Session IV

Poster # SI-1

OUTCOME OF ENTEROCUTANEOUS FISTULA AFTER TRAUMA

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Introduction: Enterocutaneous fistula (ECF) is a rare but serious complication following laparotomy in trauma patients. The purpose of this study was to describe the etiology, treatment, and outcome of ECF in trauma patients treated at our center.

Methods: A retrospective review of all patients who developed ECF following laparotomy for trauma from 2000-07 at our Level I trauma center was performed.

Results: Of 22,341 trauma admissions, 792 (3.5%) required laparotomy. Twenty-three patients (3%) developed 28 ECFs originating in the small bowel (9), colon (9), pancreas (6), stomach (2), biliary tract (1) or duodenum (1). These patients had 4+1 laparotomies for their injuries, and the eventual fistulizing organ was injured in 96%. The mean age was 43±3 years; the Injury Severity Score was 19±2; 83% were male; and 52% were due to blunt trauma. ECF developed on hospital day 31+5; 13 patients had high-output (>500 mL/d) ECFs. Spontaneous healing occurred in 9 patients (including all 6 pancreatic ECFs) 55±13 days after ECF development. Four of 10 surviving patients with high-output ECF and 5 of 10 patients with low-output ECF had spontaneous healing. Operative repair was successful in 10 of 11 patients in which it was needed (1 recurrence). Three patients (13%) died: 2 prior to spontaneous closure or operation. Infectious complications included bacteremia (61%), surgical site infection (44%), pneumonia (30%), urinary tract infection (26%), and intravascular catheter infection (9%). Patients who developed ECF were significantly older (43+3 vs. 34+0.6 yrs), had longer intensive care unit length of stay (33±6 vs. 5±0.5 d), and had more ventilator days (23±6 vs. 4±0.4 d) compared with other trauma laparotomy patients.

Conclusions: Spontaneous healing occurred in less than half of patients who developed ECF after trauma. All pancreatic ECFs healed spontaneously, but most others required operation. Fistula output did not predict the need for operation. ECF rarely occurs in the absence of injury to the eventual fistulizing organ.

Session IV

Poster # SI-2

CT GRADE DOES NOT PREDICT THE EXTENT OF VASCULAR INJURY IDENTIFIED BY ANGIOGRAPHY IN PATIENTS WITH SPLENIC TRAUMA TREATED WITH SUBSELECTIVE EMBOLIZATION

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Introduction: The success of angiography and embolization in splenic salvage after trauma varies widely in the literature. We compared the vascular injury observed at angiography with the CT grade of injury, the embolization technique used to control bleeding and clinical outcomes in an effort to correlate injury and outcome.

Methods: Patients with splenic injuries were identified from the trauma registry and charts and radiographs reviewed for patients who underwent splenic embolization in order to characterize the type of vascular injury, the embolization technique and clinical outcome.

Results: Between 2002 and 2007 398 patients were admitted to a level I trauma center with splenic trauma. Of these, 29 underwent angiography and embolization, (mean ISS=23.6). Embolization of the main splenic artery at the hilum was used when > 3 sites were identified on angiography and was used in 5 patients (grade 3 N = 1 and grade 4 N = 4 injuries). When $\leq$ 3 bleeding sites were identified subselective embolization was used (24 patients). The grade of injury, number of patients and the mean number of bleeding sites per patient undergoing subselective embolization are presented in chart form. Bleeding was controlled in all patients undergoing embolization, although one patient (3.4%), with a grade V injury required splenectomy for infectious complications. There were no other complications (e.g. arterial injury) in the embolization group.

Conclusions: The CT grade of injury does not correlate with the number of bleeding sites identified by angiography, thus all areas of the spleen must be fully visualized on the initial diagnostic angiogram. When this is accomplished subselective embolization of all bleeding sites provides excellent control of hemorrhage with a very low infectious, and overall, complication rate.

Grade	# Patients	# Bleeding Sites
I	1	3
II	2	1
III	10	1.89
IV	10	1.2
V	1	3

Session IV

Poster # SI-3

ROLE OF COMPUTED TOMOGRAPHY IN AVOIDANCE OF NON-THERAPEUTIC LAPAROTOMY FOLLOWING GUNSHOT WOUND TO THE ABDOMEN

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Introduction: Exploratory laparotomy is the recommended method of evaluating patients sustaining gunshot wounds (GSW) to the abdomen. Mandatory exploration can result in a large percentage of non-therapeutic laparotomies (NTL) in stable patients. Our study aims to retrospectively evaluate the potential benefit of employing CT scans to reduce the number of patients who undergo unnecessary laparotomy.

Methods: We reviewed trauma registry and hospital records from 2003 through 2007 on stable patients (SBP ?90) sustaining GSW to the abdomen, flank, back or buttocks. The NTL rate was determined for those who had undergone CT imaging vs. those who had been taken directly to the operating room. A positive CT scan was defined as pneumoperitoneum, extravasation of oral contrast, or hemoperitoneum with a blush. Statistical analysis was performed to calculate positive (PPV) and negative (NPV) predictive values, sensitivity and specificity.

Results: 125 patients met study criteria. Eight patients received neither operation nor CT imaging and were excluded, leaving 117 patients for analysis. Of the 65 patients who went directly to the operating room, 14 (21.5%) received NTL. Fifty-two patients had CT imaging with 12 positive scans. Eleven of the 12 patients with a positive CT scan underwent immediate laparotomy; 4 were non-therapeutic. One patient was unsuccessfully observed, and required laparotomy. Forty patients had a negative CT scan, 38 of these were observed; one observed patient failed observation requiring a laparotomy. Two patients were taken to the operating room for laparotomy despite a negative CT scan; one laparotomy was non-therapeutic. The NTL rate for all patients receiving CT scans was 9.6% vs. 21.5% for those going directly to the OR ($p<0.05$). The PPV and NPV of CT were 80.0% and 95.0%, respectively (80.0% sensitivity, 90.5% specificity).

Conclusion: The use of CT can reduce the rate of NTL in hemodynamically stable patients sustaining GSW to the abdomen, flank, back, or buttocks and a low rate of missed injury.

Session IV

Poster # SI-4

CRASH CHARACTERISTICS ARE PREDICTIVE OF SPLENIC INJURY: ANALYSIS OF THE CIREN DATABASE

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Introduction: Pre-hospital motor vehicle crash (MVC) variables may be useful for triage and treatment decisions. We hypothesized that crash variables would predict splenic injury in motor vehicle drivers.

Method: Drivers in single impact left-sided non-rollover MVCs with splenic injury were identified from the Crash Injury and Research Engineering Network (CIREN) database. Patient demographics, crash characteristics, and treatment variables were reviewed. Multiple logistic regression was used to calculate odds ratios and 95% confidence intervals.

Results: There were 677 drivers from 1995-2007 identified for analysis. Of these drivers, 105 (16%) had splenic injury (mean age 41 yrs., 45% male, 70% restrained, 78% driving passenger cars). Variables hypothesized to be predictive of splenic injury are listed in Table 1. Surgical intervention was required in 21 patients. Need for splenic operation varied by vehicle type; passenger cars (62%), sport utility vehicles (SUV) (24%), and light trucks (14%).

Table 1: Crash Characteristics and Splenic Injury Risk

	No Splenic Injury (%)	Splenic Injury (%)	P-value	Odds Ratio	95% Confidence Limits
Age Group >30 yrs.	70	62	0.33	0.80	0.51, 1.26
Struck by Non-Car*	46	55	0.69	1.09	0.70, 1.71
Delta-V >25kph	81	87	0.01	2.31	1.20, 4.42
Left Side Impact	19	45	<0.0001	4.11	2.57, 6.58

* Striking vehicle was SUV or light truck

Conclusion: Discrete crash characteristics may be predictive of splenic injury. In particular, drivers involved in left-side collisions experiencing a Delta-V >25kph are at greatest risk for splenic injury. This study identifies easily accessible data that can be provided by pre-hospital personnel to assist in triage and evaluation of the trauma patient. The CIREN database provides unique opportunities for further research into relationships between crash characteristics and specific injury patterns.

Session IV

Poster # SI-5

THE UTILITY OF LATE IN-HOSPITAL REPEAT CT SCAN IN PATIENTS WITH BLUNT SPLENIC INJURY

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Background: There remains much debate about the utility of repeat computed tomography scan (RCT) during nonoperative management of blunt splenic injuries (BSI). Recent studies have recommended early RCT 1-3 days after injury to detect splenic pseudoaneurysms (PSAs). However, there remains wide variation in the usage and the timing of RCT between trauma institutions.

Methods: A retrospective review was performed of all RCTs obtained for BSI at a Level I trauma center for a 10 year period. We analyzed the patient characteristics, timing of the RCT and outcome for all patients who had a RCT after nonoperative management of blunt splenic injury.

Results: From July 1, 1997 to June 30, 2007, there were 509 patients with BSI, 270 of whom were managed nonoperatively. RCT was performed on 106 of these patients (39%). Patients that had a repeat CT were similar in demographics and ISS to those that did not undergo RCT, but had a higher percentage of splenic injury grade (SIG) ≥3 (57.8% vs. 20.3%, $p<0.05$). All RCTs were performed after 3 days of hospitalization, with a median of day 6. Of the 106 patients that underwent RCT, 3 (2.8%) were found to have PSAs and were treated with angioembolization. Of the subset of 88 patients that underwent routine follow up CT that were asymptomatic, 2 (2.3%) PSAs were found. These 2 patients had AAST SIG 2 and 3. One patient was symptomatic and had an AAST grade I injury on initial CT. The RCTs revealing splenic PSAs were performed on post injury day 4, 5, and 6. Of the 44 RCTs performed more than 6 days after injury, none showed PSA formation. The charges per PSA found and treated were $100,300.

Conclusions: It was necessary to perform 44 RCTs for each asymptomatic splenic PSA identified. Our data suggest that the incidence of positive findings on RCT performed later in the hospital stay is low. Patients with splenic PSAs are asymptomatic and not distinguishable by splenic injury grade from those without PSAs.

Session IV

Poster # SI-6

RIB FRACTURES AND MINOR LIVER OR SPLEEN LACERATIONS IN NON-OPERATIVELY MANAGED BLUNT TRAUMA: THE POTENTIAL FOR MISSED DIAPHRAGMATIC INJURY

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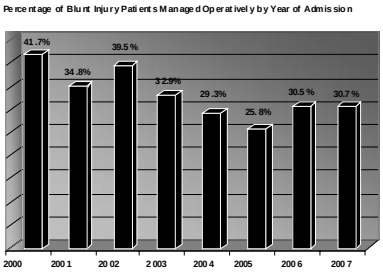
Objective: Non-operative management of blunt liver or spleen injuries (LSI) is widely accepted. Literature suggests, however, that even Multi-detector Computed Tomography (MDCT) can be equivocal in detection of diaphragmatic injuries (DI). We hypothesize that in blunt injuries the presence of rib fractures and LSI (RF+LSI) is associated with a high incidence of DI even if LSI is low grade.

Methods: All blunt injury patients undergoing exploratory laparotomy between 01 JAN 2000 and 31 DEC 2007 were identified from the registry of our Level I center. The association between injury variables and DI was examined with logistic regression. RF+LSI patients with Organ Injury Scores (OIS) of grade I or II (minor LSI) were identified. A potentially non-operative (PNO) intervention was any laparotomy in a patient with RF + minor LSI, who did not undergo a bowel procedure presenting without hypotension (SBP < 90 mmHg)



Results: There were 705 patients eligible and 53 (7.5%) had DI. The incidence of DI was 17.8% (18/101) in RF + LSI and 20% (7/35) in RF + minor LSI patients. There were 19 PNO patients and 4 (21.1%) of them had DI. RF + LSI [3.26(1.74-6.12), <.0001] and motor vehicle collisions [4.93(2.36-10.32), <.0001] were independently associated with DI. The overall incidence of laparotomy in blunt injury patients who underwent operation or were admitted to the intensive care unit only decreased significantly over the study (p = 0.003).

Conclusions: The presence of RF + LSI is associated with DI even when LSI is minor and there are no other operative injuries. Since NOM is widely accepted and may even be increasing, the potential for missed DI exists. When MDCT is not available or is equivocal, other studies including diagnostic laparoscopy should be considered in these patients.

Session IV

Poster # SI-7

SINGLE CONTRAST CT FOR THE TRIAGE OF PATIENTS WITH PENETRATING TORSO TRAUMA

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Introduction: To expedite patient evaluation and minimize costs and potential morbidity associated with oral and rectal contrast, we have used single contrast (intravenous contrast only) computed tomography (SCCT) as a primary means of triaging hemodynamically stable patients with penetrating torso trauma. We hypothesized that SCCT in this patient population safely determines the need for operative exploration. Furthermore, trauma surgeons without specialized training in body imaging can accurately apply this modality.
Methods: We retrospectively reviewed patients with penetrating torso injuries at a single center. In a separate study, 4 trauma surgeons independently reviewed 42 SCCT scans to determine the need for exploration based on SCCT alone and the results analyzed.
Results: There were 285 hemodynamically stable patients with penetrating torso trauma triaged by SCCT. The sensitivity of SCCT to predict the need for laparotomy was 98%, specificity 90%, positive predictive value (PPV) 85%, negative predictive value (NPV) 99%, and accuracy 93%. Two false negatives occurred in stab wounds: one had an enterotomy and the other a diaphragm injury. Both were explored within 3 hours of presentation based on physical exam. Overall mortality was 0.35%; the one death was from head injury. Comparisons of trauma surgeon agreement in the 42 CT interpretations were quantitated using the kappa statistic. Results ranged from 0.81 to 0.90, or "nearly perfect" concurrence. The surgeon's interpretation of the CT alone yielded a mean PPV of 93 % ± 3.1 and a mean NPV of 92 % ± 3.5 in determining the need for exploration.
Conclusions: SCCT is safe and effective in the triage of hemodynamically stable patients with penetrating torso trauma. SCCT detects the need for operative intervention with appropriate clinical accuracy without the additional costs, morbidity and delay of oral and rectal contrast. Additionally, trauma surgeons can reproducibly interpret SCCT with high predictive accuracies to guide their management of patients with penetrating torso trauma.

Session IV

Poster # SI-8

THE USEFULNESS OF DIAGNOSTIC PERITONEAL LAVAGE COMPARED WITH MDCT IN BLUNT ABDOMINAL TRAUMA

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Background: We, previously, have shown that diagnostic peritoneal lavage (DPL) with our criteria (lavage white blood cell counts over lavage red blood cell counts divided by 150 in the presence of hemoperitoneum, or lavage white blood cell counts over 500/mm3 in the absence of hemoperitoneum: J Trauma. 1998) is one of the most useful procedures to detect the hollow visceral injury due to blunt abdominal trauma. Though it's high sensitivity and specificity, we sometimes get false negative or false positive results, especially in borderline cases of which lavage white cell counts slightly more or less than cut-off value of our DPL criteria. At the same time many studies reported the efficiency of the multiple-detector computed tomography (MDCT) in blunt abdominal trauma. In this study we analyze these problematic cases and usefulness of DPL compared with MDCT.

Methods: Between September 2001 to September 2007, 259 cases underwent DPL at our institution, and we excluded 54 inappropriate cases: 22 cases of inappropriate sampling time, 2 cases of unclear accident date, 16 cases of stub wounds, 14 cases of death within 24 hours. The remaining 205 patients were included retrospectively.

Results: In this study diagnostic sensitivity in detecting intestinal injuries by DPL with our criteria is 90.5%, specificity is 95.1% (19 true-positives, 9 false-positives, 2 false-negatives and 175 true-negatives), while sensitivity for detecting free air by MDCT is 19%. In four cases with hemoperitoneum, DPL results turned from negative to positive. All these patients received laparotomy, and we found serosal or mesenteric injuries followed by intestinal necrosis need to be surgically resected. There were twelve cases that we decided to perform laparotomy not from their CT findings but from DPL results and found perforated intestinal injuries in these all cases. In conclusion, this study shows effectiveness of serial DPL examination for diagnosis of hollow visceral injuries, especially in cases with hemoperitoneum, under the era of MDCT progression.

Session IV

Poster # SI-9

A COMPARISON OF PTSD BETWEEN BURNED SERVICE MEMBERS AND CIVILIANS TREATED AT A MILITARY BURN CENTER

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Introduction Post-Traumatic Stress Disorder (PTSD) has been identified in approximately 32% of burned service members treated at the United States Army Institute of Surgical Research (USAISR) Burn Center. The USAISR provides burn care for service members injured in combat and for traumatically burned civilians. The purpose of this study is to compare PTSD between burned service members and civilians treated with the same standard of care at the USAISR. Data collection is ongoing.

Method A retrospective review of records of PTSD assessments completed between 4 Jan 2005 and 31 Jan 2008. PTSD was defined as a score of 44 or greater on the PTSD checklist (PCL-M or PCL-C). Records were stratified by PTSD or no PTSD and by date of PTSD assessments (< 30 days and > 30 days after injury). Descriptive analyses were used.

Results We assessed 417 patients for PTSD during this time period, 322 were military (77%), 95 were civilian (23%). PTSD incidence (<30D) was civilians (15.5%), service members (18.4%) and (>30D) civilians (24%), service members (30.3%). No significant difference in PTSD was found between groups at either time point [<30D $t(.733)$, $df=27$, $p=.470$; >30D $t(1.072)$, $df=75$, $p=.287$)]. Patients with PTSD were not significantly different in total body surface area (<30D 9 ± 9, $p=.221$; >30D 20 ± 17, $p=.765$); injury severity score (<30D 7 ± 6, $p=.322$; >30D 20 ± 17, $p=.064$), or length of stay (<30D 7 ± 6, $p=.295$; >30D 35 ± 53, $p=.765$). Although not significant, these data shows differences in TBSA and ISS between time points. Age was significantly different (<30D 31 ± 12, $p=.007$; >30D 25 ± 7, $p=.024$), but taken alone does not account for PTSD.

Conclusion PTSD does not differ between burned service members and civilians. The data suggests a relationship between severity of injury and PTSD. Further research is needed that focuses on risk factors of the traumatically injured and to determine whether early recognition and treatment of PTSD in burned patients can improve long-term outcomes.

Session IV

Poster # SI-10

COMBAT VERSUS CIVILIAN OPEN TIBIA FRACTURES – THE EFFECT OF BLAST MECHANISM ON OUTCOME.

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Introduction: Extremity injuries due to combat in Coalition forces serving in Iraq and Afghanistan are often severe. This study compares outcomes for open tibia fractures between US military combat injuries from the current conflict and a US Level I Trauma Center.

Methods: Data from the trauma registry of a Level I trauma center from 1985 to 2006 was compared to data from the US Marine Corps/US Navy (USMC/USN) combat trauma registry from March 2004 to August 2007. Injuries were categorized by Gustilo-Anderson (G-A) open fracture classification. Independent variables included age, gender, mechanism, shock, blood loss, associated injuries, prehospital time, tourniquet use, procedures, ISS, and LOS. Dependent variables included complications, amputation and mortality.

Results: There were 850 open tibia fractures in 28,646 Level I Trauma Center patients and 115 open tibia fractures in 2,282 USMC/USN casualties. USMC/USN open tibia fracture casualties were more likely to have a penetrating mechanism (96% vs. 6%, $p< 0.01$), were more likely to need blood transfusions (47.6% vs. 30.1%, $p< 0.01$) and had more AIS ? 3 non-extremity injuries (39.8% vs. 30.6%, $p< 0.01$). Amputation rates were higher for G-A Grades IIIB and IIIC in USMC/USN casualties than in Trauma Center cases ($p<0.05$)*. Mechanisms featuring blast proximity such as mines and improvised explosive devices (IEDs) had a higher amputation rate (37% vs 7.7%, $p= 0.02$) than other combat injuries.

Amputation rate – Open tibia fractures	Gustilo I, II, IIIA	Gustilo IIIB	Gustilo IIIC
Level I Trauma Center (n=850)	7/562 (1.2%)	8/216 (3.7%)	23/72 (31.9%)
USMC/USN casualties (n=115)	1/46 (2.2%)	5/40 (12.5%)*	18/29 (62.0%)*

Conclusions: Despite current therapy, outcomes for G-A IIIB and IIIC grades are significantly worse for open tibia fractures due to combat injuries compared to injuries at a Trauma Center.

Session IV

Poster # SI-11

CT PULMONARY ANGIOGRAPHY PROVIDES EVALUATION OF VASCULAR AND PARENCHYMAL DISEASE OF CRITICALLY ILL TRAUMA PATIENTS

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Objective: To evaluate the intervention/outcome of critically ill trauma patients undergoing CT pulmonary angiography (CTPA) for acute respiratory decompensation.
Methods: All trauma patients admitted to surgical intensive care unit with stays >48hrs during a 2 year period were reviewed (n=277).
Results: A total of 40 patients underwent 50 CTPA studies to evaluate acute respiratory compromise. The mean ISS of the patients undergoing CTPA was 28.0 ± 11.2 vs. 21.7 ± 13.1 for the patients who did not require evaluation ($p<0.05$). Mortality, age, sex were not statistically different between the two groups. Despite routine use of daily chest x-ray, only 28 of 47 studies performed in the 24 hours prior to CTPA had changes that would indicate worsening pulmonary reserve. Six of the studies (12%) were positive for pulmonary embolus (PE), 4 studies demonstrated central PE and the remaining two studies were positive for peripheral PE. Treatment of this group resulted in the placement of 5 inferior vena cava filters, and the one remaining patient was treated with long-term anticoagulation. Acute parenchymal findings that explained respiratory decompensation were found in 40 of the other 44 studies performed. These results included atelectasis/collapse (n=22), pneumonia (19), pleural effusion (6), contusion (4), pnuemothorax (2). An intervention was ordered after 41 of the studies that were performed. In the studies that demonstrated parenchymal disease the most frequent interventions were an increase in ventilator support (n=18), initiation/change in antibiotic treatment (14), chest thoracostomy tube (3) and bronchoscopy (2). No intervention was ordered after 9 of the CTPA studies, in these instances 7 patients were already on broad-spectrum antibiotics for presumed pneumonia.
Conclusions: CTPA is a high yield, minimally invasive means for evaluating the acute cause of respiratory compromise in critically ill trauma patients. These studies provide information about the pulmonary vasculature and the lung parenchyma that can direct therapeutic interventions.

Session IV

Poster # SI-12

EMERGENCY DEPARTMENT BOARDING DOES NOT IMPACT OUTCOME IN CRITICALLY ILL TRAUMA PATIENTS

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Introduction: Emergency Department (ED) boarding of critically injured patients is increasingly common in United States hospitals. This study examines the association between extended ED LOS and negative outcomes.

Methods: Trauma registry data were reviewed on 1777 adults discharged in 2006. Of these, 348 required admission from ED directly to ICU. Patients in ED <6 hours (n = 165; 47.4%) were compared to those in ED for ?6 hours (n = 183; 52.6%). Mortality, ICU LOS, tracheostomy, and prolonged ventilation were analyzed in relation to age, Injury Severity Score (ISS), Glascow Coma Score (GCS), ED LOS by chi-square, Pearson correlations, linear and logistic regression.

Results: Groups were similar in all variables (see Table). Extended ED LOS (≥ 6 hours) was not significantly associated with any negative outcomes in univariate or multivariate analyses. GCS, ISS and age were independently significant predictors of outcome.

Conclusions: ED LOS >6 hours was not associated with negative clinical outcomes but significantly decreased the incidence of prolonged ventilation. ED boarding of critically ill patients in a state-designated Level-I Trauma Center may not increase the incidence of negative outcomes, as may be expected in other settings.

	Delayed ICU Admit (n=183)	Non-Delayed ICU Admit (n=165)
Clinical/Demographic Factors:		
ISS	Median = 16; range: 1 - 66	Median = 16; range: 1 - 45
GCS	Median = 15; range: 3 - 15	Median = 15; range: 3 - 15
Age	Mean = 45.4; SD: 22.9	Mean = 44.0; SD = 21.0
Outcome measures:		
Mortality	N = 20 (10.9%)	N = 12 (9.6%)
Tracheostomy	N = 20 (10.9%)	N = 21 (16.8%)
Ventilator > 96 hrs*	N = 26 (14.2%)	N = 35 (28.0%)
ICU LOS (days)	Median = 3; range: 1 - 74	Median = 4; range: 1 - 69

* $p < 0.05$ comparing delayed vs. non-delayed admissions

Session IV

Poster # SI-13

RESPONSE OF COAGULATION AND IMMUNE SYSTEMS CONTRIBUTES TO FLUID REQUIREMENT EARLY AFTER INJURY

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Objective: The purpose of this study was to determine which markers of inflammation and coagulation predict total fluid requirement (FR) after traumatic injury.

Methods: Trauma patients admitted to the surgical intensive care unit (ICU) within 24 hours of injury with an anticipated stay of $\geq$ 3 days were enrolled during 21 months. For the first two days after admission, lab data collected included plasma clotting assays, thromboelastograms and cytokine levels. Candidate variables evaluated included age, gender, hemoglobin, PT, PTT, D-dimer, Antithrombin III activity (AT-III), Protein C activity (Prot C), maximal amplitude (MA), alpha angle (α), reaction time, fibrinogen (fib), base excess (BE) and IL-6. Clinical indices collected included total fluid input and output (mL) per day during the first 48 hours after admission. The fluid input included crystalloids and colloids. Pearson correlation coefficients and multivariate linear regressions with stepwise selection were performed to identify predictors of total fluid input.

Results: We enrolled 75 trauma patients (54 blunt and 21 penetrating) with mean ISS of 25.1±1.1 (SEM). The mean age of patients was 42.4 ±2.3 and 81% (n=61) patients were male. The mean fluid input per day was 6200ml ± 380. Variables found to be significantly correlated with FR were: PT (r = 0.216), Prot C(r = -0.296), MA (r = -0.301), α (r = -0.215), AT III (r = -0.349), IL-8 (r = 0.362), fib (r = -0.368), BE (r = -0.332) and IL-6 (r = 0.390). Multivariate linear regression analysis identified 3 independent predictors of FR during the first 2 days after injury: IL-6, BE and AT III with an r of 0.824 and an adjusted r^2 of 0.655 for the model.

Conclusion: Early after injury, the FR can be predicted based on the degree of acidosis and inflammatory response, as evidenced by its indirect correlation to BE and direct correlation to IL-6, respectively. Decline of the anticoagulant activity (AT III) is also predictive of FR pointing to its consumption in vivo in response to injury. Hence, both the immune and coagulation systems contribute to total fluid requirement after injury.

Session IV

Poster # SI-14

BACTERIAL ENDOTOXIN ACTIVATES MATRIX METALLOPROTEINASES 2 AND 9 IN PULMONARY ARTERY ENDOTHELIAL CELLS

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Introduction: Matrix metalloproteinase-2 and -9 (MMP-2 and -9) are vital in the pathogenesis of acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) since their activation is found in lung tissue and lavage fluid during development of ALI and ARDS, and MMP inhibitors prevent experimental ALI and ARDS in animals. Bacterial endotoxin (lipopolysaccharide, LPS) is an important pathogen in ALI and ARDS, in which pulmonary endothelium is targeted causing vascular leakage symptoms that are likely due to vascular matrix degradation. However, there is no data showing effect of LPS on activation of MMP in pulmonary endothelium. The present study was to investigate whether LPS would activate MMP-2 and -9 in cultured pulmonary artery endothelial cells (PAECs), if so, whether activation of extracellular signal-regulated kinases (ERKs) would be involved in LPS induction of MMP-2 and MMP-9.

Methods: Cultured PAEC monolayer was incubated in medium with or without LPS and the specific ERK inhibitor PD98059. Conditioned medium was collected for analyzing MMP activity by gelatin zymography. Remaining cells were lyzed for total protein quantification with the method of Bradford. Phosphorylation of ERKs was assessed to be an index of activation of ERKs.

Results: At resting conditions, PAECs released a significant amount of latent MMP-2 but little MMP-9. Although LPS did not affect release of latent MMP-2 by the cells, LPS induced activation of MMP-2. LPS significantly increased MMP-9 at concentration- and time-dependent manners ($P<0.05$). Additionally, LPS activated ERKs. Inhibition of ERKs by PD98059 significantly attenuated LPS induction of MMP-9 ($P<0.05$) but not MMP-2.

Conclusion: LPS directly stimulates both MMP-2 and MMP-9 in PAECs, indicating that pulmonary endothelial cells are a potential source of activated MMP-2 and -9 during endotoxemia and development of ALI and ARDS. LPS stimulation of MMP-9 in pulmonary endothelial cells involves activation of ERKs.

Session IV

Poster # SI-15

HMGB-1 LEVES ARE ELEVATED IN PATIENTS WITH VENTILATOR ASSOCIATED PNEUMONIA

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Circulating high-mobility group box 1 (HMGB1) concentrations has been shown to be elevated in community acquired pneumonia subjects. However, this has not been validated in patients with ventilator associated pneumonia (VAP).

Aim; to validate the value diagnostic of HMGB1 broncoalveolar lavage (BAL) levels in patients with VAP. Methods; Surgical and trauma patients admitted to SICU at Parkland Memorial Hospital (Dallas, TX) who underwent bronchoscopy for the diagnosis of pneumonia. Demographics, clinical and laboratory data were recorded. BAL with $\geq 10^4$ colony forming units/ml was used as a confirmatory diagnostic modality. Ventilator-associated pneumonia was defined by acquisition of the disease after 48 hours of mechanical ventilation.

Results; 234 trauma patients admitted to our surgical ICU were enrolled. (82% blunt, 18% penetrated) 65% presented traumatic brain injury. The diagnosis of pneumonia was made in 182 (78%) patients. There were not significant differences between patients who developed pneumonia and those with no pneumonia. HMGB1 was identified in 99 % with VAP and in 5 % of the patients without pneumonia. Mean levels of HMGB1 were significantly higher in patients with VAP when compared with patients with no VAP. (245 ± 35 Vs 16 ± 13) p value = 0.0001.

Conclusions; In patients receiving mechanical ventilation, detection of HMGB1 in bronchoalveolar-lavage fluid may be useful in establishing or excluding the diagnosis of ventilator associated pneumonia

Session IV

Poster # SI-16

IDENTIFYING BLUNT CEREBROVASCULAR INJURIES IN THE ERA OF MULTI-DETECTOR CT ANGIOGRAPHY: WHO SHOULD WE SCREEN?

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Introduction: The diagnosis of blunt cerebrovascular injuries (BCVI) has improved with widespread adaptation of screening protocols and more accurate multi-detector CT (MDCT) angiography. The population at risk and for whom screening is indicated is still controversial. We analyzed risk factors for BCVI at our institution over a 6½ year period following initiation of a screening protocol with MDCT.

Methods: All patients identified with BCVI during this time were entered into a prospective database. Risk factors were identified and compared to similar patients without BCVI. Risk factors for these patients were obtained from the trauma registry. Comparisons of these two populations for any type of BCVI and by specific site (carotid -CAR, vertebral-VERT) against each risk factor were performed using a Chi-square statistic with relative risk (RR), 95% confidence interval (CI) and p value.

