Session: XI: Quickshots
Paper QS1: 8:01-8:07

THIS TOO SHALL PASS: A STUDY OF INGESTED SHARP FOREIGN BODIES

Kirellos R. Zamary MD, James W. Davis* MD, Emily E. Ament MD, Rachel C. Dirks Ph.D., UCSF Fresno

Invited Discussant: Stanley Kurek, Jr., D.O.

Introduction: Gastrointestinal foreign body (GFB) ingestion is a common problem and often results in surgical consultation. Current literature is limited to case reports and fails to provide data regarding the management of sharp GFB ingestion. We hypothesized that patients who ingest sharp objects rarely have perforation or obstruction requiring surgical intervention.

Methods: Patients with GFBs were retrospectively reviewed from 1/05–9/14 at a level 1 trauma center with an acute care surgery program. Exclusion criteria were: leaving without being seen, unknown method of GFB entry, unknown GFB, GFB insertion per rectum, or ingestion of a blunt GFB. Data collected included patient demographics, length of stay, and results of operations that were performed.

Results: During the study period, there were 1169 hospital visits for GFB; 950 met exclusion criteria resulting in our study population of 219 sharp GFB ingestions. Average age was 30 ± 18, 62% were male, and 35% were incarcerated. Recidivism rate was 25%. The average length of stay was 3 days, which was prolonged due to psychiatric holds and consultations. Of the 219 patients, 169 (77%) had no intervention and none returned for complications. Forty-five patients (20%) underwent endoscopy: 27 patients had the sharp GFB removed, but none had perforation or bleeding; 4 had mucosal abnormalities noted with no further treatment. In 18 of the endoscopies (8% of total visits), no abnormalities or GFB were found. Six patients (3%) underwent surgery. Four patients underwent therapeutic surgical interventions: 3 for perforation and 1 for a necrotic gastrojejunal anastomosis (prior roux-en-Y gastric bypass) with distal GFB. Two patients underwent negative laparotomy; one included an enterotomy for removal of the GFB.

Conclusions: Necessary surgical intervention occurred in 4 (2%) patients with sharp GFB ingestions. 85% of patients required no intervention, and 13% underwent intervention without therapeutic significance. In the absence of peritonitis or psychiatric holds, these patients can be safely discharged from the Emergency Department with return precautions.

Session: XI: Quickshots
Paper QS2: 8:08-8:14

EXTRACELLULAR VITAMIN D BINDING PROTEIN-ACTIN COMPLEXES: AN IMMEDIATE PRODUCT OF TISSUE INJURY ASSOCIATED WITH PROINFLAMMATORY FUNCTIONS

Richard R. Kew Ph.D., Randeep Jawa* MD, James Vosswinkel MD, Glenda Trujillo Ph.D., Stony Brook University Hospital

Invited Discussant: Grant O'Keefe, MD, MPH

Introduction: Actin is the most abundant intracellular protein in all cells and large amounts can be released into extracellular fluids during traumatic injury. The vitamin D binding protein (DBP) is an abundant plasma protein that has two principal functions, transport of vitamin D metabolites and scavenging G-actin released during tissue injury. DBP-actin complexes are among the earliest markers of tissue damage and plasma levels correlate positively with severity of injury. However, it is not known if DBP-actin complexes are inactive by-products of tissue injury or have bioactivity. The purpose of this study was to determine if a DBP deficiency could attenuate inflammation in a mouse model of lung injury.

Methods: With IACUC approval, ten-week old control (wild-type C57BL/6J: DBP+/+) and knock-out (DBP-/- on C57BL/6J background) mice received one 0.05 unit dose of bleomycin by oropharyngeal aspiration. Lung injury was evaluated after 7 or 14 days (n = 5-6/group). Cytokine levels on day 7 in bronchoalveolar lavage (BAL) fluid and whole lung homogenates were analyzed using a BioRad 23-plex mouse cytokine assay. BAL cells were quantitated and phenotyped by flow cytometry. Lung injury was assessed by histology on days 7 and 14. DBP-actin complexes were detected in BAL fluid using non-denaturing polyacrylamide gel electrophoresis and immunoblotting.

Results: All DBP knockout mice survived to day 21 and did not display overt signs of morbidity whereas all DBP+/+ mice died between day 14 and 16 and showed clear signs of respiratory distress. BAL fluid from wild-type mice had extensive DBP-actin complexes (50-75% of total DBP) whereas DBP-/- mice had no complexes but had evidence of free actin. Analysis of BAL fluid and lung tissue on day 7 showed that DBP-/- mice had dramatically less inflammation than wild-type animals. There were similar numbers of lung macrophages and lymphocytes in both strains of mice, but DBP-/- animals had significantly fewer lung neutrophils. Analysis of the cell-free BAL fluid on day 7 revealed that, compared to DBP+/+ animals, DBP-/- mice had almost no G-CSF (99% decrease) and a 92% reduction in IL-6. This difference was confirmed in day 7 lung homogenates where DBP-/- mice had an 81% decrease in G-CSF and 42% reduction in IL-6 compared to DBP+/+ animals. Day 7 BAL fluid from DBP-/- mice also had significant reductions in CXCL1 (38%), CCL2 (50%) and CCL4 (41%) levels versus wild-type mice. There were no differences between the two strains in the 18 other cytokines tested. Finally, histological analysis showed a marked decrease in lung fibrosis and collagen deposition in DBP-/- mice on day 14.

Conclusion: This is the first study showing that deletion of DBP in mice results in an attenuated inflammatory response in the bleomycin lung injury model. Absence of DBP-actin complexes in BAL fluid was associated with decreased lung cytokine levels, neutrophil recruitment, fibrosis and mortality. This work supports the concept that DBP can be targeted to modulate inflammation and limit tissue injury.

Session: XI: Quickshots
Paper QS3: 8:15-8:21

IMPACT OF HIGH LEVEL TRAUMA CENTERS ON STATE-WIDE POPULATION BASED INJURY MORTALITY RATE

Mazhar Khalil MD, Ansab Haider MD, Tahereh Orouji Jokar* MD, Peter Rhee* MD, Bardiya Zangbar* MD, Narong Kulvatunyou* MD, Terence O'Keeffe* MD, Andrew Tang* MD, Rifat Latifi* MD, Donald J. Green* MD, Lynn Gries* MD, Bellal Joseph* MD, University of Arizona - Tucson

Invited Discussant: Joseph Galante, MD

Introduction:High level trauma centers provide the highest echelon of care for trauma patients. The distribution of trauma center across the states is extremely variable. The aim of this study was to assess the association between trauma center distribution and injury related mortality.

Methods:We did a one year analysis (2013) of CDC WISQARS database for all injury related deaths in a state. Number of trauma centers and their level of verification in each state were obtained from American College of surgeons' (ACS) trauma center registry. Area and the population of each state were obtained from US census data; and mean time to hospital after crash and vehicle miles travelled were obtained from National highway Traffic Safety Administration. States with at least one ACS verified trauma center were included in the analysis. States were divided into two groups based on the injury mortality rate: High injury mortality-HIM (mortality rate > national average) and low injury mortality LIM (mortality rate < national average). High Level Trauma Centers (HLTC) were defined as ACS verified level 1 and 2. Linear regression analysis was performed for the predictors of statewide injury mortality rate.

Results:A total of 47 states were included in the analysis with mean injury mortality rate of 84.6±15.5 deaths/100,000 population. 23 states were included in LIM and 24 in HIM. LIM states had higher number of total adult trauma centers (10.17±10.4 vs 4.33±3.5; p=0.03) and higher number of HLTC (8.43±10.2 vs 3.38±2.8; p=0.02). There was no difference in trauma center coverage area (13.1±16.3 vs 51.7±133.1 per 1000 sq.mi; p=0.1) and population per trauma center (17.9±32.6 vs 10.3±11.8 per 100,000 population; p=0.7) between the groups. On linear regression analysis, number of HLTC was the independent predictor of injury mortality rate (β [95% CI]: -0.6 [-1.2 - -0.04]; p=0.03).

Predictors of injury mortality rate			
	Beta	95% CI	p
No. of HLTC	**-0.6**	**-1.2 - -0.04**	**0.03**
PPM per trauma center	-0.3	-0.7 – 0.13	0.2
TC per 1000 sq. mi	0.02	-0.03 – 0.07	0.4
Male gender	-2.1	-10.8 – 6.6	0.6
Median population age	-0.1	-2.3-2.0	0.9
Time to hospital after crash	0.3	-0.2-0.9	0.2
Urban to rural VMT	-1.6	-2.9- -0.3	0.02

HLTC=High level trauma center (Level1 and 2), PPM=Population per million, VMT= Vehicle miles travelled

Conclusion:Presence of ACS verified trauma centers significantly impact the injury related mortality. Number of high level trauma centers is strongly correlated with lower state-wide injury mortality.

Session: XI: Quickshots
Paper QS4: 8:22-8:28

TISSUE OXYGEN SATURATION BY NEAR INFRARED SPECTROSCOPY, AN EARLY NON-INVASIVE MARKER OF MORTALITY RISK IN A NON-HUMAN PRIMATE (RHESUS MACAQUE) MODEL OF HEMORRHAGIC SHOCK

Randy F. Crossland Ph.D., Antoni R. Macko Ph.D., James K. Aden Ph.D., Darren M. Fryer BS, Forest R. Sheppard MD, FACS Naval Medical Research Unit San Antonio

Invited Discussant: Gregory Beilman, MD

Introduction: Vital signs, such as blood pressure (BP) and heart rate (HR) are presently used as markers of physiological severity to triage patients and guide resuscitation; however, these markers are inconsistent in the acute phase of trauma. Interest in tissue oxygen saturation (StO 2) as an early marker of patient severity has grown; however, the value of StO2 remains to be determined. We investigated early StO2, end-tidal CO2 (ETCO2), HR and BP as predictive markers of impending mortality outcome in a non-human primate (NHP) model of severe hemorrhagic shock.

