Sandro Rizoli, MD, PhD, FRCSC, FACS*, Kenji Inaba, MD, Peter Muskat, Karen Brasel, MD, Mitchell J. Cohen, MD, FACS, Eileen M. Bulger, MD, Jeffrey D. Kerby, MD, PhD*, John B. Holcomb, MD*, Deborah M. Stein, MD, MPH, FACS, FCCM*, Bryan A. Cotton, MD, MPH*
Center for Translational Injury Research, Department of Surgery, University of Texas-Houston

Presenter: David Meyer, MD

Discussant: Matthew J. Bradley, MD, United States Navy

Objectives: ACS-TQIP Best Practices recommends initial massive transfusion (MT) cooler delivery within 15 minutes of protocol activation, with a goal of 10 minutes. The current study sought to examine the impact of timing of first cooler delivery on patient outcomes.

Methods: Patients predicted to receive MT at 12 level-1 trauma centers were randomized to two separate transfusion ratios as described in the PROPPR trial. ABC score or clinician gestalt prediction of MT was used to randomize patients and call for initial study cooler. In this planned sub-analysis, the time to MT protocol activation and time to delivery of the initial cooler were evaluated. The impact of these times on mortality and time to hemostasis were examined using both Wilcoxon rank sum and linear and logistic regression.

Results: Among 680 patients, the median time from patient arrival to MT protocol activation was 9 minutes with a median time from MT activation call to delivery of first cooler of 8 minutes. An increase in both time to MT activation and time to arrival of first cooler were associated with prolonged time to achieving hemostasis (corr.coef 1.09, $p=0.001$ and corr.coef. 1.16, $p<0.001$, respectively). Increased time to MT activation and time to arrival of first cooler were associated with increased mortality (OR 1.02, $p=0.009$ and OR 1.02, $p=0.012$, respectively). Controlling for injury severity, physiology, resuscitation intensity, and treatment arm (1:1:1 vs. 1:1:2), increased time to arrival of first cooler was associated with an increased mortality at 24-hours (OR 1.05, $p=0.035$) and 30-days (OR 1.05, $p=0.016$).

Conclusions: Delays in MT protocol activation and delays in initial cooler arrival were associated with prolonged time to achieve hemostasis and an increase in mortality. Independent of products ratios, every minute from time of MT protocol activation to time of initial cooler arrival increases odds of mortality by 5%.

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Paper #2
January 11, 2017
8:20 am

KAOLIN-BASED HEMOSTATIC DRESSING IMPROVES HEMORRHAGE CONTROL FROM A PENETRATING IVC INJURY IN COAGULOPATHIC SWINE

Kiavash R. Koko, MD, Brian McCauley, Ashleigh Hagaman, Ryan Nolan, Marc Fromer, John Gaughan, Spencer Brown, Joshua P. Hazelton, DO, FACS*
Cooper University Hospital

Presenter: Kiavash R. Koko, MD

Discussant: Daniel J. Grabo, MD, Navy Trauma Training Center

Objectives: Retrohepatic Vena Cava (RVC) Injuries are often lethal due to challenges in obtaining hemorrhage control. We hypothesized that packing with a new kaolin-based hemostatic dressing (Z-Medica, D2 Hemostatic Dressing™) would improve hemorrhage control from a penetrating RVC injury compared to packing with standard laparotomy pads alone.

Methods: Twelve male Yorkshire pigs received a 25% exchange transfusion of blood for refrigerated normal saline to induce a coagulopathy. A laparotomy was performed and a standardized 1.5cm injury to the RVC was created which was followed by temporary abdominal closure and a period of uncontrolled hemorrhage. When the mean arterial pressure reached 70% of baseline, demonstrating hemorrhagic shock, the abdomen was re-entered and the injury was treated with perihepatic packing using standard laparotomy pads (LP;n=6) or a new kaolin-based hemostatic dressing (D2;n=6). Animals were then resuscitated for 6 hours with crystalloid solution. The two groups were compared using the Wilcoxon rank sum test and Fisher exact test for matched groups with equal variance. A $p \leq 0.05$ was considered statistically significant.

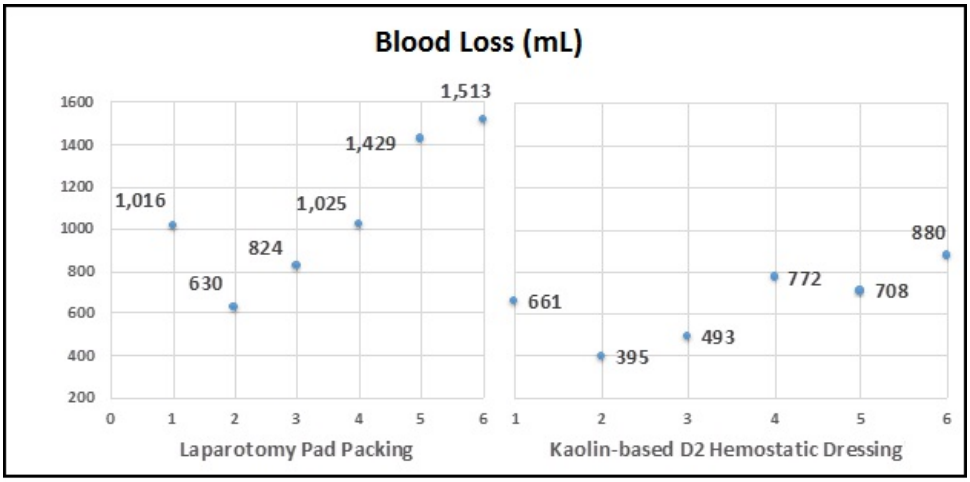
Results: There was no difference in the animal's temperature, heart rate, mean arterial pressure, cardiac output, and blood loss before at baseline or before packing was performed (all $p>0.05$). In the laparotomy pad group, 5 of 6 pigs survived the entire study period while all 6 pigs treated with kaolin-based D2 hemostatic dressings survived. Importantly, there was significantly less blood loss after packing with the new hemostatic kaolin-based dressing compared to packing with laparotomy pads (651mL$\pm$ 180 vs 1073mL$\pm$ 342;$\leq$0.05).

Conclusions: These results demonstrate that the use of this new hemostatic kaolin-based dressing improved hemorrhage control and significantly decreased blood loss in this penetrating RVC model.

Table 1: Pre-Intervention Demographics and Post-Intervention Outcomes

	Laparotomy Pads (n=6)	Kaolin D2 Dressing (n=6)	*p* value
Pre-Injury (baseline)			
Temperature (°C)	35.1 ± 0.9	34.3 ± 1.9	0.32
Mean Heart Rate (bpm)	105.1± 9.4	99.5 ±0.7	0.25
Mean Arterial Pressure (mmHg)	62.6 ± 6.7	65.5 ± 8.2	0.59
Cardiac Output (L/min)	4.7 ± 0.6	4.0	0.91
Post-Injury/Time of Intervention			
Temperature (°C)	35.1 ± 0.9	34.3 ± 1.9	0.32
Mean Heart Rate (bpm)	106.5 ± 9.7	99.5± 8.3	0.87
Mean Arterial Pressure (mmHg)	62.6 ± 6.7	65.5 ± 8.2	0.59
Cardiac Output (L/min)	4.8 ± 0.7	4.0	0.78
Post-Intervention/Resuscitation			
Surviving Animals	5	6	-
Intravenous Fluid Resuscitation (mL)	4453 ± 2351	3388 ± 1866	0.58
Blood Loss (mL)	1073 ± 342	651 ± 179	0.05

Table 1: Baseline hemodynamic parameters; Hemodynamic parameters following injury and at the time of packing; Outcomes following packing and resuscitation



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Paper #3
January 11, 2017
8:40 am

DISTANCE MATTERS: EFFECT OF GEOGRAPHIC TRAUMA SYSTEM RESOURCE ORGANIZATION ON FATAL MOTOR VEHICLE COLLISIONS

Joshua B. Brown, MD, MSc*, Matthew R. Rosengart, MD, MPH, FACS*, Timothy Billiar, MD, Andrew B. Peitzman, MD*, Jason L. Sperry, MD, MPH*
University of Pittsburgh Medical Center

Presenter: Joshua B. Brown, MD, MSc

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

Objectives: Trauma systems improve outcome; however, it is unclear how geographic organization of resources affects outcome. Our objective was to evaluate the relationship between geographic distance to trauma system resources (TSR) and rate of fatal motor vehicle collisions (MVC).

Methods: All fatal MVC in Pennsylvania 2013-14 were mapped from the FARS database. Deaths on scene were excluded. TSR including trauma centers and helicopter bases were also mapped. The distance between each MVC and the nearest TSR was determined and averaged at the county-level. Primary outcome was the proportion of fatal MVC per 100million vehicle miles traveled (VMT) in each county. Empiric Bayes Kriging and hotspot analysis were performed to evaluate geographic patterns in fatal MVC rates. The association between fatal MVC rate and distance to the nearest TSR was evaluated with linear regression. Spatial lag regression was used to evaluate this association while controlling for county-level characteristics.

Results: 863 fatal MVC were included with 884 fatalities. The median fatal MVC rate was 0.187 per 100million VMT. Figure 1 depicts that higher fatal MVC rates and fatality hotspots occur in locations farther from any TSR. The fatal MVC rate increased 0.014 per 100million VMT for each mile farther from the nearest TSR ($p<0.01$, Fig 2). When controlling for county-level factors, the fatal MVC rate increased by 0.009 per 100million VMT for each mile farther from the nearest TSR ($p<0.01$). If 2 helicopters stationed at trauma centers were relocated into the highest fatality regions, our model predicts a 12.3% relative reduction in overall MVC fatality rate.

Conclusions: Increasing distance to the nearest TSR is associated with increasing fatal MVC rate. These results suggest geographic organization of trauma systems may impact outcome, and can target problem areas to allow data-driven changes to potentially improve outcome.

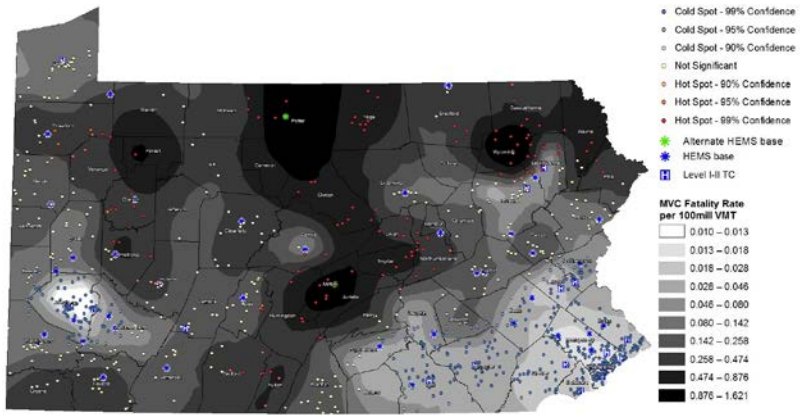

Figure 1. Fatal MVC in Pennsylvania 2013-14. Gray scale color ramp represents proportion of fatal MVC/100million vehicle miles traveled. Individual MVC are represented by color dot corresponding to hotspot analysis. Level I/II trauma centers represented by blue hospital symbol; helicopter bases represented by blue star; relocated helicopter bases represented by green star.

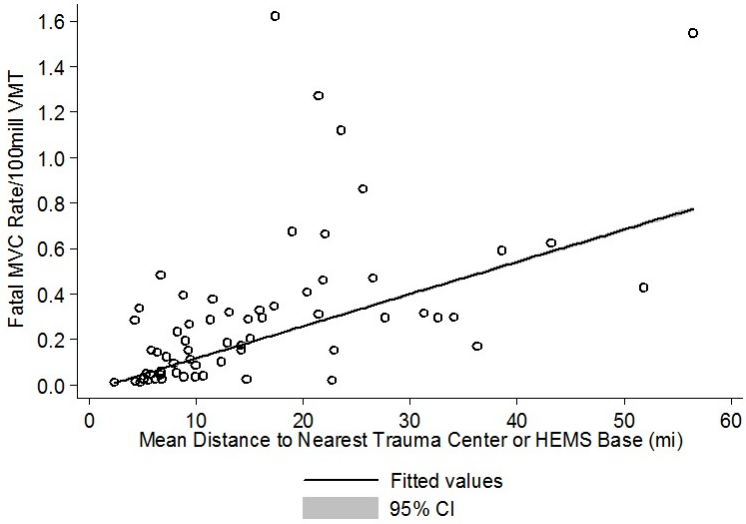

Figure 2. Plot of fatal MVC rate by mean distance to the nearest trauma system resource by Pennsylvania county. Line represents fitted linear regression values with 95% confidence interval.

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Paper #4
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9:00 am

IS AN FVC OF 1.5 ADEQUATE FOR PREDICTING RESPIRATORY SUFFICIENCY IN RIB FRACTURES?

Rachel L. Warner, DO, Nicole Cornell, Porter Knollinger, Alison M. Wilson, MD*
West Virginia University

Presenter: Rachel L. Warner, DO

Discussant: Staphanie Nitzschke, MD, Brigham and Women's Hospital

Objectives: Rib fractures (Rfx) are common injuries that can be a source of morbidity and mortality. A Rfx care pathway based on Forced Vital Capacity (FVC), rather than # of fractures, was implemented. Pts care was divided into 3 groups based on an admission FVC (aFVC): less 1.0, 1.1 - 1.5, > 1.5. Our objective was to test the hypothesize that aFVC ≥1.5L, regardless of # of Rfx, is a predictor of low risk of complications.

Methods: This was a retrospective analysis of pts admitted on the Rfx pathway from 2009-2014. In that period, the pathway was unchanged. Pts with a TBI, SCI, intubated or without a recorded admission FVC were excluded. Other injuries were not excluded. Admission, lowest and highest FVC, demographics and complications (pneumonia, re-admission, intubation and unplanned upgrade to the ICU) were collected. P-value of <0.01 was considered significant.

Results: There were 678 pts with aFVC ≥1.5 and 682 < 1.5 group. Those with aFVC of ≥1.5 had a lower complication rate [2% (≥1.5) vs 11% (<1.5), p < .0001]. The rate of pneumonia and readmission was lower in patients with aFVC ≥1.5 [PNA: 1% (≥1.5) vs 6% (<1.5), p <.0001; ReAdm: 0.7% (≥1.5) vs 4.7% (<1.5), p <.0001]. Rates of unplanned upgrades to the ICU were very low and not different [0.5% (≥1.5) vs 1.6% (<1.5), p 0.1]. Pts with aFVC ≥1.5 and COPD were not more likely to have complications, however those <1.5 were [9% (no COPD) vs 22% (COPD) p.0005]. LOS was shorter with a higher aFVC [4d (≥1.5) vs 8d (<1.5). aFVC and AIS chest were weakly correlated (R -.3).

