

EFFECT OF TRAUMA SPLENECTOMY ON LONG TERM RISK OF DEATH DUE TO INFECTIONS

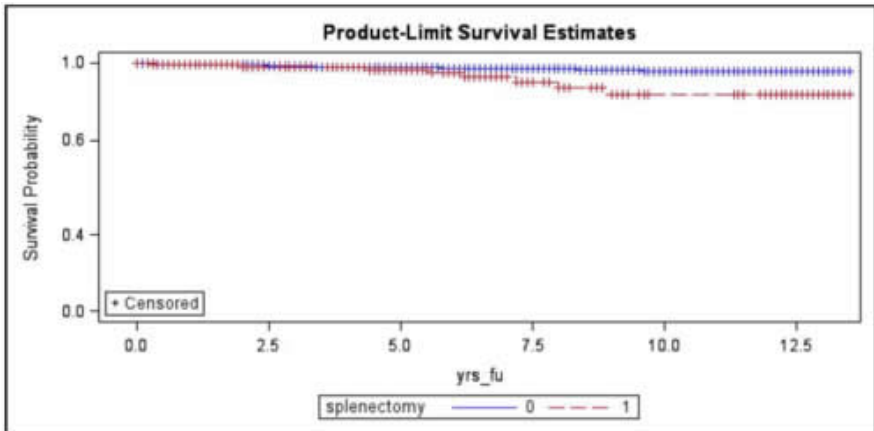
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Introduction: Long term outcomes after splenectomy in injured adults have not been clearly determined. We ascertained whether splenectomy after trauma in adults increases the risk of post-discharge long-term natural death.

Methods: Adults with blunt splenic injury admitted to a Level I Trauma Center between July 1995 and December 2008 were identified in the trauma registry. Determination of death, cause of death and date of death were obtained from the National Death Index through 12/31/2008. Differences in the 30 day-post-discharge mortality (natural, infectious related and non-infectious natural causes) in relation to splenectomy were determined by comparing Kaplan-Meier survival curves and using the log rank test. Cox proportional hazard regression was used to adjust for confounders (age, gender, injury severity, race and alcohol use) ($\alpha=0.05$).

Results: 2589 patients with blunt splenic injury were examined. Subjects who died during the initial hospitalization ($n=327$) and within 30 days after discharge ($n=296$) were excluded. Those treated with splenorrhaphy ($n=67$) were excluded due to their small number, leaving a total of 2176 (267 with and 1890 without splenectomy) for analysis. 164 deaths occurred during the 12.5 year follow up period (median 5.1 years). 119 died from natural causes, 22% of which ($n=26$) were due to infection. Survival analysis revealed that those with splenectomy had significantly higher natural and infectious cause related mortality ($p=0.004$ and 0.01 , respectively), but no effect with respect to non-infectious natural causes ($p=0.06$). Cox proportional hazard models adjusting for age, gender, race, ISS and alcohol use revealed significant associations of splenectomy with natural death [OR 1.70 (1.07-2.72)] and with infection related deaths [OR 2.50 (1.02-6.16)].

Conclusion: Injured patients treated with splenectomy have an increased long term natural cause mortality that, in part, is attributable to infections. Splenic preservation should be attempted where possible. Patients should be aware of the increased risk of infection related mortality after splenectomy. Interventions to reduce this increased risk need to be studied.



INFECTION RELATED MORTALITY

SELF EXPANDING POLYURETHANE FOAM FOR THE TREATMENT OF ABDOMINAL EXSANGUINATION: UNANSWERED QUESTIONS

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Introduction: Noncompressible abdominal bleeding is a significant cause of preventable death with no effective pre-surgical therapies. We have previously described the hemostatic efficacy of a percutaneously-administered, self-expanding polyurethane foam in several lethal hemorrhage models. Prehospital diagnosis of severe abdominal hemorrhage, use in the presence of a diaphragmatic injury, effects on spontaneous respiration, efficacy after prolonged shelf life and at temperature extremes remain important unanswered questions.

Methods: Experiment (Exp.) 1: Across a range of efficacy models, diagnostic blood aspiration was attempted through a Veress Needle at the umbilicus prior to foam deployment. Exp. 2: Foam was deployed in naïve, spontaneously breathing animals. Effects on PCO₂ and respiration were characterized. Exp. 3: In a model of lethal hepatportal hemorrhage, a one cm² full thickness injury was created in the left diaphragm. Foam was deployed ten minutes after injury (n=6) or animals received fluid resuscitation alone (n=6) and were monitored. Exp. 4: In the same model, foam was delivered with a robust, field relevant delivery system (n=5), after conditioning at 50°C for two months to simulate one year shelf life (n = 6), or after conditioning to 10°C (n=6) or 50°C (n=6) and compared to controls (n=12).

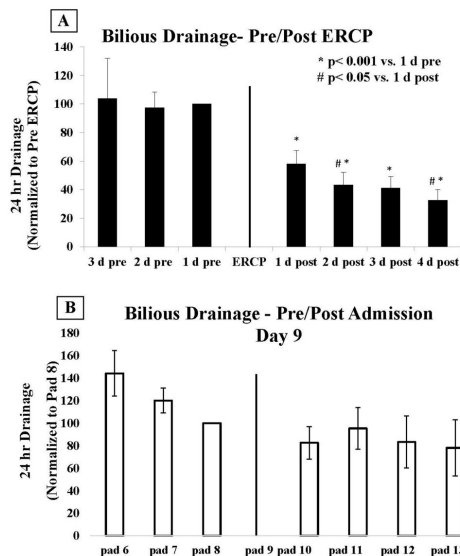
Results: Foam was tested in 76 swine across these studies. Exp.1: Foam was tested over a range of injury models in more than 40 animals. Blood was successfully aspirated from a Veress Needle in 70% of lethal iliac artery injuries and 100% of lethal hepatportal injuries. Blood aspiration was unsuccessful (0%) when less than 500 mL of intraperitoneal blood was present. Exp. 2: Animals were allowed to breathe spontaneously following foam treatment. Hypercarbia was observed: PCO₂ was 48 ± 9.4 mmHg at baseline and 65 ± 14 mmHg at 60 minutes. Exp. 3: When deployed in the presence of a diaphragm injury, between 0 and 50cc of foam was found to migrate through the diaphragmatic injury. Foam treatment resulted in a significant survival benefit relative to the control group at one hour (p=0.03). Exp. 4: Foam delivered from a fieldable delivery system improved survival relative to the control group (p=0.006).

Foam efficacy was maintained under simulated one year shelf life conditions: 3hr survival was 83% (p<0.05). Foam treatment also resulted in a significant benefit when conditioned to operational temperature extremes: 3hr survival was 83% and 67% in the low and high temperature groups, respectively (p<0.05). Temperature extremes did not result in hypothermia-related coagulopathy or thermal damage.

Conclusion: Blood aspiration through a Veress Needle may be an effective diagnostic technique to confirm peritoneal access, confirm massive hemorrhage at point of injury, as well as prevent inappropriate foam use for non-massive hemorrhage. Foam therapy remains an effective pre-surgical hemostatic intervention under a variety of possible field conditions.

SHOULD ALL BILE LEAKS AFTER LIVER INJURY BE TREATED WITH ERCP DECOMPRESSION?

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Introduction: Certain patients with complex liver injuries develop persistent bile leaks managed with perihaptic drains placed either at laparotomy or percutaneously. Endoscopic retrograde cholangiopancreatography (ERCP) with sphincterotomy +/- stent may reduce biliary sphincter resistance promoting forward bile flow, yet no study to date has evaluated its effect on daily bile leakage after liver injury. We hypothesized that ERCP in patients with liver injury and persistent bilious leakage would reduce drainage volume and time to drain removal.

Methods: Adult patients with liver injuries from a level 1 trauma center (06/01/2002 to 06/01/2013) were retrospectively reviewed. Patients with perihaptic drains found to contain bile were divided into those who did or did not undergo ERCP. Patients who died

within 48 hours of presentation, had an ERCP performed < 4 days after admission, for whom drainage was non-bilious or where volume data was missing were excluded. Daily drainage volumes (ml/24 hrs) were collected from 3 days after admission until drain removal or patient discharge. Demographics, time to drain removal and length of stay (LOS) were recorded. The Students t-test was used to compare means with $p < 0.05$ deemed significant.

Results: 1238 liver injury patients were identified of whom 58 (4.7%) met inclusion criteria for persistent bile leakage. 31 (53.4%) underwent ERCP (mean: 9 days post-injury) and 27 (46.6%) were managed expectantly (NoERCP). ERCP patients were younger (27 ± 1 vs. 34 ± 2 yrs, $p = 0.03$) and more often had penetrating injuries (100 vs. 76.9%, $p < 0.01$). Both groups had similar gender, AIS-abdomen scores and mortality. Bilious drainage decreased by half the day after ERCP and decreased further in subsequent days ($p < 0.05$) (Fig A). Drainage in the non-ERCP group remained unchanged over the same post-injury time frame (Fig B). Time to drain removal (46.8 ± 12.1 vs. 43.6 ± 7.5 days, $p = 0.82$) and hospital LOS (27 ± 3.9 vs. 26 ± 4.5 days, $p = 0.83$) were similar in NoERCP and ERCP groups.

Conclusion: ERCP is highly effective in decreasing daily bilious drain output after liver injury. Nonetheless, this does not appear to translate into faster drain removal or patient discharge. Prospective investigation is needed to determine in which injured populations this can expedite bile leak resolution and recovery from complex liver injuries.

THE POTENTIAL UTILITY OF DIRECT TRANSFERS FROM THE PREHOSPITAL SETTING TO THE HYBRID OPERATING ROOM: HOW OFTEN WOULD WE GET IT RIGHT?

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Introduction: Prehospital hypotension following injury often leads to sustained hypotension within the trauma bay. Given that patient dispositions and therefore treatment plans are time critical with regard to both ongoing hemorrhage and/or end organ ischemia, selecting the appropriate destination (operating theater, angiography suite, intensive care unit) can be extremely challenging in some clinical scenarios. Although the rapidity of these decisions are based on clinical acumen, pattern recognition, and clinician experience, it is clear that the initial destination of choice is not infrequently incorrect. The purpose of this study was to define the flow and interventions of persistently hypotensive injured patients with regard to their initial destination of choice after leaving the trauma bay (including patients who required multiple treatment destinations).

Methods: The Alberta Trauma Registry and chart reviews were employed to perform a retrospective cohort study describing the route and flow of all persistently hypotensive (2 or more systolic blood pressures (sBP) less than 90 mmHg) severely injured (ISS \geq 12) patients (1995 to 2012) over their first 24 hours of their admission to a level-one, tertiary care trauma referral center. Standard statistical methodology was utilized ($p < 0.05$).

Results: Of 913 patients with an initial sBP less than 90 mmHg (prehospital, referring hospital, or initial trauma bay reading), 56% remained persistently hypotensive on subsequent trauma bay measurements. These patients had a mean age of 41 years, were 73% male, and sustained blunt injury mechanisms in 87% of cases. Of these persistently hypotensive patients, 53% were transferred directly to the operating theater, 29% to the intensive care unit, 13% to the trauma ward after resuscitation and diagnostic imaging (i.e. responders), and 5% to the interventional angiography suite. Of all hypotensive patients, 68% underwent cross sectional imaging with computed tomography either before or after initial transfer from the trauma bay. Of the patients who were transferred to the operating theater, 64% were subsequently transferred to the intensive care unit, 23% to the trauma ward and 14% died within the theater itself. Within the operating theater, 99% of patients underwent an operative intervention (194 (79%) laparotomies). A total of 7% of patients required both emergent operative and angiographic intervention. Although varied, these were most commonly patients with ongoing hemorrhage secondary to pelvic fractures or major hepatic lacerations. The mean hospital length of stay was 24 days with an associated mean intensive care unit stay of 7 days. The overall mortality of all persistently hypotensive patients was 22% within the first 24 hours.

Conclusion: This descriptive study at a high volume, level-one, tertiary care trauma referral center confirms that the majority of persistently hypotensive patients are transferred directly from the trauma bay to the operating theater for operative intervention. At least 7% of patients in this cohort would benefit from the efficiency of a single hybrid operating theater such as the RAPTOR (Resuscitation with Angiography, Percutaneous Therapy and Operative Repair) suite. Given the high percentage of patients with an initial prehospital hypotensive blood pressure measurement that normalized with a second reading and/or short resuscitation (i.e. responders), direct transfer of patients from ground or rotary wing ambulance bays to the RAPTOR suite must remain based on experienced clinical acumen and patient assessment.

UNSTABLE HEMODYNAMICS DO NOT ALWAYS MAKE COMPUTED TOMOGRAPHY SCANS UNFEASIBLE IN THE MANAGEMENT OF PATIENTS WITH MULTIPLE TORSO INJURIES

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Introduction:

Torso computed tomography (CT) scans have been used worldwide to evaluate patients with multiple torso injuries. However, torso CT scans have traditionally been considered as a part of a secondary survey that can only be performed after hemodynamics have been stabilized. In this study, we attempted to evaluate the role of the CT scan in managing patients with unstable hemodynamics.

Methods:

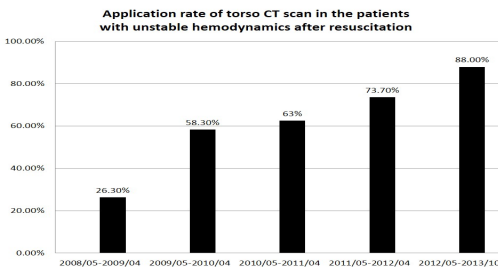
Patients who fulfilled the criteria of major torso injuries in our institution were treated according to the Advanced Trauma Life Support guideline. The selection of diagnostic modalities for patients with stable and unstable hemodynamics was discussed. Furthermore, patients with unstable hemodynamics who received hemostasis procedures were the focus of our analysis. We also delineated the influence of CT scans on the time interval between arrival and definitive treatment for these patients.

Results:

During the study period, 909 patients were enrolled in this study. Ninety-one patients (10.0%, 91/909) had a systolic blood pressure (SBP) less than 90 mmHg after resuscitation. Fifty-eight of the patients (63.7%) received torso CT scans before they received definitive treatment. There was no significant difference in the application rates of torso CT scan evaluation between patients with unstable and stable hemodynamics (63.7% vs. 68.8%, $p=0.343$). Among the 79 patients with unstable hemodynamics who underwent a hemostasis procedure (surgery or angioembolization), there was no significant difference in the time between arrival and definitive hemostasis between the patients received torso CT scans and those who did not (surgery: 57.8 ± 6.4 vs. 61.6 ± 14.5 minutes, $p=0.218$; angioembolization: 147.0 ± 33.4 vs. 139.3 ± 16.7 minutes, $p=0.093$)

Conclusion:

The traditional priority of diagnostic modalities used to manage patients with torso injuries should be reconsidered because of advancements in facilities and concepts. With shorter scanning times and transportation distances, unstable hemodynamics do not always make performing a CT scan unfeasible.



POST-RESECTION PANCREATIC DYSFUNCTION IN TRAUMA: 18-YEAR REPORT FROM A LEVEL I TRAUMA CENTER

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Introduction: Post-resection pancreatic dysfunction in trauma is not well characterized. The aim of this study was to examine the incidence of new-onset endocrine and exocrine dysfunction following traumatic pancreatic resection.

Methods: After IRB approval, all patients sustaining a pancreatic injury from 1/96-12/13 were identified. Patients with preexisting diabetes were excluded. Survivors were divided into three groups according to the extent of anatomic resection- distal, head or total pancreatectomy. Endocrine function including blood glucose levels, insulin requirements and discharge medications were abstracted from clinical records and analyzed.

Results: During the 18-year period, 331 (0.5%) trauma admissions presented with a pancreatic injury; 109 (32.9%) required pancreatectomy and 84 (77.1%) survived to hospital discharge. Four (4.8%) were excluded: 3 incomplete charts and 1 for preexisting diabetes. Of 80 cases, 73 (91.3%) received distal resection, 7 (8.8%) head and none underwent a total pancreatectomy. Distal resection mean age was 27 years (8-62), ISS 23 and BMI 27. Thirty-eight (52.1%) required insulin postoperatively, with the majority (47.4%) requiring insulin for ≤ 1 day; no patients were discharged on insulin. Head resection mean age was 29 years (17-45), ISS 28 and BMI 32. Six (85.7%) required insulin postoperatively and 28.6% were discharged on insulin. For both distal and head resections, none had evidence of exocrine dysfunction or required pancreatic enzyme supplementation at discharge.

Conclusion: Exocrine dysfunction following distal or head pancreatectomy for trauma is rare. The incidence of new-onset endocrine dysfunction following traumatic distal pancreatectomy is rare, but not uncommon following head resection.

DESCRIBING COMPLICATIONS OF NON-THERAPEUTIC LAPAROTOMY USING THE COMPREHENSIVE COMPLICATION INDEX

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Introduction: The reported high morbidity rates of non-therapeutic laparotomy (NTL) in trauma has shifted practice toward more conservative management of suspected abdominal injury. Complications associated with the procedure are frequent and typically are reported as an overall complication rate. The Clavien-Dindo Grading System is used to grade complications by severity. The Comprehensive Complication Index (CCI) generates for each patient a weighted sum of all complications on a scale from 0 to 100. These tools were applied to a cohort of trauma patients who underwent non-therapeutic laparotomy.

Methods: The registry of a single level one trauma center was used to identify patients with NTL, either as their only major procedure (NTL group) or as one of several procedures (NTL+). Complications during admission were tabulated and scored using Clavien-Dindo grades, and then used to calculate a CCI score. Patients who died in <8hours, had incomplete records, or had laparotomy in the emergency room were excluded.

Results: 54 patients were identified, 36 had NTL only and 18 had NTL as well as additional operations (NTL+). The complication rate for NTL patients was 33% with a mean CCI score of 6.4 +/- 2.0; the complication rate for the NTL+ cohort was 72% with a mean CCI score of 29.6 +/- 6.8. Increases in injury severity correlated with increased complication rates and mean CCI (Table 1).

Conclusion: Overall morbidity rate was high after NTL, consistent with previous reports. However, analysis with more sophisticated grading tools suggests that the inpatient complication burden of isolated NTL may be relatively low.

	N	Complication Rate (%)	Grade I	Grade II	Grade III	Grade IV	Grade V	Mean CCI
All	54	46	11	11	11	6	1	14.1
NTL	36	33	6	5	0	2	0	6.4
NTL+	18	72	5	6	11	4	1	29.6
ISS								
< 9	31	35	7	4	0	2	0	6.7
9 - 15	10	40	3	1	1	1	0	10.8
> 15	13	69	1	6	10	3	1	34.2

Table 1. Complication rate, Clavien-Dindo classification of complication severity, and mean CCI for NTL and NTL+ along with increasing ISS. ISS: injury severity score.

INTRAOPERATIVE FEEDING OF THE BURNED PATIENT IS SAFE AND EFFICACIOUS

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Introduction: Severely burned patients are hypermetabolic and hypercatabolic and can remain so for up to one year following injury. The goal of nutrition is to provide adequate calories, protein, and micronutrients to meet their ever-evolving metabolic needs. Historically, enteral nutrition is withheld in the perioperative period for aspiration concerns. As a result, burn patients who require multiple operative debridements and skin grafting procedures risk accumulating significant caloric deficit. We describe our burn center's experience with intraoperative feeds.

Methods: Case series describing a single-institution experience of intraoperative feeding in burn patients with major thermal injuries defined as a cutaneous burn $\geq 20\%$ total body surface area (TBSA). In patients with a tube-secured airway, a large bore salem sump nasogastric tube and a smaller bore feeding tube were placed with enteral feeds initiated within 18 hours of ICU admission. All patients with major thermal injury undergoing surgery had tube feeds continued intraoperatively provided they had a secure airway and radiographic confirmation of a post-pyloric feeding tube. For those with only a gastric feeding tube, feeding was stopped and the stomach decompressed with a salem sump tube on call to the operating room. These patients received continuous intraoperative tube feeds at the discretion of the attending anesthesiologist. Any patient undergoing surgical tracheostomy was NPO for 8 hours prior to surgery. Post operatively, tube feeds were re-initiated within 2 hours of return from the OR at the previously tolerated rate. Oxandrolone and beta-blockers were also given in patients who met requirements in both groups.

Results: Sixteen patients with a total of 116 trips to the operating room without intraoperative feeding were matched by TBSA to 16 patients with a total of 118 trips to the operating room with intraoperative feeding. The primary outcome of days to goal tube feeds was on average 3 days less for those who received intraoperative feeding (3.4 verses 6.2 days). The total percent of prescribed caloric and protein needs achieved during the hospital stay was also higher in those patients who were fed intraoperatively. With no intraoperative feeding the percent of goal caloric and protein needs that were achieved was 88 and 86, respectively, and increased to 96 and 97 percent, respectively, in those patients who were fed intraoperatively. There were no intraoperative aspiration events or regurgitations events as documented by the anesthesiologist in all 112 non-tracheotomy surgeries. This is the first time patients were fed intraoperatively in the prone and lateral positions with no adverse effects. Pre-albumin increased by 48% in those who were not fed intraoperatively and by 61% in those who were fed. CRP values decreased 25% in the patients who were not fed intraoperatively and 41% in those who were. The total LOS, ICU days, and ventilator days, on average, also decreased in the group that was fed intraoperatively. (58 to 53, 49 to 45, and 45 to 33).

Conclusion: Intraoperative nasoduodenal feeding can be administered safely in supine, prone and lateral positions in severely burned patients with a tube-secured airway. Early initiation and continuation of feeds has led to reaching goal caloric needs at half the number of days and achieving overall higher percentages of their goal prescribed needs. This has shown improvement in prealbumin and CRP levels. Trends toward decreased total LOS, total ICU days, and ventilator days can also be seen possibly due to the improvement in nutritional support.

IMPACT OF TRAUMA ON BURN MORTALITY

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Introduction: Factors influencing mortality in burns and trauma have been evaluated independently, but they are rarely evaluated together. Outcomes in combined burn/trauma injuries have assumed increased importance due to recent military conflicts. The purpose of this study is to assess the additional impact of trauma on burn outcomes.

Methods: We analyzed the American Burn Association National Burn Repository (NBR) 2009 release containing of 286,293 admissions. Analysis was restricted to years after 2000. Records missing mortality, age, burn size (total body surface area-TBSA), inhalation injury, or length of hospital stay, as well as readmissions, non-burn injuries, and duplicates were eliminated from analysis. We used generalized estimating equation with a logistic regression to model the effect of trauma, burn size, inhalation injury and age on mortality. We fit a series of models consisting of main effects and two-way interactions for Burn Only and for Burn/Trauma. Two-way interactions were analyzed for TBSA, inhalation injury, and age for Burn and Burn/Trauma. Models were compared on the significance of predictors ($p < 0.05$) and QICu values.

Results: Of the 95,579 records meeting screening requirements, 2,868 patients had documented trauma/burn injuries. Comparing the parameter estimates from all models revealed: 1. Burn Only Model: mortality was dependent on burn size, age and inhalation injury 2. Burn/Trauma Model: trauma increased mortality ~62%. On two-way interaction, trauma increased mortality, with magnitude dependent on burn size and age. Similarly, inhalation injury increased mortality, with magnitude of effect dependent on burn size and age. (Table 1) Without trauma, the odds ratio increased 2.21 for every 10 year increase in age; with trauma this increase is only 1.87. For inhalation injury, the odds ratio increased 1.05 for every 10 year age increase with inhalation injury and 2.21 per 10 years of age without inhalation injury.

Conclusion: Trauma influences burn mortality variably based on burn size and inhalation injury. Mortality for patients with <40% TBSA burn is increased with concomitant trauma. However, for larger burns (>40%) burn size is the primary determinant of mortality, and trauma does not add significantly to overall mortality for these larger burns. Treatment of combined burn/trauma should be predicated on factors influencing mortality.

Table 1. Odds ratio for impact of trauma and inhalation injury on burn mortality

Burn Size (%TBSA)	Trauma	Inhalation
0-20	8.76	56.04
20-40	5.68	20.64
40-60	4.40	9.37
60-80	3.59	6.64
80-100	1.59	6.66

Predictors of Death and Development of Clavien IV Complications in Patients with Necrotizing Fasciitis

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Introduction: Necrotizing soft tissue infections are associated with a high mortality and morbidity rate. Prompt management requires a high index of suspicion from the surgeon. We sought to identify admission characteristics associated with increased incidence of adverse outcomes.

Methods: Patients with necrotizing fasciitis from 2005 – 2012 were identified using the ACS NSQIP database. Complications were stratified based on the Clavien classification. Clavien IV (Life –threatening complications requiring ICU management) were identified. Univariate analyses were performed to identify clinical characteristics associated with high incidence of Clavien IV complications post operatively. A logistic regression was deployed to identify independent predictors of mortality.

Results: A total of 1,906 patients underwent debridement for necrotizing fasciitis. Overall mortality was 12.6% while 38.1% developed Clavien IV complications. Increasing frailty index and functional status prior to admission were associated with an increasing incidence of Clavien IV complications ($p < 0.001$). COPD, hypertension and emergency operations were associated with higher incidence of life threatening complications (58.8% vs. 36.0%, 40.0% vs. 35.7% and 43.6% vs. 28.9% respectively, $p < 0.05$). DM, African American race and tobacco use did not prove to increase the incidence of serious complications. Multivariate analysis identified frailty index and emergency operation as the only independent factors associated with increased mortality [AOR (95% CI): 28.9 (11.8, 71.0) and 2.1 (1.5, 2.9) respectively].

Conclusion: Frailty index is an accurate predictor of outcomes for patients presenting with necrotizing fasciitis.

THE SURGICAL ACUITY SCORE-GALLBLADDER (SAS-G): A STANDARD CLASSIFICATION FOR THE SEVERITY OF GALLBLADDER DISEASE IN THE EMERGENCY GENERAL SURGERY

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Introduction: Unlike the Injury Severity Score (ISS), a uniform severity scoring system for emergency general surgery (EGS) does not exist. We developed two scoring systems for the gallbladder: one based on anatomic criteria only, and the Surgical Acuity Score – Gallbladder (SAS-G) which adds measures of physiology and comorbidities to the anatomic criteria. Our aim was to evaluate and compare the performance of these two models in predicting complications, duration of stay (LOS), and mortality.

Methods: Patients ≥ 18 who underwent cholecystectomy or cholecystostomy tube placement for cholecystitis or biliary colic at our institution between July 2012 and December 2013 were identified. Anatomic, Physiologic, and Comorbidity scores (**Table**) were determined, squared, and added together to create the SAS-G. The outcomes of extended LOS ($>75^{\text{th}}$ percentile), complications, and mortality were recorded. Area under the receiver operating characteristic curve (AUROC) analysis was performed.

Results: There were 307 patients with a mean (SD) age of 62 (20) years (51% male). 85% underwent cholecystectomy during the index hospital admission (77% laparoscopic). There was an 18% complication rate, and an extended LOS (>6 days) rate of 19%. Mortality was 4%. The median (IQR) anatomic, physiologic and comorbidity scores were 2 (2-3), 2 (0-2), and 2 (0-3), respectively for an overall median SAS-G of 13 (8-22). AUROC analysis demonstrated that the SAS-G was more highly associated than the anatomic score for complications (0.68 vs. 0.58), extended LOS (0.82 vs. 0.67), and mortality (0.92 vs. 0.60).

Conclusions: The SAS-G is a reliable tool to categorize severity of gallbladder disease and is superior to anatomic criteria alone. EGS scoring systems that include physiologic and comorbidity criteria will allow enhanced standardization of disease severity between institutions. SAS-G should be validated in a prospective, multi-institutional study.

Score	Anatomic	Physiologic	Comorbidity
0	Normal	Normal	Charlson 0
1	Cholelithiasis	SIRS	Charlson 1-2
2	Cholelithiasis w/ RUQ pain >4 hours, gallbladder wall thickening, or pericholecystis edema Choledocholithiasis	Sepsis	Charlson 3-4
3	Choledocholithiasis w/ cholangitis, pancreatitis, Mirizzi syndrome	Severe sepsis	Charlson 5-6
4	Gallbladder necrosis Perforation with localized abscess	Septic shock	Charlson 7-8
5	Biliary peritonitis	MODS	Charlson ≥ 9

ALL OUR EGS IN ONE BASKET? EXAMINING THE COST OF EMERGENCY GENERAL SURGERY BY PAYER STATUS

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Introduction:

Acute Care Surgery is a new discipline encompassing Trauma, Critical Care, and Emergency General Surgery (EGS). The American Association for the Surgery of Trauma (AAST) has defined the scope of practice for EGS, but the burden in cost is unknown, as well as who pays for it. As these patients become concentrated within a specialized group of providers, we must delineate implications for reimbursement. We sought to determine the annual inpatient costs incurred by EGS patients by payer status.

Methods:

We conducted a retrospective analysis of patients with EGS admissions from the Nationwide Inpatient Sample (NIS) for 2006-2010, selected by primary diagnosis ICD-9-CM codes defined by AAST as associated with EGS. After adjustment to 2010 US dollars, hospital cost-to-charge ratios (CCR) were used to convert charges to costs. The data was then reweighted to provide national estimates of mean cost per patient, and total yearly costs for EGS.

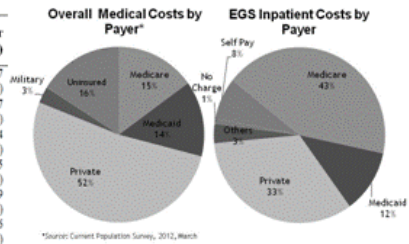
Results:

After weighting the NIS data to the US population, on average 3.9 million patients per year were admitted with a primary diagnosis encompassing EGS. Overall mean cost per EGS patient was \$9,711.75, yielding a total estimated yearly cost of \$37.62 billion. Compared to privately insured, mean cost per patient was significantly *lower* for self-pay and patients who were not charged, and significantly *higher* for those with Medicare, Medicaid, and other forms of insurance (Table 1). Self-pay and no-charge patients comprised 9% of EGS costs compared to 16% of the overall medical costs incurred by uninsured patients. In contrast to representing 15% of overall medical costs, Medicare patients represented 43% of costs related to EGS (Figure 1).

Table 1. Mean Cost per patient and mean overall cost per year by Payer Status

Payer	Yearly Mean Cost/ Patient*	95% CI	Weighted Population Estimate (%)	Mean Cost per Year* (%)
Medicare	\$10,982.25	(\$10948.21, \$11016.29)	1,645,629 (42.6)	\$18,072,703,654.87 (48.0)
Medicaid	\$9,461.45	(\$9394.81, \$9528.09)	461,380 (11.9)	\$4,365,323,338.27 (11.6)
Other insurance	\$9,176.12	(\$9070.97, \$99070.97)	137,617 (3.6)	\$1,262,788,991.74 (3.4)
Private	\$8,722.52	(\$8690.94, \$8754.09)	1,293,818 (33.4)	\$11,285,352,171.45 (30.0)
No Charge	\$8,514.97	(\$8356.76, \$8673.17)	36,643 (0.9)	\$312,013,003.39 (0.8)
Self Pay	\$7,779.58	(\$7727.13, \$7832.04)	299,060 (7.7)	\$2,326,560,039.26 (6.2)
Overall Mean	\$9711.75			
Total Yearly National Emergency General Surgery Inpatient Cost				\$37,624,741,198.98

*Costs in 2010 US Dollars



*Source: Current Population Survey, 2012, March

Figure 1. Distribution of payers for overall medical costs compared to inpatient emergency general surgery (EGS) costs, showing that burden of uninsured patients is less in EGS, while EGS bears an increased share of Medicare cost. Medicare patients are also disproportionately represented in emergency care.

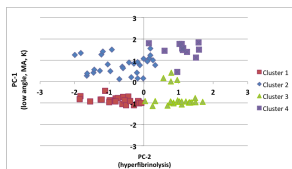
Conclusion:

The financial burden of EGS in the US is estimated to be nearly \$40 billion/year. Distribution of EGS costs across payers is significantly different from that of the overall healthcare system, with a relatively low proportion of uninsured (self-pay/no charge) patients. Medicare patients are disproportionately represented in EGS costs compared to overall costs of healthcare, which concentrates their care with Acute Care Surgeons as the specialty develops. With the changing reimbursement landscape and uncertainty surrounding current legislation, Acute Care Surgeons may become disproportionately affected. Also, because many EGS conditions are related to early-identifiable diseases that could potentially be managed more electively, this also has implications for potential cost-effectiveness of screening for early detection.

PHENOTYPES OF TRAUMA-INDUCED COAGULOPATHY

Eduardo Gonzalez MD, Angela Sauaia MD, Ph.D., Ernest E. Moore* MD, Theresa Chin MD, Michael P. Chapman MD, Hunter B. Moore MD, Christopher C. Silliman MD, Ph.D., Anirban Banerjee Ph.D., University of Colorado Denver

Introduction: Protein-C activation, platelet dysfunction, endothelial glycocalyx degradation, and hyperfibrinolysis have been demonstrated to be endogenous drivers of trauma-induced coagulopathy (TIC). Principal component analysis (PCA) of coagulation proteins and of viscoelastic parameters has been validated as a tool that identifies mechanistic pathways leading to TIC. PCA has identified that depletion coagulopathy (principal component 1, PC-1) is independent from fibrinolytic coagulopathy (PC-2). Whether these biological mechanisms translate into phenotypes that are associated with distinct clinical outcomes remains to be elucidated. We hypothesized that phenotypes of trauma-induced coagulopathy could be identified based on cluster analysis of PCA of viscoelastic parameters. **Methods:** Trauma patients admitted to our level 1 academic trauma center (Sept. 2010-Oct. 2013) that met criteria for massive transfusion protocol activation, and received ≥ 1 unit of packed red blood cells (PRBC) were studied. Rapid thrombelastography (r-TEG) values were obtained within the first 6 hours post-injury. Based on TEG variables the degree of PC-1 (x-axis) and PC-2 (y-axis) each patient had was plotted for cluster analysis (median method). Primary outcomes: mortality, and blood product requirements. Continuous values were expressed by median (IQR). Clusters were compared using the Kruskal-Wallis, Chi-square, or Wilcoxon test. **Results:** 98 patients were studied; 24 patients were categorized as cluster-1 (low PC-1, low PC-2), 30 as cluster-2 (low PC-1, high PC-2), 26 as cluster-3 (high PC-1, low PC-2), 12 as cluster-4 (high PC-1, high PC-2). Median ACT, angle, MA, and LY30 for cluster-1: 117.0 sec, 72.1 degrees, 57.7 mm, 0%; cluster 2: 124.5 sec, 69.9 degrees, 57 mm, 1%; cluster 3: 140.0 sec, 53.9 degrees, 41.6 mm, 0%; cluster 4: 148.0 sec, 47.3 degrees, 35.4 mm, 28.6%. There were no significant differences in age, sex, admission pH, base deficit, and lactate. There was a trend ($p=0.09$) towards decreased mortality in cluster-2 (13%), compared to any of the other clusters (cluster 1: 20%, cluster 3: 34%, cluster 4: 33%). Cluster-4 had more PRBC, plasma, cryoprecipitate, and platelet blood product requirements (18, 9, 1.5, 1, units, respectively) within the first 6h compared to any of the other clusters (cluster-1: 5, 1.5, 0, 0; cluster-2: 8, 4, 0, 0; cluster-3: 10, 5.5, 1.0, 1) ($p<0.001$). Cluster-2 had more red-cell, plasma, and cryoprecipitate requirements compared to clusters-1 and 2 ($p<0.001$). ISS was significantly higher in clusters-3 and 4 (34 and 38 respectively) compared to that of cluster-1 and 2 (24 and 25) ($p=0.002$). Head injury was less common in patients in cluster-2 (3.3%) compared to clusters-1, 3, and 4 (25.0%, 34.6%, and 33.3% respectively) ($p=0.002$). There were no significant differences for other injury patterns (chest, abdominal, extremity). **Conclusion:** Cluster analysis of viscoelastic components demonstrates unique patterns of coagulopathy that represent phenotypes associated with distinct clinical outcomes, allowing for more individualized management.



TRENDS IN ACUTE CARE SURGERY WORKFORCE DEMANDS 2003-2013

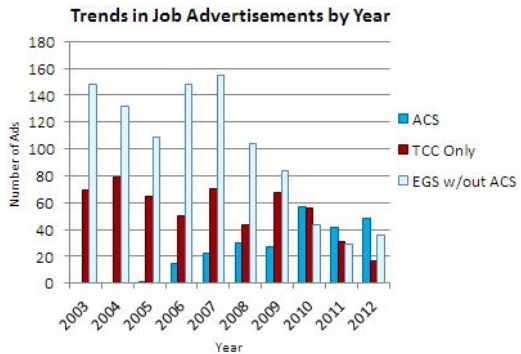
Angela Wood Pawan Barot BS, Braden Price BS, Timothy A. Emhoff* MD, Heena P. Santry* MD, University of Massachusetts

Introduction: Early in the 21st century, leading US trauma surgeons formally convened to discuss growing dissatisfaction with trauma/critical care (TCC), which was increasingly becoming a non-operative specialty. Envisioning the transformation of TCC into the new specialty of acute care surgery (ACS) addressed both the crisis in their ranks and the shrinking pool of general surgeons to take emergency general surgery (EGS) call. We examined advertisements for such positions in the years since to better understand the evolution of ACS workforce demands.

Methods: We reviewed the listings for open TCC and ACS positions in each issue of the Journal of the American College of Surgeons and Journal of Trauma from January 2003 through March 2013. A database was created to record key variables such as name of position (eg. trauma/critical care surgeon, acute care surgeon, emergency general surgeon), geographic region, and type of practice (eg. academic, public, private). Trends in numbers and types of positions available were determined using Cochran Armitage trend tests and linear regression. Job descriptions were analyzed using Nvivo qualitative software for salient themes used to market the position.

Results: We identified 1806 individual ads across both journals. The total number of ads per year decreased from 217 in 2003 (EARLY) to 101 in 2012 (LATE) ($p=6.2 \times 10^{-3}$).

The proportion of ads described only as TCC was 32% EARLY and 17% in LATE ($p=8.4 \times 10^{-3}$). Meanwhile, the proportion of ads using ACS nomenclature was 0% EARLY and 48% in LATE ($p=6.2 \times 10^{-5}$), and the proportion of EGS without ACS nomenclature was 68% EARLY and 36% in LATE ($p=1.2 \times 10^{-3}$). The figure to the right shows these proportions across all years. The figure to the right shows these proportions across all years.



Of all ads identified, 30.5% used TCC, 14% ACS, and 55.4% EGS. Differences in overall proportions according to practice type and trauma center verification were analyzed. It was noted that 39% of private practice ads used TCC; only 9.8% used ACS, and 51.2% used EGS. Level I trauma centers used 18.2% ACS, 30.1% TCC, and 51.4% EGS, while Level II used 7.2% ACS, 23.5% TCC, and 69.3% EGS.

Conclusions: The high proportion of EGS ads in early years reflects the shrinking pool that helped prompt the shift from TCC to ACS. The significant increase in the proportion of ACS positions and corresponding decreases in TCC and EGS ads indicate that the workforce demands followed the formal transformation from TCC to ACS. The overall decrease in ads per year may indicate that the demands were being better met as acute care surgeons addressed the needs of both TCC and EGS. Based on these trends, it is likely that in the coming years ACS job demand will wholly eclipse TCC and EGS.

POSTERIOR COMPONENT SEPARATION AND TRANSVERSUS ABDOMINIS MUSCLE RELEASE (TAR) FOR COMPLEX INCISIONAL HERNIA REPAIR IN PATIENTS WITH A HISTORY OF AN OPEN ABDOMEN

Clayton C. Petro MD, John J. Como* MD, MS, Sydney Yee BS, Ajita S. Prabhu MD, Yuri W. Novitsky MD, Michael J. Rosen MD, Case Surgery

Introduction: Closing large fascial defects following management of the open abdomen remains a daunting challenge. The best reconstructive approach in those patients has not been elucidated to date. We have utilized posterior component separation with transversus abdominus muscle release (PCS/TAR) as the procedure of choice for the vast majority of our complex abdominal wall reconstructions. Herein, we aimed to evaluate our outcomes using this approach in a complex cohort of patients with a previous open abdomen.

Methods: Patients with a history of an open abdomen - defined as an inability to close the fascia after an initial laparotomy – who ultimately underwent complex hernia repair with PCS/TAR from 2010-2013 were identified in our prospective database and analyzed.

Results: Of 37 patients (mean age 54, BMI 32) only one achieved fascial closure during the same hospital stay as their open abdomen. Twenty patients underwent a previous hernia repair, including four anterior component separations, before developing a recurrence. Our operations consisted of 24 (65%) contaminated cases, including five enterocutaneous fistula takedown, four stoma revisions, and two excisions of infected mesh. The mean hernia size was 445cm² (range 216-1152) with a mean width of 18cm (range 10-32). Mesh reinforcement included a macroporous polypropylene mesh in 19 (51%) patients and biologic mesh in 18 (49%) patients, all placed in the retrorectus position. Anterior fascial coverage was achieved in 35 (95%) cases. Wound morbidity consisted of 13 (35%) surgical site occurrences: two wound dehiscences, two hematomas, one seroma, seven surgical site infections (19%: four superficial, two deep, and one organ space) and one enterocutaneous fistula that closed spontaneously. There have been no mesh excisions to date. With a mean follow-up of 10.5 (range 3-40) months, there have been three (8%) parastomal recurrences, one associated with a concurrent epigastric recurrence.

Conclusion: Patients with a history of an open abdomen represent a challenging reconstructive problem. To our knowledge, this is the first report describing the use of PCS/TAR in patients with a history of open abdomen. We have demonstrated that this approach is associated with low significant perioperative morbidity and low recurrence. We advocate our approach for patients with complex hernias after an open abdomen.

INADEQUATELY MARKETING OUR BRAND: MEDICAL STUDENT AWARENESS OF ACUTE CARE SURGERY

Stephanie C. Montgomery MD, Alicia R. Privette MD, Pamela Ferguson Ph.D., Meena Mirdamadi BS, Samir M. Fakhry* MD, Medical University of South Carolina

Introduction: Despite focused national efforts to promote Acute Care Surgery (ACS) as a specialty, little is known about medical student awareness of ACS as a career choice. The impending shortage of general surgeons emphasizes the need to increase interest in a comprehensive surgical specialty such as ACS. The goal of this study was to determine whether medical students would be more likely to consider choosing ACS if they were aware of the specialty and its benefits.

Methods: An anonymous survey was distributed electronically to all medical students at our institution (N=699), a level I trauma center with an active ACS service. The survey included questions regarding specialty choice and factors that were used in making that decision. Also included were questions regarding their familiarity and affinity for ACS.

Results: The survey was returned by 524 students (response rate 75%). Each medical school year and gender were proportionately represented. 21% of students reported surgery as their career choice, but women were half as likely to choose surgery as men. When asked to define ACS, only 23% of all students gave the correct response. Only 8.9% of student in the pre-clinical years correctly defined ACS. Even in the clinical years, 54% were unaware of ACS as a specialty choice. Students reported the top three factors that influenced their choice of specialty were controllable lifestyle, predictable schedule, and a positive role model during medical school. When asked to identify a factor that would make ACS more appealing as a career choice, a 50 hour work week was deemed the most influential. When given the correct definition of ACS as well as approximate pay scale and on-call hours, 41.5% of all medical students and 75% of those interested in surgery would be very likely or somewhat likely to choose ACS as a career.