Methods: Hemorrhage was induced in anesthetized Rhesus Macaques by 60% left-lobe hepatectomy (T=0 minutes). StO2 (Deltoid), ETCO2, HR (ECG), and invasive mean arterial pressure (MAP) were continuously monitored through T=480 min. At T=120 min, bleeding was surgically controlled and blood loss (BL) quantified. Changes in StO2, HR, ETCO2 and BP values were compared between non-survivors (expired prior to T=480 min; n=5) and survivors (survived to T=480 min; n=11). Statistical comparisons utilized RM-ANOVA with Bonferroni correction and correlation analysis by Pearson r-squared, $p<0.05$ considered significant. Results reported as mean±SEM.

Results: BL was higher in non-survivors compared to survivors (53±2% vs. 41±3%, respectively; $p<0.02$). In non-survivors vs. survivors, baseline (T=0 min) MAP (79±9 vs. 78±4 mmHg; p=0.8), StO2 (91±2% vs. 92±2%; p=0.9), ETCO2 (38±1 vs. 40±1 mmHg; p=0.4) and HR (124±4 vs 102±6 bpm; p= 0.07) were equivalent. At T=5 minutes, StO 2 (55±10% vs. 78±3%; p=0.02) and ETCO2 (15±2 vs. 25±2 mmHg; p=0.0005) were lower, while MAP (18±1 vs. 23±2 mmHg; p=0.2) and HR (104±13 vs. 105±6 bpm; p=0.3) were similar in non-survivors compared to survivors, respectively (Figure 1). Correlation of vital markers over T=5-30 minutes to mortality demonstrated St2O, MAP, and ETCO2 equivalency with a significant group effect ($p\leq0.009$ for each parameter; R2=0.92, R2=0.91, and R2=0.90 respectively); whereas HR yielded the lowest correlation (p=0.8, R2=0.83).

Conclusion: In this study, StO2, ETCO2, and MAP strongly correlated with mortality; however, StO2 and ETCO2 were better acute, early, markers of subsequent mortality. Additionally, the continuous, non-invasive, "attach and forget" aspects of StO2 monitoring provide logistical benefits over other methodologies. These encouraging results warrant further investigation to optimally define a clinically meaningful StO2 threshold.

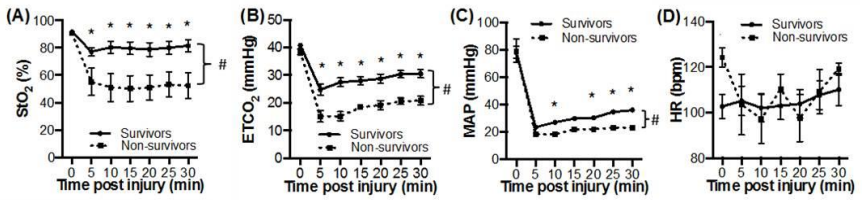


Figure 1: Early assessment of (A) StO2, (B) ETCO2, (C) MAP and (D) HR in non-survivors (n=5) vs. survivors (n=11). # group effect, $p\leq0.01$; *$p<0.05$ vs. survivors by RM-ANOVA.

Session: XI: Quickshots
Paper QS5: 8:29-8:35

TRADING SCALPELS FOR SHEATHS: CATHETER BASED TREATMENT OF VASCULAR INJURY CAN BE EFFECTIVELY PERFORMED BY ACUTE CARE SURGEONS

Megan Brenner MD, MS, Melanie Hoehn MD, William Teeter MD, Deborah Stein* MD,MPH, Thomas Scalea* MD, University of Maryland Medical Center

Invited Discussant: Jack Sava, MD

Introduction: The skillset of the acute care surgeon can be expanded by formal training. We report the first series of traumatic vascular injury (TVI) treated by acute care surgeons trained in endovascular techniques (ACSTEV).

Methods: We retrospectively reviewed patients admitted to our trauma center with TVI over 5 months that survived over 24 hours and had catheter diagnosis and/or therapy by ACSTEV. Demographics, admission data, and outcomes were reviewed. Follow-up ranged from 0-150 days.

Results: Most patients were male (63%), and sustained blunt mechanism (91%). Mean age ($\pm$ SD) was 48.2 years ($\pm$ 21.9), and mean ISS was 32.1 ($\pm$ 11.8). Mean admission SBP, HR, GCS were 126.12 ($\pm$ 30.4), 101.21 ($\pm$ 28.2), and 10.8 ($\pm$ 4.73). 46 patients underwent 48 endovascular procedures for TVI: 32 angiograms and 16 venograms were performed. 2 pelvic angiograms and 1 aortic arch angiogram were negative and required no treatment. One SFA angiogram showed minor luminal defects requiring anti-coagulation only. Pseudoaneurysms were found in 17 vessels, vessel truncation in 4, active extravasation in 5, stenosis in 1, and dissection with thrombus in 1. 4 patients had resuscitative endovascular balloon occlusion of the aorta (REBOA) performed prior to catheter intervention for pelvic hemorrhage. Procedures included aortic repair (4), pelvic embolization (11), splenic embolization (5), lumbar artery embolization (1), bronchial artery embolization (1), profunda artery embolization (1), common carotid artery stent (1), celiac artery stent (1), inferior vena cava filter placement (14) and retrieval (2), and pharmaco-mechanical thrombolysis(1). Treatment material included coils (12), gelfoam (4), and nitinol plugs(3). No procedural or device-related complications occurred. Mortality was 14.7% unrelated to any endovascular procedure. 1 patient had repeat coil embolization of a pelvic pseudoaneurysm on POD#7.

Conclusion: Acute care surgeons trained in endovascular techniques can safely treat TVI with good success. We performed nearly 10 procedures per month underscoring the role of the ACSTEV for training and care of TVI in a high-volume trauma center.

Session: XI: Quickshots
Paper QS6: 8:36-8:42

MANAGEMENT OF CIVILIAN PENETRATING CERVICOTHORACIC ARTERIAL INJURIES IN THE 21ST CENTURY: THE MORE THINGS CHANGE, THE MORE THEY STAY THE SAME?

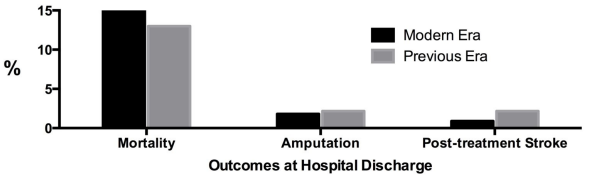
Jordan A. Weinberg* MD, Andrew H. Moore BS, Rebecca J. Teague BS, Tyler Ward BS, Joshua B. Wasmund MD, Elena M. Paulus MD, Louis J. Magnotti* MD, Thomas J. Schroeppel* MD, Stephanie A. Savage* MD, Gayle Minard* MD, George O. Maish* III, MD, Timothy C. Fabian* MD, Martin A. Croce* MD, University of Tennessee Health Science Center - Memphis

Invited Discussant: Charles Fox, MD

Introduction: The management of penetrating arterial injury at the thoracic outlet has long hinged on the fundamental principles of extensile exposure and vascular anastomosis. Nonetheless, treatment options have evolved to include both endovascular stent placement and the application of damage control temporary vascular shunts. The purpose of this study was to evaluate our recent experience with penetrating cervicothoracic arterial injuries in light of these developments in trauma care.

Methods: Patients with penetrating injuries to the innominate, carotid, subclavian, or axillary arteries managed at a single civilian trauma center between 2000 and 2013 were identified and categorized as the modern era (ME) cohort. The management strategies and outcomes pertaining to the ME group were compared to those of previously reported experience (PE) concerning injuries to the innominate, carotid, subclavian, or axillary arteries at the same institution from 1974 -1988.

Results: Over the two eras, there were 202 patients: 110 in the ME group and 92 in the PE group. Age (34 vs. 33) and gender (17% vs. 18% female) were similar between groups. No difference was observed between groups concerning the specific arteries injured ($p = 0.77$): innominate (ME: 3% vs. PE: 4%), carotid (40% vs. 38%), subclavian (28% vs. 24%), axillary (29% vs. 34%). The majority of injuries in both groups were managed with primary repair or graft (66% vs. 63%, $p = 0.62$). A similar proportion of injuries in each group were managed with anticoagulation alone (14% vs. 10%, $p = 0.40$). In the PE group, vessel ligation was performed in 7 cases, and there were no cases of temporary shunt placement or endovascular stent placement. In the ME group, vessel ligation was performed in 3 cases, and two cases were managed with temporary shunt placement. Endovascular stent placement was performed in 12 patients in the ME group. Outcomes at hospital discharge were similar (all $p > 0.05$) between groups (Figure).



Conclusion: In the modern era, outcomes following penetrating cervicothoracic arterial injury remain remarkably similar to the previous era. Endovascular stent is a viable option, but has limited impact on the overall management of penetrating injuries. Temporary shunt placement is also feasible, but is rarely deemed necessary. Proficiency with conventional vascular anatomic exposure and technique remains fundamental to the treatment of civilian cervicothoracic arterial injuries.

Session: XI: Quickshots
Paper QS7: 8:43-8:49

UTILIZING SOCIAL MEDIA FOR COMMUNITY CONSULTATION AND PUBLIC DISCLOSURE IN EXCEPTION FROM INFORMED CONSENT TRIALS

Shannon W. Stephens EMT-P, Carolyn S. Williams RN, BSN, Randal Gray MA Ed, EMT-P, Jeffrey D. Kerby* MD,Ph.D., Henry E. Wang MD, MS, Patrick L. Bosarge MD, University of Alabama Birmingham

Invited Discussant: Peter Rhee, MD, MPH

Introduction: The U.S. Food and Drug Administration and Department of Health and Human Services outline regulations allowing an Exception From Informed Consent (EFIC) for research conducted in an emergency settings when obtaining prospective informed consent is not possible due to the potential subject's critical illness or injury. Acute care clinical trials utilizing EFIC must conduct community consultation and public disclosure (CC/PD) activities. Our objective is to describe our experience using social media to facilitate the CC/PD process in two traumatic injury clinical trials.