Conclusions: Admission FVC can be used to triage pts and predict complications. Pts with aFVC ≥≥1.5 are low risk for complication independent of # of rib fx. Pts with isolated Rfx + FVC >1.5 may be able to be discharged from the ED with low risk of re-admission. Limitations include a retrospective analysis and does not account for other injuries which may confound data.

Table 1. Patient Characteristics		
Characteristics	**FVC ≥ 1.5**	**FVC < 1.5**
	n =678	**n=682**
Age	47	54
Gender (M,F)	562 (83%), 117 (17%)	399 (59%), 282 (41%)
AIS Chest	2	3
ISS	13	16
Chest tube present	66 (.09%)	54 (.07%)
COPD	54 (.08%)	104 (15%)
Hospital LOS	4	8

Table 1. demographic information for patients included in the FVC ≥1.5 group and the patients in the FVC <1.5 group. Age, AIS, ISS and Hospital length of stay are reported as mean values.

Table 2. Complication rates		
Complications	**FVC ≥ 1.5**	**FVC < 1.5**
	n =678	**n = 682**
PNA	9 (.01%)	41 (.06%)
Re-Intubation	0 (0%)	6 (.01%)
Re-admission	5 (.01%)	32 (.05%)
Unplanned upgrade to ICU	4 (.01%)	11 (.02%)
Any complication	18 (2%)	76 (11%)

Table 2. complication rates for patients in the group for patients with admission FVC ≤1.5 and the patients with admission FVC < 1.5 .

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Paper #5
January 11, 2017
9:20 am

IMPROVED OUTCOMES FOLLOWING IMPLEMENTATION OF AN ACUTE GASTROINTESTINAL BLEEDING MULTIDISCIPLINARY PROTOCOL

Tyler Loftus, MD, Kristina Go, Chasen Croft, MD*, Philip Efron, MD*, R. Stephen Smith, Steven Hughes, Frederick Moore, MD*, Scott C. Brakenridge, MD, MSCS, FACS*, Alicia M. Mohr, MD*, Janeen Jordan, MD*
University of Florida

Presenter: Tyler Loftus, MD

Discussant: Alison M. Wilson, MD, West Virginia University

Objectives: Effective multidisciplinary management of gastrointestinal bleeding (GIB) requires effective communication. We implemented a protocol to standardize communication practices with the hypothesis that outcomes would improve following protocol initiation.

Methods: We performed a retrospective cohort analysis of 442 patients who required procedural management of acute GIB at our institution during a 50 month period spanning 25 months before and after implementation of a multidisciplinary communication protocol. The protocol stipulates that when a patient with severe GIB is identified, a conference call is coordinated among the Gastroenterology, Interventional Radiology, and Acute Care Surgery teams. A consensus plan is generated and then reassessed following procedural interventions and changes in patient status. Patient characteristics, management strategies, and outcomes were compared before and after protocol initiation.

Results: Patient populations before and after protocol initiation were similar in terms of age, etiology of GIB, comorbidities, outpatient use of antiplatelet/anticoagulant medications, admission vital signs, admission laboratory values, and number of procedures performed per specialty. Management and outcome parameters are listed in Table 1. Following protocol implementation, we observed significant improvements in time to first procedural intervention (40 vs. 47 hours), incidence of packed red blood cell (PRBC) transfusion (41% vs. 50%), hospital length of stay (5.0 vs. 6.0 days), and readmission with GIB (8% vs. 15%).

Conclusions: Implementation of a multidisciplinary protocol for management of GIB was associated with earlier intervention, fewer PRBC transfusions, shorter hospital length of stay, and fewer readmissions with GIB. Future research should seek to establish causal relationships between communication practices and outcomes.

	Before protocol (n=219)	After protocol (n=223)	*p*
Hours from admission to first procedure	47 [26-72]	40 [21-64]	*0.046
Patients who had multiple procedures	52 (24%)	51 (23%)	0.910
Hours between procedures	65 [36-94]	47 [24-75]	0.064
PRBC transfusions per patient	1.0 [0.0-3.0]	0.0 [0.0-2.0]	*0.006
Patients who received a PRBC transfusion	111 (51%)	88 (40%)	*0.018
Hospital length of stay (days)	6.0 [3.0-9.0]	5.0 [3.0-8.0]	*0.014
Non-home disposition	65 (30%)	40 (18%)	*0.005
Inpatient mortality	12 (6%)	6 (3%)	0.155
Subacute rehabilitation	28 (13%)	25 (11%)	0.662
Long-term acute care	8 (4%)	1 (0.4%)	*0.019
Another hospital	7 (3%)	5 (2%)	0.573
Hospice	10 (5%)	3 (1%)	0.052
Readmission with GIB within 180 days	32 (15%)	17 (8%)	*0.023
Days to readmission	5.0 [3.0-8.0]	4.0 [3.0-6.0]	0.340

Table 1: Management and outcomes (data are presented as median [interquartile range] or n (%)).

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Paper #6
January 11, 2017
10:00 am

A COMPARISON OF PROGNOSIS CALCULATORS FOR GERIATRIC TRAUMA: A P.A.L.LI.A.T.E. CONSORTIUM STUDY

Tarik Madni, MD, Akpofure Peter Ekeh, MD*, Scott C. Brakenridge, MD, MSCS, FACS*, Karen Brasel, MD, MPH, Bellal Joseph, MD*, Kenji Inaba, MD, Brandon Bruns, MD, FACS*, Jeffrey D. Kerby, MD, PhD*, Joseph Cushcieri, Jane Mohler, Paul Nakonezny, Jonathan Imran, Steven E. Wolf, MD*, Elizabeth Paulk, Ramona Rhodes, Herb A. Phelan III, MD, FACS*
University of Texas Southwestern Medical Center

Presenter: Tarik Madni, MD

Discussant: Shea C. Gregg, MD, Bridgeport Hospital

Objectives: The nine-center PALLIATE consortium has validated the Geriatric Trauma Outcome Score (GTOS) as a prognosis calculator for injured elders. We compared GTOS' performance to that of the Trauma Injury Severity Score (TRISS) in a multicenter sample composed exclusively of geriatric trauma patients.

Methods: Three PALLIATE centers not submitting subjects to the GTOS validation study identified subjects aged 65 to 102 yrs admitted from 2000-2013. GTOS was specified using the formula [GTOS = age + (ISS x 2.5) + 22 (if transfused packed red cells (PRC) at 24 hrs)]. TRISS uses the Revised Trauma Score (RTS), dichotomizes age (<55 yrs=0 and >55 yrs=1), and was specified using the updated 1995 beta coefficients. TRISS Penetrating was specified as [$TRISS_P$ = -2.5355 + (0.9934 x RTS) + (-0.0651 x ISS) + (-1.1360 x Age)]. TRISS Blunt was specified as [$TRISS_B$ = -0.4499 + (0.8085 x RTS Total) + (-0.0835 x ISS) + (-1.7430 x Age)]. Each then became the sole predictor in a separate logistic regression model to estimate probability of mortality. Model performances were evaluated using misclassification rate, Brier score, and AUC.

Results: Demographics (mean + SD) of subjects with complete data (N=10,894) were age=78.3 yrs ± 8.1; ISS=10.9 ± 8.4; RTS=7.5 ± 1.1; mortality=6.9%; blunt=98.6%; received PRCs at 24 hrs=3.1%; arrived intubated=8.2%. The penetrating trauma sub-sample (n=150) had a higher mortality rate of 20.0%. The misclassification rates for the models were GTOS=0.065, $TRISS_B$=0.051, and $TRISS_P$=0.120. Brier scores were GTOS=0.052, $TRISS_B$=0.041, and $TRISS_P$=0.084. The AUCs were GTOS=0.844, $TRISS_B$=0.889, and $TRISS_P$=0.897.

Conclusions: GTOS and TRISS function similarly and accurately in predicting probability of death for injured elders. GTOS has the advantages of fewer variables to be collected, no reliance on data collected in the Emergency Room or by other observers, and a single formula for all mechanisms of injury.

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

Paper #7
January 11, 2017
10:20 am

ADEQUACY AND ACCURACY OF NON-TERTIARY TRAUMA CENTER COMPUTED TOMOGRAPHY: WHAT ARE WE MISSING?

Morgan M. Bonds, MD, Stephen G. Hersperger, MD*, Tabitha Garwe, PhD, R. Brian Fails, Sigrid Johannesen, Christina Kim, Ademola Adeseye, Prasenjeet Motghare, Jason S. Lees, MD*, William S. Havron III, MD*
The University of Oklahoma Health Sciences Center

Presenter: Morgan M. Bonds, MD

Discussant: Ben L. Zarzaur, MD, MPH, Indiana University School of Medicine

Objectives: Timely and appropriate use of computed tomography (CT) scans is critical in the evaluation of traumatic injuries. The objective of this study is to assess the adequacy of CT scans performed at non-tertiary trauma centers (NTCs) as they pertain to the management of trauma patients.

Methods: Adult patients transferred to our ACS-verified level 1 trauma center from any NTC between May and December 2012 were enrolled prospectively. Available CT images from NTCs were by our facility's primary trauma radiologist while being blinded to initial reads; his interpretations were compared with those from the NTC. If CT imaging was repeated at the tertiary trauma center (TTC), the reason was documented in real time. Interpretations of the TTC images were compared to those from the NTC. Means and proportions were used to summarize the data.

Results: A total of 235 consecutive patients with a complete dataset were included, of which, 203 (86.4%) had a CT scan performed at a NTC. Additional imaging was obtained at the TTC in 76% of patients with outside CT (154/203), with inadequacy of outside CTs for patient workup (76%) and technical inadequacy of outside images (31%) being the main, nonexclusive, reasons to repeat imaging. Image interpretation by the trauma radiologist at the TTC using NTC images identified missed injuries in 49% of patients, and 90% of these missed injuries were deemed clinically significant by reviewers. When the same body region was imaged at the TTC, 54% had missed injuries, of which 76% were deemed significant. Overall, images interpreted at the TTC identified additional injuries in 73% of patients with previous NTC imaging.

Conclusions: This is the first study to demonstrate inaccuracy in the interpretations of NTC images, which can lead to inappropriate management of trauma patients. Parameters other than imaging need to be utilized to identify patients requiring a higher level of care.

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

Paper #8
January 11, 2017
10:40 am

ASYMPTOMATIC NECK FRACTURES: CURRENT GUIDELINES CAN FAIL OLDER PATIENTS

Christopher D. Healey, MD, Carlos Pelaez, MD*, Sarah K. Spilman, MA
Iowa Methodist Medical Center

Presenter: Christopher D. Healey, MD

Discussant: John J. Como, MD, MPH, MetroHealth Medical Center

Objectives: Older adults represent a growing proportion of trauma patients treated in the United States. While clinical clearance of the cervical spine (c-spine) after trauma is standard practice and supported by current management guidelines, c-spine imaging may be warranted in this group given increased incidence of occult injury. The objective of this study was to investigate the prevalence of asymptomatic c-spine injury in an older trauma population.

Methods: A retrospective review was performed for patients aged 55 years or older with a c-spine fracture during the 4-year study period. All patients were GCS 15 at the time of clinical exam. Patients were considered asymptomatic or pain-free if they did not complain of neck pain on initial presentation and denied tenderness to palpation of the c-spine on exam. Differences between groups were assessed with Kruskal-Wallis and chi-square tests.

Results: Of 173 patients with c-spine fractures, 38 (22%) were asymptomatic and reported no neck pain on presentation or on exam. The pain-free group had higher median injury severity scores (15 vs 10, $p<.001$), were more likely to have a significant injury in another body region (71% vs 47%, $p=.002$), and had longer hospitalization (7 vs 5 days, $p=.004$) than patients with neck pain. One-third of patients had fractures at multiple levels. While the most common fracture was at the C2 level, more than 25% of patients with a C3, C6, or C7 fracture were pain-free.

Conclusions: Current guidelines state that radiological assessment is unnecessary for safe clearance of the asymptomatic c-spine in awake and alert blunt trauma patients, but this may not be the case for older patients. One-fifth of patients with a c-spine fracture reported no pain on initial presentation and denied tenderness to palpation on exam. We recommend liberal CT imaging of the c-spine for all older trauma patients, even with low probability of injury or normal clinical exam.

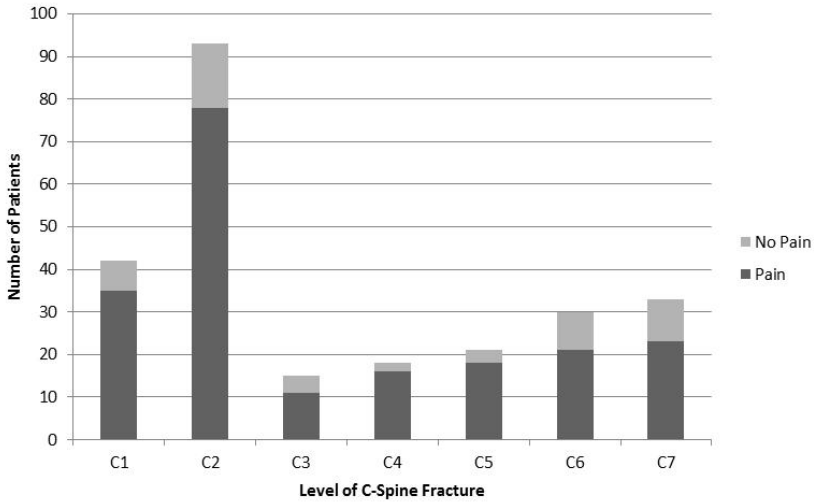


Figure 1. Level of c-spine fracture by report of neck pain, not mutually exclusive (N=173)

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

Paper #9
January 11, 2017
11:00 am

IS RESUSCITATIVE ENDOVASCULAR BALLOON OCCLUSION OF THE AORTA EFFECTIVE FOR MAJOR ABDOMINAL VENOUS INJURIES?

