Session 1

Paper 1 7:50 am

COMPLICATIONS AFTER 344 DAMAGE CONTROL OPEN CELIOTOMIES

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Introduction: We reviewed our experience with the open abdomen and hypothesized that the known high wound complication rates were related to timing and method of closure.

Methods: We reviewed all trauma admissions from 1995 to 2002 requiring an open abdomen. The study group was classified by the three closure methods used: 1) *Primary* (primary fascial closure) 2) *Temporizing* (skin only, STSG, and or absorbable mesh) 3) *Prosthetic implant* (Marlex, Prolene, AlloDerm, Surgisis, or Gore-Tex).

Results: Three hundred and forty-four patients required an open abdomen either as part of a planned staged damage control procedure (66%) or development of abdominal compartment syndrome (33%). Of these, 276 patients survived to closure. Sixty-nine of the 276 (25%) suffered abdominal complications. Thirty-one (11%) died after closure; however, 7 (2.5%) died as a result of an abdominal complication (fistula, wound infection or abscess). Complications increased significantly after 8 days ($p < 0.0001$) from the initial operative intervention to closure. The following table compares the closure type with specific outcomes. The asterisk indicates a statistical difference ($p < 0.05$).

Type of Closure N = Patients (%total)	Primary N=180 (65%)	Temporizing N=81 (29%)	Prosthetic Implant N=15 (6%)
Patients with complications (%)	17 (9%)*	43 (53%)	9 (60%)
Mean time to closure (days)	3.5*	201*	14*
Mean transfusion (units PRBC)	16*	32	26
Mean charges	$138,000*	$301,000*	$197,000*
Mean age	34	42	29
Mean ISS	35	35	37

Conclusions: 1) Morbidity associated with wound complications from the open abdomen remains high (25%). 2) Morbidity is associated with timing and method of closure and transfusion volume, but independent of injury severity. 3) Delayed primary closure before 8 days is associated with the best outcomes with the least charges.

Session 1

Paper 2 8:10 am

EFFICACY OF ROUTINE CHEST X-RAY AS A SCREENING TOOL FOR TRAUMA PATIENTS

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Introduction: The ATLS® Course advocates that injured patients have a chest x-ray (CXR) to identify potential injuries. There is little evidence to support this practice. The purpose of this study was to correlate clinical indications and clinician judgment with CXR results to ascertain if a selective policy would be beneficial.

Methods: Patients treated at a Level 1 trauma center over 8 months were prospectively evaluated. Prior to obtaining a CXR, signs, symptoms, and history suggestive of thoracic injury were identified. Additionally, a trauma surgeon (TS) recorded whether in their judgment a CXR was clinically indicated. These findings were compared to final CXR diagnoses. The sensitivity of clinical indicators or TS judgment for CXR abnormalities were calculated with a 95% confidence interval.

Results: 617 consecutive patients (age 0-102 years) were studied. 70% were male. 88% suffered blunt injury. 36% manifested one or more of the clinical indicators for CXR. 16% exhibited abnormalities on CXR of which 55% went on to have further radiographic studies.

Positive Criteria	Sensitivity	Specificity	PPV	NPV	Accuracy
Vital Signs (VS)	23.2 %	87.8 %	26.7 %	85.6 %	77.5 %
Symptoms (Symp)	27.2 %	95.2 %	51.9 %	87.3 %	84.3 %
Signs (S)	65.6 %	81.5 %	40.4 %	92.5 %	78.9 %
VS+Symp+S	76.8 %	71.6 %	34.1 %	94.2 %	72.4 %
TS Judgment	88.9 %	55.4 %	27.6 %	**96.3 %**	60.8 %

Reliance on clinical indicators to determine need for CXR would have eliminated 394 CXRs and associated hospital cost totalling (technical $194.45+professional $42.00) $93,161.30 for the 8 month study period.

Conclusion: Mandatory CXR for all trauma patients has a low yield for abnormal findings. A selective policy based on clinical indicators is safe and efficacious while reducing cost and conserving resources.