Methods: We conducted regional CC/PD activities for two multicenter trauma clinical trials: Pragmatic, Randomized Optimal Platelet and Plasma Ratios (PROPPR) and Prehospital Tranexamic Acid for Traumatic Brain Injury (ROC-TXA). As part of the CC/PD process, we developed research study advertisements using the social media website Facebook. The Facebook advertisement directed respondents to a regional study website that contained comprehensive trial information and methods for providing feedback. We targeted the advertisements to the expected age (15 years old or greater) and geographic groups (individuals with a registered Facebook account, who live within a 50 mile radius of the clinical trial site) for the trials. We determined respondent website interactions using Google analytics. The primary outcomes were the number of Facebook advertisement exposures and the number of referrals to the research study website. In addition, we determined the demographics of the respondents, the information accessed by respondents, and the number of participants who opted-out of each study. We analyzed the data using descriptive statistics.

Results: From October 01, 2012 – November 31, 2012 the Facebook PROPPR advertisement was displayed 5,001,520 times, (12 per target population), with 374 individuals selecting the advertisement for redirection to the regional study website. From August 01, 2014 – September 30, 2014 the Facebook ROC-TXA advertisement was displayed 3,806,448 times (8 per target population) with 790 individuals selecting the advertisement for redirection to the regional study website. Respondents to both advertisements were mostly male (52%), with the highest proportion between the ages 15-24 (28.2%). For both studies, web page engagement was brief (0-10 seconds) for most respondents (PROPPR 42.3%, ROC-TXA 30.4%). The most commonly accessed web pages were "Faculty & Staff" (PROPPR 13.2%, ROC-TXA 19.0%), "Q&A about trauma research" (PROPPR 6.4%, ROC-TXA 11.3%), "Training" (PROPPR 4.5%, ROC-TXA 5.2%), "Contact Us" (PROPPR 4.8%, TXA 5.6%), and "Opt-Out of Research" (PROPPR 2.2%, ROC-TXA 4.0%). Of 51 total individuals viewing the opt-out of research information (PROPPR 19, ROC-TXA 32), page engagement was modest (PROPPR 62 seconds, ROC-TXA 52 seconds), with no individuals requesting to opt-out of study participation.

Conclusion: In clinical trauma trials using EFIC, social media may provide a viable additional option for facilitating community consultation and public disclosure.

Session: XI: Quickshots
Paper QS8: 8:50-8:56

POST-DISCHARGE MORTALITY IN THE ELDERLY AFTER A FALL: OUT THE DOOR, BUT NOT OUT OF DANGER

Christine M. Leeper MD, Marcus Hoffman MD, Matthew Kutcher MD, Matthew Rosengart* MD, Gregory Watson* MD, Timothy Billiar* MD, Andrew Peitzman* MD, Brian Zuckerbraun* MD, Jason Sperry* MD, University of Pittsburgh

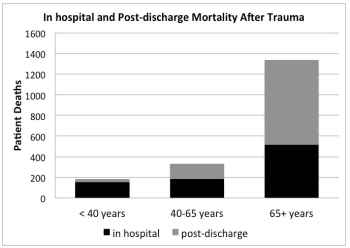
Invited Discussant: Michael Foreman, MD

Introduction: Traumatic injury remains a leading cause of death with the majority of literature focuses on in-hospital mortality. Little information exists regarding post-discharge mortality. Previous studies demonstrate that older patients are at greater risk for post-discharge death, with falls as a mechanism of injury predicting mortality. We sought to describe trauma-associated mortality in all age groups and characterize independent risk factors for post discharge mortality within 6 months of discharge in patients age 65 or greater who sustained a fall.

Methods: A retrospective analysis was performed using single institution trauma registry linked with the social security death index data from 2010-2014. Age was categorized by <40years, 40-65 years and 65+ years. We calculated mortality rates for all age categories then selected elderly patients with mechanism of injury of fall for further analysis. Backward stepwise Cox hazard regression was utilized to determine independent risk factors for in-hospital and out-of-hospital mortality.

Results: 23,7224 patients were analyzed, with inpatient and 6 month mortality as follows: age<40 [inpatient 154 (1.9%), post-discharge 31(0.4%)], age40-65 [inpatient 184 (2.2%), post-discharge 147 (1.7%)] age65+ [inpatient 513 (7.0%), post-discharge 825 (11.2%)]. Post-discharge death increases significantly with age ($p<0.001$) (figure1). For younger patients, predictors focused on injury severity and mechanism for both inpatient and post-discharge mortality. For age 65+, the only injury characteristic that predicted mortality was mechanism of injury=fall, confirming results from prior studies. Predictors of in-hospital mortality for elderly patients after fall were ISS (HR 1.03, 95%CI 1.02-1.04), head AIS (HR 1.48, 95%CI 1.37-1.61), cervical spine fracture (HR 1.34, 95%CI 1.03-1.74) serious cardiac complication (HR 1.46, 95%CI 1.08-1.97). Predictive factors for out of hospital mortality were ICU length of stay (HR 1.04, 95%CI 1.03-1.06), discharge to rehab (HR 2.41, 95%CI 1.85-3.14) or skilled nursing facility (HR 4.20, 95%CI 3.40-5.20), serious cardiac complication (HR 1.44, 95%CI 1.07-1.93).

Conclusion: Post-discharge death within 6 months of a traumatic event preferentially affects the elderly. Predictors of in-hospital death for age 65 or greater focused on injury related characteristics including injury severity score (ISS), head abbreviated injury scale (AIS) score and cervical spine fracture. Post-discharge mortality, however, is predicted by discharge disposition and ICU length of stay, which may simply be surrogate markers of frailty and deconditioning. Better characterization of this population is needed to identify the elderly patient at risk of death even after surviving to see discharge from the hospital.



Session: XI: Quickshots
Paper QS9: 8:57-9:03

A COMPARISON OF TRADITIONAL AND NOVEL INJURY SCORING SYSTEMS IN A US LEVEL-I TRAUMA CENTER: AN OPPORTUNITY FOR IMPROVED INJURY SURVEILLANCE IN LOW- AND MIDDLE-INCOME COUNTRIES

Adam D. Laytin MD,MPH, Catherine J. Juillard MD,MPH, Martin Gerdin MD, Nobhojit Roy MPH, MBBS, MS, Bhakti Sarang MBBS, DNB Surgery, Vineet Kumar MD, Rochelle A. Dicker* MD, University of California, San Francisco

Invited Discussant: Heena Santry, MD

Introduction: Trauma is a global public health priority, with over 90% of deaths occurring in low- and middle-income countries (LMIC). In high-income countries (HIC), accurate surveillance including injury severity quantification is the cornerstone for trauma prevention and systems strengthening. In most LMIC, resources necessary to accurately quantify injury using traditional injury scoring systems are limited. Novel injury scoring systems appear to have adequate discrimination—the ability to differentiate between patients with high and low likelihood of mortality—in LMIC contexts. However, these scoring systems have not been widely tested where traditional injury scores can be accurately calculated. We hypothesize that novel injury scoring systems discriminate as well as traditional ones in a HIC with complete and comprehensive data collection.

Methods: Data from an American level-I trauma registry were used to compare six injury scoring systems. The three traditional scoring systems were the Injury Severity Score (ISS), Revised Trauma Score (RTS), and Trauma Injury Severity Score (TRISS). The novel scoring systems were the Kampala Trauma Score (KTS), Mechanism, GCS, Age and (Systolic Blood) Pressure (MGAP) score, and GCS, Age and Pressure (GAP) score. Each score was calculated for all adult trauma patients treated from 2008 to 2013. Bivariate logistic regression and ROC curve analysis were used to assess the discrimination of each scoring system.

Results: Among 17,049 patients, median age was 40 years and 71% were male. Penetrating mechanisms accounted for 15% of injuries and the hospital mortality rate was 4%. All six scores could be calculated in over 96% of cases and were highly significantly correlated with hospital mortality. While TRISS was most accurate in predicting mortality, KTS, MGAP and GAP all had superior discrimination, quantified by area under ROC curves, compared with both ISS and RTS.

Discrimination of six injury scoring systems in an American level-I trauma center.

Scores	Patients with Available Data, n (%)	p-value	Pseudo R-squared	AUROC
RTS	16595 (97.3)	<0.001	0.3267	0.8478
ISS	16856 (98.9)	<0.001	0.3055	0.8650
KTS	16595 (97.3)	<0.001	0.3953	0.9078
MGAP	16800 (98.5)	<0.001	0.4578	0.9336
GAP	16800 (98.5)	<0.001	0.4411	0.9334
TRISS	16413 (96.3)	<0.001	0.4857	0.9549

Conclusion: KTS, MGAP and GAP discriminate better than ISS and RTS in a resource-rich setting. These novel injury scoring systems, which are easier to implement in resource-poor settings than traditional scoring systems, can be used to accurately quantify injury severity. Implementation of these resource-appropriate tools in LMICs can improve injury surveillance, guiding quality improvement efforts and supporting advocacy for resource allocation commensurate with the volume and severity of trauma.

Session: XI: Quickshots
Paper QS10: 9:04-9:10

MAGNET-DESIGNATED HOSPITALS ARE ASSOCIATED WITH HIGHER SURVIVAL RATES FOR GERIATRIC TRAUMA PATIENTS

Tracy Evans MD, FACS, Brian W. Gross BS, Frederick B. Rogers* MD, MS, FACS, Michael A. Horst Ph.D., Lisa Estrella MS, Nathan McWilliams MPA, RHIA, Jo Ann Miller RN, CCRN, Christina Martin RN, MSN, Claire Mooney MBA,RN, Lancaster General Hospital

Invited Discussant: Garth Utter, MD, MSc

Introduction: The impact of nursing care on trauma patient outcomes remains grossly understudied, specifically pertaining to the geriatric population. We sought to determine whether trauma centers with the performance-driven MAGNET recognition credential had improved outcomes over their non-MAGNET counterparts. We hypothesized that geriatric trauma patients admitted to MAGNET-designated hospitals would have improved survival over those treated at non-MAGNET facilities.