Medical School Class	Aware of Acute Care Surgery	Very Likely/ Somewhat Likely to Choose ACS
1 st Year	(12/101) 11.88 %	(60/101) 59.41 %
2 nd Year	(26/113) 23.01 %	(61/113) 53.98 %
3 rd Year	(60/123) 48.78 %	(40/124) 32.26 %
4 th Year	(53/124) 42.74 %	(31/124) 25.00 %

Conclusion: This study highlights that awareness of ACS as a specialty choice among medical students at our institution is lacking. This may reflect inadequate marketing of our “brand” both locally and nationally. Focused efforts at familiarizing medical students with ACS (especially in pre-clinical years) and increased efforts at role-modeling may increase interest in ACS as a career choice. Special attention should be paid to female medical students as they represent an unrealized source of new surgeons.

ADVERSE EVENTS IN EMERGENCY GENERAL SURGERY

Oliver L. Gunter* MD, Oscar D. Guillamondegui* MD, MPH, Bradley M. Dennis MD, Naji N. Abumrad MD, Daniel A. Barocas MD, MPH, Vanderbilt University Medical Center

Introduction: Outcomes research in emergency general surgery (EGS) is limited by patient population ambiguity. Teaching hospital status has previously been associated with increased morbidity and mortality in surgical patients. We hypothesized that EGS patients undergoing major abdominal surgery at teaching hospitals have an increased risk of surgical adverse events (SAE) and mortality.

Methods: Retrospective cohort study of 2010 Nationwide Inpatient Sample, restricted to adults, non-elective admissions, and APRDRG for major small and large bowel procedures. Primary outcome was SAE, defined as diagnoses/procedures derived from AHRQ patient safety indicators and NSQIP postoperative wound occurrences. Secondary outcome was hospital mortality. Survey logistic regression was utilized for outcomes with hospital teaching status as principle exposure controlling for demographics, socioeconomic status, hospital features, and comorbidities.

Results: National estimate was 39 million discharges in the US for 2010; the study population represented 156,313 cases. Mean age was 63.2 [95% CI, 62.7-63.7], 54% female, 27% nonwhite minority, 59% govt insured, 44% cared for at teaching hospitals. SAEs occurred in 14%, mortality was 5%. Pre-existing coagulopathy and weight loss were independently associated with increased odds of SAE (O.R. 1.59 [95% CI, 1.40-1.81] and 1.84 [95% CI, 1.84-2.02], respectively). Odds of SAE and mortality at teaching hospitals were 1.35 [95% CI, 1.22-1.49] and 1.16 [95% CI, 1.04-1.36].

Conclusion: Coagulopathy and nutritional status are the strongest comorbidity predictors for postoperative SAEs in EGS patients. Teaching hospitals are independently associated with increased morbidity and mortality for patients undergoing emergency major abdominal operations. Comorbidity does not account for disease severity or patient physiology and may be insufficient for risk-adjusted modeling of EGS outcomes.

THE MODERN TRAUMA AND EMERGENCY SURGEON: CHARACTERIZING AN EVOLVING SURGICAL NICHE

Brent C. Pottenger MHA, Joseph M. Galante* MD, David H. Wisner* MD, University of California, Davis

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: Trauma and emergency surgery continues to evolve as a surgical niche. The simple fact that *The Journal of Trauma* is now entitled *The Journal of Trauma and Acute Care Surgery* captures this reality. We sought to characterize more richly the niche that trauma and emergency surgeons have operated within during the transition to the acute care surgery model.

Methods: We analyzed the UHC-AAMC Faculty Practice Solutions Center database for the years 2007 to 2012 for specific Current Procedural Terminology (CPT) codes. This database includes coding and billing data for more than 90 academic medical centers throughout the United States. We analyzed frequency counts and wRVUs generated for specific codes to characterize the average trauma and emergency surgeon's work experience over time.

Results: We found that trauma and emergency surgeons generated 42.36% of wRVUs from procedural work and 57.56% from cognitive work. For procedural work, laparoscopic cholecystectomies produced the most wRVUs (2.44% of total), and placement of a non-tunneled catheter was the most frequently performed procedure (42.22 per year). For cognitive work, critical care services generated the most wRVUs (24.19% of total), and subsequent hospital care was the most frequently performed activity (1,236.55 per year). Moreover, the average trauma surgeon performed far more splenectomies per year (4.88) than splenorraphies (0.40); less than one (0.63) video-assisted thoracic (VAT) surgery operation per year; one or two (1.42) skin/muscle flap repairs on the trunk; 4.69 reducible and 2.11 strangulated hernia repairs per year; 7.71 wound vacuum device changes per year; 19.99 appendectomies and 29.62 cholecystectomies per year; and, 2.61 drainage of perirectal abscess procedures per year.

Conclusion: The modern trauma and emergency surgeon is a hybrid of critical care medicine physician and ever-evolving surgical interventionist who continues to do traditional trauma work while increasingly performing acute care surgeries that fill in the gaps amongst and overlap with other surgical specialties, serving a valuable niche in the healthcare system.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

Poster # 19

WITHDRAWN

WHO DO WE LEAVE OPEN IN SEVERE ABDOMINAL SEPSIS?

Carlos A. Ordóñez* MD, Fernando Miñan MD, Michael W. Parra MD, Marisol Badiel MD, Ph.D., MSc, Luis F. Pino MD, Fernando Rodríguez MD, Cristina Vernaza MD, Juan C. Puyana* MD, Fundación Valle del Lili

Introduction: The aim of this study was to develop a prediction model in patients with abdominal sepsis that could select out those that would benefit from an open abdomen.

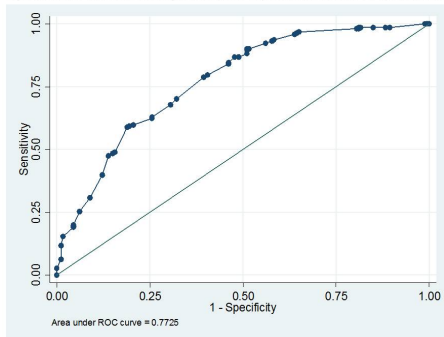
Methods: A retrospective review was performed of all adult (Age > 18) non-trauma patients who underwent damage control laparotomy (DCL) with an open abdomen (OA) for abdominal sepsis from January, 2004 to December, 2010. Patients with abdominal sepsis secondary to trauma or primary pancreatic disease were excluded. Patients were further divided into two groups: those that were not managed with an open abdomen (Non-OA) and those that were (OA). Data including indications and outcome were collected and analyzed. Variables were selected based on previous reports and common clinical sense and screened in a univariable regression analysis to identify those associated with the need for relaparotomy. Variables with the strongest association were considered for the prediction model which was constructed after backward elimination in a multivariable regression analysis. The discriminatory capacity of the model was expressed with the area under the curve (AUC).

Results: A total of 401 patients were included of which 180 (44.9%) were managed Non-OA and 221 (55.1%) underwent an OA. Both groups were similar demographically. The median age was 55 years (IQR=38-68). The most common source of the abdominal sepsis was the colon in 140 (34.9%) patients, followed by the small bowel in 129 (32.2%). A total of 52 (13%) patients

developed post-operative complications of which the most common was the entero-cutaneous fistula (10% in the OA group vs. 0.5% in the Non-OA group, $p < 0.0001$). The overall mortality was 17.5%, which was noticeably less in the Non-OA group (13% vs. 21%, $p = 0.0497$). The prediction model included abdominal sepsis from a small bowel source, abdominal sepsis from a colon source, diffuse peritonitis and an APACHE II score >15 as indicators for the need to leave the abdomen open. We also discovered that age >60 and acute perforated appendicitis were associated with higher complication rates when managed with an OA approach. Our predictive model had the capacity to determine 71.3% (goodness-of-fit test, $p = 0.4035$) and to predict the need for an open abdomen in 77.3% of cases.

Conclusion: We identified that an elevated APACHE II score >15, a colon or small bowel etiology of the abdominal sepsis, and the presence of diffuse peritonitis are the most common factors indicating the need for an open abdomen approach in severe intra-abdominal sepsis. Our data also showed that age >60 and acute perforated appendicitis were associated with higher complication rates when managed with an OA approach.

Fig.1 ROC curve obtained from regression model to predict the need for an open abdomen



MECHANISMS OF HYPERCOAGULABILITY AFTER TRAUMA: A FIBRIN OR PLATELET PROBLEM?

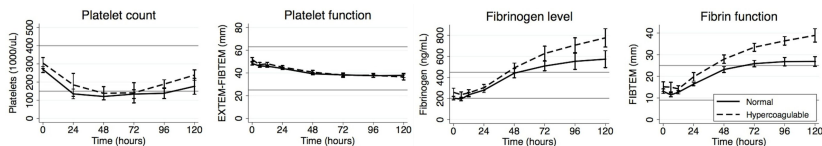
Matthew E. Kutcher MD, Lucy Z. Kornblith MD, Benjamin M. Howard MD, MPH, Sara Moore Ryan F. Vilardi Brittney J. Redick Mary F. Nelson RN, Alan Hubbard Ph.D., Mitchell J. Cohen* MD, University of California, San Francisco

Introduction: Hypercoagulability after trauma is common, leading to thromboembolic complications. The two major contributors to clot strength are fibrin polymerization and platelet function; however, their relative contributions to hypercoagulability and its clinical sequelae such as venous thromboembolism (VTE) are unknown.

Methods: Longitudinal citrated whole blood samples were collected from 177 highest-level trauma activation patients admitted to a Level I urban trauma ICU. Clot strength was assayed using ROTEM® rotational thromboelastometry in response to tissue factor (EXTEM); fibrin function was assayed using tissue factor in the presence of the platelet inhibitor cytochalasin D (FIBTEM). Platelet function was calculated as maximal clot formation (MCF) in EXTEM minus FIBTEM tests. A total of 934 measurements (median 4, inter-quartile range 4-7 samples per patient) were analyzed and matched to standard laboratory values and outcomes.

Results: EXTEM MCF increased throughout ICU stay, becoming hypercoagulable in 52 patients (29.4%) at a median of 72h. Patients who developed hypercoagulability had lower admission pH and INR, and higher platelet count, platelet function, fibrinogen level, and fibrin function (all $p < 0.05$), but had similar age and injury characteristics. Fibrin function (OR 1.18, $p = 0.038$) on admission was the only adjusted predictor of later hypercoagulability. Platelet function and count decreased over time, and did not differ by hypercoagulability; however, mean fibrin function and fibrinogen levels increased significantly into the supranormal range by 72h, and were significantly higher in hypercoagulable patients from 48h onwards ($p < 0.05$). Initiation of VTE prophylaxis was associated with a decline in platelet count and function, but did not impede increasing fibrinogen level and function. Admission fibrinogen (OR 1.01, $p = 0.019$) and fibrin function (OR 1.14, $p = 0.037$) were identified as injury-adjusted predictors of later VTE.

Conclusion: Hypercoagulability was common in this critically injured population, and occurred early. Patients who later developed hypercoagulability had elevated fibrin and platelet levels and function on admission; however, only fibrin function was a multivariate predictor of early hypercoagulability and later VTE. While mean platelet function and platelet count decreased, fibrin function and fibrinogen levels increased during ICU stay; this trend was not reversed by initiation of VTE prophylaxis. This suggests that hyperfibrinogenemia may play a previously unrecognized - and currently undertreated - critical role in the hypercoagulable state after traumatic injury.



ELIMINATING BENZODIAZEPINES IN THE TRAUMA INTENSIVE CARE UNIT (TICU): APPLICATION OF AN ATYPICAL ANTIPSYCHOTIC-BASED SEDATION PROTOCOL

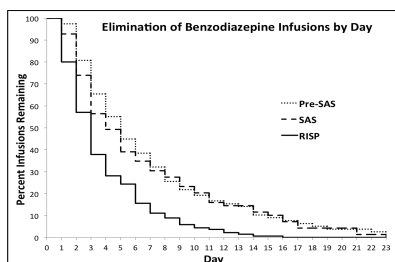
Robert S. Martin* MD, James M. Taylor BS, Melissa K. Barney MD, Gerald J. Rebo PharmD, Nathan T. Mowery* MD, Preston R. Miller* MD, Amy N. Hildreth* MD, Wake Forest University School of Medicine

Introduction: Injured, mechanically ventilated patients are given sedation to increase comfort and decrease ventilator dyssynchrony. Benzodiazepines are often administered for this purpose, but this class of drugs is associated with increased risk of ICU delirium, prolonged cognitive dysfunction, and even post-traumatic stress disorder. Risperidone is an atypical antipsychotic that has demonstrated benefit in the setting of delirium. Given the evidence of the dangers of benzodiazepine administration, we designed a protocol to systematically administer risperidone within our approach to sedation. The purpose of this study was to determine the impact of this protocol on benzodiazepine administration. Consistent with national standards we had previously adopted a nurse driven sedation protocol with daily interruption (SAS), and this was also accounted for in the analysis.

Methods: Adult patients admitted to the TICU who required mechanical ventilation for >24 hours were retrospectively enrolled from three time periods- 1/2001-12/2002, 1/2006-12/2007, and 1/2011-12/2012. These time periods were chosen to include a pre-sedation protocol group (Pre-SAS), a sedation protocol group (SAS), and an antipsychotic group (RISP). The RISP group was managed using a sedation protocol that included standard ICU methods to limit sedation in addition to daily titration of risperidone (from 1 to 8 mg BID) until benzodiazepines were no longer needed. Drugs and doses administered to these groups were determined through chart review. Benzodiazepine administration (midazolam/lorazepam) was compared between groups.

Results: Seven hundred forty six patients were included in the study. Over 48 % of patients in the RISP group received risperidone by protocol. Total ICU administration of benzodiazepines decreased across all three groups including a significant decrease from the SAS to the RISP groups (Table). Similarly, the mean daily dose administered by infusion decreased significantly from the SAS to the RISP group. A Kaplan Meier curve demonstrates the early discontinuation of benzodiazepine infusions in the RISP group compared to the Pre-SAS and SAS groups (Figure).

	Pre-SAS (1)	SAS (2)	RISP (3)	p-value (2 vs 3)
Number	178	291	277	
Risperidone percent	0	0	48.5	
Total benzo (mg)	292.5	137.0	88.0	0.029
Drip dose per day (mg)	62.6	50.2	27.8	< 0.001



Conclusion: Implementation of a sedation protocol that employs atypical antipsychotics was associated with a significant reduction in the administration of benzodiazepines in ventilated TICU patients. We present a protocol that uses these medications independent of measured delirium status and suggest that this approach would benefit from prospective study.

NSQIP CLINICAL CRITERIA FOR DIAGNOSIS OF NOSOCOMIAL PNEUMONIA ARE ACCURATE AND SPECIFIC

Andrew J. Kerwin* MD, Jhun De Villa MD, Jin H. Ra MD, J. Bracken Burns Jr., DO, Indermeet S. Bhullar* MD, David J. Skarupa MD, Joseph J. Tepas* III, MD, University of Florida, Jacksonville

Introduction: Postoperative pneumonia (PNA) remains a costly complication of surgical care and a metric for quality assessment increasingly embraced by federal and private payers. In light of our policy of aggressive broncho-alveolar lavage (BAL) to confirm suspected PNA by the presence of pathogenic organisms, we assessed the accuracy of NSQIP clinical criteria used to identify PNA by comparing BAL results to NSQIP registry data.

Methods: The registry records of 2,543 surgical patients reviewed in our NSQIP program were analyzed. Microbiology results of BAL cultures obtained during the study period were matched to the NSQIP population. Incidence of pathogenic organisms >100,000 cfu/ml was determined for patients identified by NSQIP as PNA, and for all other NSQIP patients who underwent BAL and were not recorded as having PNA. Positive (PPV) and negative (NPV) predictive values as well as positive and negative Likelihood ratios (LR +, LR-) were calculated for NSQIP clinical criteria.

Results: Over 22 months 2,543 surgical cases were reviewed. NSQIP clinical criteria identified 25 PNA, 21 of whom were confirmed by BAL. Two of the other four had positive sputum cultures and two had no bacterial confirmation. During the same period 455 BAL procedures were performed on surgical patients, 51 of which were part of the NSQIP review cohort. The 33 additional NSQIP patients with BAL results included 28 (85%) with negative results, 70% of which were sterile or mixed flora while 30% had sub threshold quantities of pathogenic organisms. The 5 positive culture patients included 2 confirmed on second BAL with organisms not present on initial BAL. NSQIP criteria screening with confirmed pathogenic organism generated a PPV of 92% with a LR+ of 194.2, and a NPV of 99% with LR- of .0052.

Conclusion: These results confirm the accuracy of NSQIP screening criteria for identifying patients with probable PNA. The 83% incidence of negative BAL may reflect overaggressive therapy, especially in light of the high incidence of negative results. Using NSQIP clinical criteria as part of fever evaluation could allow clinicians to make more accurate decisions regarding the need for BAL and empiric antibiotic use in patients with possible PNA.

SPLENECTOMY IS ASSOCIATED WITH A HIGHER RISK FOR VENOUS THROMBOEMBOLISM

Debora Lee BS, Galinos Barmparas MD, Nicole Fierro BS, Douglas Liou MD, Alex W. Lamb BS, Brandon Nguyen BS, Rex Chung MD, Eric J. Ley* MD, Cedars-Sinai Medical Center

Introduction: Thrombocytosis following splenectomy is a common post-operative finding. Whether thrombocytosis leads to a higher risk of venous thromboembolism (VTE) is unclear. The aim of this investigation was to determine if splenectomy is associated with the development of VTE.

Methods: This was a prospective, observational study conducted at a 24-bed SICU. All patients admitted from 1/2011 to 11/2013 after undergoing a splenectomy, a bowel resection/repair or a combination of both were followed. Demographics and relevant clinical data were collected and results of venous Duplex studies and CT angiographies were recorded. The primary outcome measure was development of VTE, including deep venous thrombosis (DVT) and pulmonary embolus (PE). The three groups were compared using analysis of variance and the bowel resection/repair group was used as a reference group for comparison.

Results: Over the 34 month study period, 2,308 patients were admitted to the SICU: 341 (14.8%) after a bowel resection/repair, 33 (1.4%) after a splenectomy and 14 (0.4%) after a combination of both. The mean \pm SD age was 63 \pm 19 years and 51% were male. The three groups (bowel resection/repair, splenectomy, and combination) did not differ in regards to age, gender, need for mechanical ventilation (61% v. 58% v. 79%, $p=0.378$) or pressor support (28% v. 18% v. 36%, $p=0.380$). No differences were noted for past medical history, including diabetes mellitus, cardiac history or renal failure. Trauma patients constituted 7% of the study population (5% v. 27% v. 29%, $p<0.001$). There was no difference in utilization of chemical prophylaxis between the three groups (74% v. 73% v. 76%, $p=0.913$). Overall, 34% underwent imaging to rule out VTE (32% v. 42% v. 71%, $p=0.005$). The incidence of VTE was highest among patients undergoing a combination of splenectomy and bowel resection/repair (11% v. 21% v. 57%, $p<0.001$). Splenectomy was associated with a higher adjusted risk for VTE compared to the bowel repair/resection group (AOR [95% CI]: 5.33 [1.73, 16.43], $p=0.004$). Combination of splenectomy and bowel resection/repair also increased the adjusted risk for VTE (AOR [95% CI]: 14.21 [3.64, 55.56], $p<0.001$).

Conclusion: Splenectomy significantly increases the risk for VTE, especially when performed on patients undergoing a bowel resection/repair. A high index of suspicion should be maintained for early recognition of VTE in splenectomy patients and a more aggressive policy for prophylaxis should be considered.

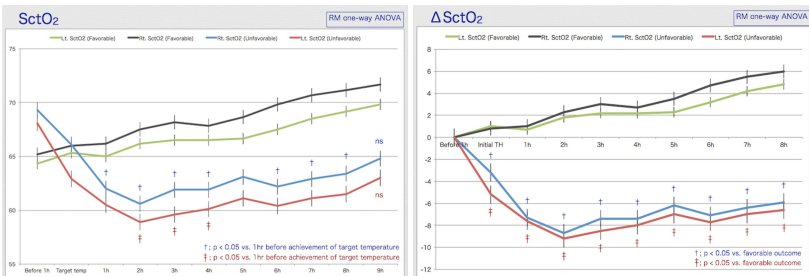
Dynamic changes of cerebral tissue oxygen saturation (SctO₂) using a Near Infrared Spectroscopy (NIRS) during therapeutic hypothermia for patients with post-resuscitated ischemic brain damage.

Junya Tsurukiri MD,Ph.D., Katsuhiro Nagata MD, Jun Oda* MD,Ph.D., Tetsuo Yukioka* MD,Ph.D., Tokyo Medical University

Introduction: The energy metabolism of the brain is often heterogeneous after successful resuscitation and induction of therapeutic hypothermia (TH) in comatose patients with post-resuscitated ischemic brain damage changes the balance between oxygen delivery and supply. Recently, cerebral tissue oxygen saturation (SctO₂) using a Near Infrared Spectroscopy (NIRS) can reflect the balance between cerebral metabolic supply and oxygen demand.

Methods: This study included post-resuscitated comatose patients treated with TH, monitored with NIRS at the intensive care unit (ICU). SctO₂ was non-invasively and continuously measured every one minute to 72 hours and calculated average of every one hour in 16 comatose patients during inducing TH and TH maintenance phase and active rewarming. A targeting temperature (TT) was at 33.5°C and rewarming was commenced at 24 hours after TH (0.5°C/4hrs).

Results: In patients with favorable outcome for a cerebral performance category (CPC) score of 1 or 2, significant increase or decrease of bilateral SctO₂ did not show. In contrast, bilateral SctO₂ in patients with unfavorable outcome for a CPC score of 3-6 significantly decreased within the first 2 hours after achievement of TT compared with those at 1 hour before achievement of TT. These significant changes were observed within 8 hours after achievement of TT (Figure 1,2). After 9 hours from achievement of TT, SctO₂ gradually returned to baseline values, with no differences between favorable and unfavorable outcomes to 72 hours.



Conclusion: Dynamic changes of SctO₂ represented by simple numerical values using a NIRS can be used to evaluate the metabolic balance of ischemic brain damage for post-resuscitated comatose patients during TH at the ICU.

DECREASING MAINTENANCE FLUIDS IN NORMOTENSIVE TRAUMA PATIENTS IS SAFE AND REDUCES LENGTH OF STAY

Galinos Barmparas MD, Debora Lee BS, Nicole Fierro BS, Douglas Liou MD, Tri Tran BS, Sogol Ashrafian BS, Danielle Tran BS, Eric J. Ley* MD, Cedars-Sinai Medical Center

Introduction: Excessive fluid administration is associated with a prolonged hospital course and worse outcomes. We provided the minimum basal fluid rate, "to keep open (TKO)", to normotensive trauma patients admitted to the surgical intensive care unit (ICU) to determine the impact on outcomes.

Methods: This study was conducted in a 24-bed dedicated surgical ICU at a Level 1 trauma center. In June 2013, all normotensive trauma patients admitted to the surgical ICU were administered crystalloids at 30 cc/hr (TKO group) and were compared to patients admitted during the preceding 6 months who were placed on a rate of 125cc/hr (non-TKO group). Changes in the maintenance fluid rate and boluses were at the discretion of the attending intensivist. Net fluid balance was collected until day of ICU transfer or ICU day 5, whichever occurred first. Exclusions included initiation of vasopressors and brain death. Primary outcomes included ICU and hospital stay and ventilation days.

Results: During the 12-month study period, a total of 134 trauma patients met inclusion criteria: 51 (38%) in the TKO and 83 (62%) in the non-TKO group. Overall the two groups were well balanced in regards to age (47.9 ± 23.4 vs. 48.6 ± 22.6 years, $p=0.87$), ISS (16.5 ± 11.2 vs. 15.6 ± 9.5 , $p=0.63$), APACHE IV scores (36.2 ± 28.4 vs. 40.3 ± 29.4 , $p=0.42$), the need for mechanical ventilation (41.2% vs. 43.4%, $p=0.80$) and the need for exploratory laparotomy (5.9% vs. 8.4%, $p=0.74$). TKO patients were more likely to be male (88.2% vs. 67.5%, $p<0.01$). As expected, TKO patients required significantly less fluid per day (1.9 ± 1.3 vs. 2.6 ± 1.8 liters, $p=0.03$). After adjusting for differences between the two groups, TKO patients had a lower overall hospital stay (adjusted mean difference AMD [95% CI]: $-2.7 [-13.5, -2.91]$ days, $p<0.01$). Differences in ICU stay ($-1.9 [-3.5, -0.25]$ days, $p=0.07$) and ventilation days ($-0.99 [-4.0, -0.07]$ days, $p=0.06$) did not reach significance. In a forward logistic regression model, TKO was associated with ICU stay ≤ 48 hours (Adjusted Odds Ratio (AOR) [95% CI]: 2.45 [1.09, 5.53]; $p=0.03$).

Conclusion: A protocol that mandates the admission basal fluid rate starts at TKO in normotensive trauma patients reduces fluid intake and predicts a shorter hospital course. Decreasing basal fluid administration in normotensive trauma patients is encouraged.

MONOCYTE DEACTIVATION IS ATTENUATED BY CRP AND MAY BE INFLUENCED BY FC γ RIIA POLYMORPHISMS

Sonlee D. West MD, Michael Krencicki BS, Carolyn Mold Ph.D., University of New Mexico

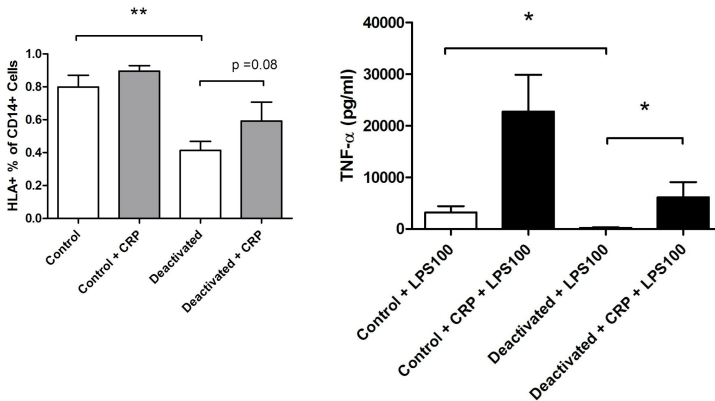
When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: We have previously shown that a single nucleotide polymorphism of the Fc γ RIIa receptor is associated with increased risk of sepsis in trauma patients. Additionally, we noted a correlation between monocyte deactivation and the Fc γ RIIa SNP in trauma patients. We sought to further identify the effects of the Fc γ RIIa on monocyte deactivation in an in vitro model. Fc γ RIIa is the receptor for CRP and IgG located on monocytes. The different polymorphisms affect receptor affinity and specificity and may represent a risk factor for certain diseases, either at the level of disease susceptibility or at the level of disease severity.

Methods: Monocytes were cultured from healthy volunteers and incubated IL-10 and TGF- β to create deactivated monocytes. Normal and deactivated monocytes were incubated with acute phase levels of C reactive protein followed by a 4 hour incubation with LPS (10 ng/ml). HLA-DR expression was then determined by flow cytometry and supernatants were collected to determine TNF- α production in response to LPS.

Results: We found that acute phase levels of CRP attenuated monocyte deactivation as demonstrated by increasing TNF- α production in response to LPS and a trend toward increased HLA-DR expression.

Conclusion: In conclusion, monocyte deactivation, an important risk factor for post-traumatic sepsis, may be influenced by the Fc γ RIIa polymorphism of the host.



All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS COLONIZATION STATUS MAY GUIDE EMPIRIC TREATMENT OF HEALTHCARE ASSOCIATED PNEUMONIA IN NEUROTRAUMA PATIENTS

Sharon Moran MD, Richard Moore MD, Caesar M. Ursic* MD, Susan Steinemann MD, Maimona Ghows MD, The Queen's Medical Center

Introduction: Patients with critical neurologic injury frequently develop nosocomial pneumonia. The etiology is multifactorial and may include endotracheal intubation, impaired cough reflex, diaphragm paresis, and reduced mucociliary function due to hypothermia or barbiturates. Due to concern about methicillin-resistant *Staphylococcus Aureus* (MRSA) infection, vancomycin is often started empirically for suspicion of nosocomial pneumonia. The purpose of this study was to determine the predictive value of admission MRSA nasal swab for subsequent development of MRSA pneumonia.

With this information, we hope to develop a tailored approach to empiric antibiotic therapy in the high risk neurotrauma population.

Methods: We retrospectively reviewed the charts of all patients admitted to our neurosurgical intensive care unit (NSICU) with a traumatic brain or spinal cord injury between May 2010 and August 2012. The study group was comprised of patients started on empiric antibiotic therapy for presumed pneumonia. Our standard trauma admission protocol involves nasal swab testing for MRSA upon admission. We compared MRSA colonization status and sputum culture results in neurotrauma patients who developed healthcare associated pneumonia during their hospital course.

Results: 220 patients were admitted to the NSICU with a traumatic neurologic injury during the study period. 201 patients had MRSA screening; 14 (7%) were positive. Of those screened, 98 patients had a sputum culture that was positive for a dominant organism. The negative predictive value of nasal culture was 95% and the positive predictive value was 64% for development of MRSA pneumonia.

Conclusion: In this population, a negative MRSA nasal swab was associated with the absence of MRSA in sputum cultures. The more discriminate use of vancomycin has been recommended to decrease evolutionary pressure for developing drug-resistant infections. Given the high negative predictive value of nasal swabs in our study, one might rationally omit the empiric use of vancomycin in critically injured neurotrauma patients with clinical evidence of pneumonia. In addition to reducing the appearance of drug-resistant organisms, this tailored approach would result in substantial cost savings and potential avoidance of allergic reactions or adverse side effects. Further study is needed into whether decolonization can prevent the development of MRSA pneumonia.

Penetrating Thoracic Trauma is not a Risk Factor for Pneumonia in Non-Intubated Patients

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Introduction: The American Thoracic Society estimates that the incidence of nosocomial pneumonia is between 0.5-1.0%, with the incidence of ventilator-associated pneumonia (VAP) being 6 to 20 fold higher. While the association of mechanical ventilation and pneumonia is well accepted, there are few studies that characterize non-ventilator-associated pneumonia (NVAP) in non-intubated patients following penetrating chest trauma. Because of the direct physical injury to the lung and possible bacterial seeding of the wound track, our hypothesis was that penetrating chest injuries was a risk factor for developing NVAP.

Methods: A retrospective chart review was performed on all trauma patients with a stab wound (SW) or gunshot wound (GSW) to the chest admitted to our university based urban trauma center between 2004 and 2013. Because hospital acquired pneumonia is thought to take 2-3 days to develop, patients with a hospital length of stay ≤ 2 days were excluded. Patient characteristics and outcomes were extracted from a trauma database and analyzed.

Results: Of 683 patients who met inclusion criteria, 24 patients (3.5%) had hospital-acquired pneumonia (VAP+NVAP). Of the 130 patients (19%) that were intubated, 17 patients (13.1%) had VAP. Of the 553 patients (81%) that did not require intubation, 7 patients (1.3%) had NVAP. Overall post-trauma pneumonia was more common in GSW patients than SW patients (4.4% vs. 1.1%; $p=0.03$). There was a higher rate of VAP in GSW patients (3.2% vs. 0.5%; $p=0.04$). However, there was no difference in the rate of NVAP between the two mechanisms (1.2% vs. 0.5%; $p=0.6$). Logistic regression demonstrated that GSW mechanism, ISS, GCS, intubation, length of stay, and length of ICU stay are all independent variables that are associated with hospital-acquired pneumonia.

Conclusion: Penetrating thoracic trauma patients have similar NVAP rates compared to the incidence of nosocomial pneumonia estimated by the American Thoracic Society. Higher rates of overall post-trauma pneumonia were seen in GSW patients compared to SW. This was mainly due to a higher rate of VAP. Despite direct injury to the lung, penetrating thoracic injuries are not associated with a higher rate of NVAP.

PRE-OPERATIVE SICU ADMISSION DOES NOT IMPROVE CLINICAL PARAMETERS PRIOR TO OPERATIVE DEBRIDEMENT OF NECROTIZING SOFT TISSUE INFECTION

Angela Neville* MD, Jessica Keeley MD, Amy Kaji MD,Ph.D., Andrew Nguyen MD, Dennis Kim MD, Christian DeVirgilio MD, Brant Putnam* MD, Scott Bricker MD, Frederic Bongard* MD, David Plurad* MD, Harbor-UCLA Medical Center

Introduction: Early surgical debridement of necrotizing soft tissue infection (NSTI) is the cornerstone of management of this morbid condition. The role for pre-debridement surgical intensive care unit (SICU) admission for goal directed resuscitation is unclear. The purpose of this study was to evaluate whether pre-surgical SICU admission improves mortality or laboratory markers of end-organ perfusion.

Methods: We analyzed all patients treated for NSTI at our county funded, academic medical center between 2008-2013. Pre-operative admission to the SICU, time to operation, admission and pre-operative laboratory values, and mortality were assessed. Admission laboratory values were compared to pre-operative values for those patients admitted to the SICU prior to surgery.

Results: During the five-year study period, 138 patients were admitted with an NSTI, of which twenty (14.5%) died. Thirty-one patients were admitted to the SICU for resuscitation via a standardized sepsis protocol prior to undergoing therapeutic debridement; 107 proceeded directly to the operating room from the emergency department (ED). There was no difference in median time to debridement in either group (8.0 hours SICU group vs. 8.8 hours ED group, $p=0.9$). The rate of severe sepsis or septic shock was 80.6% in the SICU group, while it was 47.7% in the ED group ($p<0.001$). Despite SICU admission, there was no improvement in patients' white blood cell (WBC) count, bicarbonate, creatinine, or lactate levels prior to surgery (Table 1). Patients admitted to the SICU pre-operatively had higher mortality rates compared to those who proceeded directly to surgery (OR =2.9, 95% CI 1.1-7.8, $p=0.03$). As the SICU-resuscitated cohort may have been inherently more severely ill, subgroup analysis was performed for patients with severe sepsis or septic shock. In this subgroup, there was no difference in mortality ($p=0.2$) or laboratory markers of end-organ perfusion for SICU patients versus those that went directly to the operating room.

Table 1: Laboratory values for SICU-resuscitated patients with NSTI

Variables	Admission	Pre-operative	p-value
WBC	16.5 ± 9.7	16.5 ± 9.1	0.6
Bicarbonate (mmol/L)	19.1 ± 4.4	18.3 ± 4.3	0.2
Lactate (mmol/L)	2.6 ± 1.8	2.0 ± 1.6	0.3
Creatinine (mg/dL)	2.0 ± 1.4	1.6 ± 1.2	0.06

Conclusion: Pre-operative resuscitation in a SICU prior to surgical debridement was not associated with a decrease in mortality or improvements in laboratory markers of end-organ perfusion. SICU admission prior to surgery is an unnecessary step in the management of NSTI, supporting existing literature advocating immediate surgical source control.

THE BRAIN INJURY GUIDELINES:A PROSPECTIVE ANALYSIS

Bellal Joseph* MD, Viraj Pandit MD, Bardiya Zangbar MD, Narong Kulvatunyou* MD, Andrew Tang MD, Terence O'Keefe* MD, MBChB, Donald J. Green* MD, Lynn Gries MD, Randall S. Friese* MD, Peter Rhee* MD, MPH, University of Arizona - Tucson

Introduction: The role of acute care surgeons (ACS) for management of traumatic brain injury (TBI) is evolving. We implemented (March 2012) the Brain Injury Guidelines (BIG) at our institution for managing patients with TBI without neurosurgical consultation. The aim of this study was to compare outcomes in TBI patients before and after the implementation of the BIG guidelines.

Methods: We performed a 2-year (2011-2012: pre guideline and 2012-2013: post guideline) prospective cohort study of all patients with TBI presenting to our level 1 trauma center. Patients with skull fracture and/or intracranial hemorrhage were included. Outcome measures were: number of neurosurgical consultations, repeat head computed tomography (RHCT) scan, 30-day readmission rate and hospital cost.

Figure 1: Brain Injury Guidelines

BRAIN INJURY GUIDELINES			
Variables	BIG 1	BIG 2	BIG 3
LOC	Yes/No	Yes/No	Yes/No
Neurologic Examination	Normal	Normal	Abnormal
Intoxication	No	Yes/No	Yes/No
CAMP	No	No	Yes
Skull Fracture	No	Non-displaced	Displaced
SDH	≤ 4 mm	5 – 7 mm	≥ 8 mm
EDH	< 4 mm	5 – 7 mm	> 8 mm
IPH	< 4 mm, 1 location	3 – 7 mm, 2 locations	> 8 mm, Multiple Locations
SAH	Trace	Localized	Scattered
IVH	No	No	Yes
THERAPEUTIC PLAN			
Hospitalization	No, Observation (6hrs)	Yes	Yes
RHCT	No	No	Yes
NSx	No	No	Yes

Results: A total of 796 patients (Pre: 415, Post: 381) were included. The implementation of the BIG guidelines resulted in overall savings of \$2,326,000 in hospital cost.

Table. Demographics and Outcomes

	Pre-BIG (n=415)	Post-BIG (n=381)	P
Age	39.5±23	39.6±26.2	0.8
Male	61%	65%	0.7
AP/AC	43%	40.6%	0.8
GCS	13[8-15]	13[9-15]	0.7
Head AIS	2[2-3]	2[2-3]	0.7
Outcomes			
NSx consultation	90.6% (376)	56.2% (214)	0.01
RHCT	91.8% (381)	45.7% (174)	0.01
Hospitalization	88.2% (366)	46.7% (178)	0.02
ICU admission	47.7% (198)	29.4% (112)	0.04
Mortality	16.6% (69)	16.3% (62)	0.6
30-day re-admission	8.9% (37)	8.1% (31)	0.4
Hospital cost/patient, (\$)	14,926±11,518	10,154±9,201	0.02

AP/AC, antiplatelet/anticoagulants; GCS, Glasgow coma scale; AIS, abbreviated injury scale; NSx, neurosurgical consultation; RHCT, repeat head computed tomography; ICU, intensive care unit

Conclusion: Implementation of BIG guidelines is safe, effective, and reduces healthcare cost. The BIG guidelines define the management of TBI patients without the need for neurosurgical consultation. Establishing a national multi-institutional study implementing the BIG guidelines is warranted.

EMERGENT OPERATION FOR SEVERE TRAUMATIC BRAIN INJURY: DOES TIME MATTER?

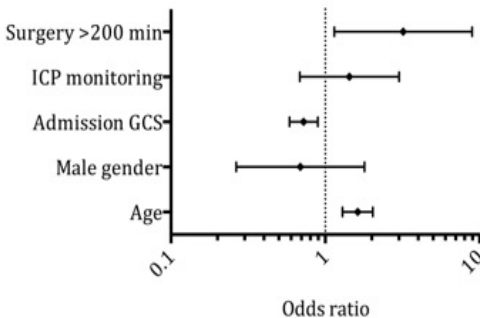
Kazuhide Matsushima MD, Kenji Inaba* MD, Stefano Siboni MD, Gregory Magee MD, Aaron Strussmayer MD, Gene Sung MD, MPH, Elizabeth Benjamin MD, Ph.D., Lydia Lam* MD, Demetrios Demetriades* MD, Ph.D., LAC+USC Medical Center

Introduction: It remains unclear whether the timing of neurosurgical intervention impacts the outcomes of patients with isolated severe traumatic brain injury (TBI). We hypothesized that decreased time between emergency department (ED) presentation to neurosurgical intervention would improve patient survival.

Methods: Our institutional trauma registry was queried for adult patients (≥ 18 years) who required emergent surgical intervention for TBI. We included all patients with altered mental status upon presentation to the ED ($GCS \leq 8$). Patients with associated severe injuries ($AIS \geq 3$) were excluded. The optimal cut-off value for the time interval between ED presentation and emergent operation was explored. In-hospital mortality for patients in the early operation group was compared with the late group using univariate and multivariate analyses.

Results: A total of 161 patients were identified between 2003 and 2012. The majority of patients were male (83.2%), median age 48 years (range: 18-94). Median ISS was 25 (range: 9-43), median GCS 4 (range: 3-8). Median time between ED presentation and surgical intervention was 137 min (range: 39-284). In the early operation group (≤ 200 min), significantly lower in-hospital mortality rate was identified (34.5% vs. 59.1%, $p=0.034$). After clinically important covariates (age, sex, GCS, ICP monitoring) were adjusted in a logistic regression model, the early neurosurgical intervention was associated with a significantly higher odds of patient survival (OR: 3.2, 95% CI: 1.14-8.94, $p=0.027$).

Conclusion: Our data suggest that the survival rate for isolated severe TBI patients who required emergent neurosurgical intervention may be time-dependent. Specific factors leading to this delay and methods of expediting surgical intervention warrant further examination.



THE EFFECT OF β -BLOCKADE ON SURVIVAL IN A SWEDISH COHORT OF ISOLATED SEVERE TRAUMATIC BRAIN INJURY

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Introduction: Several North-American studies have shown that β -blocker exposure has positive effect on survival in patients suffering from traumatic brain injuries (TBI). The purpose of this study was to evaluate the effect of β -blockade after isolated severe TBI in a Swedish population.

Methods: For the proposed study, the trauma registry of an urban academic trauma center was queried to identify patients with a blunt isolated severe TBI between 1/2007 and 12/2011. Isolated severe TBI was defined as an intracranial injury with an abbreviated injury scale of (AIS) ≥ 3 excluding all extracranial injuries AIS ≥ 3 . Multivariable logistic regression analysis was used to adjust for differences between the groups to determine whether exposure to β -blockers was protective in patients suffering isolated severe TBI.

Results: Overall, 874 patients met the study criteria. Of these, 33% (n=287) were exposed to β -blockers during their hospital admission. The exposed patients were significantly older (62 ± 16 years vs. 49 ± 21 years, $p < 0.001$), and more severely injured based on their admission GCS, ISS and AIS scores (GCS ≤ 8 : 32% vs. 28%, $p = 0.007$; ISS ≥ 16 : 71% vs. 59%, $p = 0.001$; head AIS ≥ 4 : 60% vs. 45%, $p < 0.001$). The unadjusted mortality was higher in patients who did not receive β -blockers (17% vs. 11%, $p = 0.007$). The predominantly utilized β -blockers were Labetolol (49%) and Metoprolol (45%). The mean time of initiation of β -blockade was 3 ± 4 days. The majority of patients (75%) were exposed to β -blockers within 60 hours of admission. After adjustment for significant confounders between the groups, patients who had not been exposed to β -blockers had a 5-fold increased risk of mortality (AOR 5.0, CI 95% 2.7-8.5, $p = 0.001$). We could not detect a difference in survival in regards to the type of β -blocker used.

Conclusion: β -blocker exposure after isolated severe TBI is associated with improved survival. Prospective evaluation of our results is warranted.

**Validation of a new prognostic model in patients with severe traumatic brain injury:
a multicenter observational study.**

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Hiroki MATSUDA MD, Satoshi FUJIMI MD,Ph.D., Daikai SADAMITSU MD,Ph.D.,
Takeshi SHIMAZU MD,Ph.D., Osamu TASAKI* MD,Ph.D., Nagasaki University
Hospital Emergency Medical Center

Introduction:

We established and reported a new mathematical prognostic model for severe traumatic brain injury (STBI) (Acute Medicine & Surgery, 2014). The purpose of the present study was to validate our prediction model and compared the predictive value to previously established models.

Methods:

One hundred and nine patient with a Glasgow Coma Scale score of <9 were enrolled in this multicenter cohort study consisting of four tertiary critical care medical centers in Japan. Our prognostic model included the variables of age, pupillary light reflex on admission, intracranial pressure on ICU admission, subarachnoid hemorrhage and midline shift on CT scan within 24 hours of injury. Outcome was assessed prospectively 6 months after injury according to the Glasgow Outcome Scale. GR and MD were considered to be favorable outcomes. SD, PVS, and D were considered unfavorable. The predictive accuracy was compared to the two models derived from International Mission for Prognosis and Analysis of Clinical Trials in TBI (IMPACT) or Corticosteroid Randomisation After Significant Head Injury (CRASH).