Results: There were 5441 blunt trauma admissions during the study. BCVI was identified in 48 (0.88% incidence): 26 carotid(0.48%) and 22 vertebral(0.22%). For CAR the strongest predictors were head injury(CHI) (RR-14.9, CI- 5.9 -37.0, $p<0.0001$), Glasgow Coma Score (GCS)<7(RR-13.1, CI-6.0-28.3, $p<0.0001$), Basilar skull fracture(BSF)(RR-12.9, CI-6.0-27.8, $p<0.001$,facial fractures(RR-8.3, CI-3.8-18.2, $p<0.0001$) and chest injury(RR-7.1, CI-2.8- 17.7, $p<0.001$. For VERT the only strong predictor was any cervical spine injury (RR-35.6,CI-13.2-96.1, $p<0.001$). For any type of BCVI the strongest predictors were cervical spine injuries (RR-10.4,CI-6.0-18.3, $p<0.0001$), GCS<7(RR-7.5, CI-4.2-13.1, $p<0.0001$), CHI(RR-6.3, CI-305-11.0, $p<0.0001$, BSF(RR-5.6, CI-3.0-10.4, $p<0.001$) and chest injury(RR-5.0, CI-2.8-8.7, $p<0.001$).

Conclusions: Patients with head, face, chest and cervical spine injuries as well as those with low GCS or basilar skull fractures are at high risk for BCVI and should be screened.

Session IV

Poster # SI-17

EVALUATION OF A NEW HEMOSTATIC AGENT IN A LETHAL HEMORRHAGE SWINE MODEL

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Objective: Recent data has shown that standard chitosan hemostatic dressings are only marginally better than gauze in controlling hemorrhage**.** Our objective was to evaluate the hemostatic efficacy of a newly modified chitan (MC) (Hemostasis, LLC; St Paul, MN) in a model of severe extremity arterial hemorrhage that could not be stopped with standard gauze treatment.

Methods: Anesthetized animals (n= 15, 40 ± 3 kg) were splenectomized and a reproducible femoral artery injury was created using a 6 mm aortic punch. Free bleeding was allowed for 45 seconds. Animals were randomized to either MC or gauze application. Each hemostatic agent was applied through a pool of blood with manual compression for 3 minutes. Fluid resuscitation was initiated and titrated to mean of 65 mm Hg if possible. Animals were observed for 180 minutes or until death. Endpoints were survival, survival time, blood loss, time to hemostasis, and resuscitation volume.

Results: Baseline physiologic parameters and pretreatment blood loss were the same. MC reduced bleeding ($p < 0.001$), decreased resuscitation volume, prevented exsanguination (all animals) and resulted in 100% survival ($p < 0.001$).

Outcome	**MC n =10**	**Standard gauze n=5**	*p* value
Total blood loss (ml)	206 ± 136	1313 ± 138	<0.0001
Time to hemostasis (min)	4.9 ± 1.5	None	<0.0001
Resuscitation MAP (mmHg) At 20 minutes	74 ± 23	18 ± 33	0.0003
Resuscitation Vol. (ml)	531 ± 370	943 ± 316	0.04
Survival (% at 180 minutes)	100%	0%	<0.0001

Conclusion: MC patches demonstrate the ability to control major vascular bleeding in a lethal arterial injury model over a 3 hour period. Further research is warranted.

Session IV

Poster # SI-18

THE EFFECTIVENESS OF EARLY TEMPORARY VASCULAR SHUNT PLACEMENT IN A PORCINE MODEL OF EXTREMITY ISCHEMIA-REPERFUSION

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Background Temporary vascular shunting (TVS) to restore axial flow in the setting of vascular injury has been advocated. The effectiveness of TVS in protecting against ischemic injury has not been proven and the impact of shunt timing has not been established. The objective of this study is to assess the impact of TVS and time to shunt placement on ischemic injury.

Methods A porcine model of hind-limb ischemia via iliac artery occlusion was utilized (N=30; weight (kg±SD):89±4.2). Animals were randomized into one control ($G_{control}$) and 4 study groups according to ischemic time: G_0, G_1, G_3 and G_6 hours (N=6 animals per group). Each ischemic time in the study groups (G_0,G_1 G_3 and G_6) was followed by TVS and 18 hours of reperfusion. Data consisted of repeated measures across reperfusion time points.

Results Lactate **(**mmol/L) post reperfusion (at time 0) was increased in all 4 groups relative to control ($G_{control}$ [mean±SD]: 1.0±0.2, G_0: 1.5±0.4, G_1:5.6±3.2, G_3:5.4±2.9, G_6:10.9±2.9; $p<0.001$). Immediate (G_0:1.4±0.5) and early (G_1:1.8±0.5) shunting produced a mean lactate that at one hour post reperfusion was similar to controls ($G_{control}$: 1.0±0.3; $p=0.54$ and $p=0.09$). In contrast, late TVS (G_6: 3.9±1.0) resulted in a significant increase in mean lactate compared to controls ($p<0.001$). Mid-term TVS (G_3: 2.1±0.5) resulted in a mean lactate that was significantly higher than controls ($p=0.003$) but significantly lower than late TVS ($p<0.001$). Other plasma markers in the ischemic injury profile followed similar trends.

Conclusion This study is the first of its type and provides novel insight into the benefit of early TVS in a model of extremity ischemia. Early TVS appears to protect the extremity from ischemic insult and may reduce circulating markers of organ dysfunction and inflammation. Early use of this strategy in select cases of extremity vascular injury may lessen the effects of ischemia and reperfusion injury and improve functional limb salvage.

Session IV

Poster # SI-19

17 BETA-ESTRADIOL MEDIATED PROTECTION AGAINST VASCULAR HYPERPERMEABILITY FOLLOWING HEMORRHAGIC SHOCK: REGULATION OF ESTROGEN RECEPTORS

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Objective: There are increasing evidences for the protective effects of estrogens against traumatic injury and hemorrhagic shock (HS). In this study our main objective was to understand the mechanisms of action of 17β-estradiol on vascular hyperpermeability following HS. Specifically, the role of estrogen receptors and involvement of apoptotic signaling in HS-induced vascular hyperpermeability have been investigated.

Methods: In male Sprague-Dawley rats, HS was induced by withdrawing blood to reduce the MAP to 40 mmHg for 60 minutes followed by resuscitation to 90 mmHg. They received 17β-estradiol (2 mg/kg body weight), selective estrogen receptor modulator tamoxifen (5 or 10 mg/kg body weight) or estrogen receptor antagonist fulvestrant (1 mg/kg body weight) followed by 17β-estradiol intravenously. To study changes in vascular permeability, rats were injected intravenously with FITC-albumin (50 mg/kg) and the change in integrated optical intensity was obtained using intravital microscopy. The mesenteric microvasculature was analyzed for cytosolic cytochrome *c* levels and caspase-3 activity by ELISA and fluorometric assay respectively.

Results: 17β-Estradiol (2 mg/kg body weight) attenuated HS-induced hyperpermeability ($p<0.05$). Estrogen receptor antagonist fulvestrant (1 mg/kg body weight) prevented this protective effect. A low dose of Tamoxifen (5 mg/kg body weight) attenuated HS-induced hyperpermeability where as a higher dose (10 mg/kg body weight) when given alone increased permeability. 17β-Estradiol prevented HS-induced increase in cytosolic cytochrome *c* levels and caspase-3 activity ($p<0.05$).

Conclusion: These findings demonstrate that 17β-estradiol mediated protection against vascular hyperpermeability following HS is mediated through estrogen receptors and by inhibiting intrinsic apoptotic signaling. The selective estrogen receptor modulator tamoxifen shows dose dependent variation in its agonistic or antagonist effect.

Session IV

Poster # SI-20

ANTICOAGULATION IS SAFE IN PATIENTS WITH BLUNT SPLENIC INJURY

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Introduction: Prophylactic anticoagulation using a heparin drip or subq LMWH is standard for our trauma patients without contraindications who are at high risk for venous thromboembolism (VTE). However, many perceive blunt splenic injury to be a contraindication to VTE prophylaxis due to the risk of bleeding and potential failure of non-operative management (NOM). The purpose of this study is to evaluate the safety of anticoagulation in patients with blunt splenic injury.

Methods: We reviewed the records of patients $\geq$ 16 admitted for NOM of blunt splenic injury between Jan 2001 and Dec 2004 who received anticoagulation. Patients who had splenectomy prior to the start of anticoagulation were excluded.

Results: 153 of 388 patients with splenic injury required immediate laparotomy. Of the 235 patients admitted for NOM, 146 patients never received any anticoagulation during their hospitalization. Their grade of splenic injury, ISS and length of stay (LOS) were 2.3$\pm$0.9, 16$\pm$9 and 6$\pm$5 days. 7 patients had delayed splenectomy prior to start of anticoagulation and were excluded. The remaining 80 patients met inclusion criteria. Their mean age and LOS were 39 $\pm$ 18 years and 20$\pm$17 days. The mean ISS and grade of injury were 22+ 10 and 2.1+0.8. The most common indication for anticoagulation was VTE prophylaxis (93%). Others included treatment of PE and carotid injury. The median time to anticoagulation after injury was 4 days (IQ range 3 and 6 days). No patient required delayed operative management for splenic injury. There was no significant difference in the number of blood transfusions between patients who received anticoagulation early (<72 hours) vs late (> 72 hours), (2.7$\pm$8.3 vs 3.7 $\pm$4.9 units, p=0.51).

Conclusion: The use of anticoagulation in patients with splenic injury is safe and is not associated with an increase in failure of NOM, nor an increase in transfusion requirements. Patients with blunt splenic injury at high risk for VTE should be considered for VTE prophylaxis.

Session IV

Poster # SI-21

USEFULNESS OF ULTRASOUND EXAMINATION IN DIAGNOSIS OF VERTEBRAL ARTERY OCCLUSION ASSOCIATED WITH CERVICAL SPINAL CORD INJURIES

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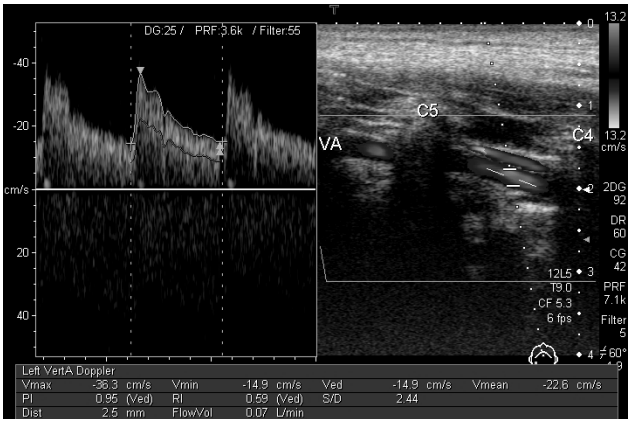
Objective. The purpose of this study was to evaluate the reliability of the ultrasound examination in the diagnosis of vertebral artery occlusion associated with cervical spine trauma. **Patients and Methods.** During the one-year period from November 2003 to October 2004, eight patients with cervical spine injury were examined with ultrasonography and magnetic resonance angiography (MRA) of the vertebral artery. The diameter and blood flow velocity of the vertebral artery were measured on the ultrasonographic imaging (Figure), and findings of the ultrasound examination concerning the presence or absence of the vertebral arterial flow were compared with these of MRA. **Results.** The diameter of the vertebral artery was 3.4 ± 0.4 mm (2.7 ? 4.2 mm) and mean flow velocity was 39.4 ± 16.3 cm/s (18.7 ? 75.5 cm/s). The results of the ultrasound examination concerning the presence or absence of the vertebral arterial flow were corresponding to these of MRA. **Conclusion.** The diagnostic accuracy of the ultrasound examination of vertebral arterial occlusion was equivalent to that of MRA in this study. The advantages of the ultrasound examination of the vertebral artery are noninvasive and can be easily performed in a short time at the patient's bedside. The ultrasound examination has clinical usefulness as a screening test for vertebral arterial occlusion of the patients with cervical spine injury.



Session IV

Poster # SI-22

TREATMENT EXPERIENCE OF TWO-PIN ONE-ROD EXTERNAL FIXATION

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Purpose: In general, the external fixation of the pelvis often used inserts left and right two pins from wing of ilium. However, the external fixation of two-pin one-rod is used devising for all patient of the unstable pelvis fracture at critical care unit in our hospital. Because this method is devised that reduction is easy, fixed power is strong and the installed device very compact. It reports on treatment results of the unstable pelvis fracture that uses this method.

Object*:* 26 patients (men: women = 12: 14) diagnosed for instability to exist in pelvis circle in-patient with pelvic fracture transported to our hospital for period of 2007 from 2003. **Method**: The operation performed that right and left one *Miami pelvic pin* , the point is dull, made by the ACE Co. Inc. is inserted from the anterior inferior iliac spine aiming at the sacroiliac joint on the same side. After the pelvis circle had been done in reduction, the external fixation of one-rod type made same company was installed in a right and left pin. This method external fixation can be promptly installed. And, there is neither breakthrough of the pin of the bone nor what is inserted in articulation coxae by mistake, too. It is possible to do without using the image in the emergency. **Result:** As for 20 cases, the pain became easy after it operated, and the changing position became possible, too. It was five cases that needed the change to internal fixation. There was four cases complain of infection in the insertion part of the pin. But, it was only one case that had to pull out pins early for that. 11 cases could be observed from the operation to the removal. As for them, all cases bone union was gotten and walking became possible, too. Having operated on chest or abdomen at the same time s operating on this method was five cases, and did not have the influence in them. Moreover, the blood pressure steady in five cases that caused bleeding shock. **Conclusions:** Because two-pin one-rod external fixation was handy, compact and obtained enough fixed power, it was very useful as not only the treatment of the fracture but also the damage control.

Session IV

Poster # SI-23

SURGICAL DECOMPRESSION FOR ABDOMINAL COMPARTMENT SYNDROME IN SEVERE ACUTE PANCREATITIS

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Introduction: Abdominal Compartment Syndrome (ACS) is associated with early Multiple Organ Dysfunction Syndrome in severe acute pancreatitis (SAP). The aim was to analyze the short-term effects of surgical decompression in patients with ACS and SAP.

Methods: A retrospective study of a 6-year period identified 26 patients undergoing either a full thickness midline (18 patients) or transverse (1) laparostomy, or a subcutaneous linea alba fasciotomy (7), of which 2 were completed to laparostomy next day. The median (interquartile range, IQR) age was 41.5 (35-49) years, 23 (89%) were men, the median body mass index was 31.5 (29-36) kg/m^2, and 21 (81%) were alcohol-induced.

Results: The median pre- and postoperative intra-abdominal pressures (IAP) were 31.5 (27-35) and 16 mmHg (14-18) ($p<0.001$), respectively, with a median decrease of 13 (10-18) mmHg, 16 (9-21) after laparostomy and 12 (10-31) after subcutaneous fasciotomy ($p=0.31$). The decrease in IAP showed strong positive correlation with preoperative IAP levels after full-thickness laparostomy ($r^2=0.889$, $p<0.001$), but not after subcutaneous fasciotomy. The median number of reoperations was 5.5 (IQR 3-10, range 1-18) per patient. Subsequent peripancreatic necrosectomy was performed on 16 patients (62%) and colon resection in one. The overall hospital mortality was 12/26 (46%). Major abdominal operation seemed to be associated with increased mortality (10/17 vs. 2/9, $p=0.11$). Of the 17 patients surviving to abdominal closure after full-thickness laparostomy (midline, transverse or completion), 7 underwent primary (one-time or gradual) fascial closure and 10 split-thickness skin grafting, respectively.

Conclusion: ACS in patients with SAP is associated with high mortality. Surgical decompression is effective in decreasing IAP. Full-thickness laparostomy is more effective than subcutaneous fasciotomy in patients with high IAP. Following laparostomy, the majority of patients requires the planned hernia approach with early skin grafting and delayed abdominal wall reconstruction.

Session IV

Poster # SI-24

THE RISK OF MALIGNANT NEOPLASM IN COMPLICATED APPENDICITIS TREATED NON-OPERATIVELY

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Introduction: Appendicitis is one of the most common diagnoses encountered by the acute care surgeon. Associated neoplasms are extremely rare and are usually carcinoids. Complicated appendicitis can be successfully treated non-operatively followed by interval appendectomy, although some authors suggest that this may not be cost effective or necessary. This review was conducted to study an unusual number of malignant neoplasms observed in complicated appendicitis managed by interval appendectomy at our institution.

Methods: A retrospective cohort review of all appendectomies for appendicitis was performed over a five year period at a tertiary care center. Patient demographics, time to surgery, operative technique, pathologic diagnosis and morbidity were examined.

Results: 316 patients were diagnosed with acute appendicitis. 24 (7.5%) were deemed complicated and underwent interval appendectomy. There were no statistical differences in the age, gender or presenting symptoms of the patients. 98% of the acute appendectomy patients and 38% of the interval group were removed laparoscopically ($p < 0.01$). Neoplasms were discovered in 1.4% of the acute appendectomy group and 21% of the interval appendectomy group ($p < 0.01$). The patients with neoplasms in the interval group were significantly older (62 vs. 37 years $p < 0.01$). All of the neoplasms in the acute group were carcinoid while 4 of the 5 in the interval group were adenocarcinoma.

Conclusion: Appendiceal or colonic neoplasms should be considered in all cases of complicated appendicitis where non-operative management and interval appendectomy are considered. This consideration is most important in older patients, in patients who forego interval appendectomy or those who potentially could be lost to follow-up. A more stringent management algorithm should be developed.

Session IV

Poster # SI-25

RUPTURED ABDOMINAL AORTIC ANEURYSMS SHOULD BE PREFERENTIALLY TREATED AT LEVEL I TRAUMA CENTERS

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Background: Trauma centers have unique resources and capabilities, including immediate availability of surgeons and operating rooms, expertise in massive transfusion and advanced surgical critical care. Such expertise may benefit non-trauma patients--in particular, patients with significant hemorrhage like those with ruptured abdominal aortic aneurysms (RAAA). The **purpose** of this study was to determine if outcomes from RAAA at our level I trauma center were superior to predicted and reported outcomes.

Methods: Patients admitted to our community level I trauma center with RAAA between 1/1/2000 and 5/20/2007 were identified and charts were obtained for retrospective review. Data were tabulated regarding patient demographics, preoperative hemodynamic stability, time to operative repair, details of the operative repair and patient outcome. Predicted mortality was determined using the RAAA-POSSUM score. Actual mortality was compared to predicted mortality as well as to mortality reported in the literature.

Results: 61 patients with RAAA were identified. 5 elected comfort care and were excluded. Thus, 56 patients underwent emergent RAAA repair. The mean age was 76 ± 1 years and 47 (84%) were male. 70% of patients were hypotensive at presentation to the hospital. Overall operative mortality was 46%. 10 patients were resuscitated and operated in the trauma OR resuscitation room. All of these patients were hypotensive and 60% had free intraperitoneal rupture at operation. The time to operation was significantly faster in these patients (48 minutes vs. 135 minutes, $p < .001$). Mortality, however, remained high at 60%. The overall actual mortality was less than the average predicted mortality of 76% and compared favorably to mortality rates reported in the literature.

Conclusions: Treatment of patients with RAAA at a level I trauma center resulted in improved survival compared to predicted survival and compared to survival reported in the literature. In patients with RAAA, preferential transport to and treatment at level I trauma centers should be considered.

Session IV

Poster # SI-26

TOO MUCH OF A GOOD THING? HOW INCREASING TRAUMA VOLUMES ARE STRESSING THE SYSTEM.

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Introduction: Trauma and non-trauma surgical emergency volumes appear to be increasing at Level 1 trauma centers, possibly due to decreased community surgical coverage. Although quality tends to increase with volume, patient flux that overwhelms fixed resources can adversely affect outcomes. The purpose of this study was to determine how the recent rapid expansion of trauma volume impacts quality and outcome.

Methods: Registry, quality and administrative databases were cross-queried to provide a comprehensive description of the expanding trauma population over six years (2002-2007) in our nationally verified Level 1 trauma center. Comparisons were made using appropriate parametric and non-parametric tests. Significance was set at $p<0.05$.

Results: 9,800 trauma patients were admitted, reflecting an average annual compound growth rate of 8.8%, or 65% over 5 years. Despite significant increases in age and ISS, survival improved as reflected by Z scores. While ICU length of stay (LOS) decreased, hospital LOS increased and fewer patients were discharged home without assistance.

Conclusions: We have adapted to the increasing flux of trauma patients. Although our outcomes have been favorable to date, there is a subtle trend suggesting an increase in hospital LOS. We conclude that our regional trauma center is becoming saturated and increased post-discharge resources will be important for future growth.

	2002	2003	2004	2005	2006	2007	
Admissions	1352	1446	1483	1595	1839	2085	*
Age, y	34	37	38	44	44	45	*
ISS	10.4	11.3	12.7	12.2	12.2	12.1	*
Hosp LOS, d (IQR)	3 (1-6)	4 (2-7)	3 (2-7)	4 (2-7)	4 (2-7)	4 (2-7)	*
ICU admissions, %	11.8	11.3	20.4	16.7	17.8	14.3	
ICU LOS, d (IQR)	3 (1-11)	2 (1-8)	2 (1-7)	3 (1-8.5)	3 (1-7)	2 (1-5)	*
Z score	2.44	5.88	5.81	6.1	5.86	8.24	
Home, no assistance, %	70.1	66.1	62.0	56.8	56.0	56.4	*
Discharged w/ assistance, %	23.5	28.1	30.2	36.8	37.5	37.8	*
Deaths, %	6.4	5.8	7.8	6.4	6.5	5.8	

*p<0.05, IQR=Interquartile range, Discharge with assistance = home with health care, rehabilitation facility, skilled nursing facility, other skilled hospital, other discharge plan.

Session IV

Poster # SI-27

CONCURRENT PI IAND THE JOINT THEATER TRAUMA SYSTEM: TOOLS THAT IMPROVE THE COMBAT CASUALTY CARE SYSTEM.

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Background: The US military created the Joint Theater Trauma System (JTTS) in 2005 to coordinate trauma care supporting combat operations in Iraq and Afghanistan. The backbone of the JTTS is the Joint Theater Trauma Registry (JTTR) which records demographics, mechanisms of injury, injury physiology and anatomy, procedures performed and performance improvement (PI) events. Landstuhl Regional Medical Center, the initial US medical center outside the combat zone, initiated a concurrent PI process in December 2006 and implemented the JTTR as the primary trauma registry in January 2007. The purpose of this study was to evaluate the effectiveness of these tools in the PI process by assessing the capture of PI events and establishment of loop closure.

Methods: A concurrent PI process was established and matured throughout 2007. We queried the JTTR for total admissions, identified PI events, PI event closure, number of days to loop closure and number of days required for complete chart abstraction.

Results:	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Admissions	511	699	588	384
# patients with PI events	84	154	184	157
% patients with PI events	16	22	31	41
# PI events	127	246	308	274
# PI Events closed	96	114	277	258
% PI events closed	76	46	90	94
# days to loop closure	18.7	12.4	12.8	5.8
Average # days post discharge to close chart	n/a	n/a	14.6	7.4

Conclusion: Establishment of a concurrent performance improvement process coupled with implementation of the JTTR resulted in both the increased identification and closure of PI events. The time to loop closure for PI issues as well as complete chart abstraction was shortened. Use of the JTTR as well as a concurrent PI process at all echelons of the combat casualty care system should be considered to maximize PI effectiveness. This may also have application to distributed models of civilian disaster management.

Session IV

Poster # SI-28

DELAY IN TRANSFER OF SEVERELY INJURED PEDIATRIC TRAUMA PATIENTS

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Introduction: Although interfacility transfer of injured patients to designated trauma centers has been shown to improve outcomes, there is little known about the characteristics of delayed transfer of injured children. The purpose of the study was to evaluate the characteristics and patterns of delay among injured children.

Methods: A retrospective review of trauma registry data from our Level I pediatric trauma center (PTC) over five years (2002-2006) was performed. Transferred patients with a documented time of injury were divided based on time from injury to arrival at our PTC: EARLY (< 2 hours) and LATE (> 2 hours). Data collected included demographics, injury severity score (ISS), Glasgow Coma Score (GCS), mode of transportation, referring hospital information, and disposition from our emergency room (ER).

Results: 34.8% (n=1,021) of patients seen at our PTC were interfacility transfers. 748 patients met inclusion criteria. 82% (n=612) were in the LATE group and arrived on average six hours after those transferred EARLY (420 versus 69.9 minutes, $p < 0.05$). 79% (n=147) of transfers with severe injuries (ISS > 15) and 47% (n=15) of those with severe head injuries (GCS $\leq$ 8) arrived LATE. Additionally, 24% (n=146) of patients in the LATE group required care in the intensive care unit, operating room or died in the ER. The disproportionate number of LATE transfers were consistent among all transferring hospitals regardless of distance, (EARLY, 31.1 versus LATE, 29.6 miles, $p = 0.6$). In addition, a significant number of patients transferred by air ambulance arrived LATE (EARLY 34.8% versus LATE 65.2%, $p < 0.001$).

Conclusions: Despite the known advantages of early care in trauma centers, a significant number of severely injured children are transferred well beyond two hours following injury. This study has demonstrated that this pattern of delayed transfer is a systemic problem occurring among all transferring hospitals regardless of distance from the trauma center or mode of patient transfer.

Session IV

Poster # SI-29

DISASTER PREPAREDNESS: WHEN IT HITS THE FAN WHO'S IN CHARGE?

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Introduction: By their nature mass casualty incidents (MCI) overwhelm resources and mandate transition of care from "maximal care for each patient" to "the most good for the most patients". To be successful in treating these patients leadership must be established. We sought to identify if surgeons are most qualified to assume MCI leadership roles.

Methods: We surveyed all surgeons and emergency medicine (EM) physicians in our region including 3 trauma centers, 2.4 million people and the state capitol. The survey tested knowledge on disaster protocols, triage principles, and command structure. We assessed their training and experience, as well as comfort level in treating MCI injuries. We also queried who should assume leadership positions during specific disaster scenarios.

Results: One hundred and forty-nine (60%) surveys were completed, 78 surgeons and 71 emergency medicine physicians. Only, one-third of surgeons and nearly one-half the EM physicians had reviewed their hospital's MCI plan. Despite this review, 57% of all surgeons did know where to report for an MCI activation.

	All surgeons (n=78)	Trauma (n=11)	EM (n=71)
MCI Training	62%	81%	93%
MCI Experience	56%	90%	63%
Correct Triage Area	52%	90%	82%
Correct Triage Category	24%	36%	42%
Correct Command Structure	38%	64%	69%
Believe They Should Be In Charge	58%	91%	80%

Of those surgeons who think they should be in charge, 78% did not know the correct triage categories or triage location and 45% never had any training or experience in MCIs.

Conclusions: Surgeons and EM physicians feel that they receive adequate training for MCIs, however, both groups lack an understanding of the protocols needed in such events. Despite this, they believe they should have leadership roles in this setting. To fulfill the ACS statement on disaster and MCI management and assume critical leadership roles, surgeons need to improve training in disaster medicine particularly, MCI protocols.

Session IV

Poster # SI-30

THE EPIDEMIOLOGY OF SUICIDE IN HAWAII AND ITS IMPACT ON THE STATE'S ONLY TRAUMA CENTER.

Andrew L Middleton, Kate A Pettigrew, Hao Chih Ho*, MD, Kurt D Edwards, MD. John A. Burns School of Medicine - University of Hawaii.

Introduction: Suicide is the leading cause of injury-related death in the state of Hawaii. The State's only trauma center is believed to treat a majority of all self-inflicted injuries that occur in the state. This study aims to identify the epidemiology of suicide in the state of Hawaii from 2002 to 2005, based on age, gender, race/ethnicity, and mechanism of self-inflicted injury. Further, this study aims to examine how self-inflicted injuries affected the State's only trauma center from 2002 to 2005.

Methods: Data were accumulated from the Centers for Disease Control Web-based Injury Statistics Query and Reporting System from the years 2002 to 2005; the State of Hawaii Department of Health Injury Prevention and Control Program; and the National Trauma Data Bank. Variables analyzed included age, gender, ethnicity, mechanism of injury, percent of trauma service admissions, percent of trauma intensive care unit (ICU) admissions, mortality, hospital length of stay, and ICU length of stay.

Results: Over the four (4) year period of 2002-2005, there were 610 suicides in the state. Males accounted for 75.8% of all suicides. The most common mechanism of self-inflicted injury in Hawaii was by suffocation at 45.7%, followed by firearm at 21%; nationally, the most common mechanism was firearm at 53.7%, followed by suffocation at 21.5%. The trauma service admitted 260 patients with a primary diagnosis of suicide or self-inflicted injury. This accounted for 4.7% of all trauma service admissions and 7.8% of all trauma ICU admissions. In-hospital mortality was 6.1%. Average hospital length of stay was 6.02 days; 101 patients were admitted to the ICU with an average length of stay of 2.25 days.

Conclusions: As the leading cause of injury-related death in the State, this study analyzed the impact of suicide on the solo functioning trauma center. While percent of admissions and hospital length of stay were similar to those found in the Western United States, variation in mechanism of injury may affect the volume and morbidity of patients seen at this trauma center.

Session IV

Poster # SI-31

ANALYSIS OF HEAD INJURIES IN TOKYO METROPOLITAN EMERGENCY CONSULTATION CENTER

Akira Fuse, MD, Yasushi Miyake, MD, Naoto Motimura, MD, Shiegeki Kushimoto, MD, Atsushi Katsumi, MD, Takashi Ishihara, MD, and Toru Aruga, MD. Emergency Consultation Center in Tokyo Medical Association.

Backgrounds: There are more than 1 million emergency calls in Tokyo metropolis, which mean 1.9 calls per a minute. This should be improved in several ways. In order to decrease numbers of emergency calls from public to the fire department, the emergency consultation center was started from 1st/ June/ '07 in Tokyo Metropolis. This system has one call number, which is "#7119", directed to the emergency consultation center, located in the operation command center of Tokyo Fire Department. The emergency consultation center includes corresponding technicians, nurses, and doctors for 24 hours/ 7days. More than 100 protocols are used for prehospital triage by telecommunication, depending on symptoms. This report analyzed head injury, which is most popular in trauma, in Emergency Consultation Center during 3 months.

Materials and Methods: Emergency consultation is divided in 4 categories, red category is indicated to call "119 (emergency call number in Japan)", orange category is to recommend going to hospitals as soon as possible, yellow is to recommend within 6 hours, green within 24 hours. Head injuries cases were analyzed in contents of consultations and results of triage during first 3 months.

Results: There were 323 cases in head injuries, 706 cases in trauma of 6549 all cases. Head injuries were most popular consultations in trauma cases. Pediatric cases are most important in head injuries, because 292 of 323 cases were pediatric cases (90.4%). In the pediatric cases, 19 cases (6.5%) were in red category, 97 (33.2%) in orange, 110 (37.7%) in yellow, 56 (19.2%) in green, 10 (3.4%) in unknown. Initial severities on admission in cases, categorized in red, are moderate-to-mild in 17 cases in which the admission is not required. **Discussion**: Head injuries are the most frequent consultations in trauma at emergency consultation center. 90.4% of head injury consultation was for children. In pediatric head injuries, the consultation tends to be over-triage. Under-triage should be verified henceforth.