Methods: All geriatric (≥65) admissions from 2009-2011 to the 13 MAGENT and 17 non-MAGNET trauma centers in Pennsylvania were extracted from the Pennsylvania Trauma Systems Foundation State Registry. The impact of MAGNET status on mortality was assessed using a multivariable logistic regression model controlling for age, gender, logit transformation of the probability of death predicted by the TMPM model (TMPM-ais), and systolic blood pressure (SBP). A p-value <0.05 was considered significant.

Results: A total of 27,178 patients met inclusion criteria. MAGNET versus non-MAGNET facilities were statistically indistinguishable in terms of level of designation, in-house surgeons, surgical residency programs, and urban locations (Fischer's exact). Geriatric patients admitted to MAGNET trauma centers had significantly decreased odds of mortality compared to their non-MAGNET counterparts (OR: 0.85; 95% CU 0.77-0.95; p=0.004), when controlling for age, gender, TMPM-ais, and SBP.

Conclusion: Admission to a MAGNET-designated trauma centers resulted in a 15% reduction in mortality for the geriatric trauma population. We believe the MAGNET program's attention to nursing excellence has profoundly benefited the geriatric trauma patient in terms of improved survival.

Variable	Adjusted Odds Ratio (95% CI)	p-value
Magnet Hospital	0.85 (0.77-0.95)	0.004
Age	1.04 (1.04-1.05)	<0.001
Gender (male)	1.52 (1.36-1.69)	<0.001
TMPM-ais	2.23 (2.14-2.29)	<0.001
Systolic BP	0.99 (0.99-0.99)	<0.001
Constant	0.10 (0.05-0.19)	-
N = 27,178		

AUROC: 0.84

Session: XI: Quickshots
Paper QS11: 9:11-9:17

IMPLICATIONS OF THE TQIP INCLUSION OF NON-SURVIVABLE INJURIES IN PERFORMANCE BENCHMARKING

Jiselle B. Heaney MD,MPH, Rebecca Schroll MD, Jennifer Turney MD, Lance Stuke* MD,MPH, Alan B. Marr* MD, Patrick Greiffenstein MD, Rosemarie Robledo DO, MBS, Amanda Theriot FNP-c, Juan Duchesne* MD, Avery B. Nathens* MD,Ph.D., John Hunt* MD,MPH, Tulane School of Medicine

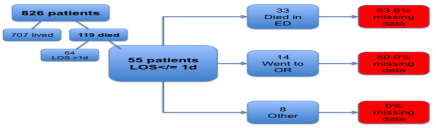
Invited Discussant: Mark Hemmila, MD

Introduction: The Trauma Quality Improvement Project (TQIP) is a nation-wide injury prediction model for performance benchmarking. Mortality is the primary outcome and may be affected by numerous variables such transport times, a high percentage of penetrating trauma, and the accuracy or completeness of the data recorded. These factors may hamper the model's ability to adequately stratify injury severity and act as a bench-marking tool. We hypothesize that at a mature level 1 high volume penetrating trauma center performance outcomes will be biased in the TQIP model due to the inclusion of a significant portion of patients with non-survivable injuries.

Methods: Data reported to TQIP was retrospectively obtained from the institutional trauma registry. Deaths included in the most recent TQIP analysis 2013-2014 were examined. Retrospective chart review was conducted for all patients with length of stay (LOS) ≤ 1 day to determine survivability of the injuries sustained. Non-survivable injuries were defined as: died in ≤ 2 hours, patients who under went ED or OR thoracotomy in extremis, patients who became organ donors or DNR, and patients who were documented by neurosurgery or general surgery tohave non-survivable injuries. O/E (observed-to-expected) ratios were calculated before and after exclusion of these patients.

Results: A total of 826 patients were reported to TQIP. There were 119 deaths with 46.2% (55 of 119) having a LOS of less than one day. Penetrating trauma accounted for 67.3% of these patients. 33 deaths occurred in the ED, with 63.3% (21/33) missing data, 14 patients went to the OR with 50.0% (7/14) missing data, and 8 patients died elsewhere with 0% (0/8) of these patients missing data. Thoracotomies were performed on 30.9% (17/55) of patients, and 41.8% (23/55) patients had significant traumatic brain injury (TBI). Non-survivable injuries accounted 90.9% (50 of 55 patients) of the deaths in patients with LOS≤ 1 day were excluded = 1.007. O/E ratio after all non-survivable injures with LOS ≤ 1 day were excluded = 0.895.

Conclusion: This study demonstrated that TQIP inclusion of patients with non-survivable injuries biases performance outcomes at an urban high volume penetrating trauma center. Missing data results in TQIP imputation of values, increasing inaccuracy. Institutions should focus on reporting complete data to improve accuracy. Further investigation is needed to determine if these findings exist at other similar institutions, and whether the current TQIP model needs revision to accurately identify and exclude patients with non-survivable injuries.



Session: XI: Quickshots
Paper QS12: 9:18-9:24

FUNCTIONAL STATUS, AGE AND LONG TERM SURVIVAL FOLLOWING TRAUMA

Allan B. Peetz MD, Gabriel Brat MD, Ali Salim* MD, Reza Askari MD, Jessica E. Rydingsward BS, Clare M. Horkan MBBCh, Kenneth B. Christopher MD, Brigham and Womens Hospital

Invited Discussant: Eric Ley, MD

Introduction:It is well known that ICU survivors have a high mortality rate and often suffer long-term physical impairments such as, profound neuromuscular weakness and lower Quality of Life following hospital discharge. Similar long-term outcomes following trauma ICU survivors are not known. The purpose of the current study is to examine long-term mortality and its association with functional status at hospital discharge.

Methods:All adult trauma patients (age ≥ 18 years) requiring ICU admission who survived hospitalization between 1997 and 2011 were included. Data was obtained from a centralized clinical data registry. The exposure of interest was functional status defined as physical function assessed at the time of hospital discharge. Patients were assessed by a certified Physical Therapist on several well accepted parameters including: Bed Mobility, Transfers, and Gait level. Each assessment was graded on a scale of function (Independent, Stand by, Minimum, Moderate, Maximum, Total assistance, Not applicable) and transformed into an integer score based on a logistic regression model describing the risk of post discharge mortality. Adjusted odds ratios were estimated by multivariable logistic regression models. The primary outcome was all cause, post discharge mortality.

Results:We analyzed 3,565 patients. 60% were male, 78% were white and had a mean (SD) age of 55.0 (12.4) years. 16.8% of the cohort were readmitted within 30 days of discharge. The 365 and 720-day post discharge mortality was 17.5% and 22.8%. In a logistic regression model the lowest quartile of functional status at hospital dischargewas associated with 3.9 fold increased odds of 720-day post discharge mortality (adjusted OR 3.94 (95%CI 2.58-6.03, P<0.001) compared to patients with independent functional status. The effect modification of the functional status-post discharge mortality association is present relative to age (P interaction <0.001). Crude all-cause 720-day post discharge mortality rates were 10.2% and 37.4% in patients under 65 and over 65 respectively. In patients with the lowest quartile of functional status at hospital discharge, the odds of 720-day post discharge mortality compared to patients with independent functional status is stronger in older adults (>/=65: adjusted OR 3.24 (95%CI 1.67-6.31, P=0.001) than < 65: adjusted OR 2.49 (95%CI 1.37-4.55, P=0.003). Finally, improvement of functional status prior to discharge was associated with a 67.5% decrease in 90-day post discharge mortality [adjusted OR 0.32 (95%CI 0.17-0.61, P<0.001] compared to those patients who failed to improve.

Conclusion:In trauma ICU survivors, the mortality progressively increases up to two years after hospital discharge. In addition, the functional status at hospital discharge is predictive of long-term mortality. Most importantly, an improvement in functional status at discharge is associated with a significant reduction in short-term mortality.

Session: XI: Quickshots
Paper QS13: 9:25-9:31

CLINICAL SIGNIFICANCE OF COMPUTED TOMOGRAPHY CONTRAST EXTRAVASATION IN BLUNT TRAUMA PATIENTS WITH A PELVIC FRACTURE

Jeremy S. Juern MD, David Milia MD, Panna Codner MD, Marshall Beckman MD, Lewis Somberg* MD, Travis Webb* MD, John A. Weigelt* MD, Medical College of Wisconsin

Invited Discussant: George Velmahos, MD, PhD

Introduction: Blunt pelvic fractures can be associated with major pelvic bleeding. Contrast enhanced computed tomography (CT) may show contrast extravasation (CE) in the pelvic hematoma, but the significance of CE on CT scan is debated. Our institution previously reported on the significance of CE on CT scan from the years 1998-2005. We sought to update our experience with CE on CT scan for the years 2009-2014 to determine the accuracy of CE in predicting the need for angioembolization.

Methods: This is a retrospective review of data from the prospectively maintained trauma registry and our electronic medical record. Patients seen from July 1, 2009 to September 7, 2014 with blunt pelvic fractures were included. Patients transferred from referring institutions as well as those without a contrast enhanced CT were excluded. Standard demographic, clinical, and injury data were obtained. Patient records were queried for presence of contrast enhanced axial imaging, contrast extravasation, performance of angiography, and angioembolization. Positive patients were those where CE was associated with active bleeding requiring angioembolization. All other patients were considered negative. The sensitivity, specificity, and positive and negative predictive value of CE on CT scan was determined.