Michael S. Lallemand, MD, Donald Moe, John McClellan, Joshua Smith, Leo Daab, Shannon Marko, Nam Tran, Benjamin Starnes, Matthew J. Martin, MD*
Madigan Army Medical Center

Presenter: Michael S. Lallemand, MD

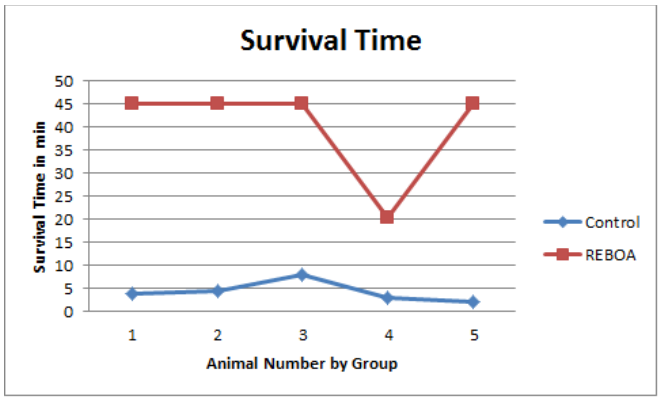
Discussant: Jason Pasely, DO, R Adams Cowley Shock Trauma Center

Objectives: Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) has emerged as a rescue maneuver for unstable patients with non-compressible torso hemorrhage. The efficacy of REBOA in the setting of a major abdominal venous injury is unknown. Our objective was to assess REBOA in an animal model of major abdominal venous injury, and characterize any impact on hemodynamics, rate and volume of hemorrhage, and survival.

Methods: Ten adult swine underwent controlled 35% blood volume hemorrhage then an ischemia/reperfusion injury protocol to produce shock physiology. Animals were assigned to either a control arm(N=5) or a treatment (REBOA) arm(N=5). An injury was created in the proximal right common iliac vein. Bleeding was allowed for 60 seconds and the balloon was then inflated in the REBOA arm. Vitals and hemodynamics were recorded for 45 minutes or until death. Balloon placement and blood loss was verified post-mortem, and bleeding rate calculated.

Results: All animals were in shock at the time of randomization. There were no differences between groups in baseline MAP, pH, lactate, or INR. All animals became hypotensive with the venous injury, but the REBOA animals demonstrated improvements in MAP throughout. There was no difference in blood loss between the arms, but the rate of bleeding was lower in the REBOA animals (control 197 cc/min, REBOA 18 cc/min, $p=0.02$). There was a significant difference in survival between groups, with a mean survival time of 4.1 minutes for controls and 40 minutes for REBOA($p<0.01$).

Conclusions: In the setting of major abdominal venous injury, inflow occulsion via REBOA improved hemodynamics and lengthened survival time. Blood loss was similar between groups and rate of bleeding was markedly decreased with REBOA. REBOA appears effective even for central venous injuries and provides a sustained period of stabilization and window for surgical intervention.



Comparison of survival times of animals between control arms and REBOA

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

Paper #10
January 11, 2017
11:20 am

BIGGER IS BETTER: COMPARISON OF ALTERNATIVE DEVICES FOR TENSION HEMOPNEUMOTHORAX AND PULSELESS ELECTRICAL ACTIVITY IN A YORKSHIRE SWINE MODEL

Matthew L. Leatherman, DO, Laura Fluke, DO, Robert Ricca, MD
Christian McEvoy, MD, Douglas Pokorny, MD, Christopher Gamble, DVM, Travis M. Polk, MD*
Naval Medical Center Portsmouth, Virginia

Presenter: Matthew L. Leatherman, DO

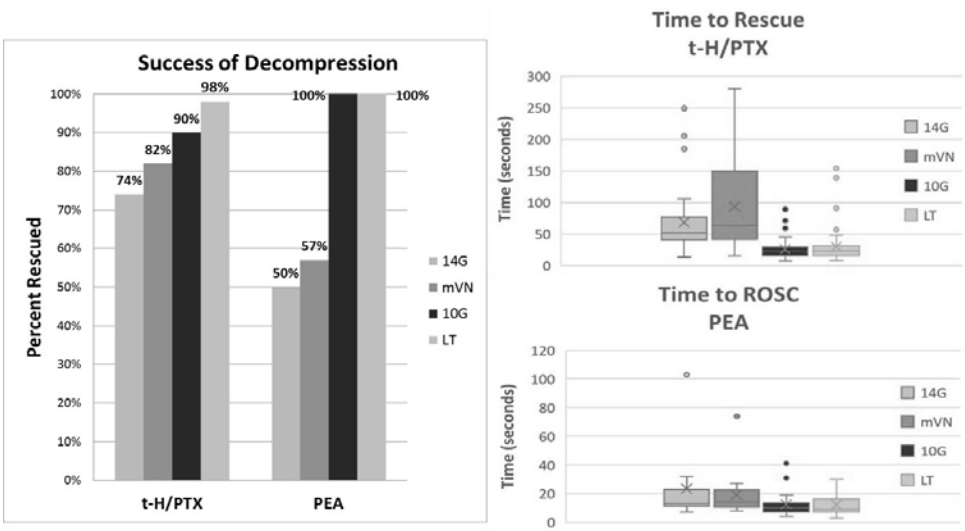
Discussant: Bellal Joseph, MD, The University of Arizona

Objectives: Tension pneumothorax (t-PTX) is a potentially survivable injury that often involves some degree of hemothorax. Although 14g angiocatheter (AC) thoracostomy remains the recommended treatment for t-PTX, it has a high failure rate and no proven efficacy with concomitant bleeding. We sought to compare the relative efficacy of the 14g AC with three other devices in a positive pressure ventilation tension hemopneumothorax (t-H/PTX) model.

Methods: Our t-PTX model was adapted to simulate t-H/PTX. 10% estimated blood volume was sequentially instilled into each chest. Serial tension events (50% drop in cardiac output) were achieved via intrathoracic CO2 insufflation with a simulated air leak. Decompression occurred with 14g AC, 10g AC, modified Veress needle (mVN), or 3mm laparoscopic trocar (LT). Following recovery, serial PEA events were induced and decompressed. Rescue was defined as a return to >80% systolic blood pressure for t-H/PTX or return of spontaneous circulation (ROSC) for PEA. Success of rescue, time to rescue, physiologic and necropsy data were recorded.

Results: 195 t-H/PTX and 88 PEA events were conducted in 25 Yorkshire swine. LT and 10g AC were more successful than 14g AC at rescue from both t-H/PTX and PEA , while mVN performed comparably(Fig 1a). 10g AC and LT were faster at rescue from t-H/PTX than both 14g AC and mVN(Fig 1b). Time to ROSC did not differ between devices(Fig 1c); however, there was a noticeable difference between the rates of hemodynamic recovery following PEA (Fig 2). Necropsy showed no significant injuries.

Conclusions: 10g AC outperforms both 14g AC and mVN in treatment of t-H/PTX. While LT is as effective as 10g AC, this device would require significant manufacturing work and other devices are readily available. Expeditious replacement of 14g AC with 10g AC in civilian and military t-PTX protocols should be strongly considered.



Figures 1a, 1b, 1c

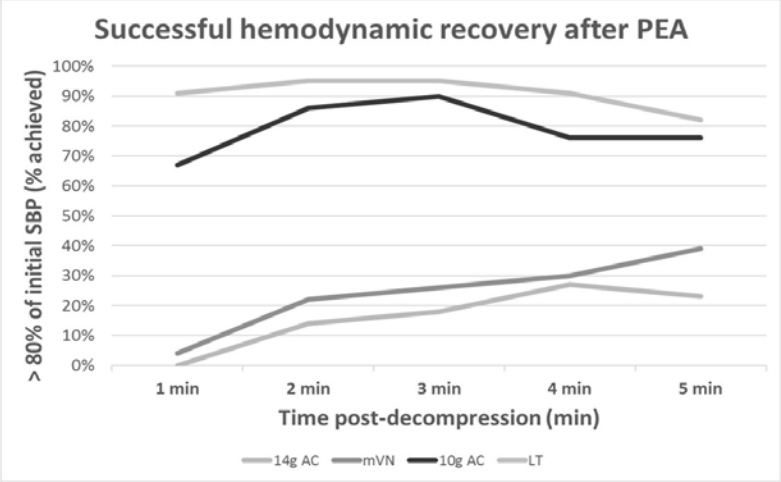


Figure 2

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

Paper #11
January 11, 2017
11:40 am

THE HYPERFIBRINOLYTIC PHENOTYPE IS THE MOST LETHAL AND RESOURCE INTENSE PRESENTATION OF FIBRINOLYSIS IN MASSIVE TRANSFUSION PATIENTS

John R. Taylor, III, MD, Erin Fox, John B. Holcomb, MD*, Sandro Rizoli, MD, PhD, FRCSC, FACS*, Kenji Inaba, MD, Martin A. Schreiber, MD, FACS*, Karen Brasel, MD, MPH
Thomas M. Scalea, MD, FACS, FCCM*, Charles E. Wade, PhD, Eileen M. Bulger, MD, Barbara Tilley, Terence O'Keeffe, MD, MSPH*, Bryan A. Cotton, MD, MPH*
Center for Translational Injury Research, Department of Surgery, University of Texas-Houston

Presenter: John R. Taylor, III, MD

Discussant: Myung Park, MD, MPH, Mayo Clinic

Objectives: Among bleeding patients, we hypothesized that the hyperfibrinolytic (HF) phenotype would be associated with the highest mortality, while shutdown (SD) patients would have the greatest complication burden.

Methods: Severely injured patients predicted to receive a massive transfusion at 12 level-1 trauma centers were randomized to one of two transfusion ratios as described in the PROPPR trial. Fibrinolysis phenotypes were determined based on admission clot lysis at 30 minutes (LY30): SD ≤0.8%, physiologic (PHYS) 0.9-2.9% and HF ≥3%. Univariate and multivariate analysis was performed. Logistic regression was used to adjust for age, gender, arrival physiology, shock, injury severity, center-effect and treatment arm.

Results: Among the 680 patients randomized, 547(80%) had admission TEG values available to determine fibrinolytic phenotypes. Compared to SD and PHYS, HF patients had higher ISS (25 vs. 25. vs. 34), greater base deficit (-8 vs. -6 vs. -12) and were more uniformly hypocoagulable on admission by PT, PTT and TEG values; all $p<0.001$. HF patients also received more RBC, plasma and platelets (at 3, 6 and 24 hours), had fewer ICU, ventilator and hospital-free days, and had higher 24-hr and 30-d mortality (TABLE). There were no differences in complications between the three phenotypes. Multivariate logistic regression demonstrated that HF on admission was associated with a 3-fold higher mortality (OR 3.06, 95% C.I. 1.57-5.95, p=0.001)

Conclusions: Previous data have shown that both the SD and HF phenotypes are associated with increased mortality and complications in the general trauma population. However, in a large cohort of bleeding patients, HF as confirmed to be a much more lethal and resource intense phenotype. These data suggest that further research into the understanding of SD and HF is warranted to improve outcomes in this patient population.

	SD (n=333)	PHYS (n=95)	HF (n=119)	p-value
Median 24 hr RBC	9 (5, 14)	7 (4, 12)	15 (9, 24)	<0.001
Median 24 hr plasma	6 (3, 10)	4 (2, 10)	11 (4, 17)	<0.001
Median 24 hr platelets	6 (6, 12)	6 (0, 12)	12 (6, 24)	<0.001
Median ICU-free days	6 (1, 12)	7 (3, 11)	0 (0, 5)	<0.001
Median vent-free days	8 (2, 16)	10 (5, 17)	0 (0, 7)	<0.001
Median hosp-free days	4 (0, 17)	11 (0, 19)	0 (0, 10)	<0.001
24-hour mortality	9%	5%	35%	<0.001
30-day mortality	17%	13%	54%	<0.001

Transfusion volumes, resource utilization and mortality by fibrinolytic phenotype

Scientific Session III-A - Military/Hemorrhage

Paper #12
January 12, 2017
8:00 am

TOWARDS PRECISION MEDICINE: ACCURATE PREDICTIVE MODELING OF INFECTIOUS COMPLICATIONS IN COMBAT CASUALTIES

Christopher J. Dente, MD*, Matthew J. Bradley, MD*, Seth Schobel, Beverly Gaucher, Timothy G. Buchman, MD*, Allan Kirk, Eric Elster, MD, FACS
Emory University School of Medicine

Presenter: Christopher J. Dente, MD

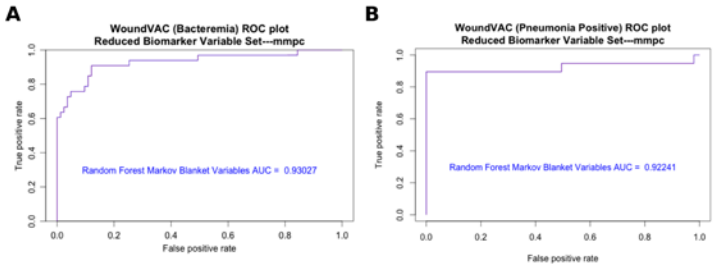
Discussant: Matthew Tadlock, MD, Naval Hospital Camp Pendleton

Objectives: The biomarker profile of trauma patients may allow for the creation of models to assist bedside decision making & prediction of complications. We sought to determine the utility of modeling in the prediction of bacteremia & pneumonia in combat casualties**.**

Methods: This is a prospective, observational trial of patients with complex wounds treated at Walter Reed National Military Medical Center (2007-2012). Tissue, serum and wound effluent samples were collected during operative interventions until wound closure. Clinical, biomarker & outcome data were used in machine learning algorithms to develop models predicting bacteremia or pneumonia. Modeling was performed on the first operative washout to maximize predictive benefit. Variable selection of dataset variables was performed and the best fitting Bayesian belief network (BBN), using Bayesian information criterion (BIC), was selected for predictive modeling. Random forest was performed using variables from BBN step. Model performance was evaluated using area under the receiver operating characteristic curve (AUC) analysis.

Results: 73 patients (mean age 23, mean Injury Severity Score 25) were enrolled. Patients required a median of 3 (2-13) operations. The incidence of bacteremia & pneumonia was 22% & 12%, respectively. Best fitting variable selected BBNs were max-min parents & children (MMPC) for both bacteremia (BIC-24948) and pneumonia (BIC-17886). Full variable & MMPC random forest models AUC were 0.93 & 0.93 respectively for bacteremia and 0.93 & 0.92 respectively for pneumonia (Figure)

Conclusions: We identified a profile predictive of bacteremia and pneumonia in combat casualties. This has important clinical implications and should be validated in the civilian trauma population. This and similar tools will allow for increasing precision in the management of critically ill and injured patients.