Session IV

Poster # SI-32

TERRORIST SUICIDE BOMBINGS: LESSONS LEARNED IN METROPOLITAN HAIFA

Michael M. Krausz*, MD, Amir Bumenfeld MD , Zvi Feigenberg MD, , Daniel Ben-Dov, MD , Michael Kafka, MD , Moshe Michaelson, MD , Michal Mekel, MD. Rambam Health Care Campus.

Objective: To study the triage system during multiple casualty incidents (MCI's) caused by suicide bombers and seriously challenged the medical facilities.

Methods: A retrospective analysis of the organization of the urban medical system, function of the pre-hospital triage system, in-hospital rearrangement and medical management of victims from the six suicide bombing attacks that occurred in Metropolitan Haifa.

Results: The six terrorist suicide bombing attacks resulted in 411 victims with 69 dead (16.8%) and 342 injured. Of the 342 injured, there were 31(9.1%) severely injured, 7(2.4%) moderately severe injured, and 304 (88.9%) mildly injured patients.

Twenty four (77%) of the 31 severely injured victims were evacuated to the level I trauma center at Rambam Medical Center (R.M.C.). Of the seven severely injured victims that were evacuated to the level II trauma centers (Bnai Zion Medical Center and Carmel Medical Center) because of proximity to the detonation site, three were secondarily transferred to R.M.C. after initial resuscitation. Eight of the 24 severely injured casualties admitted to R.M.C. eventually died of their wounds. There was no in-hospital mortality in the level II trauma centers.

Conclusions: A predetermined metropolitan triage system is described which directed trauma victims of 6 MCI's to the appropriate medical center and prevented overcrowding of the level I facility with less severe injured patients. This will assure that critically injured patients of a suicide bombing attack will receive a level of care that is comparable to the care given to similar patients under normal circumstances. Severely blast injury victims without penetrating injuries but with significant pulmonary damage were effectively managed in ICUs of level II trauma centers.

Session IV

Poster # SI-33

SHOULD PATIENT VOLUME BE A DETERMINANT FOR TRAUMA CENTER LEVEL DESIGNATION?

Manuel Lorenzo*, MD, Rexford Santerre, PhD, Alicia J. Mangram, MD, Ernest L. Dunn*, MD, Joseph D. Amos, MD, Michael S. Truitt, MD. Methodist Hospital.

Introduction: Current literature has not precisely defined the number of admissions per institution necessary to generate a difference in trauma patient outcome. Is patient volume a significant variable for survival in trauma centers? Should the ACS COT continue to use the current volume criteria (> 1,200 admissions/yr) for verification of Level I trauma centers?

Method: Data provided by the National Trauma Data Bank (NTDB) was used in a retrospective analysis of all patients age 24-65 years who were admitted to Level I and II hospitals during a 5-year period (2000-04). Data elements included: age, ISS, mechanism of injury, gender, volume of patients, level designation, ICU average length of stay, hospital average length of stay and mortality rate. Three multivariable logistic regression models were created to analyze the relationship of multiple independent variables to survival outcome using mortality rate as the dependent variable.

Results: The average number of patients with an ISS> 15 per Level I trauma center was 1743.3 in contrast to 963.4 patients per Level II center. The mortality rate for a Level I center was 27% compared to 30% for a Level II. Notably, the difference in mortality rate was found only among the younger patient population as geriatric trauma patients showed equal survival probabilities at both types of centers. Female trauma patients had a 2.5% statistically significant decrease in mortality compared to males. Regression analysis demonstrated that as the volume increased by 10%, there was a decrease of 4.5% in mortality rate. ($p<0.05$)

Conclusion: Aggregate data analysis has shown a decrease in the mortality rate as the number of admissions per year increases. Ideally, institution specific data with adjusted ratios would more precisely predict trauma patient outcomes in an institution and as such should be a more appropriate determinant of a trauma center's level designation.

Session IV

Poster # SI-34

MINIMIZING DEAD TIME DURING TRAUMA RESUSCITATIONS

John R. Clarke*, MD. Drexel University College of Medicine.

Introduction: No one has defined the optimal team configuration for the resuscitation of trauma patients. We sought to correlate team configurations and resuscitation times because of previously shown relationships between time and mortality for hypotensive trauma patients.

Methods: We used times collected for 54 different procedures from quality assurance videotapes of 104 de-identified trauma resuscitations at a trauma center. We assigned a minimum level of experience needed to perform each procedure and determined which could be performed in parallel. For each theoretical team configuration, we calculated the theoretical resuscitation times for each of the 104 patients, and then compared the averages.

Results: A trauma-trained attending, scribe nurse, and x-ray technician comprised the minimum necessary core trauma team among our theoretical configurations (averaging 30 min:38 sec to resuscitate a trauma patient). A minimum average of 5.5% savings in time occurred by adding 2 more team members (28:56), 8.9% with 3 (27:55), 10.4% with 4 (27:26). The best average of 11.4 % savings occurred with an optimal 5 more team members: 3 trauma-trained physicians, 1 other physician, and 1 nurse (27:09). Looking only at patients in shock, the 5 additional members yielded a theoretical 15.9% savings in resuscitation times (22:55) over baseline (27:15) and 16.9% over actual times (27:35).

Conclusions: Our best theoretical trauma team configuration consists of a trauma-trained attending, 3 trauma-trained assistants, another physician, 2 nurses, and an x-ray technician. For patients in shock, the optimal team offers a potential saving of more than 4 minutes over some suboptimal configurations.

Session IV

Poster # SI-35

WHAT EVER HAPPENED TO THE GOLDEN HOUR? A GROWING NEED FOR OUTREACH EFFORTS TO IMPROVE TIMELINESS OF REGIONAL INTERFACILITY TRANSFERS

A. Britton Christmas, MD, Greg P. Fleming, ART, Lynette M. Schiffern, MD, Ronald F. Sing*, DO, Michael H. Thomason*, MD. The F.H. Sammy Ross, Jr. Trauma Center at Carolinas Medical Center.

Objective: In cases of severe trauma, the survival rate decreases as the time interval between injury and treatment increases. We undertook this study to assess the timeliness of regional interfacility referrals to a level I trauma center and its potential effect on patient outcomes.

Methods: All regional interfacility transfers to our trauma service, for a catchment area composed of 18 referral centers in a 22 county region, from January through December 2007 were retrospectively reviewed. Demographic, severity of injury, length of stay in minutes in referring emergency department (RED), disposition on arrival (DISPO), and outcome data were recorded.

Results: 1078 interfacility transfers occurred during a 12 month period for which length of stay at referring facility data was available for 622 patients (58%).

ISS	N	Age	GCS	ICULOS	HLOS
1-15	355	38+22*	14+3*	1+2*	5+7*
16-30	246	48+25*	11+5*	3+6*	9+12*
>30	21	31+19*	7+6*	9+8*	22+20*

*p<0.05 among ISS stratifications

A number of patients required immediate operative intervention or transfer to an ICU.

ISS	RED	RED>1Hr	RED>2Hr	OR DISPO	ICU DISPO	Mortality
1-15	118+119*	319 (90%)	256 (72%)	32 (9%)	70 (20%)*	8 (2%)*
16-30	159+102*	212 (86%)	152 (62%)	26 (11%)	152 (62%)*	30 (12%)*
>30	112±101*	10 (48%)	5 (24%)	2 (10%)	19 (90%)*	2 (10%)

*p<0.05 among ISS stratifications

Conclusions: We identified disturbingly prolonged stays in referring emergency departments during interfacility transfer. The most pronounced delays occurred in patients with ISS 16-30, a number of which required immediate operative or critical care intervention on arrival. As a result, we propose further outreach efforts to identify potential causes for delay and to promote compliance with regional referral guidelines.

Session IV

Poster # SI-36

STATIC RELOCATION OF AMBULANCE SERVICES IN A RURAL AREA CAN IMPROVE EMS RESPONSE TIME TO MOTOR VEHICLE CRASHES

R.P. Gonzalez*, MD, G.R. Cummings, MBA RN, S.M. Harlan, RN MSN FNP-C, M.S. Mulekar, PhD, C.B. Rodning*, PhD MD. University of South Alabama.

Objective: To assess whether repositioning of ambulance stations in a rural county of Alabama can improve emergency medical services (EMS) response time to motor vehicle crashes (MVC) without adversely affecting response time to non-MVC related emergencies.

Methods: Using geographical information system (GIS) software, locations of MVCs during a one-year period in a rural county of Alabama were plotted on a map. A single ambulance station provided EMS services for the entire county. Based upon the number of ambulances serving the county and concentrated areas of MVCs, the county was geographically divided into two regions. A new ambulance station was assigned to each region based upon high MVC concentrations and access to a major thoroughfare. The number of ambulances in-service did not change. Following establishment of both ambulance stations (redeployment), data was prospectively collected for EMS miles to scene, EMS time to scene, fatalities, and type of call (MVC vs. Non-MVC) during a 9-month period (01/06-09/06). The prospective data was compared to historical data (non-redeployment) from a similar time period (01/02-09/02).

Results: During the redeployment period, 597 EMS calls were documented, 106 (17.8%) of which were MVCs. 764 EMS calls were documented from the non-redeployment period, 62 (8.1%) of which were MVCs.

Group	Call Type	EMS Miles to Scene	p-value	EMS Time to Scene (min)	p-value
Redeployment	MVC	8.6	P=0.038	8.0	P=0.03
Non-redeployment	MVC	10.7		9.5	
Redeployment	Non-MVC	7.0	P=0.71	8.6	P=0.27
Non-redeployment	Non-MVC	6.9		9.2	

Conclusions: Utilizing GIS software, EMS response time to MVCs could be improved in rural areas by optimal location of ambulance stations based upon geographical highest concentration of MVCs and vicinity of major thoroughfares. This can be accomplished without adversely affecting response time to non-MVC related emergencies

Session IV

Poster # SI-37

PREHOSPITAL TRANSPORT AND SURVIVAL FROM PENETRATING THORACIC INJURIES: AN URBAN TRAUMA SUCCESS STORY

David Straus, BA, Marie Crandall*, MD MPH, Thomas J. Esposito*, MD MPH, Carol R. Schermer*, MD MPH. Northwestern University.

Background: Achieving the "Golden Hour" (GH) of trauma care by minimizing response times has been consistently integrated into the design of regional trauma systems. Our hypothesis was that shorter transport times would predict outcomes, independent of injury severity.

Methods: A retrospective cohort study was performed using a statewide trauma registry for the years 1999-2003. The study was limited to urban victims of penetrating thoracic trauma. STATA statistical software was used for descriptive statistics and multivariate analysis.

Results: During the study period, 657 patients were brought to the hospital after penetrating thoracic trauma, with 76% survival. Mortality was significantly associated with ISS and ED hypotension (systolic blood pressure <90; p-values<0.05). Patients transported within 15 minutes had much higher injury severity scores (ISS) and were more likely to be hypotensive, but equally sick patients with longer transport times suffered much higher mortality rates (p-values<0.05). FIGURE 1

Conclusions: For victims of penetrating trauma, more severely injured patients arrive at urban trauma centers sooner. Mortality was strongly predicted by injury severity, but shorter transport times improved survival. In summary, these results validate the careful planning which has created the catchment areas for urban Level I trauma centers, to encompass hospital capacity and existing resources, traffic patterns, and trauma incident densities.

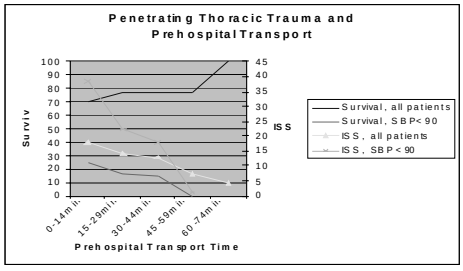


FIGURE 1

Session IV

Poster # SI-38

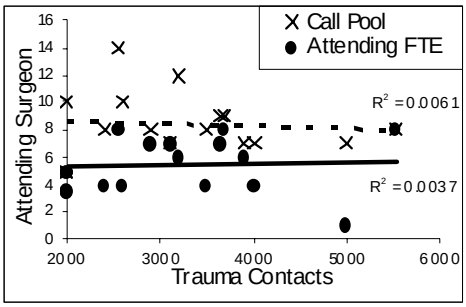
VARIABILITY OF INSTITUTIONAL TRAUMA PROGRAM RESOURCES AT ACADEMIC LEVEL I TRAUMA CENTERS

David J Ciesla*, MD, David Shapiro, MD, Suneel Khetarpal*, MD. University of South Florida-Tampa General Hospital.

Background: Information on how disparate trauma programs arrange resources to achieve Level I goals is not readily available. We undertook this study to describe spectrum of trauma program personnel in use at a sample of Academic Level I trauma Centers.

Methods: Information was obtained via email survey. Questions focused on clinical volume, personnel, and administrative structure. Data is presented as mean (range)

Results: Data was provided by 16 trauma programs with an average of 3253 annual trauma contacts and an average ISS>15 = 36%. Trauma surgeons provided critical care consult services in 12 centers, covered general surgery emergencies at 15 centers, and routinely performed elective surgery at 12 centers. Protocols for primary admission to specialty services were present in 9 of 12 centers. Centers employed 5.5 (1-10) trauma surgeons and 4.0 (0-11) midlevel practioners with a total of 8.5 surgeons (5 to 14) in the call pool. The number of trauma surgeons, the size of the call pool and the number of midlevel practioners did not correlate with annual clinical volume. All centers reported an average of 7 (2-15) residents assigned to the trauma service which increased with clinical volume (R^2=0.29). A senior hospital administrative representative to the trauma program was reported at 10 centers and a 1.0 FTE trauma program manager reported at 13 centers. Additional trauma coordinators were reported at 11 centers, at least part time (FTE>0) outreach coordinator at 9 centers, and an FTE>0 injury prevention officer at 11 centers.



Conclusions: Trauma Program structure appears to be influenced more by available local resources than clinical demand. The information gathered in this survey is valuable for planning resource allocation and calls for a more comprehensive registry of Level I and II resources currently in use.

Session IV

Poster # SI-39

USE OF TELEMEDICINE FOR MASS CASUALTY TRIAGE

Antonio Marttos, MD, Donald W Robinson, MD, Katherine A Wilson, PhD, Carl Schulman, MD, Gabriel Alonso, BS, Sandra Krauthamer, BS, Rodney Atwood, BS, Mauricio Lynn, MD, Mark McKenney, MD, MBA, Jeffrey S Augenstein*, MD PhD. University of Miami Miller School of Medicine.

Introduction: Telemedicine has been readily used in surgery and intensive care, but has been underutilized in trauma. In a mass casualty situation, where resource allocation is of critical importance, triage is often delayed due to a lack of trauma surgeons or is performed by non-trauma surgeons. A strong argument can be made for utilizing telemedicine to facilitate this process. Therefore, we hypothesized that the use of telemedicine would allow a remote trauma surgeon to accurately triage mass casualty victims.

Method: We participated in a mass casualty exercise in a large, urban Level 1 Trauma Center that provides training for the US Army Forward Surgical Teams, before deployment. This exercise consists of anesthetized porcine subjects with wounds inflicted to replicate battlefield injuries. On site was a triage officer training as a member of a forward surgical team. Video conferencing software on a tablet PC connected to a portable camera was used to stream live audio and video to a remote trauma surgeon to assess and triage all victims. The decisions made by the on-site and remote clinician (e.g., send patient to triage or the operating room) were compared for accuracy and effectiveness.

Results: Findings from this exercise supported our hypothesis. Of the seven porcine subjects observed on-site and remotely, there was 100% agreement in management and triage between the on-site triage officer and the remote trauma surgeon. A post-exercise interview with the remote trauma surgeon revealed that there were no audio or video limitations encountered.

Conclusion: Telemedicine appears to be an effective method for remote triage of mass casualty victims. This very simple and inexpensive technology can be rapidly deployed with minimal training. Further studies should determine the optimal use of this technology in “real world” conditions and with larger patient numbers.

Session IV

Poster # SI-40

ISS AS A PREDICTOR IN PENETRATING INJURIES: THE WORST CASE SCENARIO

Joe Corallo, MD, Fahim Habib, MD, Ed Lineen, MD, Dror Soffer, MD, Jeffrey Augenstein*, MD PhD, Carl I Schulman, MD MSPH. University of Miami Miller School of Medicine.

Introduction: The Injury Severity Score (ISS) has been extensively studied and many shortcomings are well known. Most agree that it is a poor predictor in penetrating trauma but this has not been validated with extremely large national databases. We hypothesized that mortality rates for penetrating injuries would be higher than blunt trauma for the exact same Injury Severity Score.

Methods: The National Trauma Databank was queried for all patients with complete data on injury mechanism, ISS and age for the years 2001-2005. Mortality rates were compared for blunt and penetrating injuries for the ISS scores 9 (minor injury), 16 (moderate injury) and 25 (severe injury). Z-test for proportions was used to compare rates and significance was assumed if $p < 0.05$.

Results:

ISS	n (Blunt)	Mortality (Blunt)	n (Penetrating)	Mortality (Penetrating)	p
9	221371	1.95%	22342	3.1%	<0.001
16	31279	6.4%	4447	20.9%	<0.001
25	19272	29.1%	7264	55.5%	<0.001

Conclusions: The Injury Severity Score is a useful tool for population-based predictions. Like all scoring systems, it has limitations in certain patient sub-populations. The magnitude of this effect for penetrating injuries, however, appears to be great and worsens as the ISS increases. Perhaps a modified score that takes into account injury mechanism would be a better predictor for penetrating injuries.

Session IV

Poster # SI-41

THE LEACHING OF PLASTICIZERS FROM THE BAGS OF DONATED PACKED RED BLOOD CELLS DUE TO LENGTHY STORAGE

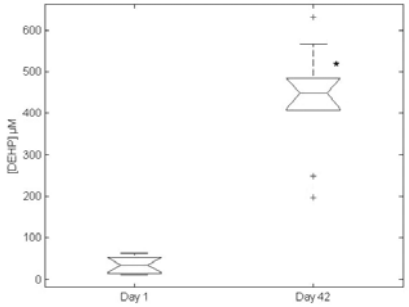
Leonard T. Rael, MS, Raphael Bar-Or, BS, Daniel R. Ambruso, MD, Charles W. Mains, MD, Denetta S. Slone, MD, Michael L. Craun*, MD, David Bar-Or, MD. Swedish Medical Center, Trauma Research Laboratory.

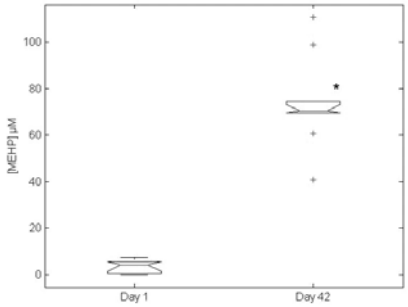
Introduction: Phthalate esters are plasticizers used to soften PVC-based blood bags and other medical devices. Phthalate esters are the most abundant man-made pollutants and increase the risk of developing an allergic respiratory disease or a malignancy. The leaching of plasticizers in donated PBRCs during normal storage was quantitated.

Methods: A total of 10 transfusion bags containing PBRCs stored in ACD buffer at 4°C were included in the study. At Bonfils Blood Center (Denver, CO), samples were collected on storage day 1 and day 42. Samples were immediately centrifuged, and the supernatants were collected and stored at -80°C until further analysis. Two phthalate esters, di-ethylhexyl phthalate (DEHP) and mono-ethylhexyl phthalate (MEHP), were measured by liquid chromatography coupled to mass spectrometry (LCMS).

Results: Both DEHP and MEHP increased significantly during the 42 day storage period. DEHP increased from 34.3µM (± 20.0SD) on day 1 to 433.2µM (± 131.2SD) on day 42, a 12.6-fold increase. Similarly, MEHP levels increased from 3.7 µM (± 2.8SD) on day 1 to 74.0µM (± 19.1SD) on day 42, a 20.2-fold increase.

Conclusion: The transfusion of older units of PBRCs in trauma patients could lead to an accumulation of plasticizers possibly resulting in pro-inflammatory and other effects. This accumulation could be exacerbated due to the decreased metabolism of phthalate esters since trauma patients have a lower esterase activity, the enzymes responsible for metabolizing phthalate esters.





Session IV

Poster # SI-42

LIFESAVING WITH EMERGENCY TOURNIQUET USE TO STOP BLEEDING IN MAJOR LIMB TRAUMA

JF Kragh Jr, MD, ML Litterell, RN, JA Jones, MS, TJ Walters, PhD, DG Baer, PhD, CE Wade, PhD, JB Holcomb*, MD. USA Institute of Surgical Research.

Introduction: We previously reported major lifesaving and minor morbidity with emergency tourniquet use to stop bleeding in major limb trauma, and we here report further study for a second time period.

Objective: The purpose of the present study was to compare the first and second time periods for consistency and then pool the data if consistent for more powerful analyses.

Methods: We continued a prospective survey of casualties with tourniquet use seen at a combat support hospital in Baghdad. Patients were evaluated for prehospital versus emergency department (ED) tourniquet use, limb outcome, and survival. In the first part of the current report, we compare the two time periods to see if pooling the two is indicated. In the second part, we report mortality and morbidity results.

Results: In the two time periods, survival rates (87%, 87%) and the morbidity rates for palsies at the level of the tourniquet (1.7%, 1.5%) and for major limb shortening(0.4%, 0.4%) were all similar ($p>0.5$). The two time periods were statistically and clinically similar so we pooled data. The pooled 499 patients had 862 tourniquets applied on 651 limbs. For the 498 patients with known site of use, the association between survival and use before shock onset and survival and prehospital use were significant ($p<0.0001$, $p=0.015$, respectively).

Lived/Died Counts by Shock & Site		Shock		
		Shock Absent	Shock Present	Sum
Hospital	Prehospital	373/43	1/5	422
	ED	56/4	3/13	76
	Sum	476	22	498

Conclusions: The current study found that the major lifesaving benefit and minor morbidity risk were consistent with our prior reports. Tourniquets save lives by controlling hemorrhage and preventing shock. In war, tourniquet use saves more lives when used early, before shock onset.

Session IV

Poster # SI-43

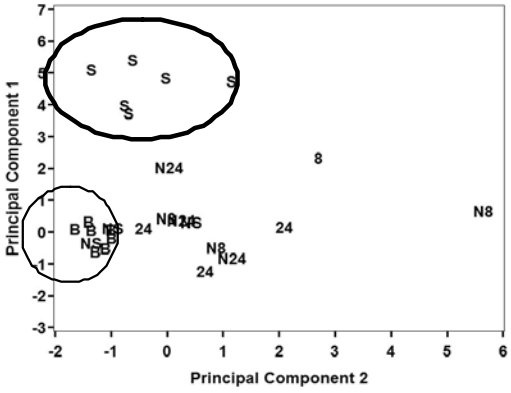
PRINCIPAL COMPONENT ANALYSIS ALLOWS MULTIDIMENSIONAL MODELING OF HEMORRHAGIC SHOCK

Teresa R. Nelson, MS, Nancy E. Witowski, PhD, Greg J. Beilman*, MD. Technomics Research, LLC.

Introduction: Hemorrhagic shock as a result of trauma is a frequent cause of death and multiple organ dysfunction and results in multiple derangements of physiologic and metabolic variables. In order to understand the relative importance of these multiple derangements in our porcine model of hemorrhagic shock we used principal component analysis (PCA) to describe this multidimensional process.

Methods: A randomized study was conducted in pigs using three treatment groups; 1) hemorrhage, standard resuscitation, 2) hemorrhage, no resuscitation, and 3) no hemorrhage, no resuscitation. Multiple streams of data were collected at baseline (B), during shock (S) or an equivalent time point (NS) and post-resuscitation (8, 24) or an equivalent time point at 8 and 24 hours (N8, N24). PCA was performed using 14 chosen variables derived from physiologic measurements, biochemical measurements, and ^{31}P and ^{1}H NMR tissue measurements.

Results: Principal components 1 and 2 collectively explained 59% of the variation.



Baseline animals (B) form a tight cluster of measurements indicating lack of variability at baseline in both principal component 1 and 2 scores. Shocked animals (S) shared an increase in principal component 1 but not 2. Animals post-resuscitation (8, 24) showed variability in principal component 2 while returning to baseline for principal component 1. Interestingly, animals that underwent surgical intervention only (N8, N24) shared intermediate variability of principal component 2.

Conclusion: PCA simplifies the multi-dimensional process of hemorrhagic shock and resuscitation into 2 dimensions that successfully describe shock state.

Session IV

Poster # SI-44

FRESH WHOLE BLOOD DURING COMBAT OPERATIONS: A RAPID AND SAFE ALTERNATIVE WHEN COMPONENT THERAPY IS UNAVAILABLE

Travis Polk, MD, Scott Deeds, MD, Janos Taller, MD, Jinu Kamdar, MD, Paul Dabrowski*, MD, Charles Blankenship, MD, Richard Sharpe, MD. Naval Medical Center, Portsmouth.

Introduction: In most austere military settings, packed red blood cells (PRBCs) are the only stored blood components available for resuscitation and emergent surgery. When necessary, fresh whole blood (FWB) is obtained from a "walking blood bank" (WBB). While the use of FWB has been well rooted in military medical experience since World War II, its use is frequently frowned upon due to safety and logistical concerns.

Methods: An IRB-approved retrospective review of blood usage was performed from a quality assurance database. This data was obtained prospectively from August 2006 to February 2007 at the U.S. Navy Forward Resuscitative Surgical Suite at Al Asad Airbase in Iraq.

Results: Type O PRBCs and FWB were the only blood products available at this Echelon II facility. When required, the WBB was activated using a locally-established standard protocol and resuscitation was begun with PRBCs. Once the WBB was fully activated, FWB was available within 10 minutes of donation. All blood was cross-matched and underwent rapid viral testing for HIV, HsBAg, and HCV prior to transfusion. There were no documented transfusion reactions and all transfused units tested negative on follow-up confirmatory serology testing.

Combat Injuries	610
Surgical cases/ procedures	282/ 706
Patients transfused	75
Total PRBC	285 units
Total FWB	319 units
Patients receiving FWB	22
Massive transfusions (>10 units)	16
FWB as part of massive transfusion	290 units (91%)

Conclusion: This experience demonstrates an effective protocol for the rapid collection and safe administration of FWB including cross match and rapid viral testing of all units. Additionally, in light of recent terrorist events and natural disasters such as 9/11 and Hurricane Katrina, strong consideration should be given to the development of similar contingency protocols in our civilian trauma centers.

Session IV

Poster # SI-45

DIFFERENTIATION OF THE MONOCYTE TUMOR CELL LINE THP-1 INTO MACROPHAGES INCREASES THE EXPRESSION OF AND SENSITIVITY TO STIMULATION BY CD28 AND CD86-SPECIFIC MONOCLONAL ANTIBODIES.

Richard Shimonkevitz, PhD , Denetta Sue Slone, MD , Charles W. Mains, MD , Michael Craun*, MD , David Bar-Or, MD. HealthONE Swedish Medical Center.

Introduction: THP-1 human monocyte cells (ATCC TIB 202) can be *in vitro* differentiated into macrophages using PMA plus Interleukin-4. Activation of CD28-expressing cells in humans has been shown to incite a "cytokine storm" resulting in a severe systemic inflammatory response. We investigated if the expression of CD28 and its ligand CD86 on macrophages might have a role in CD28-mediated inflammation.

Methods: THP-1 cells were *in vitro* differentiated into macrophages with PMA plus Interleukin-4. Cells were analyzed for surface expression of CD28, CD86 and other macrophage markers by flow cytometry and stimulated *in vitro* to determine if phenotypic increases observed in CD28 and CD86 correlated with a functional capacity to release inflammatory cytokine as quantified by enzyme immunoassay.

Results: Differentiation of THP-1 into macrophages was found by flow cytometric analysis to significantly increase the expression of B7 (2-fold mean increase in expression), CD11b (13-fold), CD18 (2-fold), CD28 (1.2-fold) and CD86 (4-fold), while CD31 was decreased (2-fold). *In vitro* stimulation with antibody specific for CD28 resulted, on average, in 20 to 30-fold increases in Interleukin-8 release by differentiated THP-1 cells (4,043 +73 vs 117 +3.8 pg/ml for FBS-cultured cells in a typical experiment) as well as an increased sensitivity to LPS (4,278 $\pm$126 pg/ml using 100 ng/ml LPS vs 3,874 $\pm$126 pg/ml with 333 ng/ml LPS, maximal stimulation by dose response). Stimulation *in vitro* using antibody specific for CD86 gave similar results (1,912 +26 vs 141 +6.6 pg/ml Interleukin-8). The N-terminal fragment of human serum albumin, DA-DKP, previously shown to decrease cytokine release by human T lymphocytes, reduced CD28-activated Interleukin-8 release from differentiated THP-1 by 40% and CD86-mediated release by 20% on average.

Conclusion: *In vitro*-differentiated macrophages increased their surface expression of CD28 and CD86 with a concomitant increase in functional capacity to release Interleukin-8 inflammatory cytokine, which could be modulated by DA-DKP.

Session IV

Poster # SI-46

LIPID EMULSION IS SUPERIOR TO RINGER'S LACTATE IN OXYGEN CONTENT AND INCREASING BLOOD PRESSURE OF MICE IN SEVERE HEMORRHAGIC SHOCK

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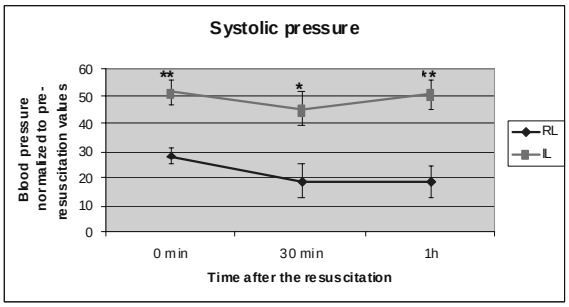
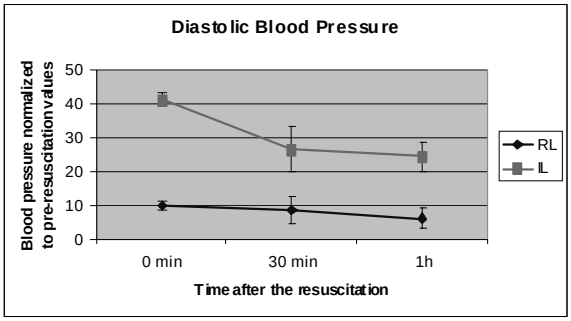
Background: Lipid micelles (LM) should absorb lipophilic gases such as oxygen and nitric oxide. We hypothesized that LM would carry oxygen and increase blood pressure.
Methods: Mice were anesthetized (xylazine/ketamine) and the carotid artery cannulated. BP was monitored. As much blood as possible was removed/2 min. Once respirations stopped, LM (20% Intralipid) or Ringer's lactate (RL) was rapidly infused in a volume equal to the volume of blood removed. Univariate analysis with Student's t test was used. O2 content (room temp/1 Atm.) of LM, by mass spectrometry, was 84% greater than in RL or water and is extracted nearly as rapidly as from RL. LM has more oxygen than reported values for 50% perfluorcarbon. LM (n=6) raised the BP significantly higher than RL (n=6 $p<0.01$). All mice in the LM group lived until euthanized at 1-4 hours. 2 mice in the RL group died after less than 10 minutes. Infusion of 2 x the volume of blood removed as IL raised the blood pressure beyond the pre-hemorrhage value ($p<0.01$).