Results:

Out of 109 patients, 25 (22.9%) had favorable outcome, and 84 (77.1%) had unfavorable outcome. The area under the receiver operating characteristic curve of our model was 0.813. That of IMPACT and CRASH was 0.768 and 0.787, respectively. If the cut off value of probability of unfavorable outcome was imposed at 0.51 in our model, the positive predictive value was 87.5%, negative predictive value was 66.7%, and total predictive value was 83.5%. Sensitivity was 91.7%, and specificity was 56.0%.

Conclusion:

Our prognostic model was shown to have high predictive value on external validation, and superior to IMPACT or CRASH models. It will be useful for decision-making of treatment strategy, family counseling, and review of treatment in patients with severe traumatic brain injury.

NEURONAL CELL CYTOTOXICITY DUE TO BETA ADRENERGIC AGONISM INCREASES AFTER OXYGEN-GLUCOSE DEPRIVATION AND DIFFUSE AXONAL INJURY

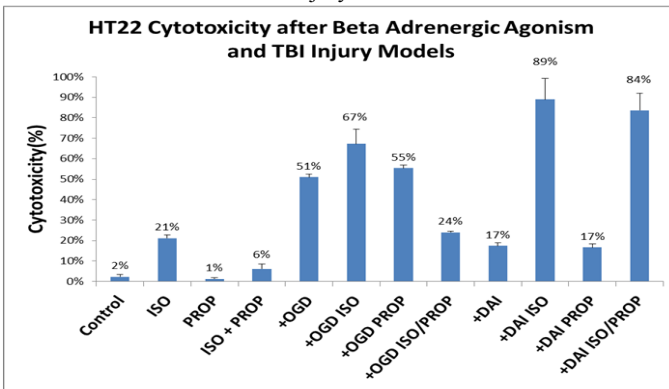
Alexander W. Lamb BS, Galinos Barmparas MD, Brandon Nguyen BS, Kevin Chen BS, Patrick Lyden MD, Eric J. Ley* MD, Cedars-Sinai Medical Center

Introduction: Beta adrenergic receptor (BAR) activity modulates the related immune deficiency that occurs after traumatic brain injury (TBI). The aim of this study was to determine the effect of BAR agonist and/or antagonist on neuronal cells before and after oxygen glucose deprivation (OGD) or diffuse axonal injury (DAI).

Methods: The BAR agonist isoproterenol (ISO) and/or the antagonist propranolol (PROP) were distributed to wells of HT22 cells, an immortalized mouse hippocampal cell line. OGD was performed using glucose free media, N₂/CO₂ gas mixture for 10 minutes, and then anoxic incubator for 2 hours. DAI was performed by stretch injury using a Cell Injury Controller II at 7 PSI. Cytotoxicity was measured from supernatant Lactate Dehydrogenase (LDH) as a percentage of total lysed cell LDH.

Results: While ISO was cytotoxic to HT22 compared to control (21.1% v. 2.4%, $p < 0.0001$), PROP did not alter cytotoxicity (1.2% v. 2.4%, $p=0.38$). ISO induced cytotoxicity was inhibited by PROP (21.1% v. 6.2%, $p=0.001$). (21.1% v. 6.2%, $p=0.001$). OGD increased cytotoxicity compared to control (50.9% v. 2.4%, $p < 0.0001$). While ISO increased cytotoxicity in OGD conditions (50.9% v. 67.3%, $p=0.005$), PROP did not (50.9% v. 55.3%, $p=0.083$). When PROP was added to ISO in OGD conditions, a reduction in cytotoxicity was observed compared to ISO alone (67.3% v. 24%, $p<0.0001$). DAI increased cytotoxicity compared to control (17.4% v. 2.4%, $p<0.0001$). While ISO added to DAI increased cytotoxicity compared to DAI alone (89% v. 17.4%, $p<0.0001$), PROP did not (16.6% v. 17%, $p=0.54$). When PROP was added to ISO after DAI, no reduction in cytotoxicity was observed (89% v. 84%, $p=0.45$). Although OGD injury was greater compared to DAI (50.9% v. 17.4%, $p<0.0001$), the addition of ISO to DAI increased cytotoxicity compared to OGD with ISO (89% v. 67.3%, $p=0.01$).

Conclusion: BAR agonism is lethal to neuronal cells and this effect increases after cell models of TBI. While BAR agonism could be inhibited after OGD, no inhibition occurred after the mechanical injury from DAI.



DESTINED TO FAIL? PREDICTORS OF EXTUBATION FAILURE IN PATIENTS WITH TRAUMATIC BRAIN INJURY

Andrew Nguyen MD, David Plurad* MD, Amy Kaji MD,Ph.D., Scott Bricker MD, Fred Bongard* MD, Angela Neville* MD, Brant Putnam* MD, Dennis Kim MD, Harbor-UCLA Medical Center

Introduction: Extubation failure is a morbid complication associated with increased mortality in critically ill patients. The physiologic insult of failed extubation may be more pronounced in patients with traumatic brain injury (TBI). The purpose of this study was to identify risk factors for extubation failure in patients with TBI.

Methods: We performed a 4-year retrospective analysis of our Level 1 trauma center database to identify all adult blunt TBI patients requiring intubation for >48 hours. Extubation failure was defined as the need for reintubation within 48 hours of initial extubation. Variables analyzed included demographics, injury patterns and severity, weaning parameters, and outcomes. Patients that failed extubation were compared to patients that were successfully extubated. Multivariate logistic regression analysis was performed to identify independent risk factors for extubation failure.

Results: Of 127 patients, 26 patients (20.5%) failed extubation. On univariate analysis, extubation failure patients were older and more likely to have sustained multiple rib fractures. There were also significant differences in pre-extubation weaning parameters (Table). The median time to reintubation was 14 (8-19) hours. Patients that failed extubation required a greater duration of mechanical ventilation (14 vs. 3 days, $p<0.0001$), intensive care unit (17 vs. 6 days, $p<0.0001$), and overall length of stay (21 vs. 16 days, $p=0.02$). Patients in the extubation failure group were at an increased risk for pneumonia (OR=2.8; 95% CI, 1.1-7.3, $p=0.03$). On multivariate analysis, after controlling for age, weaning parameters, and ≥ 4 rib fractures, a rapid shallow breathing index (RSBI) ≥ 87 (OR=6; 95% CI 1.2-29.8, $p=0.03$) and ≥ 4 rib fractures (OR=10.4; 95% CI 1.0-111.3, $p=0.05$) were the only independent risk factors for extubation failure.

Variable	Extubation Failure	Extubation Success	p value
Age	58 (28-74)	48 (31-62)	<0.0001
≥ 4 Rib fractures	3 (12%)	1 (1%)	0.03
PaO2	122 (92-148)	136 (107-171)	0.04
RR	23 (20-29)	18 (14-24)	0.01
RSBI	50 (36-88)	39 (26-51)	0.01

Conclusion: Extubation failure is a common complication among patients with TBI. Application of a more conservative RSBI in TBI patients may minimize the risk for reintubation in this patient population.

CERVICAL SPINE CLEARANCE IN CLINICALLY UNEVALUABLE PATIENTS: A POOLED ANALYSIS OF COMBINED CT AND MRI

Timothy P. Plackett DO, Franklin Wright MD, Anthony Baldea MD, Michael J. Mosier MD, Casey Thomas DO, Fred Luchette* MD, Hieu H. Ton-That MD, Thomas J. Esposito* MD, MPH, Loyola University Medical Center

Introduction: The role of cervical spine magnetic resonance imaging (MRI) in the evaluation of clinically unevaluable blunt trauma patients has been called into question by recent studies. Proponents of MRI note a superior sensitivity for detection of soft tissue and/or ligamentous injury compared to computed tomography (CT) scan. However, opponents highlight the low incidence of finding a significant missed injury and the high risk for developing soft tissue breakdown from use of immobilization devices.

Methods: A PubMed search was performed to identify all studies describing clinically unevaluable patients imaged with both CT and MRI to evaluate the cervical spine for injury. Results were combined for both radiologic findings and clinical outcomes. A pooled analysis was performed of the aggregate data. Subgroup analysis was performed to evaluate for any effects associated with improved computed tomography technology or timing of the MRI.

Results: A total of 1,714 clinically unevaluable patients were identified from 17 studies. All of the patients had a negative CT scan of the cervical spine and went on to receive a MRI. 271 (16%) patients had a new finding on MRI, with the majority being a ligamentous injury. Seventy-two patients (27%) were maintained in a cervical collar after the MRI and five patients (2%) underwent a surgical intervention. The remainder of the patients (71%) had the cervical collar removed. The propensity of MRI to find additional findings or direct treatment has not improved with increasing number of CT scan slices. Delaying MRI beyond 4 days after injury was associated with a significantly decreased incidence of new findings on MRI and lower probability for continued application of a cervical collar, however it had no effect on the incidence of surgery. Analysis of the patients requiring surgical intervention after the MRI questions whether these should have been noted on CT, the acuity of the finding, and whether the MRI findings were a contributing factor to the decision to operate.

Conclusion: This study demonstrates that MRI identifies additional injuries. However, these tend to be of minor clinical significance. The practice of routine MRI after a negative CT in clinically unevaluable patients is not supported by this study and should only be performed on an individual case basis.

EVIDENCE BASED TIMING FOR DVT CHEMOPROPHYLAXIS IN TBI PATIENTS

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Introduction: Multiple studies in the literature have addressed timing of DVT chemoprophylaxis (CP) in traumatic brain injury. However, experts indicate that a precise time for safe and effective CP is uncertain.

Methods: A comprehensive brain injury literature review was performed to delineate temporal rates for 1) spontaneous intracranial hemorrhage (ICH) progression, 2) post-CP ICH expansion, and 3) post-CP DVT. Nineteen publications were found and included 5,163 patients.

Results: Spontaneous ICH expansion at 24 hours was 14.8% in 1,437 patients from CP studies and 29.9% in 1,257 patients not involved in a CP study ($p < 0.0001$). With low risk ICH ($n=136$), 99% of spontaneous ICH expansion occurred within 48 hours. With moderate or high risk ICH ($n=109$), 18% of spontaneous ICH expansion occurred after day 3. If patients with pre-CP ICH expansion are included, the post-CP ICH expansion rate was 5.6% in 1,258 with CP on days 1-3 and 1.5% in 401 with CP after day 3 ($p = 0.0116$). If patients with pre-CP ICH expansion are excluded, the post-CP ICH expansion rate was 3.1% in 1,570 with CP on days 1-3 and 2.8% in 582 with CP after day 3 ($p = 0.7769$). With DAI ($n=188$), the post-CP ICH expansion rate was 1.6% with CP after day 3. DVT rates were: no CP, 2.4% in 913; CP on days 1-3, 2.6% in 2,384; and CP after day 3, 3.4% in 930 ($p = 0.3430$).

Conclusion: Spontaneous ICH expansion rates at 24 hours substantially vary between CP and non-CP studies. CP should not be given within 3 days of injury for moderate or high risk ICH. CP is reasonable, when low-risk patients have not developed ICH expansion within 48 hours post-injury. CP is also acceptable after day 3, when low-risk patients develop ICH expansion within 48 hours post-injury. In DAI patients who have not developed an ICH within 72 hours, CP is reasonable.

AN ANALYSIS OF THE PROTECTIVE BENEFITS OF BETA-BLOCKERS ON TBI PATIENTS

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Introduction: The cerebroprotective benefits of beta-blockers (BB) in TBI patients are supported by a growing body of literature; however, the mechanism through which this effect is mediated is not well-understood. We sought to determine if selective BB (SBB) and nonselective BB (NSBB) impact TBI outcome in the same way.

Methods: In a PA-verified level II trauma center, all admissions ≥ 45 years of age and GCS ≤ 13 from October 2011 to May 2013 were queried. The impact of BB, both pre-injury and in-hospital, on stability at discharge was analyzed controlling for demographic and injury-specific variables in a multivariate logistic regression model. Stable at discharge was defined as neither moribund nor deceased at discharge A $p < 0.05$ was significant.

Results: A total of 270 patients met study inclusion criteria. There were a total of 49 patients on selective BB (SBB) pre-injury and 17 patients on nonselective BB (NSBB) pre-injury. Additionally, a total of 80 patients were administered SBB in hospital and 39 patients were administered NSBB in hospital. When controlling for age, arrival GCS, ISS, ventilator use, and pre-existing conditions (PECs), SBB and NSBB administration in hospital as well as SBB pre-injury were associated with increased odds of stability at discharge for TBI patients. NSBB pre-injury was not found to significantly impact odds of stability at discharge.

Conclusions: Our data indicate that BB pre and post-injury can be beneficial to TBI patients. Interestingly, while SBB and NSBB both have protective effects when administered in hospital, only SBB pre-injury are beneficial to TBI patients.

	Adjusted* Odds Ratio (95% CI)	p-value
BB Pre-Injury		
None	Reference	-
Selective	4.90 (1.25-19.22)	0.023
Nonselective	0.96 (0.09-10.13)	0.974
BB In Hospital		
None	Reference	-
Selective	3.09 (1.06-8.99)	0.038
Nonselective	9.78 (2.28-42.0)	0.002

*Adjusted for age, arrival GCS, ISS, Vent use, & PECs.

ROC: 0.90

HEAD COMPUTED TOMOGRAPHIC MEASUREMENT: A PREDICTOR OF OUTCOME IN PATIENTS WITH SUBDURAL HEMATOMA WITH CEREBRAL EDEMA

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Introduction: This study aimed to evaluate whether differences in head computed tomographic (CT) measurements in Hounsfield units (HU) of white matter (WM) and gray matter (GM) can be used as a predictor of outcome in patients with subdural hematoma with cerebral edema.

Methods: We evaluated 34 patients who had subdural hematoma with cerebral edema and had undergone head CT within a few hours of admission. We divided the patients into two groups according to outcome: survival (S group, n=24) and death (D group, n=10). We obtained HU measurements of the WM and GM at 6 points (injury and non-injury site at each of the frontal, temporal, and occipital lobes). We also measured the displaced distance from the median (DDM). We assessed the correlation between outcome and HU measurements of the WM and GM or DDM. The paired t-test was used to calculate statistical significance. Data are shown as the mean (SD).

Results: Causes of head injury were motor vehicle accident (n=19), fall (n=9), and other cause (n=6). Operations for hematoma removal and external decompression were performed on 24 patients. All patients who died underwent these operations, and cause of death in each patient was brain herniation due to cerebral edema. At the injury site, HU of GM was 38.4 (2.9) in the S group and 36.8 (3.1) in the D group (p=0.45). The HU of WM at the injury site in the S group was significantly higher than that in the D group (34.2 [2.5] vs. 29.5 [3.4]) (p<0.01). The HU of GM at the non-injury site was 38.9 (2.9) in the S group and 36.8 (3.1) in the D group (p=0.92), and the HU of WM was 34.2 (2.5) in the S group and 32.9 (3.4) in the D group. There was no significant difference in the DDM between the S and D groups (p=0.15).

Conclusion: This study suggests that measurement in HU of WM at the injury site may be useful as a predictor of outcome in patients with subdural hematoma with cerebral edema.

NOSOCOMIAL PNEUMONIA IS INDEPENDENTLY ASSOCIATED WITH WORSE FUNCTIONAL OUTCOME IN BRAIN INJURY PATIENTS 5 YEARS AFTER INJURY

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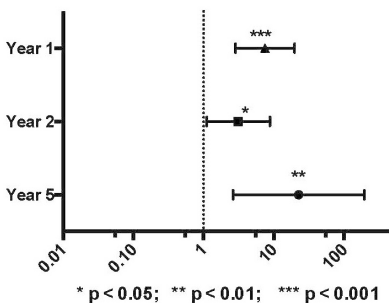
Introduction: Long term outcomes following traumatic brain injury (TBI) are known to correlate with initial head injury severity. Hospital-acquired pneumonia (HAP) is a common complication in patients with TBI. However, little information exists regarding the significance of infectious complications and their effect on long term outcome following TBI. We sought to characterize the risks associated with HAP on long term neurological outcome following severe TBI.

Methods: A retrospective analysis was performed utilizing data derived from the merger of a single institution trauma registry and TBI Model Systems outcome data. Individuals with severe head injuries (Abbreviated Injury Scale ≥ 4), who survived to rehabilitation were analyzed. Primary outcome was Glasgow Outcome Scaled Extended (GOSE) at 1, 2, and 5 years after discharge. GOSE was dichotomized into LOW (GOSE < 6) and HIGH (GOSE ≥ 6) groups. Logistic regression was utilized to determine the independent risk of a LOW GOSE score associated with HAP after controlling for differences in age, head and overall injury severity, cranial surgery, Glasgow Coma Scale (GCS), early intubation status, and other important confounders.

Results: A total of 141 individuals met inclusion criteria, with a 30% incidence of HAP. Individuals with and without HAP were similar in demographics, presenting vitals, head injury severity and the need for cranial surgery. Individuals with HAP were more likely to be intubated and had a corresponding lower presenting GCS. After controlling for potential confounders, logistic regression demonstrated that HAP was independently associated with LOW GOSE scores at 1 year, (OR = 7.5, $p < 0.001$, 95%CI 2.85-19.91), at 2 years, (OR = 3.1, $p = 0.031$, 95%CI 1.11-8.84), and at 5 years (OR = 22.76, $p = 0.004$, 95%CI 2.64-196.5). After stratifying the analysis by the need for early intubation, HAP remained a significant independent predictor of LOW GOSE at 1 year even in patients who required early intubation.

Conclusion: HAP is independently associated with poor neurological outcome in individuals with severe TBI. This significant greater risk of poor neurological outcome extends out to 5 years post-injury. This study suggests that precautions should be taken to significantly reduce the risks of HAP, and other infectious complications, in those individuals with severe TBI.

Independent Odds Ratio of Poor GOSE with HAP



PRE-ADMISSION DO NOT RESUSCITATE (DNR): AN INDEPENDENT PREDICTOR OF DEATH FOLLOWING TRAUMA?

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Introduction: Hospitals are required to inquire about advanced directives on patient admission. There is very limited literature on the influence of DNR status on outcomes in trauma; it is not commonly used in evaluating hospital case mix or outcomes. We hypothesized that pre-admission DNR status is an independent risk factor for death following trauma. **Methods:** We reviewed the trauma registry for patients over age 40 admitted between 2008-2013 at all hospitals in a suburban county of 1.5 million people. This county-based registry includes data from state designated non-trauma centers, area trauma centers, and 1 regional trauma center. Isolated hip fractures are not included. Statistical analyses were performed using parametric tests, nonparametric tests, and multivariate logistic regression; $p \leq 0.05$ was considered significant.

Results: * $p \leq 0.05$, IQR - interquartile range, LOS- length of stay

	Pre-admission DNR	No DNR
Patients with age > 40 year (n)	330	7748
Gender (male)	37.9	51.3*
Age (years, median with IQR)	87 (81-91)	69 (54-82)*
Dementia (%)	43.1	8.6*
On anticoagulants (%)	28.1	17.2*
Respiratory Disease (%)	14.7	8.5*
Fall (%)	94.2	65.1*
MVC/pedestrian struck/bicycle (%)	3.4	27.2*
Injury Severity Score (median, IQR)	14 (9-17)	11 (9-17)*
Head AIS ≥ 3 (%)	67.6	47.1*
Hospital LOS (days, median, IQR)	7 (4-11)	6 (4-11)
ICU stay (%)	39.4	36
mechanical ventilation (%)	16.2	31.8
mechanical ventilation days (median, IQR)	3 (2-6)	5 (2-12)*
Pneumonia (%)	12.5	5.9*
Acute MI (%)	3.4	1.3*
Comfort care (withdrawal of care) (%)	9.5	2.8*
In-hospital mortality (%)	33.6	5.9*

Multivariate logistic regression identified multiple significant risk factors for in-hospital mortality, in order of odds ratio with 95% CI: mechanical ventilation 27.7 (19.9-38.5), pre-admission DNR 7.56 (5.4-10.7), ICU stay 1.8 (1.3-2.4), pre-admission respiratory disease 1.5 (1.1-2.2), male sex 1.5 (1.2-1.9), pre-admission anticoagulation 1.3 (1.0-1.7), ISS 1.1 (1.1-1.1), and age 1.1 (1.0-1.1). Injury mechanism, head AIS ≥ 3 , dementia, the presence of complications (grouped together) were not significant. **Conclusion:** After mechanical ventilation, pre-admission DNR status is the strongest independent predictor for in-hospital mortality. Only a fraction of the mortality was because of subsequent change in patient status to comfort care. Consideration should be given to adding DNR status to trauma outcome scoring systems and in benchmarking hospital quality measures following trauma, with its attendant financial implications.

"TIER 3": A NOVEL ADDITION TO A CONVENTIONAL TWO-TIERED TRIAGE SYSTEM DESIGNED TO EXPEDITE CARE OF GERIATRIC TRAUMA PATIENTS

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Reading Health System

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: Prior to February 2009, patients presenting to the emergency department (ED) were either evaluated by the trauma team as "activations" if they met formal activation criteria or as "consults". To improve the efficiency of triage in the ED, a three-tiered system was introduced in February 2009. This additional triage tier (T3) utilized a time-targeted evaluation and treatment protocol aimed at patients who remained at risk for life threatening injuries but did not meet formal activation criteria. T3 required initial evaluation by a rapid response team headed by the ED physician using resources intrinsic to the ED without trauma team involvement. Criteria for T3 included patients without hemodynamic alteration but had risk factors including antiplatelet or anticoagulant agents, as well as elderly patients with low energy injury mechanisms that did not meet conventional activation criteria.

Methods: All adult patients from two time periods, one prior to introduction of T3 (Pre T3, Nov 2007-Jan 2009) and one after (postT3, Nov 2010- Jan 2012) were compared with respect to admission systolic blood pressure (SBP), Glasgow Coma Score (GCS), Injury Severity Score (ISS) and mortality, using univariable analyses. Patients above 60 years old were similarly compared between the two periods separately. A p value of 0.05 indicated statistical significance.

Results: The trauma team evaluated 2682 and 3360 patients in the PreT3 and PostT3 period respectively. In the PostT3 period, 23% of patients were seen as T3 patients initially by the ED team. The proportion of all trauma patients requiring trauma team activation declined after T3 introduction (74 vs. 62%, $p<0.001$). Compared to PreT3 patients, PostT3 patients had a greater mean age (54.1 ± 24.9 vs 47.2 ± 24.1 years, $p<0.001$), lower mean GCS (14.2 ± 2.4 vs 14.4 ± 2.3 , $p=0.02$), and a lower mean ISS (7.5 ± 7.8 vs 9.3 ± 9.1 , $p<0.001$). Mortality was similar (3.1 vs 3.3%, $p=0.6$). Patients above 60 years comprised a greater proportion of all patients in the postT3 period (44 vs 31%, $p<0.001$). Compared to PreT3, PostT3 elderly patients had similar mean GCS, lower SBP (147.8 ± 35.1 vs 151.4 ± 35.3 mmHg, $p<0.001$) and lower mean ISS (8.0 ± 6.8 vs 10.8 ± 8.9 , $p<0.001$). Mortality was lower in the postT3 elderly cohort (4.6 vs 7.0%, $P=0.02$).

Conclusion: Addition of a new triage level harnessing resources intrinsic to the ED reduced the need for trauma team activations and was associated with a lower mortality rate in elderly patients. As elderly patients with low energy injury mechanisms form a significant proportion of trauma patients, this triage level potentially can expedite trauma evaluations while sparing trauma team resources.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

TIME TO DEATH FOLLOWING INJURY -- 20 YEARS WITH LITTLE PROGRESS

Carrie Valdez MD, Babak Sarani* MD, Hanna Young BA, Richard Amdur Ph.D., James Dunne* MD, Lakhmir Chawla MD, George Washington University

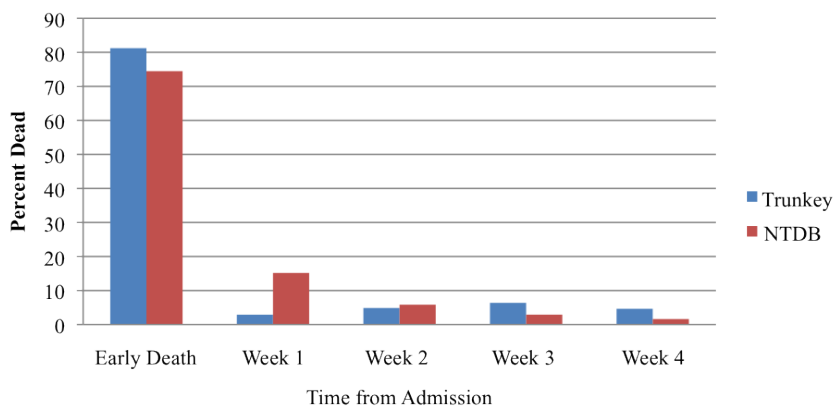
Background: The trimodal distribution of death following injury was first described by Trunkey in 1983. Subsequent studies have found that admission to a trauma center significantly decreases the probability of death following injury. However, there have not been any recent studies to determine the time to death following injury. Given advances in trauma care, we postulate that the time to death histogram described has shifted to the right. This study seeks to determine the timing of trauma-associated mortality and to describe injury or combination of injuries that are associated with early or late death versus survival.

Methods: A retrospective analysis was conducted on the National Trauma Data Bank (version 7.2) from 2002 to 2006. Pediatric patients (age < 18) and burn victims were excluded. Early death was defined as dead on arrival or died within 24 hours of admission. Pearson's χ^2 test was used to compare region of injury to mortality. Multivariate logistic regression was conducted to show the independent effect of region of injury on mortality while controlling for demographic factors and injury type.

Results: The cohort includes 898,982 patients. The mean injury severity score (ISS) was 10.54 ± 10.11 . Overall mortality rate was 5.14%, 54% died early. The majority of all deaths occurred between day 0 and 1 with 41% of occurring on day 1. No difference was noted in time to death relative to Trunkey's report (Figure 1). Torso injuries were more prevalent among early deaths (7.78% v 5.43%, $p < 0.001$). Survivors were more likely to have a blunt mechanism of injury (89% v 11%, $p < 0.001$) and had a lower ISS (10 ± 9 v 28 ± 17 , $p < 0.001$). These results did not change on multivariate regression modeling.

Conclusion: The time to death following injury has not changed since 1983. In addition to stressing injury prevention, ample opportunity remains to impact mortality in the first 24 hours following injury, particularly following penetrating or torso injuries. Studies directed at early treatment of these injuries are needed.

Figure 1: p = NS



DETERMINATION OF THE RELATIONSHIP BETWEEN MILD TRAUMATIC BRAIN INJURY DIAGNOSIS AND THE DEVELOPMENT OF POSTTRAUMATIC STRESS DISORDER IN CIVILIAN TRAUMA SURVIVORS

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INTRODUCTION: The development of posttraumatic stress disorder (PTSD) in civilian trauma survivors significantly decreases quality of life. In these patients, mild traumatic brain injury (mTBI) is often undiagnosed. The goals of the present study were to establish the missed rate of mTBI and determine the relationship between mTBI and PTSD.

METHODS: Records of all patients 18 - 96 years with blunt mechanism trauma who were admitted at a Level I trauma center and reported a PTSD Checklist-Civilian version (PCL-C) score 6 months post injury were reviewed. A PCL-C score of >44 was used as the standard for diagnosis of PTSD symptoms. Patients with clinically diagnosed mTBI based on ICD-9 codes and DSM-V criteria during admission were recorded. A missed mTBI diagnosis was defined using World Health Organization criteria of loss of consciousness and/or neurological symptoms and Glasgow Coma score ≥ 13 . Statistical analysis was performed using ANOVA, chi squared, t-test and linear regression.

RESULTS: Of 347 trauma patients, 215 (62%) were male and 132 (38%) were female with an average age of 52 years. Assaultive mechanism of injury was present in 28 (8%) of patients. 31 (9%) had clinically recognized mTBI and 48 (13.8%) had a missed mTBI. Patients with a clinical and missed diagnosis of mTBI ($n=79$) reported significantly higher PCL-C scores ($p=.001$) and significantly higher incidence of PCL-C score >44 ($p=.019$, relative risk=1.58) than those without an mTBI. Using a linear regression of younger age, male gender, assaultive injury mechanism and mTBI, mTBI diagnosis significantly predicted a higher PCLC score $f(4,374)=19.445$, $p<.0005$, $R^2=.172$, with all four variables adding significantly to the model, $p<.05$.

mTBI Diagnosis	Mean PCL-C score (SD)	Patients with PCL-C Score >44
Missed and clinical ($n=79$)	41.09 (19.16)*	28 (35.4%)*
Absent ($n=268$)	33.68 (16.42)	60 (22.4%)

* $p<.05$

CONCLUSION: Having a diagnosis of mTBI predicted clinically significant PTSD scores and increased the relative risk of screening positive for PTSD symptoms. Given the underdiagnosis of mTBI and its associated risk for PTSD, screening for mTBI may help identify at risk patients for early intervention.

FROM TQIP TO THE GERIATRIC TRAUMA INSTITUTE: DEVELOPING AN INNOVATIVE CARE MODEL FOR THE COMING STORM

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Introduction: By 2030, the US geriatric population is projected to steadily increase to 20.6% . The increased burden to trauma services will be significant. Advanced age is a risk factor for adverse outcomes following trauma. An inverse relationship exists with mortality and age. These facts have led leading US trauma organizations to establish practice guidelines. The American College of Surgeons Committee on Trauma has published triage criteria in an attempt to address the need for a more specialized treatment approach in these patients. This study sought to transform the existing geriatric trauma care model into one that is more effective, efficient, financially sustainable, and capable of absorbing the anticipated increased demand.

Methods: The study goals were to improve the geriatric trauma care process - for patient and hospital, to detail its creation, development, implementation, and to provide a formative evaluation of the result. A team, comprised of stakeholders, both internal and external to the hospital, was assembled and included clinicians from multiple disciplines and administrative and technical staff. During 18 months, tools and concepts of process redesign and Lean Six Sigma were applied to create, develop, implement, and evaluate the resulting novel model of care. Retrospectively, formative evaluation was accomplished by comparing pre-GTI data time matched with that from the first eight months post-GTI initiation.

Results: The intense process redesign produced the Geriatric Trauma Institute (GTI). This novel multidisciplinary care model has achieved 100% involvement of institution orthopedists with 100% of geriatric trauma admissions being converted to the GTI. In the 8 months after GTI inception, geriatric trauma service admissions increased 26.6%, from 338 to 460 patients, with a 78.2% decrease in non-trauma service admissions. A 28.2% decrease in transfers to other hospitals was seen. The analysis revealed a 26.1% increase of patients dispositioned to home, a 47.2% decrease to rehabilitation facilities, and notable decreases to both skilled nursing and transitional care facilities.

Conclusion: The GTI has succeeded as evidenced by the quantifiable benefits to both the patient and the hospital. During the development process, new work processes, tools, and staff training helped to boost the utilization of the trauma service regarding geriatric trauma care via a novel multidisciplinary approach. The GTI has demonstrated sustained and continuous quality improvement in geriatric trauma care. The trauma service maintains the performance gains through the trauma service performance improvement initiative.

PREOP CT IN PATIENTS MEETING ATLS DIRECT-TO-OR CRITERIA FOR EXPLORATORY LAPAROTOMY: RISKY BUSINESS?

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Introduction: Previous studies suggest that preop CT in patients with abdominal trauma who meet criteria to go directly to the OR for exploratory laparotomy (Ex Lap) results in worse outcomes. We tested that hypothesis.

Methods: Patients who underwent Ex Lap for abdominal trauma over a 7-year interval at a Level I trauma center were retrospectively evaluated using ATLS criteria to identify those who should go directly to the OR. Patients who actually went directly to the OR (D-OR) were compared to those who received CT prior to going to the OR (CT-OR). Injury data, time in CT, and operative procedures were reviewed. Death and complication rates were determined to compare outcomes.

Results: Of the 402 patients who underwent Ex Lap, criteria to go directly to the OR were met in 157 (39%). D-OR occurred in 123 (78%) and CT-OR in 34 (22%). In CT-OR, mean time in CT was 27 minutes. Mean age was lower in D-OR compared to CT-OR (28.9 vs. 36.5, $p=0.002$). Penetrating mechanism was more frequent in D-OR vs. CT-OR (76% vs. 47%, $p=0.001$). Mean ISS and AIS-abdomen were similar in D-OR and CT-OR (22.6 vs. 23.6, $p=0.75$; 3.3 vs. 3.5, $p=0.49$). Mean AIS-chest was 1.6 in both groups. Operative procedures and outcomes for D-OR and CT-OR are displayed in the Table. Rates of D-OR vs. CT-OR neither varied over the study interval ($p=0.09$) nor among trauma surgeons ($p=0.67$).

Conclusion: Preop CT in patients who met direct-to-OR status by ATLS criteria was not associated with worse outcomes. CT findings may be important in effective operative management. This merits further study.

	D-OR	CT-OR	P-Value
N (%)	123 (78%)	34 (22%)	
Non-therapeutic Ex Lap	6 (5%)	0	0.34
Mean units PRBC	4.8	4.6	0.85
Resuscitative Thoracotomy	14 (12%)	0	0.041
Damage Control Ex Lap	44 (36%)	6 (18%)	0.045
Death in the OR	10 (8%)	1 (3%)	0.46
Deaths Predicted / Observed	18% / 15%	16% / 9%	0.67 / 0.57
Complications	29%	18%	0.20

RECRUITMENT OF TRAUMA/SURGICAL CRITICAL CARE FACULTY REVERSES DECLINE OF PATIENT OUTCOMES NOTED WITH PREVIOUS FACULTY ATTRITION

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Introduction: Attrition of surgeons occurs with frequency due to a high rate of burnout. Disruption of a trauma/critical care service may have an impact on quality measures. We examined the effect of the attrition and recruitment of a trauma/surgical care team on trauma patient outcomes.

Methods: A retrospective review was performed encompassing fiscal years (FY) (Oct-Sept) 2010-2012 at an 825-bed Level I trauma center. In 2010, surgical faculty included a full complement of trauma surgeons. During 2011, 7 trauma/surgical critical care faculty departed. Between September 2011 and January 2012 four full time trauma/surgical critical care faculty members were recruited. Total number of trauma admissions, Injury Severity Scores, and both infectious and non-infectious clinical outcomes were reported across this time of evolution. Fiscal year 2010 was compared to 2011 (*attrition*) and 2011 was compared to 2012 (*recruitment*). Student t-tests and Chi squared were applied where appropriate. P-values < 0.05 were significant.

Results: 6,633 patients were evaluated with no ISS change over time. During *attrition* an increase in ICU days was observed (5.9 vs. 6.9; $p<0.05$). Trends toward greater episodes of VTE (115 vs. 142; $p=0.02$), sepsis (42 vs. 60; $p=0.09$), unplanned ICU readmissions (37 vs. 45; $p=0.42$), and mortality (4.5% vs. 5.4%; $p=0.20$) were observed. During *recruitment*, sepsis cases (60 vs. 38; $p=0.02$), pressure ulcers (25 vs. 13; $p=0.04$), ICU readmissions (45 vs. 29; $p<0.049$), VTEs (142 vs. 83; $p=0.0001$), ventilator days (8.5 vs. 5.4; $p<0.0001$), ICU days (6.9 vs. 5.2; $p<0.0001$), and hospital days (6.3 vs. 5.4; $p<0.001$) improved. Trends toward lower episodes of VAP (7 vs. 2; $p=0.09$) and mortality (5.4% vs. 4.2%; $p=0.07$) were observed.

Conclusion: Disruption of a dedicated trauma/surgical critical care service impacts trauma patient quality measures and ICU throughput. Commitment to recruitment/retention appears to reverse the associated decline in quality and resource utilization within 1 year. A symbiotic relationship between hospital and trauma surgeon personnel is required to obtain excellent patient outcomes and optimal use of resources.

THE DIFFERENCE BETWEEN THE PERFORMANCE OF PARAMETERS OF PROBABILITY OF SURVIVAL IN DEVELOPED AND DEVELOPING COUNTRIES

Cristiane A. Domingues Ph.D.,RN, Raul Coimbra* MD,Ph.D., Renato S. Poggetti* MD,Ph.D., Lilia S. Nogueira Ph.D.,RN, Regina M. Sousa Ph.D.,RN, University of Sao Paulo

Introduction: Despite its known limitations, the TRISS methodology remains the "gold standard" for the analysis of probability of survival in trauma. Several efforts have been taken to increase its accuracy. TRISS has been criticized for being based on North American data, which may not be applicable to low and middle income countries. Therefore, we evaluated the accuracy of three models of probability of survival in both a high (HIC) and a middle income country (MIC) to compare the performance of the three new adjustments to the TRISS equation models (NTRISS-like, TRISS SpO₂ e NTRISS-like SpO₂) when derivatives and applied to different groups of trauma patients.

Methods: This is a two center, retrospective study of trauma victims admitted to a university medical center in South America and a Level-1 university-based trauma center in the US during the period between January 1st, 2006 and December 31st, 2010. Patient data were grouped into two different databases: derivation and testing; the first served to derive the equations and the second was used to validate the equations initially generated. The model coefficients were established by logistic regression analysis. Receiver Operating Characteristic curves (ROC) were used to evaluate the performance of the models and the De Long et al. algorithm was used to compare the areas under the curves (AUC).

Results: 2,416 patients from the MIC and 8,172 patients from the HIC were studied. The models applied were NTRISS-like which included the Best Motor Response (BMR), Systolic Blood Pressure (SBP), New Injury Severity Score (NISS) and age; TRISS SpO₂ which included Glasgow Coma Scale (GCS), SBP, peripheral oxygen saturation (SpO₂), Injury Severity Score (ISS) and age; and NTRISS-like SpO₂ (BMR + SBP + SpO₂ + NISS + age). All equations had adjusted coefficients for blunt and penetrating trauma. The performance of the models was different when applied to patients from the MIC compared to the HIC. Regardless of the population where the equation was generated it had better performance when applied to HIC patients (AUC from 0.911 to 0.982) compared to MIC patients (AUC from 0.840 to 0.852).

Conclusion: Models of probability of survival derived from injury data collected in HIC are not reliable when used in data obtained in MIC, where trauma care may not be organized in the same manner. The results of the study suggest that other factors besides physiologic and anatomic data may have an impact on final outcome and should be identified in each environment if they are to be used in the development of a trauma performance improvement process in MIC.

ANTICOAGULANT AND ANTIPLATELET AGENTS: NO PROBLEM FOR THE ELDERLY WITH A LOW-LEVEL FALL

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Introduction: Falls are the leading cause of injury in older patients. Use of antiplatelet (AP) and anticoagulant (AC) drugs in this population is common and thought to complicate the care of these patients. We hypothesized that AP and AC use in older patients with low-level falls worsens outcomes.

Methods: We studied all patients ≥ 60 years admitted to our level II trauma center with low-level falls during 2012-2013. Use of AC or AP medications, labs, outcomes, type of fall, and injuries were extracted from the electronic record and trauma registry. Fischer exact and Student t-tests were applied, where significance was $p \leq 0.05$.

Results: 900 patients had a low-level fall with an overall mortality of 5.6%. AC/AP patients were older but with similar outcomes as non AC/AP patients (see table). For head-injured patients, AC/AP mortality was the same as for those not taking these medications ($p=0.45$). The mean head AIS was higher for those who died, 4.5 compared to 3.3, $p<0.001$. The percentage of AC/AP use was the same in survivors (55%) as non-survivors (53%). For AC patients only, there was a slightly longer LOS at 5.3 days ($p<0.05$), but similar ISS, age and mortality to patients not on AC/AP medications. Our hospital severity of illness measure, which scores premorbid medical conditions, was worse for patients who died whether in the AC/AP or no medication group ($p<0.0001$).

Conclusion: Despite our clinical bias that elderly patients who take AC/AP agents are more likely to sustain higher degrees of injury and worse outcomes after low impact falls, AC/ AP patients had the same overall injury severity and mortality as their non-AC/AP peers. Mortality was associated with severity of medical comorbidities at admission.

Group	Age years	ISS	Brain AIS (N)	Hospital LOS days	Mortality N (%)
AC/AP (N= 493)	83 \pm 9	8.7 \pm 5	3.4 (60)	4.8 \pm 4	27 (6)
No AC/AP (N=407)	80 \pm 10	8.5 \pm 5	3.5 (34)	4.5 \pm 4	24 (6)
P value	<0.001	NS	NS	NS	NS

EFFECT OF PREHOSPITAL INTUBATION ON SCENE TIMES IN THE URBAN SETTING

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Introduction:

Prehospital intubation is often necessary to support the respiratory physiology of the critically injured patient. It is however skill and time intensive. We hypothesized that need for Prehospital intubation would lead to prolonged scene times delaying arrival to definitive care.

Methods:

A retrospective analysis of trauma registry data at our urban level I trauma center was performed to identify patients who arrived with an advanced airway intervention for the 10-year period, 2003-2012. Data abstracted included: demographics, injury type and severity, physiologic variables, scene and prehospital time, and outcome. Statistical analysis was performed using the student's t test, ANOVA, and chi square test as appropriate. A p value of <0.05 determined statistical significance.

Results:

Over the 10-year period, complete data was available in 844 of 919 patients who arrived having received active advanced airway intervention in the Prehospital setting. The majority were male (648 vs. 196, $p=0.31$), and had sustained blunt trauma (679 vs. 155, $p=0.31$). Scene times were significantly longer in patients who were either intubated in the field or had undergone a failed attempt at intubation compared to those brought with bag-mask ventilation (17.66 ± 9.59 vs. 15.1 ± 10.15 vs. 13.3 ± 7.32 minutes, respectively, $p<0.0001$, ANOVA). No difference in total Prehospital time was noted (33.62 ± 11.23 vs. 30.17 ± 11.45 vs. 29.76 ± 10.26 minutes, $p=0.15$, ANOVA). Patients arriving by air were significantly more likely to be intubated ($p<0.00001$). Intubated patients were significantly more likely to be in shock/extremis on arrival, have no signs of life, and have a GCS < 8. They were more severely injured (ISS 27.22 ± 19.1 vs. 24.08 ± 15.35 for intubated vs. bag-mask, $p<0.0005$, Student's t test). Mortality was highest in the intubated group (65.5% for intubated, 61.2% for failed intubation, and 54.6% for bag-mask group, $p=0.01$, chi square test).

Conclusion:

Prehospital intubation prolongs scene times and potentially delays arrival to definitive care for the more severely injured patients in whom it is more often employed. Intubated patients arrive with a greater degree of hemodynamic instability and have higher mortality rates. Bag-mask ventilation when adequate reduces scene time. When inadequate, the use of supra-glottic devices should be explored as a means of achieving the goal of expeditious transport while maintaining physiology.

WHAT SYSTEM-LEVEL FEATURES, IF ANY, PREDICT BETTER OUTCOMES FOR PATIENTS IN TRAUMATIC CARDIAC ARREST?

Luke McIntosh MBChB, Denise Bunting Emma Enraght-Mooney Ph.D., Steven Raven Jamie Quinn Stephen Rashford MBBS, Michael C. Reade MD, MPH, Ph.D., Queensland Ambulance Service

Introduction: Many perceive resuscitation is futile in established cardiac arrest due to trauma as outcomes are so poor. This position is supported by Guidelines from the American College of Surgeons Committee on Trauma, which recommend withholding resuscitation in blunt trauma patients who are apneic, pulseless and without organized ECG activity, and in penetrating trauma if signs of life are absent. Expected transport time to an emergency department of more than 15 minutes implies a non-survivable condition. In contrast, several published case series report better outcomes, especially in selected patients and when prioritizing hemorrhage control, relief of tension pneumothorax and airway opening over conventional cardiopulmonary resuscitation. We wished to assess the effectiveness of our ambulance service protocol for traumatic cardiac arrest and identify system-level features associated with improved outcomes.