AUC curves for prediction of bacteremia (left) and pneumonia (right) using Random Forest modeling

Scientific Session III-A - Military/Hemorrhage

Paper #13
January 12, 2017
8:20 am

COMBAT SURGICAL WORKLOAD IN OIF/OEF: THE DEFINITIVE ANALYSIS

Zsolt T. Stockinger, MD, FACS*, Caryn A. Turner
DoD Joint Trauma System

Presenter: Zsolt T. Stockinger, MD, FACS

Discussant: Brian J. Eastridge, MD, University of Texas Health Science Center San Antonio

Objectives: Relatively few publications exist on surgical workload in the deployed military setting. This study analyses U.S. military combat surgical workload in Iraq and Afghanistan in order to inform military medical planning and training.

Methods: A retrospective analysis of the Department of Defense Trauma Registry (DoDTR) for performance improvement was done for all Role 2 and Role 3 Military Treatment Facilities (MTF), from January 2001 to May 2016. ICD-9 procedure codes were then grouped into 34 categories based on functional surgical skill sets. The 189,818 surgical procedures identified were stratified by Role of care and month and year of procedure, and percentiles were calculated for the number of procedures for each skill set. A literature search was performed for publications documenting combat surgical workload during the same period.

Results: A total of 23,571 surgical procedures were performed at Role 2 facilities while 166,247 surgical procedures were performed at Role 3 facilities. The most common procedures performed at both Role 2 and Role 3 facilities were soft tissue (37.38%), abdominal (12.96%), orthopedic (14.75%) and vascular (6.51%). Craniotomies and eye procedures were performed primarily at Role 3s. Despite a much lower workload, the majority of fasciotomies and external fixations were performed at Role 2s.

Mean surgical workload at any point in time clearly underrepresented those units in highly kinetic areas, at times by an order of magnitude or more.

The published literature always demonstrated workloads well in excess of the 50^{th} percentile for the relevant time period.

Conclusions: The published literature on combat surgical workload represents the high end of the spectrum of deployed surgical experience. Mean workload is a poor planning factor for medical support of military operations. Combining analyses such as these with operational tempo and a known population at risk could improve medical planning. Understanding the diversity of surgical cases performed can better inform military surgical deployed manpower and training requirements.

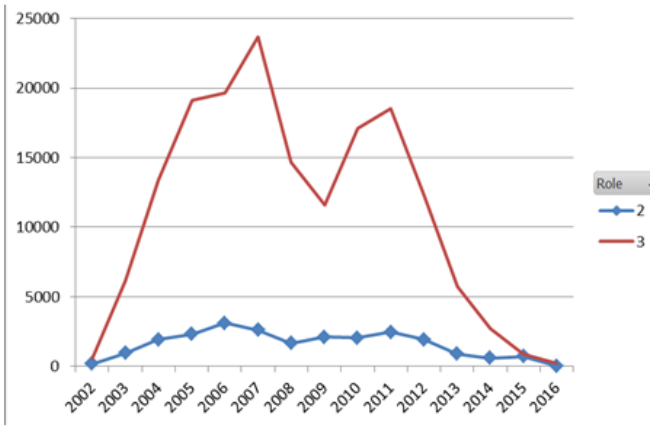


Fig 1: Procedures performed each year in Role 2 and Role 3 facilities.

	Role 2	Role 3	Total
Abdominal	17.67%	12.29%	12.96%
Amputation	5.42%	4.41%	4.53%
Cardiac	0.36%	0.21%	0.22%
Cranial	0.61%	3.30%	2.96%
Endoscopy	0.87%	2.28%	2.11%
External Fixation	6.82%	3.83%	4.20%
Fasciotomy	4.67%	2.26%	2.56%
Genitourinary	0.69%	1.22%	1.15%
Head & Neck	2.73%	4.60%	4.36%
Ophthalmologic	0.39%	2.79%	2.49%
Orthopedic	14.62%	14.77%	14.75%
Spine	0.00%	0.38%	0.34%
Soft Tissue	32.12%	38.12%	37.38%
Thoracic	1.14%	0.90%	0.93%
Trach/ Cric	1.26%	1.74%	1.68%
Vascular	10.08%	6.00%	6.51%
Total	**100.00%**	**100.00%**	**100.00%**

Table 1: Proportion of surgical procedures by facility type.

Scientific Session III-A - Military/Hemorrhage

Paper #14
January 12, 2017
8:40 am

OUTCOMES FOLLOWING CONCOMITANT TRAUMATIC BRAIN INJURY AND HEMORRHAGIC SHOCK: A SECONDARY ANALYSIS FROM THE PROPPR TRIAL

Samuel M. Galvagno, DO, PhD*, Deborah M. Stein, MD, MPH, FACS, FCCM*,
Erin Fox, Savitri Appana, Sarah Baraniuk, Patrick Borsarge,
Eileen M. Bulger, MD, Rachel Callcut, Bryan A. Cotton, MD, MPH*, Michael Goodman, MD*,
Kenji Inaba, MD, Terence O'Keeffe, MD, MSPH*, Martin A. Schreiber, MD, FACS*,
Charles E. Wade, PhD, John B. Holcomb, MD*
R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine

Presenter: Samuel M. Galvagno, DO, PhD

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

Objectives: The clinician is faced with a diagnostic and therapeutic dilemma in patients with concomitant traumatic brain injury (TBI) and hemorrhagic shock (HS), as rapid deterioration from either can be fatal. Knowledge about outcomes following concomitant TBI and HS (TBI+HS) may help prioritize the emergent management of these patients. We hypothesized that patients with TBI+HS had worse outcomes and required more intensive care compared to patients with only one of these injuries.

Methods: This is a post-hoc analysis of the Pragmatic, Randomized Optimal Platelets and Plasma Ratios (PROPPR) trial. TBI was defined by a head abbreviated injury scale >2. HS was defined as a base deficit ≥ 4 and/or shock index ≥ 0.9. Advanced regression techniques were used to model the primary outcome for this analysis (mortality at 30 days).

Results: 670 patients were included. Patients with TBI+HS had significantly higher lactate compared to the TBI group, but not the HS group. TBI+HS patients had higher activated prothrombin times and lower platelet counts compared to other groups at admission and upon termination of the study protocol. In the adjusted analysis, odds of death in the TBI and TBI+HS groups were 8.2 (95% CI, 3.9-19.8) and 10.6 (95% CI, 4.9-22.8) times higher, respectively. Ventilator, ICU- and hospital-free days were lower in the TBI and TBI+HS groups compared to the HS and neither groups. Patients with TBI+HS or TBI had significantly greater odds of developing a respiratory complication (ARDS, ALI or VAP) compared to the neither group.

Conclusions: TBI remains the predominant predictor of death following injury. The combination of TBI and HS is associated with worse coagulopathy both prior to and after resuscitation, and increased mortality. The diagnosis of TBI alone or TBI+HS was associated with significantly greater odds of developing respiratory complications.

Notes

Scientific Session III-A - Military/Hemorrhage

Paper #15
January 12, 2017
9:00 am

CLOT DYNAMICS AND MORTALITY:THE MA-R RATIO

Stephanie Savage, MD, MS*, Ben L. Zarzaur, MD, MPH*,
Timothy H. Pohlman, MD*, Brian L. Brewer, MD*, Louis J. Magnotti, MD*,
Martin A. Croce, MD*, Garrett Lim, Ali Martin
Indiana University

Presenter: Stephanie Savage, MD, MS

Discussant: Anuradha Subramanian, MD, Emory University School of Medicine

Objectives: Thromboelastography (TEG) is used to identify coagulation defects in the clotting cascade. The coagulopathy of trauma, seen with a short R-time, may be due to early thrombin burst with rapid clot formation. At the same time, rapid fibrinogen consumption may result in weak clot and substrate depletion, resulting in low MA. Using TEG to identify risk for subsequent bleeding diathesis, especially in those who do not demonstrate early signs of physiologic derangement, is challenging. We have developed a novel TEG ratio to describe patients at specific risk for traumatic coagulopathy and to predict death.

Methods: Patients admitted with major trauma at two Level 1 trauma centers were included if they received at least one unit of packed red blood cells in the first 24 hours. Admission TEG was used to calculate a ratio by dividing the MA by the R-time (MAR). MAR quartiles were defined and multivariable logistic regression was used to determine odds of mortality.

Results: 330 patients were included. Median age was 35 years (IQR 25-54), ISS was 20 (IQR 13-29), 76% were male and 43% had penetrating trauma. MAR quartiles were constructed– Group 1 < 14, Group 2 14-20, Group 3 20-24 and Group 4 > 24. Controlling for mechanism of injury, ISS and base excess, results showed as MAR increased, odds of death decreased significantly(*Table 1*). The lowest MAR ratios were significantly associated with higher ISS, higher rates of blunt injury and higher plasma utilization without a significant difference in red cell use).

Conclusions: Patients with the lowest MAR ratios demonstrated the highest mortality rates. This novel ratio may be helpful for early prediction of at-risk patients, when other physiologic indicators are absent. The mechanism driving this finding may be fibrinogen depletion resulting in weak clot. Patients with low MAR ratios may need earlier resuscitation with cryoprecipitate, rather than the traditional use of plasma in current massive transfusion protocols.

Table 1. Odds of Death Compared to MAR 1

Group	Odds Ratio (95% CI)	p-value
MAR1 (<14)	-REF-	-REF-
MAR 2 (14-19.5)	0.235 (0.096, 0.574)	0.0015
MAR 3 (19.5-23.7)	0.221 (0.084, 0.581)	0.0022
MAR 4 (>23.7)	0.137 (0.047, 0.398)	0.0003

Table 2. Characteristics of Patients with Varying MAR Ratios

	Group 1 (n=82) *MAR < 14*	**Group 2** (n=84) *MAR 14-19.5*	**Group 3** (n=80) *MAR 19.5-23.7*	**Group 4** (n=83) *MAR > 23.7*	**p-value**
Male (%)	76%	77%	74%	76%	NS
Age (years)	35 (21-58)	35 (28-49)	41 (27-57)	35 (25-53)	NS
Penetrating (%)	31%	46%	43%	51%	<0.05
ISS	26 (17-43)	18 (13-28)	20 (9.5-26)	17 (9-26)	<0.05
Admit BE (mEq/L)	-9.2(-16.3- -3.3)	-5.6(-10.1- -3)	-6.4(-10.2- -1.6)	-6.3(-10.3- -4.6)	NS
Admit SBP (mmHg)	116 (85-135)	125 (95-141)	120 (92-139)	122 (98-142)	NS
Total PRBC/24hr (units)	6 (4-13)	5 (2-11)	4 (3-9)	4 (3-9)	NS
Total FFP/24hr (units)	3 (0-8)	2 (0-6)	2 (0-6)	0 (0-4)	<0.05

* All values presented as median (IQR) or percentages

Scientific Session III-A - Military/Hemorrhage

Paper #16
January 12, 2017
9:20 am

USE OF INCOMPATIBLE TYPE A PLASMA TRANSFUSION IN PATIENTS REQUIRING MASSIVE TRANSFUSION PROTOCOL: OUTCOMES OF AN EAST MULTICENTER STUDY

Bryan C. Morse, MS, MD*, W. Tait Stevens, Andrew C. Bernard, MD*, Christopher J. Dente, MD*, Caitlin A Fitzgerald, Nadeem N. Haddad, MD, Asad Choudhry, Xian Luo-Owen, David Turay, Russell Dumire, MD*, Patrick McCarthy, Jose F. Quesada, Valerie Sams, MD*, Jason Gregory, Matthew M. Carrick, MD*, Timothy A. Pritts, MD, PhD*, Martin D. Zielinski, MD, FACS*
Emory University School of Medicine

Presenter: Bryan C. Morse, MS, MD

Discussant: Jennifer M. Gurney, MD, US Army Institute of Surgical Research

Objectives: With a relative shortage of type AB plasma, many centers have converted to type A plasma for acute resuscitation. The goal of this study is to determine outcomes after incompatible plasma transfusions for trauma patients who underwent massive transfusion protocol (MTP) activation.

Methods: As part of an EAST multi-institutional trial, registry and blood bank data were collected from 5 trauma centers for trauma patients (age ≥ 15 years) receiving emergency release plasma transfusions as part of MTP from January 2012 – May 2016. Incompatible type A transfusion was defined by patient's blood type.

Results: Of the 1212 patients identified [mean age = 37 years, male = 74%, blunt = 66%, median ISS = 25], 1130 (93%) received compatible plasma transfusions while 82 (7%) received incompatible type A plasma. Demographics were similar except for greater ISS (29 vs. 25, p=0.05) and penetrating injuries (45% vs. 33%, p=0.03) in the incompatible group. In the incompatible group, patients were transfused more plasma units at 4 (12±10 vs. 7±8, p<0.01) and 24 hours (11±11 vs. 7 ±9, p<0.01). Only one hemolytic transfusion reaction and one TRALI event were reported in the compatible group. Between incompatible and compatible groups, there was no difference in the rates of ARDS (4% vs. 6%, p=0.31), thromboembolic events (10% vs. 7%, p=0.28), sepsis (5% vs. 7%, p=0.53), or acute renal failure (9% vs. 7%, p=0.51). Mortality at 6 (15% vs. 16%, p=0.88) and 24 hours (26% vs. 24%, p=0.73) and 28 days (39% vs. 36%, p=0.60) were similar between groups. Multivariate regression model demonstrated that ISS, older age, & more RBC transfusion at 4 hours were independently associated with death at 28 days; only ISS was a predictor for morbidity (Table I & II). Incompatible transfusion was not an independent determinant of mortality or morbidity (Table I & II).

Conclusions: In the largest study to date, these results support the safety of incompatible type A plasma transfusions as part of a MTP at multiple trauma centers.