Results: There were 497 patients during the study time period with blunt pelvic fracture meeting inclusion criteria and 75 patients (15%) had CE. Of those patients with CE, 30 (40%) underwent angiography, and 17 (23%) required angioembolization. The sensitivity, specificity, PPV, and NPV of CE on CT were 100%, 87.9%, 22.7% and 100% respectively. Two patients without CE underwent angiography but did not undergo embolization. Patients with CE had higher mortality (13 vs 6%, $p<0.05$) despite no significant difference in injury severity score (Table).

Table. Outcome Based on Contrast Extravasation on Computed Tomography

	CE	**No CE**
Angiography n,(%)*	28(37)	2(0.5)
Embolization n,(%)*	17(23)	0(0)
Mortality n,(%)*	10(13)	27(6)

$p<0.05$

Conclusions: This study reinforces that contrast extravasation on CT pelvis with blunt trauma is common, but most patients will not require angioembolization. Compared to our previous study, the sensitivity of CE on CT was higher while the specificity and PPV were both lower. We did not have any patients without CE requiring embolization. This is in contrast to the 33% rate of the previous study . This is likely due to both changes in our practice as well as the increased sensitivity of modern CT scanners.

Session: XI: Quickshots
Paper QS14: 9:32-9:38

EVALUATING THE TRADITIONAL DAY AND NIGHT IN AN ACUTE CARE SURGERY FELLOWSHIP: IS THE SWING SHIFT A BETTER CHOICE?

Paul J. Chestovich MD, Nichole K. Ingalls MD, Douglas R. Fraser MD, Shawna L. Morrissey DO, John J. Fildes* MD, University of Nevada School of Medicine

Invited Discussant: Grace Rozycki, MD, MBA

Introduction: Trauma center schedules usually follow standard 12 hour day/night or 24 hour shifts, while resident and fellow trainees often follow a similar schedule. Fellowship trainees of Trauma and Acute Care Surgery require experience managing complex trauma patients, including both operative and non-operative cases. Although trauma admissions can be unpredictable, we sought to analyze our trauma volume to determine if a different scheduling model may increase exposure to complex and operative cases for trainees in Acute Care Surgery.

Methods: Our center's prospectively maintained trauma registry was queried for three events: trauma laparotomies, thoracotomies, and patients with ISS > 15. Ten years (2005-2014) of trauma volume were analyzed by hour of patient arrival. Three shifts were chosen to compare retrospectively: Day (7a-7p), Night (7p-7a) and Swing (12p-12a). The Swing shift was chosen since it covers the peak volume during the afternoon and evening hours, and is generally less disruptive to a weekly schedule and normal sleep patterns. A Visual Basic script was used to retrospectively populate a daily shift calendar. Frequency of events per shift were compared using Student's t-test, with $p < 0.05$ considered significant.

Results: During the study period, our center treated 8137 patients with ISS > 15, performed 2105 laparotomies and 479 thoracotomies. Daily trauma volume was plotted by hour of patient arrival (Fig 1). The frequency of events per 12 hour shift is shown in Table 1 below (avg ± SD). The frequency of patients with ISS>15 in the swing shift was higher than either day or night shifts ($p<0.001$). Frequency of laparotomies ($p<0.001$) and thoracotomies ($p=0.003$) were higher in the swing shift than the day shift, but not greater than the night shift (p=NS).

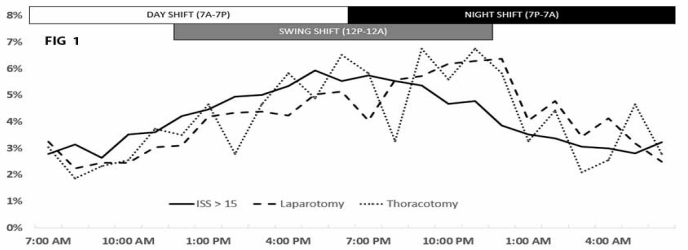


Table 1

Shift	ISS > 15	Laparotomy	Thoracotomy
Day (7a-7p)	1.15 ± 1.17	0.24 ± 0.52	0.054 ± 0.24
Night (7p-7a)	1.08 ± 1.16	0.31 ± 0.59	0.063 ± 0.25
Swing (12p – 12a)	1.37 ± 1.37 *†	0.32 ± 0.59 *	0.072 ± 0.27 *

Statistical significance compared to *day shift and †night shift.

Conclusion: Daily trauma volume follows a pattern which can be used to increase exposure to trauma cases. At our center, a swing shift was superior to day shift in all events compared, and greater than night shift for ISS>15. We believe that Acute Care Surgery training programs should analyze their trauma volume and schedule trainees to maximize exposure to complex trauma cases.

Session: XI: Quickshots
Paper QS15: 9:39-9:45

GENDER DIFFERNCES IN THE GENOMIC RESPONSE AND CLINICAL OUTCOMES AFTER BLUNT TRAUMATIC INJURY AND HEMORRHAGIC SHOCK: IS THERE A TRUE "GENDER GAP" AFTER SEVERE INJURY?

Scott Brakenridge MD, MSCS, Maria-Cecilia Lopez BS, Philip Efron* MD, Jianyi Zhang Ph.D., Joseph Cuschieri* MD, Ronald Maier* MD, Joseph Minei* MBA,MD, Henry Baker Ph.D., Frederick Moore* MD, Lyle L. Moldawer Ph.D., University of Florida - Gainesville

Invited Discussant: Sonlee West, MD

Introduction: The effect of gender on differences in outcomes after severe traumatic injury remains debated, with conflicting supportive literature. Several recent interventional trials have failed to show benefit of sex hormone interventions after severe injury. Therefore, our understanding of gender differences after injury remains incomplete. We sought to determine the relationship of gender to the genomic response and clinical outcomes after severe traumatic injury and hemorrhagic shock.

Methods: Male and female blunt trauma patients in hemorrhagic shock were analyzed from a prospective, multi-institutional cohort study in order to assess for gender based differences in the genomic response and clinical outcomes. Logistic regression models were developed to assess the effect of gender on clinical outcomes after controlling for age, injury and shock severity, blood transfusion amount, and comorbidities. Peripheral blood leukocytes were analyzed via microarray analysis to evaluate genome-wide expression on days 0.5, 1, 4, 7, 14, 21 and 28 days after injury. Expression differences were identified with individual fold gene changes (FDR<0.001; vs. control, $p<0.05$) and functional pathway analysis.

Results: The cohort consisted of 1,285 (67%) male and 643 (33%) female blunt trauma patients. Injury and shock severity were similar between the two groups. There were small, but statistically significant differences in age (42 vs 44 yrs, $p<0.01$), BMI (27 vs 26, $p<0.001$), 12-hr blood transfusion (5.0 vs 4.0 U, $p=0.002$) and crystalloid administration (6.0 vs 7.0 L, $p<0.001$) between males and females, respectively. Genomic analysis revealed 474 genes with significant differential expression between males and females ($p<0.001$). The top 10 differentially expressed genes at each time point include genes associated with inflammation, innate immune function, cell adhesion and cell signaling. None of the genes in this subset were directly associated with sex hormones or the sex chromosomes. Organ failure was more severe (Marshall score 5.2 vs 4.4, $p<0.001$) with slower recovery (MOF recovery day 9.0 vs. 6.5, $p=0.01$) in males compared to females. However, multivariate analysis revealed that gender was not a significant independent risk factor for a complicated recovery (persistent organ dysfunction >14 days) or 28-day mortality.

Conclusion: There are gender-specific differences in the leukocyte genomic response to severe injury and hemorrhagic shock that are associated with more robust, and longer duration, multiple organ dysfunction in males. However, these expression patterns do not appear to be associated with gender specific genes, and do not translate to worsened gender-specific differences among inpatient outcomes, including ICU and hospital length of stay, persistent organ dysfunction or mortality.

Session: XI: Quickshots
Paper QS16: 9:46-9:52

PEDIATRIC TRAUMA CENTERS AND AMERICAN COLLEGE OF SURGEONS COMMITTEE ON TRAUMA VERIFICATION: IMPACT ON MORTALITY

Emily E. Murphy MD, Mark D. Cipolle* MD,Ph.D., Glen Tinkoff* MD, Stephen Murphy MD, Barry Hicks* MD, Gerard Fulda* MD, Christianacare Health Services

Invited Discussant: Jeremy Cannon, MD

Introduction: Pediatric mortality is lower in states with American College of Surgeons Committee on Trauma (ACS COT) verified pediatric trauma centers (PTC) compared to states without verified PTCs. We hypothesize that mortality rates will be lower for severely injured children cared for at a PTC that is ACS verified.

Methods: Children ≤14 years old with an injury severity score (ISS) >15 were selected from the 2010 National Trauma Databank research dataset (NTDB RDS). Entries with missing ISS or age information were excluded. Patients who were dead on arrival were excluded. Univariate analysis was performed for age, gender, mortality, ACS adult verification and ACS pediatric verification. Significant variables were subsequently assessed by logistic regression. A subset analysis was performed on freestanding pediatric hospitals. A p-value of <0.05 was considered significant.

Results: The 2010 NTDB RDS included 11,859 pediatric patients with an ISS > 15. Univariate analysis was statistically significant for the primary outcome of mortality among the following variables: race, payment type, ISS, region, ACS adult verification and ACS pediatric verification. Other variables (gender, age, ethnicity, location of injury, hospital type and teaching status) were not statistically significant and were not included in logistic regression. The results of the logistic regression are displayed in table 1. ISS, region, race, payment and ACS pediatric level were significant among patients with an ISS >15. Subset analysis of freestanding pediatric hospitals demonstrated that ACS pediatric level (p=.007), ISS (p<0.001) and payment (p<0.001) had a significant impact on mortality, while region, race, gender and teaching status were non-significant.