Methods: We identified all adult patients (≥ 16 years old) with pre-hospital cardiac arrest secondary to trauma were in our ambulance service Out-of-Hospital Cardiac Arrest (OHCA) Database 2000-2012. We sought predictors of sustained return of spontaneous circulation (ROSC) to hospital arrival in those patients for whom resuscitation was attempted. Our ambulance service protocol for traumatic arrest mandates resuscitation be attempted for at least 20 minutes in all but patients with an obvious non-reversible condition (such as massive head injury), with airway control, chest decompression, hemorrhage control and IV fluid prioritized over chest compressions and defibrillation. Transport is not attempted until ROSC.

Results: We identified 45,742 adult OHCA, with the leading cause being cardiac disease (65.8%), followed by trauma (7.9%). Compared to non-trauma arrests ($n=42,124$), trauma arrests ($n=3,617$) were more likely to occur in younger (median 41 vs. 68 years old) males (78% vs. 67%). Of the 3,617 traumatic arrests, resuscitation was attempted in 1,277 (35.3%). Traumatic OHCA patients in whom resuscitation was attempted attained ROSC in 17.6% of cases; not significantly different from ROSC in non-traumatic arrest (22.8%). Asystole was the most common initial rhythm in traumatic OHCA (70.1%). In multivariable analysis, significant predictors of ROSC in traumatic OHCA were age > 65 (OR 2.2; $p=0.003$) (possibly due to a lesser magnitude of trauma), shockable rhythm (OR 2.0; $p=0.022$), ambulance response time ≤ 8 minutes (OR 1.8; $p=0.009$), attendance of an intensive care paramedic or physician (OR 5.8; $p<0.001$) and time on scene > 15 minutes (OR 2.7; $p<0.001$). Attempted cardiopulmonary resuscitation by a bystander prior to ambulance arrival did not predict ROSC.

Conclusion: Attempted resuscitation of patients with traumatic OHCA treated with our ambulance service protocol is not futile. Reducing ambulance response times, augmenting standard ambulance crews with advanced-care clinicians, and emphasizing that transport should not be attempted until ROSC is attained might all further improve outcomes. Bystanders would be better advised to facilitate early ambulance attendance, and perhaps to attempt airway and hemorrhage control, than to undertake conventional cardiopulmonary resuscitation. Further information is needed on survival to hospital discharge and neurological function post-resuscitation.

TRANSPORTATION TIME IN A RURAL ENVIRONMENT FOLLOWING SPLENIC INJURY: DOES TIME MATTER

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Robert Hines Ph.D., University of Kansas Medical Center

Background: Failure rates remain high following attempted non-operative treatment of spleen injuries despite progress made in identifying risk factors. In the past, transportation times were excluded from predictive models although rapid transportation is advocated to improve patient outcomes. For patients living in a rural environment, this time may prove critical. The purpose of this study was to evaluate survival rates and hospital length of stay for patients selected to receive non-operative versus operative treatment of splenic injury, inclusive of transportation time.

Methods: A 10-year retrospective review was conducted of patients > 18 years presenting to an ACS-verified level 1 trauma center from January 1, 2003 to December 31, 2012. Failed non-operative management (FNOM) was defined as angioembolization or planned operation > 2 hours. Proportional hazard Cox regression and logistic regression analysis were conducted to identify factors associated with hospital length of stay (H-LOS) and mortality. The possible factors include: age, gender, injury severity score (ISS), injury type (blunt or penetrating), treatment modality (non-operative management (NOM), FNOM, or immediate operation (OR) within 2 hours), and transportation time from the time EMS received the phone call to admission.

Results: Among the 364 patients included in the final analysis, 11.0%(n=40) died before hospital discharge. The median transport time was 64 minutes (average=92.6 ± 81 minutes, range=6 to 480 minutes). Majority (92.9%, n=338) of patients underwent NOM, with 7.1% (n=26) receiving OR < 2 hours. Among those 338 NOM patients, 92.3% (n=312) remained NOM after 2 hours, and others had FNOM after 2 hours (7.7%, n=26). Those who received operative intervention<2 hours or NOM before 2 hours were associated with 45.5% and 47.4% of the transportation time being less than 60 minutes, respectively. After 2 hours, those who initially received an immediate OR within 2 hours, remained NOM, or qualified as FNOM had an average ISS score of 23.83, 21.96, and 28.07. Proportional hazard Cox regression analysis reported that ISS score was the only significant predictor for H-LOS. Logistic regression revealed that ISS score and age were associated with mortality. Transport time was not statistically associated with H-LOS or mortality.

Conclusion: While not predictive of H-LOS or mortality, transportation time demonstrated that in rural environments prolonged transportations allow physiologic symptoms to manifest prior to admission. This resulted in decreased FNOM, where the majority (96%) occurred < 6 hours following admission and 100% < 48 hours. Recommendations call for intensive observation < 24 hours following admission, with less robust surveillance through hospital day 2. Discharge can be considered on hospital day 3 based on other injuries.

VIOLENT TRAUMA RECIDIVISM: UNUSUAL BUT DEADLY

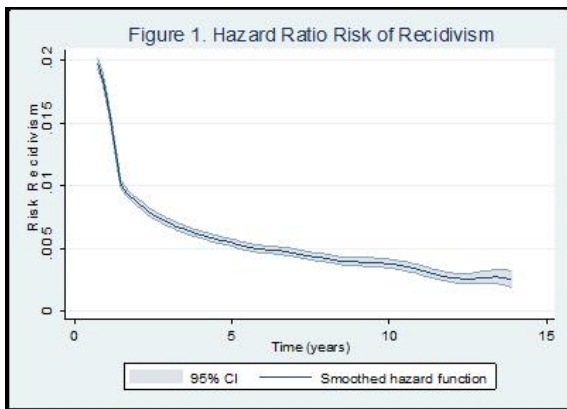
Leslie M. Kobayashi* MD, Laura Godat MD, David C. Chang MBA, MPH, Ph.D., Christopher S. Evans BS, Raul Coimbra* MD, Ph.D., University of California, San Diego

Introduction: Recurrent violence is a significant problem, however studies of recidivism following violent trauma are difficult due to the poor follow up and the migratory nature of trauma patients. We sought to identify risk factors for recidivism following admission for violent trauma within the state of California, and the effect of recidivism on mortality.

Methods: The California Office of Statewide Health Planning and Development (OSHPD) hospital discharge database was searched for all patients admitted between 1995-2010 with E-codes for violent assaults. Recidivists were defined as patients with repeat admissions for violent assaults. Multivariate analysis was used to compare recidivists to non-recidivists. Factors included; admission year, age, gender, race, insurance status, injury type, Survival Risk Ratio, Charlson co-morbidity index, hospital type, and county. Mortality differences between recidivists and non-recidivists were also compared.

Results: 168,814 patients met inclusion criteria, the majority of patients, 84.5%, were male. Penetrating trauma accounted for 43.6% of patients. Recidivism was seen in 6.8% of patients; the majority (43.6%) occurring within the first 6 months, with a median follow up of 7 years (Figure 1). Migration among recidivists was high with 41.9% of patients presenting to different hospitals for subsequent admissions. A significantly ($p < 0.001$) increased risk of recidivism was seen in those of African American race (OR 1.25), MediCal (OR 1.37), Medicare (OR 1.43), alcohol (OR 1.36) or illicit substance use (OR 1.25) and combined alcohol/illicit substance use (OR 1.52). Patients in Alameda (OR 1.17), San Francisco (OR 1.19), and Los Angeles (OR 1.68) county were more likely to be recidivists compared to those in San Diego County. 2,925 (1.73%) patients died during the study period. Being a recidivist significantly ($p < 0.005$) increased risk for mortality (OR 1.1).

Conclusion: Recidivism following violent assaults is rare, however, it is associated with increased mortality. Risk factors for recidivism include male gender, poor insurance, African American race and intoxication with alcohol or illicit substances suggesting this subgroup of patients may benefit most from violence intervention programs.



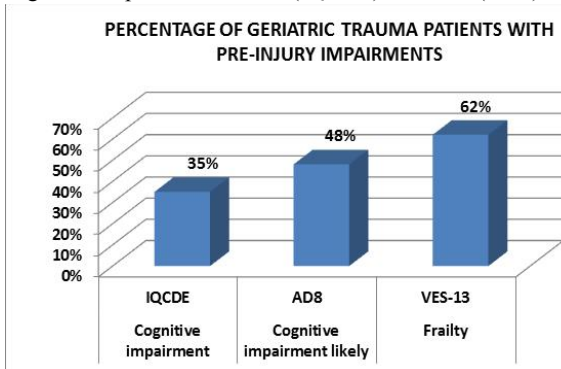
PRE-INJURY COGNITIVE AND PHYSICAL FUNCTION OF INJURED OLDER ADULTS: DOES A BRIEF SCREENING INSTRUMENT IDENTIFY PATIENTS AT RISK?

Cathy A. Maxwell Ph.D.,RN, Richard S. Miller* MD, Addison K. May* MD, Lorraine C. Mion Ph.D.,RN, Mary S. Dietrich Ph.D., Ann Minnick Ph.D.,RN, Vanderbilt University Medical Center

Introduction: Pre-injury cognitive and physical function impairments predict functional decline after injury in older adults. Validated admission screening tools for pre-injury impairment can establish patients' baseline and goals. Thus, the purpose of this study was to evaluate the use of validated brief screening instruments to identify pre-injury impairments in geriatric trauma patients.

Methods: Design: Prospective cohort study. Sample: Patients \geq age 65 (targeted n = 200) admitted to a level I trauma center between October 2013 and March 2014 with a mechanism of injury and primary injury diagnosis. Instruments: *Cognition:* Informant Questionnaire on Cognitive Decline in the Elderly (IQCDE), AD8 Dementia Screening Interview. *Physical Function:* Vulnerable Elder Survey (VES-13), Paffenbarger Physical Activity Questionnaire (PPAQ). Procedure: Patients and/or surrogates were screened by trained research assistants within 48 hours of admission to determine pre-injury cognition and physical function. Data Analysis: Frequencies (%), measures of central tendency.

Results: 150 of 325 (46%) patients (with surrogates) enrolled thus far. Mean (SD) age: 77.3 (8.9); 57% female. Surrogate-administered instruments identified pre-injury cognitive impairment in 35% (IQCDE) and 48% (AD8) of subjects; the VES-13



identified pre-injury frailty in 62% of subjects. 75% (PPAQ) of patients did not engage in weekly exercise; median daily activity (hours): vigorous (0.0, IQR: 0-0), moderate (0.0, IQR: 0-4), light (4.0, IQR: 2-6), sitting (8.3, (IQR: 5-12), reclining (8.0, IQR: 6-10).

Conclusion: A

significant percentage of geriatric trauma patients are admitted with pre-injury cognitive and physical function impairments. Few patients engage in exercise, with most time spent sitting or reclining. Admission screening is a recommended quality indicator. Our next steps include: 1) determining the feasibility of incorporating these screening instruments into provider workflow; and 2) utilization of pre-injury impairment measures for geriatric trauma predictive modeling.

THROMBOELASTOGRAPHY DOES NOT DETECT PRE-INJURY ANTIPLATELET THERAPY IN ACUTE TRAUMA PATIENTS

Marc D. Trust MD, Mitchell J. Daley PharmD, Evan J. Peterson Pharm, Jayson D. Aydelotte MD, Ben Coopwood MD, Sadia Ali MPH, Adam R. Clark BA, Andrew H. Miller MD, Kevin M. Luftman MD, Carlos V. Brown* MD, University of Texas Southwestern - Austin

Introduction: As life expectancy in the United States continues to rise, the aging trauma population presents with a higher incidence of pre-existing medical conditions, including the use of antiplatelet agents (APA). Thromboelastography (TEG) with platelet mapping has been proposed as an assay to detect the presence of APA to trigger reversal strategies, yet no study has evaluated TEG markers of platelet dysfunction in acute trauma patients stratified by the use of pre-injury APA. We hypothesized that patients on pre-injury APA would demonstrate prolonged TEG markers of platelet dysfunction compared to those not on pre-injury APA.

Methods: This retrospective chart review evaluated all trauma patients admitted to an urban, level 1 trauma center from February 2011 to April 2013 who received a TEG within the first 24 hours of admission. Patients were classified as receiving pre-injury APA or no APA if their documented medications prior to admission included either aspirin or adenosine diphosphate (ADP) antagonists, including clopidogrel, prasugrel, ticagrelor.

Results: A total of 139 patients were included (APA, n=38; no APA n=101). The time from admission to the first TEG was similar between groups (APA 206±313 minutes vs. no APA 244±347 minutes, p=0.55). There was no significant difference in TEG markers of platelet dysfunction, including maximum amplitude (MA; APA 64.3±6.04 mm vs. no APA 60.8±10.2 mm; p=0.05), % ADP inhibition (APA 60.9±25.4% vs. no APA 60.9±25.4%; p=0.84), % arachidonic acid (AA) inhibition (APA 58.4±31.4% vs. no APA 54.4±33.8%; p=0.54). Both groups had similar proportion of severe platelet dysfunction, defined as ADP inhibition greater than 70% (APA 34% vs. no APA 32%; p=0.82) and AA inhibition greater than 70% (APA 43% vs. no APA 36%; p=0.42).

Conclusion: TEG markers of platelet dysfunction did not identify the use of pre-injury APA in acute trauma patients, which may be explained by early platelet dysfunction following major trauma. There is a continued need for an assay to detect the presence of APA to trigger reversal strategies.

VALIDATION OF A BRIEF, 2 QUESTION DEPRESSION SCREEN IN TRAUMA PATIENTS: NOW WHAT'S YOUR EXCUSE?

Ann Marie Warren Ph.D., Monica Bennett Ph.D., Megan C. Reynolds MS, Laura B. Petrey MD, Michael L. Foreman* MD, MS Baylor University Medical Center

Introduction: Increasingly, depression following traumatic injury is being recognized as a complication of injury that can last long after the physical injury has healed. Unlike mandated screening for risky alcohol use in trauma centers, screening for psychological risks, such as depression, is not required by the American College of Surgeons Committee on Trauma (ACS-COT). Limited resources and time constraints are commonly given reasons against routine screening for psychological risks. The purpose of this study was to determine if a shorter, two item screen was as valid as the standard eight question screening instrument for depression.

Methods: This prospective longitudinal study consisted of patients admitted to a Level I trauma center. 421 patients were given the Patient Health Questionnaire-8 (PHQ-8) during initial hospitalization to assess depression. A cut off score ≥ 10 (possible range of 0-24) on the PHQ-8 is routinely used as diagnostic for depression. The PHQ-2, a two item screen (possible range 0-6), is derived from the first two questions of the PHQ-8 and contains items assessing sad mood and loss of interest/pleasure over the previous two weeks. A cut off score ≥ 3 was considered to be a positive screen for depression. Using the PHQ-8 as the standard; sensitivity, specificity, and positive predictive values were calculated. Demographic and injury related variables (e.g., etiology of injury, injury type) were also collected.

Results: The sample was predominantly male (65%) and Caucasian (67%). The majority (85%) sustained a blunt trauma, and the primary cause of injury was motor vehicle collision (37%), with a mean Injury Severity Score of 11.6. One hundred and forty two subjects (34%) were positive for depression on the PHQ-8. When comparing the PHQ-2 to the PHQ-8 in this sample, a sensitivity of 76.1 and specificity of 92.8 were found, as well as a positive predictive value of 84.4.

Conclusions: The result of our study confirms that depression is a frequently occurring condition (34%) among individuals who sustain physical injury requiring hospital admission. Screening using the two item PHQ-2 appears to have acceptable sensitivity and specificity to identify depression in this population. The use of a two item screening questionnaire is a minimal addition to the evaluation of patients after injury. Early identification of depression allows earlier intervention and hopefully better outcomes.

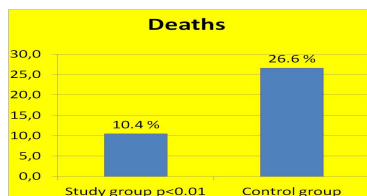
IMPACT OF ATLS GUIDELINES INTRODUCTION ON 24 HOURS MORTALITY IN SEVERE TRAUMA IN A BUSY ITALIAN METROPOLITAN HOSPITAL

Stefano Magnone MD, Roberto Manfredi MD, Federico Coccolini MD, Dario Piazzalunga MD, Fabrizio Palamara MD, Marco Ceresoli Medical Student, Luca Ansaloni MD, Pope John XXIII Hospital

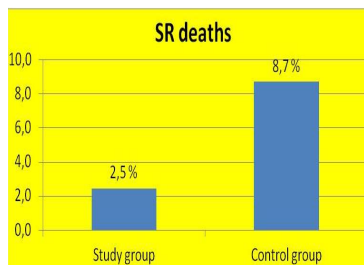
Introduction: ATLS guidelines in the initial management of trauma patients are widely accepted and implemented. Our hospital started to apply them, together with the establishment of a Trauma Team, in April 2011. Aims of this study are to evaluate changes in mortality in the first 24 hours both in the Shock Room (SR) and after admission.

Methods: This is a retrospective study based on patients admission for trauma. Study period was from 4/2011 to 12/2012 and control period was from 1/2007 to 3/2011. Patients were identified by first diagnosis (ICD 9-CM), excluding traumatic brain injuries, peripheral lesions (ie limb fractures) and burns and stratified by admission ward, considering only ICU, General Surgery and Traumatology.

Results: There were 207 patients in the control group (CG) and 163 in the study group (SG). The two groups were not different for age (mean 51,8 years old in the CG, vs 50,2 in the SG), or gender (75,4% males in the CG vs 78,8% in the SG). The died patients were not different in terms of systolic blood pressure (mean 98 mmHg in the CG, vs 103 mmHg in the SG), metabolic acidosis (mean base excess -10,1 units in the CG vs -12,9 units in the SG) or Packed Red Blood Cell consumption (mean of 8,8 units in the CG, vs 10 in the SG). Mortality was significantly better in the SG: 55 patients died in the CG, accounting for 26,6% and 17 in the SG, 10,4% ($p < 0,01$, OR 0.32, 95% CI 0,17-0,60).



Mortality in the Shock Room was significantly lower in the SG: 2,5% vs 8,7 ($p = 0,012$, OR 0.26, 95% CI 0.07-0.08).



Conclusion: The introduction of ATLS guidelines and Trauma Team had a good impact on first 24 hours mortality both in the SR and after admission.

TRENDS IN THE MANAGEMENT OF PELVIC RING FRACTURES

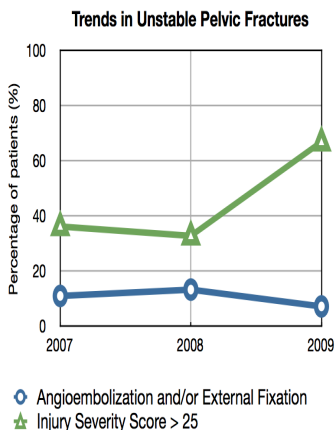
Reza Kermani MD, Lakshika Tennakoon MD, David A. Spain* MD, Kristan L. Staudenmayer* MD, Stanford University

Introduction: The management of unstable and bleeding pelvic fractures involves multiple modalities including surgery, angioembolization (AE), and external fixation (EXFIX). Trends in pelvic fracture management across the U.S. are unknown. We sought to determine the use of AE and EXFIX for pelvic fractures throughout the U.S. in both trauma and non-trauma centers.

Methods: The Nationwide Emergency Department Sample from 2007-09 was queried for all patients who were admitted to the hospital with the diagnosis of a pelvic ring fractures and who had an Injury Severity Score (ISS) >15. We excluded patients who were treated at centers that never performed AE or EXFIX. All reported numbers represent weighted values. Trend analysis over time was performed using ANOVA and Poisson regression.

Results: A total of 6,416 patients met the inclusion criteria. Mean age was 46 years and 50 % were female. AE and EXFIX were mostly performed at trauma centers (98.6% of all patients), however, for patients treated at non-trauma centers, there was no significant difference in rate of AE or EXFIX (10.3% in non-trauma centers vs. 8.6% in trauma centers, $p=0.57$). Over the study period, the rate of AE and EXFIX decreased (10.9% in 2007 to 7.1% in 2009, $p<0.001$). This occurred despite an increase in the proportion of patients with an ISS>25 (36.1% in 2007 vs. 66.8% in 2009, $p<0.001$). Over the same time, the mean age of patients increased (40 ± 21 in 2007 vs. 58 ± 21 in 2009, $p<0.001$). There was also substantial variability in the rate of AE or EXFIX by U.S. region (6.2% in South vs. 14.2% in Northeast, $p<0.001$).

Conclusion: The rate of AE and EXFIX decreased over the study period, despite increases in injury severity. This trend was associated with an increasing age. These findings suggest that trends in the management of pelvic fractures in severely injured patients are due to changes in patient demographics rather than injury severity.



THE IMPACT OF A MASSIVE TRANSFUSION PROTOCOL ON TRANSFUSION RATIOS AND PATIENT OUTCOMES

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Introduction: Combat experience has demonstrated transfusion ratios of 1:1:1 (PRBC to FFP to platelet units) improves outcomes for resuscitation of massive hemorrhage. A massive transfusion protocol (MTP) was implemented to guide the resuscitation of the acutely injured in a 1 PRBC:1 FFP:1 platelet fashion. The purpose of this study is to assess the effectiveness of the MTP on transfusion ratios and outcomes

Methods: A retrospective review was conducted of all trauma admissions which received ≥ 10 units of PRBCs in the first 24 hours of hospitalization from 2004 to 2012. Standard demographic data including blood products administered in the first 24 hours, mortality, ISS, GCS, hospital length of stay, ICU length of stay, and ventilator days were collected from the trauma registry. Patients before (PRE) and after (POST) the protocol implementation in May, 2008, were compared.

Results: During the 9 year period, 447 trauma patients required massive transfusion. There was no difference in age, gender, or mechanism between the PRE and POST groups. The

	PRE (n=239)	POST (n=208)	p-value
Mean PRBCs	19.72	19.76	0.9639
Mean FFP	14.28	16.17	0.0791
Mean Platelets	2.60	3.43	0.0006
FFP:PRBC	0.72	0.80	0.0221
<u>Platelet:PRBC</u>	0.13	0.18	<0.0001
Mortality	47.28%	40.87%	0.1732
ISS	26.05	29.90	0.0021

PRE and POST transfusion ratios are displayed in the table. In survivors, the hospital length of stay was less in POST compared to PRE (26 vs. 31 days, $p=0.04$) as was the ICU length of stay (12 vs. 16 days, $p=0.02$). Linear regression identified the POST group as an independent predictor of decreased ventilator days after adjusting for age, GCS, and chest AIS ($p<0.0001$).

Conclusion: The MTP improved our blood product ratios during massive transfusions. There was no change in mortality in the POST group despite an increased ISS. Ventilator days, ICU days, and hospital LOS were all decreased post-MTP implementation.

INJURY SEVERITY AND COMORBIDITIES ALONE CANNOT BE USED TO PREDICT FUTILITY OF CARE AFTER INJURY FOR ELDERLY TRAUMA PATIENTS

David B. Duvall MD, Xiujun Zhu PhD candidate, Alan C. Elliott MBA, MAS, Steven E. Wolf* MD, Herb A. Phelan* MD, MSCS UT Southwestern/Parkland

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: Counseling families of elderly trauma patients is a difficult part of delivering these patients' care. When making decisions about the aggressiveness of interventions, surrogates ask for prognostic information which in turn is often based on the clinician's anecdotal experience rather than data. While multiple models have attempted to predict rates of mortality after injury, we undertook this study in an attempt to specifically predict futility of care in the elderly trauma patient in order to facilitate objective prognoses using easily available parameters: Injury Severity Score (ISS) and preinjury comorbidities.

Methods: Two age cohorts (70-79 years and 80 years or older) were constructed from The National Trauma Data Bank (NTDB) for the years 2007-2011. Subjects with a preexisting advanced directive limiting care or an ISS of 75 were excluded. Clinically relevant comorbid conditions were tabulated for each patient. Mortality rates at every ISS score were tabulated for subjects with 0, 1, or ≥ 2 comorbidities. Futility was defined a priori as an in-hospital mortality rate of $\geq 95\%$ in a cell with more than five patients.

Results: A total of 570,442 subjects were identified (age 70-79 years, $n=217,384$; age ≥ 80 years, $n=352,608$). Overall mortality rates for the groups were 5.3% for ages 70-79 and 6.6% for patients aged 80 or older. No individual ISS score was found to have a mortality rate of 95% or greater for any number of comorbidities in either age cohort. The highest mortality rate seen in any cell with an adequate number of observations was for an ISS of 66 in the 80 year old cohort with no listed comorbidities (93.3%). Even at very high ISS levels mortality rates, while high, did not approach our definition of futility of care regardless of the number of pre-injury comorbidities. The table represents mortality rates at the upper extremes of ISS when aggregated into deciles ($NA = \leq 5$ patients per cell).

ISS	40-49	40-49	40-49	50-59	50-59	50-59	>60	>60	>60
#comorbidities	0	1	2	0	1	2	0	1	2
70-79 yo (%mortality)	45.5	42.6	46.8	62.3	58.3	56.6	73.9	NA	NA
80 or older (%mortality)	64.8	60.3	60.9	76.1	71.9	81.4	93.3	NA	NA

Conclusion: ISS and preinjury comorbidities alone cannot be used to predict futility of care in elderly patients. Future attempts to predict futility in these age groups may benefit from incorporating a measure of physiologic distress.

ALL IT'S CRACKED UP TO BE? FALLOUT OF TQIP IN HIGH VOLUME PENETRATING TRAUMA CENTERS

Jiselle B. Heaney MD,MPH, Rebecca Schroll MD, Min-Young Kwak MS, Amy Lawrence MS, Norman McSwain* MD, Peter Meade MD,MPH, Juan Duchesne* MD, Tulane School of Medicine

Introduction: High volume urban trauma centers care for more penetrating trauma patients in whom emergency department thoracotomies (EDT) are indicated. This patient population has a very high mortality outcome. The Trauma Quality Improvement Project (TQIP) performs inter-institutional benchmarking by comparing mortality outcomes. We hypothesize that a trauma center in an urban environment with high volume penetrating trauma will have a significantly higher overall penetrating mortality outcome due to the increased rate of mortality for EDT patients.

Methods: A 5-year retrospective analysis was performed for all adult penetrating trauma patients who presented to an urban ACS-verified Level 1 trauma center between 2009-2013. Patient demographics, mechanism of injury, injury severity score, and mortality outcome were analyzed. Mortality outcomes were studied for all patients and compared with mortality outcomes after exclusion of EDT patients. Data was analyzed with mortality risk ratios, odds ratios, and t-tests using Stata12 software

Results: Over the 5-year period 3,544 patients met inclusion criteria. These patients were mostly young (mean age 32 ± 12.2), African-American (2,659, 73.62%) males (3,079, 86.9%). EDT was performed for 84 (2.37%) patients, comprising almost 17 EDTs per year. The odds of death was more than 300 times more likely in EDT patients ($OR=325$, $Chisq=733.3$, 95% CI 108.0-979.7). When these 84 EDT patients were removed from the cohort, the mortality outcome was significantly decreased compared to overall penetrating traumas (mortality $7.66\% \pm 0.3$ vs $9.76\% \pm 0.3$, $p < 0.005$).

Conclusion: At our institution, EDTs are performed frequently and significantly impact our mortality rate. These patients would likely be considered dead or unsalvageable at lower volume institutions where EDT and high volume penetrating trauma care is not often performed, therefore being excluded from their overall mortality rates. National benchmarking projects must take this into account when performing inter-institutional comparison. New benchmarking standards for high volume, high penetrating trauma centers should be considered.

RECREATIONAL ACTIVITIES IN ELDERLY TRAUMA PATIENTS: IS PRE-INJURY BLEEDING TENDENCY ASSOCIATED WITH WORSE OUTCOMES?

Zach M. DeBoard MD, Jonathan Grotts MA, Lisa Ferrigno MD, Santa Barbara Cottage Hospital

INTRODUCTION: With an increase in life expectancy, the aging population is participating in recreation traditionally considered activities of youth. Elderly trauma patients have many reasons for higher morbidity and mortality after trauma, one of which may be the use of anticoagulant agents. Our aim was to determine whether pre-injury bleeding tendency had an adverse influence on outcomes in geriatric patients engaging in certain “high risk” recreational activities.

METHODS: A retrospective review of the American College of Surgeons National Trauma Data Bank from 2007-2010 for patients admitted to a Level I or II trauma center, age 65 years or older, and with specific ICD-9 E-codes was performed. Activities included riding motorcycles, bicycles, snowmobiles or ATVs, and horses or other animals, as well as skiing and snowboarding. Patients with a pre-injury comorbidity of “bleeding disorder,” which includes warfarin and clopidogrel but excludes aspirin use, were compared to those without. After coarsened exact matching was used to balance patient and injury covariates, a multivariate regression analysis was performed to determine differences in outcomes.

RESULTS: Two hundred sixty eight patients with a bleeding disorder were matched to 2900 without. The bleeding disorder group had increased adjusted odds of blood product transfusion ≥ 5 units and of deep vein thrombosis. No statistically significant differences in length of stay, pulmonary embolism, or mortality were observed.

Complications and Outcomes (Matched Data)

	No Bleeding Disorder (n = 2,900)	Bleeding Disorder (n = 268)	Odds Ratio (95% CI)	p-value
Hospital Length of Stay	4 (6)	5 (6)		0.700
≥ 5 Units Transfused	2.1%	7.0%	4.7 (2.2-9.9)	< 0.001
Pulmonary Embolism	1.3%	2.2%	1.7 (0.6-5.2)	0.374
Deep Vein Thrombosis	3.8%	7.6%	2.1 (1.2-3.9)	0.018
Mortality	4.2%	5.6%	1.6 (0.8-3.2)	0.197

CONCLUSION: Elderly patients with bleeding tendencies, including use of warfarin and clopidogrel, who participate in certain recreational activities do not have increased mortality, but are more likely to have greater transfusion requirements. Increased risk of deep vein thrombosis in this group may reflect aggressive treatment for or correction of the bleeding disorder. Further studies to better characterize the risks associated with use of anticoagulant medications during some recreational activities are warranted.

HEALTHCARE DISPARITIES & RISK FACTORS FOR READMISSION AFTER EMERGENCY GENERAL & VASCULAR SURGICAL PROCEDURES

George Kasotakis MD,MPH, Elizabeth Peitzman PA-C, Elizabeth G. King MD, Nichole Starr MPH, Christopher J. Hebert BS, Pamela Rosenkranz RN, Beda Sarkar MD,Ph.D., Tracey Dechert MD, David McAneny MD, Peter A. Burke* MD, Boston University Medical Center

Introduction: The Affordable Care Act of 2010 mandates healthcare organizations to enact programs to reduce readmission rates. However, risk factors for readmission in emergency surgical patients have not yet been adequately studied. With this project we aim to identify factors associated with 30-day readmission days after non-elective surgery and assess if differences exist across populations at risk.

Methods: Data were obtained from the 2011-2013 Boston University Surgical Quality Improvement Program. Patients undergoing elective procedures, had a length of stay > 30 days and those that expired before any readmission were excluded. Demographic (age, gender, race), socioeconomic (profession, income, insurance status, distance from hospital), pre- (comorbidities, smoking, steroid use, body mass index, routine laboratories, wound & ASA class) and postoperative (complications, length of stay, discharge destination) variables with $p < 0.1$ on univariate analysis were included in a backward elimination logistic regression model selection, to determine the factors that independently predict readmission.

Results: After excluding 44 subjects, 441 patients underwent emergency general or vascular surgical procedure and were prospectively monitored by the program between 01/2011-11/2013. Approximately 13% were readmitted in 10.2 ± 7.3 days after discharge, most commonly for healthcare-associated infections (38.5%), gastrointestinal (17.9%) or cardiopulmonary (12.8%) complications. African American race was independently associated with readmission [Odds Ratio 3.3 (95% C.I. 1.38–7.9), $p = 0.007$], and so were postoperative surgical site infections [6.5 (2.2–19.3), $p = 0.001$], highest white count [1.1 (1–1.3), $p = 0.007$], and ASA class [2.5 (1.3–4.8), $p = 0.006$]. Lengthier hospital stays conferred a protective effect [0.89 (0.82–0.97), $p = 0.007$]. Key socioeconomic differences between African American and other ethnicities treated at our institution may help explain the effect of race on readmission rates and healthcare disparities.

Conclusion: Pre-operative and pre-discharge efforts to limit re-admission risk may be focused based upon socioeconomic factors. Improved access to healthcare and preexisting comorbidity control could be targeted to improve readmission rates after general surgical procedures.

	African American	Non-African American	p-value
N=	174 (39.7%)	266 (60.3%)	
Median income (by residence zipcode) (\$1,000)	48.4 ± 17.1	59.3 ± 22.6	<0.001
# of comorbidities	1.2 ± 1	0.9 ± 1	0.037
Preop Creatinine (mg/dL)	1.3 ± 1.3	0.9 ± 0.6	<0.001
ASA class	2.5 ± 0.8	2.3 ± 0.8	0.045
Discharge to facility	20.6	15.3	0.159
Readmission	17.6	10.5	0.075

OBSERVATION IS AN INADEQUATE APPROACH FOR INJURED EXTREMITIES WITH SINGLE TIBIAL VESSEL RUN-OFF

Anahita Dua MD, MS, Sapan S. Desai MBA, MD, Ph.D., Sean Johnston MD, Naga R. Chinapuvvula MD, Joseph J. DuBose MD, Ali Azizzadeh MD, Kristofer Charlton-Ouw MD, Andrew R. Burgess MD, Charles E. Wade* Ph.D., Charles J. Fox MD, John B. Holcomb* MD, Center For Translational Injury Research (CeTIR), Department Of Surgery, University Of Houston

Introduction: Trauma patients with sudden loss of distal perfusion due to tibial injuries are frequently not offered vascular interventions if a single vessel retains patency. Given that acutely injured patients have minimal preexisting collateral circulation, we hypothesized that sudden loss of tibial vasculature would result in increased non-operative failure and higher amputation rates.

Methods: Traumatically injured patients with CT-Angiogram (CTA) confirmed tibial (AT), posterior tibial (PT), or peroneal artery injury were included. Demographics, injury severity score (ISS), mechanism of injury, distal vessel patency, management approach (observation, procedural), and 30 day limb salvage outcome were recorded. Failed observation was defined as requiring a revascularization procedure or a primary/secondary amputation after attempting conservative vascular management. Statistical analysis was completed using descriptive statistics, chi-squared testing, and univariate analysis.

Results: From 2009 to 2012, 437 patients were admitted with arterial extremity injury of which 234 (53%) were lower extremity. From this group, 84 (36%) patients were identified with (CTA) confirmed limited or no flow in the tibial (AT, PT, or peroneal) arteries. From the 84 patient cohort, acute intervention was performed in 57% (48) and non-operative observation was instituted in 43% (36). In the acute intervention group, bypass/interposition placement was performed in 66% (32), stenting 6% (3), primary repair 15% (7), embolization/ligation 9% (4), primary amputation 4% (2). The secondary amputation rate in the acute intervention arm was 12% (6) with a mean time to amputation of 5.8 days (range 1-16). Initial observation (n = 36) failed in 16% (6). 83% (5) underwent a revascularization procedure (mean time to revascularization 5.6 days [range 1-15]). One patient from this revascularization sub-group underwent a secondary amputation (necrotic toes) on day 19 post injury. One patient from the failed observation cohort underwent a primary amputation (below knee amputation) on day 8 post injury. 44% with 0 or 1 tibial vessel failed observation while only 8% failed if they had 2 or 3 patent vessels. Patients with 0 or 1 patent tibial vessels were significantly more likely to fail initial observation compared to those with 2 or 3 patent vessels ($p < 0.05$). Patency of the tibial vessels impacted limb salvage rates of the overall cohort ($P < 0.001$). The number of open tibial vessels was associated with limb salvage, with 2.7 open tibial vessels in the limb salvage group compared to 1.1 in the amputation group ($P < 0.05$).

Conclusion: Patients who failed an initial trial of observation were significantly more likely to have only 0 or 1 tibial vessels patent. The number of open tibial vessels is significantly associated with limb salvage. These data suggest that the common practice of avoiding revascularization in acutely injured trauma patients with single tibial run-off may contribute to early limb loss.

Early fixation for mid-shaft femur fractures: variation in practice across TQIP centers

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Introduction: Early definitive stabilization of mid-shaft femur fractures has been associated with decreased rates of complications, shorter length of stay, and lower costs when compared to delayed fixation. Deviations from optimal practices with delayed fixation are often attributed to patient or injury factors. We postulated that institutional factors might also be responsible for delays to definitive fixation. To test this hypothesis, we evaluated the extent of variation in the rates of delayed fracture fixation across trauma centers (TC) participating in the American College of Surgeons Trauma Quality Improvement Program (TQIP).

Methods: Data were derived from the TQIP analytic dataset (01/2010-03/2013). Adults with mid-shaft femur fractures who underwent definitive internal fixation (ORIF) were included. Delayed fracture fixation was defined as ≥ 24 hours from ED arrival. The crude rate of delayed fracture fixation was calculated at each TC. To adjust for case-mix, hierarchical logistic regression modeling was used to estimate the TC-specific odds of delayed fracture fixation. Patient, injury and TC characteristics were included in the model. To quantify the extent of variability present across TCs, we calculated the median odds ratio (MOR). In addition, we quantified the proportion of the total variance explained by patient factors as well as the variance explained by TC factors alone.

Results: We identified 3,342 patients over 93 TC's meeting inclusion criteria. The median time to fixation was 16 hours (IQR 7 – 27 hours) and 28% of patients underwent late (≥ 24 hours) fixation. There was marked variation in the rates of delayed fixation across TCs (median 29%, IQR 20 - 36%). Six TCs were identified as having a significantly lower than expected rate of delayed fixation and seven centers had higher rates of delayed fixation given their respective case mixes. The MOR for delayed fracture fixation across TCs was 1.95; suggesting that the odds of delayed fixation were 1.95-fold greater if the same patient was admitted to a randomly selected TC as opposed to another. After multivariate multilevel analysis, patients who were 65 years old or older, had history of ischemic heart disease or hypertension, sustained a fall-related injury or had significant injury (AIS ≥ 3) in the head, chest, or abdomen were more likely to undergo delayed fixation. At the hospital level, TC designation level, teaching status, number of orthopedic surgeons per hospital, and volume of patients were not independently associated with timing of fixation. Our hierarchical model, which included both patient and TC factors, explained 46.3% of the variability in the rates of delayed fracture fixation across TCs. Patient factors accounted for 37.4% while TC factors accounted for 8.9% of the explained variation. In other words, TC factors were responsible for 20% of the explained variation in our model.

Conclusions: Differences in rates of delayed mid-shaft femur fracture fixation were observed across TQIP centers. Institutional factors were in part, driving these differences. Specific causal factors including resource availability, critical care practices, or orthopedic commitment, among others, need to be further evaluated.

ANTIBIOTICS AND OPEN FRACTURES OF THE LOWER EXTREMITY: LESS IS MORE

Michael Truitt* MD, Brittany Bankhead-Kendall MD, Jason Murry MD, Timothy Gutierrez MD, Matthew Weldon MD, Danny Holland MD, Methodist Hospital of Dallas

Introduction: Historically, orthopedic guidelines have recommended Grade II/III open fractures receive a first generation cephalosporin and an aminoglycoside. The use of aminoglycosides in the trauma patient has been criticized for nephrotoxicity with questionable utility. The literature is limited in comparing the outcomes of patients treated with a cephalosporin alone (Group 1) vs a cephalosporin + aminoglycoside (Group 2) for open fractures. At our trauma center we have a unique trauma service where half of our surgeons treat open fractures with a cephalosporin alone and half use a cephalosporin + aminoglycoside. We hypothesized that our rates of infection and need for secondary intervention were the same between the two groups.

Methods: We identified all Grade II/III open fractures of the lower extremity admitted to the trauma service over a 5 year period. Charts were retrospectively reviewed to identify demographic information, injury severity score (ISS), type of antibiotic administered, fracture location, grade of fracture, comorbidities, incidence of acute kidney injury (AKI), wound infection, and hardware removal.

Results: From January 1, 2008 to December 31, 2013 there were 126 grade II/III open fractures of the lower extremity admitted to the trauma service. There were 65 (52%) patients in Group 1 and 61 (48%) in Group 2. Demographics, ISS, fracture grade/location and comorbidities were not different between the two groups. Patients in Group 1 had a 4% incidence of AKI, while the incidence was 10% of patients in Group 2 ($p < .05$). Group 1 had a 6% risk of wound infection, compared to 5% in Group 2. One patient in Group 1 (1.5%) and two patients in Group 2 (3.3%) required hardware removal secondary to infection.

Conclusion: The addition of an aminoglycoside to antibiotic prophylaxis in open lower extremity fractures was associated with a significant increase in AKI with no change in the incidence of wound infection or hardware removal. Cephalosporins alone may be sufficient for prophylaxis in Grade II/III open fractures of the lower extremity. A large scale prospective randomized trial is needed to confirm these findings and inform clinical practice.

A STATEWIDE, POPULATION-BASED STUDY OF IN-HOSPITAL DEATH AFTER TRAUMATIC BRAIN INJURY: HAS OUTCOME IMPROVED OVER 14 YEARS?

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Introduction: Traumatic brain injury (TBI) accounts for the largest proportion of injury-related disability and death in the United States. Disparities in neurotrauma outcomes exist between regions, age groups and races. The purpose of this study was to analyze patient outcomes from a statewide database and evaluate mortality patterns over the 14 year period of interest.

Methods: Patients, age 16 and older, with TBI (ICD-9 codes 800 to 801, 803 to 804, 850 to 854, and 959.01) were selected from a validated, statewide database of all TBI admissions at nonfederal hospitals in South Carolina, 1998 – 2011. Observation was censored at discharge. Elixhauser comorbidities were determined for each patient based on ICD-9 codes. Injury Severity Score (ISS) and In-Hospital Mortality were determined. Cox regression was performed to examine the risk of in-hospital death. Kaplan-Meier survival curves compared survival probabilities across hospitalization based on admission year.

Results: We identified 42,842 patients with TBI with a mortality rate of 8%. Sixty four percent of patients were male and the median length of stay was 4 days (IQR 2 – 9). Patients who died had higher age (57.8+/- 23.9 vs. 49.3+/- 22.9 years, $p < 0.001$), AIS-H (4.24+/- 0.90 vs. 3.05 +/- 0.95, $p < 0.001$), ISS (22.6+/- 10.3 vs. 13.9+/- 7.8, $p < 0.001$). Relative risk of death increased as severity of TBI increased based on AIS-H =3 [HR 1.651, $p < 0.001$] and AIS-H = 4-6 [HR 3.478, $p < 0.001$] compared to patients with AIS-H =1-2. Adjusted hazard ratios for heart disease (1.254), liver/digestive disorders (1.463), renal disease (1.768), coagulopathy (2.181), and stroke (2.135) were associated with mortality (each with $p < 0.05$). Adjusted hazard ratios for year treated decreased progressively through the study period compared to the index group 1998 – 2000 [2001 – 2003 (0.878), 2004 – 2006 (0.757), 2007 – 2009 (0.668), 2010 – 2011 (0.605)] (figure, $p < 0.05$). There was no difference in outcome between white and black patients.

Conclusion: In-hospital mortality for TBI has progressively improved over the last 14 year period in South Carolina. We could not detect a difference in outcome between white and black patients. Outcomes for geriatric patients especially those with significant co-morbidities lagged and deserve additional attention given the aging of the population. Additional research is needed to elucidate the reasons behind these outcome patterns including the question of why disparities in care exist and how to close the gap for older patients.

SHOULD TRAUMA SURGEONS PERFORM LIMB REVASCULARIZATION?