	95% Confidence Interval			
	Odds Ratio	Lower	Upper	p-value
Incompatible plasma (vs. compatible)	0.94	0.567	1.55	0.80
Site (UK = reference)				0.01
1	1.08	.780	1.51	0.63
2	1.24	.786	1.95	0.36
3	0.63	.435	0.92	0.02
4	1.70	.918	3.13	0.91
ISS	1.04	1.03	1.05	<0.01
Age	1.01	1.01	1.02	<0.01
Penetrating mechanism (vs. blunt)	.088	0.644	1.20	0.40
PRBC transfusion (@ 4 hrs)	1.04	1.024	1.05	<0.01

Table I. Multivariate regression analysis of determinants affecting 28-day mortality (PRBC = packed red blood cells; ISS = injury severity score)

	95% Confidence Interval			
	Odds Ratio	Lower	Upper	p-value
Incompatible plasma (vs. compatible)	1.24	0.752	2.058	0.40
Site (UK = reference)				<0.01
1	1.80	1.26	2.57	<0.01
2	2.51	1.58	3.99	<0.01
3	1.07	0.718	1.60	0.73
4	2.29	1.23	4.26	.01
ISS	1.03	1.02	1.04	<0.01
Age	1.00	0.997	1.01	0.28
Penetrating mechanism (vs. blunt)	0.75	0.534	1.04	0.08
PRBC transfusion (@ 4 hrs)	1.01	0.996	1.02	0.16

Table II. Multivariate regression analysis of determinants affecting aggregate morbidity (PRBC = packed red blood cells; ISS = injury severity score)

Scientific Session III-A - Military/Hemorrhage

Paper #17
January 12, 2017
9:40 am

PRIMARY PULMONARY THROMBUS IN COMBAT CASUALTIES, IS TREATMENT NECESSARY?

Matthew J. Bradley, MD*, Dean Baird, Eric Elster, MD, FACS,
Carlos J. Rodriguez, DO, MBA, FACS*
Walter Reed National Military Medical Center

Presenter: Matthew J. Bradley, MD

Discussant: Matthew L. Moorman, MD, Cleveland Clinic

Objectives: The treatment for primary pulmonary thrombus (PPT), a diagnosis with increasing recognition, remains in question. The objective of this study is to describe the natural history of PPT in combat casualties.

Methods: We performed a retrospective study of combat casualties treated at Walter Reed National Military Medical Center (WRNMMC) from 2010-2012. All patients with a downrange CT scan of the chest were included. Each chest CT was retrospectively reviewed by two independent, blinded board certified radiologists to confirm presence or absence of PPT on initial imaging. Follow up CT imaging, if obtained, was also independently reviewed to determine the progression or resolution of clot burden. Patients with PPT were grouped according to presence or absence of therapeutic anticoagulation (AC) on admission to WRNNMC.

Results: 249 casualties with downrange chest CT and acceptable imaging quality were included. 9% (23/249) of patients sustained PPT. 39% (9/23) of these patients were initially treated with therapeutic AC. Conversely, 61% (14/23) arrived without AC for PPT. Eight of these sustained segmental (S) pulmonary thrombus, one had evidence of S+subsegmental (SS), one had SS, one had evidence of main pulmonary artery (PA), while three demonstrated main PA+S thrombus. Seven of these patients arriving without AC developed pulmonary symptoms during their hospital course and subsequently had interval chest CTs at WRNNMC. Of those, three had no evidence of pulmonary thrombus. The other four had persistent SS filling defects and three were started AC while one had an IVC filter inserted due to contraindications to AC. All patients managed without AC were discharged without readmission for pulmonary complications.

Conclusions: Consideration can be given to managing PPT in combat casualties without AC. Patients with symptoms and persistent thrombus may need to be treated. Further studies are warranted to identify those at risk for persistent, symptomatic clot.

Notes

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

Paper #18
January 12, 2017
8:00 am

THE EAST ICVP'S ANNUAL DISTRACTED DRIVING OUTREACH EVENT: EVALUATING ATTITUDE AND BEHAVIOR CHANGE IN HIGH SCHOOL STUDENTS

Lisa Allee Barmak, MSW, LICSW*, Tracey Dechert, MD, FACS*,
Sowmya Rao, Marie L. Crandall, MD, MPH*,
A. Britton Christmas, MD, FACS*, Alexander L. Eastman, MD, MPH, FACS*,
Thomas K. Duncan, DO, FACS*, Shannon Marie Foster, MD, FACS*
Boston University School of Medicine

Presenter: Lisa Allee Barmak, MSW, LICSW

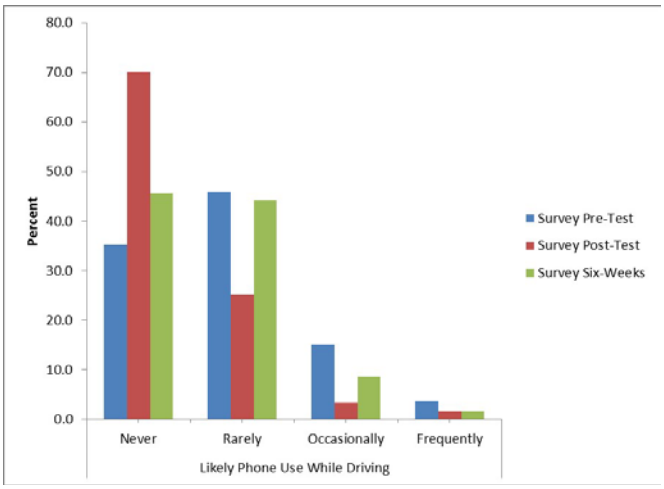
Discussant: Oscar D. Guillamondegui, MD, MPH, Vanderbilt University Medical Center

Objectives: The National Center for Statistics and Analysis report at least 8 deaths and 1,160 daily injuries due to distracted driving (DD) in the U.S. Drivers under age 20 are most likely to incur a distraction related fatal crash. We aimed to determine short and long term impact of a multi-modal educational program including student developed interventions, simulated driving experiences, and presentations by law enforcement and medical personnel.

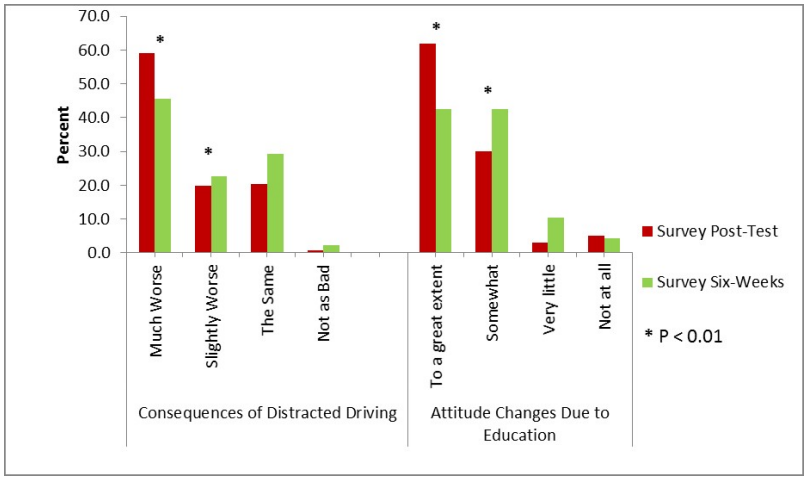
Methods: A single day program aimed at DD prevention was conducted. Students were surveyed before, after, and at 6 weeks. We surveyed age, gender, knowledge and experience regarding DD. Summary statistics were obtained at each survey time point. Bivariate and multivariable (MV) analysis were conducted to assess whether change in responses varied over time points. MV models adjusted for sex, urban and rural driving.

Results: Pre, post, and 6 week follow up surveys were completed by 359, 272, and 331 students respectively. At baseline and 6 week follow-up, the most frequent passenger reported DD behaviors were cell phone 63% (63% at follow-up) and radio use 61% (63%). Similarly, the most frequent driver reported DD behaviors were cell phone 68% (72%) and radio use 79% (80%). When students were asked, 'how likely are you to use your cell phone while driving?', they answered 'never', 35%, 70%, and 46% on the pre, post and 6 week surveys.(Fig.1) They were less likely to report consequences to be worse or change in attitude to a great extent at 6 weeks($p<0.01$) (Fig.2). Gender, urban or rural driving were not significantly associated with responses.

Conclusions: While DD education may facilitate knowledge and attitude changes, there appears to be no lasting effect on behavior. Research should be focused toward strategies for longer term impact.



Reported anticipated behavior of High School student's cell phone use while driving



Reported level of consequence of DD and reported attitude change related to DD post education and at 6 week follow up

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

Paper #19
January 12, 2017
8:20 am

FALL INJURY PREVENTION: CREATION OF A COMMUNITY FALL PREVENTION PROGRAM TO PREVENT RECURRENT FALLING

Thomas K. Duncan, DO, FACS*, Kenneth Waxman, Graal Diaz
Ventura County Medical Center

Presenter: Thomas K. Duncan, DO, FACS

Discussant: Bryan R. Collier, DO, Carilion Roanoke Memorial Hospital

Objectives: Falls are the leading cause of fatal traumatic injury and the most common cause of non-fatal trauma-related hospital admissions among the elderly. Emergency Medical Service (EMS) personnel are often the first responders in assessing and treating older adults who have fallen. Some fall victims are transported to the hospital, while pre-hospital personnel are the sole providers of those not transported. Some hospitals have begun to create programs to assess and mitigate fall risk in trauma patients, but have not been described for patients treated only in the field. The purpose of this study is to describe our progress in creating a community fall prevention program, underscoring the Center for Disease Control and Prevention's (CDC) endorsement of the EMS' prime position to provide interventions that can prevent future falls.

Methods: To address the increasing problem of elderly fall injury in Ventura County California, we formed a multidisciplinary coalition of trauma centers, the EMS agency, and community leaders in 2012 to design a community fall injury prevention program. The program includes training of first responders. Appropriate mitigation measures were conducted in the field, by the EMS upon responding. First responders also were trained to assess patients for fall risk factors. A computerized database was created to track data, including risk factors, on all consenting fall patients. Data are provided to a community Fall Prevention Coordinator (FPC) on a daily basis. A pilot program was instituted in July, 2014. Consenting patients were enrolled in Evidence Based Classes (EBC).

Results: The average number of elderly falls entered into the program from July, 2014 to December, 2015 was: 1497. Risk factors identified by the FPC include: Prior falls, weakness, use of assistive devices, unsteadiness, arthritis, vision and balance problems. 28% agreed to a follow up call. Of those that agreed to a follow up call, 84% accepted home services, while 7% agreed to sign up for EBC – and continues to rise from month-to-month. Recidivism rate of prior fallers that declined EBC classes was 18% vs 6% recidivism rate of prior fallers that enrolled in EBC.

Conclusions: We have successfully launched a community fall injury prevention program utilizing EMS personnel to begin the process of fall assessment and prevention in the field. The program has raised community awareness of fall dangers, educated the community about fall prevention services and programs, enabled EMS to be an integral part of home mitigation efforts, and expanded the availability of EBC with decreased recidivism.

Notes

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

Paper #20
January 12, 2017
8:40 am

EVALUATION OF A POPULATION HEALTH STRATEGY TO REDUCE DISTRACTED DRIVING: EXAMINING ALL "E'S" OF INJURY PREVENTION

Tanya Charyk Stewart, B.Sc, M.Sc, Jane Edwards, Alyssa Penney, Jason Gilliland, Andrew Clark, Tania Haidar, Brandon Batey, Douglas D. Fraser, Neil Merritt, Neil G. Parry, MD*
London Health Sciences Centre

Presenter: Tanya Charyk Stewart, B.Sc, M.Sc

Discussant: Rachael Callcut, MD, MSPH, University of California San Francisco

Objectives: Cell phone use while driving (CPWD) increases the risk of crashing and is a major contributor to injuries and deaths. The objective of this study was to describe the evaluation of a multifaceted, evidence-based population health strategy for the reduction of distracted driving.

Methods: A multi-pronged campaign was undertaken from 2014-16 for 16-44 year olds, based on epidemiology, focused on personal stories and consequences, utilizing the E's of injury prevention. Education consisted of distracted driving videos, informational cards, social media AdTube campaign and movie theater trailer which was evaluated with a questionnaire regarding knowledge, attitudes and behaviors. Spatial analysis of data within a Geographic Information System was utilized to target advertisements. Random sample telephone survey evaluated the public's awareness of the campaign. Increased CPWD enforcement was undertaken by police services.

Results: AdTube campaign had a high view rate >10% (41,101 views); higher for females. The top performing age group was 18-24 year olds (49%). Our survey found 61% of respondents used hand-held CPWD (14% all of the time) with 80% reporting our movie trailer made them think twice about future CPWD. Spatial analysis targeted our advertisements in areas of close proximity to high schools, universities, near intersections with previous MVCs, high traffic volumes and population density. Telephone survey revealed 41% of the respondents were aware of our campaign; 17% from our print and movie theatre ads; 3% social media. Police enforcement blitzes resulted in 163 tickets with nearly 2500 annual charges against drivers for CPWD.

Conclusions: A multifaceted, evidence-based population health strategy utilizing the E's of injury prevention (Epidemiology, Education, Environment, Enforcement and Evaluation) is a comprehensive method to be utilized for the reduction of distracted driving.

Notes

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

Paper #21
January 12, 2017
9:00 am

REDUCING PEDIATRIC AUTO VS. PEDESTRIAN ACCIDENTS AMONG ELEMENTARY SCHOOL-AGED CHILDREN

Christy Carroll, BSN, RN, Spencer Kieu, Craig Anderson, Joel Wright,
Bharath Chakravarthy, Cesar Figueroa, MD, Cristobal Barrios, MD*
University of California Irvine

Presenter: Christy Carroll, BSN, RN

Discussant: Michael W. Dingeldein, MD, Rainbow Babies & Children's Hospital

Objectives: Auto vs. pedestrian accidents (including bicyclists) continue to be a major source of trauma for the pediatric population (age 14 years old and younger). Many studies have looked at injury prevention strategies. Some of these strategies can include educational programs as well as city engineering. There still remain few studies proving the effectiveness of education. It was our aim to show that education specifically targeting street crossing behavior could help prevent accidents.

Methods: This was a two pronged study. We performed a retrospective geographic incident study, attempting to locate the proximity of pediatric auto vs. pedestrian/bicycle accidents within school zones. We then performed an observational study of street crossing behavior of elementary school students in one school district, before and after an educational program provided by each school site. We analyzed the rates of different aspects of street crossing behavior such as looking before crossing the street, using the cross-walk, jay walking, crossing with the crossing guard, and walking in the street.

Results: In regards to geographic location of incidents of auto vs pedestrian/bicyclists, we showed an association with occurrences and proximity to school zones. Our before and after analysis of street crossing behaviors indicates an improvement in looking before crossing the street (10.6% to 27.6%), an increase in the number crossing in cross-walks (mean 45 to 50), and a decrease in jay-walking (mean 16 to 17). An increase in the percent of elementary school-aged children who looked before crossing reached statistical significance (10.6% to 27.6%, $p<0.01$).

Conclusions: Trauma continues to be a major source of morbidity and mortality in the pediatric population. Auto vs. pedestrian/bicycle represents a large portion in this group. Our data shows that even brief education has a role in improving street crossing behavior and preventing accidents.