		Mortality	P value
ISS	16-24	1.5% (131/8551)	<.001
	>24	22.3% (739/3308)	
ACS pediatric level	I	6.3% (218/3460)	.003
	II	7.1% (68/954)	
	N/a	7.8% (584/7445)	
ACS adult level	I	7.9% (320/4042)	.162
	II	7.8% (100/1289)	
	III	3.6% (6/167)	
	IV	0% (0/19)	
	N/a	7% (444/6342)	
Race	Black	10.3% (177/1720)	<.02
	White	6.8% (469/6925)	
	Asian	4.7% (11/236)	
	Other	7.2% (213/2978)	
Region	South	8.5% (370/4374)	.001
	Midwest	7.6% (225/2970)	
	West	6.9% (184/2658)	
	Northeast	4.8% (87/1826)	
	NA	12.9% (4/31)	
Payment	Self-pay	14.4% (103/713)	<.001
	Government insurance	7.7% (397/5174)	
	Private insurance	4.7% (189/3987)	
	Other	9.1% (181/1985)	

Conclusions: ACS pediatric verification is associated with decreased mortality of severely injured children in ACS verified adult trauma centers as well as in freestanding pediatric hospitals. ACS adult verification alone does not confer this mortality benefit. Race, payment and region are additional factors that impact pediatric trauma mortality.

Session: XI: Quickshots
Paper QS17: 9:53-9:59

DIRECT TRAUMA TRANSPORT REDUCES MORTALITY IN RURAL TRAUMA

Henry R. Moore III, MD, Mary B. Voights RN, Joseph Burton DO, Uretz Oliphant MD,
Carle Foundation Hospital

Invited Discussant: Babak Sarani, MD

Introduction: The goal of trauma systems for many years has been 'get the right patient, to the right hospital, at the right time.' The American College of Surgeons, based on predominantly urban data, further directs ambulances to bypass local facilities if they will not meet the needs of the patient. And yet, when faced with greater than one hour transport times to a trauma center in the rural setting, is it best to stop at the local hospital for stabilization prior to continuing on to that 'right hospital for definitive care' or risk further instability given the very long interval of transport? The objective of our study is to determine if there will be improved outcome by transporting a specific cohort of severely injured patients directly to the trauma center from the initial injury site rather than transporting them to the nearest hospital which is a non-trauma center despite potentially long transport times.

Methods: All adult and pediatric trauma patients being transported or transferred from outside the local county who met regional criteria for the Direct Trauma Transport Protocol were included. The study period was December 2009 through December 2012. We conducted a retrospective review of our hospital trauma database and hospital records. Exclusion to direct transport was the need for an airway or EMS discretion. Primary endpoint was mortality. Secondary endpoints included: morbidity, hospital length of stay, ICU length of stay, days on the ventilator, and disposition at discharge. Cohort groups of patients transported directly to the trauma center were compared with patients that were transported first to a local hospital and then transferred to the trauma center. Analysis of Covariance (ANCOVA) and logistic regression were used to analyze the relationship between direct transport and the outcomes.

Results: 589 patients meet criteria. 291 were transported to another facility first, 298 were transported directly. Demographics were similar between the two groups. The groups demonstrated major trauma with very similar acuity and Injury Severity Scores (ISS) of 22.65 and 22.42 ($P = 0.8710$). Morbidity, length of stay (LOS), ICU days and ventilator days were similar between the two groups. The interval to definitive care was lower in the group transported directly (116.88min) versus those who went to another hospital first (189.16min). Mortality was significantly lower in the patients who were transported directly (22/194 or 11%), compared to those who went to another hospital first (42/198 or 21%) ($P=0.008$). Conversely, more patients from the direct transport group were discharged home (102/194 or 53%), vs. those who went to another hospital first (87/198 or 44%) ($P=0.087$). There was no statistical difference in the number of people who went to rehab or nursing homes.

Conclusion: Despite longer transport times in non-urban areas, direct transport and definitive management of severe injury at a level one trauma center improves mortality. The 'right place' and 'right time' in non-urban areas continue to be expert treatment at the level one trauma center, as in urban areas.

Session: XI: Quickshots
Paper QS18: 10:00-10:06

SARCOPENIA AS A MARKER OF FRAILTY: PSOAS MUSCLE SIZE PREDICTS FUNCTIONAL OUTCOME IN MILD TO MODERATELY INJURED TRAUMA PATIENTS

Ryan Balogh MD, Philip Edmundson MD, Arash Shirvani MD, Ankit Shah MD, Jacob Roden-Foreman Megan Reynolds MS, Michael Foreman* MD, Baylor University Medical Center

Invited Discussant: A. Peter Ekeh, MD

Introduction:The term frailty attempts to capture a patient's vulnerability to clinical and functional decline over time. Although clinicians tend toward a Stewart-esque "I know it when I see it" threshold, frailty has proven difficult to quantify. The purpose of this study is to evaluate frailty as a predictor of long term outcomes in trauma patients using psoas muscle size as a metric.

Methods:Patients who were admitted to an urban ACS-COT Level I trauma center from March to December 2012 and had undergone an abdominal and pelvic CT scan as a part of their initial evaluation were selected from an ongoing concurrent functional outcome study. Functional data was gathered prospectively during initial hospitalization and 3, 6, and 12 months after injury. Functional outcome was measured using the Veterans Rand-12 Item Health Survey. All statistical models were stratified by injury severity score < 15 or > 15 and adjusted for age, gender, and pre-injury physical function scores. Radiographic data was viewed on Centricity PACS system which has a built in capability to trace a structure and calculate the area of the selection. A minimum of 20 points were used to measure the psoas muscle area on one side, taken at the slice in which both transverse processes of L4 could be seen. Exclusion criteria included psoas muscle or paravertebral hematoma, spine instrumentation, L4 fracture, scoliosis, motion degradation or artifact on CT and obvious asymmetry in psoas muscle diameter.

Results:123 patients met inclusion criteria and were included in the data analysis. Of those, 90 completed 3 month follow-up, 76 completed 6 month follow-up, and 66 completed 12 month follow-up. Pre-injury functional scores were similar when stratified by gender, with medians of 50.9 and 50.5 respectively. For ISS <15 psoas area was significantly associated with functional outcome scores at 3 ($p=0.02$), 6 ($p=0.0015$), and 12 ($p<0.0001$) months post injury, with an increase in psoas area at the time of injury corresponding to a higher functional score. Increased psoas muscle size was also associated with a decreased length of stay by a factor of 0.99 ($p=0.03$).

Conclusion:Psoas area proved to be a significant predictor of functional outcome at all follow-up time points for ISS<15 when controlled for age, gender and pre-injury function score. Further study is warranted to evaluate the feasibility of using psoas muscle size at presentation as a predictor of other short and long term endpoints.

Session: XI: Quickshots
Paper QS19: 10:07-10:13

MILITARY SURGEON CONFIDENCE IS IMPROVED BY PARTICIPATION IN A CIVILIAN TRAUMA TRAINING CENTER

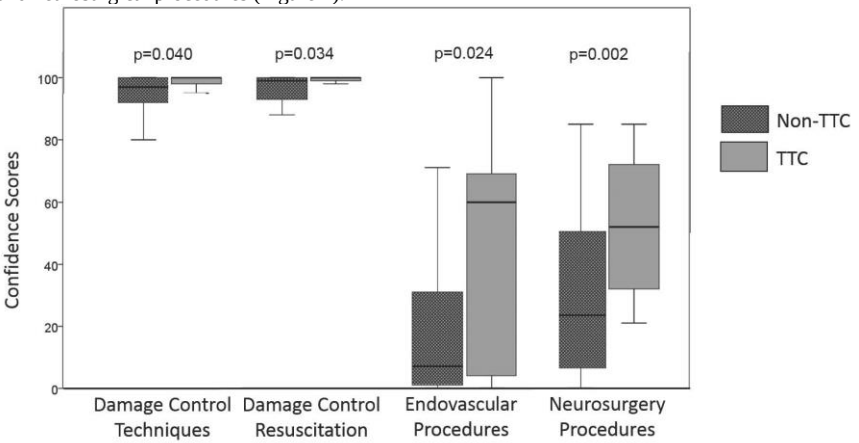
Brian P. Smith MD, MS, Travis Polk MD, D. Joshua Mancini MD, Daniel Grabo MD, Kyle N. Remick MD, Charles W. Schwab* MD, University of Pennsylvania

Invited Discussant: John Fildes, MD

Introduction: Since 2001, all 3 branches of US Armed Forces have offered pre-deployment surgeon training by assignment to a designated group of civilian trauma training centers (TTC). The impact of these programs on surgeon confidence remains largely unknown. We hypothesized that participation in TTC is associated with increased surgeon confidence in various trauma skills.

Methods: We surveyed military affiliated physicians nationwide using a novel instrument piloted and refined by experienced combat surgeons. We analyzed demographics, education, practice patterns, and pre-deployment training preparation. We also measured confidence for battlefield trauma skills validated from previous studies. Surveyors were blinded to participants and surveys were collected electronically using REDCap Database. Data were analyzed with SPSS using Mann Whitney tests and regression models.

Results: Eighty-six of 174 surveys were completed. Army physicians accounted for 50.0% of respondants, followed by navy (23.3%) and Air Force (20.9%). Most of the participants completed a trauma/surgical critical care fellowship (87.2%). Of respondents, 21 (24%) participated in TTC. The distribution of confidence scores for TTC physicians were significantly higher than non-TTC physicians for damage control techniques, damage control resuscitation, endovascular procedures and neurosurgical procedures (Figure 1).



After adjusting for years of practice, average number of monthly non-deployment trauma resuscitations, critical care fellowship training, and experience at role 2 facilities, there remained a significant positive association between TTC training and confidence in damage control techniques (p=0.004), damage control resuscitation (p=0.001), endovascular procedures (0.039) and neurosurgical procedures (p<0.001).

Conclusion: Regardless of prior trauma experience, participation in TTC is associated with increased confidence in battlefield trauma skill sets for military surgeons.