Elizabeth A. Zubowicz MD, Shabnam Hafiz MD, MPH, Chadi Abouassaly MD, Chandana Lanka
John J. Ricotta MD, Jack A. Sava* MD, Washington Hospital Center

Introduction: Revascularization after extremity vascular injury has long been considered an important skill among trauma surgeons. Increasingly, some trauma surgeons defer vascular repair to vascular surgeons, in response to training or local practice patterns. This study was designed to document results of extremity revascularization surgery when performed by trauma and vascular surgeons.

Methods: The trauma registry of an urban level I trauma center was used to identify all patients from 2003-2013 who underwent an early (<24h) procedure for urgent management of acute injury to axillary, brachial, radial, ulnar, femoral, popliteal, or calf arteries. Patients were managed by trauma (TRA) vs. vascular surgeons (VAS) based on the practice pattern of the on-call trauma surgeon. Injury and outcome variables were recorded, including successful revascularization, postoperative debridement, compartment syndrome, bleeding, thrombosis, and amputation. Patients were excluded if they died within 24 hours of hospitalization, had arterial ligation or solely venous injuries, or were treated by both trauma and vascular surgery.

Results: Of 115 patients, 84 patients were revascularized by trauma surgery and 31 by vascular surgery. Three endovascular surgeries were performed, all by vascular surgery. Complications are displayed in Table 1. There was no difference in type of complication or overall rate.

Conclusion: In appropriately selected patients, trauma surgeons achieve good outcomes after revascularization of injured extremities. Bypass grafting is associated with more complications, presumably due to more complex injury. Open repair remains the mainstay of extremity vascular injury management.

	All patients	TRA (%)	VAS (%)	<i>p</i>
Total	115	84	31	
Complications	19 (17)	11 (13)	8 (26)	0.2
Compartment Syndrome	3 (3)	2 (2)	1 (3)	1
Thrombosis	5 (4)	2 (2)	3 (10)	0.6
Debridement of tissue	5 (4)	3 (4)	2 (7)	1
Postoperative bleeding	3 (3)	2 (2)	1 (3)	1
Wound infection	2 (2)	2 (2)	0	0.5
Amputation	1 (1)	0	1 (3)	0.4

Table 1. Type of complication by service line. TRA- trauma surgery; VAS- vascular surgery.

INTRAVASCULAR ULTRASOUND ENHANCED AORTIC SIZING FOR ENDOVASCULAR TREATMENT OF BLUNT AORTIC INJURY

Ramyar Gilani MD, Peter I. Tsai MD, Matthew J. Wall* Jr., MD, Baylor College of Medicine

Introduction: Blunt aortic injury (BAI) often occurs in young patients with compliant aorta and resulting hyperdynamic physiology thereby creating potential for significant variation in aortic diameter during the cardiac cycle. Intravascular ultrasound (IVUS) may hold promise as a modality to detect real time variations in aortic diameter for more reliable sizing in patients undergoing endovascular repair (EV) of BAI.

Methods: Retrospective review of a single institution Level 1 trauma registry was performed from January 2004 to January 2014 identifying patients who underwent EV of BAI. Patients were divided into those who underwent EV after CT angiography (CTA) alone (CT Group) and those who had IVUS performed in addition to CTA (IVUS group). Direct comparison between groups using standard statistical methods was performed regarding pre-deployment aortic measurement, size of device implanted, landing zone, and repair outcomes.

Results: In the ten year period, a total of 38 patients underwent EV of BAI. There were 28 patients in the CT group and 10 in the IVUS group. Left subclavian artery (SCA) coverage was performed in 50% (CT group) and 40% (IVUS group) of cases. Mean aortic diameter based on CTA was similar (20.7mm, CT vs. 18.9mm, IVUS) in both groups. In the CT group, average proximal diameter of proximal device implanted was 25.9mm resulting in 20.1% oversizing. With the addition of IVUS, measured maximum aortic diameter was increased by average of 12.4% ($p<0.05$) for the whole group and 21.0% ($p<0.05$) in patients undergoing left SCA coverage resulting in change of device diameter implanted in 40% of patients. The average resulting oversizing of device implanted in the IVUS group was 30% with CTA measurement and 18% with IVUS in the IVUS group. Technical success for repair for both groups was 100% with no secondary interventions required in either group.

Conclusion: EV repair of BAI is safe with excellent results when performed with CTA alone or with additional IVUS without need for excessive oversizing. However, CTA appears to undersize aortic diameter in reference to IVUS which is most prominent proximal to the left SCA possibly due to impulse variation of aortic diameter. This undersizing may predispose patients to long-term repair failure and continued evaluation of both measurement modalities is necessary.

Poster 71

WITHDRAWN

VALIDATION OF THE QUALITY OF ULTRASOUND IMAGING AND COMPETENCY (QUICK) SCORE FOR THE FOCUSED ASSESSMENT WITH SONOGRAPHY FOR TRAUMA (FAST) EXAM

Markus T. Ziesmann MD, MSc, Jason Park MD, MEd, Bertram Unger MD, Ph.D.,
Andrew W. Kirkpatrick* MD, MHSc, Ashley Vergis MD, MMedEd, Chau Pham
MBA, MD, Dave Kirschner MD, Sarvesh Logsetty MD, Lawrence M. Gillman MD,
MMedEd University Of Manitoba

Introduction:

Despite the recent push for medical training to enter an era of “competency-based” assessments, little evidence guides the current credentialing standards regarding point of care ultrasound using the Focused Assessment with Sonography for Trauma (FAST) exam. To date, no tool has been validated for evaluating the quality of image acquisition when performing a FAST examination; we propose to develop and validate such a tool.

Methods:

Two scoring systems were developed by a modified Delphi technique. A nine domain Global Rating Scale (GRS) rated the quality of performance of ultrasound techniques on a five point Likert scale, and a twenty-four point Task Specific Checklist (TSC) served as a binary measure of the successful versus non-successful imaging of important anatomic landmarks. Two cohorts of novice (n=12) and expert (n=12) sonographers were recruited to watch an instructional video and perform a FAST examination on a live volunteer for evaluation by the proposed scoring systems. “Novices” were resident physicians with no formal FAST training while “experts” were staff physicians with credentialed FAST training in accordance with Canadian Emergency Medicine guidelines for independent scanning skill. Performances were scored by two additional experts blinded to participant identities and the scores between cohorts were compared to assess the validity of the scoring metric.

Results:

Experts scored significantly better than novices on the TSC (mean 17.21 vs 11.08, $p < 0.01$) with an inter-rater agreement 0.7951. Experts also scored significantly better than novices on all tested domains of the GRS tool, including the mean total GRS scores (mean 29.79 vs. 18.42, $p < 0.01$) with an inter-rater agreement of 0.6066. Scoring tools were modeled with univariate logistic regression, and areas under the receiver operating curves (AUROCs) of 0.8988 for the TSC and 0.9762 for the GRS indicated excellent discriminatory power.

Conclusion:

We have successfully developed a quantitative model of FAST exam quality assessment which is able to discriminate with high power between novice and expert sonographers. Such a tool may be useful in helping to define training standards and guiding future FAST research, and also serves as a template for future competency-based ultrasound imaging research.

SURGEMAN, TRAUMAMAN AND PORCINE MODELS FOR THE SURGICAL SKILLS STATION IN THE ATLS(R) COURSE

Diogo F. Garcia MD, Cristiane A. Domingues Ph.D., Francisco S. Collet E Silva MD,Ph.D., FACS, Newton D. Mori MD,Ph.D., FACS, Karen Brasel MD,MPH, FACS, John Kortbeek MD, FACS, Jameel Ali MD, FACS, Renato S. Poggetti* MD,Ph.D., FACS University of Sao Paulo

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: Universities and Hospitals are requiring the use of suitable alternatives to animals for training wherever possible. The cost of the currently approved artificial mannequins often effectively makes their use prohibitive in low income countries. A low cost Brazilian artificial mannequin (SurgeMan) has been developed. Our primary objective was to determine if SurgeMan would have equivalent learner and instructor satisfaction scores compared with the currently approved TraumaMan and animal model for the surgical procedures of ATLS®. Our secondary objective was to determine if user satisfaction scores for Surgeman exceeded 80%.

Methods: Prospective observational cohort study with three models. SurgeMan, TraumaMan and an animal model (Landrace pigs) were used. A convenience sample of 36 students enrolled in ATLS® courses were divided into 9 groups and were monitored by 1 instructor per group throughout the skills station. Each group participated in all skills in each of the three models. The procedures performed were: Tube Thoracostomy, cricothyroidotomy, pericardiocentesis and diagnostic peritoneal lavage (DPL). Psychometric testing was completed by having students and instructors fill out a Likert scale at the completion of each activity.

Results: Animals and Trauma Man performed better than SurgeMan for all skills except pericardiocentesis, where there was no difference in the models. When no ethical or financial factors were taken in consideration: 58% of the students chosen pigs as their preferred model ($p=0.057$). When all ethical factors were considered all models were equally recommended $p=1.00$. For the adequacy of each model for learning ATLS skills, students thought all models were adequate. (81% S.Man; 94% T.Man; 86% Pigs; $p=0.184$)

	Thoracostomy	Cricothyroidotomy	DPL
Trauma Man	4.09 (0.66)*	3.9 (0.87)*	3.92 (0.64)#
SurgeMan	3.03 (0.89)	3.00 (1.03)	2.94 (0.86)
Animals	4.10 (0.91)*	3.37 (1.26)	4.39 (0.93)*

* $p<0.05$, significantly better than all comparator groups.

$p<0.05$, significantly better than SurgeMan

Conclusion: TraumaMan performed better than SurgeMan in most procedures. Students found that both TraumaMan and SurgeMan are acceptable for learning ATLS® surgical skills.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

Poster # 73

WITHDRAWN

TRAINING FUTURE TRAUMA SURGEONS; EFFICACY OF THE US DESIGNED ADVANCED SURGICAL SKILLS FOR EXPOSURE IN TRAUMA (ASSET) COURSE FOR UNITED KINGDOM TRAINEES

Christopher M. Lamb MB BChir MA MSc, Alex P. Navarro Ph.D., Patrick MacGoey MBBS, Katie Rollins MBBS, Joseph Galante* MD, Mark Bowyer* MD, Adam Brooks MD, Queen's Medical Centre

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction: To assess the efficacy and desirability of conducting the ASSET course for United Kingdom (UK) general surgical trainees.

Methods: Prior to the course participants were presented with the course manual, a DVD depicting the surgical exposures, and a pre-course self-efficacy evaluation (pre-score); a measure of confidence in performing the skills with a range of scores from 1 to 5, with 1 being little confidence and 5 extreme confidence.

Fresh frozen human cadavers were used with one trained ASSET faculty per table and four participants. The faculty presented topics that were delivered by PowerPoint presentations and videos. The presentation topics were in five segments: upper extremity, lower extremity, neck and chest, abdomen, and pelvis. After each segment, the participants completed the surgical exposure in the cadaver under supervision. On completion, mean pre-scores were compared with the post-scores scores using the Mann-Whitney U-test.

Results: 27 UK higher surgical trainees (HSTs) were trained on 2 separate courses. HST level of experience ranged from 1-6 years (median 3). The overall mean efficacy scores were 2.26 ± 1.34 pre-course versus 3.86 ± 0.95 post-course ($p < 0.0001$). Across the 5 anatomical areas taught, pre-scores ranged from 2.07 ± 1.11 (chest) to 2.37 ± 1.14 (lower extremity), with post scores of 3.51 ± 0.95 (neck) to 4.07 ± 0.67 (pelvis and abdomen). The area of greatest benefit was chest, pre- 1.99 ± 1.11 to post- 3.96 ± 0.78 . However all areas demonstrated significant improvement in efficacy scores ($p = < 0.0001$).

Conclusion: Within this cohort of UK HSTs the ASSET course produced significant improvements in objective measures of self-confidence with respect to surgical exposure for trauma. In particular, teaching directed at anatomical areas less commonly encountered during routine general surgical practice in the UK yielded the greatest benefits. The ASSET course appears relevant to current UK surgical trainees of all levels.

ALL FINGERS POINT TO NO DIGITAL RECTAL EXAM IN TRAUMA PATIENTS

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INTRODUCTION: Digital rectal exams (DRE) are routinely used on trauma patients during the secondary survey as recommended by current advanced trauma life support (ATLS) protocols. Gross blood, decreased or absent sphincter tone, and a high-riding prostate are a few findings we search for during the DRE. ¹ Recent literature has called the blanket use of the DRE in trauma into question. The purpose of this study is to evaluate the efficacy of the DRE as a diagnostic tool in the setting of urethral, spinal cord, small bowel, colon, and rectal traumatic injuries. **METHODS:** A retrospective review of trauma cases at a Level I trauma center from 2008 to 2012 was performed utilizing ICD-9 coding for small bowel, colon, rectal, urethral, and spinal cord injuries. Inclusion criteria included all trauma patients with the above injuries, age of 18 years or older, and a noted DRE. Exclusion Criteria included an age less than 18, patients who received paralytics during intubation, a GCS of 3, and previous history that would make a DRE unreliable (a history of paraplegia, or quadriplegia). The DRE findings were compared to the final diagnosis for each patient. Sensitivity, specificity, and positive and negative predictive value were determined. **RESULTS:** A total of 111 cases (83% male, 17% female) were retrospectively reviewed ranging in age from 18 to 90 years with a mean GCS of 13.7. Ninety-two (82.9%) patients were found to have documented injuries. The majority of cases were level I trauma activations (60.4%) with level II and III (36.9%; 2.7%) following in decreasing frequency. Sixty-two (55.9%) cases were penetrating with the remaining 49 (44.1%) blunt injuries. Seven urethral (6.3%), 24(21.6%) spinal cord, 29(26.1%) small bowel, 19(17.1%) colon, and 3(2.7%) rectal, 4(3.6%) bladder, 5(4.5%) pelvic, and 20(18.0%) intracranial injuries were noted. The DRE missed (false-negative rates) 100% of urethral, 91.7% of spinal cord, 93.1% of small bowel, 100% of colon, and 66.7% of rectal injuries. For injuries confirmed with radiologic modalities, the DRE missed 93.3%. For injuries confirmed on exploratory laparotomy, the DRE missed 94.9%. Positive predictive value (PPV) was poor for urethral (0.0), spinal cord (33.3%), colon (0.0), and rectal (50.0%) injuries. Small bowel injuries demonstrated a PPV of 100% but only a 6.9% sensitivity. For 75 injuries documented by radiology, only 5 had positive findings on DRE (PPV 71.4%, 6.7% sensitivity, 2 false positives). For the 39 injuries confirmed by exploratory laparotomy, only 2 cases had positive findings on DRE (PPV 100%, 5.1% sensitivity, 0 false positives). **CONCLUSION:** From this data we can conclude the DRE does not provide adequate clinical data to warrant its blanket use in the trauma setting. The DRE has poor sensitivity for the diagnosis of urethral, spinal cord, small bowel, and large bowel injury. The DRE was most sensitive in the setting of rectal injuries. When compared to other confirmatory modalities for injury (radiology or surgery), the DRE offers no benefit or predictive value as a diagnostic tool in the setting of traumatic injury. Elimination of the DRE from the secondary survey is a safe option, which will minimize risk to both patients and the trauma team.

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An integrated trauma and critical care simulation curriculum for surgical residents

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Introduction: Expectations continue to rise for residency programs to provide integrated simulation training to address clinical competence. How to implement such training sustainably remains a challenge. We developed a compact module for first-year surgery residents integrating theory with practice in high-fidelity trauma and critical care simulations.

Methods: The three-day module features a combination of simulated patient encounters using standardized patients and electronic manikins, didactic sessions, and hands-on training. Manikin-based scenarios developed in-house were used to teach trauma and critical care management concepts and skills. Separate scenarios in collaboration with the regional organ donation program addressed communication in difficult situations such as brain death. Didactic material based on contemporary evidence, as well as skills stations were developed to complement the scenarios. Residents were surveyed before and after training on their confidence in meeting the fourteen learning objectives of the curriculum on a 5-point Likert scale.

Results: Data collected from eleven residents that have completed this training shows an overall improvement in confidence across all learning objectives defined for the module, with median score pre to post-training improving significantly from 3 to 4 (out of 5), $p < 0.001$. Greatest improvement was confidence in ability to communicate in ethically challenging or end-of-life situations with a mean score increase of 1.5, followed by confidence in skills of mechanical ventilation, as well as confidence in skills of pulmonary artery catheter placement with mean score increases of 1.4.

Conclusions: We successfully implemented a multimodal simulation-based curriculum that provides skills training integrated with the clinical context of managing trauma and critical care patients, simultaneously addressing a range of clinical competencies. Results to date show consistent improvement in residents' confidence in meeting learning objectives. Development of the curriculum continues for sustainability, as well as measures to embed objective evaluations of resident competence.

THE ATLS PARTNERSHIP MODEL: AN INNOVATIVE STRATEGY TO EXPAND ATLS TEACHING IN LOW RESOURCES AND UNDERSERVED AREAS

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Introduction: Despite the worldwide reach of ATLS courses since 1980, many areas of the world with high rates of trauma remain untouched. The partnership for region 14 (Latin-America) ACS-COT started in October of 2013, a model designed to expand ATLS to countries with limited resources. It consists in the assistance and supervision from countries with mature ATLS programs to countries without ATLS and low resources. The objective of this study is to determine, the components, challenges and impact encountered in planning and executing this model. **Methods:** We review the process, number of courses and financial information from the three countries where the partnership program started in the Region 14: Belize, Curacao, and Cuba. These results were compared to those from the last two countries, which promulgate ATLS in our Region: Uruguay and Paraguay. **Results:** Several partnership programs were planned in the Region: Antigua, Belize, Curacao, and Cuba. We held a demonstration course in Belize (December 2013), and two inaugural courses: Curacao (January 2014), and Cuba (February 2014). The time elapsed from the site visit to the inaugural ATLS course, the number of courses/participants in each course, the human resources and expenses, was determined for each country. **Table.** The partnership model required less time than the promulgation model. The expenses were significantly reduced (in average \$60.000 USD) by the financial and time contribution and donations from members of the region, members of other regions, the Brazilian COT, and the ACS-COT compared to the traditional estimated expenses of \$118.300- 133.200 USD for the promulgation model.

Country/ Partner	Model	Local Surgical Society	Time to Inaugural Course	Number of ATLS Courses (n) Participants (n)	Local Expenses/ACS and Region 14 contributions (USD)
Uruguay Paraguay	Promulgation		Uruguay/ Paraguay 15 months	2009- 2013 Provider courses: 9/8 Instructor course: 1/0	Total Estimated expenses 118.300- 133.200
Belize/ Costa Rica 2013	Demonstration/Part nership December 01/13	Medical and Dental Association J.Hidalgo P. Arriaga	24 months	Provider course: 1 Participants: 13	20.202/11.676
Curacao/ Colombia 2014	Partnership January Student: 22/01/14 Instructor: 25- 26/01/14	St Elizabeth Hospital Michel Berry Sandra Cova,	4 months	Provider course: 1 Participants: 17 Instructor course: 1 Participants: 9	41.140/200
Cuba/ Brazil 2014	Partnership Student: 18-9/02/14 Instructor: 20/02/2014	Sociedad Cubana de Cirugía Martha Larrea	1month	Provider course: 1 Participants: 17 Instructor course: 1 Participants: 9	750/39.328

Conclusion: Three new countries have joined the region 14. We have created a new future - one that would not have occurred without the introduction of the partnership model. This model subsidizes the cost of bringing ATLS to areas that otherwise could not afford it. It could not succeed without the support and the commitment from faculty members of the COT from many regions, the local societies, other region societies, and the ACS-COT.

THE IMPORTANCE OF TAILORING PHYSICIANS' TRAUMA CARE TRAINING NEEDS IN RURAL ENVIRONMENTS

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Introduction: Trauma training courses for physicians significantly improve technical and non-technical (judgement, management, prioritization) skills, yet gaps in the provision of care exist. These gaps are most evident in the initial evaluation and management of patients first cared for in the most rural settings. The purpose of this work was to explore what unmet educational needs might exist so as to improve the care of patients prior to transfer.

Methods: We designed a survey to evaluate the educational experiences, needs, and preferences of MDs working in emergency departments (EDs) at least 20 miles from a trauma center (TC) level I/II. The survey (n=2563) was disseminated through professional associations and potential respondents were sampled by type of training (specialty certification in Emergency Medicine – EM vs other) and actual practice location (urban vs rural). Responses were stratified by rural/urban (self identified) status of providers.

Results: There were 466 respondents, 372 of whom self identified as rural. Rural MDs had less experience caring for trauma patients, greater exposure to ATLS and were more likely to state that ATLS met their training needs (Table). The educational content most needed was similar for both groups of MDs: pediatric trauma, orthopaedic/peripheral vascular trauma, and airway management were considered priorities.

Preferred modes of educational delivery differed

across groups: urban MDs preferred didactic and self-learning, while rural MDs preferred case-based discussions and distance education via video-conference. Both felt simulation-based training was the preferred method of learning.

Conclusion: While ATLS is perceived as important for most MDs in ED's remote from TC, human patient simulators are highly preferred. The preferred learning modalities differed significantly, indicating a requirement to tailor educational experiences to local needs. These findings should allow for improvements in trauma educational programs to prepare physicians working in more rural environments.

	Urban (%)	Rural (%)	p-value
EM certified	64	23	<0.001
Annual experience (number of patients)			<0.001
< 5	22	51	
5-10	30	27	
>10	48	22	
ATLS meets educational needs	68	82	.005
Recent ATLS certification	58	70	.031

TRAUMA CENTERS AND THEIR INVISIBLE ARCHITECTURE: A WAKE UP CALL FOR SURGICAL LEADERS

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Introduction: Organizational culture (OC), or *invisible architecture*, is defined as a system of shared values held by organizational members that are unique to each organization. OC has been studied extensively in the world of business and has been the subject of increasing attention in the healthcare setting. It is well known that leadership plays a very important role in establishing the culture of an institution. Furthermore, it is important that leadership and employees of all levels perceive culture similarly ensuring that everyone is “on the same page.” We postulate that perception of a healthy culture within a trauma center (TC) varies by position and sought to explore this hypothesis using the previously reported Trauma Center Culture Survey (TRACCS).

Methods: We conducted a cross-sectional survey of organizational culture across centers participating in the ACS Trauma Quality Improvement Program (TQIP). TRACCS was administered to members with a variety of roles within each center. We explored differences in responses between those holding leadership positions and those without, as well as responses across roles defined as administrative, physician, or nursing. Overall scores and scores by domains (opportunity, pride and diversity; TC leadership; and employee respect and recognition) are reported. Descriptive statistics are reported as mean (SE).

Results: Responses were obtained from 1,912 in 144 centers. Leaders reported significantly higher total TRACCS score compared to non-leaders (Table 1). The lowest domain scores and largest differences across roles were evident in TC employee respect and recognition. There were significant differences across administrative, nursing and physician roles in total and across all domains.

Conclusion: Within an organization, leaders consistently perceived a healthier OC than non-leaders, particularly in the domain of employee respect and recognition. These differences may not be apparent to TC leadership and can serve as barriers to achieving optimal clinical outcomes. In conclusion, the differences found in perception across domains might have significant impact on organizational performance and mandate further study.

Table 1. Total TRACCS and Factor Scores

	Leadership	Non-Leadership	Leadership vs Non-Leadership	Administration	Physicians	Nurses	Admin vs Physicians	Admin vs Nurses	Physicians vs Nurses
Total TRACCS Score	4.23(0.05)	3.82(0.03)	0.41(0.05)	4.38(0.08)	3.99(0.04)	3.85(0.03)	0.39(0.08)	0.53(0.08)	0.14(0.04)
Factor 1 Opportunity, Pride & Diversity	4.36(0.05)	4.00(0.03)	0.36(0.05)	4.50(0.08)	4.18(0.04)	4.01(0.03)	0.33(0.08)	0.49(0.08)	0.17(0.04)
Factor 2 TC Leadership	4.50(0.07)	4.09(0.04)	0.41(0.06)	4.47(0.11)	4.35(0.06)	4.11(0.05)	0.12(0.11)*	0.36(0.10)	0.24(0.05)
Factor 3 Employee Respect and Recognition	3.78(0.07)	3.22(0.05)	0.56(0.07)	4.02(0.11)	3.49(0.06)	3.26(0.05)	0.54(0.11)	0.76(0.10)	0.23(0.05)

Values are reported as Mean (SE). All groups statistically significant, $p \leq 0.0001$, except*

PEDIATRIC SEVERE TRAUMATIC BRAIN INJURY: HYPO OR HYPERCOAGULABLE STATE?

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Introduction: Coagulopathy after severe traumatic brain injury (sTBI) occurs frequently and is independently associated with worse outcome. Reduced clot strength measured by TEG with platelet mapping (TEG-PM), has been associated with increased mortality in adults. No studies on the frequency and outcomes associated with clot strength abnormalities have been reported in children with sTBI.

Methods: Prospective observational study in children <18 years of age admitted with sTBI (Glasgow Coma Scale score (GCS) \leq 8) from June 2012 to January 2014. Data collected included; injury severity score (ISS), standard coagulation tests (prothrombin time [PT], INR, activated partial thromboplastin time [aPTT], platelet count). TEG-PM was measured daily for 5 days. Outcomes measured were mortality, length of ICU stay, and pediatric functional independence measure [WeeFIM scale]). We defined coagulopathy by standard coagulation tests as platelet count <100,000 per cumm, INR >1.2 or aPTT >36 seconds and by TEG-PM as reaction time (R) >12 minutes, K time >3 minutes or G <6. Data are described as median (interquartile range).

Results: We enrolled 16 children with sTBI with median age of 13.5 years (10.2-16.7). Seventy five percent were male and 37% of patients had isolated sTBI. Median admission GCS was 5 (3-6) and median ISS was 29 (17-41). Coagulopathy after sTBI based on standard coagulation parameters occurred in 62.5% patients in the first 24 hours after injury. However, only one patient had evidence of hypocoagulability on TEG-PM. Instead, 87.5% patients had hypercoagulability (R < 5 minutes). For simultaneously sampled INR and TEG samples, 58% of INR results > 1.2 also had a TEG R-time of < 5 min. Moderate platelet inhibition was found on day 1 with median platelet inhibition on adenosine diphosphate receptor of 54% (24-65%). TEG-PM parameters trended towards normal on serial evaluation over 5 days. One patient died, 50% patients had moderate (WeeFIM 71-84) and 37.5% patients had good functional independence measure (WeeFIM >85) at hospital discharge. There was no correlation between any of the measured coagulation parameters and outcome.

Conclusion: In our preliminary data in children with sTBI, we found divergent results between standard coagulation tests and TEG-PM (specifically, INR-TEG). TEG-PM parameters suggest a mixed coagulopathic state with increased thrombin generation but moderate platelet inhibition. Larger prospective studies are needed to determine whether standard coagulation tests or TEG-PM more accurately identify and classify coagulopathy in children with sTBI.

PREHOSPITAL IV FLUIDS ARE NOT ASSOCIATED WITH INCREASED MORTALITY IN PEDIATRIC TRAUMA PATIENTS

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Introduction: The association between pre-hospital intravenous fluid (IVF) administration and mortality has been reported with mixed findings in adult trauma patients; some results have shown increased survival and others increased mortality. Because the administration of prehospital IVF is not random, more severely injured patients are more likely to receive IVF. When this confounding by indication is not accounted for, estimates of IVF effect on mortality will be biased by residual confounding, even after risk adjustment. We sought to evaluate whether the observed increase in mortality associated with the use of pre-hospital fluids in our pediatric trauma population is wholly or partly explained by indication bias.

Methods: We performed a retrospective cohort study on all pediatric (0-18 years) trauma patients with an injury severity score (ISS) of 9 or higher who were transported directly from the scene of injury to a Level I pediatric trauma center between January 2008 and June 2011. The outcome of interest was in-hospital mortality and the exposure of interest was amount of pre-hospital IVF administered. This was dichotomously defined as either GT250 (receiving 250ccs or more [exposed]) or LT250 (receiving 0-249 ccs [not exposed]). The cutoff value was determined based on receiver operating characteristic (ROC) curve analysis, which maximized sensitivity and specificity in predicting mortality (AUC=0.7, sensitivity=0.81 and specificity=0.56). Using logistic regression, propensity for exposure assignment for each patient was then determined based on the following pre-hospital variables: mode of transport (air vs. ground), mechanism of injury, patient age, patient weight, intubation status, initial scene vital signs and time (from injury) to Level I trauma center (model c-statistic=0.8, 95%CI: 0.76 - 0.84). Using Cox's regression to minimize survival bias, the independent effect of pre-hospital IVF on mortality was evaluated with and without adjusting for the exposure assignment propensity.

Results: A total of 482 patients met study criteria. Of these, 46.3% (223/449) received 250ccs or more of IVF. In-hospital mortality for the GT250 group was 9.4% (21/223) compared to 2% (5/259) in the LT250 group ($p < 0.05$). After adjusting for ISS, presence of a severe head injury, presence of shock and a penetrating injury, all of which were significant predictors of mortality, receiving 250ccs or more of pre-hospital IVF was significantly ($p=0.0373$) associated with an almost three-fold increase in the risk of in-hospital mortality, hazard ratio (HR) 2.96, 95%CI: 1.1-8.2. However, adjusting for the propensity to receive 250ccs of IVF or less (pre-hospital baseline risk) attenuated the effect estimate and resulted in a non-significant ($p=0.3408$) association between pre-hospital IVF and mortality, HR 1.8, 95%CI: 0.5 – 6.2.

Conclusion: Propensity-adjusted survival analysis suggests neither a beneficial nor an adverse effect from pre-hospital resuscitation on mortality after adjusting for confounding variables in our pediatric trauma population. Our data would suggest that IVF resuscitation should not be a reason to delay patient transport to definitive care.

THE ROLE OF ACTIVATED PROTEIN C IN THE DEVELOPMENT OF COAGULOPATHY AFTER PEDIATRIC TRAUMA

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Introduction: Recent evidence for a distinct mechanism of early posttraumatic coagulopathy involves the activation of the anticoagulant protein C pathway. Whether this new mechanism of posttraumatic coagulopathy plays a role in children is still unknown. The purpose of this study was to determine the role of the activation of the protein C pathway in the development of coagulopathy early after severe civilian pediatric trauma.

Methods: We conducted a prospective observational study of pediatric patients after sustaining injury at a level 1 pediatric trauma hospital. Inclusion criteria: highest level trauma activation and arrival within 6 hours of injury. Exclusion criteria: >18 years of age, burns > 20% total body surface area and primary asphyxiation. Blood samples were collected within 20 minutes of arrival to the trauma bay for analysis of partial thromboplastin (PTT), prothrombin times (PT) and activated protein C (aPC).

Results: A total of 49 consecutive patients were enrolled. The mean age was 8.3 ± 4.9 years with 86% sustaining blunt trauma. The mean injury severity score was 20, median pediatric BIG score was 14.9 and overall mortality was 10%. The overall incidence of coagulopathy, defined as a PT ratio >1.2, was 29%. Patients presenting with an early coagulopathy showed a mortality rate of 38%. Non-survivors had a significantly higher PT ratio (2.2 vs 1.06, $p < 0.0001$) and significantly higher PTT levels (178 vs 27.9, $p < 0.0001$). Significantly higher aPC levels were seen in non-survivors versus survivors, 4.32 ng/mL and 3.13 ng/mL respectively ($p = 0.033$).

Conclusion: Coagulopathy on arrival is associated with higher mortality in pediatric trauma patients with significantly higher levels of aPC demonstrated in non-survivors. Further evaluation of the mechanisms associated with coagulopathy in pediatric trauma and potential targets for treatment are warranted.

PREDICTORS FOR EARLY BLOOD PRODUCT ADMINISTRATION IN THE PEDIATRIC TRAUMA POPULATION

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Introduction: Trauma is the leading cause of death in children, and hemorrhage accounts for 20-40% of all early trauma-related mortality. In adult trauma, there is an associated mortality benefit with early activation of transfusion protocols; however, this has not been well studied in the pediatric trauma. Our purpose was to identify predictors available early in the assessment phase that may predict need for transfusion and better assist our blood bank refining the products available at resuscitation.

Methods: Demographics, mechanism of injury, admission vitals, Glasgow Coma Scale score (GCS), and outcome were collected for all pediatric trauma patients retrospectively at a Level I pediatric trauma center from 2008 to 2013. Exclusion criteria included burns, patients with age >16, and those with insufficient data for analysis. We utilize a two tiered trauma activation system: Level 1 trauma includes those patients with intubation prior to arrival, hemodynamic instability, penetrating injury, GCS < 10, deteriorating neurologic status, multi-system injury, and significant soft tissue injury/amputation. All level 1 and level 2 trauma activations were included in the analysis. Transfusion was defined as the administration of any blood product within 24 hours of admission. A logistic regression model estimated odds ratios and 95% confidence intervals for the association between the need for transfusion and the predictors. Also, a sensitivity analysis was performed to assess how accurately these factors predict transfusion.

Results: Of the 1,945 pediatric trauma patients, 8.8% needed transfusion in the first 24 hours. There was a significant difference in mortality between those requiring transfusion and those who did not [28.1% vs. 1.1% ($p < 0.001$)]. Factors associated with transfusion included GCS ≤ 8 , Level I activation, low systolic blood pressure, increased heart rate, and age < 3 years (Table 1). The c-statistic for the final model was 0.84. In patients with ≥ 2 predictors, we identified 79% of patients requiring transfusion (sensitivity) and 73% not requiring transfusion (specificity).

Conclusion: GCS ≤ 8 and Level I activation were the most predictive factors for transfusion available early in the pediatric trauma assessment. Prospective validation is warranted.

Table 1. Adjusted odds ratios (ORs) and associated 95% confidence intervals (CIs) for the association between demographic, injury, and clinical characteristics and need for transfusion

	Crude OR (95% CI)	Adjusted* OR (95% CI)
Age <3 years	2.25 (1.59-3.19)	1.87 (1.20-2.90)
GCS ≤ 8	15.51 (10.85-22.17)	4.29 (2.42-7.59)
Level 1 Activation	14.40 (10.06-20.61)	5.20 (2.91-9.30)
Increased heart rate (age-appropriate values)	1.14 (0.78-1.68)	1.78 (1.06-2.99)
Low systolic blood pressure (age-appropriate values)	5.19 (3.35-8.03)	3.73 (2.02-6.88)

* Adjusted for other variables in table

ENTERAL ACCESS IN PEDIATRIC AND ADOLESCENT TRAUMA PATIENTS: DISPARITY BETWEEN ADULT AND PEDIATRIC HOSPITALS

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Introduction: Providing enteral access is a necessary component in the rehabilitation process of trauma patients. In the pediatric population, open gastrostomy tubes are often placed in combination with an anti-reflux procedure, which differs from the percutaneous approach that is common in the adult population. There are currently no evidence based recommendations as to the ideal method of providing enteral access in pediatric trauma patients. The aim of this study is to examine differences in the method of enteral access in pediatric and adolescent trauma patients at Level 1 pediatric versus adult trauma centers.

Methods: We performed a retrospective review of all trauma patients age 1 to 21 years who underwent an enteral access procedure between 1/2007 and 6/2013. Infants less than age 12 months were excluded. Patients from a pediatric Level 1 trauma center were compared to patients from an adult Level 1 trauma center. Demographic data, primary diagnosis, technique utilized for feeding tube placement, time to enteral access, time to discharge, and 30 day complications were recorded.

Results: Thirty patients underwent enteral access procedures in this time period. Twelve patients were treated at the children's trauma center with an age range of 20 months to 13 years, with a majority (77%) admitted due to closed head injury. At the children's hospital, surgical gastrostomy was performed in 10 patients, while 2 patients had enteral access placed under fluoroscopic guidance. Of the 10 patients undergoing open surgical gastrostomy, 8 patients (80%) underwent simultaneous fundoplication. Average time to enteral access was 35 days (range 14-63 days) and average time to discharge was 33 days (range 4-104 days). Eighteen patients were treated at the adult trauma center with an age range of 17 to 21 years. Closed head injury was the primary diagnosis in the majority of patients (72%). All patients received a percutaneous gastrostomy tube. Average time to access was 11 days (r 5-29 d) and average time to discharge was 14 days (r 6-32 d). There were no 30 day complications in either group.

Conclusion: There is a disparity in the method of enteral access utilized between adult and pediatric trauma centers. Permanent enteral access can be safely performed in the pediatric and adolescent population through either a percutaneous or surgical approach. There is a need for prospective multi-institutional studies to determine the optimal approach for enteral access and the role of fundoplication in this patient population.

THE EVOLUTION OF PEDIATRIC TRANSFUSION PRACTICE

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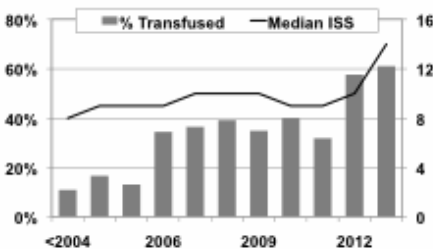
Introduction: The concept of hemostatic resuscitation has significantly changed adult trauma resuscitation. Transfusion practice patterns in pediatric resuscitation likely have changed as well; however, this evolution has not been quantified. We studied pediatric transfusion practices over time within a combat trauma system.

Methods: The Department of Defense Trauma Registry (DoDTR) was queried from 2001-2013 for pediatric trauma patients (<18 y). Burns, drowning, and missing injury severity score (ISS) were excluded. A subset without head injuries (isolated or predominant) was also evaluated. Volumes of packed red blood cells (PRBC), plasma (PLAS), platelets (PLT), cryoprecipitate (CRYO), and whole blood (WB) given in the first 24 hours were calculated per kg body weight. Transfusion practices were then evaluated from 2001-2005 (EARLY) vs. 2006-2013 (LATE) including proportion of transfused patients, volume of blood products administered, ratio of PLAS and PLT to red blood cells (RBC), and tranexamic acid (TXA) use. ICU and hospital length of stay (LOS) and 24-hour and in-hospital mortality were compared.

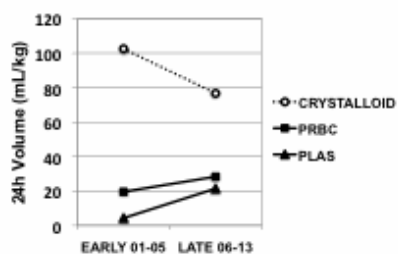
Results: 4,990 pediatric combat casualties were identified in the DoDTR. 632 were excluded for burns, drowning, and incomplete ISS data. The remaining 4,358 patients comprised the study cohort. Over time, the proportion of transfused patients rose along with an increasing ISS (Figure A). Comparing EARLY vs. LATE, median ISS (9 vs. 10, $p<0.0001$), injuries from explosions (33.8% vs. 47.4%, $p<0.0001$) and isolated or predominant head injuries (12.4% vs. 17.5%, $p<0.0001$) all increased significantly. In the 1,377 transfused patients, mean 24-hour crystalloid volume decreased while PRBC and PLAS volume increased (Figure B). Transfusion of a high ratio of PLAS to RBC (≥ 0.5) increased (17.2% vs. 63.4%, $p<0.0001$). The volume of PLT and CRYO increased while WB was unchanged, and TXA use increased. ICU and hospital LOS decreased in the LATE group. Mortality increased in the overall cohort at 24 hours (2.0% vs. 4.2%, $p=0.0006$) and in-hospital (5.7% vs. 7.8%, $p=0.01$). Excluding those with isolated or predominant head injury ($n=708$), 24-hour mortality increased (1.2% vs. 2.6%, $p=0.02$) while in-hospital mortality was unchanged (3.6% vs. 5.2%, $p=0.07$) over the study period.

Conclusion: Transfusion practice in pediatric combat casualty resuscitation has shifted towards a more hemostatic approach since 2001. Further study is required to determine if this practice should apply to civilian pediatric resuscitation.

A



B



Racial Bias in the Management of Severe Traumatic Brain Injury: Fact or Fiction?

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Introduction: A complex interplay exists between socioethnic factors and outcome after traumatic brain injury (TBI). While few physicians would claim overt discrimination, several studies have identified racial or ethnic disparity in clinical outcomes and functional recovery following TBI. However, the impact of race on the acute management of patients treated for severe TBI at trauma centers is unknown. Therefore, we asked the question: Is there a racial bias associated with neuro-monitoring and operative intervention in the acute management of patients treated at trauma centers following severe TBI, and does this have an effect on mortality?

Methods: We performed a retrospective analysis of adult patients (aged 18-55) admitted to level 1 & 2 trauma centers between 2007-2011 using the National Trauma Data Bank (NTDB). Patients were included if they had an initial Glasgow Coma Scale (GCS) 3-8 and a head Abbreviated Injury Scale (AIS) of 3-5. Patients were excluded if any anatomical AIS other than head was 3 or greater or if their file contained an empty data field in specific categories (race, mortality, neuro intervention). Coarsened exact matching was performed using age, GCS, Injury Severity Score (ISS), systolic blood pressure and respiratory rate on admission, gender, blunt versus penetrating mechanism of injury, and comorbidities to compare white to non-white patients. Missing data for variables used in the matching was imputed via a multiple regression approach. Outcomes were then analyzed using mixed effects regression analyses with patients nested within facility. Primary outcomes of neuro-monitoring or therapeutic intervention were identified using ICD-9 codes. Secondary outcomes were recorded for intensive care unit days, total length of stay, and mortality.

Results: 7618 patients were identified for analysis. Median age was 36, 81.2% were male and 64.5% were white. Medians for GCS, head AIS, and ISS were 3, 4, and 21 respectively. Rates of neuro-monitoring, operative intervention, and mortality were 8.8%, 16.5%, and 28.5% respectively. 6886 patients were able to be matched and below is the summary of the matched multivariate analysis comparing white to non-white patients. Results were unchanged when patients were stratified by mechanism (blunt and penetrating) and when looking only at blunt mechanism TBI patients with a length of stay > 1 day.

Matched Multivariate Analysis

	White	Non-White	Odds-Ratio	p-value
Hospital LOS - Days, median (IQR)	6 (3)	7 (7)		< 0.001
ICU LOS - Days, median (IQR)	4 (4)	4 (4)		0.071
Pneumonia, %	6.8	6.6	0.97	0.765
Neuro Monitoring, %	9.4	8.1	0.85	0.129
Neuro Intervention, %	16	18	1.04	0.610
Mortality, %	28.8	29.9	1.12	0.096

Conclusion: In a matched analysis using the NTDB, there were no observed differences in neuro-monitoring, operative intervention and mortality between adult white and non-white patients with severe isolated TBI treated at level 1 and level 2 trauma centers. Hospital length of stay was greater for non-white patients when compared to white patients. There does not appear to be a racial bias in the acute management of severe TBI at high level trauma centers. This controversial topic remains an important area for future research.

PULSE PRESSURE VARIATION MEASURED IN THE ICU FOLLOWING HEMORRHAGE CONTROL DOES NOT IDENTIFY FLUID RESPONSIVENESS IN MECHANICAL VENTILATED TRAUMA PATIENTS

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Introduction: Pulse pressure variation (PPV) predicts fluid responsiveness (FR) in septic shock and high-risk surgery ventilated patients. It has been proposed to guide initial fluid resuscitation in severe trauma patients but its accuracy has not been evaluated in the immediate post-operative trauma patient following hemorrhage control procedures.