Notes

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

Paper #22
January 12, 2017
9:20 am

AN INNOVATIVE APPROACH FOR DECREASING HAY HOLE FALLS IN THE RURAL ANABAPTIST POPULATION

Frederick Rogers, MD, MS, FACS*, Brian Gross, Ronald Baier, Erich Batra,
Dennis Murphy, Susan Lackmann, Jo Ann Miller, RN, BSN, CCRN
Penn Medicine Lancaster General Health

Presenter: Eric H. Bradburn, DO, MS, FACS

Discussant: Scott B. Armen, MD, Penn State University

Objectives: Pennsylvania is home to a quarter of the nation's Anabaptist population, many of whom reside in the South Central region of the state. As many Anabaptists rely on livestock farming, trauma resulting from hay hole falls is common. We sought to decrease hay hole falls in South Central Pennsylvania through the development and distribution of all-weather hay hole covers to members of this community.

Methods: Following the creation of a rural trauma prevention syndicate, a hay hole cover co-designed and endorsed by the Pennsylvania Amish Safety Committee was developed. Composed of a metal frame with a mesh-netted interior, the cover is strong enough to prevent hay hole falls, yet aerated enough to allow for adequate hay loft ventilation (Figure 1). Hay hole covers were distributed across the most trauma-prone rural centers in South Central Pennsylvania in accordance with trauma registry data. Pre- and post-intervention survey data was collected to analyze the efficacy and acceptance of these covers.

Results: A total of 250 hay hole covers were distributed within eight rural trauma-prone counties in South Central Pennsylvania (Lancaster, Lebanon, Cumberland, Chester, York, Berks, Dauphin, and Adams). According to pre-intervention survey data, 52% of cover recipients reported at least one hay hole fall on their property, with 47% reporting multiple falls (mean fall rate: 1.63 hay hole falls per respondent). The average self-reported distance from hay hole to ground floor was 9.61 feet, and the average number of hay holes present on-property was 3.61 per respondent. Post-intervention survey data found 98% compliance with hay hole cover installation and no subsequent hay hole falls.

Conclusions: Hay hole falls are a major source of trauma in the rural Anabaptist population. We developed a well-received, effective hay hole cover that could prevent these injuries in other rural communities throughout the United States.

Figure 1: Hay hole cover preventing falls and allowing hay loft ventilation.

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

Paper #23
January 12, 2017
9:40 am

SUICIDE, GUNS, AND BUYBACK PROGRAMS: AN EPIDEMIOLOGIC ANALYSIS OF FIREARM-RELATED DEATHS IN CONNECTICUT

Laura Baumann, Heather Clinton, Robert Berntsson, Susan Williams, James Rovella,
David S. Shapiro, MD*, Shefali Thaker, MPH, Kevin Borrup, JD, MPA,
Garry Lapidus, PA-C, Brendan T. Campbell, MD, MPH*
Connecticut Children's Medical Center

Presenter: Laura Baumann

Discussant: Zoë Maher, MD, Temple University Hospital

Objectives: Gun buyback programs aim to remove unwanted firearms from the community with the goal of preventing firearm injury and death. Buyback programs are held in many communities, but evidence demonstrating their effectiveness is lacking. The purpose of this study is to compare firearms collected at buyback events to crime guns and firearms used in homicides and suicides.

Methods: Detailed firearm and case data was obtained from the Hartford Police Department and the CDC's National Violent Death Reporting System from January through December of 2015. Information was reviewed for guns collected at buyback events, crime guns confiscated by police, and for weapons associated with firearm fatalities. Detailed firearm data included type, manufacturer, model, and caliber (SMALL $\leq$ .32 caliber, MEDIUM = .357 caliber to 9 millimeter, LARGE $\geq$ .40 caliber). Chi-square analyses were used for comparisons between groups.

Results: In 2015, 224 crime guns were seized by the Hartford Police, 169 guns were collected at four community buyback events, and there were 187 firearm-related deaths statewide (105 suicides, 81 homicides, 1 legal intervention). Comparisons between buyback, crime and fatality-related firearms are shown in the table below. Medium caliber handguns account for the majority of crime guns and fatalities, and buyback programs collected smaller caliber handguns. The demographics of individuals who turn in guns at buyback events and commit suicide are similar: age (buyback=63±12, suicide=52±18, homicide=34±12 years), sex (buyback=83%, suicide=92%, homicide=84% male), and race (buyback=81%, suicide=96%, homicide=48% white).

Conclusions: Handguns account for the majority of crime guns and firearm-related fatalities in Connecticut. Buyback programs are both an opportunity to remove unwanted handguns from the community, and to remove firearms from the homes of individuals at increased risk of suicide.

	Buyback	Crime	Homicides	Suicides	p-value
Handguns (%)	72	86	92	67	p <.05
Long Guns (%)	28	14	8	33	
Caliber (%)					
Small	66	23	9	8	p <.05
Medium	31	56	64	69	
Large	4	21	27	23	

Scientific Session IV-A - Emergency General Surgery

Paper #24
January 13, 2017
8:30 am

VALIDATION OF A CLINICAL TRIAL COMPOSITE ENDPOINT FOR PATIENTS WITH NSTI

Eileen M. Bulger, MD, Gregory Maislin, Addison K. May, MD*, Wayne Dankner, Bryce R.H. Robinson, MD, MS, FACS, FCCM*, Anat Shirvan
University of Washington

Presenter: Eileen M. Bulger, MD

Discussant: Rondi Gelbard, MD, Emory University School of Medicine

Objectives: Our objective was to develop and validate a composite endpoint for patients with NSTI that incorporates local tissue injury, systemic organ dysfunction, and mortality.

Methods: Necrotizing Infection Clinical Composite Endpoint (NICCE) was defined as follows:(i) Alive at day 28 (ii) ≤3 debridements prior to day 14 (iii) No amputation beyond first debridement (iv) Modified SOFA score(mSOFA) at day 14 ≤1. To be considered a success, all individual criteria must be met. Several data sets were used to assess validity: (i) a retrospective dataset of 198 patients treated during 2013 at 12 US trauma centers (ii) a subset with high disease acuity, admission mSOFA score ≥3 (n=69); and (iii) 40 patients from a multicenter, phase 2 randomized trial of a CD28 immunomodulator(AB103). Clinical success based on each parameter and the composite score was assessed.

Results: Using the retrospective data set for all patients and those with high disease severity (respectively), survival rates were 92.4% and 84.9%; d14 mSOFA ≤1 score was 71.6% and 50%; ≤3 debridements was 83.3% and 75.4%; and no subsequent amputations were 96% and 94.2%. Overall, the percent meeting all success criteria for NICCE was 57.6%(all patients) and 33.3%(mSOFA > 3). NICCE success was also associated with reduced utilization of health care resources, ICU free days were 21.8 and 11.9 days(1-sided Wilcoxon $p<0.001$) and ventilator free days were 25.9 vs. 17($p<0.001$) for NICCE success vs. failure, respectively. Using the phase 2 data set, the treated group(0.5 mg/kg, n=15) demonstrated a NICCE success rate of 73.3% vs 40% for placebo(n=10). NICCE success also utilized statistically significantly less hospital resources.

Conclusions: These data demonstrate internal consistency of the components and face and criterion validity of the NICCE endpoint. NICCE offers an opportunity to demonstrate a clinically relevant treatment effect for patients enrolled in clinical trials for NSTI.

Notes

Scientific Session IV-A - Emergency General Surgery

Paper #25
January 13, 2017
8:50 am

DIVERTING LOOP ILEOSTOMY VS. TOTAL COLECTOMY AS SURGICAL TREATMENT FOR CLOSTRIDIUM DIFFICILE ASSOCIATED DISEASE: AN EAST MULTICENTER TRIAL

Paula Ferrada, MD*, Rachael Callcut, MD, MSPH, FACS*, Martin D. Zielinski, MD, FACS*, Brandon Bruns, MD, FACS*, Daniel Dante Yeh, MD*, Tanya L. Zakrison, MD, MPH, FRCSC, FACS*, Jonathan P. Meizoso, MD, MSPH*, Babak Sarani, MD, FACS, FCCM*, Xian Luo-Owen, Peter Kim, Valerie Plant, Elliott R. Haut, MD, PhD, FACS*, Linda Dultz
Virginia Commonwealth University

Presenter: Paula Ferrada, MD

Discussant: C. William Schwab, MD, Penn Presbyterian Medical Center

Objectives: Clostridum Dificile Associated Disease (CDAD) is associated with a high mortality. Surgery can be a lifesaving therapy. The objective of this study is to compare total colectomy (TC) with loop ileostomy (LI) to help the surgeon decide what procedure is best suited for the patient in need.

Methods: This was a retrospective multicenter study conducted under the sponsorship of the Eastern Association for the Surgery of Trauma. Demographics, medical history, clinical presentation, APACHE score, and outcomes were collected. We used the Research Electronic Data Care (REDCap) to store the data. Mann-Whitney (continuous data) and Fisher's Exact (categorical data) were utilized to compare TC with LI. Logistic regression was used to determine predictors of mortality.A propensity score analysis was done to control for potential confounders and determine adjusted mortality rates by procedure type.

Results: We collected data from 10 centers of patients that presented with CDAD requiring surgery between July 1of 2010 to July 30 of 2014. 100 patients underwent operative intervention with an overall mortality of 32% and 75% suffered postoperative complications. Median age was 64.5 years, 59% were male. Regarding preoperative patient conditions 54% were on pressors, 47% had renal failure, and 36% suffered respiratory failure. LI was performed in 21% of the patients. Patients with LI underwent operation later when compared with TC patients (25 hours vs. 12 hours after diagnosis, p=0.005). Univariate pre-procedure predictors of mortality were age, lactate, timing of operation, vasopressor use, and acute renal failure. Overall, TC patients were sicker with an increased APACHE score (22 vs 16) and higher rate of pre-operative vasopressors (57% vs 38%), although the not statistically different. Adjusted mortality (controlled for pre-procedure confounders) was significantly lower in the LI group (17.2% vs. 39.7%, p=0.002).

Conclusions: This is the first multicenter study comparing TC with LI for the treatment of CDAD. In this study LI carried less mortality than TC. In patients without contraindications, LI should be considered for the surgical treatment of CDAD.

Notes

Scientific Session IV-A - Emergency General Surgery

Paper #26
January 13, 2017
9:10 am

BEWARE OF THE INTERVAL CHOLECYSTECTOMY

James M. Ackerman, MD, Mark Scaife, Ryan Agebblen, J. Wallis Marsh,
Andrew B. Peitzman, MD*, Kurt Stahlfeld, MD
University of Pittsburgh Medical Center

Presenter: James M. Ackerman, MD

Discussant: Kareem AbdelFattah, MD, UT Southwestern Medical Center

Objectives: Despite limited data regarding the indications and effectiveness of percutaneous cholecystostomy (PC) in the treatment of acute cholecystitis (AC), usage has increased by over 500% since 1994. Many of these patients subsequently undergo interval cholecystectomy (IC), a procedure that has not been rigorously evaluated. This aim of this study was to compare the outcomes of the IC to those of cholecystectomy for AC.

Methods: We included all consecutive adult patients (>18 years old) who underwent PC and IC from January 2008 to December 2013. Conversion rate, length of operation, biliary injury, estimated blood loss, surgical site infection, length of stay, and mortality were compared to 227 patients who underwent cholecystectomy for acute cholecystitis during the same time interval.

Results: Of 18,501 patients who underwent cholecystectomy, 337 had at least one PC and 177 underwent subsequent IC. Compared to patients undergoing cholecystectomy for clinically diagnosed AC, patients undergoing IC were older (69.8 v 54.9 years, $p<0.001$), thinner (BMI 28.7 v 31.1, $p=0.002$), more complex by Tokyo grade (1.93 v 1.14, $p<0.001$) and ASA classification (3.0 v 2.5, $p<0.001$), had longer operative times (120.7 v 92.5 minutes, $p<0.0001$), more blood loss (148.0 v 57.8 cc, $p=0.01$), and increased rates of conversion (26.6% v 12.8%, $p<0.001$), surgical site infection (12.4% v 0.4%, $p<0.01$), bowel injury (6.21 v 0.4%, $p<0.01$), and one-year mortality (15.3% v 0.4%, $p<0.01$). Non-significant trends included significant biliary tract injury (3 v 0, $p=0.08$) and longer length of stay (5.27 v 4.78 days, $p=0.39$). Linear regression identified BMI ($p=0.03$), time from admission to PC ($p=0.03$), and ASA classification ($p=0.06$) as predictors of a difficult IC.

Conclusions: PC has been widely adopted with limited description of the subsequent IC. Our data detail the factors predicting the challenges of IC and document that it is a difficult operation associated with significant morbidity.

Notes

Scientific Session IV-A - Emergency General Surgery

Paper #27
January 13, 2017
9:30 am

EARLY FEVER AFTER TRAUMA: DOES IT MATTER?

Holly E. Hinson, MD, MCR, Martin A. Schreiber, MD, FACS*, Cynthia Morris, Susan E. Rowell, MD*
Oregon Health and Science University

Presenter: Holly E. Hinson, MD, MCR

Discussant: Margaret Moore, MD, Tulane University School of Medicine

Objectives: Fever is strongly associated with poor outcome after traumatic brain injury (TBI), but it is unknown if the relationship between fever and poor outcome is specific to brain trauma, as studies often lack non-head injured controls (NHT). We hypothesized that early fever is a direct result of brain injury and thus would be more common in TBI than in NHT.

Methods: We prospectively enrolled patients with major trauma with and without TBI from a level I trauma center. Patients were assigned to one of two groups based on their presenting Abbreviated Head Injury Severity Scores (HAIS): **NHT**: HAIS score ≤2 or **TBI**: HAIS score>2. Hourly temperatures were recorded. Early fever (<48 hours) was defined as at least one recorded temperature of >38.3°C. Outcome measures included length of stay, hospital mortality, and discharge Glasgow Coma Score-Extended (GOSE). Group comparisons for categorical variables were performed using Fisher's exact tests and ordinal comparisons were made with the Wilcoxon-Mann-Whitney test. Logistic regression was used for multivariate analysis, with 95% confidence intervals; significance ($p \leq 0.05$).