Conclusion: 1. LM is an oxygen carrying and releasing emulsion that increases the blood pressure. **2**. LM is superior to RL and did not demonstrate any adverse effects in severe hemorrhagic shock.





Session IV

Poster # SI-47

COMBINING A PREDICTIVE MODEL FOR MASSIVE TRANSFUSION AND INCREASED PLASMA:RBC RATIOS

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Objective: Improved outcomes are associated with increased use of plasma:RBC ratios (P:R) after massive transfusion (MT, ? 10 units of RBCs in 24 hours), while other studies have described predictive models for MT. No study combines both approaches. We hypothesized that combining a MT prediction model with optimal vs suboptimal P:R ratios could maximize the benefits and minimize the risks associated with increased plasma use.

Methods: Records of 1574 trauma patients who received at least 1 unit of RBC's at 17 major Level 1 trauma centers between July 2005 and June 2006 were reviewed. The elements of the model were SBP, HR, pH, Hct and had a ROC of 0.775. The optimal P:R ratio from a previous study was determined to be > 1:2. Four groups were created, group #1=positive model prediction and optimal ratio (++), #2=positive model and suboptimal ratio(+-), # 3=negative model and optimal ratio (-+) and #4=negative model and suboptimal ratio (--). Injury Severity Score (ISS), cause of death (head, truncal bleeding, MOF, airway and other) and time to death (6 and 24 hours and 30 days) were recorded.

Results: 838 patients had the data for model use, with 240 predicted to require a MT, while 597 did not. Results were compared between groups 1 and 2 and groups 3 and 4, [a] $p < 0.05$. Those patients predicted to require a MT who did not receive an optimal P:R ratio died from truncal hemorrhage, ($p<0.05$). Significance was set at $p < 0.05$.

Group (n)	ISS ± SD	6 hr Surv (%)	24 hr Surv (%)	30 day Surv (%)	Truncal hem (%)	Head (%)	MOF (%)
1 ++ (105)	35±15[a]	91[a]	87[a]	70[a]	12	10	8
2 +- (133)	30±16	74	66	56	27[a]	13	5
3 -+ (193)	29±13[a]	97	91	73	5	19[a]	3
4 – (404)	22±13	98	95	88[a]	2	7	3

Conclusions: Using parameters rapidly available in the ED, an optimal plasma:RBC ratio can be delivered to patients at risk of truncal hemorrhage, decreasing both early and late mortality, without an increase in MOF. Patients not predicted to receive a MT and who received an increased plasma:RBC ratio were at increased risk of dying from head injury.

Session IV

Poster # SI-48

THE MECHANISM OF ARGININE PROTECTION IN HEMORRHAGIC SHOCK

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Objective: To determine if the mechanism of arginine (Arg) protection in a rodent model of hemorrhagic shock (HS) is due to alterations in Nitric Oxide (NO) synthesis.

Methods: Adult rats were bled by 40% blood volume and resuscitated with normal saline to produce HS. Animals were divided into 5 treatment groups: 1) Sham, 2) HS, 3) HS + L-Arg, 4) HS + L-Arg + non-selective NOS inhibitor (L-NAME), and 5) HS + D-Arg. Throughout the experiment, HR, MAP, arterial blood gas, and lactate were measured. At the end of 4 hours post resuscitation (PR) or upon death, lung and liver were harvested for measurement of i-NOS and MPO.

Results: In L-Arg treated animals, terminal arterial pressures were higher, serum lactates were lower, and survival was significantly higher during HS, relative to the control HS group. This effect was reversed by the NOS inhibitor L-NAME, suggesting the effects of L-Arg were NOS mediated. The L-Arg effect was also lost with D-Arg, which is an enantiomer of L-Arg that is not metabolized by NOS.

Table 1.	**Terminal Values Following Hemorrhage and Resuscitation**			
RAT Group	**MAP** (mmHg)	**Lactate** (mmol/L)	**% Survival** (240 minutes following resuscitation)	**MPO in Lung** (ng/ml) (Preliminary Data)
Sham (n=6)	122.4 +/-15.9	1.5 +/-0.5	100	25.4 +/-8.6
Control (n=6)	54.4 +/- 28.4*	8.1 +/-3.0*	0	51.9 +/-22.2
L-Arg (n=6)	82.7 +/- 27.5**	3.7 +/- 1.8**	83***	32.9 +/- 26.5
L-Arg/L-NAME (n=6)	48.9 +/- 33.8	13.3 +/-5.0	17	
D-Arg (n=2)	39.6 +/- 0.5	8.3 +/-2.1	0	
*Sham vs. Control $p<0.05$ **Sham vs L-Arg not statistically different *** L-Arg. Vs Control $p<0.05$				

In other experiments, i-NOS expression in hemorrhaged control animals was significantly higher compared to shams.

Conclusion: L- Arg confers significant protection in severe hemorrhagic shock that is due to metabolism through NOS and not via non-specific effects. The benefit occurs at resuscitation, thus making this effect clinically attractive.

Session IV

Poster # SI-49

TRAUMATIC BRAIN INJURY PATIENTS REQUIRING MASSIVE TRANSFUSION BENEFIT FROM A HIGH PLASMA:RED CELL RATIO

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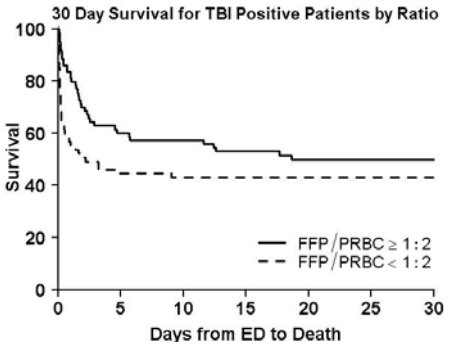
Objective: To investigate the influence of traumatic brain injury (TBI) on mortality as a function of the transfusion ratio (plasma: packed red cells) and coagulopathy (INR) in severely injured patients requiring massive transfusion (MT)(> 10 units RBC/ 24 hours).

Methods: Records of 435 MT patients from 16 major trauma centers between 2005 and 2006 were reviewed. Severely injured patients were divided into TBI + (head AIS? 3) or TBI- (head AIS<3) and assessed for high (? 1:2, more plasma) vs. low (<1:2) transfusion ratios and mortality (Kaplan Meier) as a function of coagulopathy.

Results: TBI+ pts (AIS head 4.1±.1) had significantly higher ISS (43±1 vs. 26±1) and overall mortality (51% vs. 34%) than TBI- (AIS head 0.1±0) but presented with the same degree of shock (BD 11.4±0.6 vs. 11.9±0.5). 27.6% (120/435) of pts arrived coagulopathic (INR? 1.5), of those 42.5% were TBI+ and 57.5% TBI-. Mortality data is shown below:

VARIABLES		INR <1.5 (N=315)			INR ? 1.5 (N=120)		
	mortality	ratio < 1:2	ratio ? 1:2	p value	ratio < 1:2	ratio ? 1:2	p value
TBI -	24 hr	39/112(35%)	12/105(11%)	< 0.01	13/26(50%)	7/42(17%)	< 0.01
TBI-	30 d	45/113(40%)	23/106(22%)	< 0.01	16/26(62%)	14/43(33%)	< 0.01
TBI+	24 hr	18/50(36%)	7/46(15%)	0.02	10/16(63%)	8/34(24%)	< 0.01
TBI+	30 d	27/50(54%)	22/46(48%)	0.34	11/17(65%)	15/34(44%)	0.02

Regardless of admission INR, high ratio resuscitation significantly reduced 24 hr and 30d mortality in TBI- pts. Moreover, high ratio resuscitation reduced mortality at 24 hrs and at 30 days in coagulopathic TBI+ pts (shown in Figure).



Conclusion: All patients presenting in shock and requiring massive transfusion should receive high ratio resuscitation, regardless of associated TBI or presence of admission coagulopathy.

Session IV

Poster # SI-50

UNIVERSAL DONOR PLASMA FOR IMMEDIATE RESUSCITATION IN INJURED PATIENTS

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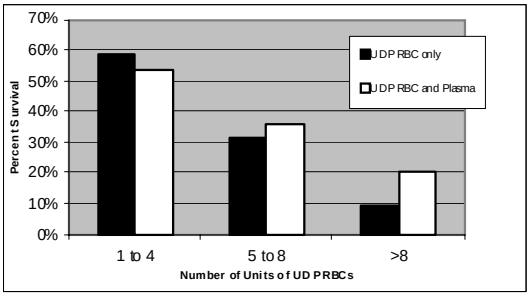
Objective: Use of universal donor (UD) type-O red cells (PRBCs) is common in hemorrhaging trauma patients. Recent work has suggested benefit to early aggressive use of plasma in the same patient. Immediate access to plasma is difficult due to the logistics of blood typing and plasma preparation. Since January 2007, we have maintained 4 units of pre-thawed UD type-AB plasma in our admitting unit, hypothesizing that immediate plasma use was feasible, safe and would improve resuscitation results.

Methods: Unused plasma units were replaced every 4th day. Unused units were returned to the blood bank and issued to compatible patients. Demographics and blood bank data of patients who received UD plasma from 1/2007 to 1/2008 were recorded. Survival rates were compared to patients who received uncrossmatched type-O PRBCs over a previous **5** year period.

Results: 345u of UD plasma were given to 111 patients. 250u were returned to the blood bank. Only 7u (1.2%) expired before use. The mean number of units of UD plasma transfused per patient was 3.1 ±1.2 (range 1-7). Mean patient ISS was 31.7 ±15.7. There were no transfusion reactions to UD plasma. 16 patients with coagulopathy and brain injury received UD plasma but no PRBCs. Overall survival was 46% in the UD plasma group, consistent with the ISS. Comparing patients who received UD plasma and UD PRBCs vs. patients who received only UD PRBCs, survival rates were not statistically different.



Conclusion: Immediate use of UD plasma is both safe and feasible. Further studies of this strategy are indicated to evaluate if it improves survival in hemorrhaging trauma patients who are likely to develop dilutional coagulopathy.

Session IV

Poster # SI-51

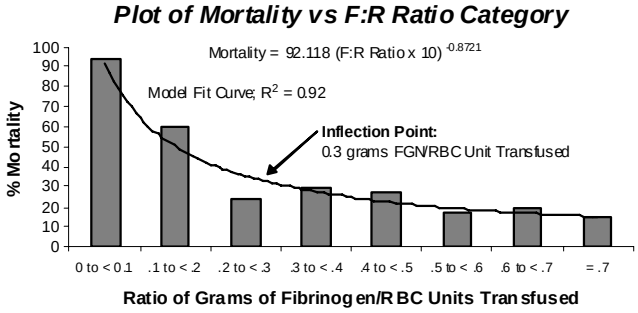
EARLY FIBRINOGEN REDUCES MORTALITY IN COMBAT CASUALTIES REQUIRING MASSIVE TRANSFUSION

Harry K Stinger, MD, Philip C Spinella, MD, Jeremy G Perkins, MD , Jose Salinas, PhD, Wenjun Z Martini, PhD, Clayton D Simon, MD, John R Hess, MD, Dietmar Fries, MD , Kurt W Grathwohl, MD, Michael A Dubick, PhD, Steven E Wolf, MD, Charles E Wade, PhD, John B Holcomb*, MD. U.S. Army Institute of Surgical Research.

Background: In casualties requiring massive transfusions (MT), early transfusion of plasma has been associated with improved survival. It is unclear why plasma reduces mortality. With acute blood loss, fibrinogen (FGN) is rapidly depleted. Our objective was to determine if the FGN component of plasma was associated with improved survival.

Methods: We performed a retrospective review of patients who received a MT (?10 units of red blood cells (RBCs) in 24 hours) during a 3-year period from a combat support hospital. The amount of FGN within each blood product received was used to calculate the FGN: RBC (F:R) ratio transfused for each MT patient. We then plotted mortality versus the F:R ratio and determined the optimal F:R ratio associated with survival.

Results: Four hundred-fifty casualties who received a MT had a mean (SD) ISS of 24.2 (±11.1) and an overall mortality of 125/450 (28%). An optimal F:R Ratio of 0.3 g/RBC unit (see graph) was generated. Two groups of patients who received either a low (<0.3 g/RBC Unit) or high (?0.3 g/RBC Unit) F:R ratio were identified. ISS was similar in both groups (p= 0.127). Mortality in the high F:R ratio group was 23%, in the low ratio group, 46% (p<0.001). Death from hemorrhage in the high F:R ratio group was 59%, in the low ratio group, 91% (p<0.001). Logistic regression demonstrated both the F:R ratio and the FFP to RBC ratio to be predictive of mortality (AUC 0.66/0.68; OR's 0.186/0.194)(p<0.001).



Conclusions: In combat casualties requiring massive transfusion, an increased Fibrinogen: RBC ratio was independently associated with a reduced mortality and improved survival to hospital discharge, primarily by decreasing death from hemorrhage.

Session IV

Poster # SI-52

IMPROVEMENTS IN EARLY MORTALITY AND COAGULOPATHY ARE SUSTAINED BETTER IN BLUNT TRAUMA PATIENTS AFTER INSTITUTION OF A MASSIVE TRANSFUSION PROTOCOL IN A CIVILIAN LEVEL I TRAUMA CENTER

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Introduction: Transfusion practices across the country are changing with aggressive use of plasma (FFP) & platelets (Plt) during massive transfusion based on military experience.

Methods: A massive transfusion protocol (MTP) was designed to achieve a goal Red Blood Cell (RBC):FFP:Plt ratio of 1:1:1 We prospectively gathered demographic, transfusion and patient outcome data during the first year of the MTP and compared this to a similar cohort of injured patients (pre-MTP) receiving $\geq$10 RBC in the first 24 hours of hospitalization prior to instituting the MTP.

Results: 116 MTP activations occurred. 12 non-trauma patients and 31 who did not receive 10 RBC (15 deaths, 16 early bleeding control) were excluded. 73 MTP patients were compared to 84 pre-MTP patients who had similar demographics and injury severity (ISS 28.9 vs. 29, p=.99). MTP patients received an average of 23.7 RBC and 15.6 FFP transfusions compared to 22.8 RBC (p=.67) and 7.6 FFP (p<.001) transfusions in pre-MTP patients. Early crystalloid usage dropped from 9.4 L (pre-MTP) to 6.9 L (MTP) (p=.006).

Data Point	MTP	Pre-MTP	p Value
Total 24 hour Mortality	**17%**	**36%**	**.008**
Total 30 day Mortality	38%	50%	.14
Blunt 24 hr Mortality	**14%**	**39%**	**.006**
Blunt 30 day Mortality	**34%**	**55%**	**.042**
Penetrating 24 hour Mortality	24%	34%	.38
Penetrating 30 day Mortality	41%	43%	.91

Early deaths from coagulopathic bleeding occurred in 4 of 13 patients in the MTP group vs. 21 of 31 patients in the pre-MTP group (p = .023).

Conclusions: In the civilian setting, aggressive use of FFP and Plt drastically reduces 24 hour mortality and early coagulopathy in trauma patients. Reduction in 30 day mortality was only seen after blunt trauma.

Session IV

Poster # SI-53

INDICATIONS AND COMPLICATIONS OF ANGIOGRAPHY AND EMBOLIZATION IN THE MANAGEMENT OF HIGH ENERGY PELVIC RING INJURIES

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Purpose. To characterize the patients in our institution undergoing pelvic angiography and to determine: 1) the efficacy of CT scans in identifying patients with active arterial extravasation and 2) the rate of complications associated with the procedure.

Methods. An IRB-approved retrospective review was performed on patients with high energy pelvic ring injuries from 2004 to 2006. A total of 263 patients were identified, of which 45 (17%) underwent pelvic angiography (Group A). Angiography was indicated if the initial CT scan demonstrated an IV contrast blush (n=33) or if other sources of bleeding were ruled out and the patient remained hemodynamically unstable (n=12). Complications of angiography such as renal failure, failed embolization, gluteal muscle necrosis, and post-operative wound infection were recorded.

Results. There were 30 males and 15 females with a mean age of 45 years in Group A. The mean Injury Severity Score (ISS) was 27, and there were 2 Type A, 24 Type B, and 19 Type C fractures. The sensitivity of a blush on pelvic CT for detecting active extravasation visualized during angiography was 82.4% (28/34), positive predictive value was 84.8% (28/33), and specificity was 44.4% (4/9). Embolization was performed on 41 patients (91.1%); 35 out of 35 patients with active extravasation (100%) and 6 out of 10 without extravasation (60%). Acute renal failure requiring hemodialysis during initial admission occurred more frequently in Group A than the non-angiography group (Group NA) (8.9% vs. 0.5%, $p = 0.0038$). In Group A, gluteal muscle necrosis was observed during surgery in two cases (8.7%), and there were two acute, deep post-operative wound infections (8.7%). Neither was observed in Group NA.

Conclusions. The presence or absence of contrast blush on admission CT scan does not always predict the presence of active extravasation during angiography. Significant complications such as acute renal failure, gluteal muscle necrosis, and post-surgical wound infection may result following this procedure.

Session IV

Poster # SI-54

PREDICTIVE VALUE OF THE FLAT INFERIOR VENA CAVA ON INITIAL COMPUTERIZED TOMOGRAPHY (CT) FOR HEMODYNAMIC DETERIORATION IN BLUNT TORSO TRAUMA PATIENTS

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Introduction: We previously reported that administration of soluble thrombomodulin is effective to improve survival in a rat fatal crush model. This suggests that hindlimbs compression causes systemic endothelial damage. The purpose of this study is to demonstrate the systemic involvement following crush injury and to evaluate the effect of antithrombin III (AT), which was reported to have anti-inflammatory effects.

Materials & methods: Crush injury was made by compression of both hindlimbs of a rat for 6 h (CR group, n=13). Sham (S group, n=13) underwent the same procedure without compression. AT group (n=13) was administered 1 h before releasing by intravenous injection of AT. Mortality was analyzed at 7 days after the injury. Immunohistochemistry was performed on the lung sections obtained 24 hours after the injury. Inflammatory cells were detected by anti OX-42 antibody. To estimate endothelial damage, anti E-selectin and VCAM-1 antibodies were used. AT, TAT, PIC, vWF and tPA/PAI-1 complex (T-IC) level was measured using plasma collected 24 hours after the injury.

Results: In CR group, along with the expression of E-selectin or VCAM-1 on the endothelium, the number of OX-42 positive cells was significantly increased compared to S group. vWF and T-IC level was significantly increased in CR group compared with S group. Mortality in AT group was significantly decreased compared with S group (69.2% vs 23.1%). AT administration tended to ameliorate the infiltration of inflammatory cells.

Discussion: Our findings revealed that crush injury in the hindlimbs caused significant accumulation of inflammatory cells in the lung, suggesting that systemic inflammation was induced by the crush injury. The elevation of vWF and T-IC and the expression of E-selectin and VCAM-1 in crush injury model indicated that a certain kind of molecules derived from damaged tissue might enter bloodstream and impair endothelial cells, leading to systemic inflammation. AT administration significantly improved the survival following crush injury and may become a promising therapy.

Session IV

Poster # SI-55

PERFORMANCE OF CAPILLARY REFILL AS A SCREENING TEST FOR HYPOPERFUSION OF TRAUMATIZED PATIENTS

Naoto Morimura, MD, PhD , Tetsuya Sakamoto, MD, PhD , Kohei Takahashi, MD, Noriaki Aoki, MD, PhD , Yasuyuki Uchida, MD, Takashi Fujita, MD*, Hiroto Ikeda, MD, PhD , and Pascal Yoshida, MD. Teikyo University Hospital.

Purpose: Capillary refill (CR) has been one of widespread triage methods to evaluate circulatory status on mass casualties. This paper aims; (1) to clarify the performance of CR as a screening test of hypoperfusion of traumatized patients, and (2) to compare the performance between CR and heart rate (HR).

Methods: A total of 550 adult patient records in 2000- 2005 from a registration data of a trauma center were analyzed. Cases less than 14 years of age or out-of hospital cardiac arrest were excluded from this study. Hypoperfusion was defined as a base deficit > 5 mEq/l, and cases with CR delay or HR>=120 were predicted as hypoperfusion status. Sensitivity, specificity, and predictive values of CR were calculated, and compared with the performance of HR.

Results: Sensitivity, specificity, positive predictive value, and negative predictive value were 67.1%, 84.7%, 44.5%, 93.4% by CR and 47.1%, 94.6%, 61.5%, 90.7% by HR, respectively. There was no statistically significant difference between CR and HR with respect to the area under the ROC curve (CR: 0.759 (95%CI: 0.697 – 0.821), HR: 0.708 (95%CI: 0.638 – 0.778)).

	Base Deficit		Total
	> 5.0	<= 5.0	
CR Delay	57	71	128
CR No-Delay	28	394	422
Total	85	465	550

	Base Deficit		Total
	> 5.0	<= 5.0	
HR >= 120	40	25	65
HR < 120	45	440	485
Total	85	465	550

Conclusions: Although the performance of CR was superior to HR as a screening test, CR did not appear enough to be a useful test for detecting hypoperfusion of trauma in adult. To improve the diagnostic accuracy of CR, additional physiological parameters will be needed However, increase the evaluation items risks to deteriorate the assessment speed which is crucial in the evaluation of mass casualties. Further large studies are needed to determine the performance of CR as an indicator of circulatory impairment.

Session IV

Poster # SI-56

SCREENING FOR BLUNT CAROTID INJURIES IS COST-EFFECTIVE

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Objective: Screening for blunt carotid injury (BCI) is increasing without understanding whether the chosen approach is cost effective. We hypothesized that screening for BCI using CT angiography (CTA) was cost-effective in populations at high risk for BCI.

Methods: A decision analysis was performed modeling current BCI screening approaches: no screening, Duplex ultrasound, magnetic resonance angiography, angiography, and CTA. Treatment options included antiplatelet therapy, anticoagulation, stents, and no treatment. Probability estimates for incidence of injury and stroke, sensitivity and specificity of the screening modality, type of treatment, and lifetime stroke costs were taken from published data. Average wholesale price was used for drug costs. Medicare reimbursement costs were used for diagnostic tests and procedures. Two perspectives were taken; societal (including lifetime stroke costs) and institutional (ignoring lifetime stroke costs).

Results: From the societal perspective, CTA has the lowest cost and stroke rate. No treatment has the highest cost and stroke rate, allowing all approaches to save money while preventing stroke. From the institutional perspective, no screening is the least costly option while Duplex is the most cost-effective. Stroke rates are the same for each perspective. Two-way sensitivity analyses did not change results.

		Societal perspective	Institutional perspective*
Screening method	**Stroke rate**	**Cost per patient ($)**	**Cost/stroke prevented ($)**
None	0.11	34,139	baseline
Duplex	0.06	19,993	8,900
MRA	0.04	13,406	16,986
Angiography	0.01	5,410	29,490
CTA	0.01	3,633	10,600

*institutional perspective does not consider lifetime stroke costs of $589,613

Conclusion: From the societal perspective, CTA is the most cost-effective screening strategy for patients at high risk for BCI. From the institutional, perspective CTA prevents the most strokes at acceptable cost.

Session IV

Poster # SI-57

THE RETURN OF GENERAL SURGERY: A MEANINGFUL OPERATIVE AND FINANCIAL MODEL FOR THE FUTURE OF TRAUMA SURGERY

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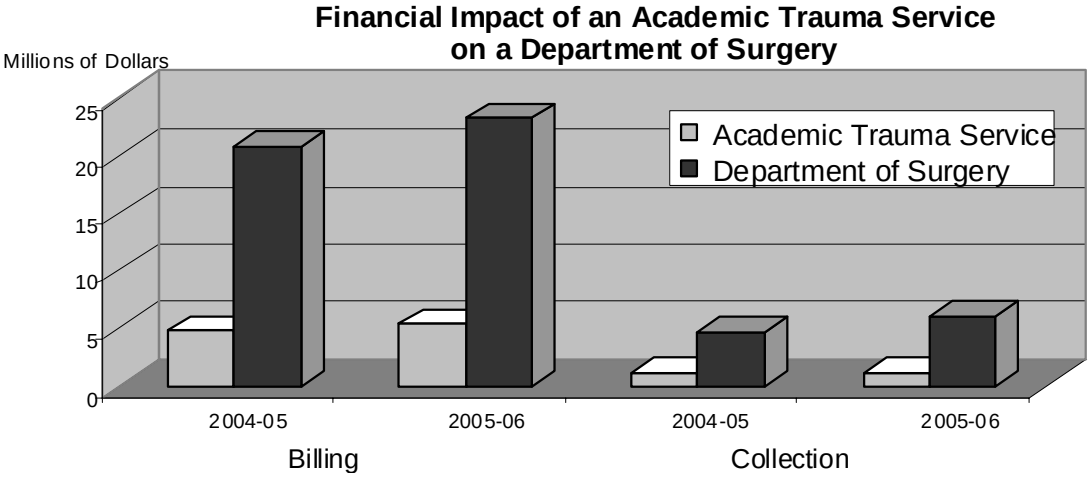
Objectives: To evaluate the quantitative and fiscal contributions of our long standing practice, the academic trauma service (ATS), of including emergent and elective surgery with our trauma practice.

Methods: Prospectively collected databases from the Emergency Department (ED), Outpatient Clinic (OC) and Operative and Trauma Registries during Fiscal Years '05 and '06 for 5.2 FTE trauma surgeons were reviewed. ATS clinical outcomes, quality assessment, and revenue were reviewed in aggregate with the remainder of the department.

Results: There were 113911 ED visits, 4192 admissions excluding observations and 16500 ATS OC visits. Trauma surgery billing, combined, was higher than that of any other sections without an increase in morbidity or mortality. Three thousand two hundred eighty nine operative cases were performed by the ATS.

Conclusions: An ATS model based on trauma surgery, emergent general surgery, and an outpatient experience allows for a meaningful and diverse operative experience. This model makes it unnecessary for Trauma Surgeons to acquire skills outside their specialty but, rather, focus on maintaining and advancing traditional general surgical skills.



Session IV

Poster # SI-58

ATTITUDES TOWARDS ORGAN DONATION IN SURGEONS AND MEDICAL STUDENTS.

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Intro: There are currently 97,000 people waiting for a transplant. Last year(1-10/07) only 21,403 transplants were performed due to organ availability. Attitudes of health care personnel play a significant influence on popular attitudes towards organ donation (OD).

Study Design: In this multi-institutional study we looked at attitudes towards OD in surgical attendings (SA), surgical residents (SR) and medical students (MS). The study consisted of an anonymous questionnaire. Questions included whether the individual had signed an organ donor card (ODC), would they encourage others to do so, and would they consent to donation of a family member's organs. This was compared with their experience on the transplant surgical service (TSS).

Results: There were 106 responses, 35 MS, 41 SR and 30 SA. Fifty-two (49%) had signed their ODC. Sixteen of the remaining 54 stated that they planned to sign. Of the medical students, residents and attendings, 60%, 39%, and 50% had signed their ODC. In this group, 94% would encourage others to sign and would be willing to sign for OD on a family member. Of the 37 (35% of respondents) who had not signed nor planned to sign their ODC, 47% would still encourage others to sign and 60% would sign for a family member. In the group that would not sign, 6(16%) said it was related to their experience on the TSS and 83% said it was related to the procurement procedure.

Conclusion: This is the first scientific evaluation of physician attitudes towards OD in the U.S. Despite knowledge of the critical need for organs, less than 50% of physicians have signed ODC's. The percentage of physicians who would agree to the donation of a family member's organs is significantly lower if the physician had not signed an ODC. In many of those that had not signed, their experience on the TSS played a significant role in this decision. As many non-physicians look for guidance from physicians in decision making for OD there needs to be, first and foremost, a greater effort to create a more positive attitude among physicians about the OD process.

Session IV

Poster # SI-59

THE EFFECT OF INSURANCE STATUS ON TOTAL HOSPITAL COSTS IN TRAUMA PATIENTS

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Introduction: Trauma centers care for patients regardless of ability to pay. Uninsured trauma patients rarely generate any revenue for the hospital, however, putting a strain on limited resources. We hypothesize that under- and uninsured trauma patients also generate higher total hospital costs than their well-insured counterparts.

Methods: Registry data from our Level I trauma center were reviewed to identify all patients admitted to the hospital with a traumatic diagnosis over a 6 year period (2001-2006). Cost data were obtained from the hospital finance department. Patients who died within 48 hours of admission were excluded from the analysis. Patients were divided according to insurance status into four groups: those with commercial insurance (COMM), Medicaid (CAID), Medicare (CARE), or no insurance (NONE). Total costs were calculated as the sum of fixed and variable direct costs and indirect costs.

Results:

	COMM	CAID	CARE	NONE
Number (%)	7386 (57%)	1004 (8%)	1973 (15%)	2776 (20%)
Age	34	34	77†	34
ISS	9.8†	10.7	10.7	10.3
LOS	5.8	10.7†	8.8†	6.9†
deaths (%)	1.1%	1.3%	7.5%†	1.4%

†statistically significant to $p<0.05$

COMM patients were less severely injured and had a shorter length of stay than all other groups. Total hospital costs were also lowest for the COMM group. NONE had the highest hospital costs, despite a shorter LOS than CAID or CARE.

Conclusion: Uninsured and under-insured patients at our trauma center tend to be more seriously injured than the commercially-insured. The uninsured have the highest total hospital costs, despite a shorter LOS than the under-insured. This suggests that decreasing LOS is not the key to decreasing costs for trauma patients.

Session IV

Poster # SI-60

PATTERN OF CRANIOFACIAL FRACTURES PREDICTS CRANIAL NERVE INJURY AFTER BLUNT TRAUMA

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Background: Cranial nerve (CN) injuries from blunt trauma are uncommon but may result in significant long-term disability. Earlier diagnosis may allow for more timely intervention and reduced disability. We hypothesized that specific craniofacial fracture (FX) patterns are associated with CN injuries after blunt trauma and may assist with earlier identification.

Methods: The trauma registry at a single institution was queried for all patients with basilar skull and facial FX from 1/2000-3/2007. Individual electronic medical records were reviewed to identify patients with documented CN injuries. Demographics, location of craniofacial FX, procedures, and outcomes were recorded. Associations between each CN injured and craniofacial FX were determined by Fisher's exact test.

Results: There were 320 patients with basilar skull FX and 358 patients with facial FX. 59 patients with 90 CN injuries were identified. Most frequent injury mechanisms were MVC (31%), falls (27%), and MCC (12%). Mean ISS was 22.9. Head injuries occurred in 76% of patients. 21 (45%) patients had CN injuries identified the day of admission (N=47). Most frequently injured CNs were CN7 (22), CN1 (16), CN6 (14), CN2 (11), and CN3 (10). Occipital FX were associated with CN1 injuries (p=0.001). Frontal (p=0.002), maxillary (p=0.033), nasal (p=0.014), orbital (p=0.011), and sphenoid (p=0.033) FX were all associated with CN2 injuries. Sphenoid FX were associated with CN3 injuries (p=0.019). Maxillary FX were associated with CN5 injuries (p=0.033). Temporal FX were associated with CN7 injuries (p=0.011). 4 patients underwent acute operative repair of CN7 injuries. Follow-up data were available for 77 CN injuries at a median of 132 days. Recovery of function was complete for 13, partial for 28, and none for 36 injuries.