Methods: Previous IRB approval, a prospective cross sectional study was designed to evaluate PPV and static preload measurements (PVC and WPP) as predictors of FR in trauma patients with class IV hemorrhagic shock, after controlling bleeding by either surgery or angio embolization, who continued to receive fluid resuscitation in the ICU. All the patients were mechanically ventilated (V_T 6 – 8 mL/Kg), and receiving intravenous sedation and neuro muscular blockade drugs as necessary. A continuous cardiac output (CO) pulmonary artery catheter (Baxter-Edwards, Irvine, Ca) and a radial artery catheter connected to a bedside monitor were used for the assessment of the hemodynamic variables. PPV calculations were made by the freezing and caliper tools available in the monitors. Displayed values were measured by triplicate, averaged and registered before and after the administration of successive 500 mL bolus (up to three) of Gelatine Polysuccinate in Ringer Acetate. ROC-AUC analyses were performed to evaluate discriminating ability of each of the tests, to identify a CO change >15% as an indicator of positive FR.

Results: A total of 54 fluid challenges administered in 19 patients with penetrating (n=13) blunt (n=4) and explosion (n=2) injuries were registered. At the start of the intervention four patients remained hypotensive, three received vasopressors and all included subjects showed biochemical evidence of hypoperfusion. We found that CO increased >15% in 27 of the events (50%). ROC-AUC for predictions of FR were 0.36 (IC 95% 0.21 - 0.52) for WPP, 0.37 (IC 95% 0.21 - 0.52) for CVP and 0.40 (IC 95% 0.25 - 0.56) for PPV.

Conclusion: PPV measured by bedside monitors did not discriminate the responsiveness to IV fluids in trauma patients under resuscitation after surgical control of bleeding.

TRANSESOPHAGEAL ECHOCARDIOGRAPHY IS EQUAL TO PULMONARY ARTERY CATHETERIZATION FOR TRAUMA AND CRITICAL CARE RESUSCITATION

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Introduction: Pulmonary artery catheter (PAC) use in critically ill populations is being increasingly questioned, with conflicting reports on reliability. A hemodynamic transesophageal echocardiography (hTEE) probe was used to validate its use in resuscitating critically ill trauma patients compared to PAC.

Methods: In a prospective case-series of critically ill trauma patients with PACs, 29 patients received an hTEE probe. Each patient was evaluated with respect to optimal preload (pulmonary arterial occlusion pressure [PaoP] 18-24mm, left ventricular end-diastolic area [LVEDA] 10-12cm²), then with respect to optimal contractility (cardiac index [CI] 2.6, fractional area change [FAC] 40%). Data obtained simultaneously from both modalities was interpreted and compared; treatment was then rendered according to protocol.

Results: In 20 patients, the hTEE supported PAC data in the treatment needed, demonstrating moderate agreement ($\kappa = 0.54$). In 9 patients, the hTEE and PAC data were not synchronous: in 6 of these patients, hTEE favored volume resuscitation, and in the remaining 3 patients PAC favored volume resuscitation. Of these 9 patients, clinical therapy was guided by hTEE in 7, with one mortality and resolution of the clinical picture in the remaining six. In 2 patients, clinical therapy was guided by the PAC, with one mortality and resolution of the clinical picture in the other patient. In 23 patients, data from the hTEE changed management of the patient, 7 of which differed from the recommended PAC treatment. In 3 patients where PAC indicated no change in therapy, the hTEE suggested volume resuscitation.

Conclusion: In trauma patients there is moderate agreement between hTEE and PAC in the ability to diagnose predominant shock etiology and direct therapy, and can help validate PAC data. Further research is warranted to determine if hTEE is a better means of detecting preload problems than PAC.

INDICES OF INFLAMMATORY RESPONSES AND OXIDATIVE STRESS IN TISSUES FROM PIGS SUBJECTED TO EXSANGUINATION SHOCK

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Introduction: Uncontrolled torso bleeding remains a leading cause of death from potentially survivable injuries in both military and civilian trauma patients. It has been estimated that such massive bleeding and resultant cardiac arrest many account for up to 80% of preventable deaths in combat casualties. We have developed a porcine model of exsanguination cardiac arrest (ECA) to test novel surgical and pharmacological interventions. The present study characterized the inflammatory responses in this model.

Methods: Conscious, sedated swine (n=5/gp) were subjected to a computerized hemorrhage of 80% total blood volume over 20 min and monitored until development of cardiac arrest and death. Then, lung, heart, kidney and liver were collected, frozen and stored at -80 oC for analysis of indices of oxidative stress (thiobarbituric acid reactive substances (TBARS), antioxidant status (total antioxidants, glutathione, antioxidant enzymes) and cytokines (IL-1 β , IL-6, TNF- α) plus HSP90. Results were compared to historic sham control animals similarly instrumented (n=4).

Results: Time to cardiac arrest was 18.3 ± 0.7 min and blood loss at time of ECA was $71.0 \pm 1.5\%$. TBARS were nearly 50% higher in ECA liver and elevated in kidney compared to corresponding sham tissue. In liver, heart and lung, the reduced-to-oxidized glutathione levels were significantly higher in shams than ECA swine. Mn-superoxide dismutase (Mn-SOD) activity was over 40% higher in ECA liver and kidney compared to shams. IL-1 β in liver and lung, and TNF- α in lung from ECA animals were markedly elevated compared to shams, whereas IL-6 levels were not significantly different between groups in all tissues. HSP90 levels were significantly higher in all ECA tissue than shams.

Conclusion: These data indicate that ECA induced a significant inflammatory response as indicated by elevations in TBARS, cytokines, HSP90 and Mn-SOD activity and lower ratios of reduced to oxidized glutathione levels. Interestingly, there were differential responses among the tissues analyzed. Taken together with sustained cardiac contractility in ECA animals reported previously, these data suggest that lifesavings interventions to include pharmacologic therapy targeted to the inflammatory response may be beneficial in exsanguination cardiac arrest.

A PROSPECTIVE ANALYSIS OF URINARY TRACT INFECTIONS AMONG ELDERLY TRAUMA PATIENTS

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Introduction: Catheter-associated urinary tract infections (CAUTI) have been deemed “reasonably preventable” by the Centers for Medicare and Medicaid (CMS) thereby eliminating reimbursement. Elderly trauma patients, however, are at high risk for developing urinary tract infections (UTI) given their extensive comorbidities, immobilization, and environmental changes in the urine which provide the ideal environment for bacterial overgrowth. Whether these patients develop CAUTI as a complication of their hospitalization or have asymptomatic bacteriuria (ASB) or UTI upon admission must be determined in order to justify the “reasonably preventable” classification. We hypothesize that a significant proportion of elderly patients will present with ASB and UTI on admission.

Methods: IRB permission was obtained to perform a prospective, observational clinical trial of all elderly (≥ 65 years) patients admitted to our Level I Trauma Center as a result of injury. Urinalysis (UA) and culture (UCx) were obtained at admission, 72 hours, and, if diagnosed with UTI, at 2 weeks after injury. UTI was defined as a bacteriuria ($\geq 10^5$ colony forming units) with associated symptoms while ASB was defined as a bacteriuria without symptoms. Pyuria was defined as ≥ 4 neutrophils per high power field (HPF) and microscopic hematuria was defined as ≥ 3 RBC per HPF. Mean cost of UTI was calculated based Center for Disease Control estimates of \$862 - \$1,007 per UTI.

Results: Of 201 eligible patients, 129 agreed to participate (64%). Mean age was 81 ± 8.6 years. All patients had a blunt mechanism of injury (76% falls) with a mean Injury Severity Score of 13.8 ± 7.6 . Of the 18 (14%) patients diagnosed with UTI, 14 (78%) were present at admission. Additionally, there were 18 (14%) patients with ASB on admission. Therefore, 32 (25%) patients had a bacteriuria (UTI + ASB) at admission. All of the admission UTIs resolved by day 3 but 2 patients with admission ASB had persistent bacteriuria. The most common bacterial species present on admission urine culture were *E. coli* (24%) and *Enterococcus* (16%). Clinical features associated with bacteriuria on admission included a history of UTI (76% vs 41%, $p < 0.01$), positive gram stain (68% vs 1.5%, $p < 0.01$), abnormal microscopy (91% vs 45%, $p < 0.01$), and pyuria (83% vs 39%, $p < 0.01$). The estimated loss of reimbursement for 18 UTIs on admission was \$15,516 - \$18,126; however, given an estimated cost of \$1981 to screen all patients with UA and UCx at admission, \$16,144 savings was realized.

Conclusion: Many elderly trauma patients present with concurrent bacteriuria. Most UTIs which would have otherwise been diagnosed in the hospital were in fact present on admission. Screening UA and UCx on admission for elderly trauma patients identifies these UTIs and is cost-effective.

INCREASING ORGAN DONATION AFTER CARDIAC DEATH IN TRAUMA PATIENTS

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Introduction: Trauma patients form one of the largest pools of organ donors. Organ donation after cardiac death (DCD) is not optimal but still remains a valuable source of organ donation. The aim of this study was to assess national trends in donation after cardiac death from trauma patients.

Methods: We performed a 12 year (2002-2013) retrospective analysis of the United Network for Organ Sharing (UNOS) database. Eligible trauma patients who donated solid organs after cardiac death were analyzed. Outcome measures were: conversion rate (number of donors divided by number of eligible donors), and number and type of solid organs donated.

Results: A total of 120,512 eligible trauma organ donors were reviewed and the conversion rate was 11.36%. Donation after cardiac death resulted in procurement of 16,248 solid organs from 8,724 donors. The number of organs donated per donor remained unchanged over the study period (2 organs/donor in 2002 and 1.8 organs/donor in 2013, $p=0.1$). Donation after cardiac death increased significantly from 3.1% in 2002 to 14.6% in 2013 ($p=0.001$). There was a significant increase in the proportion of kidney (2002: 3.4% vs. 2013: 16.3%, $p=0.001$) and liver (2002: 1.6% vs. 2013: 5%, $p=0.041$) donation over the study period.

Conclusion: Organ donation after cardiac death from trauma patients provides significant number of solid organs. The rate of organ donation after cardiac death increased significantly over the last 12 years. Increasing education regarding donation in general to the public and to the trauma community may aid in increasing the number of organs available for donation.

THE UNINSURED, THE HOMELESS AND THE UNDOCUMENTED IMMIGRANT TRAUMA PATIENT. REVEALING HEALTH CARE DISPARITY AT A LEVEL ONE TRAUMA CENTER.

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Introduction: Insurance status has been linked to patient outcome. Differences between patients that are uninsured and have additional disparities such as homeless or undocumented immigrant patients have not been defined. The objective of this project is to review and compare the degree of injury, and financial burden between uninsured trauma patients with and without further disparities.

Methods: The trauma registry was used to evaluate these patients retrospectively from January 1st to December 31 of 2013. Data evaluated included age, mechanism of injury, ISS, hospital length of stay, ICU length of stay, mortality, hospital cost, physicians' charges, hospital charges, and actual payments received. Comparison was made between uninsured patients without further disparities or self-pay (SP), uninsured patients that are homeless (H) and uninsured patients that are undocumented immigrants (UI).

Results: During the study period 2619 patients presented as trauma alerts to a level one trauma center. The total number of uninsured patients was 900. Of those 873 were self-pay (SP), 11 were homeless (H) and 16 were undocumented immigrant (UI) patients. Age was similar between the groups (Mean: SP=34.7, H=36.3, and UI=31. Median: SP=31, H=32, and UI=27). The homeless patients had a median ISS five times higher when compared with the other groups (Mean: SP=8.8, H=21.3, and UI=9.2. Median: SP=5, H=25, and UI=5.5). Homeless patients also had an increased hospital length of stay (Mean: SP=3.9, H=15.4, and UI=8.8 Median: SP=1, H=4, and UI=2) and ICU length of stay (Mean: SP=1.3, H=3.4, and UI=2.9). Mortality in homeless patients was four times higher when compared with undocumented immigrants and five times higher when compared with self-pay patients. (SP=4.47, H=27.27, and UI=6.25). Accordingly, hospital costs were also higher in the homeless group (Mean: SP=15550, H=47370, and UI=28714. Median SP=6298, H= 11937, and UI=7025), as well as physician charges (Mean SP=6533, H=24788, and UI=9780) and hospital charges (Mean: SP=61144, H=170353, and UI=112034). No actual payments were received at all, to cover for the care of homeless trauma patients during the study period (Mean: SP=1890, H=0, and UI=9494).

Conclusions: In this retrospective review of a single center, uninsured homeless trauma patients were sicker and congruently represented more cost for the hospital when compared with other uninsured trauma patients. Interestingly no actual payments have been received to cover for the care of homeless patients . A multi-center trial could be conducted to elucidate the problem better and create awareness, to promote the search for a solution.

THE IMPACT OF INSURANCE STATUS, DIABETES AND UNDIAGNOSED DIABETES ON OUTCOMES AMONG TRAUMA PATIENTS

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Introduction: Medical factors, such as diabetes, and non-medical factors, such as insurance status, affect outcomes following traumatic injury. We recently demonstrated that when accounting for medical co-morbidities, the effect of insurance status upon trauma outcomes is minimized. Indeed potentially undiagnosed and/or poorly controlled medical co-morbidities appear to exert a tremendous effect upon trauma outcomes. The effect insurance status plays on trauma outcomes may be a reflection of access to health care, more co-morbidities diagnosed and better control of these co-morbidities pre-trauma admission. We wished to assess the impact of insurance status on the pre-trauma diagnosis and management of diabetes, rates of potentially previously undiagnosed diabetes, and whether any undiagnosed diabetes was associated with trauma outcomes.

Methods: A 10 year retrospective review of admitted trauma patients, 18 years and older to a level 1 trauma center. Patients who died within 24 hours were excluded. Charts were reviewed for age, gender, medical co-morbidities, specifically diabetes, insurance status, mechanism, and ISS. Hospital course was reviewed for HbA1c levels, any infectious outcome, length of stay and mortality. Further, charts were reviewed for potentially undiagnosed diabetes. Charts of patients with no known diagnosis of diabetes were reviewed for the four glucose levels prior to discharge as well as any HbA1c measured during their trauma admission. Patients were considered undiagnosed diabetic if they had any of the following: HbA1c $\geq 6.5\%$, two fasting glucose levels $>125\text{mg/dL}$, or two random glucose levels $>200\text{mg/dL}$. Chi-squared, t-test and regression analyses were undertaken.

Results: Over the 10 year period 23,220 patients were admitted, 21% of whom were uninsured. Insured patients were older (55.7 vs 36.9 years; $p<0.001$), less likely to be male (59.5% vs 79%; $p<0.01$), but had similar injury severity scores (11.3 vs 11.5; $p=0.3$). Insured patients were more likely to have a pre-trauma diagnosis of diabetes (6.7% vs 3.5%; $p<0.001$). Among these diabetics, insured patients had better pre-trauma diabetes control as reflected by lower average HbA1c levels (7.9% vs 9.6%; $p=0.006$). Of the non-diabetic patients, 34.7% were potentially undiagnosed diabetics. Adjusting for age and gender, insurance status did not affect the possibility of having undiagnosed diabetes (OR=1.05; 95%CI=0.95-1.17). However, adjusting for age, gender and ISS, patients with potentially undiagnosed diabetes were noted to have an increased risk of infection during their hospital stay (OR=1.5; 95%CI=1.06-1.36) and an increased risk of death (OR=2.4; 95%CI=1.9-3.1)

Conclusion: It is becoming increasingly evident that pre-trauma medical health is a large determination of outcomes following admission for traumatic injuries. Insurance status may be affecting trauma outcomes through access to health care and better control of known medical conditions. We have herein demonstrated that potentially a large portion of the trauma population may have un-diagnosed diabetes. Further, undiagnosed diabetes plays a significant role in trauma related outcomes. Trauma remains a leading cause of morbidity and mortality. We believe that better access to health care and screening for controllable medical conditions is crucial to further advances in trauma care.

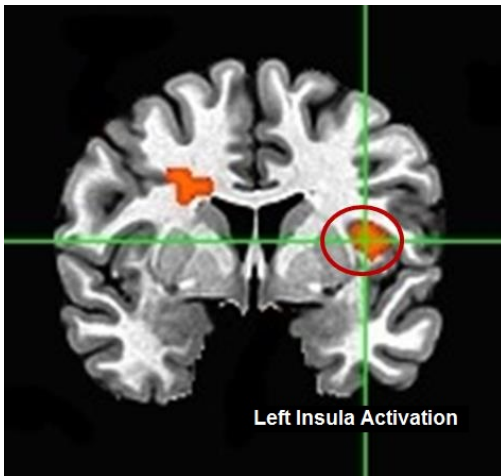
FMRI EVIDENCE FOR THE USE OF A 4-ITEM SCREEN FOR PTSD IN INJURED TRAUMA SURVIVORS

Jacob R. Peschman MD, Lauren Taubitz MS, Terri DeRoan-Cassini Ph.D., Christine Larson Ph.D., Karen J. Brasel* MD, Medical College Of Wisconsin

INTRODUCTION: Functional magnetic resonance imaging (fMRI) research suggests that early emotional dysfunction is evident at the neural circuitry level in patients who go on to develop posttraumatic stress disorder (PTSD) at 6 months. The purpose of this study was to determine the relationship between the primary care – PTSD (PC-PTSD) screen and neurologic dysfunction using fMRI technology.

METHODS: Twenty-four motor vehicle crash survivors treated at a Level I trauma center were recruited within 2 weeks post trauma, were given a measure that included the four questions from the PC-PTSD, and underwent fMRI imaging during a trauma narrative paradigm (listening to the story of their motor vehicle crash). Two tailed Pearson Correlations were used to evaluate the relationship between activation of brain structures responsible for emotional processing of fear and the four items from the PC-PTSD.

RESULTS: There was a significant positive relationship between PC-PTSD scores and left insula activation (corrected $p < 0.05$, min. cluster size = 12). There was also a significant cluster in left superior temporal gyrus where there was a significant negative relationship between PC-PTSD scores and activation (corrected $p < 0.05$, min. cluster size = 12).



CONCLUSION: Early intervention is efficacious in the management of PTSD if at risk patients are identified. While imaging every trauma survivor to determine PTSD risk is not feasible, the use of this 4-item screen would be clinically useful and efficient. This short, easily administered scale appears to be a valid tool for early identification of patients at increased risk of developing PTSD.

DETERMINANTS OF DRIVING UNDER THE INFLUENCE PROSECUTION IN TRAUMA PATIENTS AT AN URBAN LEVEL 1 TRAUMA CENTER

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Introduction:

We sought to determine the prosecution rate (PR) for alcohol-intoxicated drivers injured in motor vehicle crashes presenting to a Level 1 Trauma Center. This study investigates the differences between those charged and not charged with driving under the influence (DUI).

Methods:

Alcohol-intoxicated drivers from 2009-2012 were identified through the local trauma registry. Patient medical and public judicial records were retrospectively reviewed. Demographic, injury severity, length of stay, and prosecution data were collected.

Results:

1715 patients with prosecution data were identified. Of these, 78 persons were prosecuted yielding an overall prosecution rate (PR) of 4.6%. The PR was significantly higher in females (6.5% vs. 4.0%, $p=0.0309$) and was significantly higher in blacks (8.3%) and Hispanics (8.8%) than in whites (3.9%) ($p=0.0020$). We observed no difference in injury severity, length of stay, or patient outcomes. Patients with one or more previous DUI conviction(s), prior vehicular or alcohol infractions, or comorbid intoxication with cocaine or marijuana did not experience higher PR. The association between insurance type and prosecution status exhibited a trend toward significance ($p = 0.0595$), with managed care patients having the highest prosecution rate (9.5%), and Medicare (1.3%) having the lowest. The PR was significantly higher among recidivist patients than among non-recidivist patients (14.3% vs. 5.0%), and the overall rate of recidivism within the study period was 3.9%. There was no significant association between prosecution status and age (even when categorized as < 21 and ≥ 21), type of machine driven, ED disposition, or DMV notification of DUI status by physicians.

In our multivariate analysis, the main predictors for prosecution were gender, race, and level of intoxication. Women were 1.8 times more likely than men to be prosecuted ($p=0.0151$). Black patients were 2.4 times more likely than whites to be prosecuted ($p=0.0020$); Hispanic patients were also more likely to be prosecuted, but this did not achieve statistical significance. The likelihood of prosecution increased by 3.7% for every 10 mg/dL increase of BAC.

Conclusion:

PRs for DUI at our trauma center were dismal at 4.6%, and the main predictors for prosecution were female sex, black race, and higher BAC level. Our high recidivism rate with almost 4% of patients acquiring a subsequent DUI within the study period highlights the need for urgent multidisciplinary intervention.

NATIONAL MANDATORY MOTORCYCLE HELMET LAWS CAN SAVE \$2.2 BILLION PER YEAR: INPATIENT AND VALUE OF STATISTICAL LIFE ANALYSIS

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Introduction:

As of 2010, 19 states have mandatory motorcycle helmet laws. Two states, Illinois and Iowa, do not have any motorcycle helmet laws. While ample statistics exist regarding the overall rate of fatalities in motorcyclists with and without helmets, a combined inpatient and value of statistical life (VSL) analysis has not previously been reported.

Methods:

Statistical data of motorcycle collisions were obtained from the Centers for Disease Control, National Highway Transportation Safety Board, and Governors Highway Safety Association. The VSL estimate was obtained from the 2002 Department of Transportation calculation. Statistics on helmeted vs. nonhelmeted motorcyclists, death at the scene, and inpatient death was obtained using the 2010 National Trauma Data Bank. Inpatient costs were obtained from the 2010 National Inpatient Sample. Population estimates were generated using weighted samples and all costs are reported using 2010 USD using the Consumer Price Index.

Results:

3,951 fatal motorcycle accidents were reported in 2010, of which 77% of patients died at the scene, 10% in the ER, and 13% as inpatients. 37% of all riders did not wear a helmet, but accounted for 69% of all deaths. Of those motorcyclists who survived to the hospital, the odds ratio of surviving with a helmet was 1.51 compared to those without a helmet ($P<0.001$). 6.5% of hospitalized patients died following motorcycle collision. A VSL analysis (\$47,040 per year) yielded \$6.8 billion of indirect losses. Total costs for nonhelmeted motorcyclists were 66% greater at \$5.5 billion, compared to \$3.3 billion for helmeted motorcyclists ($P<0.001$). Direct inpatient costs were 16% greater for helmeted riders (\$203,248 vs. \$175,006) but led to over 50% greater VSL generated (absolute benefit \$602,519 per helmeted survivor).

Conclusion: A cost analysis of inpatient care and indirect costs of motorcycle riders who do not wear helmets leads to an excess of \$2.2 billion in losses per year, with almost 1.9 times as many deaths compared to helmeted motorcyclists. The per capita cost per fatality is over \$800,000. Institution of a mandatory helmet law can lead to an annual cost savings of over \$2.2 billion, plus an additional \$2.4 billion generated as a result of a VSL calculation for a total of \$4.6 billion net gain per year.

IMPROVING TRAUMA PATIENT COMPLIANCE WITH FOLLOW UP CLINIC APPOINTMENTS

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Introduction: Compliance with follow up clinic appointments is considered to be quite poor in the trauma population with approximately 40-50% of patients being lost to follow up.¹ The perception that trauma patients do not follow up has implications on patient care that include choice in medication, operative decisions and even the length of time a patient is kept in the hospital. More recent studies have challenged this perception and found that 79% of patients keep at least one scheduled appointment.^{2,3} Follow up appointments are an important component in the care of the traumatically injured patient. Malhotra and colleagues found that 17% of trauma patients had significant health issues that were not discovered until follow up visits.⁴

Methods: This study was conducted at an urban level one trauma center. Usual protocol for post inpatient follow up consists of a letter being mailed to the patient supplying them with appointment dates and times. As part of a quality improvement project, all trauma patients discharged during a two-month period were met with by either the nurse practitioner (NP) or surgical intern prior to discharge. During this visit the NP or intern performed a simple intervention; they told the patient when their appointment would be before they left the hospital. A chart review was then performed to ascertain which appointments the patient had kept as well as other demographic information. These patients were then compared to patients admitted during the preceding six months.

Results: Prior to the study intervention there were 465 patients, which made up our control group (PRE). During the two-month study period there were ninety-nine patients admitted and included in the quality improvement initiative (POST). 34% of these patients were victims of penetrating trauma and 66% blunt trauma. The average ISS score was 12.5 ± 8.6 and 61% of patients underwent at least one operation during their hospital stay. Overall 38% of all patients were lost to follow up. When looking at the breakdown of specialty clinic 57% were compliant with trauma clinic follow up, 44% with neurosurgery, 69% with orthopedic surgery and 64% with other clinics. When comparing the PRE and POST intervention groups 42% of PRE patients were lost to follow up (58% compliant) and only 24% of POST patients did not keep at least one appointment (76% compliance) ($p=0.0027$). Sub group analysis of individual clinics did not show any statistically significant differences between PRE and POST patients. Several factors were analyzed by univariate analysis to see if they had any affect on patient compliance with follow up. Being in the intervention group (POST) ($p=0.0027$), having an operation ($p<0.0001$) and a higher ISS were all associated with increased probability of keeping at least one appointment. Patients who were compliant had an average ISS of 13.9 ± 8.64 , whereas those who were lost to follow up had an average ISS of 10.0 ± 7.69 ($p<0.0001$).

Conclusions: Aaland and colleagues found that among their trauma patients lost to follow up, 36.8% of them were lost due to errors on part of the physician or hospital.² The perspective that trauma patients do not comply with follow up visits may have a negative impact on clinical decision-making. In this study we have shown that by merely providing the patient with the time and date of their follow up appointment prior to discharge, follow up compliance improved significantly from 58% to 76%.

INTERNAL STAFF SURGE DURING MASS CASUALTY EVENT PRESERVES OTHER HOSPITAL RESOURCES

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Introduction: Mass casualty events disrupt normal hospital operations that go beyond trauma or surgical services. Certain key resources are invaluable during such events and these appear as bottlenecks that impair patient flow. We reviewed our mass casualty event to assess patient flow and resource consumption as well as the impact on non-trauma services.

Methods: As part of Performance Improvement and with IRB approval, we studied our recent mass casualty event. Twelve elderly patients were injured in a freeway bus crash and brought to the nearest level 1 trauma center after EMS scene triage based on START methodology. The time of patients to ED diagnostic studies and to ICU/Floor transfer were recorded and analyzed. ED non-trauma patient flow and OR patient flow were similarly studied. Patient demographics and outcomes were recorded from the NTRACS database. Outcomes were compared with chi-square analysis and case matched outcomes.

Results: The average age was 69.7 years old and the average ISS was 24.3. ED LOS was 3.4 hours (range 0.6-9 hours). Patients arrived within a 35 minute window midafternoon. Those patients requiring ICU/OR disposition had an ED LOS of 2.3 hours (range 0.6-5.4 hours). Additional resources for patient care were derived from three additional trauma surgeons and one fellow as well as three additional mid-level residents above the designated trauma team (an attending and 4 residents). Four nurses were mobilized from administration and three clerks were shifted to handle non-clinical trauma victim duties. Housekeeping prioritized ICU bed cleaning for 2 hours from on duty personnel. During the time interval, ED patient flow was maintained (238 patients/day, 5 patients/day left without being seen, not different than quarterly data) and OR volume was 67 cases (not significantly different from daily case volume preceding three months). All patients survived, mean LOS was 13.6 days, and 9 patients (75%) were discharged to SNF/Rehab. Survival was improved from case matched controls ($p < 0.05$), but LOS was significantly longer ($p < 0.05$).

Conclusion: A mature trauma center can handle a mass casualty event with internal resources without delaying other non-trauma services and maintaining sound trauma care. Administration, however, must recognize the value of staffing for surge contingency and maintaining a flexible pool of trained clinicians readily available from other assignments to avoid hospital wide impact.

On the Feasibility of Using All Payer Claims Data to Monitor Regional Trauma Care Transitions

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BACKGROUND: American College of Surgeons trauma verification includes pre-review of service and referral geographic catchment areas around trauma centers from data collected in hospital and state-level trauma registries. Service area data from such registries based on farthest Euclidean pre-hospital transport distance of ZIP code clusters lacks health exchange information that could quantify out migration of service area patients to surrounding states. Out migration information would facilitate state-level gauging of care fragmentation, assessing regional gaps in specialty taxonomies, and determining to what extent drops in trauma center requisite patient volume are attributable to catchment drift. We sought to determine the feasibility of using Massachusetts (MA) All Payer Claims Database (APCD) to fill this critical gap in state-level and hospital-level information on trauma care navigation by MA residents outside of state boundaries, specifically in bordering New England Region States, and profile referral and transfer patterns in 'in state' and 'out of state' trauma care seekers.

METHOD: An extraction of 1.74 million private-sector health plan beneficiary trauma care (CY 2009-2011) medical claims for 229,557 episodes of care needed by 91,477 MA residents from APCD for MA Level I, II, and III trauma center primary service area ZIP codes were analyzed for out of state inpatient trauma care seeking patterns by service provider specialty taxonomy, referral indicators, covered days, patient outcomes, patient age, and in network payment flags. Statistical tests and patient-level roll up of claims by patient and payer claim control numbers, demographic and diagnoses information, service payment window dates and provider information were performed using SAS (version 9.2). Geographic data visualization of maximum MA resident out of state linear trauma care seeking distance using de-identified aggregated ZIP codes and census attributes were performed using ESRI's ArcMap (version 9.3.1).

RESULTS: Private health plan beneficiary MA residents receiving inpatient trauma care out of state constituted 9% of the patient sample with 50% of that care provided in New England (NE) states bordering MA in order of the following MA patient volume ranking: RI, NH, CT, NY, ME, and VT. Comparing in state care seekers (mean age 53) to NE care seekers (mean age 44), NE patients had increased odds of care destination through referral (OR 1.34, 95% CI 1.28-1.4, $p < 0.0001$ and a 42% higher risk of charges not paid in comparison to MA ($p < 0.0001$). Florida and Texas rank as the highest volume non-New England region sites of care. Clinically, NE patients had a higher rate of care sought for open fracture of base of skull with subarachnoid, subdural, and extradural hemorrhage, with loss of consciousness of unspecified duration than non-MA care seekers outside of the NE region. SAS method for patient rollout of claims data was successfully validated against trauma registry volumes for single eligibility beneficiaries. Trauma Registry data had higher quality external cause of injury than claims data.

CONCLUSION: APCD systems in combination with existing clinical registries and pre-hospital data can fill gaps in information needed for care coordination and monitoring disparities in access to care and provide new information on in state and out of state post discharge care settings.

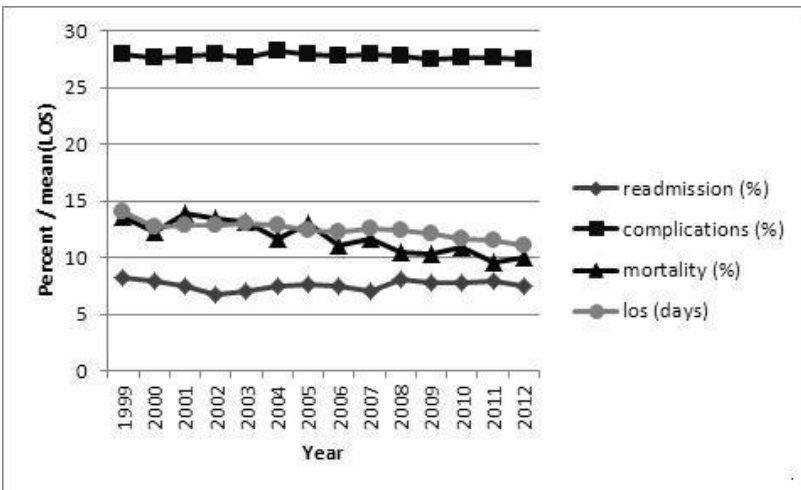
EVOLUTION OF PATIENT OUTCOME IN AN INTEGRATED TRAUMA SYSTEM: 1999-2012

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Introduction: The introduction of trauma systems in many countries worldwide has been shown to improve outcomes following injury. However, few data are available on the evolution of patient outcomes in fully integrated trauma systems. The objective of this study was to describe the evolution of patient outcomes in a Canadian provincial trauma system from 1999 to 2012.

Methods: This population-based retrospective cohort study was based on patients with major trauma (Injury Severity Score >15) treated in the integrated trauma system of Quebec, Canada between 1999 and 2012. Over 90% of major trauma admissions are treated within the system and this proportion has remained stable over the study period. Data was drawn from the trauma registry linked to the hospital discharge database and mortality files. Performance was evaluated using quality indicators of 30-day mortality, unplanned readmission, length of stay, and complications, derived and validated previously. Performance over time was evaluated using general linear mixed models with a correction for hospital clusters. Analyses were performed for the whole sample then stratified for designation level (levels I and II versus levels III and IV) and patient age (

Results: Risk-adjusted mortality decreased from 13.6% to 10.1% between 2009 and 2012 and mean LOS decreased from 14 days to 11 days (trend-p



Conclusion: The results of this study suggest that there have been important improvements in patient mortality and resource use in the integrated trauma system of Québec over the last decade. Results also suggest that efforts should be made to reduce in-hospital complications and unplanned readmissions. Future research should assess whether improvements have occurred in longer-term outcomes such as functional capacity and quality of life.

THE GERIATRIC TRAUMA TEAM: A NOVEL APPROACH TO CARING FOR ELDERLY TRAUMA PATIENTS

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The Geriatric Trauma Team: A novel approach to caring for elderly trauma patients.

Introduction: Nationwide, geriatric trauma has progressively increased over the last two decades with mechanisms like falls becoming a dominant mechanism of injury. This population often has comorbidities requiring complex concurrent medical management. In view of this rising proportion of elderly trauma patients, in January 2012, at our Level I Trauma Center, we instituted a separate Geriatric Trauma Team – led by a Geriatrician with trauma mid-level practitioners, dedicated to caring for elderly patients with single system injury, who after initial evaluation by the Trauma Team did not require Intensive Care Unit (ICU) management. We studied patients on this new exclusive “team”, comparing their outcomes with those patients under the prior traditional model.

Methods: At our ACS verified Level I Trauma Center, trauma registry data of patients admitted to the Geriatric Trauma Team single system injury, age ≥ 55 , not requiring ICU) was collected from the period between January 1- December 31st, 2012. Data was also collected for the preceding 12-month period (Jan-Dec 2011) – the Pre-Geriatric Team Period. Length of stay (LOS), re-admission rates, Injury Severity Score (ISS), mechanism of injury, injury type, complications and mortality data were recorded. Comparisons were performed for readmissions and LOS based on ISS groupings (0-9, 10-15, 16-24 & ≥ 25). Independent t-test and chi-squared testing were used for continuous and discrete variable comparisons with 0.05 considered statistical significance.

Results: A total of 310 patients were admitted to the Geriatric Team in the 12-month period studied vs. 906 patients ≥ 55 yrs. in the preceding 12 months. Falls and Motor Vehicle crashes were the most common mechanism of injury in both groups. Subdural hematomas, intra-cerebral hemorrhage and spine fractures were the most common injuries in both periods. Mean ISS was expectedly overall higher in the Pre-Geriatric group that consisted of all elderly patients in that 12 month period (12.3 vs. 10.4, $p < 0.0005$) Analyzing four individual ISS groupings stated above, there were no statistically significant differences in the LOS and readmission rates comparing the Geriatric team to the Pre-Geriatric Team period. There was no in hospital mortality on the Geriatric Team during the 12-month period studied.

Conclusion: A team led by a geriatrician exclusively caring for elderly patients with single system injuries after clearance by primary Trauma Team’s assessment is equally as effective as the traditional trauma team model with regard to LOS and re-admissions. The ability to specifically focus on the complex medical and social issues potentially proffers an additionally advantage to this population. In the current climate of Trauma personnel shortages and resident hour restrictions at large Trauma Centers, this model and adaptations to it, could present viable options for caring for the increasing ranks of elderly injured patient

A NOVEL MODEL TO PREDICT ADMISSION VOLUME AT A LEVEL I TRAUMA CENTER

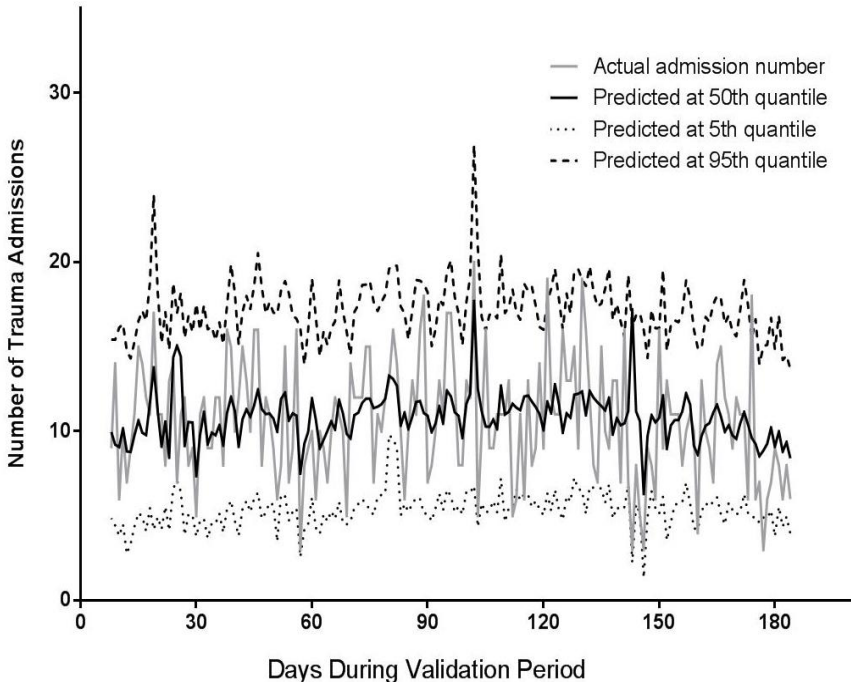
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INTRODUCTION: It is widely believed that multiple factors influence trauma volume including seasonal and weather variations as well as other social and environmental elements. We hypothesized that such factors could be used to create a prediction tool to model trauma volume and injury patterns, making it possible to more accurately predict the number and type of trauma resources that will be necessary on any given shift.

METHODS: A retrospective review of the trauma registry of a level I trauma center from 1/1/2009 to 4/30/2013 was performed, correlating activation and admission data with system factors, local events, and weather data. A prediction model was created using simultaneous quantile regression for the 5th, 25th, 50th, 75th, and 95th quantiles of daily trauma admission volume. This model was then validated on a new data series over a 6-month period from 5/1/2013 through 10/31/2013 where predicted and actual numbers of trauma admissions were compared.

RESULTS: There were 15,873 trauma admissions in the initial series on which the prediction model was developed and 1,940 admissions in the test series on which the model was validated. Factoring in both groups, the number of daily trauma admissions ranged from 2 to 33 with a mean of 10.4 admissions per day. After adjusting for the seasonal, monthly, and weekly cyclic patterns in trauma, several additional parameters including daily high temperature, rain, fog, recurring annual events, and the trauma volume one week and one day prior continued to be independently predictive of daily trauma admissions ($p < 0.05$). Model validation revealed an average difference between the predicted and actual number of admissions at the 50th quantile of 2.5 admissions per day. Additionally, well over 90% of trauma admissions fell between the model's 5th and 95th quantiles demonstrating validity for this prediction tool (See Figure).

CONCLUSION: We have presented a novel application of quantile regression to predict the number of daily trauma admissions based on several measurable parameters. This model accurately forecasts both the number of daily admissions as well as a valid range of admissions for the 5th and 95th quantiles. Considering a daily admission range from 2 to 33, the fact that our predictions varied from observed values by an average of only 2.5 is indicative that our model provides reasonable estimates to allow for better allocation of resources, including the number and scheduling of trauma surgeons, residents, and physician extenders.



EFFECTIVENESS OF GROUND AMBULANCE VERSUS HELICOPTER TRANSPORT FOR INTER-HOSPITAL TRANSFERS IN RURAL TRAUMA

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Introduction: The clinical benefits of helicopter transport over ground transport for inter-hospital transfers are unclear. This study compares patient outcomes in helicopter emergency medical services (HEMS) and ground emergency medical services (GEMS) in rural trauma inter-hospital transfers (IHTs).

Method: This is a retrospective cohort study of 3308 IHT patients by HEMS or GEMS between January 2006 and December 2012. Outcomes of interest were hospital length of stay (LOS), ICU LOS, pre-hospital times, and mortality. Patients were divided into minor (ISS<15) and major (ISS≥15) trauma. Multiple logistic regression analysis was performed for patients transferred within 30, 30-59, ≥60 miles from trauma a center (TC).

Results: A total of 1257 (38%) patients were transported by helicopter and 2051 (62%) patients were transported by ground. Patients transported by HEMS were more severely injured: average ISS (18.3 vs 13.1 $p<.0001$), average GCS (12.7 vs 14.4 $p<.0001$), and SBP <90 (3.6 % vs 1.4% $p<.0001$). Patients transported by helicopter were significantly likely to be in the traumatic brain injury (TBI) cohort and were more likely to have pre-hospital intubation. Total pre-hospital time and transportation time were significantly shorter in the helicopter group. Helicopter-transported patients were more significantly likely to be directed to the ICU and operating room from the emergency department. There was no difference in mortality in patients with an ISS <15 and on multivariate analysis there was no difference in survival between the two modes of transport. For patients with an ISS ≥15, helicopter-transported patients had higher mortality (11.4% vs 6.0% $p<0.0003$). However, on multivariate analysis, patients transferred ≥60 miles from the TC had significant survival benefit in the HEMS group.

Conclusion: Helicopter transport is faster than ground transport in rural trauma IHTs. Patients with major trauma (ISS ≥15) transported by helicopter had survival benefit if transferred ≥60 miles from the TC. This highlights the potential benefit of helicopter-transferred patients with major trauma as the distance increases from a TC.

SAFE AND COST EFFECTIVE METHOD OF DECREASING TRAUMA SYSTEM OVERTRIAGE WITHOUT OVERBURDENING THE TRAUMA SERVICE

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Introduction: Overtriage and under triage is a balancing act for Trauma Systems. With the changing economics of healthcare reimbursement, efficient utilization of resources without increasing outcome measures is optimal. We implemented a process to decrease overtriage without adversely affecting patient (pt) outcome or overburdening the Trauma Service.

Methods: Patients not meeting strict American College of Surgeons (ACS) trauma criteria for trauma team activation in a mature Trauma System were designated as Trauma Resource (TR) and brought to a designated Trauma Center for expedited evaluation in the Emergency Department (ED) with early involvement of a Trauma Surgeon (TS) as needed. All TR pts were expedited in the ED. A board certified ED physician, trauma nurse and ED nurse met the pt on arrival to the ED. The CT technician, respiratory therapist and lab technician were notified on pt's arrival. CT scans for TR pts were expedited. Data over a 7 month period were collected concurrently and analyzed.

Results: 871 pts meeting ACS trauma criteria and 318 TR pts were treated over the study period. Of the 318 TR pts, 5 pts were upgraded to Trauma Activation (TA) status immediately upon arrival to the ED, 52 pts required TS consultation and hospital admission, 40 pts were admitted to a non-trauma service and 221 pts were evaluated in the ED and discharged home.

Data for Trauma Patients by Triage Group

Patient Group	N	MeanAge	% Males	% Falls	Mean ISS	Hospital LOS(days)	Mortality	Time to definitive care (min)
TA	684	47.2±22.2	66.5	35	9.8±8.5	5.2±10	28(4.1%)	132±74
ED -TS consults	187	57±23.8	58.2	56	9.9±6.0	4.2±4.1	2(1.1%)	98±59
TR upgraded to TA	5	50.6±31.4	40.0	40	15.2±7.8	4.4±4.4	0	74±31
TR admitted to TS	52	60.4±23.7*	61.5	52*	9.7±5.3	3.4±1.6	1(1.9%)	79±24 *^
TR admitted to nonTS	40	70.8±21.9	47.5	82.5	na	na	na	na
TR discharged home	221	47.4±24.7	61.5	44	na	0	na	na

*Time to definitive care = time from TS contact with pt until admission to IR, OR, ICU, step down unit or floor bed. *Statistically significant difference compared to TA group. ^Statistically significant difference compared to trauma consults from ED group.