Results: We enrolled 268; TBI(n=113) and NHT (n=155). The incidence of fever was 16% in each group. Febrile patients were younger (48 v. 57, P<0.01), had a lower admission GCS (14 v. 15), and higher ISS (22 v. 19, P=0.04) than those without early fever. Patients in both trauma groups with fever had longer ICU stays (5 v. 2 days, P<0.01). Fever was associated with worse outcomes only in the TBI patients: GOSE scores at hospital discharge (3 v. 7, P<0.001). Overall, controlling for admission GCS, the odds of dying during the hospitalization were 6.2 times higher in patients with early fever, (1.32 to 29.1 95% CI).

Conclusions: Contrary to our hypothesis, early fever was not more common in TBI, though fever appeared to have more serious consequences in TBI. Early fever may reflect inflammation which might contribute to secondary brain injury in TBI patients.

Notes

Scientific Session IV-A - Emergency General Surgery

Paper #28
January 13, 2017
9:50 am

MULTI-INSTITUTIONAL, PROSPECTIVE, OBSERVATIONAL STUDY COMPARING GASTROGRAFIN TO STANDARD TREATMENT IN ADHESIVE SMALL BOWEL OBSTRUCTION - AN EAST MULTICENTER TRIAL

Martin D. Zielinski, MD, FACS*, Nadeem N. Haddad, MD, Daniel C. Cullinane, MD*, Kenji Inaba, MD, Daniel Dante Yeh, MD*, Salina M. Wydo, MD*, David Turay, MD*, Andrea Pakula, MD, MPH*, Therese M. Duane, MD, FACS*, Jill Watras, MD*, Kenneth A. Widom, MD, John Cull, MD*, Carlos J. Rodriguez, DO, MBA, FACS*, Eric A. Toschlog, MD, FACS, FCCM*, John Christopher Graybill
Mayo Clinic

Presenter: Martin D. Zielinski, MD, FACS

Discussant: James M. Bardes, MD, LAC+USC Medical Center

Objectives: Existing trials of Gastrografin (GG) for management of adhesive small bowel obstruction (ASBO) are limited by methodological flaws and limited sample sizes. We compared institutional protocols with and without GG, hypothesizing that GG protocols are associated with decreased rates of exploration, length of stay (LOS) and complications.

Methods: EAST supported multi-institutional, prospective, observational study was performed for patients meeting indications for GG for ASBO. Exclusion criteria were internal/external hernia, signs of strangulation, Hx of abdominal/pelvic malignancy, or exploration within 6 weeks. Patients receiving GG were compared to patients receiving standard care.

Results: 316 patients were included (58±18 years; 53% male). There were 173 (55%) patients in the GG group of whom 118 [75%] successfully passed and 143 patients in the non-GG group. There were no differences in prior abdominal operations (2.2 vs 1.9, p=0.07), duration of obstipation (1.6 vs 1.9 days, p=0.84), or small bowel feces sign (32.9% vs 25.0%, p=0.15). There was a lower rate of bowel resection (24% vs 44%, p=.02), mesenteric edema on CT (16.3% vs 29.9%; p= 0.009), and exploration in the GG group (20.8% vs 44.7%, P<0.0001). In addition, GG patients had shorter LOS (4 IQR 2-7 vs 5 days IQR 2-12; p=0.036) but similar complication rates (12.5% vs 18.1% p=0.20). GG was an effective diagnostic test for exploration (Table 1). Multivariable analysis revealed that GG was the only feature independently associated with successful non-op management (Table 2). There were 2 missed strangulations and 2 GG pneumonitis cases in the GG group.

Conclusions: Patients receiving GG for ASBO had lower rates of exploration and shorter LOS compared to standard treatment. Well developed, multi-institutional prospective randomized trials are necessary to confirm these findings and establish causality.

Sensitivity	87.2%
Specificity	71.9%
Positive Predictive Value	92.4%
Negative Predictive Value	59.0%
Accuracy	84.1%

Table (1)

Variable	**OR**	**95% CI**
GG	3.1	1.8-5.7
Age (per year)	0.99	0.97-1.01
Female sex	0.6	0.3-1.1
Small bowel feces sign	0.96	0.5-1.9
Mesenteric edema	1.04	0.5-2.0

Table (2)

Scientific Session IV-A - Emergency General Surgery

Paper #29
January 13, 2017
10:10 am

THE EMERGENCY SURGERY ACUITY SCORE (ESAS) ACCURATELY PREDICTS THE OCCURRENCE OF POSTOPERATIVE COMPLICATIONS

Anirudh Nandan, BA, Jordan D Bohnen, MD, MBA, Naveen F Sangji,
Thomas Peponis, Kelsey Han, Myriam Martinez, Daniel Dante Yeh, MD*,
Jarone Lee, MD, MPH*, Marc A. deMoya, MD*, George Velmahos, MD, PhD, MSEd,
David C Chang, Haytham Kaafarani, MD, MPH*
Massachusetts General Hospital

Presenter: Anirudh Nandan, BA

Discussant: Anna Goldenberg-Sandau, DO, Cooper University Hospital

Objectives: The Emergency Surgery Acuity Score (ESAS) was recently validated as a scoring system to predict mortality in emergency surgery (ES) patients. We sought to examine the ability of ESAS to predict the occurrence of 30-day postoperative complications in ES.

Methods: The 2011-2012 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database was screened for all surgeries classified as "emergent". Thirty-day postoperative complications were defined as per ACS-NSQIP (e.g. surgical site infection, respiratory failure, acute renal failure). Each patient-related ESAS was calculated, and the correlation between ESAS and the probability of occurrence of 30-day postoperative complications was assessed by calculating the c-statistic. Univariate and multivariable models were also created to identify which ESAS components independently predict complications.

Results: Of 37,999 cases that captured all ESAS variables, 14,446 (38%) resulted in at least one 30-day complication. The observed probability of a 30-day complication gradually increased from 6% to 53% to 91% at scores of 0, 7, and 15, respectively, with a c-statistic of 0.78 [Figure 1]. For ESAS>15, the complication rate plateaued at a mean of 92%. On multivariable analysis, each of the 22 ESAS components independently predicted the occurrence of postoperative complications.

Conclusions: ESAS reliably predicts postoperative complications in ES patients. Such a score could prove useful for: 1) perioperative patient and family counseling and 2) benchmarking the quality of ES care.

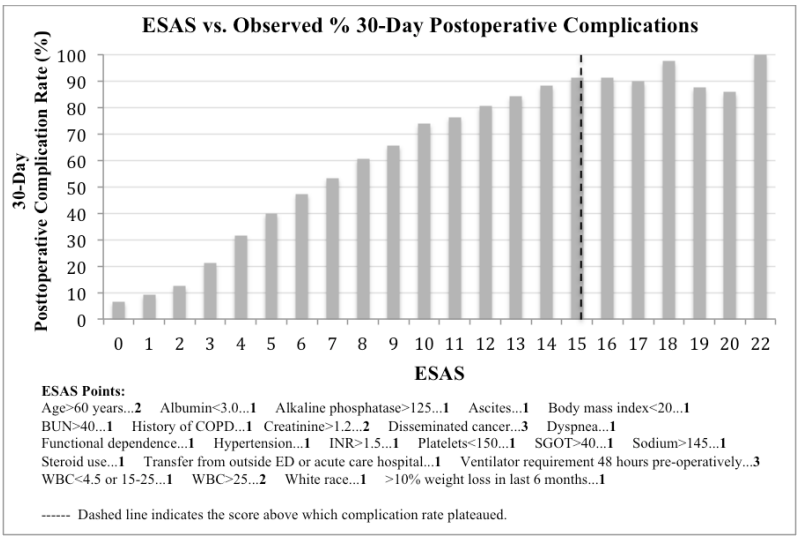


Figure 1: **ESAS** Variables, Points per Variable, and Observed 30-day Complication Rates

Scientific Session IV-B - Trauma

Paper #30
January 13, 2017
8:30 am

EARLY HEPARIN ADMINISTRATION AFTER TBI: PROLONGED COGNITIVE RECOVERY IS ASSOCIATED WITH REDUCED CEREBRAL EDEMA AND LEUKOCYTE SEQUESTRATION

Katsuhiro Nagata, MD, Kevin Browne, Yujin Suto, Kenichiro Kumasaka, Jesse St-Pierre, John Cognetti, Victoria Johnson, Joshua A. Marks, MD*, Shengjie Li, Douglas Smith, Jose L. Pascual, MD, PhD, FRCS(C), FACS*
University of Pennsylvania

Presenter: Katsuhiro Nagata, MD

Discussant: Cherisse Berry, MD, R Adams Cowley Shock Trauma Center

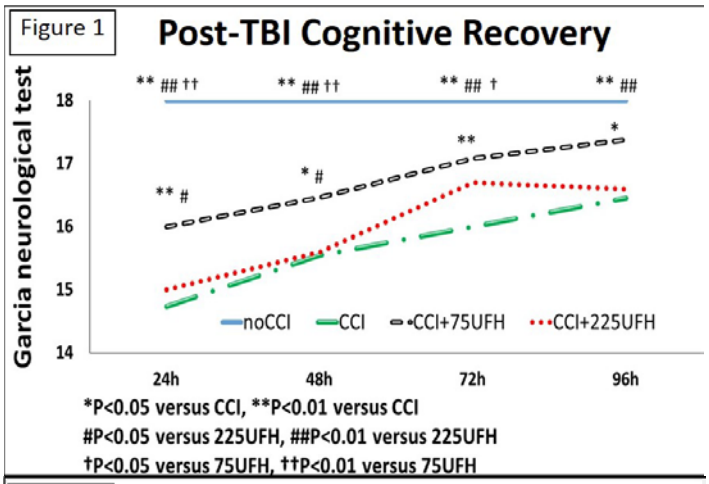
Objectives: Early administration of prophylactic unfractionated heparin (UFH) after TBI reduces in vivo circulating polymorphonuclear neutrophils (PMN) in peri-injury penumbral brain tissue, enhancing post-injury cognitive recovery. It is unknown if this effect lasts beyond hours after injury and if UFH reverses penumbral tissue PMN sequestration. We hypothesized that UFH reduces cerebral PMN accumulation resulting in persistently improved cognition.

Methods: CD1 mice underwent either TBI (controlled cortical impact-CCI) or sham craniotomy. UFH (75 U/kg or 225 U/kg) or vehicle was repeatedly administered after TBI. Neurologic function (Garcia Neurological Test, GNT [max score=18]) and body weight were evaluated 24-96h after TBI. Brain/lung wet-to-dry ratios, hemoglobin levels (Hb) and brain PMN (via Ly6G-immunohistochemistry) were evaluated post mortem (96h). ANOVA with Bonferroni correction determined significance ($p<0.05$).

Results: Compared to untreated CCI animals, low dose UFH accelerated cognitive recovery throughout the entire post TBI period (Fig 1). High dose UFH increased 48h-body weight loss (10.2±4.7%) above sham (5.5±2.9%, $p<0.05$). Both UFH doses reduced penumbral PMN brain tissue accumulation (Fig 2) 96h post TBI. Compared to untreated CCI (78.8±0.8), low dose UFH (77.3±0.6) reduced cerebral edema to sham levels (77.4±0.6, $p=0.04$ vs either). 96 hours after CCI, high dose UFH (10.6±1.2g/dL) resulted in significantly lower Hb than in sham animals (13.0±1.2g/dL, $p<0.05$).

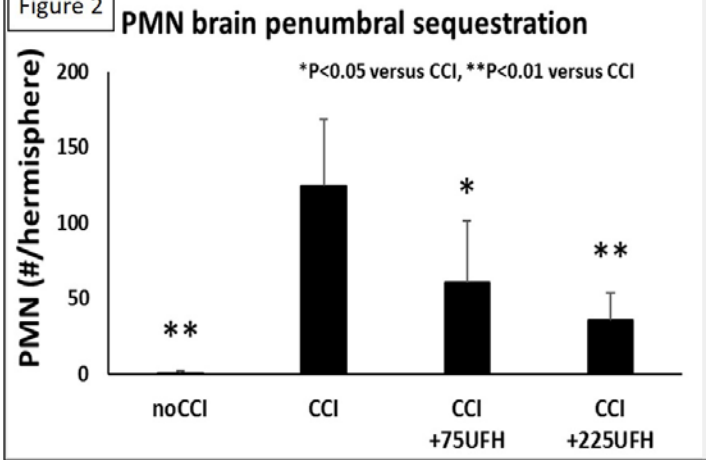
Conclusions: UFH early after TBI reduces accumulation of PMN and edema in injured brain tissue. This is associated with persistently improved cognitive recovery, but only when standard prophylactic dose UFH is used. Higher doses may negate this effect by increasing bleeding. Human evaluation is needed to determine if early UFH reduces secondary brain injury progression and improves outcomes after TBI.

Figure 1



*P<0.05 versus CCI, **P<0.01 versus CCI
#P<0.05 versus 225UFH, ##P<0.01 versus 225UFH
†P<0.05 versus 75UFH, ††P<0.01 versus 75UFH

Figure 2



Scientific Session IV-B - Trauma

Paper #31
January 13, 2017
8:50 am

BETTER THAN NOTHIN': PERMISSIVE REGIONAL HYPOPERFUSION REDUCES THE DISTAL ISCHEMIC BURDEN COMPARED TO REBOA

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Rachel M. Russo, MD, Anders J. Davidson, MD, Lucas Neff, Joseph Galante, MD
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Presenter: Sarah-Ashley Ferencz, MD

Discussant: Megan Brenner, MD, R Adams Cowley Shock Trauma Center

Objectives: The duration of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for hemorrhage control is limited by mounting ischemia in distal tissue beds. We hypothesized that a small amount of continuous distal blood flow during aortic occlusion would reduce this ischemic burden without sacrificing proximal hemodynamic support compared to complete REBOA.

Methods: Seventeen swine were subjected to controlled hemorrhage of 25% blood volume, followed by treatment with 100%("complete" REBOA), 90-95%("partial" REBOA) or 0%("control") restriction of native aortic flow. Restoration of systemic circulation occurred after 60mins in the intervention groups, followed by resuscitation and monitoring for 4½hrs. Blood gases were collected from distal veins prior to hemorrhage (baseline) and at standard intervals following reperfusion.

Results: In all groups, mean arterial pressure (MAP) declined during hemorrhage and was maintained above 70mmHg in intervention groups. Baseline pH was not different between groups (control 7.43, complete 7.40, partial 7.43; p=0.19). Immediately following reperfusion, pH in the complete and partial groups was significantly lower than controls (7.02 and 7.06 vs 7.21,respectively;p=0.0016). Following reperfusion, the distal tissue beds in the complete group remained significantly more acidotic than either the partial or control groups (7.11 vs 7.28 and 7.36,respectively;p=0.02).