Conclusion: Specific patterns of craniofacial FX were associated with individual CN injuries. The majority of CN injuries were managed non-operatively. Partial or complete recovery of function occurred in 53% of patients.

Session IV

Poster # SI-61

CLINICAL AND HEALTH CARE RESOURCE UTILIZATION OUTCOMES AFTER INTENTIONAL INJURY

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Objective: To compare outcomes of intentional injury to those of unintentional injury.

Methods: The National Trauma Data Bank was used. The study population consisted of all reported adult trauma patients from 2000 to 2005 admitted to an emergency department with an Injury Severity Score (ISS) ? 15 for whom the nature of the injury was known (intentional vs. unintentional). Transfers between hospitals were not included. Intentionally injured patients were divided into two groups: self-inflicted injury and injury after assault. Clinical outcomes and health care resource utilization markers for these two groups were compared against unintentionally injured patients. Students T-, chi-square, and Kruskal-Wallis tests were used as appropriate for comparisons. Risk-adjusted multivariable analysis was used for comparison of mortality rates. P values < 0.05 were considered significant.

Results: Outcomes of the three groups are shown in the table below:

	Unintentional (n = 56,192)	Assault (n = 6,753)	P Value	Self-Inflicted (n= 732)	P Value
Age (years)	42.6 ± 20.1	33.0 ± 12.8	<0.05	38.5 ± 15.1	<0.05
Female	31.5%	10.9%	<0.05	22.4%	<0.05
% Penetrating	0.8%	52.5%	<0.05	60.5%	<0.05
ISS	23.7 ± 8.3	21.6 ± 7.1	<0.05	23.8 ± 8.6	0.659
GCS	12.5 ± 4.4	12.9 ± 3.9	<0.05	10.4 ± 5.1	<0.05
In-hospital Mortality	1.7%	0.9%	<0.05	2.1%	<0.05
ICU LOS	5.2 ± 9.7 days	4.5 ± 8.5	<0.05	7.9 ± 11.1 days	<0.05
Ventilator Days	2.7 ± 10.4 days	2.2 ± 8.2	<0.05	4.2 ± 9.0 days	<0.05
Hospital LOS	11.9 ± 14.7%	11.1 ± 14.5	<0.05	18.4 ± 19.7	<0.05
Discharge to facility	37.1%	19.0%	<0.05	50.2%	<0.05

Statistical comparisons are made between Assault or Self-Inflicted groups versus Unintentional group.

Risk-adjusted mortality after assault was significantly less than after unintentional injury (OR 0.57, 95%CI [0.43, 0.74], p<0.05). Risk-adjusted mortality after self-inflicted injury did not significantly differ from unintentionally injured patients (OR 1.16, 95%CI [0.69, 1.94], p=0.582).

Conclusion: Patients with intentional self-inflicted injury have similar mortality rates as unintentionally injured patients but require greater levels of health care resource utilization.

Session IV

Poster # SI-62

OVERUSE OF ABDOMINAL AND PELVIC COMPUTED TOMOGRAPHY IN PEDIATRIC TRAUMA PATIENTS?

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Introduction: Children are more sensitive to the effects of ionizing radiation than adults (including developing cancer), even at equivalent doses. Furthermore, the effective radiation dose for an abdominal CT is 1.5 to 2.5 times greater for children. This study evaluated the use of CT scans in pediatric trauma patients during their initial evaluation and its impact on the need for operative management.

Methods: We performed a retrospective review for pediatric patients (age <16 years) from 2005 thru 2006. Demographics, focused sonography exam (FAST) results, chest and pelvis x-ray results, CT scan findings, operative intervention, and mortality data were collected. Radiation doses (from CT) were recorded. Data analysis was descriptive.

Results: 435 patients were identified (mean age 10.6 ± 5.3 years) mean ISS 10.4 (± 9.8). 271 had abdominal/pelvic CT as part of the initial evaluation. Mean radiation exposure was 11.0mGy (range 2.61–67.8mGy). Of these patients, 7.7% did not have FAST, 72.7% had a negative FAST, and 19.6% had a positive FAST. 38.6% of the patients with a negative FAST exam had findings on CT scan. 27 patients had isolated pelvic fractures on CT scan, 20 of which seen on prior plain pelvic x-ray. 8 patients required immediate laparotomy (<24 hours), of these only 2 patients underwent CT (both positive). Overall there were 16 deaths, 2 coming from isolated abdominal trauma (hemorrhage).

Conclusion: The majority of pediatric patients underwent abdominal/pelvic CT scans as part of their initial evaluation. Most resulted in negative findings or no change in clinical management; however exposing patients to high doses of radiation. Although CT is a valuable diagnostic tool, efforts should be made to reduce its overuse in pediatric trauma patients.

Session IV

Poster # SI-63

INITIAL GENOMIC RESPONSE DOES NOT PREDICT DIFFERENCES IN OUTCOME BETWEEN OBESE AND NORMAL WEIGHT PATIENTS FOLLOWING SEVERE BLUNT TRAUMA

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Background: Obesity and morbid obesity are known risk factors for the development of complications following injury. Individuals with excess adiposity have been shown to have cytokine derangements suggestive of a pro-inflammatory state. We hypothesized that obese and morbidly obese patients would display differences in inflammatory response to blunt trauma that might explain their increased risk for complications.

Methods: Prospectively collected data and samples obtained through the "Inflammation and the Host Response to Injury" collaborative program supported by the NIGMS, were analyzed retrospectively. Patients were grouped according to NIH Body Mass Index (BMI) classifications and compared clinically using regression analysis and in terms of leukocyte genomic expression using a significance analysis of microarray multiclass comparison.

Results: 455 patients underwent clinical data analysis. Regression analysis demonstrated an association between increasing BMI and adverse outcomes, but not mortality (Table 1). Genomic data was present on 163 patients. Multiclass comparison of genomic expression between BMI groups within the first 12 hours following injury revealed no probe sets with a significant degree of intergroup difference (0 with p value <0.05, 1000 permutations).

Conclusions: Increasing BMI is independently associated with adverse outcomes, but not mortality, following severe blunt trauma. The initial inflammatory response, as measured by changes in the leukocyte genome, does not appear to differ between patients of different BMI classifications. Early resuscitative practices altered by differences in BMI, rather than inherent inflammatory dysfunction, likely explain the differences seen in outcome.

Table 1. BMI Class Relationship to Adverse Outcome

	Odds Ratio	R^2	p-Value
Acute Respiratory Distress Syndrome	1.324	0.299	0.043
Cardiac Arrest	2.110	0.309	0.016
Acute Renal Failure	2.597	0.368	0.046
Bloodstream Infection	1.468	0.231	0.020
Mortality	0.870	0.380	0.583

Session IV

Poster # SI-64

IN-HOSPITAL TRAUMA DEATHS AT A COMBAT SUPPORT HOSPITAL: A PROCESS IMPROVEMENT FOCUSED MORTALITY ANALYSIS

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Background: Analysis of the epidemiology and attribution of in-hospital deaths is a critical component of learning and process improvement for any trauma center. We sought to perform a detailed analysis of in-hospital deaths at a Combat Support Hospital (CSH).

Methods: All trauma patients who survived to admission and subsequently died prior to transfer or discharge over a 1-year period were included. The timing, location, etiology, and circumstances surrounding the death were recorded. Opportunities for improvement of care were identified for analysis. Cases were presented to a panel of experts, and preventability of the deaths was scored on a continuous 10 point scale.

Results: There were 151 deaths, with the predominant mechanisms of GSW (47%) and blast injuries (42%). Most had severe injuries, with a mean ISS of 38, pH of 7.09 and base deficit of 12. Predominant causes of death were head injury (45%) and hemorrhage (32%), and 85% died within 24 hours of admission. Most deaths occurred during the intensive care (35%) or resuscitation phases (31%), but the majority of deaths among non-expectant patients occurred during the operative phase (38%). Opportunities for improvement were identified in 74 (49%) deaths, and were found in 78% of non-expectant deaths. Most improvement opportunities occurred during the resuscitation and transport phases. The majority of potential improvements were identified at the system level (54%) or individual provider level (42%). Preventability scoring showed excellent inter-rater reliability ($r=0.92$, $p<0.001$). Deaths with high preventability scores (mean > 5.5) were primarily related to delays in hemorrhage control during the transportation (47%) or resuscitation (43%) phases, and attributed to the system (63%) and individual provider levels (70%).

Conclusions: In-hospital combat trauma related deaths at a modern CSH differ significantly from their civilian counterparts, and present multiple opportunities for improvement of care and potential salvage. Delays in pre-hospital and in-hospital hemorrhage control are the primary contributors to potential preventability.

Session IV

Poster # SI-65

SHOULD HELICAL COMPUTER TOMOGRAPHY (CT) SCAN BE THE SCREENING TOOL FOR DETECTION OF ONGOING INTERNAL BLEEDING FROM CHEST AND ABDOMINAL TRAUMA?

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Introduction: Occult internal bleeding in the trauma patient can result in serious morbidity or mortality if missed. The purpose of the study was to identify the sensitivity and specificity of the CT scan and the angiogram in detecting the continuous internal bleeding.

Methods: Patient's clinical information, CT scan and angiography were reviewed. Extravasations of contrast from CT scan and/or angiogram was considered positive for ongoing internal bleeding. The exact confidence intervals (CI) were calculated for the sensitivity and negative predictive values. The chi-square test was used to compare ratios between groups.

Results: From January 2002 through July 2007, one hundred and thirteen consecutive adult trauma patients with multiple injuries underwent CT scan of chest and abdomen followed by angiogram. Sixty six patients did not show any bleeding from either of the scan tests. 24 out of 35 patients had both positive CT scan and angiogram. 11 patients with positive CT scan did not have bleeding on angiogram. Similarly, twelve out of thirty six patients were positive on angiogram but did not show any extravasations of contrast on CT scan. Both scan tests had a specificity of 100% based on clinical definition. The sensitivities of CT scan and angiogram were 74.5% (95% CI: [59.7%, 86.1%]) and 76.6% (95% CI: [62.0%, 87.7%]), respectively. They were not significantly different (P=0.95). The negative predictive values for CT and angiogram were 84.6% (95% CI: [74.7%, 91.8%]) and 85.7% (95% CI: [75.9%, 92.6%]). They were not significantly different (P=0.95). When CT scan was used alone for identifying bleeding, 25.5% of the bleeding patients were missed.

Conclusions: Relying on only CT scan for ongoing internal bleed can miss a high proportion of patients. Angiogram should be used even if CT scan does not show extravasation of contrast in high risk patients.

Session IV

Poster # SI-66

RESOURCE UTILIZATION AND OUTCOMES OF INTOXICATED DRIVERS

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Introduction: There is a lack of literature on intoxicated drivers involved in motors vehicle crashes with respect to outcome variables and resource utilization. We investigated the impact of intoxicated drivers on hospital resources and assessed outcomes.

Methods: Retrospective study (Jan 2002-June 2007) using trauma registry data, and our institutional financial database, to compare intoxicated drivers with alcohol levels > 80 mg/dl (ETOH>80) with drivers who had alcohol levels of 0 mg/dl (ETOH=0). The ETOH >80 group was case matched with ETOH=0 by age, gender, and injury severity score (ISS). Data was collected on outcome variables (mortality, complications, ICU and hospital LOS, ventilator days) and resource utilization (time in ED, insurance, charges, costs, payments or PMT). Statistical analysis: $p < 0.05$* vs. ETOH>80; chi square.

Results: Out of 1732 drivers, the combined study group of 623 ETOH=0 and 364 ETOH >80 trauma patients had a mean age of 38.8$\pm$ 17.9, ISS of 18.0$\pm$12.1, and 69.8%% male.

	ED $\geq$ 220 min.	ICU LOS $\geq$ 5days	Vent days $\geq$ 8	Hospital LOS > 14 days
ETOH=0	25.6%*, 159/598	19.0%*, 118/621	10.5%*, 65/618	17.8%*, 111/623
ETOH>80	22.5%, 78/346	13.5%, 49/364	5.0%, 18/361	11.5%, 42/364

There was no difference in mortality (p=0.06) or complications (p=0.38). ETOH>80 had fewer DVT's (1.9% vs. 5.0%, p=.038) and decreased coagulopathy (0% vs. 1.9%, p<.01)

	Self-pay	Charges > $50K	Costs > $25K	PMT/Charge > 0.9
ETOH=0	0.7%*, 3/416	29.6%*, 123/416	25.5%, 106/416	28.4%*, 118/416
ETOH>80	4.9%, 10/203	20.8%, 42/202	18.1%, 38/202	16.3%, 33/202

Conclusion: ETOH>80 had better outcomes and were less likely to have prolonged hospital LOS, ICU LOS, and ventilator days. There was a trend towards decreased mortality (p=0.06) in the intoxicated group. ETOH>80 were more likely to be self-pay, less likely to have charges > $50K, and less likely to pay > 90% of the charges.

Session IV

Poster # SI-67

IMPACT OF CEREBRAL OXYGEN MONITORING IN SEVERE HEAD INJURY

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Introduction: Traumatic Brain Injury (TBI) is a leading cause of death and disability. In addition to the treatment of intracranial pressure, monitoring and optimizing cerebral oxygenation has been advocated to improve outcome in head-injured patients.

Methods: Patients with severe TBI (GCS $\leq$ 8) were identified upon admission to a Level 1 trauma center. Data collected included elements from the prehospital record, the ED record and the first ten days of the ICU hospitalization. A polarographic cerebral oxygen monitor (Licox) or fiberoptic intracranial pressure monitor (Camino) was inserted based on attending surgeon preference. An evidence-based algorithm for treatment was implemented to provide uniform care.

Results: One hundred nineteen patients were entered into the study over a three year period. There were 64 patients in the Licox group (L) and 55 patients in the Camino group (C). There were no significant differences between the study groups in patient age, gender, Abbreviated Injury Score-Head or Injury Severity Score. However L patients had a mean of 85.6 + 56.6 hours with an ICP > 20, and C patients had a mean of 24.7 + 34.8 hours (p = 0.000), indicating a greater severity of cerebral edema in the L group. Despite this difference, outcomes between the two groups were not different.

	LICOX GROUP		CAMINO GROUP		
	Mean	SD	Mean	SD	p value
ICU LOS (days)	12.89	0.96	13.55	10.31	0.69
Hospital LOS (days)	24.03	20.69	23.27	19.62	0.84
Survival Ratio	0.73	0.45	0.73	0.45	0.99

Conclusion: Despite more prolonged cerebral edema in the Licox group, ICU length of stay, hospital length of stay and survival ratio were not different between the study groups, implying cerebral oxygen monitoring facilitates care of more severely head injured patients, allowing achievement of results equivalent to those of less severely injured patients.

Session IV

Poster # SI-68

USING HOSPITAL OUTCOMES TO PREDICT 30-DAY MORTALITY FOR INJURED MEDICARE PATIENTS

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Introduction : Survival to a fixed time after injury has been proposed as a better outcome measurement than survival to hospital discharge. For large populations, collecting outcome data after hospital discharge may be difficult and expensive. We sought to determine whether data available at the time of discharge, including length of stay (LOS) and discharge destination, could accurately predict 30-day survival in older trauma patients.

Methods: We analyzed 1999 Medicare fee-for-service records for patients aged >=65 with principal injury diagnoses (ICD-9 800-959, excluding 905, 930-939, 958). Cases were classified by maximum Abbreviated Injury Score (AISmax) and Charlson Comorbidity Score (CCS: 0,1,2,>=3). For patients leaving the hospital alive, probability of surviving until 30 days after admission for injury (PS30) was modeled as a function of discharge home (DH), discharge to long-term care (DLTC), and LOS, as well as age, sex, AISmax, CCS, and geographic region (Northeast, Midwest, South, West).

Results: 436,104 patients met inclusion criteria. For the baseline group of Northeastern women aged 65-69, with AISmax<3, CCS=0, DH with LOS 1-2, the model predicted PS30=0.99. Predicted PS30 (given hospital discharge status) was lower for other regions, male sex, older age, more severe injury, or greater comorbidity. For DH patients, longer LOS was associated with lower PS30, although the effect was fairly level after day 14. For DLTC patients, PS30 was lower than for DH patients with the same LOS, and lowest with LOS 1-2 or LOS 8-14; however, for DLTC patients after day 14, longer LOS was associated with higher PS30 and was similar to the baseline group after day 21.

Conclusion: For injured Medicare patients, PS30 can be estimated using data known at the time of hospital discharge. When only hospital discharge data are available, hospital survival could be multiplied by PS30 or a similar statistic to allow more valid hospital or regional outcome comparisons, at least for older trauma patients.

Session IV

Poster # SI-69

USE OF AN ELECTRONIC MEDICAL RECORD LEADS TO A REDUCTION IN MORTALITY

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Introduction: The Electronic Medical Record (EMR) has been proposed as a way to reduce medical errors. It can also be used to document clinician involvement and profile physicians which may affect outcomes. The purpose of this study was to determine if the EMR can profile surgeons, change involvement, enhance revenue, and lower mortality. Methods: The Trauma Division adopted an EMR program and implemented profiling reports on physician involvement in patient care. Instructions were given to all surgeons that they would be profiled by their notes in the EMR. Prior to this, notes were recorded in the paper chart and were difficult to track. Differences among proportions were determined with z-test or Chi with significance of $p<0.05$.

Results: Table 1 shows the change in surgeon documented notes and divisional revenue.

	12 months prior	12 months after	12-24 months after	p
Floor Notes	1%	89%	88%	<0.001
Procedures Notes	78%	95%	96%	<0.001
Resus Notes	81%	97%	98%	<0.001
ICU Notes	80%	99%	99%	<0.001
Revenue	$4,272,057	$5,132,325	$6,278,274	

Table 2 demonstrates the changes in mortality with mean ISS at death.

	Patients	Deaths	ISS	% death	p
12 months prior to EMR	3481	312	40.7	8.96	
12 months after EMR	3715	283	41.9	7.61	0.03
12-24 months after EMR	4038	304	42.7	7.52	0.02

Conclusions: The EMR can be used to profile surgeons and change their involvement in patient care. The increase in involvement was associated with increased revenue. Use of the EMR was associated with a significant reduction in mortality.

Session IV

Poster # SI-70

CHARLSON COMORBIDITY INDEX IS A PREDICTOR OF MORTALITY IN THE OLDER TRAUMA PATIENT

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Objective: To determine whether the Charlson Comorbidity Index (CCI) is an independent predictor of mortality in the older trauma patient.

Method: A six-year retrospective study of trauma patients using the North Carolina trauma registry from 2000-2005 was conducted after institutional review board approval. All patients 50yrs and above were included in the study. Data collected included demographics, mechanism of injury, ISS, ICU length of stay (ICU-LOS) and CCI. Multivariate logistic regression was used to model mortality outcome.

Results: 28,379 patients met inclusion criteria of which 7.0 % (n=1995) patients died. 45.47% (n=12,969) were male. 86.10% (n=24,405) were white. The mean age of the patient population was 71yrs (range 50-107). The mean ISS was 10.64. The average ICU length of stay was 6.84 days. CCI was stratified into 3 groups, 1-3, 4-6 and >7. Increasing CCI was significantly associated with increasing ICU length of stay with 7.2 ($p<0.0001$), 8.16 ($p<0.0001$) and 11.5 ($p<0.0005$) days, respectively. Logistic regression analysis revealed that CCI is an independent predictor of mortality, with an Odds Ratio of 1.069 ($p < 0.0002$, CI 1.033-1.107) after controlling for age, race, gender, and ISS.

Conclusion: Comorbid disease influences patient of outcomes, particularly in the elderly critically ill population. CCI is an independent predictor of mortality in the critically ill elderly trauma patient and has a linear relationship to increasing ICU-LOS. CCI is a valuable adjunct to ISS in predicting mortality in the elderly trauma patient and its use may help guide clinical management of the elderly trauma patient.

Session IV

Poster # SI-71

MISSING DATA IN THE NATIONAL TRAUMA DATA BANK (NTDB): IS MULTIPLE IMPUTATION THE ANSWER?

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Background: NTDB (v 6.2, 2001-05) contains 1.4 million patient records and is being used for trauma outcomes research and hospital benchmarking. These studies are subject to information bias since patients with any missing variables are often simply ignored. Multiple imputation (M.IMP), deriving likely values for data which is missing at random, has been suggested as a solution. This study demonstrates the feasibility of M.IMP as an approach to assist in trauma outcome analyses that use multivariate regression.

Methods: Proportions of missing data for known co-variates of trauma mortality (table) were calculated. Five rounds of Imputation by Chained Equation (model included all covariates and the primary outcome, death) was performed in STATA v. 10 to develop an imputed dataset. Identical multivariate regression analyses were then performed to investigate the effect of race and insurance status on mortality, controlling for co-variates mentioned above in both the imputed and non imputed datasets. White insured patients (reference group) were compared to White uninsured, Black insured, and Black uninsured patients and the adjusted relative odds of death calculated for each race / insurance group.

Results: Approximately 50% of patients had at least one missing data element. The M.IMP dataset was twice as large and revealed qualitatively similar results. Black and uninsured patients have a higher risk of death after trauma.

Adjusted Odds Ratio of Death	Non Imputed n= 632,817	Imputed n=1,282,166
Insured White	1.00	1.00
Uninsured White	1.80 (1.69 -1.94)	1.67 (1.61 -1.74)
Insured Black	1.37 (1.24 -1.51)	1.27 (1.18 -1.36)
Uninsured Black	2.61 (2.41 -2.83)	2.35 (2.24 -2.47)

(95% confidence interval)

Co-Variates	Missing
Age	3.5%
Gender	0.4%
Race	8.4%
Insurance	16.5%
Injury Severity Score	5.7%
Revised trauma score	19.6%
Type of trauma	2.9%

Conclusion: Multiple imputation is feasible in the NTDB. Investigators using large databases should use M.IMP to verify results of their multivariate analyses to ensure that missing data does not lead to biased results.

Session IV

Poster # SI-72

MANAGEMENT OF CHILDREN AT RISK FOR DEEP VENOUS THROMBOSIS: RESULTS OF A CLINICAL GUIDELINE

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Childrens Hospital of Pittsburgh.

Introduction: Trauma is a well known risk factor for the development of deep venous thrombosis (DVT) in adults. However the risk in children is poorly understood. Despite the low reported incidence, we have noted patients with DVT in our pediatric trauma population. We therefore developed a practice guideline to provide a uniform approach to the prophylaxis, screening, and treatment of pediatric trauma patients at risk for DVT.

Methods: As part of a quality improvement initiative, the trauma and hematology divisions of a pediatric level one trauma center developed a "DVT practice guideline" for pediatric trauma victims. Reported risk factors including patient age, injuries, mechanical ventilation, presence of a central line (CVL), and family history were incorporated into the guideline, which went into effect on March 6, 2006. IRB approval was obtained to examine our data pre and post guideline implementation (2001-2007).

Results: During the study period, 11,109 children were admitted. 40 developed DVTs, for an incidence of 0.36%. Patients with DVT were young (8.2 ±5.4 years), severely injured (ISS 29±17; GCS median 3), and all but one had a CVL (25 femoral, 3 subclavian, 11 both). Since protocol inception, 61 patients (1.8%) met screening criteria; of those 5 were found to have a DVT on duplex ultrasound imaging (8.2%). 5 additional DVTs were identified clinically (failure of screening). 2 patients with DVT underwent removable IVC filter placement; 6 were treated with enoxaparin (ENX), and 2 observed. 13 patients qualified for pharmacologic prophylaxis with ENX, 8 additional patients were treated outside the guideline. There were no DVT in the prophylaxis group. There was one bleeding complication from therapeutic ENX. Over the entire study, no patient suffered a pulmonary embolism; there were 3 deaths, all related to underlying brain injury.

Conclusion: DVT in children is rare and strongly associated with the presence of a CVL. The vast majority of children do not require pharmacologic prophylaxis for DVT. A highly selective clinical guideline is an effective means of utilizing resources.

Session IV

Poster # SI-73

DOES ELECTRONIC NOTIFICATION IMPROVE CAVAL FILTER RETRIEVAL RATES ?

Mark L Shapiro, MD, Dawn M Emick, MD , Michael J Miller, MD, Tony P Smith, MD, Syamal D Bhattacharya, MD, Steven N Vaslef*, MD PhD. Duke University Medical Center.

Introduction: Caval Filtration Devices (CFD) have been in use for many years. Since the introduction of retrievable devices, clinicians may have expanded their indication or lowered their threshold for placing CFDs. Most series looking at their experience with retrievable CFD (rCFD) are small (n < 200). Multiple factors account for low CFD retrieval rates: compliance, recurrent deep venous thrombosis, surgeon preference. We report our single institutional experience with rCFD, including our experience in the trauma population. In conjunction with our interventional radiology department, an electronic method of contacting the attending physician in order to notify patients of the opportunity to retrieve their CFD has been instituted. We hypothesize that: (1) the retrieval rate for trauma patients is less than for patients with filters inserted for other reasons, and (2) retrieval rate increased with the initiation of the electronic notification system.

Methods: A retrospective database of all patients with rCFD placement at our institution was compiled. Chi-square and Fisher tests were used for statistical analysis.

Results: 839 patients had rCFD placed from 12/2001 to 9/2007. There were 177 trauma patients included in this sample. Retrieval rates were 23.5% for all patients and 18.9% in trauma patients (p=NS). Among trauma patients, 100% of attempted retrievals were successful, with a mean dwell time of 51 days (range 1-140 days). After initiation of the notification system, the overall retrieval rate increased from 16.3% to 28.8% ($p<0.0001$). Among trauma patients, retrieval rate varied by attending, from 4.3% to 41.7% (p=0.01).

Conclusions: Although we report a retrieval rate similar to previously reported, we show that retrieval rates nearly doubled with the initiation of an electronic notification system. Furthermore, retrieval rates were significantly higher for certain trauma surgeons, suggesting that variance in diligence of the individual physician is a major factor contributing to successful filter retrieval in this population. This dispels a commonly held notion that patient factors are solely responsible for lower rates of retrieval.

Session IV

Poster # SI-74

PATIENT PHYSIOLOGY AT INTERNAL FIXATION AFTER ORTHOPEDIC DAMAGE CONTROL SIGNIFICANTLY AFFECTS OUTCOMES IN COMBAT MULTI-TRAUMA PATIENTS

Steven P Bowers, MD, Jeffrey A Bailey*, MD, Mark W Richardson, MD, Eric T Nelson, MD, Henry T Leis, MD, Donald H Jenkins*, MD. Wilford Hall Medical Center.

Objective: It has been established from reports of civilian trauma care, that early fixation of long bone (femur, tibia, humerus) shaft fractures is associated with decreased respiratory complications and improved outcomes. The damage control concept of caring for multi-trauma patients has been successfully applied to orthopedic injuries; however the optimal timing of conversion to internal fixation of long bone fractures is a topic of debate. We report the in-hospital clinical outcomes of patients who underwent internal fixation (ORIF) for combat-related long bone shaft fractures between Jan 2006 and Jan 2008 at the Air Force Theater Hospital (AFTH) in Balad, Iraq.

Methods: Patients undergoing long bone shaft internal fixation were identified from an operative report database, and charts were reviewed retrospectively.

Results: Of the 286 patients, 84 underwent primary ORIF, and 202 patients underwent initial damage control, consisting of soft tissue debridement and external fixation or splinting, followed by delayed conversion to ORIF at the AFTH. Of the orthopedic damage control patients, 60 required ICU care at the time of ORIF. Of the 35 patients requiring mechanical ventilation at the time of ORIF, 8 died and 15 had complications (9 life-threatening). Of the 25 non-ventilated ICU patients, 1 died and 8 had complications (4 life-threatening). Need for mechanical ventilation was significantly associated with postoperative death or severe complication ($p=0.03$, Fisher's exact test). Of the 45 ICU patients who underwent femoral or tibial shaft internal fixation, need for mechanical ventilation at time of ORIF was associated with postoperative death (8 of 24 vs. 1 of 21 non-ventilated patients, $p=0.03$, Fisher's exact test).

Conclusion: The inflammatory response to long bone internal fixation may represent a critical or fatal "second hit" in physiologically stressed combat-wounded multi-trauma patients. Delaying internal fixation in mechanically ventilated combat multi-trauma patients improves resource allocation, and may improve clinical outcome.

Session IV

Poster # SI-75

DEFINING THE ROLE OF THE SURGICAL INTENSIVIST IN THE ERA OF ACUTE CARE SURGERY

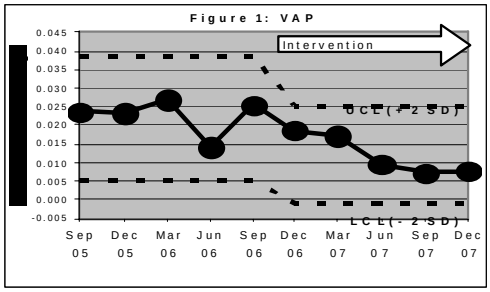
Jeffrey L Johnson*, MD, Jeffry L Kashuk*, MD, Ernest E Moore*, MD, C Clay Cothren*, MD, Walter L Biffl*, MD, Angela Sauaia, MD PhD. Denver Health Medical Center, UCDHSC.

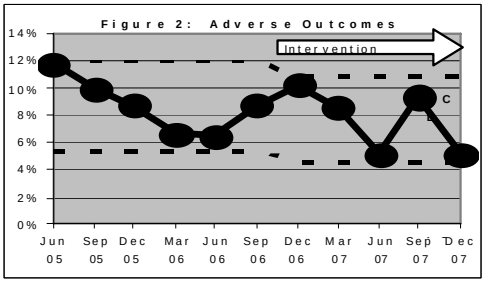
Introduction: In the face of a continuing shortage of intensivists nationally, the optimal role of the new acute care surgeon in the intensive care unit remains to be defined. Furthermore, as preventable complications become publicly reportable and carry direct financial consequences, defining best practice for this new paradigm becomes an imperative. We **hypothesized** that shifting SICU (surgical intensive care unit) attending supervision from a continuous "open" approach to a designated "attending of the week" (mixed model) would improve patient outcomes.

Methods: We prospectively evaluated outcomes in an academic level 1 trauma center SICU over a 33 month period. Six acute care surgeons were responsible for the care throughout the study period. Beginning in July 2006 (start of intervention), one "attending of the week" worked with the ICU team, and served as consultant to the primary surgeons. Outcomes (length of stay, reintubation rates, VAP, central line associated infections, "cor-zero" frequency, mortality) were prospectively monitored using quality control charts.

Results: 3,808 patients were admitted during the study period. All outcomes that we measured were associated with reductions in variation post- intervention. For example, Figure 1 shows the reduction in VAP variation and Figure 2 the combined adverse outcome (mortality/ reintubation), which shows a larger than expected decrease in variation post-intervention. (UCL, LCL: upper and lower control limits; 2 standard deviations).

Conclusion: Based on these initial results, a mixed ICU model, using the "SICU attending of the week" is associated with improved patient outcome.