TR pts admitted by the TS were similar to TA pts with regards to gender, mean ISS, hospital LOS and mortality; however, the TR admitted pts were significantly older than TA pts ($p<0.0001$), had more falls as a mechanism of injury ($p=0.0170$) and had a shorter time to definitive care ($p=0.0001$).

TR pts admitted by the TS were similar to trauma consult pts from the ED with regards to age, gender, fall mechanism, ISS, LOS, and mortality but had significantly shorter time to definitive care compared to trauma consults from the ED ($p=0.0274$).

Utilization of resources were significantly less in the TR pts compared to TA pts. Charges were significantly different. ED charges for the 52 TR pts admitted to the TS was \$253,708 vs \$1,168,270 if they had all been trauma activations. There were no ED deaths. The one TR death was a nonagenarian who was made comfort care the following day and expired.

Conclusion: Designating patients as TR pts prehospital with expedited evaluation in the ED with early TS consultation resulted in the utilization of fewer resources, lower hospital charge without increase in hospital LOS, time to definitive care or mortality.

Parallel Universes for Statewide Trauma Triage: Variability of Trauma System Performance Based on Mechanism of Injury and Age

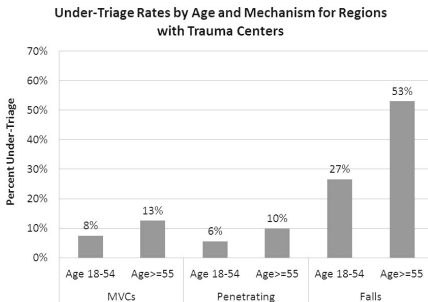
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Introduction: Trauma system performance is often determined for aggregated populations, which makes it difficult to identify opportunities for improvement. We hypothesized that under-triage is a function of age and mechanism of injury, when controlling for regions with similar access to trauma care.

Methods: We conducted a retrospective analysis of all hospital visits in California using the Office of Statewide Health Planning and Development Database over a 5 year period. All hospital admissions and emergency department visits associated with injury were longitudinally linked. We included patients who were severely-injured patients as defined by an injury severity score (ISS) > 15. Regions were categorized by “Local Emergency Medical Services Agencies” (LEMSAs) with and without trauma centers. The primary outcome was the rate of under-triage, defined by admission to a non-trauma hospital.

Results: A total of 60,182 severely injured patients were included in the analysis. Triage patterns depended on mechanism of injury and age when trauma center access was held constant. In regions with trauma center access, under-triage was low for motor vehicle collisions (MVCs) and penetrating injuries (10-16%), but high for fall injuries in both younger and older adults (27% for 18-54 years and 53% for ≥55 years; Figure). Under-triage was higher in regions without trauma center access, and remained the highest for fall injuries (57% for 18-54 years vs. 78% for ≥55 years). Overall, age ≥55 was associated with a 25-30% increase in under-triage rates, due largely to greater disparities in fall under-triage. Stratifying by access, age, and mechanism identified specific regions that were outliers for high rates of under-triage.

Conclusion: Triage patterns are primarily determined by access to care, mechanism of injury, and age. Fall injuries in all age groups were associated with high rates of under-triage. This suggests that triage guidelines should be refined to better identify severely injured fall patients. Furthermore, stratification of triage patterns by these characteristics allowed the identification of specific regions that were outliers, allowing for targeted education and interventions to improve under-triage.



EQUAL OUTCOMES FOR ALL: PROPORTION OF DIFFERENT TYPE OR MECHANISM OF INJURY SEEN AT LEVEL 1 TRAUMA CENTERS DOES NOT IMPACT SURVIVAL

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Introduction: Trauma centers (TCs) differ in the proportions of specific injuries treated. Although there is some evidence suggesting that absolute TC volume does not affect patient outcomes, it is unclear if TCs treating a higher proportion of specific injuries perform better. The objective of this study was to determine if patients treated at level I trauma centers that routinely care for higher proportions of specific type and mechanism of injuries have improved survival.

Methods: Data from National Trauma Data Bank (NTDB) 2007-2011 was analyzed. Patients ≥ 16 years of age, with blunt/penetrating injuries and an Injury Severity Score (ISS) ≥ 9 admitted to level I TCs were included. Proportions of patients with specific injuries (penetrating, traumatic brain, spinal cord, thoracic, abdominal and pelvic injuries) treated at each TC were calculated and were used to classify TCs into proportional quintiles for these injuries. To determine if higher proportional quintiles were associated with improved survival, separate multiple logistic regression analyses for each injury were performed, adjusting for known predictors of trauma mortality (age, gender, injury type, pulse on admission, presence of hypotension on admission, total Glasgow Coma Scale, total ISS) as well as overall hospital mortality performance status (high performing, average or low performing).

Results: A total of 172 centers, with 720,563 patients, from an available 223 level I TCs in the NTDB were included. The overall unadjusted mortality rate was 6.7%. On average, a two-fold variation was noted between the lowest and highest proportional quintiles for all injury cohorts. On unadjusted analyses, higher proportional quintiles predicted improved survival for penetrating and traumatic brain injuries versus the lowest quintile. However, this relationship was mitigated after adjusting for patient factors and overall hospital performance (Table).

Conclusion: While level I TCs differ substantially in the proportions of types and mechanisms of injuries treated, these differences do not affect patient survival. Structural factors other than proportions of specific injuries need to be explored for their contribution to overall TC performance.

	Adjusted Odds of Mortality by Quintiles of Proportions of Specific Injuries Treated, OR (95% CI)				
	1 "Lowest Quintile"	2	3	4	5 "Highest Quintile"
Penetrating Injury <i>n</i> =75,509	ref	1.20 (0.98-1.48)	1.03 (0.80-1.33)	1.15 (0.96-1.39)	1.26 (1.01-1.57)
Traumatic Brain Injury <i>n</i> =332,178	ref	1.04 (0.94-1.16)	1.06 (0.96-1.17)	1.01 (0.90-1.12)	1.04 (0.94-1.15)
Spinal Cord Injury <i>n</i> =26,883	ref	0.83 (0.63-1.10)	0.98 (0.76-1.27)	0.93 (0.72-1.22)	0.75 (0.59-0.95)
Thoracic Injury <i>n</i> =269,123	ref	1.01 (0.88-1.16)	1.00 (0.86-1.16)	0.99 (0.86-1.14)	0.90 (0.78-1.04)
Abdominal Injury <i>n</i> =115,332	ref	0.92 (0.80-1.06)	0.93 (0.81-1.08)	0.93 (0.80-1.08)	0.96 (0.84-1.09)
Pelvic Injury <i>n</i> =88,895	ref	0.97 (0.85-1.10)	0.98 (0.85-1.14)	0.93 (0.80-1.08)	0.93 (0.80-1.08)

LONG DISTANCE MEDICAL EVACUATION FOR TRAUMA: DOES THE “GOLDEN HOUR” APPLY ON THE FRONTIER?

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Introduction: The state of Alaska is set over enormous distances, and is dotted at great intervals with small settlements and villages.. Medical resources have tended to concentrate in the larger towns and cities, and most specialty care in Alaska is delivered in the largest city, Anchorage. The population of the state, therefore, relies on a fairly robust medical evacuation system composed of both fixed wing and rotary aircraft, and medical evacuation distances of up to 1500 miles. This retrospective review evaluates the effect of distance of medical evacuation on outcomes of care for high acuity trauma patients by comparing urban (Anchorage city) high-acuity victims to those with transport distances of greater than 20 miles.

Methods: The trauma database of a single tertiary medical facility was searched for high acuity (“Status 1”) trauma patients over the calendar three-year period 2011-2013. The data were examined for geographical location of injury and the distance calculated between injury site and the hospital address. The patients were then divided into two groups –local/urban and remote. These two groups were then compared for demographic, injury severity, mechanism of injury, and survival.

Results: During the three year period 2011-2013, there were 151 patients who entered the trauma facility as a “status 1” trauma. There were 119 males and 32 females. The average age of the group was 35.3 years. There were 74 local/urban patients (transport < 20 miles) and 77 remote (transport > 20 miles). The remote group was transported an average of 83.2 miles (range 20-795 miles). Nineteen of the 77 remote transports were for over 100 miles, and nine were over 200 miles. The transport distances of two of the transports could not be accurately determined as they occurred on ships in the Bering Sea. Transport distance was calculated from first landfall in the Aleutian Islands, where the patients were recovered by fixed wing aircraft. There were several instances of mixed mode transport, including National Guard para-jumper rescue. There were no statistically significant differences between groups for age, gender, mortality, ED mortality (<12 hours), or ISS score. The urban group had a significantly higher proportion of penetrating trauma than the remote group ($p=0.0003$). In the local group there was no difference between genders in mechanism of injury. A trend noted in dispositions from ED, with a greater portion of urban going from ED to OR, and a greater portion of remote patients going from ED to ICU. ($p=0.10$) The length of stay after trauma admission was also significantly longer in the remote group (14 days) than in the urban group (avg. 10 days).

Conclusion: The results were surprising in a number of ways. The authors had anticipated that significant differences in transport time would have resulted in differences in patient findings, either for better or for worse. It was felt that a process of natural selection would have occurred outside of the “golden hour.”. Instead, the significant differences were in mechanism of injury and then, reflective of proportional differences in mechanism between the two groups, more urban patients went to the operating room, and more remote patients went to the ICU for initial management. In the local trauma group, there were no gender differences in mechanism of injury Further work is indicated using state transport data to determine whether selection bias and overall death rates for trauma differ between urban and remote populations.

PREHOSPITAL TOURNIQUET USE AT THE BOSTON MARATHON BOMBINGS: FAILURE TO TRANSLATE

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Introduction: The Boston Marathon bombing was the first major US terrorist event with multiple, severe extremity injuries. This is a common scenario on the battlefield, but uncommon in the homeland. A decade of warfare demonstrates that improvised tourniquets are rarely effective, and that the ubiquitous availability and aggressive use of commercially-available, purpose-made tourniquets has dramatically reduced deaths from extremity exsanguination. In Boston, civilian first responders, including trained professionals and bystanders, rushed to aid the injured. Bleeding limbs had tourniquets applied, but the type and effectiveness of those tourniquets remains unknown.

Methods: A database was created and populated by all the Boston Level I trauma centers following the Boston Marathon bombings. Data regarding specific injuries, limbs affected, demographics, prehospital interventions (including tourniquet types), and outcomes were extracted.

Results: Of 243 injured, 152 patients presented to the ED within 24 hours. There were 66 patients (63.6% female) suffering at least one extremity injury (age 15 to 71 years, ISS median 10 [range 1-38], AIS Extremity median 3 [range 1-4]). Of these 66 patients, 4 had upper limbs affected, 56 lower limbs only, and 6 had combined upper and lower limb injuries. There were 17 lower extremity traumatic amputations in 15 patients.

Additionally, there were 10 patients with 12 lower extremities suffering major vascular injuries. Of the 66 patients with limb injuries, 29 patients had recognized extremity exsanguination at the scene. In total, 27 tourniquets were applied: 16 of 17 traumatic amputations, 5 of 12 lower extremities with major vascular injuries, and 6 additional limbs with major soft tissue injury. Eight limbs with severe bleeding had no tourniquet applied. All tourniquets were improvised and no commercially-available/purpose-made tourniquets were identified. Among these 66 patients mortality was 0%.

Conclusion: After the Boston Marathon bombing, extremity exsanguination was either left un-treated or treated with an improvised tourniquet in the prehospital environment. Effective, purpose-made tourniquets (and adequate training) should be made widely available to civilian prehospital responders. The Boston Marathon bombing response represents a failure to translate a valuable lesson learned from war.

TRAUMA TRANSFERS TO LEVEL 1 CENTERS: MEDICAL NECESSITY OR FISCAL CONVENIENCE?

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Introduction: Level 1 trauma centers are obligated to accept the transfer of trauma victims when a higher level of care is indicated. Based on the forthcoming healthcare access changes through the Affordable Care Act, we hypothesized that transferring institutions subconsciously select trauma transfer cases based on payer status or cost of treatment and injury complexity ratio, and hence transfer patients when perhaps medically unnecessary.

Methods: Our single institution trauma registry was queried to identify trauma transfers and primary trauma patients from December 2002 to May 2013. Demographics, payer status, and injury severity score (ISS) were analyzed to examine any trends associated with transferred patients.

Results: During the study period 6,044 trauma victims were transferred (TTP) to our rural ACS Level 1 trauma center, compared to 11,775 primary trauma patients (PTP). Uninsured patients made up 10% (N=630) of TTP compared with 15% (N=1,804) of PTP. Medicaid recipients comprised 13% (N=630) of TTP compared with 11% (N=1,309) of PTP. Surprisingly 53% (N=3,207) of TTP were Medicare (N=1,326) or HMO (N=1,881) insured, versus 41% of PTP (Medicare=1,528, HMO=3,346) being insured. The discharging services were predominantly subspecialist surgeons (i.e.: General Adult Trauma and Pediatric Trauma comprised <50% of discharges) for all trauma patients. Adult and Pediatric Trauma services accounted for 30% (N=1,781) of TTP versus 45% (N=5,343) of PTP discharges. Mean ISS of TTP was 11.5 ± 0.11 compared with PTP of 11.6 ± 0.10 .

Conclusion: Contrary to expectations, these data suggest over half the patients who were transferred to our facility for higher level of trauma care were insured — in fact there were fewer insured patients among our primary trauma population. The notion that trauma transfers increase institutional fiscal burden is unsubstantiated. Transfer of trauma patients should continue based on medical necessity given the availability of subspecialty surgeons.

TRAUMA PREVENTION TASKFORCE DECREASES FALL ADMISSIONS AT A LEVEL II TRAUMA CENTER

Tracy Evans MD, Katelyn J. Rittenhouse BS, Jo Ann Miller RN, BSN, Ronald Baier BS, EMTP, Roxanne Chandler RHIA, CTR, CSTR, Frederick B. Rogers* MD, MS Lancaster General Hospital

BACKGROUND: Geriatric falls cost the U.S. healthcare system approximately \$30 billion in medical costs each year. In 2012, more than 2 million adults 65 and older were treated in emergency departments for falls, 1 million of which required hospital admission. As the paradigm of healthcare in the United States is rapidly changing with the implementation of the Patient Protection and Affordable Care Act, there is a renewed and strong emphasis being placed on preventative medicine. Our trauma team hypothesized that a community outreach program designed to better educate the geriatric population about fall prevention would reduce trauma admissions due to falls and consequently decrease medical costs for the geriatric population.

METHODS: In 2011, a Trauma Prevention Taskforce consisting of a nurse, a trauma surgeon, and a trauma prevention coordinator visited 5 senior living facilities in Lancaster County, PA and presented a protocol to identify patients at high risk for falls as well as helped staff members identify steps to reduce falls. To determine the impact of this intervention, the registry of Lancaster County's only Level II trauma center was queried for all geriatric (age \geq 65) trauma admissions. Admissions due to falls of patients living at a Lancaster senior living facility with \geq 3 falls trauma admissions between 2010 and 2013 and total number of beds data provided by the PA Department of Health were included in our analysis. The fall rates (total falls/total beds) of 2010-2011 were compared to 2012-2013 at the intervention facilities and the control facilities in Lancaster County that were not visited by the Trauma Prevention Taskforce.

RESULTS: There were a total of 23 (5 intervention, 23 control) nursing homes meeting study inclusion criteria. Between 2010 and 2013, there were a total of 2,196 geriatric trauma admissions attributed to falls; 487 (22.2%) of these admissions were attributed to patients living at one of the study nursing facilities. The fall rate was found to have decreased at intervention facilities from 8.9% from 2010-2011 to 8.1% from 2012-2013 ($p<0.001$), and the fall rate was found to have increased at control sites from 5.9% from 2010-2011 to 7.7% from 2012-2013 ($p=0.018$).

DISCUSSION: We have associated a statistically significant decrease in fall admissions from senior living facilities with a visit by a Trauma Prevention Taskforce. Trauma centers should pursue community outreach initiatives as they can significantly benefit public health and decrease unnecessary injury and healthcare costs.

RELIABILITY OF GGT, MCV, AND BLOOD ALCOHOL LEVEL AS A NEGATIVE PREDICTOR OF CHRONIC ALCOHOL MISUSE IN TRAUMA PATIENTS

Donald N. Reed* Jr., MD, Kevin O'Connor BS, Vickie L. Meyer RN, Annette M. Chard RN, Joel F. Nagel RN, Ronald J. Jones Pharm.D, Gordon H. Bokhart Pharm.D, Katherine E. Kruse MD, William A. Kunkle DO, Lutheran Hospital of Indiana

When creating your abstract, the only section headers to be used are listed below and they need to be in this format:

Introduction:Alcohol screening is required for verified trauma centers. Verbal questionnaires have been shown to reliably screen for chronic alcohol misuse, but they take time and personnel. Biomarkers of excess alcohol use were considered long ago to have utility for this, but data is lacking. A prospective study was performed to compare several biomarkers with trauma patients' answers to their AUDIT questionnaire results.

Methods:After institutional review board (IRB) approval, consenting adult trauma patients admitted to a level II trauma center from 2010 to 2013 were evaluated for study enrollment. Standard trauma serum laboratory tests gamma-glutamyltransferase (GGT), mean corpuscular volume (MCV), and blood alcohol level were drawn and recorded as positive if elevated (BAL \geq 100mg/dl) or negative. With patient consent a blinded trained study operator administered the Alcohol Use Disorders Identification Test (AUDIT) questionnaire. Using AUDIT scores as a "gold standard" for alcohol misuse potential, biomarker results were compared to AUDIT results. Results were evaluated statistically (SPSS and statistics in R) for Cohen's Kappa coefficient for agreement, and sensitivity, specificity, predictability.

Results:Out of 179 enrolled subjects, 113 were evaluable. The resulting Kappa was 0.30, (95% Confidence Interval 0.118-0.481) suggested "fair agreement" when all 3 markers were compared to AUDIT. Sensitivity and specificity were found to be 0.605 and 0.70 with 74% of negatives truly negative when all markers were negative and a NPV of 0.941 was assessed when an accepted 10% prevalence was applied. Interestingly, if ANY positive ethanol level was applied as positive the result was Kappa 0.374, resulting in sensitivity and specificity of 0.721 & 0.671, respectively with 80% of negatives being true negatives via markers and giving a NPV of 0.956.

Conclusion:While AUDIT is an established tool for alcohol misuse evaluation, it is time consuming and not useful for those with consciousness issues; therefore these biomarkers may have utility. Although as an overall predictor of misuse these biomarkers fall somewhat short, their utility as a possible tool to identify those without ethanol issues is suggested by these results. Our findings demonstrate the potential these three serum tests have to limit the need for further evaluation of biomarker-negative patients and suggest this combination may be a valid preliminary screening mechanism for trauma patients -both conscious and not- in understaffed and resource-limited hospitals.

All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

OLDER ADULT PEDESTRIANS NAVIGATING NEW YORK CITY - AGE-ASSOCIATED LIMITATIONS

Patricia Ayoung-Chee MD,MPH, Stephen Wall MD, Dekeya Slaughter BS, Gary Marshall* MD, Samuel Todd* MD, Chad Wilson MD, Spiros Frangos MD,MPH, New York University Langone Medical Center

INTRODUCTION - In New York City (NYC) older adults (≥ 65 yrs) comprise 12% of the population but account for 36% of pedestrian fatalities. NYC can be convenient for older adults to access necessary resources, but the busy streets can pose many hazards. We sought to better understand risk factors associated with older adults who are struck by motor vehicles (MV) while walking in NYC.

METHODS - Data were prospectively collected on all pedestrians injured by MV who presented to a NYC level 1 trauma center from 2008 to 2011. Demographics, patient behavior and scene variables were obtained from patient and EMS interviews.

RESULTS - Of the 1,471 patients enrolled, 127 older adults and 803 adult pedestrians (18-64 yrs). Fifty percent of older adults had an ISS >9 and 60.6% required hospital admission. Older adults more frequently had serious injury (49.6% vs 21.3%) and TBI (20.5% vs 5.7%; $p=0.0001$) compared with younger adults. Older adults were more likely to have unstable gait (11.0% vs 1.1%), hearing (33.0% vs 3.6%) and vision impairment (24.4% vs 5.6%) ($p<0.0001$). Older adults were less likely to be intoxicated (2.4% vs 17.2%), or distracted by a cell phone (0.8% vs 4.4%) or music (0% vs. 4.4%) ($p<0.01$). Older adults were less likely to be crossing midblock (13.4% vs 18.9%) or against the signal (6.3% vs 8.7%) ($p=0.05$). Older adults were more likely to be hit by a vehicle making a turn (41.7% vs 36.0%; $p=0.01$) and be hit in their home neighborhood (40.2% vs 12.75%; $p<0.0001$). Multivariate analysis showed that older adult collisions occurring during rush hour and involving pedestrians in the crosswalk or sidewalk were associated with decreased risk of severe injury, although not significant (Table 1).

Table 1. Factors Associated with Severe Injury (ISS >9) in Older Adults

	Unadjusted OR (95%CI)	Adjusted OR (95% CI)
Unstable gait	0.89 (0.3-2.64)	2.05 (0.58-7.23)
Two-way traffic	1.28 (0.57-2.87)	1.11 (0.37-3.34)
Rush hour	0.78 (0.37-1.7)	0.74 (0.28-1.98)
SUV/truck/van	2.11 (0.97-4.59)	2.34 (0.93-5.9)
Bus	0.42 (0.08-2.20)	
Road surface - wet/ice	1.54 (0.64-3.7)	3.15 (0.96-10.3)
Vehicle turning	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Pedestrian in crosswalk/sidewalk	1.34 (0.54-3.32)	0.88 (0.31-2.46)
Distraction (music/cell phone)	0.33 (0.03-3.27)	0.75 (0.10-5.69)

CONCLUSION - Older adults are less likely to engage in risky behavior as they navigate the city, and physical impairments associated with aging may contribute to pedestrian collisions. Future multi-site studies should focus on better defining the extent to which age-related disabilities put older adults at risk for pedestrian injuries and how best to mitigate this risk.

IT'S NOT ONLY THE STRONG THAT SURVIVE: HOW RESILIENCE EFFECTS TRAJECTORIES OF RECOVERY AFTER INJURY

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Introduction: Chronic, non-healing wounds don't just occur to the flesh. Often, the psychological consequences after injury persist long after physical healing has occurred. These psychological and behavioral incapacities can have significant influence on functional well-being and quality of life. In order to efficiently utilize resources, determining the trajectory of recovery for patients during inpatient hospitalization, as well as factors that may predict those trajectories, may prove beneficial in determining individuals at risk for poorer quality of life outcomes after injury. Four prototypical classes of adjustment (i.e., resilient, chronic, delayed, and recovery) as described by Bonanno (2004) were reproduced.

Methods: This prospective study consisted of 406 subjects who completed assessments while hospitalized, and at three, six, and twelve months post-discharge. The Patient Health Questionnaire-8 (PHQ-8) and the Primary Care Posttraumatic Stress Disorder Screen (PC-PTSD) were used to identify the latent classes (e.g., resilient, chronic, delayed, or recovery). Demographic information, presence of mild traumatic brain injury (mTBI), mental health, pain levels, and Injury Severity Score (ISS) were explored as covariates. Following the process model of resilience, we analysed data from participants over the course of up to a year following treatment at the trauma center and identified four distinct groups that had four different trajectories of adjustment over the year. Data was analyzed using latent growth mixture modelling.

Results: The sample was predominantly male (62.5%) and European-American (65.3%). A four-class model was the best fit for the data. Fifty-seven percent of subjects had stable low levels of depression and 44% had stable low levels of PTSD following injury (i.e., resilient). The three other groups' depression and PTSD analyses reflected high chronic levels of distress (10.1% depression, 24.7% PTSD), distress increasing over time (18% depressed, 11.7% PTSD) or decreasing levels of distress that resolved (15% depressed, 19.1% PTSD). Each non-resilient class represented a minority response type when compared to the resilient class. The inclusion of covariates improved model fit (e.g., gender, income) and the pre-existing mental health variable was a significant predictor of the resilient class.

Conclusion: The majority of survivors following a traumatic event experienced minor and transient symptoms of depression and PTSD, suggesting the most common adjustment pathway after injury was resilience. While encouraging that the majority of trauma patients are resilient, the quarter of patients who showed chronic PTSD and 10% with depression, as well as the 18% of patients who became increasingly depressed over time and the 11.7% who also eventually developed PTSD remain concerning. Demographic factors including race and education level did not predict trajectories of adjustment. Of note, no injury related variable, including etiology of injury, ISS, or mTBI predicted adjustment trajectory. However, patients without a pre-injury mental health diagnosis were significantly more likely to be resilient after injury. This study increases our understanding of psychological adjustment post injury and highlights that severity of injury as well as other injury factors do not predict psychological response.

ONE-YEAR EVALUATION OF THIRD PARTY VIOLENCE INTERVENTION PROGRAM IN A PUBLIC HOSPITAL

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Introduction: Injury prevention is a key component of the modern trauma center; patients who are victims of intentional injury have a 5 year re-injury rate as high as 45%. Recent attempts to decrease this rate have lead to the creation of hospital-based violence intervention programs (VIP). Our publicly-funded level 1 trauma center has been a member of a city wide VIP for 12 months. We sought to evaluate program effectiveness over this period and to investigate areas for improvement.

Methods: Over a 12 month period, patients who were seen at our publicly-funded level 1 trauma center and who were victims of intentional injury were offered enrollment with a third party violence intervention program (VIP) partner during their visit. Our hospital differs from other hospitals participating in the program in that we require written consent from the patient for a referral. The trauma center also had two Masters-candidate Social Work interns on service during that period who interfaced with several of the referred patients. After 12 months of the partnership a phone survey of referred patients was conducted to evaluate program performance. Our primary outcome was successful enrollment with the VIP as evidenced by more than one outpatient follow-up. Secondary outcome measures included patients' subjective feelings regarding the VIP and identification of needs addressed.

Results: A total of 205 patients consented and were referred who were identified as high-risk victims of intentional injury over the 12 month period, with 28 responses (n=22 or 79% GSW, n=2 or 7% SW, n=4 or 14% Blunt trauma). Of those contacted 35% (n=10) had no memory of referral to the VIP and were not contacted once discharged from hospital by the VIP; 9 requested another referral to VIP program. Those with any post-discharge contact by the VIP reported overall adequate follow up and that their needs were addressed. Additionally 32% (n=9) with follow up were "strong supporters"; 42% (n=12) recommended services to similar patients. Patients with no recall saw trauma SW 10% of time (n=1); patients considered strong supporters had trauma SW 55% of time (n=9)

Conclusion: Our primary endpoint demonstrates low enrollment rates in third party VIP program; the need for written consent may have had a significant effect on this outcome. Contact with the hospital-based Social Work interns was highly correlated with successful post-discharge follow up by the VIP, suggesting the benefit of permanently placed in-house personnel to facilitate enrollment. Secondary outcomes were positive in those who successfully enrolled with the VIP. Our data also suggests a role for scheduled follow-up with those patients who are referred but do not have post-discharge contact with the VIP, as the majority of them requested a new referral. Future areas of investigation: survey of patients who declined referral to determine reasons for the initial refusal as well as the willingness to accept a new referral.

RISKY MOTORCYCLIST BEHAVIOR CORRELATES WITH SMALL MOTORCYCLE (MC) ENGINE SIZE (ES)

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Introduction: The United States has seen an increase in the popularity of MC with larger engines, concurrent with increasing motorcyclist fatalities and injuries. We performed an analysis of patients admitted after a MC crash to evaluate rider behavior by ES. We hypothesized that riders with larger ES would be more likely to exhibit risky behavior.

Methods: We performed a retrospective analysis of adult inpatients after MC accident at a level 1 trauma center from April 2002-March 2007. Demographics, helmet type, helmet fastening, MC licensure, and MC insurance were collected from charts or prospective patient interviews. Risky behavior was determined to be failure to wear a fastened full-face helmet, or unlicensed or uninsured MC operation. ES were categorized as: small (<500 cc), medium (500-850 cc), large (>850 cc), or unknown. Data were analyzed using chi-square and Fisher's exact tests.

Results: 190 inpatients were identified; of these, MC-specific data were obtained for 115 (60.5%). Mean age was 28.3 (SD±8.6) years; 93% were male. 33 (28%) motorcyclists had large engines, 57 had medium (50%), 14 had small (12%), and 11 were unknown (10%). Helmet use and type of helmet used varied by ES (Table). 50% of small engine motorcyclists had fastened helmets versus 85% for riders of large engines, $p=0.02$. 86% of small ES motorcyclists were unlicensed, whereas 21% of riders with large ES were riding without a license, $p<0.001$. Large ES riders were more likely to have insurance (82%) compared to small ES riders (7%), $p=<0.001$.

Conclusion: Within our population, MC riders with larger ES were more likely to mitigate risk by wearing full-faced helmets, fastened helmets, and obtaining proper licensure and insurance than MC riders with small engines. Small MC ES was significantly associated with risky behavior.

Table: Motorcycle Rider Behavior by Engine Size

Factor	Small ES, n=14	Medium ES, n=57	Large ES, n=33	Unknown ES, n=11	p-value
Any Helmet	9 (64%)	53 (93%)	32 (97%)	8 (73%)	0.002
Full-Face Helmet	3 (21%)	38 (67%)	20 (61%)	3 (27%)	0.004
Fastened Helmet	7 (50%)	47 (82%)	28 (85%)	6 (55%)	0.02
License	2 (14%)	42 (74%)	28 (85%)	1 (9%)	<0.001
Insurance	1 (7%)	37 (65%)	27 (82%)	0 (0%)	<0.001

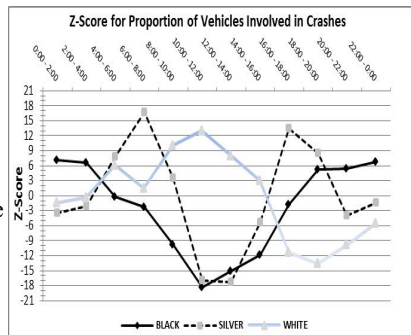
VISIBLE...IMPACT: RELATIONSHIP BETWEEN COLOR OF VEHICLE AND PROPORTION OF CRASHES BY TIME OF DAY

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Introduction: Motor vehicle crashes are the leading cause of traumatic injury in the USA, and account for 46% of the total volume of the Arizona State Trauma Registry between 2009-12. Some research has shown that vehicle color may have an impact on the likelihood of crashing, due to the visibility properties of the color, however the published findings are few and inconsistent. We hypothesize that the visibility properties of various vehicle colors are impacting the likelihood of crashes and identify which colors exhibit susceptibility at which times of day.

Methods: The Arizona Safety Data Mart (2009-13) was used to calculate the proportion of vehicles involved in crashes which correspond to each color type and time of day. This dataset is derived from the compiled incident reports produced by responding law enforcement. The proportion of vehicles involved in crashes within each two hour bin was used to normalize for variations in the crash volume caused mainly by changes in vehicle miles traveled by time of day. Variations in that proportion were examined across times of the day to find relationships between visibility and crashes. A statistical test was performed to determine the significance of the variations in proportion relative to the daily average.

Results: There were over one million vehicles involved in crashes during the study period. White was the most common color reported on average (23.65%), followed by black (10.39%), gray (10.36%), aluminum (10.14%), red (8.70%), and blue (8.60%). Crash proportions for certain color types were shown to have a very significant ($p < 0.01$) sensitivity to time of day. The most significant and distinct patterns were found for black, silver, white, and aluminum vehicles. The remaining colors tended to fall into families which exhibited similar time sensitivities to one of those four or else had no statistically significant pattern. Black was highest at night (18:00-4:00) and lowest during the day (8:00-16:00). Silver vehicles peaked at sunrise (4:00-10:00) and sunset (16:00-20:00). White experienced an increase through midday (8:00-16:00) but decreased in the evening (16:00-20:00). Aluminum exhibited an increase from midday through the evening (10:00-0:00), and a decrease during the morning (4:00-8:00). All forms of blue and green exhibited almost no statistically significant variation by time of day.



Conclusions: The results of this analysis lend credence to the hypothesis that vehicle visibility properties interact with ambient lighting conditions to increase susceptibility to crashes. As a matter of public safety care should be taken when consumers select vehicle colors, municipal services pick colors for their vehicle fleets, or manufacturers determine which paint colors to use. Drivers should have an increased awareness of their own visibility and crash risk as a result of vehicle color.

SIGNIFICANT DIFFERENCES IN OXIDATIVE STRESS BETWEEN HEALTHY CONTROLS AND TBI PATIENTS: A 5-YEAR MULTICENTER PROSPECTIVE OBSERVATIONAL COHORT STUDY

Alessandro Orlando MPH, Leonard Rael MS, Raphael Bar-Or BS, Denetta S. Slone* MD, Charles W. Mains MD, David Bar-Or MD, St. Anthony Hospital

Introduction: Oxidative stress has been related to the onset or progression of multiple diseases. Significant differences in oxidation-reduction potential (ORP) were previously demonstrated between traumatic brain injury (TBI) patients and non-TBI controls, utilizing technology not suitable for point-of-care use. The objective of this preliminary study was to examine the differences in the point-of-care RedoxSys system ORP measurement between an isolated TBI (iTBI) population and healthy controls.

Methods: Consecutively admitted adult (18 y/o) trauma patients to two Level I Trauma Centers (2008—2012) with an iTBI and ≥ 5 plasma samples, collected once-daily. Admission samples were taken within 48h, and control samples were obtained from healthy volunteers. Static ORP (sORP, mV) measures the balance between pro and antioxidants, and the capacity ORP (cORP) measures the antioxidant reserves. cORP measures were not normally distributed, thus an inverse transformation was used to achieve normality. Student's T-tests examined differences in the mean ORP values between iTBI and control patients. Higher values of sORP and inverse cORP are indicative of higher oxidative stress. Alpha was set at 0.10.

Results: There were 115 iTBI patients who met inclusion criteria, and 53 healthy controls. Compared to healthy controls, iTBI patients had significantly higher admission sORP (185.2 vs 178.0, $p=.08$) and inverse cORP values (3.3 vs 2.4, $p<.001$). Moreover, iTBI patients' maximum ORP values were significantly higher than control samples (Max sORP [Figure 1]: 220.4 vs 178.0, $p<.001$; Max inverse cORP [Figure 2]: 4.3 vs 2.4, $p<.001$). Both ORP indices had mean (SD) times from injury to maximum values approximately 5 days after injury (sORP: 5.5d [4.16]; inverse cORP: 5.2d [4.25]).

Conclusion: This preliminary study utilized a novel, point-of-care measurements of oxidative stress and confirmed previous findings observed in the TBI population. These data are consistent with the concept of increased oxidative stress subsequent to TBI. Future investigations are aimed at using ORP values to create an ascorbate-equivalent concentration to aid in clinical decision making.

Figure 1

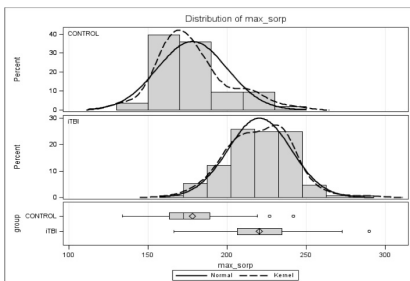
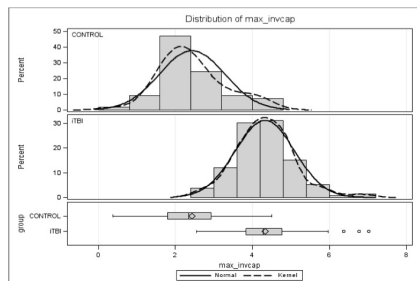


Figure 2



GERIATRIC NURSING HOME FALLS HAVE INCREASED MORBIDITY AS COMPARED TO THEIR COMMUNITY COUNTERPARTS BUT MORTALITY REMAINS THE SAME

Isadora C. Botwinick MD, Joshua Johnson BS, Saman Safadjou MD, Wayne Cohen-Levy BA, Srinivas H. Reddy MD, John McNelis MD, Sheldon Teperman MD, Melvin E. Stone Jr., MD, Jacobi Medical Center

Introduction: Falls are the leading cause of fatal injury in geriatric patients. Nursing home falls occur at twice the rate of community falls, yet few studies have compared these groups. We hypothesized that nursing home residents admitted for fall would be sicker than their community counterparts on presentation and therefore would have worse outcomes.

Methods: We reviewed 1765 patients, 65 years and older, admitted to our Level 1 trauma center after fall. Demographic data including injury severity score (ISS), admission Glasgow coma scale (GCS), in-hospital complications, length of stay (LOS), operative intervention, and in-hospital mortality was collected. Continuous data was analyzed using Mann Whitney test and categorical data using Fisher exact test. Variables in the univariate tests were analyzed in a multivariate logistic regression.

Results: Table 1 shows comparisons of nursing home and community subgroups. Rates of traumatic brain injury and operative intervention were not significantly different (not shown in Table 1). In a multivariate logistic regression, ISS, GCS and age, but not nursing home status, were significant predictors of in-hospital mortality after fall.

Table 1. (mean +/- SD)	Nursing home n=163	Community n=1545	P value
Age (years)	83 +/- 9	80 +/- 9	0.0002
ISS	9 +/- 7	7 +/- 6	NS
GCS	14 +/- 2	15 +/- 2	< 0.0001
Systolic blood pressure	146 +/- 28	155 +/- 28	0.0020
Hemoglobin	11.8 +/- 2.3	12.4 +/- 1.8	< 0.0001
INR	1.3 +/- 0.9	1.2 +/- 0.6	0.0185
LOS (days)	9 +/- 12	8 +/- 12	0.0277
Complications	53 (33%)	313 (20%)	0.0006
Mortality	9 (6%)	55 (4%)	NS

Conclusions: Our study demonstrates that nursing home patients presenting after fall were sicker and had increased morbidity, as evidenced by older age, lower GCS, more anemia, coagulopathy, complications and increased length of stay when compared to their community counterparts. However, mortality was similar between both groups and nursing home residency was not a significant predictor of mortality.

AN ANALYSIS OF GERIATRIC RECIDIVISM WITHIN AN ACCOUNTABLE CARE ORGANIZATION

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INTRODUCTION: To date, there are almost 500 Accountable Care Organizations (ACOs) across the United States with a strong emphasis on cost-effectiveness of care. Readmission is a huge driver of healthcare cost, and to that end, we sought to determine the factors associated with geriatric trauma readmissions (recidivism) within our institution. We hypothesized that falls and increased age would be significant predictors of geriatric recidivism.

METHODS: All admissions from 2000-2011 attributed to patients age \geq 65 at our 500 bed Level II trauma center, recently verified by Medicare as an ACO, were queried. Patients were classified as recidivist (RC) or non-recidivist (NRC). The first admissions of recidivist patients were compared to the non-recidivist admissions with respect to gender, age, race, primary insurance, admitting GCS, ISS, hospital LOS, mechanism of injury (MOI), pre-existing conditions, and discharge destination. Factors found to be significant predictors of recidivism in univariate analyses were subsequently incorporated into a multivariate logistic regression model. Additionally, the second admission's MOI was compared to the first admission's MOI, and the proportion of first, second, and third admissions attributed to falls was calculated. A p-value <0.05 was significant.

RESULTS: Between 2000 and 2011, there were a total of 4,963 unique patients admitted to the trauma center age \geq 65. This population was composed of 287 (5.8%) RCs and 4,676 (94.2%) NRCs. When placed in a multivariate logistic regression, female gender, admitting GCS=15, MOI as fall, history of head trauma, and pre-existing pulmonary disease were identified as significant predictors of recidivism (Table 1). A trend toward increasing proportion of injuries attributed to falls was found with each subsequent trauma admission: 81.5% (234/287) of first admissions, 88.2% (253/287) of second admissions, and 90.5% (19/21) of third admissions.

CONCLUSION: Our study identifies specific factors that should be targeted by social service and prevention resources to inhibit recidivism in the elderly. In the brave new world of ACOs, trauma centers must identify high-risk populations for the consumption of limited resources.

	Recidivism Rate	Adjusted Odds Ratio (95%CI)	p-value
Gender			
Male	3.9%	Reference	
Female	5.8%	1.36 (1.02-1.81)	0.036
Admitting GCS			
GCS 15	5.3%	1.49 (1.03-2.14)	0.034
GCS <15	3.7%	Reference	
MOI			
Fall	5.8%	1.93 (1.36-2.76)	<0.001
Other	2.9%	Reference	
PECs			
Hx Head Trauma	8.3%	1.89 (1.18-3.04)	0.008
Pulmonary Disease	6.8%	1.48 (1.04-2.11)	0.032

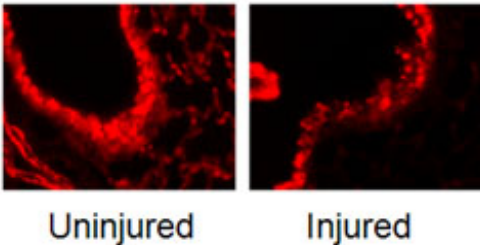
SIRTIIN 1 MEDIATES A PRIMED RESPONSE TO IMMUNE CHALLENGE AFTER TRAUMATIC LUNG INJURY

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Introduction: Pulmonary contusion (PC) is a common, potentially lethal injury that results in priming for exaggerated inflammatory responses to subsequent immune challenge like infection (2nd hit). The molecular mechanism of priming and the 2nd hit phenomenon after PC remain obscure. Using a mouse model of PC, we have found that Sirtuin 1 (SIRT 1) can regulate the response to immune challenge and hypothesize PC alters SIRT 1 levels and/or activity that in turn, modulates 2nd hit responses.

Methods: Male, 8-9 wk, C57BL/6 mice underwent blunt chest trauma resulting in PC and changes in SIRT 1 were assessed in lung tissue and isolated immune cells at various times after the PC. Injury-primed 2nd hit host responses were tested at 24H after PC by (1) *in vivo* infectious challenge of injured mice or (2) *ex vivo* inflammatory challenge of isolated immune cells from injured mice. SIRT activators or repressors were used to test for SIRT 1 participation in these 2nd hit responses. Data were analyzed using one way ANOVA with Bonferroni multiple comparison post-test with significance defined as $p \leq 0.05$. All experimental protocols were approved by the WFUHS Animal Care and Use Committee.

Results: Immunocytochemistry of the injured lung at 24H showed that PC reduced SIRT 1 levels (Figure). SIRT 1 levels in isolated bronchoalveolar lavage (BAL) cells were quantitated by immunoblot and showed a 50% and 40% decrease in SIRT 1 protein at 3 and 24H after injury, respectively. Injured animals given an infectious challenge by cecal ligation and puncture (CLP) had increased mortality compared injury or infectious challenge alone. To test for SIRT participation in the 2nd hit response to infection, injured animals were treated with a SIRT activator before CLP. Treated mice improved survival to 80%. Isolated BAL cells from injured mice given an *ex vivo* inflammatory challenge with bacterial lipopolysaccharide (LPS) had increased levels of TNF- α mRNA compared to uninjured mice. To test for SIRT participation in the 2nd hit inflammatory response, BAL cells of injured animals were pre-treated with a SIRT activator before LPS challenge. SIRT activation decreased TNF- α mRNA.



Conclusion: We found that PC decreases SIRT 1 levels in the lung. Host responses to infection or inflammatory stimuli are enhanced in injured mice. Our results suggest that SIRT participates in priming and that increasing SIRT may improve outcomes to the 2nd hit response after injury.

NATURAL HISTORY OF A POST PULL PNEUMOTHORAX OR EFFUSION: IS OBSERVATION SAFE?

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Introduction: Placement of a thoracostomy tube (TT) for drainage of hemopneumothorax is the most common intervention in thoracic trauma. Post pull pneumothorax or effusion (PPP/PPE) is common after removal of the TT. The natural history of untreated PPP /PPE after discharge has not been described. This study evaluates the outcomes and management of PPP/PPE after discharge.