Session: XI: Quickshots
Paper QS20: 10:14-10:20

DOES SEX MATTER? GENDER EFFECTS ON VENOUS THROMBOEMBOLISM RISK IN SCREENED TRAUMA PATIENTS

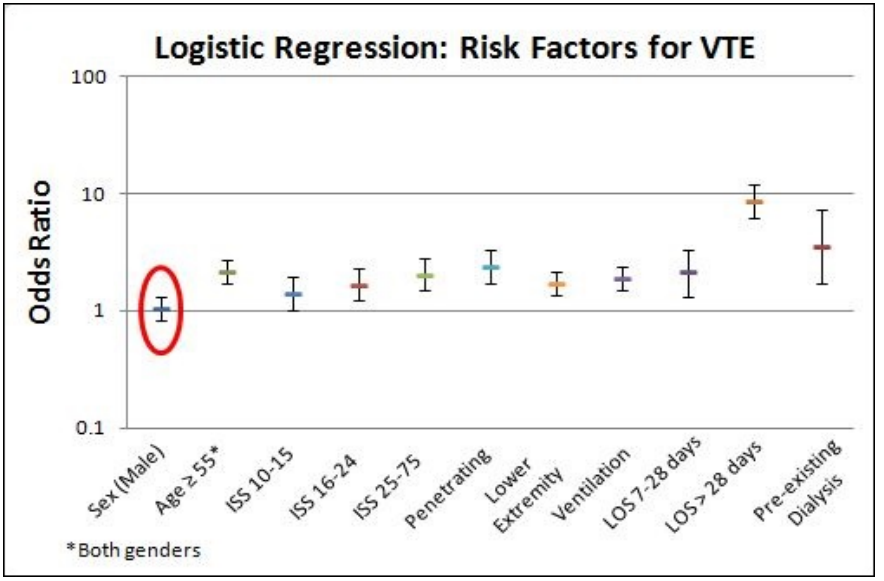
Allison E. Berndtson MD, Todd W. Costantini MD, Alan M. Smith Ph.D., Leslie Kobayashi* MD, Raul Coimbra* MD,Ph.D., University of California, San Diego

Invited Discussant: Jason Sperry, MD, MPH

Introduction: Gender is associated with disparate risk of venous thromboembolism (VTE) in non-trauma patients, with increased risk seen during pregnancy and in women on hormone-containing medications. The effects of gender on the risk of VTE after trauma are unclear. Some studies have demonstrated no gender effect while others have instead shown a higher incidence of VTE among men. We hypothesized that male gender would increase risk of VTE in trauma patients undergoing a standardized duplex screening protocol.

Methods: All admissions to a Level-1 academic trauma center between 2000 and 2013 were reviewed. We excluded patients for age <18 years, pregnancy, pre-admission anticoagulant use and hospital length of stay (LOS) <72 hours. A strict venous duplex screening protocol was followed. Patients were initially screened within 48 hours of admission; a second duplex was performed during the first week of hospitalization, then weekly thereafter. Patients were also studied when symptomatic. Female patients were sub-categorized into pre- and post-menopausal groups based on age (18-44 vs. ≥ 55 years). Univariate analysis and logistic regression were used to identify variables correlating with VTE risk.

Results: 8,731 patients met inclusion criteria. The overall VTE rate was 5.3%. Univariate analysis did not find a difference in VTE risk by gender (4.8% women vs. 5.5% men, p=0.20), or between women and men within age-defined menopausal categories (pre-menopausal women 3.8% vs. men 4.6%, p=0.32; post-menopausal women 5.7% vs. men 7.1%, p=0.18). Logistic regression (see figure) did identify other risk factors for VTE including age ≥ 55 (OR 2.2), increasing ISS (OR 1.4 – 2.0), penetrating mechanism of injury (OR 2.4), lower extremity injuries (OR 1.7), need for mechanical ventilation (OR 1.9), increasing hospital length of stay (LOS 7-28 days, OR 3.6; LOS > 28 days, OR 8.7) and patients on hemodialysis prior to injury (OR 3.5).



Conclusion: There was no difference in VTE rates based on gender, or in female subgroups based on menopausal status. Gender has no effect on VTE risk in trauma patients following injury. Aggressive VTE screening of over 8,700 patients did identify several other patient populations at increased risk of developing VTE. More intensive VTE prophylaxis may be appropriate in these patients.

Session: XI: Quickshots

Paper QS21:10:21-10:27

PROSPECTIVE EVALUATION OF NUTRITIONAL ADEQUACY OF VOLUME BASED ENTERAL FEEDING IN A SINGLE CENTER TRAUMA/SURGICAL ICU

Ashley K. McCusker MD, MSc, Martha Betts MS, Brandy M. Msall MS, Heather A. Prentice MPH,Ph.D., Anna N. Bradford Ph.D., LCSW, Jeffrey Wright MPH, Elena Lita BS, Erik J. Teicher MD, FACS Inova Fairfax Hospital

Invited Discussant: Timothy Browder, MD

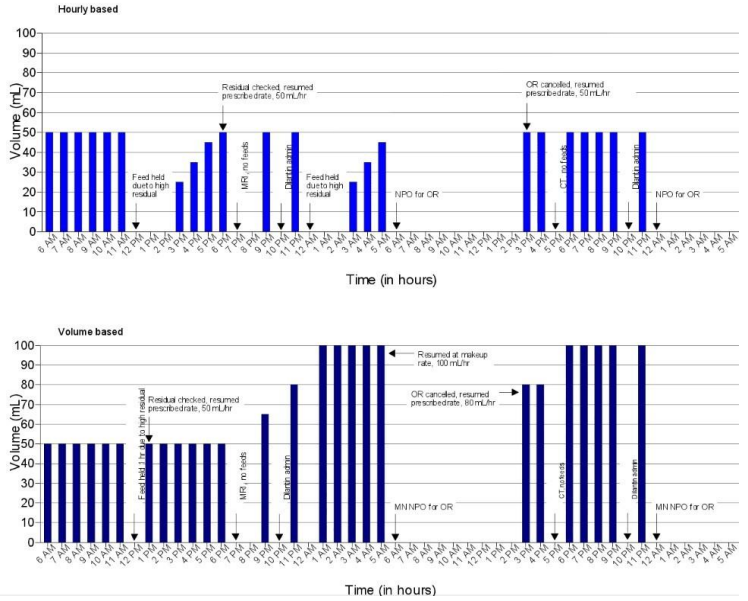
Introduction: The traditional protocol for intensive care unit (ICU) enteral feeding has been based on hourly goals. Numerous studies have demonstrated that, when receiving feeding based on an hourly protocol, ICU patients receive between 50-70 percent of recommended nutritional goals. This can be detrimental while they are in a hypercatabolic state. Volume based feeding has been shown to be a feasible alternative to hourly based feeding in the ICU and improve the delivery of the prescribed nutritional goal. We hypothesized that patients will receive on average at least 80 percent of their prescribed nutritional goals after the implementation of a volume based tube feeding protocol, as compared to a historical hourly feeding protocol.

Methods: A daily volume goal was calculated based on the patient's ideal body weight and daily caloric needs. All patients received a standard bowel regimen and protein supplements. Gastric volume residuals were liberalized to 500cc, with tube feeds held for one hour after a high residual, and promotility agents were initiated with the first feed intolerance. Interruptions in tube feeds were minimized and reasons were documented. Volume delivered was recorded for each morning and night shift to determine the daily volume received. The average percentage of daily volume received over goal volume was calculated for patients and compared to the previous hourly feeding protocol, as well as to published rates of delivery of enteral nutrition in the ICU population..

Results: In a five month period, 85 patients admitted to the trauma/surgical ICU received enteral feeding using a volume based protocol. Patients received on average 82.8 percent of the prescribed nutritional goal using the volume-based protocol. In comparison, only 66 percent of the prescribed nutritional goal was met using hourly feedings ($p < 0.0001$).

Conclusion: Preliminary data shows that a volume based enteral feeding protocol is feasible for a large surgical ICU in a Level I trauma center. The implementation of the volume based protocol improved delivery of the prescribed amount of enteral feeds while also calling attention to avoidable interruptions of enteral feeding.

Figure 1. Sample patient enteral feedings for 48 hours for the hourly-based feeding protocol and volume-based feeding protocol.



Session: XI: Quickshots
Paper QS22: 10:28-10:34

CONTINUING TRAUMA: THE UNMET NEEDS OF TRAUMA PATIENTS IN THE POST-ACUTE CARE SETTING

Samir M. Fakhry* MD, Pamela L. L. Ferguson Ph.D., Heidi S. Resnick Ph.D., Jennifer Haughney RN, Jama Olsen MPA, Kenneth J. Ruggiero Ph.D., Medical University of South Carolina