Session IV

Poster # SI-76

QUANTFYING ERROR TYPES, ATTRIBUTION AND TIMING IN TRAUMA RESUSCITATION

Meredith S Tinti, MD, Aleksandra Sarcevic, MLIS, Ivan Marsic, PhD, Jeffrey S Hammond*, MD MPH, Randall S Burd*, MD PhD. UMDNJ-Robert Wood Johnson University Hospital.

Introduction: Previous studies have classified the types of errors that occur during trauma resuscitation but have neglected to analyze their time of occurrence, association with team members' roles, and subject matter. The purpose of this study was to identify factors contributing to errors during trauma resuscitation using an ethnographic approach.

Methods: Repeated reviews of eight resuscitations videotaped at a Level 1 Trauma Center were performed to identify, time, and transcribe tasks and utterances of team members. Events were coded using task and communication coding schemes developed to capture observable activities and communications. Using time-stamped and coded transcripts, three trauma surgeons identified errors during each resuscitation using an error classification scheme adapted from previously validated systems and the principles of ATLS.

Results: We identified an average of 19 errors/resuscitation (range 11-27). Communication errors (37%) and errors of omission (36%) were each more common than errors of commission (14%) and selection errors (13%). The rate of errors of omission and selection errors were higher during the primary survey than in the secondary survey ($p=0.01$ and $p=0.02$), while other errors occurred at similar frequencies in both portions of the resuscitation ($p>0.37$). Communication errors were more often associated with nursing staff, while other error types were more often associated with physicians. Errors from all categories were commonly related to the incomplete performance or reporting of the physical examination findings (36%). Incomplete orders for medications were observed in 7 of 8 resuscitations and were the most common cause of errors of omission (27%).

Conclusions: Communication errors and errors of omission are the most common error types during trauma resuscitation. Errors of omission frequently occur during the primary survey, are associated with physicians and involve incomplete medication orders. The association and pattern of each error type is unique, requiring an individualized approach to prevent triggering major adverse events.

Session IV

Poster # SI-77

ADULT BLUNT CERVICAL SPINE INJURIES: WHEN IS ICU ADMISSION WARRANTED?

Jitesh A Patel, MD, Aurelio Rodriguez*, MD, Jack Protetch, BS, Adrian Ong*, MD. Allegheny General Hospital.

Introduction: Complications such as respiratory failure, neurogenic shock and death have been reported in patients with cervical spinal cord injury (CSCI), thereby justifying ICU admission for these patients. The purpose of this study is to evaluate the incidence of respiratory complications i.e. mechanical ventilation and adverse outcomes in neurologically intact adults with BCSI and determine factors predictive of deterioration.

Methods: The hospital database was retrospectively reviewed for patients whose admission diagnosis included BCSI. Exclusion criteria were GCS <13, intubation within 1hr of or prior to admission, age <18y, neurological deficit, or systolic blood pressure <100mmHg. Statistical analysis was calculated using Chi-square analysis.

Results: Following exclusions, 854 records were reviewed. Data collected is summarized in Table 1.

Initial Admission Location	Floor		ICU	
Post-Admission Intubation	No	Yes	No	Yes
	N=572	*N=25*	*N=180*	*N=77*
Admission GCS	14.9 ± 0.32	14.8 ± 0.4	14.9 ± 0.4	14.6 ± 0.7
Deterioration	1 (0.2%)	2* (8.0%)	2 (1.1%)	6* (7.8%)
Transfer to ICU	29 (5.1%)	25* (100%)	-	-
Mortality	3 (0.5%)	8* (32.0%)	3 (1.7%)	25((32.5%)
Comorbidities	0.7 ± 0.9	2.9 ± 0.6*	0.9 ± 1.1	1.3 ± 1.3
Age	51.7 ± 21.9	75.4 ± 17.7*	56.6 ± 20.8	61.8 ± 23.7
Gender	60.1% M	36.0% M*	61.1% M	66.2% M
RISS	11.4 ± 6.3	12.9 ± 14.7	17.7 ± 8.6*	23.5 ± 16.0*
LOS	4.2 ± 3.7	26.4 ± 21.1*	2.7 ± 6.4	18.0 ± 12.9*
ICU Days	0.14 ± 0.73	20.7 ± 21.6*	3 ± 4.8*	14.8 ± 13*
30d Vent Free	29.8 ± 2.2	10.4 ± 12.1*	28.9 ± 5.3	12.2 ± 11.8*

Table 1. Data of patients presenting with BCSI.
SD - standard deviation; GCS - Glascow Coma Scale; ICU - intensive care unit; LOS - length of stay; ISS - injury severity score.
**p <0.05* when compared to patients admitted to the floor without the need for post-admission intubation

Conclusions: Respiratory and neurological deterioration following BCSI are associated with an increased mortality. Pre-existing comorbidities, age, and ISS are associated with adverse outcomes following BCSI which include subsequent MV and increased ICU and overall LOS. This data suggests that a subset of patients presenting with BCSI are at high risk for adverse events, and that it is prudent to admit them initially to the ICU.

Session IV

Poster # SI-78

TRAUMA CT SCANNING OF THE ABDOMEN AND PELVIS IS A RELIABLE TOOL FOR SIGNIFICANT THORACOLUMBAR INJURY RESULTING FROM BLUNT TRAUMA

Micah Smith, MD, John D Reed, MD, Raymond Facco, MD, Thein Hlaing, MBBS, Mary Aaland*, MD, B Matthew Hicks, MD. Fort Wayne Medical Education Program.

Introduction: Recent literature suggests that non-reformatted trauma CT scan of chest, abdomen and pelvis diagnoses thoraco-lumbar spine (TLS) fractures more accurately than X-Ray of TLS. The hypothesis of our study is to validate that non-reformatted trauma CT scan is a reliable screening tool for TLS injuries in blunt trauma patients with altered mental status.

Methods: The design was a prospective cohort study consisting of 75 consecutive patients admitted to a verified Level II Trauma Center presenting with altered mental status. Each patient had a trauma CT Abdomen/Pelvis (A/P) per trauma scan (TS) protocol of 5mm slices; AP (Anterior-Posterior)/Lateral X-Ray (XR) of the TLS; reformat CT (RF) of the spine competed at 2 mm slices; trauma chest CT when indicated. Sensitivity and specificity and 95% confidence intervals (CI) were calculated for TLS injuries.

Results: The study patients were mentally altered victims of motor vehicle crash (58), fall (9), pedestrian struck (5), and assault (3). RF of the spine detected 72, TS chest/A/P 70, and XR 16 TLS fractures. Using RF as the standard, TS had a sensitivity of 89% (95% CI: 77-96) and specificity of 85% (95% CI: 65-96) for all fractures detected; sensitivity and specificity were 100% for the presence of a fracture in a patient. The corresponding values for XR against RF were sensitivity 37% (24-51) and specificity 76% (55-91) fracture-wise; sensitivity 54% (25-81) and specificity 86% (65-97) patient-wise. Overall, TS missed eight transverse process fractures, and two superior endplate fractures; L-spine XR missed one chance fracture. No fractures missed by TS required surgery or other interventions.

Conclusion: The TS diagnosed TLS fractures more accurately than XR. Only minor fractures were missed by TS, suggesting that in an acute trauma setting, an RF is not required unless something found on TS needs further elucidation. We have thus validated the TS as a reliable screening tool for TLS injury diagnosis in mentally altered blunt trauma patients.

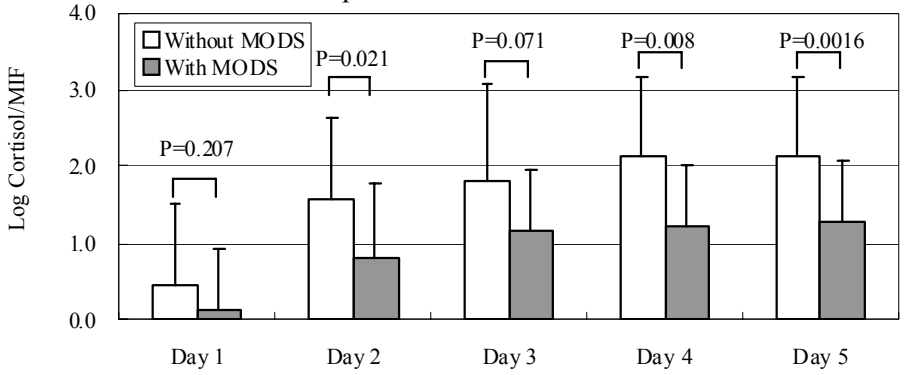
Session IV

Poster # SI-79

IMBALANCE BETWEEN MACROPHAGE MIGRATION INHIBITORY FACTOR AND CORTISOL LEVELS INDUCES MULTIPLE ORGAN DYSFUNCTION SYNDROME IN PATIENTS WITH SEVERE BLUNT TRAUMA

Mineji Hayakawa, MD, Takeshi Wada, MD, Masahiro Sugano, MD, Hirokatsu Hoshino, MD, Atsushi Sawamura, MD, PhD , and Satoshi Gando, MD, PhD, FCCM. Hokkaido University Hospital.

Macrophage migration inhibitory factor (MIF) acts as a counter regulator of the immunosuppressive effects of glucocorticoids and plays a pivotal role during severe stress condition. However, the role of MIF in trauma has not been clear. To investigate the influences of the balance MIF and cortisol in patients with severe blunt trauma, we prospectively examined the serial changes of MIF and cortisol. This study included 45 patients with severe blunt trauma who were admitted to our intensive care unit. Twenty-four patients complicated with multiple organ dysfunction syndrome (MODS) in the first 5days. Twenty-one patients complicated without MODS in the first 5days. Daily plasma levels of MIF and cortisol were measured from days 1 to 5 after the injury. The serum levels of cortisol were identical between the patients with and without MODS. However, the MIF levels in the patients with MODS were statistically higher than those of the patients without MODS, and the high levels of MIF in the patients with MODS were persistent during the observation. The cortisol/MIF ratios in the patients with MODS were statistically higher than those of the patients without MODS. The duration of systemic inflammatory response syndrome in the patients with MODS was statistically longer than those of the patients without MODS. In conclusion, the excessive and persistent release of MIF overrides the immunosuppressive effects of cortisol and may induce systemic inflammation and MODS in the patients with severe trauma.



Session IV

Poster # SI-80

OUTCOME OF UROLOGICAL INJURIES MANAGED BY FIRST LINE TRAUMA SURGEONS

A Shiyab, MD, R Chung, MD, N Ahmed*, MD. Huron Road/Cleveland Clinic Health System.

Background: With increasing scarcity of subspeciality support, trauma surgeons (TS) are increasingly called upon to render first line care of urological injuries (UI). We studied the results of such system of care under the parameters of expeditiousness, definitive repair, timeliness of referral for specialized care and functional out come.

Study design: After IRB approval, a retrospective review of abdominal and pelvic UI for the past three years was undertaken. System of care: TS undertake initial assessment and damage control, phone consultation with urologist if available, definitive or temporary (staged) repair undertaken by the TS. Results compared with National trauma Data Bank for LOS and survival and with urological literature for functional recovery. Statistics: analysis of variance, followed by the t-test.

Results: N=63

Organ n=number	Kidney n=24	Ureter n=4	Bladder n=11	Urethra n=6	Ext.Gentalia n=18
Penetrating/ Blunt	16/8	4/0	10/1	1/5	12/6
Stable/ Unstable	16/8	3/1	7/4	4/2	18/0
Procedures	2 Nephrec. 22 drainage	3 repair 1 Extern.	11 repair	4 supra pubic 2 Foley	12 scrotal exploration
ISS @ (Range)	15.1 (2-45)	12.5 (7-18)	13.4 (1-54)	8.3 (3-23)	3.8 (1-15)
Complications	2 leaks	1 leak	1 leak	0	3 ED
LOS*	9 (1-14)	10 (7-14)	8 (2-24)	9 (1-15)	2 (1-5)

LOS = Length of Stay in days, Nephrec. (Nephrectomy) .Extern. (Externization), ED (Erectile dysfunction).

Urologist was called in all instances came in once, urologist helped in post operative care of all patients

Conclusion: Outcome of UI managed by TS resulted in outcome no different from resent published literature and NTDB (ISS 16-24). We believe all TS should be exposed to management of urologic injuries in their training.

Session IV

Poster # SI-81

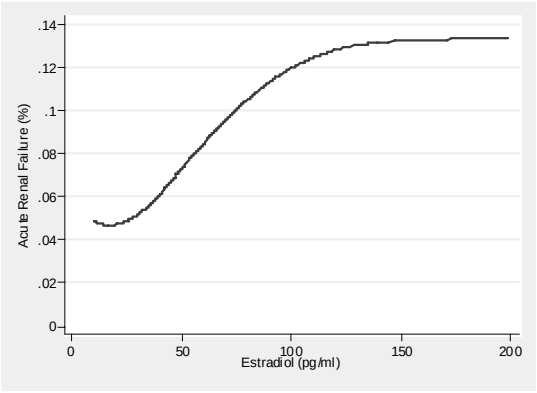
GENDER AND SEX HORMONE SPECIFIC RISK OF POST-INJURY ACUTE RENAL FAILURE

Lesly A Dossett, MD MPH, Robert G Sawyer, MD, Addison K May*, MD. Vanderbilt University Medical Center.

Background: The administration of 17β-estradiol attenuates renal injury induced by ischemia/reperfusion in animal models, and estradiol has been suggested as a possible therapy for ischemic renal injury. However, the relationship between endogenous estrogens and acute renal failure (ARF) in the critically ill patient is unknown. We hypothesized that female gender and high endogenous estrogens would protect patients from post-injury or illness ARF.

Methods: A multicenter, prospective cohort study of high risk critically ill and injured adults (?48h ICU admission) was performed. 17β-estradiol was assayed at 48 hours. ARF was defined by a rise in creatinine to >2.0 mg/dl in patients without previous renal disease.

Result: 2,291 patients were enrolled with an overall ARF rate of 7.0% (n=157). There was no difference in ARF by gender (7.3% in males versus 6.3% in females, p=0.36), and this remained true after adjustment for age, BMI, and illness severity. Conversely, ARF was strongly associated with high endogenous estrogens. Patients in the highest quartile of estradiol had a markedly increased risk for ARF (OR 2.66, 95% CI 1.69 – 4.17, p<0.001).



Conclusion: High levels of endogenous estrogens are associated with increased rates of ARF after critical illness and injury. These findings:

1. Identify a previously unknown risk factor for ARF.
2. Do not support clinical trials of estradiol administration for ARF.
3. Further clarify the relationship between high endogenous estrogens and outcomes in the critically ill patient.

Session IV

Poster # SI-82

THE INCIDENCE AND COMPLICATIONS OF METHICILLIN-RESISTANT SAPHYLOCOCCUS AUREUS IN A COMMUNITY LEVEL I TRAUMA CENTER

Alan Cook, MD, John Berne*, MD, Scott Norwood*, MD. East Texas Medical Center.

Introduction: Methicillin-Resistant Staphylococcus Aureus (MRSA) is a growing cause of infections in both hospitalized trauma patients and persons in the community. We examined the incidence and infectious consequences of MRSA among trauma patients admitted to our hospital over 24 months.

Methods: Nasal swab cultures were obtained on admission and on hospital day 5. Patient demographics and infectious complications were recorded. Statistical significance was tested using the chi-square and Kruskal-Wallis tests where appropriate. Differences with P-values less than 0.05 were considered significant.

Results: A total of 751 patients stayed a minimum of 5 days and were included in the analysis. In this cohort, 702 patients (93.5%) did not have MRSA on admission and remained free of MRSA for greater than 5 days. Thirty seven patients (4.9%) had MRSA on admission screening and 12 patients (1.6%) who were free of MRSA on admission, tested positive for MRSA on day 5. A greater than 9-fold increase in the rate of catheter-related bloodstream infections (CR-BSI) was observed among those who develop MRSA by the fifth hospital day, compared to those who never test positive for MRSA (0.9% vs. 8.3%, p=0.01). Only one of the eight catheters actually grew MRSA on culture. Two important infections were more common among those who tested positive for MRSA on hospital day 1 or 5: catheter-related bloodstream infections (4.1% vs. 0.9%, p=0.03), and pneumonia (10.2% vs. 4%, p=0.04). Seventeen patients (2.3%) developed clinical infection with MRSA. Twelve of the 17 (71%) MRSA infections occurred in patients who were negative for MRSA on screening. In logistic regression models of risk factors for CR-BSI and pneumonia, screening positive for MRSA was not significantly associated with either complication, (CR-BSI: OR 2.5, p=0.44; pneumonia: OR 0.8, p=0.78).

Conclusions: Widespread screening of the trauma population does not identify patients at risk for the development of infectious complications and should not be practiced.

Session IV

Poster # SI-83

TRANSFUSION AND VENTILATOR-ASSOCIATED PNEUMONIA IN THE TRAUMA ICU: ASSOCIATION OR CAUSATION?

Jordan A. Weinberg, MD, Gerald McGwin Jr., PhD, Marisa B. Marques, MD, Loring W. Rue III*, MD. University of Alabama at Birmingham.

Background: Transfusion has been demonstrated to be associated with ventilator-associated pneumonia (VAP) in injured patients, and blood of older storage age may potentiate this morbidity. It remains unclear, however, whether or not this association is causal, as prior studies have not accounted for pre-VAP vs. post-VAP transfusion. We sought to evaluate the temporal relationship between transfusion and VAP and the influence of blood age on this relationship.

Methods: Admissions to a level I trauma center between July 2004 and October 2007 with the following characteristics were selected for inclusion: overall length of stay (LOS) of ? 4 days; ICU LOS of ?1 day; and ?1 ventilator days. Date(s) of transfusion and blood storage age (defined as "old" ? 14 days; "young" < 14 days) were obtained. VAP was diagnosed by BAL (>10^5 colonies/mL). Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for the association between VAP and both date (in relation to VAP) and age of blood transfused, adjusted for age, injury severity, ventilator days, and transfusion volume.

Results: 1610 patients met study criteria. Adjusted OR (CI) for the association between VAP and receipt of blood at any time was 1.63 (1.08-2.45). However, when considering only pre-VAP transfusions no association was observed (OR 0.88; 95% CI 0.62-1.25). Analysis by blood age, however, demonstrated that pre-VAP receipt of old blood was significantly associated with an increased odds of VAP.

Storage Age of Transfusions Prior to VAP	OR (CI)
Exclusively Old Units vs. No Transfusion	**1.86 (1.14-3.04)**
Mixed Units vs. No Transfusion	1.37 (0.85-2.20)
Exclusively Young Units vs. No Transfusion	0.76 (0.36-1.61)

Conclusions: Prior reports of an association between transfusion and VAP may reflect transfusions received as a consequence of VAP rather than etiologically relevant transfusions received prior to the onset of VAP. Exclusively old blood, however, increased the risk of VAP, further suggesting the importance of blood age with respect to outcomes.

Session IV

Poster # SI-84

POTENTIAL DYSREGULATION OF THE PYRUVATE DEHYDROGENASE COMPLEX BY BACTERIAL ENDOTOXIN

Gregory W. Thomas, BS, Raphael Bar-Or, BS, Leonard T. Rael, MS, Charles W. Mains, MD, Denetta S. Slone, MD, Michael L. Craun*, MD, David Bar-Or, MD. Swedish Medical Center, Trauma Research.

Objective: To determine the effect of gram positive and negative bacterial toxins on message RNA levels of regulatory enzymes of the pyruvate dehyrogenase complex (PDC) in hepatocytes.

Methods: HEP G2 hepatocarcinoma cells were incubated for 24 hours in the presence of lipopolysaccaride (LPS) or lipoteichoic acid (LTA). Total RNA was then isolated and message RNA levels for both pyruvate dehydrogense kinase (PDK) and phosphatase (PDP) were determined by RTPCR. Amplified DNA fragments were visualized by ethidium bromide in agarose gels and densitometry of the bands was performed using Biorad software. Data was normalized to the housekeeping gene, GAPDH.

Results: Increases in PDK message of 82% and 96%, while decreases of 20% and 15% in PDP message were observed after LPS and LTA stimulation respectively.

Conclusion: The PDC catalyses the conversion of pyruvate to acetyl CoA, effectively controlling the entrance of glycolysis products into aerobic metabolism. The enzymatic activity of this complex is regulated by a balance of activity between PDK and PDP effecting the phosphorylation of the E1 subunit of the complex. Deficiencies in this complex have been associated with hyperlactatemia and lactic acidosis. This data may indicate that exposure to bacterial cell wall components could create a cellular environment favoring PDC phosphorylation and inactivation, resulting in a build up of lactate.

Representative RTPCR gel

Densitometry Results normalized To GAPDH

	PDK	% increase	PDP	% decrease
Nil	3106		5686	
50 ng/ml LPS	5637	82%	4554	20%
1 µg/ml LTA	6093	96%	4845	15%

Session IV

Poster # SI-85

POSTTRAUMATIC TRYPTOPHAN METABOLISM RATHER CORRELATES WITH IMMUNOACTIVATION THAN WITH THE DEGREE OF PRIMARY INFLAMMATION AND CELL DAMAGE

Siegfried Zedler, PhD, Robert Kraft, MD, Johannes Rubenbauer, MD, Dietmar Fuchs, PhD, Eugen Faist*, MD. Ludwig-Maximilians-University, Klinikum Grosshadern.

Introduction: Tryptophan (Trp) is an essential amino acid and its depletion might contribute to sepsis, organ failure and death after trauma and burns. Activation of IFN-gamma dependent indoleamine 2,3-dioxygenase (IDO) results in Trp degradation via kynurenin (Kyn). Thus, we determined if enhanced IDO-mediated Trp degradation is associated with immune activation, cell damage, inflammation and clinical outcome, or depends on injury severity after severe multiple (T) or burn (B) trauma. For this purpose Neopterin(Neo),IL-6, CRP and HMGB1 were correlated with IDO activity (Kyn/Trp ratio).

Methods: Injury severity was assessed with the Injury Severity Score (ISS) in T and %burned total body surface area (%TBSA) and presence of inhalation injury (Yes/No) in B. 21 T(ISS 28±2) and 31 B(%TBSA 41±3) were included. Controls: 30 (C). Mediators were determined on days 0,1,3,5,7 in plasma by ELISA or HPLC and reported as median with $25^{th}/75^{th}$ percentile. Statistics: Spearman correlation, ANOVA/Dunn´s ($p<0.05$).

Results: Trp was significantly lower after injury with a nadir on day0 vs. C (T:31[27-39];B:31[26-40];C:73[67-79];$p<0.05$). Kyn/Trp increased steadily in patients vs. C, with peak levels on day7 (T:53[38-69];B:89[60-117);C:25[21-29];$p<0.05$). In B Kyn/Trp correlated significantly positive with %TBSA (all days: $p<0.05$), survival (S vs. NS) (S:40[28-74];NS:97[73-118];$p<0.01$) and was higher with inhalation injury (all days: Yes:77(46-99); No:56(32-86);$p<0.05$). Kyn/Trp did further strongly correlate with Neo (B:r=0.844;T: r=0.674;$p<0.001$), which was significantly rising after injury (cumulated days 0-7 vs. C: B:10,0[5,5-19,3;T:8,9[4,9-15,1];C:4,7[4,2-5,0]. SOFA scores (B:r=0.322;$p<0.001$), IL-6 (B:r=0.419;$p<0.001$;T:r=0.338; $p< 0.01$) and CRP (B:r=0.417;T:r=0.406;$p<0.001$) correlate to a lesser extend with Kyn/Trp, and finally no association was found with HMGB1.

Conclusion: Increased Trp degradation and Kyn levels after trauma, along with high Neo, suggest that Trp and Kyn are markers, which predominantly indicate immune activation and are less important in estimating the degree of primary inflammation or cell damage.

Session IV

Poster # SI-86

MYELOID DERIVED SUPPRESSOR CELL EXPANSION IS DEPENDENT ON CXCL12 MEDIATED COMMON MYELOID PROGENITOR SPLENIC ACCUMULATION DURING SEPSIS

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Introduction: We have previously identified a GR-1^{+}CD11b^{+} myeloid derived suppressor cell population (MDSC) whose numbers dramatically increase in the spleen, lymph nodes and bone marrow during polymicrobial sepsis and that suppress CD8^{+} T cells and contribute to T_H2 immune polarization. The specific mediators that influence complete splenic expansion of this heterogeneous myeloid population still remain a mystery.

Methods: Female, 8 week, C57BL/6 or CCR2 null mice underwent cecal ligation and puncture (LD_{20}) or sham treatment and were followed out to7 days. For stromal cell derived factor-1 (CXCL12) inhibition, a polyclonal goat-anti mouse CXCL12 antibody was injected i.p. [500µL/day, (2mg)] for 7 days. CD115 (c-*fms* receptor) inhibition was carried out by i.p. injection [200µL/daily (1mg)] for 7 days. At day 7, total splenocytes were harvested and analyzed by flow cytometry.

Results: MDSC expansion during sepsis has only a modest dependence on the CCR2-MCP-1 and c-*fms*-M-CSF signaling pathways. Both CCR2 and c-*fms* blockade during sepsis inhibited GR-1^{intermediate}CD11b^{+} cell expansion ($p < 0.05$) with minimal effect on the overall myeloid cell numbers in the spleen. In contrast, we found that complete splenic myeloid cell expansion during sepsis is dependent on the CXC chemokine, CXCL12. CXCL12 blockade inhibited nearly 70% ($p < 0.01$) of the splenic myeloid cell expansion during sepsis when compared with sepsis controls. Moreover, CXCL12 depletion, while not effecting splenic granulocyte monocyte progenitors or megakaryocyte erythroid progenitors, did in fact, prohibit the splenic increase in common myeloid progenitor cells-the earliest precursor in the myeloid differentiation pathway ($p < 0.01$).

Conclusion: We conclude that splenic expansion of MDSCs during sepsis has only a modest association on the c-*fms* and CCR2 signaling pathways. However, CXCL12 signaling plays a pivotal role in MDSC expansion and provides a potential therapeutic target by which MDSC induced immune suppression could be eliminated during sepsis.

Session IV

Poster # SI-87

PROLONGED HYPERGLYCEMIA WAS CORRELANTED WITH HIGH NOSOCOMINAL INFECTION RATE IN TRAUMA PATIENT

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Background: There are few studies on the influence of hyperglycemia on trauma patients. It remains to be shown which trauma patients should receive intensive insulin therapy (IIT). We adapted the IIT based on blood glucose (BG) change after admission of trauma patients.

Materials and Methods: The records of 727 trauma patients form January 2004 to December 2007, were reviewed for age, injury severity score(ISS), nosocominal infection(NI) rate, mortality, admission BG level(mg/dl)and BG change during the first 7 days after admission.

Results: 92% were victims of blunt trauma. Mean ISS was 20.0±14.2; mean±SD. NI rate was 17.1%. Admission BG was higher in the infection group(NI group vs non-NI group: 188.3±84.5 vs160.0±65.5;p=0.001). The NI group had higher ISS:(22.9±12.4 vs 19.4±14.5;p=0.006)and longer hospitalization (66.2±60.2 vs 25.5±28.7;p<0.001) than the non-NI group. Prolonged hyperglycemia (BG level ? 150mg/dl lasted more than 24 hours after admission)was associated with a significantly higher NI rate (36.8% vs 14.1%;p<0.001). In multivariable logistic regression analysis, prolonged hyperglycemia was an independent risk factor for nosocomial infection.([OR] 2.61;[CI]1.46-4.66).

Conclusion: In trauma patients, IIT may be needed if BG remains ? 150mg/dl for more than 24 hrs after admission.

Multivariable logistic regression analysis for NI

	Odds ratio	95% CI	P value
Age	0.981	0.968-0.994	0.003
ISS	1.021	1.003-1.038	0.019
Admission BG	0.999	0.996-1.002	0.643
Prolonged hyperglycemia	2.615	1.466-4.663	0.001
Shock	0.535	0.318-0.9	0.018
Artificial ventilation	5.365	3.254-8.846	? 0.001

Session IV

Poster # SI-88

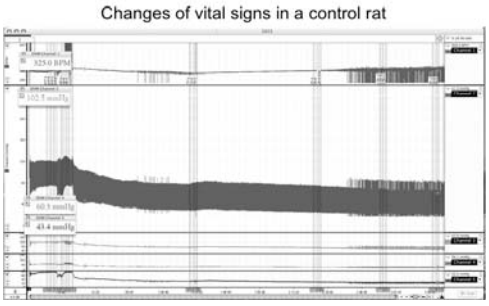
EFFECT OF HEMOPERFUSION USING POLYMYXIN B-IMMOBILIZED FIBER ON NON-HYPOTENSIVE RAT SEPSIS MODEL

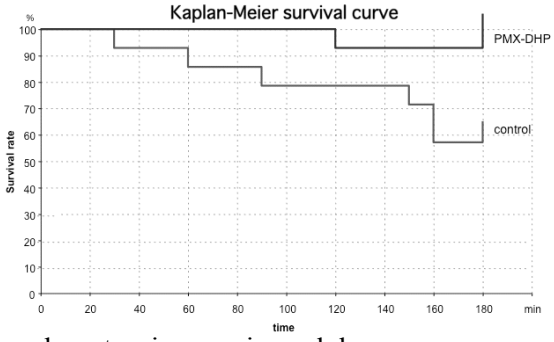
Toshiaki Iba, MD. Juntendo University.

Background: Polymyxin B direct hemoperfusion (PMX-DHP) was reported to be effective for the treatment of septic shock and widely applied in Japan. However, it is still unknown the effect of this modality is limited to cardiovascular disorder. The purpose of this study is to examine the effects of PMX-DHP on a non-hypotensive sepsis model.

Methods: 28 Wistar rats were assigned to either PMX-DHP group or control group (n=14 each). Sepsis model was made with intravenous infusion of *E.coli*. Changes in mean systemic blood pressure (mSBP) was less than 20% of the initial level. In PMX-DHP group, an arteriovenous extracorporeal circuit with a PMX-column was performed until 3 h post-*E.coli* infudion. Same procedure with empty column was applied for the control group. Plasma levels of tumor necrosis factor alpha (TNF), interleukin (IL)-1, IL-6, interferon gamma,ALT, LDH and lactate was measured at one and three hours after *E.coli* infudion.

Results: The levels of pro-inflammatory cytokines were lower in the PMX-DHP groups than in the control. The survival was significantly better in PMX-DHP group (13/14, 93%)compared to the control group (8/14, 57%, p= 0.03). Organ damage markers were lower in the PMX-DHP group.





Summary: PMX-DHP was effective in a non-hypotensive sepsis model.

Session IV

Poster # SI-89

UNHELMETED MOTORCYCLISTS INVOLVED IN A CRASH: RISK FACTORS AND OUTCOMES

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Introduction: Twenty states currently require protective helmets for all motorcycle riders, three states do not require a helmet for any riders, and 27 states require helmet use under specific conditions. States without a universal helmet law allows riders to choose whether or not to wear a helmet when riding a motorcycle. This study aims to determine which individuals are likely to crash a motorcycle without a helmet and investigates the outcomes of unhelmeted motorcyclists involved in a motorcycle collision.

Methods: This13-year (1994–2006) retrospective study of adult motorcycle crashes admitted to our trauma center compares helmeted to unhelmeted motorcyclists.