Methods: Trauma patients with chest tubes placed from July 1, 2008 to June 30, 2013 were identified from a billing database and our trauma registry. PPP/PPE was defined as the presence of air or fluid in the chest on the last chest image with a TT in place or on a post pull chest image. The electronic medical record (EMR) and final staff radiology interpretation of chest imaging were reviewed to confirm PPP/PPE during the initial admission and on discharge. Subsequent clinical follow up and imaging were reviewed for presence of persistent PPP/PPE. Interventions and readmissions directed towards the PPP/PPE as well as readmissions were recorded for patients with and without a PPP/PPE. A multivariate logistic regression was performed to identify factors a chest related readmission.

Results: Three hundred patients surviving to discharge had one or more TT placed during the study period. Of the 154 (59%) patients with documented PPP/PPE on discharge, 105 patients had follow-up data available. Outpatient imaging was obtained in 34 patients with persistent PPP/PPE noted in 15(44%). Seven patients (6.6%) with available follow up data required readmission and intervention. Patients in the non-PPP/PPE had a lower readmission rate (0.7% vs 6.6%, $p=0.02$). Multivariate logistic regression noted chest tube days (OR 1.4, $p=0.015$) and presence of persistent effusion or pneumothorax at clinic follow-up (OR 445, $p=0.001$) to be associated with readmission.

Conclusion: A PPP/PPE is a common occurrence after removal of a TT, occurring in over half of our patients. While patients discharged with PPE/PPT have a statistically higher readmission and reintervention rate, the absolute value remains low. This should be considered during the decision to treat clinically stable, asymptomatic PPT/PPE.

AGE NOT THE NUMBER OF RIB FRACTURES AND THE PRESENCE OF PULMONARY CONTUSION DETERMINES THE OUTCOME OF PATIENTS WITH RIB FRACTURES

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Introduction: Because of the growing number of patients age > 75 whose performance status is superior to the former generation of > 65, we decided to evaluate the impact of the number of rib fracture (Rib Fx) and the presence of pulmonary contusion (PC) on the Rib Fx related mortality of the “new old” patients.

Methods: retrospective review of 1529 patients with isolated Rib Fx between 9/1/2010 and 12/31/2013. 316/1529 (20.7%) had PC. Patients were stratified by the number of Rib Fx, age < and > 75, and the presence or absence of PC. Statistical analysis by chi-square included comparison of mortality stratified by age and absence or presence of PC. Data are presented as proportions. Statistical significance was accepted to correspond to a p value < 0.05.

Results: Mortality in patients without PC, independent of the number of Rib Fx, was statistically greater in patients > 75 years. The presence of PC did not increase mortality independent of age.

Mortality in patients with and without PC

# Rib Fx	Mortality < 75 No PC	Mortality < 75 PC	Mortality ≥ 75 No PC	Mortality ≥ 75 PC
1-3	19/498 (3.8%)	10/177 (8.5%)	11/87 (12.6%)**	1/9 (11.1)*
4-7	15/34 (4.4%)	5/99 (5.0%)	12/98 (12.2%)**	1/17 (5.9%)
8 or more	13/146 (8.9%)	6/56 (10.7%)	2/41 (4.9%)	1/18 (5.6%)
Total	47/987 (4.8%)	21/272 (7.7%)	25/226 (11.0%)**	3/44 (6.8%)

* p < 0.05 versus ≥ 75 No PC; ** p < 0.05 versus < 75 No PC

Conclusion: Based on the result of this study we conclude that the presence of PC contusion does not affect rib Fx related mortality independent of age. However, age alone remains a determinant of mortality, independent of the number of rib Fx. Further studies should address the impact of the volume of the contused lung on the outcome of patients with rib Fx.

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All images, charts and tables must be placed and uploaded in the body of your abstract exactly as you want them.

CLAMSHELL THORACOTOMY: UNDERUTILIZED OR OVERLY AGGRESSIVE?

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Introduction: Resuscitative thoracotomy is a potentially lifesaving operative procedure. Despite the unparalleled exposure and access that a bilateral or clamshell thoracotomy may afford, few studies describe the indications for and the outcomes of patients undergoing this highly morbid procedure. The objective of this study was to review our institutional experience with clamshell thoracotomies. We hypothesized that the performance of a clamshell thoracotomy would be associated with an increased risk for mortality.

Methods: Patients who underwent a resuscitative thoracotomy were identified from our Level I trauma center registry. We performed a 13-year retrospective cohort study comparing demographics, injury patterns and severity, operative procedures, and outcomes between patients undergoing a resuscitative versus clamshell thoracotomy. Multiple logistic regression analysis was performed to determine independent predictors of mortality.

Results: Of 413 patients who underwent a resuscitative thoracotomy, 49 patients (12%) underwent a clamshell thoracotomy. The overall survival rate was 23%. There was no difference in age, sex, or mechanism of injury between patients who underwent a resuscitative versus clamshell thoracotomy. Patients who underwent a clamshell thoracotomy had a higher mean chest AIS (4 ± 2 vs. 3 ± 2 , $p \leq 0.05$) and ISS (48 ± 21 vs. 39 ± 22 , $p = 0.01$). There was a higher incidence of cardiac (45% vs. 29%, $p < 0.05$) and pulmonary (76% vs. 58%, $p < 0.05$) injuries among patients who underwent a clamshell thoracotomy. These patients were also more likely to sustain right-sided and bilateral injuries ($p \leq 0.05$). There was no difference in mortality between patients undergoing a resuscitative versus clamshell thoracotomy (76% vs. 86%, $p = 0.13$). On multivariate analysis, an ISS > 25 (OR 7.88; 95% CI, 2.70-23.00, $p < 0.001$) and admission GCS ≤ 8 (OR=23.54; 95% CI, 12.08-45.85, $p < 0.001$) were found to be independently associated with mortality. Clamshell thoracotomy was not associated with an increased risk for mortality.

Conclusion: Clamshell thoracotomy is an invasive yet potentially lifesaving procedure that is not associated with increased mortality among patients requiring a resuscitative thoracotomy. Further study is required to determine the indications and optimal timing for performing this procedure.

EXTINCTION OF THE PREHISTORIC TRAUMA EVALUATION: ELIMINATION OF THE ROUTINE TRUAMA BAY CHEST X-RAY

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Introduction: Thoracic injuries occur in one third of all trauma patients admitted to major trauma centers. Advanced trauma life support emphasizes the role of portable chest x-ray (CXR) to screen for thoracic injuries. However, with advances in imaging technology, the chest computed tomography (CT) is a better imaging modality for thoracic injury and ultrasound (US) allows for real time evaluation for pneumothorax (PTX). This study sought to determine the role of the routine trauma bay CXR in the evaluation and management of injured patients.

Methods: This study is a retrospective review of a process improvement projects reviewing all trauma alerts at a single institution from April 2013 – February 2014. Patients underwent routine trauma bay CXR, extended focused assessment with sonography for trauma (eFAST), and chest CT. Radiographic images were reviewed by an attending radiologist, ultrasound findings were interpreted by a chief resident and/or a trauma attending.

Results: During the study period 527 patients underwent complete thoracic imaging with CXR, US, and chest CT. The CXR missed an injury in 68 patients, detected an injury that was confirmed on CT in 52 patients, and was read as having an injury in 11 patients that had no injury seen on chest CT. There were two blunt aortic injuries during the study period and neither one had evidence of a widened mediastinum on CXR. Ultrasound detected all PTX seen on CXR. The sensitivity of US for PTX was greater than CXR (29.5% vs 18.1%) when compared to chest CT.

		Computed Tomography		
Chest X-Ray		Thoracic Injury	No Thoracic Injury	
	Thoracic Injury	52	11	PPV- 82.5%
	No Thoracic Injury	68	396	NPV- 84.4%
		Sens- 43.3%	Spec- 97%	Accuracy- 84.2%

Conclusion: The routine use of trauma bay CXR can be safely eliminated from the initial evaluation. Use of the eFAST allows rapid detection of clinically significant pnuemothoracies and expedites acquisition of definitive imaging by chest CT or transport to the operating room. Routine trauma bay CXR has been eliminated from this institution's current trauma evaluation.

RIB FRACTURES AND MORTALITY: BREAKING THE CAUSAL RELATIONSHIP

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Introduction: Rib fractures have long been considered to be a major contributor to mortality in the blunt trauma patient. Previous studies have shown that the number of rib fractures can be a reliable predictor in patient outcomes in the trauma setting. What has not been determined is whether or not rib fractures contribute to the actual cause of death. We hypothesized that while rib fractures can be an excellent predictor of mortality, they rarely contribute to the cause of death.

Methods: This retrospective chart review evaluated all blunt trauma patients admitted to an urban, level 1 trauma center from January 2008 to April 2013 who sustained one or more rib fractures. Patients who died had their medical records (including trauma peer review summary) reviewed in detail to determine the cause of death. Cause of death was broken down into seven categories (neurological, cardiac, hemorrhage, respiratory, dead on arrival/indeterminable, and other). Deaths were classified as being caused by rib fractures in any of the following cases: any respiratory death, death secondary to pneumonia, death secondary to hemorrhage from rib fractures.

Results: There were 2,514 blunt trauma patients who sustained one or more rib fractures and 130 (5.2%) of them died. Patients with rib fractures who died were an average of 51 years old, 68% male, 65% Caucasian, had an mean admission GCS = 6, systolic blood pressure = 64 mm Hg, pulse = 65 beats per minute, and respiratory rate = 10 breaths per minute. The rib fracture population who died was severely injured with a mean ISS = 40 and Chest AIS = 4. However, rib fractures were the cause of death in only five patients (0.2% of the entire rib fracture population). The cause of death of all five patients who died as a result of their rib fractures was respiratory failure. The other 125 rib fracture patients, who died, died as a result of something other than rib fractures. Cause of death included hemorrhage (42%, n = 53), dead on arrival/indeterminable (28%, n = 35), neurological (15%, n = 19), cardiac 10%, n = 13), infection (2%, n = 3), and other (2%, n = 2). Patients who died as a result of their rib fractures were older (81 years old vs. 51 years old, $p < 0.001$) and had a higher respiratory rate at presentation (25 vs. 9, $p = 0.009$) but were more stable at presentation with a higher admission GCS (14 vs. 6, $p < 0.001$) and systolic blood pressure (122 mm Hg vs. 61 mm Hg, $p = 0.02$). There was no difference in ISS (32 vs. 40, $p = 0.27$) or Chest AIS (4 vs. 4, $p = 0.48$).

Conclusion: Rib fractures after blunt trauma are a marker for severe injury. However, rib fractures rarely actually contribute to mortality. Blunt trauma patients with rib fractures most commonly die from hemorrhagic shock or are dead on arrival.

PULMONARY CONTUSIONS ARE NOT A CONTRAINDICATION TO RIB FRACTURE STABILIZATION

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Introduction: The indications for operative fixation of rib fractures resulting from trauma to the chest wall remain controversial. Early studies indicated that patients with pulmonary contusions were suboptimal candidates for rib fracture repair. However, imaging modality and ventilatory management have changed considerably over the past decade, and pulmonary contusions that are seen with today's CT scanners may no longer be a valid contraindication to rib stabilization. Given the high rates of morbidity and mortality in patients with multiple rib fractures, more aggressive treatment with rib fixation may be indicated.

Methods: A retrospective review of 106 trauma patients with acute rib fractures who had undergone operative rib stabilization between 8/2009 -- 8/2013. The chest wall and pulmonary injury pattern, specifically the degree of lung injury as identified on initial imaging, was standardized and graded by use of the American Association for the Surgery of Trauma Lung Injury Scale (AAST LIS) and AAST Chest Wall Injury Scale (AAST CWIS). Patient demographics, mechanism of injury, ISS, TRISS, complications, ventilator days, ICU and hospital length of stay were measured.

Results: All 106 patients identified underwent rib stabilization, of which 47 (44%) had flail chest. The mean age was 60 (\pm 16.6), and 68% of patients were male. The number of ribs plated ranged from 1-12. Sixty nine patients (64%) had significant (AAST LIS score of 3-4) pulmonary contusions identified on initial imaging. Patient demographics and comorbid pulmonary conditions were similar between AAST LIS score groups. There were no differences in time to repair ($p=0.60$), OR time ($p=0.48$), ICU days ($p=0.95$), hospital LOS ($p=0.91$) or pneumonia ($p=0.92$) across AAST LIS scores. The presence or absence of pulmonary contusion did not affect ICU days ($p=0.91$), hospital LOS (0.98), or rates of pneumonia (0.50) or need for tracheostomy ($p=0.65$) in patients undergoing rib fracture stabilization.

Conclusion: Trauma patients with multiple rib fractures who have higher AAST lung injury scores can safely undergo operative rib fixation with equivalent outcomes to patients with less severe parenchymal lung injury. Pulmonary contusions should no longer be seen as a contraindication to rib stabilization.

THE EFFECT OF ISOLATED RIB FRACTURES ON QUALITY OF LIFE SCORES IN TRAUMA PATIENTS

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Introduction: Rib fractures are a common injury and can lead to chronic pain and disability. There are limited data on the effects of rib fractures on quality of life measures. Although poorly characterized, patient perceived quality of life (QOL) following trauma has been shown to be lower when compared to uninjured adults. This study was designed to evaluate the impact of isolated rib fractures on QOL.

Methods: A retrospective review of our trauma registry was performed to identify trauma patients with isolated rib fractures over a four year period. Under our Quality of Life Program Initiative (QOLPI) a SF-36-2 is administered during admission, 1 month, and 6 months after discharge. The SF-36-2 measures QOL across eight domains and reports them as Physical Component Score (PCS) and Mental Component Scores (MCS). The PCS and MCS were compared to established scores in the general adult and adult trauma populations. Linear regression and correlation techniques were performed to determine if any variables predicted lower QOL scores.

Results: 45 of 134 isolated rib fracture patients had SF-36-2 data available. Average age was 62.6 and 53% were male. MVC (48.9%) and falls (33.3%) were the most common mechanisms. No variables were found to predict low QOL scores.

<i>Measure</i>	<i>Rib Fracture</i>	<i>Trauma Population</i>	<i>General Population</i>
PCS initial	24.6 (1.8)	NA	50* (0.2)
PCS 1 month post	26.3(1.3)	32.8 (0.9)	50* (0.2)
PCS 6 months post	28.0(2.3)	41.3 (1.0)	50* (0.2)
MCS initial	18.5 (2.2)	NA	50* (0.2)
MCS 1 month post	16.7 (2.1)	47.5 (1.1)*	50* (0.2)
MCS 6 months post	16.5 (2.3)	47.2 (1.1)*	50* (0.2)

*p<.05 values mean (SD)

Conclusion: Patients with isolated rib fractures have significantly lower SF-36-2 MCS compared to both general trauma patients and the general population, at 1 and 6 months after injury. PCS was not significantly lower than the general trauma population. As MCS scores were dramatically lower compared to norms, further investigation is warranted to evaluate the impact of rib fractures on psychological health and to identify potential treatment options.

AN AUDIT OF COMPLICATIONS OF INTERCOSTAL CHEST DRAIN INSERTION IN A HIGH VOLUME TRAUMA SERVICE IN SOUTH AFRICA.

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Pietermaritzburg Metropolitan Trauma Service

Introduction: Intercostal chest drain (ICD) is a commonly performed procedure in trauma and is associated with significant morbidity.

Method: This was a retrospective review of ICD complications in a major trauma service in South Africa over a 4 year period from January 2010 to December 2013.

Results: A total of 1054 ICDs were inserted in 1010 patients. 966 patients had unilateral ICDs, 44 had bilateral ICDs. Male: 91%, Female: 9%, Median age: 24 (20-29) years. Mechanism of injury: Penetrating: 75% (762/1010), Blunt: 25% (248/1010). Indications: Hemothorax: 30% (314/1054), Hemopneumothorax: 32% (339/1054), Simple Pneumothorax: 25% (268/1054), Tension Pneumothorax: 7% (79/1054), Open Pneumothorax: 5% (54/1054). 235 (22%) complications were identified: 63% (147/235) were insertional complications: Kinked: 24% (26/147), Subcutaneous: 24% (36/147), Too deep: 19% (28/147), Too shallow: 18% (27/147), Inadequate fixation: 10% (14/147), Organ injuries. 37% (88/235) were positional complications: Outside the safety triangle: 94% (83/88), Wrong side: 6% (5/88). 91% (214/235) of complicated drains were inserted by junior doctors and only 9% (21/235) by senior doctors. There was no mortality as a direct result of ICD insertion.

Conclusions: ICD was associated with a high rate of complications with the majority related to insertion. A large number of complications occurred amongst junior doctors. A multifaceted quality improvement program is urgently needed to reduce the complication rate.

EXPENSE OF ED THORACOTOMY: IS TEMPORARY RETURN OF CIRCULATION THE CULPRIT?

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INTRODUCTION: Resuscitative thoracotomy offers many injured patients one last slim chance for survival. The mean cost per patient of (EDT) has been described, but these studies typically do not discriminate between the thoracotomy and other downstream surgical and critical care. If EDT itself only contributes a small fraction to the hospital costs/charges among patients who undergo the procedure, then the decision of whether or not to perform thoracotomy may not impact costs as much as other decisions in the early hours of care.

METHODS: Using the trauma registry, all itemized charges were documented for patients who underwent EDT at an urban Level One trauma center from 2003-2013. Non-survivors were categorized based on survival time and interventions. Charges were categorized as ED, post-ED, and transfusion-related. All patients taken to OR had spontaneous circulation at time of transfer.

RESULTS: 209 patients were included. Mean total hospital charges were \$36,267. Patients pronounced dead in ED had mean charges of \$11,524, and charges increased dramatically with time and OR intervention (Table 1). 49/63 patients who went to OR after ED died (78%). 14 patients (6.7%) survived their hospitalization with an average cost of \$241,235 and \$19,243 in blood transfusion related charges.

CONCLUSION: The charges associated with EDT itself are small compared to the cost of ongoing resuscitation and operative care after temporary return of circulation. To maximize cost effectiveness, efforts to define futile care at/after thoracotomy may be more important than further restriction of the procedure.

	N	ED Charges (thousands \$)	Post-ED Charges (thousands \$)	Blood Transfusion Charges (thousands \$)	Total Charges (thousands \$)
All patients	209	10.3 ± 0.5	20.2 ± 4.9	5.8 ± 0.8	36.3 ± 5.2
Died in ED	146	10.7±0.6	0	0.8 ± 0.1	11.5 ± 0.7
OR, died <1 hr	12	10.2 ± 1.7	14.0 ± 1.7	6.8 ± 2.3	31.0± 3.4
OR, died 1-4 hr	23	10.0± 1.3	23.4 ± 3.3	13.7 ± 4.5	47.0 ± 5.5
OR, died 4-8 hrs	8	6.7 ± 1.9	32.8 ± 5.8	23.0 ± 3.9	62.4 ± 8.0
OR, died >8 hrs	6	8.0 ± 1.9	50.4 ± 7.8	35.4 ± 11.5	94.8 ± 15.2
Survivors	14	10.1 ± 1.5	211.9 ±48.9	19.2 ± 3.2	241.2 ± 49.9

Table 1. Mean hospital charges of patients who underwent EDT.

PREHOSPITAL INTUBATION ADVERSELY AFFECTS OUTCOMES IN PATIENTS RECEIVING MASSIVE TRANSFUSION

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Introduction: Prehospital intubation (PI) remains a controversial intervention provided by Emergency Medical Services (EMS) personnel on severely injured trauma patients. It has been shown to adversely affect mortality in traumatic brain injury and in animal models with penetrating hemorrhagic shock. We hypothesized that PI adversely affects outcomes in patients requiring massive transfusion (MT) in an urban level I trauma center.

Methods: We reviewed our trauma registry for all patients requiring MT (defined as total blood products > 12units/ first 24h) from 2009-2013. Patient demographics, injury severity, body region severity, prehospital airway interventions, scene and transport times and outcomes were extracted from the database. A Mann-Whitney test was used for continuous variables, a Chi-square test for categorical variables and a logistic regression analysis was used to adjust for confounding variables.

Results: A total of 193 patients were identified to have received MT during the study period. PI was performed on 21 patients (11%) vs. 172 patients (89%, no-PI group). Age, gender and initial blood pressure were similar amongst groups. ISS was 24.6 for PI vs. 23.3 for no-PI, p=NS. Mortality was significantly worse for the PI group after both blunt and penetrating trauma; conversely hospital and ICU LOS was shorter (table). Scene and transport times were significantly longer for the PI group: 18.3 min vs. 13.7 for no-PI group, p<0.05 and 17.8min vs. 13.3 min, p<0.05 respectively. A logistic regression model confirmed that PI was associated with increased mortality despite adjusting for age, ISS, blood units given, transport and scene times: OR 7.5, 95% CI: 2.1-27.6, P<0.05.

Conclusion: Prehospital intubation was associated with increased mortality in a cohort of trauma patients requiring massive transfusions despite adjusting for severity of illness, scene and transport times. Other faster, less invasive airway adjuncts combined with rapid transport should be encouraged in this patient population.

	PI n=21	No PI n=172	P value
Mortality (overall)*	17/21 (81%)	69/172 (40%)	<0.01
Blunt*	13/17 (77%)	46/104 (44%)	<0.01
Penetrating*	4/4 (100%)	23/68 (34%)	<0.01
Hospital LOS* (days)	4.5 +/- 8	17.1 +/- 20	<0.01
ICU LOS* (days)	4.3 +/- 3	8.2 +/- 8	<0.01
Blood products/first 24h (units)	37 +/- 32	29 +/- 24	0.31

DOES LIMITED PREHOSPITAL RESUSCITATION WITH COLLOIDS OR CRYSTALLOIDS INFLUENCE HEMOSTASIS AND SURVIVAL IN RABBITS WITH AN UNTREATED NON-COMPRESSIBLE HEMORRHAGE

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Introduction: Prehospital, low-volume resuscitation of combat casualties using an artificial colloid (Hextend) has been recommended due to military logistics. We studied hemostatic effects of limited resuscitation with a newer synthetic colloid (Voluven) compared to a natural colloid (albumin) or crystalloids in an uncontrolled hemorrhage model.

Methods: Spontaneously breathing NZW rabbits (3.4±0.1 kg) were anesthetized, instrumented and subjected to a splenic injury with uncontrolled bleeding. 15 min after injury (MAP<40 mmHg), rabbits were resuscitated with colloids [Voluven (V) or 5% albumin (A), 15ml/kg], or crystalloids [normal saline (NS), 30 ml/kg or 5% hypertonic saline (HS), 7.5 ml/kg], given in two bolus IV injections (20 min apart) to achieve a hypotensive pressure (MAP) of 65 mmHg, n=8-9/group (gp). Blood loss (BL) was continuously measured and animals were monitored for 2.5 hrs or until death. Blood samples were collected and analyzed for ABG, CBC, and Coag tests. Data were analyzed by Kruskal Wallis and Chi-square tests and expressed as mean ± SEM.

Results: There were no differences in baseline measures and initial blood loss at 10 min (11±0.3 ml/kg) among gp. Thirty min after fluid resuscitation, MAP was higher and shock indices were lower in colloids vs. crystalloids gp ($p<0.05$). PT changes were minimal but aPTT was ~35% higher than at baseline in all gp except in the V gp which doubled. TEG parameters were most affected by V treatment. Post-resuscitation (30 min) blood test results and final bleeding outcomes are shown in the table. (* $P<0.05$ vs. others, + $P<0.05$ vs. Crystalloids)

gp	Hct %	MAP mmHg	Base def (mM)	Lactate (mM)	aPTT (sec)	TEG R (min)	TEG a angle	TEG MA	BL ml/kg	Survival rate
V	20±0.8	32±3 ⁺	3.4±0.3 ⁺	7.6±1.6 ⁺	40±5*	5.5±0.4	62±2*	53±2*	30±3*	2/8
A	24±1.6	41±6 ⁺	4.6±1.3 ⁺	8.2±1.1 ⁺	25±2	5.9±0.5	67±1	62±2	21±2	7/9*
NS	24±0.7	25±1	9.8±1.2	12±1.4	25±2	5.9±0.5	70±1	63±1	27±1	1/9
HS	29±2*	26±2	9.1±1.1	11.6±1	25±3	6.6±0.6	68±1	65±1	22±2	2/9

Conclusion: Small volume resuscitation with crystalloids appeared inadequate to effectively perfuse organs and improve tissue oxygenation and survival. Voluven was effective hemodynamically, but it was most detrimental to hemostasis leading to the largest blood loss and poor survival. The best outcomes were achieved with 5% albumin, consistent with our previous observation in this model. These data suggest that plasma protein colloids should be further considered for prehospital, low-volume resuscitation of casualties with uncontrolled hemorrhage.

Poster 133

WITHDRAWN

BLOOD ON BOARD: PRE-HOSPITAL TRANSFUSION OUTCOMES IN HYPOTENSIVE PATIENTS

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Introduction: Damage Control Resuscitation (DCR) with early high ratio resuscitation has become standard practice in patients with severe hemorrhage. Pre-hospital Blood Transfusion (PBT) as a key component of early DCR has not been well studied in patients with uncontrolled hemorrhage. We hypothesize improved survival in hypotensive patients with PBT by Emergency Medical Services (EMS) en route to a Level 1 trauma center.

Methods: All adult patients with hypotension (systolic blood pressure <100mm Hg) transferred to a Level 1 trauma center from 2003-2013 were included. Patients were divided into two groups based on receipt of blood products during transfer (PBT vs. non-PBT). The two groups were matched by a mean age, ISS, mechanism of injury, transfer Systolic BP, and emergency department SBP. Heart rate (HR) and shock index (SI) were analyzed for transfer and on arrival to the emergency department (ED). The changes in physiologic parameters from transfer to the ED were calculated. Statistical analysis was completed using SAS 9.3. Chi-square, Fisher exact tests, and t-tests were performed.

Results: Of 234 patients, 144 met inclusion criteria with 32 in P-BT group, and the remaining 112 in non-PBT group. T-test between the matched groups PBT vs. non-PBT showed no significant difference between the matched group in regards of age (40.94 vs 40.16, $p=0.81$), ISS (19.16 vs 15.97, $p=0.14$), transfer SBP (76.34 vs 82.85, $p=0.07$) transfer HR (96.25 vs 91.59, $p=0.41$) and mechanism of injury (penetrating 22 vs 11, blunt 21 vs 90, $p=0.097$), though there was small difference in transfer SI (1.25 vs 1.07) $p=0.03$. Upon arrival to ED significant differences for PBT vs non-PBT groups were found for ED HR (105.41 vs 94.79, $p=0.01^*$), ED SBP (112.30 vs 121.50, $p=0.05^*$) and ED SI (0.99 vs 0.82, $p=0.006^*$). After both modalities of resuscitation, the changes in physiologic parameters were not significantly different: Δ SBP (35.9 vs 38.7, $p=0.93$), Δ HR (9.2 vs 3.2, $p=0.24$), and Δ SI (-0.25 vs -0.25, $p=0.90$). Chi-square and Fisher exact tests showed no difference in mortality between PBT vs. non-PBT groups: 4/32 (12.5%) vs. 8/112 (7.1%) ($p=0.46$) respectively.

Conclusion: DCR has been shown to improve outcomes in the military and civilian setting for patients with severe hemorrhage when used in the ED, OR, and ICU. Intuitively this benefit would extend to the pre-hospital resuscitation period. This 10 year retrospective study demonstrated no survival advantage for patients with hypotension that received PBT early en route to the trauma center.

	PBT	Non-PBT	p-value
Transfer			
SBP	76.3	82.7	0.07
HR	96.2	91.5	0.41
SI	1.25	1.07	0.03
ED			
SBP	112.3	121.5	0.05
HR	105.1	94.8	0.01
SI	0.99	0.82	0.006
ED vs Transfer			
Δ SBP	35.9	38.7	0.93
Δ HR	9.2	3.2	0.24
Δ SI	-0.25	-0.25	0.90

MASSIVE TRANSFUSION POLICIES AT U.S. TQIP TRAUMA CENTERS

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Introduction: Massive Transfusion Protocols (MTPs) have been developed to implement Damage Control Resuscitation (DCR) principles. The Trauma Quality Improvement Program (TQIP) recently published a best practice guideline for massive transfusion in trauma. We performed a survey of MTP policies at TQIP centers to establish which aspects of DCR are included in massive transfusion guidelines for patients with severe bleeding.

Methods: We administered a cross-sectional electronic survey to 187 American College of Surgeons (ACS) TQIP participants. Surveys were distributed on October 10, 2013 by ACS-TQIP administration.

Results: There were 138 responses to the survey for a 74% response rate. 62% of sites are level I, and 38% are level II ACS trauma centers. 97% of centers reported having a written MTP. The three most common reported triggers for MTP activation were: physician discretion (100%), hypotension (54%), and administration of uncross-matched blood products (54%). 66% of TQIP centers indicated that they have plasma immediately available (within 2 minutes) for MTP activation. For those with immediate use plasma, 52% utilized thawed plasma, (previously frozen), 10% used both thawed and liquid plasma, and 4% used only liquid plasma. For all respondents, plasma products were immediately available in 42% of Emergency Departments (EDs), 34% of Operating Rooms (ORs), and 30% of Intensive Care Units (ICUs). Target packed red blood cells (RBCs) to plasma ratios for the first group of blood products administered during MTP guided transfusion were: 1:1 (54% of sites), 2:1 (15%) and 1.5:1 (10%) Likewise, target ratios for RBCs to platelets were: 1:1 (68%), 2:1 (6%), and no ratio (4%). 17% of sites reported having point of care thromboelastogram (POC TEG) available for use during MTP activations, while only 9% reported using TEG to guide blood use during MTP activation. Among all respondents, POC TEG is located in 13.2 % of ORs, 10% of EDs, and 10% of ICUs. Hemostatic adjuncts incorporated into MTPs included tranexamic acid (48%), cryoprecipitate (48%), recombinant activated factor VII (32%), prothrombin complex concentrates (24%), and fibrinogen concentrates (10%). 63% of sites reported that some or all of their Emergency Medical Services (EMS) prehospital agencies had the ability to administer blood products or hemostatic agents during transport. The most common blood products and hemostatic agents available and administered in transport included: RBCs (27%), TXA (14%), and Plasma (9%). There were no significant differences between level 1 and level 2 ACS trauma centers in RBC:plasma ratio, RBC:platelet ratio and hemostatic agents included in MTPs.

Conclusion: The majority of TQIP trauma centers reported having MTPs that support the use of damage control resuscitation (DCR) principles including plasma:RBC and platelet:RBC ratios >1:2. The immediate availability of thawed plasma and product use by EMS was common, while the use of TEG to guide transfusion was low.

EFFICACY OF FIBRINOGEN CONCENTRATE, PROTHROMBIN COMPLEX CONCENTRATE AND TRANEXAMIC ACID ON ACUTE TRAUMATIC COAGULOPATHY

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Introduction: Acute traumatic coagulopathy is common in bleeding trauma patients and is a target for therapeutic approaches to reduce haemorrhage and improve outcomes. The consistent delivery of plasma and other blood-derived components can be challenging for even the largest trauma centers, and is even more so in resource-poor environments. Factor concentrates and other therapeutics are therefore attractive alternatives and are utilized in some centers around the world. However their efficacy in reversing acute traumatic coagulopathy has not been fully evaluated.

Methods: Male Wistar rats were subjected to trauma (paramedian laparotomy with crushing of anterior abdominal muscles and bilateral tibia-fibula fracture) and haemorrhage ($40 \pm 5\%$ of estimated blood volume) to a target mean arterial blood pressure of 30 ± 5 mmHg. 45 minutes after the start of the bleeding the animal was treated with haemostatic agents (prothrombin complex concentrate 50 IU/kg, fibrinogen 100 mg/kg and tranexamic acid 100mg/kg) or saline and coagulation response was assessed via rotational thrombelastography. Blood samples were taken at the beginning of the experimental period before drug administration and 30 minutes after the treatment. Rats were allocated to therapeutic groups after blind randomisation (Crystalloid (CRYST); Fibrinogen (FIB); Prothrombin Complex (PCC); Tranexamic acid (TXA); and FIB+TXA)

Results:

The shock severity was similar across all studied groups (average lactate at T60= 9 mEq/L; base excess =-20mEq/L and blood withdrawal= 36% of estimated blood volume).

The clot generation improved significantly after treatment with FIB, TXA and FIB+TXA (CA5: CRYST 47.4mm; FIB 52.5mm; TXA 50.7mm; FIB+TXA 52.2mm). Maximum clot firmness also showed significant improvements with all three therapeutics (MCF: CRYST 54.2mm; FIB: 63.3mm; TXA: 62.4mm; 65.9mm). PCC showed little effect on CA5 (47.4mm) or MCF (58.5mm).

Conclusion: Fibrinogen concentrate and tranexamic acid appeared to have the most efficacy in reversing acute traumatic coagulopathy in this experimental model.

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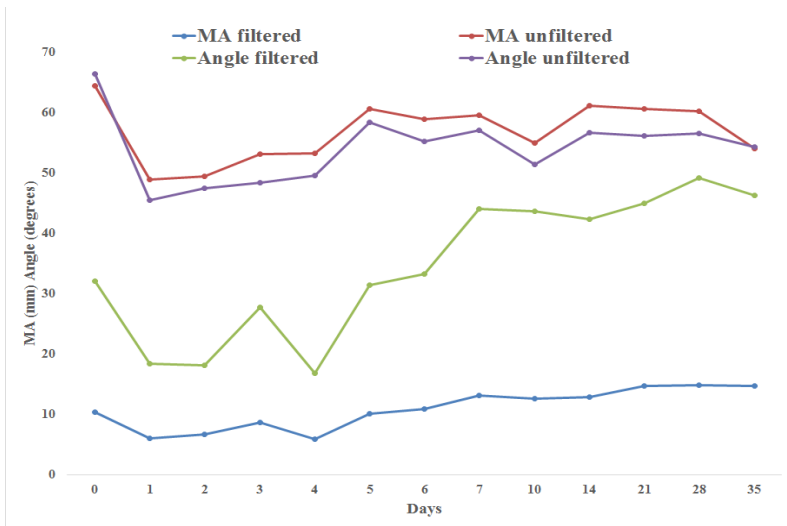
FILTRATION LESIONS IMPAIR FUNCTIONAL COAGULATION IN BANKED WHOLE BLOOD

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INTRODUCTION: Whole blood (WB) has been proposed as the ideal product for hemostatic resuscitation, but the shelf life and coagulation function have not been determined in leukoreduced banked whole blood. We hypothesized that coagulation impairment occurs during storage in filtered and unfiltered refrigerated WB.

METHODS: Seven donated WB units underwent leukocyte filtration and 7 did not. Units were stored at 4°C and sampled for 35 days for thromboelastogram (TEG) and centrifuged and stored at -80°C for later Calibrated Automated Thrombogram (CAT) and coagulation factor tests. Results were analyzed using t-test and mixed model regression analysis.

RESULTS: K-dependent factors and fibrinogen were low normal, and decreased slightly over 35 days but were similar between groups. Labile factors were better preserved in filtered units. CAT studies showed that thrombin production is largely preserved in both filtered and unfiltered units for 35 days. TEG studies showed that unlike unfiltered blood, filtered blood had significantly decreased clot strength (MA) and rate of clot generation (angle) as seen in the graph. Time to first sign of clot (TEG R) did not differ between filtered and unfiltered units over time.



CONCLUSION: Remarkably, unfiltered banked WB had no impairment of coagulation function over 35 days of storage. However, filtered WB had significantly decreased rate of clot growth, and clot strength and does not appear to be suitable for hemostatic resuscitation as a stand alone product.

OUTCOMES OF THE MASSIVE TRANSFUSION PROTOCOL IN THE NON-TRAUMA POPULATION

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Introduction: Massive transfusion protocols (MTPs) have become the standard of care for trauma patients in hemorrhagic shock. The adoption of MTP in the non-trauma patient population is a logical extension of a practice with significant survival benefit. However, there currently is little data to support its use. Therefore, we sought to determine the effect of MTP on outcomes in non-trauma patients and to determine differences in outcome between trauma and non-trauma patients undergoing MTP.

Methods: Retrospective data were collected on 159 patients who received a massive transfusion over an 18 month period from June 2012 to December 2013. Patients were stratified by age, gender, severity of illness, indices of shock and blood product transfusions. Severity of illness was assessed by APACHE II scoring. Univariate and multivariate regression analyses were used to assess outcomes including infection, pulmonary edema, resource utilization and mortality.

Results: The mean age of the study cohort was 57 ± 20 , mean APACHE II was 15 ± 8 and 53% were male with 62 % (n=99) being non trauma patients. Non-trauma patients were more likely to be female (59% v 27%, $p < 0.0001$), more severely ill (APACHE II 16 ± 12 , $p = 0.023$), have a lower hemoglobin level at time of initiation of MTP (9 ± 12 g/dL, $p < 0.0001$), a higher PT/PTT pre-MTP (21 ± 16 seconds and 49 ± 33 seconds, respectively, $p < 0.0001$) but equivalent coagulation parameters post-MTP compared to trauma patients undergoing MTP. In addition, prior to MTP, the non-trauma patients had significantly longer HLOS ($5 \pm 9 \pm 0.6 \pm 1.6$ days, $p < 0.01$) and received significantly more red blood cells (PRBC) ($3.7 \pm 7 \pm 1.6 \pm 0.6$ units, $p = 0.01$) compared to trauma patients. Non-trauma patients had a significantly increased incidence of pulmonary edema (16% v 0%, $p = 0.001$) and longer ICU and total HLOS ($11 \pm 16 \pm 6 \pm 9$ days and $17 \pm 21 \pm 11 \pm 12$ days, respectively, $p < 0.02$) compared to trauma patients. There was no significant difference in infection rates between the groups. Logistic regression analysis revealed no significant difference in mortality when controlling for severity of illness.

Conclusion: The use of MTP is common in the non-trauma patient population. Non trauma patients undergoing MTP have increased morbidity and resource utilization but not increased mortality when compared to trauma patients. The higher incidence of coagulopathy in non-trauma patients may be due to a delay in activation of MTP as evidenced by the lower hemoglobin and longer LOS prior to MTP use in this group. Further study is warranted to determine the true etiology of these differences.

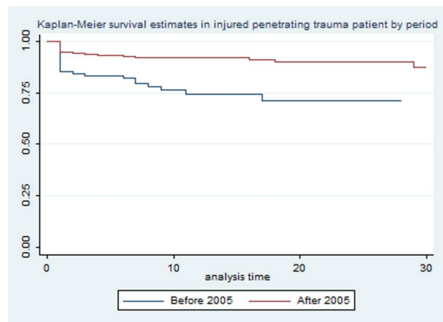
ASSOCIATION OF CRYOPRECIPITATE WITH IMPROVED SURVIVAL FOLLOWING PENETRATING INJURY

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Introduction: The approach to managing severe penetrating injuries has undergone major changes over the past several years. The objective of this study was to quantify the impact of fibrinogen containing cryoprecipitate on survival in penetrating trauma patients

Methods: Retrospective observational study comparing major changes in trauma resuscitative management from two separate periods at a large regional level one trauma center between the periods of 1998-2005 and 2005 -2013. All adult patients that suffered penetrating trauma who required immediate operative therapy and that required at least two units of packed red blood cells were included. Data including indications and outcomes were collected and analyzed using a univariable and bivariable regression analysis. Due to the fact that several data points were lacking, 1000 simulations were performed using the bootstrap method to verify the data. The overall survival rates were estimated via the Kaplan-Meier method.

Results: A total of 401 patients were included. The median age was 30 ± 11.6 years and 92.8% were males. Three hundred and forty one (85%) were from gun shot wounds. During the first 24 hours of damage control resuscitation in which the patients received in addition to the packed red blood cells (PRBC's), sixty eight percent received fresh frozen plasma (FFP), 54.6% received platelets (PLT) and 39.4% received cryoprecipitates (CRYO). The mean of transfused units in the first 24 hours was PRBC's 8.3 ± 8.12 , FFP 6.0 ± 7.5 , PLT 7.5 ± 13.03 and CRYO 3.7 ± 5.86 . The median NISS was 34 (IQR 25-44). The median intravenous fluids infused in the first 24 hours prior to 2005 was 9200cc (IQR 5400 – 13600cc) and after 2005 was 5763cc (3700-8300cc [$p = 0.0001$]). The initial fibrinogen was <200 mg/dl in 78.9% of patients. Seventy six point nine percent of patients received CRYO after 2005 and only 23.1% of patients prior to 2005 ($p < 0.001$). The median intra-operative blood loss was 3000cc (2000-4650cc) prior to 2005 and of about 2000cc (1000-3000cc) after 2005 ($p = 0.001$). The overall mortality was 13.9% (56/401), of which 22/56 (39.2%) were intra-operative. Prior to 2005 the mortality was higher than that of those after this date: 26.4% vs 10.1% (RR 0.38 CI95% 0.24-0.62 [$p = 0.0001$]). The probability of survival by the Kaplan-Meier method at 30 days was 71.2% (Prior to 2005) vs 87.4% (After 2005, [$p = 0.005$]). The possible factors that influenced the decrease in mortality over time were (adjusted according to NISS and age): the use of cryoprecipitate, and the decrease use of intravenous fluids.



Conclusion: Cryoprecipitate may independently add to the survival benefit in the seriously injured penetrating trauma patient requiring transfusion. Additional study is necessary to define the role of fibrinogen in resuscitation from hemorrhagic shock.

ACHIEVING EARLIER 1:1 HEMOSTATIC RATIO WITH LIQUID PLASMA DURING DAMAGE CONTROL RESUSCITATION: A NON-INFERIORITY ANALYSIS

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Introduction: Damage control resuscitation (DCR) requires early administration of close ratio of plasma to Packed Red Blood Cells (PRBC) in patients with severe hemorrhage. Rapid acquisition of fresh frozen plasma (FFP) on an as-needed basis can be challenging in a civilian trauma center. We hypothesized that never frozen plasma in the form of Liquid Plasma (LP), when compared to FFP can be a non-inferior alternative in patients with severe hemorrhage managed with DCR.

Methods: All massive transfusion protocols (MTP) from June 1, 2012 to January 1, 2013 were reviewed and analyzed. Patients in which the first plasma product used was LP were identified and compared to those in which FFP was the initial plasma product. Primary outcome analyzed was the time (min.) from initiation of an MTP to the issuance of the first plasma product (LP vs. FFP). Secondary outcomes included: 1.the rapidity with which the first unit of plasma was issued relative to the first unit of PRBC, 2.the number of thawed, type-specific FFP units patients received within an hour of the initial dose of LP and FFP, and 3.overall 24-hour survival between groups.

Results: A total of 42 MTP's were reviewed of which 17 received FFP as the initial plasma product and 25 received LP. Mean time from initiation of the MTP to the issuance of the first plasma product: 5.7 ± 6.4 LP vs. 19.8 ± 7.3 FFP ($p = 0.01$). Mean time between issuance of the first unit of PRBC and the first unit of plasma was: 1.5 ± 3.4 LP vs. 10.9 ± 8.8 FFP ($p = 0.02$). Mean number of type specific units of FFP issued within 1 hour of the first plasma product was 4.3 ± 3.9 FFP vs. 10.4 ± 5.1 LP ($p = 0.04$). No difference in 24-hour survival was noted between groups: 56% LP vs. 53% FFP ($p = 0.58$).

Conclusion: In this non-inferiority analysis Liquid Plasma can provide advantages over fresh frozen plasma in terms of improved turn-around times, earlier 1:1 plasma to PRBC delivery and overall mean number of plasma infused during the first hour of resuscitation with no difference in 24-hour survival. Integration of liquid plasma as the first plasma administered in MTP's should be taken into consideration.