Invited Discussant: Erik Barquist, MD

Introduction: Trauma care and trauma systems have improved substantially over the past 50 years. The majority of this progress has been in the pre-hospital and hospital settings. Significant challenges remain in the post-acute care setting with many patients reporting emotional and psychological distress in the months following injury. We interviewed trauma patients within two months after discharge to assess how they were recovering emotionally and psychologically. **Methods**: 101 patients aged $\geq$ 21 years from our level I trauma center were contacted after discharge, 97% within 2 months, and agreed to participate in a survey from 1/2014 through 12/2014. Most (n = 86) were interviewed by phone, 15 chose to take the survey online. Participants were asked about functional outcomes, modes of communication they used/preferred, hospital course, discharge information, cigarette and substance use, help seeking for emotional issues, and were screened for posttraumatic stress disorder, depression, acute psychological distress (Kessler 6). Descriptive statistics were done, as well as t-tests or Kruskal-Wallis tests to compare continuous and categorical variables, and chi-square to compare categorical variables. **Results**: Survey participants were 64% male, 64% white, aged 21-88 years. Most participants (89%) owned a cellphone and 65% of those with cellphones owned a smartphone. Our sample had a higher percentage with no insurance, a stay in the ICU and discharge to home than the trauma population. Participants who recalled being in the ICU were almost twice as likely (49%) to screen positive for depression than those who were not in the ICU (27%) (p=.0493). One in 5 (19%) reported injury in the context of a crime. 34% were normally not employed and 22% continued to be employed; 45% who had been employed were not employed on a job for pay at the time of the interview. Of the 50 participants scoring positive for PTSD, depression or serious psychological distress, 17 (34%) considered getting professional help for a personal/emotional problem, but only 5 (10%) actually received professional help. The barrier most cited (58%) for not getting help was concern about cost; 42% did not know how or where to get help. Most participants responded "no" or "I don't know" when asked if they had received information in the hospital about how to cope with negative emotions after injury (79%) and how to seek help from a doctor (70%) to address these emotions. 45% of the interviewees had smoked cigarettes since hospital discharge, compared to 22% of adults in SC. 74% of those who screened positive for depression reported smoking, significantly higher (p<.0001) than the 24% who screened negative and smoked. 38% of those who screened positive for depression reported heavy smoking, which was significantly higher (p=.0008) than the 10% who screened negative and smoked heavily. **Conclusion**: A large proportion of trauma inpatients (50%) showed signs of depression, PTSD, or other serious psychological distress 1-2 months after discharge. Both psychological distress and smoking are known to impair physical healing. Many patients consider seeking help but face numerous barriers to receiving services for emotional difficulties in their recovery after trauma. Cost and lack of information are particularly important barriers. Trauma centers should develop novel scalable and sustainable solutions to ensure that patients are provided with resources to enhance resilience and recovery after injury.

Session: XI: Quickshots
Paper QS23: 10:35-10:41

NATIONWIDE ABSENCE OF UNIFORM GUIDELINES FOR THE PRE-HOSPITAL USE OF TOURNIQUETS TO CONTROL SEVERE EXTREMITY EXSANGUINATION

Elie P. Ramly MD, Gem Runyan BS, David R. King* MD, Massachusetts General Hospital

Invited Discussant: Laura Moore, MD

Introduction:
Following the Sandy Hook shootings and the resulting Hartford Consensus, as well as the recent Boston Marathon bombing, the need for a uniform, detailed, aggressive, prehospital, extremity exsanguination control protocol became clear. We hypothesized that most states, within the United States, lack a detailed, uniform protocol.

Methods:

We performed a systematic, nationwide assessment of Emergency Medical Services (EMS) prehospital extremity exsanguination control protocols. An online search (updated 02/07/2015) identified state, region, or county-specific EMS protocols in all 50 states. If unavailable online, the protocols were retrieved directly by contacting each state's Department of Public Health (or other appropriate agency). Two investigators independently screened each extremity exsanguination control protocol. Protocols were first grouped into three categories: I – tourniquet not included; II – tourniquet included, without specific guidance; III - tourniquet included, with specific guidance related to type, indications, application technique, and safety concerns. Each protocol was then scored on a 5-points scale, with no points given when tourniquets were absent, one point for mention of each of: the word "tourniquet", tourniquet type, indication, application technique, and safety.

Results:

Forty-two (84%) states had statewide and 14 (28%) had at least one county-specific protocol. Four (8%) states had no statewide protocol available online. One state (Mississippi) had neither state nor county-specific protocols. Of statewide protocols, 4 (9.5%) were in Category I, 23 (54.8%) in Category II, and 15 (35.7%) in Category III. The average score for statewide tourniquets was 2.4/5 (SD 1.25; range 0-5). Fourteen (33%) statewide protocols referred to "commercial" or "approved" tourniquets, with only 3 (7%) recommending a particular commercial device. The average score for the county-specific protocols of states with no statewide protocol was 3.10 (SD 1.56; range 0-5)

Conclusion:
Throughout the United States, there is considerable variability in EMS protocols for the management of extremity exsanguination, with an alarming absence of specific guidance for tourniquet use. Nationwide, most states do not have a uniform, detailed, aggressive, prehospital, extremity exsanguination control protocol. Policy-makers should work with trauma experts to develop appropriate state protocols and training programs for EMS.

Session: XI: Quickshots
Paper QS24: 10:42-10:48

NO TIME TO BLEED: THE IMPACT OF TIME FROM INJURY TO THE OPERATING ROOM ON SURVIVAL IN PATIENTS WITH HEMORRHAGE FROM BLUNT ABDOMINAL TRAUMA

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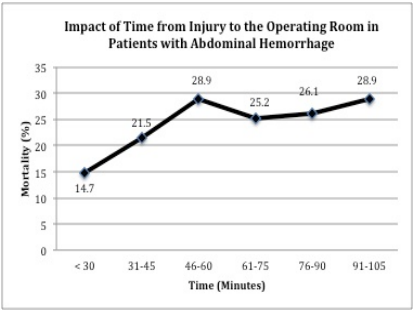
University of Texas Health Science Center at San Antonio

Invited Discussant: Mark Shapiro, MD

Introduction: The concept of a "Golden Hour" after injury has been inculcated into the culture of emergency medical services and surgery with sparse evidence to substantiate it's validity. The most useful measure of the impact of time should optimally reflect the time to effect definitive hemorrhage control relative to the time of the traumatic event. We hypothesized that amongst patients with uncontrolled abdominal hemorrhage, the probability of death would be related to the degree of hypotension and the time from injury to the operating room (INJOR).

Methods: The National Trauma Data Bank Research Data Set 2012 was queried with respect to recorded field SBP, pre-hospital time, emergency department time and mortality. The INJOR metric was derived from the composite of pre-hospital time and time spent in the emergency department for patients with a subsequent operating room destination noted in the registry. Patients with abdominal injury managed non-operatively, severe head injuries (AIS > 3), or any missing data elements were excluded. .

Results: From a total of total of 833,312 records, the NTDB RDS, identified 2,011 adult patients admitted directly to trauma centers from injury scenes with abdominal vascular or solid organ injuries requiring exploratory laparotomy for hemorrhage control. The mortality rate of the study population was 22.8% (460 / 2,011).



The risk of mortality increased proportionally as the time lapse from injury to operative intervention increased such that for the first 60 minutes, every 15 minute interval without operative control of hemorrhage increased the probability of death by ~ 7%. Stratifying the data by degree of hypotension; profound hypotension (SBP<60), moderate hypotension (SBP 60-90 mmHg), and mild hypotension (SBP >90-110 mmHg,) all exhibited similar trends in mortality escalation, most prominent within the first 90 minutes after injury and manifest as mortality increases of 24% to 54%, 23.1% to 32.9%, and 12.5% to 21.0% respectively.

Conclusion: This analysis serves to quantify the impact of time and degree of hypotension in a subset of injured patients with noncompressible torso hemorrhage. In addition, it provides an evidence basis for future clinical practice guidelines to optimize evacuation and expedite hemorrhage control for patients at risk for uncontrolled bleeding.

Session: XI: Quickshots
Paper QS25: 10:49-10:55

CARING FOR CRITICALLY INJURED CHILDREN: AN ANALYSIS OF 56 PEDIATRIC DAMAGE CONTROL LAPAROTOMIES

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Invited Discussant: Mary Fallat, MD

Introduction: Injury is the leading cause of death in children between the ages of 1-18 years, yet scientific data pertaining to this population is limited. Damage control surgery principles have been extensively studied, applied, and proven in critically injured adults but remain relatively unstudied in children. Our primary study objective was to evaluate the use of damage control laparotomy (DCL) in critically injured children.
Methods: A review (1996-2013) of all patients who underwent trauma laparotomy at an ACS verified Level I trauma center was undertaken. Exclusion criteria included: age >18, laparotomy >2hrs after admission, and laparotomy for secondary compartment syndrome. All study patients were evaluated with respect to demographics, mechanism, physiologic and resuscitation variables, anatomic injuries, surgical procedures, need for DCL, and outcomes. Independent T-Test, Mann-Whitney U Test, and Fisher's Exact Test assessed statistical significance. The primary study endpoint was hospital survival while secondary study endpoint was DCL complications.
Results: Of 371 pediatric patients who underwent trauma laparotomy, the mean age was 14±5 years while most (73%) were male and injured by blunt mechanism (65%). Fifty-six (15%) critically injured patients (mean ISS 32±16, Pediatric Trauma Score 5±4, PATI 29±18) underwent DCL. The DCL patients often had major solid organ (63%), vascular (36%), thoracic (38%), pelvic (36%), and traumatic brain (29%) injuries. Physiologic compromise was evident on arrival (GCS 9±6, SBP 94±33, pH 7.17±0.17, base deficit 11±6, MTP activation 78%) and continued in the operating room (mean temp nadir 94±3ºF, pH 7.11±0.19, abdominal packing 68%) despite intraoperative blood product resuscitation (mean RBCs 11±10 units) during abbreviated (mean duration 118±72 min) laparotomy. Fifty-five percent of children who underwent DCL survived their hospitalization and required a mean of 3±2 laparotomies during 6±6 days until closure (primary fascial 90%, vicryl/STSG 10%). DCL survivors were analyzed for common DCL complications (SSI/organ space infection 18%, dehiscence 2%, ECF 2%, tracheostomy 18%) during their hospitalization (LOS 18±21 days). When the DCL subset was further stratified by age (<15 vs 15-18 years), no difference was detected with respect to arrival GCS, hemodynamics, temperature, pH, ISS, blood product and crystalloid resuscitation, solid organ or major vascular injury, days until closure, LOS, or survival (all $p>0.05$).
Conclusions: In our study of 56 children who underwent DCL, we report that these children have survival rates similar to those reported in large case series and collective reviews in adults, but with markedly better morbidity rates than adult survivors. Substantial closure rates along with lower rates of SSI, dehiscence, ECF, and need for tracheostomy in this age group suggests that DCL is a valid management strategy in critically injured children of any age.