Conclusions: Regional differences in ischemia with varying levels of aortic occlusion manifest with changes in pH on venous blood gas analysis. Preservation of a small amount of distal blood flow reduces distal ischemia compared to sustained aortic occlusion, without compromising hemodynamic support. Innovations in REBOA catheter design to permit permissive regional hypoperfusion may extend the duration of this intervention and extend the utility of these technologies closer to the point of injury.

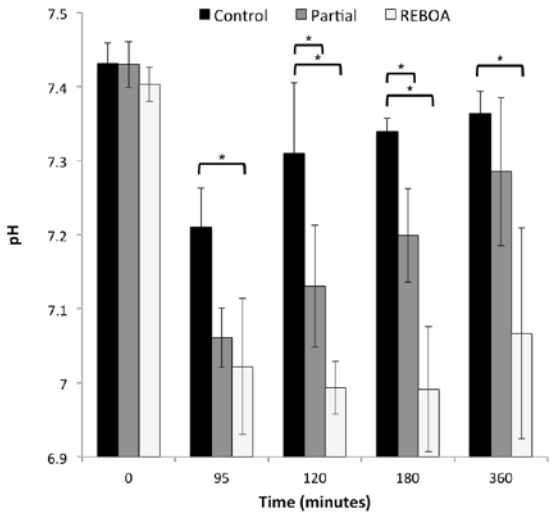

Figure 1. Change in pH over time. Statistically significant differences are marked with an asterisk (*).

Scientific Session IV-B - Trauma

Paper #32
January 13, 2017
9:10 am

UNIVERSAL SCREENING FOR INTIMATE PARTNER AND SEXUAL VIOLENCE IN TRAUMA PATIENTS: AN EAST MULTICENTER TRIAL

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Presenter: Tanya L. Zakrison, MD, MPH, FRCSC, FACS

Discussant: Joan M. Pirrung, RN, MSN, APN-BC, Christiana Care Health System-Christiana Hospital

Objectives: A single center trial recently demonstrated a prevalence of 14% of intimate partner and sexual violence (IPSV) amongst both male and female trauma patients, regardless of mechanism of injury. We aimed to determine if this phenomenon was similar to rates in other trauma centers by assessing the feasibility of universal screening, and determining the prevalence and association of IPSV with other trauma-associated comorbidities.

Methods: We designed an EAST- supported multicenter, prospective observational cohort study involving four Level I trauma centers throughout the United States. Screening occurred from 03/15-04/16. We performed universal screening of adult trauma patients using the validated HITS (Hurt, Insult, Threaten, Scream) and SAVE (sexual violence) screening surveys. Trauma recidivism, substance use and mental illness were also measured and were classified as “trauma-associated comorbidities”. Chi squared test compared categorical variables with significance at $p<0.05$. Parametric data is presented as mean +/- standard deviation.

Results: A total of 2034 eligible trauma patients were screened by clinical social workers at each site over one year. The mean age was 37.05 ± 20.32 with 63% men, 37% women and one transgendered participant. The overall rate of IPSV was 11.4%. The proportion of positive screens for men was 9.3%, with variability between centers (3.8%-72.7%) and for women was 16.1% (15.3%-50.0%) ($p<0.001$). The transgendered patient screened positive for IPSV. Of patients that screened positive for IPSV, 60.0% had one or more trauma-associated comorbidity compared to 15.1% of patients that screened negative ($p<0.001$).

Conclusions: More than 1 in 9 trauma patients is at risk of IPSV, regardless of gender or mechanism of injury. IPSV may be a risk factor for other trauma-associated comorbidities.

Notes

Scientific Session IV-B - Trauma

Paper #33
January 13, 2017
9:30 am

PRACTICE PATTERNS AND OUTCOMES FOR PEDIATRIC MASSIVE TRANSFUSION PROTOCOL ACTIVATIONS

Maraya N. Camazine, BS, Julie Leonard, Cassandra Josephson,
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Presenter: Maraya N. Camazine, BS

Discussant: Jonathan I. Groner, MD, Nationwide Children's Hospital

Objectives: To compare epidemiology, practice patterns and outcomes for children who have a massive transfusion protocol (MTP) activated for life-threatening bleeding due to trauma (T) and non-trauma (NT) etiologies.

Methods: We conducted a multicenter, prospective observational study of children age < 18 years, with an MTP activation at 8 academic children's hospitals. Children who had an MTP activation and received at least one transfusion between 1/2014-6/2016 were compared by groups based on T vs NT causes for activation. Blood product utilization was analyzed. Outcomes recorded occurred after MTP activation.

Results: Of 80 patients with MTP activations, 67 (84%) received blood products. The T patients (n=35) were older than the NT patients (n=32), median (IQR) of 9.1 years (4.5-15.3) vs 2.0 years (0.2-10.5), respectively (p=0.01). T patients had an MTP activation for either blunt (51%) or penetrating trauma (49%). NT patients had an MTP activation for intra-operative bleeding (38%), post-operative bleeding (28%) or medical bleeding (34%). Table 1 compares MTP duration and therapies during MTP between groups with differences noted for tranexamic acid and blood product use. MTP activation location for T and NT are as follows: Emergency department: 66%, 6.25%, OR: 17%, 25%, Pediatric ICU: 17%, 34.4%, Cardiac ICU: 0%, 28.1%, and Neonatal ICU: 0%, 6.25%. Table 2 displays outcomes that occurred after MTP activation. Patients with T had reduced incidence of sepsis and acute kidney injury after MTP activation.

Conclusions: The epidemiology, practice patterns, and outcomes for massive transfusion protocol activation are different between children with T and NT bleeding. High quality trials are needed to determine optimal MTP resuscitative strategies for all children with life-threatening bleeding.

Table 1. MTP Resuscitation Parameters		
	Trauma (n=35)	Non-Trauma (n=32)
MTP duration (hours)	5.3 (2.6-6.8)	3.0 (1.0-6.9)
TXA use (%)	27%	5%*
TXA dose (mg/kg)	16.1 (10.3-22.7)	39.4 (37.8-40.9)
Total blood products (ml/kg)	55.1 (29.0-102.3)	92.6 (48.9-169.1)
Total crystalloids (ml/kg)	50 (13.7-73.6)	43.2 (31.8-66.5)
No Plasma Given	17%	6%
Plasma:RBC < 1:2	20%	41%
Plasma:RBC > 1:2	63%	53%
RBC - Plasma Deficit (ml/kg)	8.9 (-1.2-20.5)	17.4 (-6.1-37.5)
No Platelets Given	40%	16%*
Platelet:RBC < 1:2	49%	50%
Platelet:RBC > 1:2	11%	34%*
RBC - Platelet Deficit (ml/kg)	17.2 (7.9-3.1)	22.5 (6.4-58.3)

* Indicates p value < 0.05 between study groups

Table 2. Outcomes Post-MTP		
	Trauma	Non-Trauma
Acute Respiratory Distress Syndrome	40% (14/35)	47% (14/30)
Sepsis	9% (3/35)	33% (10/30)*
Acute Kidney Injury	6% (2/35)	53% (16/30)*
Abdominal Compartment Syndrome	9% (3/35)	7% (2/30)
New or Progressive Multiple Organ Dysfunction Syndrome	51% (18/35)	69% (20/29)
Death (28 days or discharge)	49% (17/35)	53% (17/31)

* Indicates p value < 0.05 between study groups

Scientific Session IV-B - Trauma

Paper #34
January 13, 2017
9:50 am

ROUTINE INCLUSION OF LONG-TERM FUNCTIONAL AND PATIENT REPORTED OUTCOMES (PRO) INTO TRAUMA REGISTRIES: CAN THIS BE DONE?

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Presenter: Juan P. Herrera-Escobar, MD

Discussant: Maureen McCunn, MD, MIPP, R Adams Cowley Shock Trauma Center, University of Maryland

Objectives: The Institute of Medicine recently recommended inclusion of post-discharge Health Related Quality of Life (HRQoL) and Patient Reported Outcomes (PRO) as metrics to benchmark the quality of trauma care. Currently, these measures are not routinely collected at most trauma centers. We sought to determine the feasibility and value of adding such long-term outcome measures to trauma registries.

Methods: Trauma patients with an ISS ≥9, admitted to a Level-I trauma center were identified retrospectively using the institutional trauma registry and contacted 6 or 12-months post-injury to participate in a telephone survey evaluating: HRQoL (Short Form-12 [SF-12]), PRO (Trauma Quality of Life [T-QoL]), Post-Traumatic Stress Disorder (PTSD), return to work, residential status, and healthcare utilization.

Results: Data were collected for 171 (43%) of 394 eligible patients: 85 at 6mo and 86 at 12mo. 106 (27%) patients could not be contacted, 61 (16%) declined to participate, and 56 (14%) were interested in participating at another time but were not reached again. Many patients screened positive for PTSD and half had not yet returned to work (Tables 1 and 2). There were significant reductions in SF-12 physical composite scores relative to population norms (mean [SD] = 50[10]) at 6mo (mean [95%CI] = 44[41-47]) and 12mo (44[42-47]); no difference was noted in the SF-12 mental composite scores (50[47-53] / 49[46-52]).

Conclusions: Measuring PRO and HRQoL of trauma patients at 6 and 12 months post-injury uncovered a significant level of impairment. Routine collection of such data characterizes trauma outcomes beyond mortality and will enable the development of quality improvement metrics that better reflect patients' post-injury experience. Improved methods are needed to enhance data collection methods and response rates before widespread adoption across trauma centers in the United States.

Table 1. Patient-reported outcomes			
Outcome	**6 Months**	**12 Months**	**Overall**
Post-traumatic stress disorder positive screening	23%	16%	20%
Living with assistance (without prior need)	24%	25%	24%
Injury-related change in insurance (<65 y/o)	22%	19%	20%
Stopped working (injury-related)	52%	48%	50%
Injury-related readmissions	21%	12%	16%
Rehabilitation use (inpatient and/or outpatient)	72%	84%	77%

Table 2. Proportion of patients who agreed with each Trauma Quality of Life (T-QoL) questionnaire statements.			
T-QoL Patient-Reported Outcome Measure	**6 Months**	**12 Months**	**Overall**
EMOTIONAL WELL-BEING	**n= 62**	**n= 62**	**n= 124**
I still feel fear when I think about the injury	49%	44%	47%
Rely on others because of financial limitations	37%	33%	35%
FUNCTIONAL ENGAGEMENT*	**n= 82**	**n= 80**	**n= 162**
I need help walking up stairs (directly attributable to injury)	33%	29%	31%
I need help walking on flat surfaces (directly attributable to injury)	27%	24%	26%
RECOVERY/RESILIENCE	**n= 62**	**n= 62**	**n= 124**
Even though I was injured, my life is better now than it was before the injury	50%	44%	47%
My recovery was shorter than I expected	50%	52%	51%
PHYSICAL WELL-BEING	**n= 62**	**n= 62**	**n= 124**
I currently have physical limitations	71%	63%	67%
Pain limits what I am able to do	44%	52%	48%
Note: Not all domains are responded by all participants. * This domain was answered by both patients and caregivers			

Scientific Session IV-B - Trauma

Paper #35
January 13, 2017
10:10 am

MULTICENTER RETROSPECTIVE STUDY OF NON-COMPRESSIBLE TORSO HEMORRHAGE: ANATOMIC LOCATIONS OF BLEEDING AND COMPARISON OF ENDOVASCULAR VERSUS OPEN APPROACH

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Presenter: Ronald Chang, MD

Discussant: Edgardo S. Salcedo, MD, University of California Davis

Objectives: To describe the anatomic location of truncal bleeding in patients presenting with non-compressible torso hemorrhage (NCTH) and to compare endovascular (ENDO) versus open (OPEN) management.

Methods: Retrospective study of adult trauma patients with NCTH admitted to 4 urban level 1 trauma centers in 2008-2012. Inclusion criteria: NCTH defined as named axial torso vessel disruption, AIS chest or abdomen ≥ 3 with shock (base excess <-4) or operation in ≤ 90 minutes, or pelvic fracture with ring disruption. Exclusion criteria included isolated hip fractures and falls from standing. After dividing patients into ENDO and OPEN groups based on the initial approach to control NCTH, a purposeful multivariate logistic regression model was used to test the hypothesis that ENDO was associated with reduced in-hospital mortality in NCTH patients.

Results: 560 patients with NCTH underwent ENDO (n=175, 31%) or OPEN (n=385, 69%). ENDO patients had more blunt trauma (95% vs 32%, $p<0.01$); were more severely injured (median ISS 34 vs 25, $p<0.01$); had increased time to intervention (median 295 vs 87 min, $p<0.01$); and had lower mortality (17% vs 31%, $p<0.01$) compared to OPEN. ED vital signs and presence of shock were similar ($p>0.05$). ENDO was used for a narrow range of vascular injuries, while OPEN injuries were more diverse (Table). Use of ENDO for NCTH increased from 23% in 2008 to 39% in 2012. After adjusting for age, mechanism, ISS, use of REBOA, and admission SBP, base excess, and platelet count, multivariate logistic regression found that ENDO was associated with decreased mortality compared to OPEN (OR 0.38, 95% CI 0.19 - 0.77).

Conclusions: ENDO was used in a relatively narrow range of bleeding control indications in this NCTH population. Although ENDO may reduce mortality in NCTH patients, significant group differences limit the generalizability of this finding.

	ENDO (n=175)			OPEN (n=385)	
Ascending aorta, arch, and arch vessels	7	4.0%		33	8.6%
Superior vena cava	0	0.0%		14	3.6%
Internal thoracic arteries	0	0.0%		19	4.9%
Descending aorta	44	25.1%		16	4.2%
Pulmonary vessels	0	0.0%		10	2.6%
Abdominal aorta	2	1.1%		17	4.4%
Common hepatic & splenic arteries	14	8.0%		16	4.2%
Other abdominal visceral arteries	8	4.6%		49	12.7%
Abdominal visceral veins	2	1.1%		33	8.6%
Inferior vena cava	0	0.0%		56	14.5%
Renal arteries	14	8.0%		10	2.6%
Renal veins	0	0.0%		8	2.1%
Common & external iliac arteries	5	2.9%		24	6.2%
Internal iliac arteries & branches	73	41.7%		34	8.8%
Common, external, & internal iliac veins	3	1.7%		32	8.3%
Unknown/other	3	1.7%		14	3.6%

Table. Anatomic location of NCTH.