Results: 1,738 motorcyclists were admitted; including 978(56%) helmeted (38 years old, 87% male) and 760(44%) unhelmeted (38 years old, 85% male). Independent predictors of being involved in a motorcycle crash without a helmet include:

Risk Factor	Odds Ratio	95% CI	p-value
Alcohol Intoxication	2.9	2.3-3.8	<0.001
Passenger	1.7	1.1-2.6	0.001
Uninsured Status	1.4	1.1-1.7	0.001

Unhelmeted riders had a higher ISS (16 vs. 13, $p<0.001$), lower GCS (13 vs. 14, $p<0.001$), and more hypotension at admission (6% vs. 4%, $p=0.03$). Unhelmeted riders had worse outcomes including higher rate of severe disability (16% vs. 10%, $p<0.001$), more days in the hospital (7 vs. 6, $p<0.001$) and ICU (2 vs. 1, $p<0.001$), incurred higher hospital charges per admission ($44,744 vs. $31,369, $p<0.001$), and had higher mortality (6% vs. 4%, $p<0.001$).

Conclusions: Motorcyclists who are intoxicated, uninsured, or riding as a passenger are less likely to wear a helmet when involved in a motorcycle crash and these unhelmeted motorcyclists sustain more severe injuries, adverse outcomes, and incur significantly higher hospital charges. Education, prevention, and legislative strategies should be targeted at these high-risk populations.

Session IV

Poster # SI-90

DOUBLE VISION: REPEAT CT SCANNING IN PATIENTS TRANSFERRED TO A LEVEL I TRAUMA CENTER

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Objective: To quantify the incidence of repeat CT scans obtained for patients transferred to a Level I trauma center and to evaluate the impact of direct broadband interfacility image transfer on the rate of repeat scanning.

Methods: Retrospective review of interhospital transfers for definitive trauma care to our institution between January 1 and December 31, 2007. On arrival, 234 patients met criteria for Class I or Class II trauma activation. During this period, direct broadband image transfer was available between one referring hospital and our radiology department.

Results: Repeat CT scanning was a frequent occurrence in transferred trauma patients. Broadband access alone did not guarantee timely image availability. There was a trend towards less torso reimaging and more decision-making based on original scans in Class II patients from the hospital with direct transfer capability compared to the hospitals without.

		Percentage (n) of patients with repeat CT					
	n[#]	Any	Head	Cervical spine	Thorax	Abdomen/ Pelvis	Facial
Class I Broadband	8	50.0 (4)	12.5 (1)	0.0 (0)	12.5 (1)	25.0 (2)	0.0 (0)
Class I All Other	29	34.5 (10)	31.0 (9)	13.8 (4)	10.3 (5)	6.9 (2)	3.4 (1)
Class II Broadband	35	40.0 (14)	34.3 (12)	25.7 (9)	2.9 (1)*	8.6 (3)	0.0 (0)
Class II All Other	145	52.4 (76)	33.8 (49)	24.1 (5)	14.5 (21)	17.9 (26)	2.8 (4)

[#]17 patients not requiring CT scans are excluded from analysis * p =0.06, Fisher's exact vs. all other

Conclusions: Trauma patients requiring transfer to tertiary care are frequently subjected to repeat CT scanning. Rapid access to original digital images may provide an opportunity to reduce repeat studies, particularly for torso imaging. More timely image transfer and standardized imaging, reporting and transmission protocols are needed to facilitate care of the most critically injured patients.

Session IV

Poster # SI-91

PREEMPTIVE CONTACT PRECAUTIONS FOR INTUBATED PATIENTS REDUCED NOSOCOMIAL INFECTION OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS (MRSA) IN INTENSIVE CARE UNIT

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Background: Nosocomial infection of MRSA in critically ill patients is associated with prolonged intensive care unit (ICU) stay and high mortality. Our preliminary study revealed that intubated patients are at high risk of acquiring MRSA in ICU. We hypothesized that preemptive contact precautions to all intubated patients would prevent nosocomial transmission and infection of MRSA.

Methods: Patients who stayed in our trauma and medical ICU for more than 2 days were included. The study was divided into two periods. During the first period (in 2004), contact precaution was performed only for the patients found to have MRSA. In the second period (from 2005 to 2007), contact precaution was applied to all intubated patients without regard to have MRSA. The patients were defined as MRSA positive on admission when MRSA was detected by screening culture within 2 days from admission. The other MRSA positive patients were defined as nosocomial transmission. Nosocomial infection was diagnosed according to National Nosocomial Infection Surveillance manual.

Results: 415 and 1277 patients were included in the 1st and 2nd periods, respectively. In intubated patients, nosocomial transmission and infection rate of MRSA were significantly decreased in the second period (Transmission, 1st period 24%; 2nd period 16%: Infection, 1st period 12%; 2nd period 6%). As a result, nosocomial infection rate of all patients was also decreased in the second period (1st period, 5.0%; 2nd period, 2.8%), despite the rate of patients with MRSA positive on admission significantly increased in the second period (1st period, 2.7%; 2nd period, 6.1%). The amount of antibiotics used for MRSA infection was decreased in the second period, which resulted in the reduction of the antibiotics cost in the ICU.

Conclusion: Preemptive contact precaution for intubated patients is effective to reduce not only the nosocomial transmission but also nosocomial infection of MRSA in ICU.

Session IV

Poster # SI-92

ANALYSIS OF 1,021 MOTOR VEHICLE FATALITIES AMONG US ARMY PERSONNEL FROM 1998-2006

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Background: Previous reports have shown a decline in the incidence of motor vehicle accident fatalities among Army personnel similar to age matched cohorts from the civilian US population. It is our hypothesis that an increase in motor vehicle fatality rates would be observed among Army personnel during periods of increased deployments and combat operations.

Methods: Retrospective review of all privately-owned motor vehicle (POV) fatalities involving US Army personnel from 1998-2006 from the US Army Safety Center database, with comparison to civilian population fatality data from the Centers for Disease Control and Prevention.

Results: There were 1,021 POV fatalities among Army personnel serving on active duty between 1998 and 2006, involving predominately young (17-24, 59%), junior enlisted (E1-E4, 62%), males (91%). Fatality rates were significantly higher for junior enlisted when compared to senior enlisted and officer personnel. The overall fatality rate was 18.2 per 100,000 versus 18.1 for the age-matched US civilian population during the same period. From 2003 to 2006, the active duty fatality rate has increased by 20%, from 15 to 18 per 100,000.

Conclusions: While motor vehicle fatality rates have remained stable in the US civilian population, an increasing trend has been observed among Army personnel serving on active duty since 2003. In the setting of recently reported increased risk-taking behaviors, suicide and substance-abuse among active duty service members, injury prevention programs should be focused upon higher risk groups within the Army, including younger and junior enlisted personnel, particularly during periods of increased operational tempo.

Session IV

Poster # SI-93

CASE VALIDATION STUDY TO ASSESS DATA QUALITY IN THE NATIONAL TRAUMA DATA BANK

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Purpose: Multi-institutional trauma registries are critical for external benchmarking; and injury surveillance. Data integrity must be assured by both internal and external validation. The primary objective of this work was to externally validate data submitted to the National Trauma Data Bank (NTDB).

Methods: Key registry variables on patient demographics, comorbidities, injury severity, diagnoses, complications, and discharge disposition were re-abstracted in ten trauma centers randomly selected from the NTDB National Sample Project. In each of the ten centers, 50 charts from 2005 were randomly chosen. A data dictionary and study protocol were developed and two trained coders independently reabstracted hospital records. The Kappa statistic was used to measure agreement between the reabstracted data and the corresponding data in NTDB submitted by the hospital.

Results: Kappa scores were high for directly attainable variables such as dates, gender, GCS scores, first systolic blood pressure, first respiratory rate in ED, and discharge status (Kappa range from 0.57- 0.99). Variables such as GCS assessment qualifier, ICU days, ventilator days, complications, comorbidities, and diagnosis codes demonstrated lower Kappa scores (range from 0.05-0.40). Where Kappa scores were low, closer review of the data suggested that variability among centers in data mapping (i.e translation of submitted data into NTDB) and field definitions were responsible for the low agreement.

Conclusion: External validation of this multi-institutional registry suggests that data quality is relatively high. Importantly, agreement varies considerably among hospitals. Lesser degrees of agreement are due to easily remedied problems; mapping into NTDB and standardized data definitions. An important component of the NTDB has been the development of a new data standard, National Trauma Data Standard, with improvements in mapping across registries into NTDB, which will be introduced in year 2008.

Session IV

Poster # SI-94

GROUND LEVEL FALLS IN THE ELDERLY: DO YOU NEED TRAUMA TEAM ACTIVATION?

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Introduction: Falls from height are considered to be high-risk for multi-system injury, yet ground-level falls (GLF) are often considered a low energy mechanism and do not meet triage criteria for trauma team activation. We hypothesized that elderly patients who are admitted after a GLF may represent a high risk group and should be triaged appropriately.

Methods: This is a retrospective study based on the National Trauma Data Bank (NTDB). All patients with a mechanism consistent with GLF were identified based on ICD-9 E-code. Demographics, type and severity of injuries, as well as outcomes were analyzed.

Results: We identified 33517 patients with GLF. The group was 38% male, mean age of 62±26 years, and mean injury severity score of 8±5. Overall mortality was 3.2%. Subgroup analysis noted that though the rate for truncal injuries is low (0.4 to 0.6%) in the elderly, they are at higher risk for other injuries from a GLF.

	Non-elderly (<65) (n=13532)	Elderly (>65) (n=18590)	*p*
ISS	6.99±4.9	8.81±4.94	<0.0001
Long bone fracture	2821 (20.8%)	7602 (40.9%)	<0.0001
Pelvic fractures	131 (1%)	690 (3.7%)	<0.0001
Major TBI	287 (2.1%)	512 (2.8%)	<0.0001
Spinal fractures	52 (0.4%)	135 (0.7%)	<0.0001
Spinal cord injuries	45 (0.3%)	36 (0.2%)	0.017
Intraabdominal injuries	277 (2%)	103 (0.6%)	<0.0001
Hemo/Pneumothorax	56 (0.4%)	70 (0.4%)	0.598
ICU-LOS	0.63±2.95	0.74±4.23	0.02
LOS	3.69±8.03	6.11±7.22	<0.0001
Mortality	139 (1%)	880 (4.7%)	<0.0001

Conclusion: GLF does not pose a significant risk for truncal injury that would require trauma team activation. However, in the elderly population there is a statistically significant higher risk for mortality, as well as significant injury – especially for long-bone fractures. In general, these patients might be best served by trauma service consultation prior to final triage to the appropriate service.

Session IV

Poster # SI-95

PRE-HOSPITAL SPINE IMMOBILIZATION IN PENETRATING TRAUMA - MORE HARM THAN GOOD?

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Introduction: Previous studies have suggested that pre-hospital spine immobilization provides almost no benefit to penetrating trauma patients but does take up valuable time, delaying definitive trauma care. We hypothesized that penetrating trauma patients have higher mortality if they are spine immobilized prior to transport.

Methods: We performed a retrospective analysis of penetrating patients in the National Trauma Data Bank (v 6.2). Multiple logistic regression was utilized with mortality as the primary outcome measure. We compared patients with vs. without pre-hospital spine immobilization, using patient demographics, mechanism (stab vs. gunshot wound), physiologic and anatomic injury severity, and other pre-hospital procedures as covariates. Subset analysis was performed based on ISS category, mechanism, and blood pressure.

Results: A total of 45,284 penetrating trauma patients were studied, 4.3% of whom underwent spine immobilization. Overall mortality was 8.1%. Unadjusted mortality was twice as high in spine-immobilized patients (14.7% vs. 7.2%, $p<0.001$). The odds ratio (OR) of death for spine-immobilized patients was 2.06 (95% CI 1.35-3.13) compared to non-immobilized patients. Subset analysis showed consistent trends in all populations. Only 30 patients had incomplete spinal cord injury and underwent operative spine fixation.

Odds Ratio of Death in Spine Immobilized Penetrating Trauma Patients by Subset

Patient Group for Subset Analysis	OR of Death	95% CI
All patients	2.06	1.35-3.13
Injury Severity Score (ISS) <15	3.40	1.48-7.81
Injury Severity Score (ISS) >15	1.45	0.91-2.29
Normotensive (systolic bp >= 90 mmHg)	1.10	0.57-2.14
Hypotensive (systolic bp < 90 mmHg)	2.42	1.37-4.27
Gunshot Wound	2.12	1.33-3.37
Stab Wound	2.17	0.79-5.96
Hypotensive Gunshot Wound	3.19	1.62-6.28

Conclusions: Pre-hospital spine immobilization is associated with higher mortality after penetrating trauma. Spine immobilization should not be used in this patient population.

Session IV

Poster # SI-96

SECONDARY SPINE FRACTURES DIAGNOSED IN A RURAL TRAUMA CENTER

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Introduction: Based on previous studies, it is estimated that 3 – 16% of all patients with a cervical spine fracture due to blunt trauma may suffer a second non-contiguous spine fracture. Concerned that this estimate may be conservative because of advances in technology, we investigated the incidence of secondary non-contiguous spine fractures in patients who had suffered a cervical spine fracture.

Methods: Our trauma center's registry database was queried to gather patient data on all cervical spine fractures from January 2001 to January 2006. Based on a review of these data by trauma surgeons, the incidence of second non-contiguous spine fractures in patients having a cervical spine fracture was calculated from the entire patient population suffering from a spine fracture during this 5 year period.

Results: Out of 3,162 trauma cases, 258 were identified with a cervical spine fracture. Of these, 22.1% (57) had a second non-contiguous spine fracture. Further, 17% (44) had a thoracolumbar or sacral fracture, of which 38.6% (17) required immediate treatment. We found no difference in the proportion of these patients before and after the practice of examining the whole spine using a Multislice CT scanner (16.5% vs. 17.5%).

Conclusion: The incidence of a second non-contiguous spine fracture in patients suffering from cervical spine fracture appears to be higher than previous studies suggest. These findings strongly support the importance of examining the entire spine when a cervical spine fracture is detected as the result of blunt trauma. Our findings, also suggest the importance of Trauma Centers and their role in evaluation in rural areas, since 88.5% of the cases transferred from smaller rural hospitals did not identify the second non-contiguous fracture below the cervical spine.

Session IV

Poster # SI-97

COMPARISON OF THREE DIFFERENT REGIMENS FOR PREVENTION OF VENOUS THROMBOEMBOLISM (VTE) IN TRAUMA PATIENTS

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Introduction: We have previously reported, at this meeting, outcomes of the VTE prevention (VTEP) program employed at our Level I trauma center. Since then, the protocol has undergone two major changes. The primary objective of this study was to determine if these protocol changes had an affect on the incidence of VTE.

Methods: Based on VTE risk factor assessment, moderate risk patients received compression devices only, while high-risk patients received both compression devices and low molecular weight heparin. In 2002, uniform (UNI) compression devices replaced sequential compression (SCD) devices and dalteparin, 5000 units SQ daily (DALTQD) replaced enoxaparin, 30 mg SQ bid (ENOXBID). In 2004, DALTQD was replaced with enoxaparin, 40 mg SQ daily (ENOXQD).We retrospectively reviewed prospectively collected trauma registry data for three different calendar years, i.e., 2001 (ENOXBID/SCD), 2003 (DALTQD/UNI) and 2006 (ENOXQD/UNI). Records were reviewed of all trauma patients who had at least one duplex exam or were diagnosed with a PE. Chi square analysis was used to test for differences between groups.

Results:

Year	Admits	Duplex (% +)	Duplex/100 admits	DVT (%)	PE (%)
2001	3016	156 (16.7)	5.2	26 (0.86)	5 (0.16)
2003	3774	255 (14.9)	6.8*	38 (1.00)	10 (0.26)
2006	4510	354 (16.4)	7.6*	58 (1.29)	26 (0.58)#

*p<0.01 compared to 2001, #p<0.05 compared to both 2001 and 2003.

There was a trend in increased DVT (p=0.09) when ENOXBID/SCD was compared to ENOXQD/UNI. **No** PE was diagnosed by CT scan in 2001. In 2006, **all** PE were diagnosed using CT scan.

Conclusion: VTE rates increased with a change to ENOXQD, but remained at acceptably low levels. However, there was an increase in DVT surveillance and use of CT scanning to detect PE over this time period which could account for the increase in incidence of this silent disease.

Session IV

Poster # SI-98

PEDIATRIC NON-ACCIDENTAL TRAUMA: THE IMPACT IS ABUSIVE

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Objective: Traumatic injuries, both accidental (AT) and non-accidental (NAT), cause significant morbidity and mortality in the pediatric population. We undertook this study to compare the characteristics and outcomes of pediatric AT patients versus NAT patients.

Methods: We retrospectively reviewed the records of 2678 pediatric trauma patients younger than 16 years admitted to our Level I trauma Center from 2003-2007. Only those cases formally confirmed by the department of social services were considered NAT. Demographic, severity of injury, and outcome data were recorded. Student t-test and Chi-Square were utilized for statistical analysis and a $p<0.05$ was significant.

Results: NAT accounted for 95 (3.4%) of all pediatric trauma admissions during the study period, while AT accounted for 2583 (96.6%) admissions. No gender difference was observed between the groups. Females represented 38% of the NAT group and 39% of the AT group, while males composed 62% and 61%, respectively. However, mortality (7.4%) and number of ICU admissions (44.2%) were significantly higher for the NAT group compared to the AT group (1.2% and 22.9%, respectively). The following outcome and cost data were also observed:

	Age	GCS	ISS	HLOS	ICULOS	Vent Days	Cost
NAT	2±3*	11±5*	13±9*	7±7*	2±4*	1.4±3*	$29,582±$32,435*
AT	8±6	13±4	9±8	3±5	1±3	0.5±3	$18,427±$35,955

P<0.05 comparing NAT to AT

Victims of NAT were more likely to incur traumatic brain injuries (40% vs. 9%), retinal hemorrhages (29% vs. 0.2%), seizures (29% vs. 2%), head contusions (27% vs. 6%), skull fractures (20% vs. 16%), and pulmonary failure (24% vs. 3%) compared to AT victims.

Conclusions: Child abuse remains a considerable cause of morbidity and mortality in pediatric patients. Victims of NAT sustain more severe injuries often focused to the head, require more ICU admissions and resources, and are more likely to die than victims of AT. Suspicion must be maintained in efforts to protect and to care for this NAT population.

Session IV

Poster # SI-99

MULTIPLE BODY SYSTEM INJURIES PREDICT LONG-TERM PTSD AND PROFOUND QUALITY OF LIFE DEFICITS IN INJURED ADOLESCENTS: IMPLICATIONS FOR IMPROVED OUTCOMES AFTER MAJOR TRAUMA

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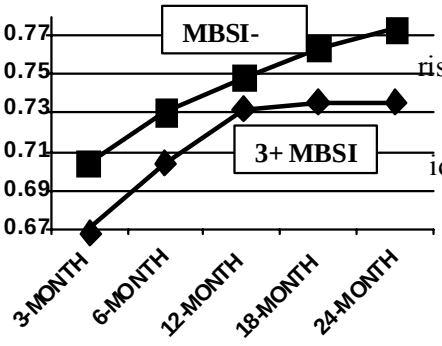
Introduction: Injury is a leading cause of preventable morbidity in adolescents. The impact of multiple body system injuries (MBSI) on Post-Traumatic Stress Disorder (PTSD) and quality of life (QoL) outcomes in injured adolescents has not been well studied. A prospective epidemiologic study was conducted to examine PTSD and quality of life (QoL) outcomes in injured adolescents. The specific objectives of the present report are to describe the impact of MBSI on PTSD onset and long-term Qol outcomes.

Methods: 401 eligible trauma patients were enrolled in the study (age range 12-19 years; Injury Severity Score (ISS) >=4; spinal cord injuries excluded). MBSI were classified as 3+ body systems injured (3+ MBSI) vs. MBSI-, based on AIS scores in all 6 AIS body regions. PTSD was diagnosed with the Impact of Events Scale Revised (24+ = PTSD+). QoL was measured using the Quality of Well-being (QWB) scale. Patient outcomes were assessed at 3, 6, 12, 18 and 24 months after discharge.

Results: Injured adolescents with 3+ MBSI combined with lower extremity fractures were significantly more likely to develop long-term PTSD (OR = 4.0**, P < 0.01) and acute stress disorder (ASD) (Odds Ratio (OR) = 3.0**). 3 + MBSI had marked and significant deficits in QoL throughout the 24-month follow-up period, shown in the Figure below (**P < 0.01). These deficits were independent of age, sex, ISS, and mechanism.

FOLLOW-UP QWB SCORES BY MBSI STATUS



Conclusions: 3 + MBSI are associated with a high risk of PTSD and large significant deficits in long-term QoL outcomes in injured adolescents. Early identification and treatment of risk factors for PTSD and QoL outcomes may improve trauma care in this vulnerable age group and advance the continuing evolution of mature trauma care systems.

Session IV

Poster # SI-100

SCREENING FOR RISKY ALCOHOL USE AMONG CAREGIVERS OF PEDIATRIC TRAUMA PATIENTS

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Introduction. Alcohol screening and intervention in trauma centers has proven so effective for injured adults that the American College of Surgeons now requires verified trauma centers to provide these services in order to reduce injury recidivism, though no guidelines for screening or intervention of an injured child's caregiver exist. The literature shows a link between injuries in pediatric patients and risky alcohol use by their adult caregivers; however, the magnitude of this problem is unknown. Retrospective examination of caregivers and children presenting to our emergency department following a common motor-vehicle collision, found 19.5% of caregivers screened positive for blood alcohol and 23.3% given a urine drug screen, tested positive. The aim of this study is to determine through a prospective screening program the prevalence of risky substance use among caregivers of all injured children admitted to a pediatric trauma service.

Methods. Caregivers of admitted pediatric trauma patients were screened for risky alcohol and recreational drug use as part of a "healthy habits" interview during a standard injury prevention consultation. A positive screen was defined as answering "yes" to any recreational drug use or more than 4 (females) or 5 (males) drinks on a single occasion in the previous 12 months. Positive screens were referred to social work for intervention.

Results. Caregivers (n=120) of 93 patients were screened. Screening took 5-7 minutes to complete and no caregivers refused to participate. Thirty-five caregivers (29.2%) screened positive for risky alcohol use and zero (0%) screened positive for illicit drug use.

Conclusion. Considering that over a quarter of the caregivers of injured pediatric patients screened positive for risky alcohol use, the study shows that there is a need for pediatric trauma centers to provide screening and intervention/referral services to their injured patients' caregivers. The process showed excellent feasibility during this pilot program, but demonstrates a need for further investigation into the reliability of self-reported behaviors as well as the effectiveness of alcohol screening and intervention in this setting.

Session IV

Poster # SI-101

FAIT ACCOMPLI: SUICIDE IN A RURAL TRAUMA SETTING

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Purpose: An unknown proportion of rural trauma patients attempt suicide, are saved at a trauma center, but ultimately succeed (suicide recidivists). We hypothesized that rural adult trauma patients exhibit a high rate of suicide recidivism.

Methods: 5-year single institutional retrospective cohort analysis. All admissions to our rural, Level I trauma center from 1997-2007 (n=9816) were cross-referenced with a Vermont Medical Examiner database containing information regarding all suicide deaths in the State of Vermont from 2002-2007 (n=502), in order to determine the rate of recidivism.

Results: 16/502 (3.2%) suicides arrived at the trauma center in near-moribund states (average: ISS 22.3 ± 4.5, GCS 3.8 ± 0.79) and died after admission (survived and died), but had never been previously admitted to the trauma center. Men were more likely to present after suicide attempt and die on admission ($p<0.03$). 9/502 (1.8%) of suicide deaths had been previously admitted to our trauma center after a previous suicide attempt (PA), while 7/502 (1.4%) patients had been previously admitted for a non-suicide related trauma (PT). Average delay from previous admission to successful suicide was 1040 days (2.8 years). Most patients 9/16 (69%) were not discharged to inpatient psychiatry from their previous trauma admission.

(Values: Mean ± SEM)	Survived and Died	Previous Attempt (PA)	Previous Trauma (PT)	*P-value*
n	16	9	7	
Males	15 (94%)	4 (44%)	5 (71%)	<0.03
Age (yrs)	40.7 (20-71)	46.8 (24-72)	38.1 (24-53)	0.46
Suicide delay (dys)	N/A	885 ± 181	1240 ± 384	0.38
Disposition from previous admission	N/A	5 Psychiatry 4 other	7 Home	

Conclusion: A staggering majority (94%) of suicide deaths in our rural state were never seen at a trauma center, and only a small minority of suicides were recidivists. Suicidal tendencies may last for a prolonged period of time. More research is needed.

Session IV

Poster # SI-102

PREHOSPITAL SPINAL IMMOBILIZATION IS NOT BENEFICIAL AND MAY COMPLICATE CARE FOLLOWING GUNSHOT INJURY.

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Introduction: Prehospital spinal immobilization (PHSI) is routinely employed in the care of patients with isolated gunshot wounds (GSW). The purpose of this study was to analyze the degree to which PHSI potentially prevented spinal cord injury (SCI) in this patient population and to assess the impact of PHSI on the delivery of timely care following GSW.
Methods: All GSW patients were identified in the National Trauma Databank (NTDB) from 2001-2005. Patients with torso GSW were also identified at the authors' institution (AI), a level 1 trauma center, from 1/1/03 - 6/1/07. PHSI was considered potentially beneficial in patients without evidence of SCI but with unstable vertebral fractures requiring surgical intervention. Prehospital transport times, airway management, need for any emergent surgical intervention (ESI), and neurological status were all examined.
Results: 75,210 NTDB subjects and 357 AI subjects were included. The rate of any type of spinal injury was 4.3% in the NTDB and 9.2% at AI. No patients at AI and only 26 (0.03%) NTDB patients potentially benefited from PHSI. No patient with SCI at AI had any neurological worsening or improvement by discharge. No patient developed a deficit during treatment at AI. ESI was required by 43% of NTDB subjects and 54.5% of AI subjects. Intubation in the field or ED occurred in 33.8% of NTDB subjects with intubation data (17.5% overall) and 40.6% of AI subjects. Prehospital scene time of AI subjects was longer than transport time (13.1 min. vs. 9.4 min), and the average ratio of time on scene to transport time calculated for each patient was 1.7.
Conclusion: While routinely employed, the number of patients who potentially benefit from PHSI following GSW is negligible. Conversely, these patients frequently require intubation and ESI, particularly following torso GSW. Proper PHSI may complicate airway management and delay ESI while not improving neurological outcomes and potentially benefiting only a tiny fraction of patients. Routine use of PHSI following GSW does not appear to be justified and may interfere with care in this patient population.

Session IV

Poster # SI-103

SERUM ETHANOL LEVELS: PREDICTOR OF SURVIVAL AFTER SEVERE TRAUMATIC BRAIN INJURY

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Background: Recent studies have suggested that moderate doses of ethanol prior to traumatic brain injury (TBI) may have a neuroprotective role.

Objective: The objective of this study is to investigate the effects of serum ethanol (ETOH) levels in outcomes after TBI.

Methods: All patients sustaining severe TBI (head Abbreviated Injury Score ? 3) admitted to the Surgical Intensive Care Unit at a County Level I trauma center from 01/2000 to 12/2005 that had a serum level of ethanol (ETOH) measured on admission were analyzed. Patients were classified into ETOH-Positive and ETOH-Negative, according to the serum levels of ethanol, and compared for differences in outcomes using logistic regression to adjust for clinically and statistically relevant confounding factors.

Results: During the 5-year study period, 482 severe TBI patients admitted to the ICU had an ethanol serum level obtained on admission. Ethanol levels were positive in 37% (179) and negative in 63% (303) of the TBI patients. The ETOH-Positive group had a higher percentage of males (91% vs. 79%, p=0.001), lower percentage of penetrating injuries (9% vs. 20%, 0.002) and lower ISS (25.7±11.5 vs. 28.4±14.1, p=0.05). Overall mortality was significantly lower in the ETOH-Positive group at 27% vs. 40% (odds ratio=0.55, 95% CI: 0.37-0.82; p=0.004). This survival benefit remained significant after multivariable analysis (adjusted odds ratio=0.54, 95% CI: 0.31-0.92; adjusted p=0.02). The mean serum ETOH level was significantly higher for survivors than for non-survivors (0.11±0.21 vs. 0.05±0.10, p<0.001). The serum levels of ETOH significantly correlated with the probability of survival (r=0.21, p<0.001), but this correlation was not strong as shown by the low r-value.

Conclusion: Elevated ethanol serum levels are independently associated with higher survival in patients with severe traumatic brain injuries. Additional research is required to further investigate the mechanism and potential therapeutic implications of this association.

Session IV

Poster # SI-104

EPIDEMIOLOGICAL CHARACTERISTICS OF TRAUMA PATIENTS AT THE RURAL EMERGENCY MEDICAL CENTER IN JAPAN: A COMPARISION WITH LEVEL III/IV TRAUMA CENTERS IN USA

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Background: Although much has been written about the benefits of trauma center care, most experiences are from urban trauma centers with a large number of patients. Little is known about the smaller rural trauma centers. **Purpose**: We clarified the characteristics of trauma patients and identified the problems related to trauma care in an emergency medical center in a rural area in Japan. **Methods**: From April 1, 2006 to November 30, 2007, we collected data from the Japan Trauma Data Bank (JTDB) regarding trauma patients with an Abbreviated Injury Scale (AIS) of 3 or more. **Results**: Of the 260 registered patients, 175 (67.3%) were aged ?65 years. Slipping, a motor vehicle accident, and falling from a height were the mechanisms of injury in 86 (33.1%), 83 (31.9%), and 67 (25.8%) patients, respectively. The ISS was greater than 15 in 127 (48.8%) patients. The total number of deaths and unexpected deaths were 36 and 11 (30.6%), respectively, but the modified unexpected death rate was 5.6%. Seventeen patients (6.5%) were admitted in shock, and 29 (11.2%) had a Glasgow Coma Scale score of <9. Thirteen patients underwent an emergency surgical head injury (5, epidural; 5, subdural hematomas; and 3, other injuries). Eight patients (3.1%) required an emergency abdominal operation. **Conclusions**: Since the proportion of the aging population is large, the characteristics of trauma patients in rural areas differ from those of trauma patients in urban areas. Further, compared to a level III trauma center in the US, the severity and mortality of trauma patients at a rural emergency medical center in Japan was higher. This implies that we have to function completely as a level I trauma center in order to respond to trauma patients in accordance with the expectations of the resident rural population, even though we have only level III resources and capability. At present, in many rural areas in Japan, there is the lack of a system for transferring patients with severe injury directly to a level I trauma center. Therefore, it is necessary to organize trauma system coverage similar to the level I trauma centers in the rural areas of Japan.

Session IV

Poster # SI-105

CERVICAL SPINE INJURY IS NOT A CONTRAINDICATION TO PERCUTANEOUS TRACHEOSTOMY: RESULT OF 139 CASES

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Objective Evaluate the safety and feasibility of percutaneous dilatational tracheostomy (PDT) in trauma patients with known fractures of the cervical spine.

Methods Sixty month retrospective review of patients identified from the trauma registry of a university level I trauma center as having cervical fracture and tracheostomy.

Results Of 926 patients receiving PDT during the study period, 139 had an associated cervical spine fracture. 134 cases were performed at the bedside. 48 patients had a spinal cord injury. 32 patients underwent operative spine fixation prior to tracheostomy. 17 patients were stabilized with an external fixation device (HALO). The remaining 90 patients were immobilized with only a hard cervical collar. Bronchoscopic assistance was used in 49 cases at the discretion of the operating surgeon. There were no procedural related deaths. Two cases were complicated by bleeding, with only one requiring conversion to open tracheostomy. There were no peri-procedural neurologic complications noted. The overall success rate was 99.2%.

Stabilization	N	Spinal Cord Injury			Bronchoscopy	
		Incomplete	Complete	None	Yes	No
Cervical Collar Alone	90	7	9	74	28	62
Ant Fusion/Collar	5	3	1	1	2	3
Post Fusion/Collar	22	13	7	2	7	15
Ant & Post Fusion/Collar	5	4	1	0	1	4
Halo	17	3	4	10	11	6
Total	**139**	**27**	**21**	**59**	**49**	**90**

Conclusions Percutaneous dilatational tracheostomy can be safely and successfully performed at the bedside in trauma patients with known fractures of the cervical spine and inability to extend the neck. We do not believe that cervical spine fracture or the inability to extend the neck is a contraindication to PDT.

Session IV

Poster # SI-106

STABILIZING THE UNSTABLE THORACOLUMBAR SPINE FRACTURE USING POSTERIOR SHORT-SEGMENT FIXATION: CHARACTERIZING 10 YEARS OF TRAUMA DATA

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Background: Posterior short-segment (PS) fixation is one of four operative methods for treating thoracolumbar fractures. Compared to other surgical methods, PS is associated with a lower risk of iatrogenic intra-abdominal organ injury, decreased blood loss, shorter hospital length of stay (LOS), and lower cost. The purpose of this study was to characterize PS among trauma patients from one American College of Surgery verified level II center.

Methods: Trauma registry data from 1997 – 2006 were used to identify cases with a thoracolumbar fracture as identified by International Classification of Disease – 9th Revision codes: 805-806, 952.1, or 952.2. Registry cases excluded non-hospitalized injured individuals. A z-test statistic was used to compare proportional differences.

Results: Between 1997 and 2006, there were 12,448 trauma registry patients, 677 (5.2%) with thoracolumbar fractures. A total of 118 out of 677 cases were treated operatively using PS; the majority were less than 65 years of age, injured by motor vehicle crash, and had similar average LOS regardless of cord injury status. Statistically significant differences ($p<0.05$) were observed among those 45-64 and ? 65 years of age.

CHARACTERISTIC	NO CORD INJURY		CORD INJURY	
	Operative Mang (n=95)	Nonoperative Mng (n=553)	Operative Mng (n=23)	Nonoperative Mng (n=6)
Age (in years)	**Number (%)**	**Number (%)**	**Number (%)**	**Number (%)**
0-24	27 (28.4)	136 (24.6)	10 (43.5)	2 (33.3)
25-44	28 (29.4)	182 (32.9)	10 (43.5)	2 (33.3)
45-64	30 (31.5)	116 (21.0)*	2 (13.0)	2 (33.3)
?65	6 (10.7)	108 (21.5)*	0 (0.0)	0 (0.0)
Mechanism				
MVA	36 (37.9)	237 (42.8)	9 (39.0)	3 (50.0)
MCA	11 (11.6)	39 (7.0)	4 (17.4)	2 (33.3)
Falls	26 (27.3)	167 (30.1)	5 (21.8)	1 (33.3)
Other	22 (23.2)	110 (20.1)	5 (21.8)	0 (0.0)
Average LOS (days)				
ISS < 15	5.27	3.31	5.33	20.0
ISS > 15	11.89	9.79	13.6	8.8

Conclusion: The results of this study indicate that PS is a favorable method for fixing thoracolumbar fractures as measured by average LOS. Multiple regression analysis should be used to adjust for factors associated with positive outcomes following PS fixation.

Session IV

Poster # SI-107

EARLY ELEVATION OF HEAT SHOCK PROTEIN 70 IN THE CEREBROSPINAL FLUID OF TRAUMATIC BRAIN INJURY PATIENTS CORRELATES TO CLINICAL OUTCOME

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Introduction: Complications from blunt traumatic brain injury (TBI) represent the leading cause of morbidity and mortality in head injured patients who survive to receive medical care. The secondary brain injury results from the endogenous cellular response following the primary insult, and Heat shock protein 70 (HSP70) is a key component of this response. We hypothesize that HSP70 levels correlate with the severity of the stress response, and that its elevation is predictive of clinical outcome.

Methods: All patients with traumatic brain injury (TBI) over the age of 18 who underwent insertion of external ventricular catheter (EVD) were screened for enrollment. Indications for EVD were altered mental status with 5mm of midline shift on head CT. Informed consent was obtained from next of kin or healthcare proxy within 24 hours of insertion of EVD. CSF samples were drawn on post injury days 1,2,3 and 4, centrifuged at 1000 G for 2 minutes and frozen at -80C. Samples were assayed for total protein and HSP70 using ELISA and western blot. Demographics and clinical outcome data were correlated with cerebrospinal fluid (CSF) HSP70 level collected from 10 head injured patients. Data were analyzed using the Chi Square test for nonparametric data.

Results: 10 patients (mean age = 41 years) with TBI were enrolled in the study. 5 patients demonstrated elevated CSF levels of HSP 70; in the remaining 5, HSP70 was undetectable. Patients with elevated HSP 70 more frequently underwent ventriculoperitoneal (VP) shunt placement (3/5 vs 0/5). Elevated HSP70 also correlated with prolonged duration of osmotherapy. All correlations were significant with $P<0.05$ by Chi Square.

Conclusions: HSP 70 can be detected in the CSF of TBI patients, and the levels correlate with clinical outcome. In this study of early TBI, early elevation of HSP70 in CSF is associated with a prolonged course of treatment for intracranial hypertension.

Session IV

Poster # SI-108

CT VS. MRI FOR EVALUATION OF THE CERVICAL SPINE: HOW MANY SLICES DO YOU NEED?

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Introduction: Controversy exists regarding the correlation between Computed Tomographic (CT) scan and Magnetic Resonance Imaging (MRI) for evaluation of the cervical spine. However, studies comparing the two modalities use a wide range of CT scan technology. We hypothesize that newer generation CT scanners will improve diagnostic accuracy for cervical spinal injuries and may obviate the need for MRI in patients with a normal CT scan. The specific aim of this study was to compare the missed injury rate of 4-slice CT and 64-slice CT performed to evaluate the cervical spine.

Methods: Four year (2004 – 2007) retrospective study of all blunt trauma patients admitted to our trauma center that underwent both a CT scan (with sagittal and coronal reconstructions) and an MRI to evaluate the cervical spine. Missed injury rates of 4-slice CT and 64-slice CT were compared.

Results: A total of 98 blunt trauma patients (37 years old, 60% male) underwent both a CT scan and an MRI to evaluate the cervical spine, including 41 patients with 4-slice CT and 57 patients with 64-slice CT. CT missed three injuries (3%), all of which were clinically significant ligamentous injuries seen only on MRI. Two patients were treated with a cervical collar while one required operative cervical spine stabilization. The 64-slice CT missed no injuries (0%), while the 4-slice CT missed all three (7%) of the clinically significant ligamentous injuries ($p = 0.05$). Two of the three patients with missed injury in the 4-slice group had associated degenerative joint disease seen on CT scan.

Conclusions: Older generation CT scanners miss clinically significant injuries in blunt trauma patients, particularly in the presence of degenerative joint disease, and should not be independently relied upon to evaluate the cervical spine. The newer 64-slice CT scan does not appear to miss clinically significant cervical spine injuries and may allow clearance of the cervical spine in blunt trauma patients without the addition of an MRI.

Session IV

Poster # SI-109

DECOMPRESSIVE CRANIECTOMY FOR SEVERE BRAIN INJURY: LESSONS LEARNED

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Objective: The use of decompressive craniectomy (DC) has gained popularity in managing patients with severe CHI despite the lack of beneficial results from a prospective, randomized trial. We reviewed our experience to determine possible factors related to outcome in order to improve our selection criteria for this procedure.

Methods: Trauma Registry was utilized to identify all patients undergoing DC for trauma from 2005-2008 from one Level II Trauma Center. Data was abstracted and analyzed.

Results: 26 DC patients were identified. Mechanism of injury was blunt in 25. Mean Head-AIS 4.8. DC was performed early (E = < 24 hrs) in 18 patients and late (L = > 24 hours) in 8 patients. Delayed DC was performed due to clinical deterioration, recalcitrant intracranial hypertension, or worsening head CT.

	N	Age	ISS	GCS	LOS	Blown pupils pre-op	Hydro-cephalus post-op	Head Wound & cranioplasty complications	Deaths
Early	18	33.7 yrs	30.9	7.8	36.9 days	7	2	5	4
Late	8	33.4 yrs	36.4	7.8	67.4 days	3	5	6	2

E and L surgery groups were similar except for a greater length of stay (LOS) in the L group. 4 patients had DC due to clinical deterioration or recalcitrant ICP without a focal mass lesion; of these, 1 died, 2 had severe disabilities and 1 (age 16) has improved to a functional state. 9 patients had blown pupils immediately prior to DC; of these 5 had a poor outcome. 4 of 7 cranioplasties performed during the initial hospitalization had complications requiring bone flap removal; 5 of 5 patients who had outpatient cranioplasty had no complications. 6 patients died in-hospital (23%); 3 patients died < 48 hours of admission due to injury severity. Support was withdrawn in 4 patients, 2 died and 2 were transferred to Hospice. One unexpected death had a sagittal sinus thrombosis on autopsy.

Conclusions: DC is associated with a high morbidity rate but yields survivors who otherwise may have died from their head injuries. The timing of bone flap replacement needs to be reexamined. The results from 2 ongoing randomized-controlled trials are much anticipated to help shed light on indications and timing of DC for severe brain injury.

Session IV

Poster # SI-110

ELEVATED EXTRACELLULAR GLUTAMATE CONCENTRATION IN PATIENTS WITH SEVERE TRAUMATIC BRAIN INJURY DURING INDUCED HYPOTHERMIA

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Objectives: Improvement of therapeutic outcomes in severe traumatic brain injury (TBI) depends on early detection of and intervention for secondary brain injury in an intensive care unit (ICU) setting. The present study investigated the frequency and clinical characteristics of elevated extracellular glutamate concentration ([glu]e) in patients with severe TBI, using a microdialysis (MD).

Materials and methods: In 21 patients with severe TBI during induced hypothermia admitted to ICU, a MD catheter was inserted approximately 10-15 mm into the cerebral cortex around the ventricular drainage tube or site of brain injury in the operative field under direct vision to measure [glu]e at 10- to 30-min. intervals. This research was conducted with the approval of the Institutional Ethics Committee and informed consent was obtained from properly authorized family members of patients.

Results: 1. A total of 2268 measurements were performed. 2. In 95% of samples at the site of injury, elevated [glu]e (? 20 μmol/L) were recorded, associated with increased ICP, decreased BP and decreased CPP, and prolonged 3 to 6 hour even after pathological improvement. 3. Even in the absence of factors for secondary brain injury, elevated [glu]e were recorded around the site of brain injury, most frequently in cerebral contusions (33%). 4. In 2 patients that received delayed induced hypothermia, elevated [glu]e were suppressed. 5. Three patients with increased intracranial pressure during the re-warming phase in induced hypothermia showed elevated [glu]e.

Conclusion: MD allowed early clinical detection of brain injury secondary to severe TBI at the cellular level. Induced moderate hypothermia would be partially effective for secondary brain injury at the cellular level.

Session IV

Poster # SI-111

PROSPECTIVE EVALUATION OF SPINAL FRACTURES IN PATIENTS WITH HIGH-ENERGY TRAUMA USING 64-MDCT

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Objective: Multidetector-row Computed Tomography (MDCT) with rapid high-resolution scans and high-quality reformatting is suitable for detection of spinal fractures in an emergency setting. The purpose of our study was to determine the percentage of high-energy trauma patients with spinal fractures using a 64-MDCT scanner.

Patients and Methods: All patients with high-energy trauma who were admitted to our Trauma Center between April and December 2007 were included in this prospective study. Patients with severe hemodynamic instability and those who underwent urgent thoracotomy or laparotomy were excluded. After initial resuscitation, patients received 64-MDCT. Trauma radiologists read the images of 2-mm thick axial views and sagittal reformations on a PACS viewer. The patients were followed up with clinical examinations and plain radiographs if necessary to detect false-positive and negative CT scans.

Results: During the study period, 304 individuals (mean age 39.8 years, 241 male) out of 2,720 trauma patients were included. The cause of injury was a motorcycle accident in 112 cases, a fall in 66, a motor vehicle accident in 28, and other causes in the remaining cases. Thirty one (10.2%) patients had some kind of spinal fractures.Ten patients had cervical, 18 had thoracic, and 13 had lumbar spine fractures. Ninety eight spinal fractures (39 fractures of the transverse process, 29 of the vertebral body, 20 of the spinous process, and others) were detected in those patients. Unstable vertebral fractures were encountered in six patients. There were no false-positive CT scans or missed spinal injuries on follow-up examinations.

Conclusion: Using 64-MDCT, spinal fractures were detected in 10.2% of high-energy trauma patients. High-energy trauma patients possibly have occult spinal fractures associated with post-injury retained back pain.

Session IV

Poster # SI-112

ADRENAL INSUFFICIENCY IN THE ICU: DEBUNKING THE CLASSIC MYTH

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Objective: Adrenal insufficiency (AI) is associated with hyponatremia, hyperkalemia, hypercalcemia, hypoglycemia, and eosinophilia. We hypothesize that these diagnostic markers do not predict relative AI in the critically ill/injured.

Methods: We reviewed all ICU patients from 2000-2007 with cortisol tested. AI was defined as a cortisol concentration < 25 mcg/dl. Abnormal labs were defined as: hyponatremia < 135 mmol/L; hyperkalemia > 5.3 mmol/L; hypercalcemia >10.2 mg/dL; and hypoglycemia < 70 mg/dL, and eosinophilia as > 5% of WBC. Data analysis of normal vs. abnormal labs and the presence or absence of AI was with Chi Square.

Results: 296 patients qualified: 55% were male. Mean age was 59.4 years. Types: trauma 40%, surgery 41%, and medical 19%. Of the 296 patients, 55% had AI. Mean laboratory values are seen below in table 1. Table 2 shows the low number of patients with lab values consistent with ranges that would correlate with AI. In fact, many AI patients had opposite findings, 11% were hypernatremic, 32 % hypokalemic, 85% hypocalcemic, 77% were hyperglycemic.

Table 1	adrenal state	
	adrenal insufficiency	control
	Mean	Mean
eosinophil percent	1.06	.63
sodium level	138.13	137.83
potassium level	4.3	4.2
calcium	7.4	7.2
glucose	145.15	137.46

Table 2

Lab test	AI <25mcg/dl (n=164)	Control = 25 mcg/dl (n=132)	Pvalue
Eosinophil %	4 (2%)	2 (2%)	0.607
Hyponatremia	45 (27%)	41 (31%)	0.495
Hyperkalemia	19 (12%)	16 (12%)	0.887
Hypercalcemia	0 (0%)	0 (0%)	N/A
Hypoglycemia	5 (3%)	11 (8%)	0.037

Conclusion: Contrary to traditional teaching, hyponatremia, hyperkalemia, hypercalcemia, hypoglycemia, & eosinophilia do not predominate in relative AI. None of the classic findings correlated with AI, except glucose correlated in the opposite direction. In the ICU setting classic diagnostic tests are of minimal value in predicting patients who have AI.

Session IV

Poster # SI-113

HYPERBILIRUBINEMIA IN THE TRAUMA PATIENT – A YELLOW HERRING?

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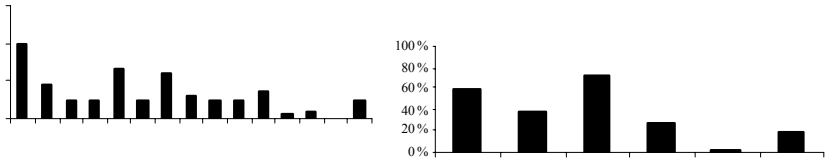
Background: Hyperbilirubinemia is often discovered during the workup of abdominal pain, distention, or sepsis in critically injured trauma patients, prompting concern about whether extrahepatic biliary pathology exists and requires intervention. If present, biliary obstruction may quickly become a surgical emergency. This study was evaluated the implications of hyperbilirubinemia in the critically ill trauma patient.

Methods: Computerized laboratory information in a Level One trauma center was used to identify 100 consecutive trauma patients with hyperbilirubinemia (institution standard range 0.2-1.2). Demographics and injury data were collected, as well as laboratory values, clinical and imaging findings, surgical reports, and pathology findings. Primary outcome measure was necessity of intervention for biliary obstruction. Data is presented as mean±SEM.

Results: Mean peak total bilirubin level was 2.8+/-0.5 (range 1.3-8.5) with a mean peak direct bilirubin level of 1.1+/-0.5 (range 0-6.3). 24 patients (24%) died. 19 patients (19%) underwent ultrasound evaluation of their gallbladder and 70 patients (70%) had a CT scan performed. 1 patient (1%) developed cholecystitis, with typical signs and symptoms of abdominal sepsis.



Conclusion: While cholecystitis must be considered in the evaluation of all septic critically ill patients, hyperbilirubinemia without evidence of sepsis does not suggest biliary tract disease requiring intervention. Expensive or invasive tests are not indicated in critically ill trauma patients with isolated hyperbilirubinemia.

Session IV

Poster # SI-114

GAS ANALYSIS OF THE BLOOD PERSISTENTLY DRAINED THROUGH THORACIC CATHETER CAN QUICKLY SUGGEST AN INITIAL THERAPEUTIC STRATEGY IN MASSIVE HEMOTHORAX PATIENTS

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Background: Although massive hemothorax (MH) is one of the acute indications for thoracotomy, interventional radiology (IVR) is effective to stop bleeding in some MH cases such as massive bleeding from intercostal arteries or internal thoracic arteries. Transcatheter arterial embolization (TAE) can not stop bleeding from veins or lungs, therefore these injuries should be excluded before TAE.

Purpose: The aim of this study is to clarify the predictive value of Gas Analysis of the Blood Persistently Drained through Thoracic Catheter (GAB-PDTC) for planning an initial therapeutic strategy for MH patients.

Patients and Methods: GAB-PDTC was examined in MH patients without persistent massive pneumothorax. Cardiopulmonary arrest on arrival (CPAOA) patients were excluded.

Results & Discussions: Eight patients were studied. In 5 patients, saturated oxy-hemoglobin of GAB-PDTC ($SpdO_2$) was high (High Group [HG]: $SpdO_2$=98-99%). In the other 3 patients, $SpdO_2$ was low (Low Group [LG]: $SpdO_2$=63-66%). In the HG, massive bleeding from intercostal arteries in 4 patients and from internal thoracic arteries in 1 patient were confirmed by chest contrast enhanced computed tomography (CE-CT) and/or angiography. Four of these patients survived and vital signs improved immediately following TAE. Meanwhile in the LG, massive bleeding from the lung was confirmed by CE-CT and/or thoracotomy. In all LG patients, emergency thoracotomies were required. Blood drawn from injured lung may contain less oxy-hemoglobin, because both pulmonary arterial blood and pulmonary venous blood hemorrhaging from the damaged lung area may not be oxygenized.

Conclusion: GAB-PDTC allows the physician to make a quick and accurate choice between thoracotomy or IVR for the initial treatment of MH.

Session IV

Poster # SI-115

OUR TREATMENT STRATEGIES FOR BLUNT THORACIC AORTIC INJURIES WITH SEVERE CONCOMITANT INJURIES

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Objective: Treatment strategies for blunt thoracic aortic injuries are decided in relation to the acuteness and severity of associated injuries. Today, delayed operative repair is preferred to immediate repair for lower morbidity and mortality, and recently developed immediate endovascular stent grafting is becoming a safe and effective alternative. The aim of this work is to analyze the safety and efficacy of procedural strategies employed in our institution in treating blunt thoracic aortic injuries with severe concomitant injuries.
Method: Patients who had sustained blunt thoracic aortic injuries with at least one severe concomitant injury (AIS>=3) and were treated at our hospital between January 2006 and December 2007 were categorized into 3 groups according to the treatment method and analyzed for mortality and morbidity. Group I included patients who did not require early surgery for concomitant injuries and underwent delayed surgical repair for aortic injuries. Group II included patients who needed early surgery for concomitant injuries and who had previously undergone immediate endovascular stent grafting. Group III included patients whose aortic injuries could be managed conservatively. The overall follow-up rate was 80 % and the average duration of follow-up was 6.9 ± 7.4 months.
Results: Ten cases were identified. The overall mean age was 47.8 ± 26.7 years. Fifty percent were male. One died preoperatively secondary to severe head injury. The rest were categorized in Groups I, II and III, and the numbers of patients were five, two and two, respectively. Of the two in Group II, one had pancreaticoduodenectomy for duodenal injuries and the other had open repair for diaphragmatic injury, subsequent to emergent endovascular stent-grafting insertion. The mean Injury Severity Score (ISS) of Group I, II and III were 31.6 ± 9.8, 29 ± 0, and 28 ± 5.6 respectively. All patients survived their follow-up periods. No procedure-related morbidity occurred in Groups I and II.
Conclusion: This study demonstrates that our treatment strategies are safe and feasible, achieving zero midterm mortality and morbidity. Further long-term studies are required.

Session IV

Poster # SI-116

RESUSCITATIVE EMERGENCY FIELD THORACOTOMY IN JAPANESE HEMS SYSTEM

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Objective: It is well known that resuscitative emergency thoracotomy (ET) is of value in selected (penetrating) trauma patients, while moribund patients who have suffered blunt trauma generally have dismal prognosis even though carried out ET. However, this is not clearly defined about effectiveness of ET in the pre-hospital setting for blunt trauma patients through the Helicopter Emergency Medical Service (HEMS) system.

Methods: Twenty-six patients with severe blunt trauma (mean age: 51.3y.o., male/female: 19/7) carried out emergency field thoracotomy (EFT) between January 2003 and December 2007 through the HEMS system, which provides an advanced pre-hospital treatment by emergency physician boarding a helicopter from the base hospital, were reviewed, retrospectively.

Result: Of 26 patients, median ISS was 34.0 (range 25-59) and median RTS was 0.0 (range 0-5.43). The mean time from EMT call to HEMS activation and to on-scene treatment were 11 min. and 25min., respectively. Nineteen of 26 had already been recognized cardiac arrest when EMT were arrived at the scene, however, four and three cases were came down to cardiac arrest after EMT arrival and physician arrival, respectively. Of these 7 cases, 6 patients had a resumption of their heart beating with pulsation. Overall rate of the heart beating with pulsation after EFT was 38.5% (10/26), 5 of these 10 cases were underwent surgical repair for thoracic or abdominal injuries (lt. diaphragmatic rupture, IVC laceration, injury of the azygos vein) and/or external fixation for pelvic fracture after emergency department arrival. While 6 cases were admitted to the intensive care unit, there was no survivor, unfortunately.

Conclusion: A high resumption rate of the heart beating after EFT for blunt trauma patients with cardiac arrest was shown. This implies that EFT for severe blunt trauma patients with impending cardiac arrest through early access of emergency physician by HEMS system may be a significant and life-saving procedure.

Session IV

Poster # SI-117

SUCCESSFUL SELECTIVE USE OF PERCUTANEOUS SMALL BORE CHEST TUBES IN TRAUMATIC PNEUMOTHORAX

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Introduction: Management of a traumatic closed pneumothorax depends on size, degree of symptoms, and associated injuries. Standard therapy includes tube thoracostomy. We hypothesized that use of a percutaneous small bore (9 French) chest tube (pneumocath, PC) is an effective alternative to standard tube thoracostomy (TT) for pneumothorax evacuation in selected patients.

Methods: We examined 780 consecutive tube thoracostomies performed in 489 trauma patients for pneumothorax and hemothorax at an urban Level One trauma center over three years. Of these, 239 TT and 37 PC were placed for evacuation of a closed pneumothorax. Baseline patient characteristics were determined. Main outcome measures included duration of chest tube placement, time to discharge after chest tube removal, and further interventions performed for inadequate pleural drainage. Data expressed as mean ± SEM.

Results: Patients undergoing PC placement had a significantly lower Injury Severity Score (18.8 ± 1.57 vs. 32.2 ± 1.05, PC vs. TT, $p<0.01$). There were no differences in treatment efficacy between the two therapies, with similar rates of additional TT placement needed to treat persistent pneumothorax or subsequently developed pleural effusion (10.8% vs. 10.9%, PC vs. TT, $p=1.0$). Patients who underwent definitive PC therapy without further intervention had a shorter duration of therapy (3.81 ± 0.38 days vs. 4.73 ± 0.22 days, PC vs. TT, $p<0.05$), were discharged earlier following chest tube removal (2.26 ± 1.0 vs. 10.11 ± 1.07 days to discharge, PC vs. TT, $P<0.01$), and had a lower mortality rate (0% vs. 28%, PC vs. TT, $P<0.05$). Treatment failures in the PC group were from unresolved pneumothorax (n=2) and increased pleural effusion (n=1). All three of these treatment failures occurred in patients requiring mechanical ventilation.

Conclusions: Minimally invasive chest tube placement is a safe and effective alternative for evacuation of a traumatic closed pneumothorax in selected patients. Less severely injured, nonventilated trauma patients are most likely to benefit from pneumocath use.

Session IV

Poster # SI-118

A NEW TECHNIQUE FOR AN AGE OLD PROBLEM: PERCUTANEOUS CONTINUOUS NERVE BLOCK FOR TREATMENT OF PAIN IN CHEST WALL TRAUMA

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Background: Rib fractures are the most common injury seen in chest trauma. No single approach to chest wall analgesia is adequate. The OnQ catheter system is a minimally invasive analgesic delivery system approved for postoperative wounds. We developed a bedside approach to insert OnQ catheter(s) as an intercostal nerve block for chest wall pain that avoids the complications and side effects seen with current treatments. The purpose of this study is to review our experience with OnQ placement, and its effectiveness for treating pain in trauma patients with multiple rib fractures (unilateral and bilateral).

Methods: All OnQ catheters were inserted bedside in a percutaneous over the ribs technique. Either Bupivacaine 0.25% or Ropivacaine 0.5% was used for analgesia. Pre and post insertion pain scores were assessed using a visual analog score (VAS) and were compared using paired samples t-test with significance set at 0.05.

Results: 41 patients received OnQ placement for rib fractures from 7/2004-2/2008. The mean age was 61 years. Motor vehicle collision and falls were the most common etiologies. The average number of fractured ribs was 7.61. Concurrent injuries included flail chest, pulmonary contusion, pneumothorax, hemothorax; as well as intracranial hemorrhage, ruptured aorta, and pelvic, vertebral, long bone, and sternal fractures. Based on VAS patients had a pre insertion mean pain assessment of 9.325 ±1.61 vs. post insertion 4.775±1.51 ($p<0.001$). Nine of ten patients were extubated post OnQ insertion, 3 patients in the study group died. There were no catheter related complications or adverse events.

Conclusion: Rib fractures are a significant cause of pain and disability in the trauma population with increased morbidity and mortality in the elderly. The OnQ system described decreased pain by 51% and offers a simple, safe and effective alternative to the current treatment regimens without narcotic associated side effects. Patients can be discharged with the OnQ allowing continued pain control. Effective pain control is essential in this patient population to improve outcomes and decrease length of stay.

Session IV

Poster # SI-119

ARE THE SUPER-ELDERLY (>80 YEAR OLD) MORE SUSCEPTIBLE TO THE EFFECTS OF THORACIC TRAUMA?

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Background: Our Center admits a large volume of elderly patients with thoracic trauma. The super-elderly (?80 years. old) has become one of the fastest growing segments. Despite their advancing age, the super-elderly are leading increasingly active lifestyles putting them at increased risk from injury due to their lack of physiologic reserve. Most literature on outcomes in elderly trauma patients groups these individuals into one over 65 years old category. We wished to see if thoracic trauma has a greater impact on hospital course in the Super-Elderly.

Materials and Methods: A retrospective review of elderly (65yrs to 79yrs old) and super-elderly (?80 years old) trauma patients admitted to a single level 1 trauma center over a 5 year period (2001 – 2006). We excluded head injured patients. Chi Square and Mann-Whitney U tests were used. Significance was set at 0.05.

Results: 369 Elderly and Super-Elderly patients were admitted. Table 1 reflects the data. The groups were matched for ISS and gender. There was no difference in mortality, need for ICU care, rates of intubation, pneumonia or Ventilator Associated Pneumonia rates between the groups.

Factor	**65 – 79 yrs(n=209)**	**80 + yrs (160)(n=160)**	**P value**
Median ISS	14	14	0.13
Mortality	28 (13.4%)	29 (18%)	0.24
Pneumonia	23 (11%)	17 (10.6%)	0.95
Intubated Yes/No	51 (24%)	37 (23%)	0.8
VAP rate	20 (39.2%)	11 (29.7%)	0.37
Median ICU LOS (days)	5	4	0.13

Conclusions: The Super-Elderly are not more susceptible to the adverse effect of thoracic trauma, since the rates of mechanical ventilation, pneumonia and death were the same despite potentially declining physiologic reserve.

Session IV

Poster # SI-120

MULTIDISCIPLINARY APPROACH TO TORSO TRAUMA

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Introduction: Successful conservative management of trauma patients requires a multidisciplinary approach, particularly interventional radiologist for ongoing internal bleeding following torso trauma. The purpose of this study was to analyze the outcome of conservative management in patients with internal arterial bleeding from the abdominal organs as well as the chest after sustaining multiple injuries.

Methods: Demographics, clinical information, computed tomography (CT) scans and angiograms were retrospectively reviewed from the prior 5 years. Included in the study were all the patients who underwent CT scan followed by angiogram. Extravasation of contrast on CT scan was considered positive for ongoing internal arterial bleeding. Angio-embolization was performed with positive findings on angiography.

Results: Eighty nine consecutive patients were included in the study. Of the 89 patients, 46 patients had one or more organ system injuries requiring embolization. Five out of 46 (11%) patients underwent surgery after failure of non-operative management including one mortality with multiple sites of extravasations. Two out of five failures were due to splenic injury and three failures were seen in patients with hepatic injuries which included one patient with multiple sites of extravasation. The distribution of angiograms and embolizations were respectively: spleen 34.3% and 34.8%, pelvic vessels 22.2% and 23.9%, liver 18.5% and 19.6%, renal and adrenal 13.9% and 10.9%, and others 10.4% and 10.9 The spleen was the organ to most commonly undergo embolization, with specificity and sensitivity for extravasations on CT of 77.8% and 73.9%, while the liver demonstrated specificity and sensitivity of 93% and 67%.

Conclusion: The study showed that initial contrast CT scan followed by angiogram and, angio-embolisation has a very high success rate of conservative management across the injury spectrum.