Session 1

Paper 3 8:30 am

A RANDOMIZED PROSPECTIVE STUDY OF EARLY VS LATE TRACHEOSTOMY IN TRAUMA PATIENTS

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Objective: The effect of an early tracheostomy in ventilated trauma patients was evaluated. We hypothesized that early tracheostomy would reduce the number of days of mechanical ventilation, frequency of pneumonia and ICU length of stay.

Methods: We conducted a randomized prospective study in trauma patients admitted to a single ICU. Patients were eligible if they were older than 15 years, were intubated longer than 72 hours and had either a Glasgow Coma Score (GCS) $\geq$ 4 with a negative brain CT, or a GCS $\geq$ 9 with a positive head CT. Patients who required tracheostomy for CNS injury (see above) and/or facial/neck injuries were excluded. Patients were randomized to either tracheostomy on day 8 or after day 28. Because of consent issues, patient enrolled in the study were non-consecutive. Power analysis estimated 70 patients required per arm (α= 0.05, change in mean of 5 $\pm$ 9 days, $\exists$=90% (power to detect)) for the primary outcome variable of ventilator free days in the 30 days following study entry.

Results: The study was halted at the first interim analysis (60 enrolled patients). Groups were comparable (Table 1). Data is presented as mean $\pm$ STD. There was no significant difference between groups in any outcome variables (Table 2).

Table 1. Demographics	EARLY (n = 29)	LATE (n = 31)	
Age	53.7 ± 21.5	49.9 ± 18.3	p=0.4
Male/Female	20/9	26/5	p=0.2
Blunt/Penetrating	26/3	24/7	p=0.3
ISS	26.3 ± 10.2	27.3 ± 10.2	p=0.7
P/F Ratio	254.1 ± 63.7	234.4 ± 67.8	p=0.2
% pts P/F ratio<250	45%	62%	p=0.3
Pts "Trached"	27	11	
Days to Trach	7.62 ± 3.1	35.4 ± 17.2	

Table 2.	EARLY	LATE	
Vent free days 30	8.57 ± 7.9	8.83 ± 9	p = 0.9
ICU free days 30	4.96 ± 6	5.26 ± 6.5	p = 0.8
Vent free days 20	2.65 ± 4.2	3.19 ± 5.1	p = 0.6
ICU free days 20	0.89 ± 2.5	1.19 ± 2.8	p = 0.6
Pneumonia	28/29 (96.5%)	28/31 (90.3%)	p = 0.6

Conclusion: Performance of early tracheostomy in this group of trauma patients did not reduce the number of days of mechanical ventilation, frequency of pneumonia or ICU length of stay as compared to the group with tracheostomy performed after > 28 days.

Session 1

Paper 4 8:50 am

TRANSFUSIONS RESULT IN PULMONARY MORBIDITY AND DEATH FOLLOWING MODERATE DEGREE OF INJURY

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INTRODUCTION: Prior studies have suggested that blood transfusions (Tx) are associated with infectious and respiratory complications in trauma patients. However, these studies are difficult to interpret due to small sample size, inclusion of severely injured patients in traumatic shock, and combination of a variety of unrelated low morbidity/mortality infections, such as wound, catheter related, and UTI as outcomes. To eliminate these confounding variables, this study evaluates the association between *delayed* Tx and serious, well defined respiratory complications (VAP and ARDS) and death in a cohort of ICU admissions with less severe (ISS<25) blunt trauma who received no Tx within the initial 48 hours after admission. **METHODS**: Patients with blunt injury and ISS<25 admitted to the ICU over a 7 year period were identified from the registry and excluded if within 48 hours from admission they received any Tx or if they died. VAP required quantitative BAL culture (? 10^5 colonies/mL), and ARDS required P/F< 200, no congestive heart failure, diffuse bilateral infiltrates, and peak airway pressure >50 cm H_2O for diagnosis. Outcomes were VAP, ARDS, and death. **RESULTS**: 8795 with blunt injury were ICU admissions, and 4677 (53%) met study criteria (72% male). Means for age, ISS, and GCS were 38, 12, and 14. 683 (15%) received delayed Tx. Incidences of VAP, ARDS, and death were 5, 1, and 1%. Significance levels for independent predictors of outcomes based on logistic regression are depicted below:

Outcome	Age	Chest AIS	GCS	Admission BE	Tx
VAP	.0001	.0001	.002	.0001	.0001
ARDS	.003	.0001	-	-	.0001
Death	.0001	-	.002	-	.0001

CONCLUSIONS: Delayed transfusion is independently associated with VAP, ARDS, and death in trauma patients regardless of injury severity. This data mandates a judicious transfusion policy after resuscitation, and emphasizes the need for safe and effective blood substitutes and transfusion alternatives.

Session 1

Paper 5 9:10 am

MAXIMIZING REIMBURSEMENT FROM TRAUMA ACTIVATION FEES (UB-92:68X) – LESSONS LEARNED FROM A HOSPITAL COMPARISON

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Background: The trauma activation fee (UB-92:68x) recently has been approved to be used by hospitals to cover expenses resulting from continuous trauma team availability. These charges may be made by designated trauma centers for all defined trauma patients when notification has been received prior to arrival (eligible pt). This study compares two trauma centers' performance in collecting this fee help define methodologies that can enhance reimbursement. **Methods:** Our trauma system uses two hospitals (A and B) that are designated as the Level I trauma center for the region on alternate years. This allows hospital performance comparisons with relatively consistent patient demographics, injury severity, and payer mix. Data were collected for a one-year period beginning on January 1, 2003 and included charges, collections, and payer source for the trauma activation fee. This time frame allowed the comparison of two six-month sequential periods at each trauma center. **Results:** Out of a total of 871 trauma patients, 625 were eligible for the trauma activation fee (72%): hospital A = 65% and hospital B = 77%. Total charges for both centers were $1,111,882 with collections of $319,684 (28.8%). The following payer sources contributed to the collections: Indemnity insurance (77.4%), Managed Care (22.1%), Medicare (0.3%), and Medicaid (0.2%). No collections were obtained from any self-pay patient. The table shows the comparison of reimbursements for the trauma activation charge between the hospitals:

Hosp	Eligible pts	Activation Charge Level I	Activation Charge Level II	% Eligible Patients Charged	Total Collections	Collection / Eligible pt
A	246	$2000	$1750	24.7	$41,300	$174
B	379	$2533	$2978	95.7	$278,000	$735

Enhanced collection by hospital B was a result of a higher charge, compulsive billing of all eligible patients, and emphasis on pre-admission designation of trauma patients.

Conclusions: Effective billing and collection process related to trauma activation fees results in substantial additional revenue for the trauma center without additional expense.

Session 1

Paper 6 9:30 am

PRONE POSITIONING IMPROVES OXIGENATION IN POST-TRAUMATIC LUNG INJURY - A PROSPECTIVE RANDOMIZED TRIAL

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Dieter Nast-Kolb, M.D.,
From the Departments of Trauma Surgery, University Hospital Mannheim, 68135 Mannheim (Drs. Voggenreiter, and Obertacke), University Hospital Essen, 45122 Essen (Drs. Aufmkolk, Waydhas and Nast-Kolb) and Philipps-University Marburg, 35043 Marburg (Drs. Stiletto,

Objective: In a prospective randomized trial the effect of prone positioning on the duration of mechanical ventilation was evaluated in multiple trauma patients and was compared to patients ventilated in supine position.

Methods: In two trauma intensive care units of university hospitals multiple trauma patients were considered eligible if they met the criteria for acute lung injury or the acute respiratory distress syndrome. Patients in the prone group (PG; ISS 38 ± 14) (N=21) were kept prone for at least eight hours and a maximum of 23 hours per day. Prone positioning was continued until a PaO_2:FiO_2 ratio of more than 300 was present in prone as well as supine position over a period of 48 hours. Patients in the supine group (SG; ISS 35 ± 13) (N=19) were positioned according to standard care guidelines.

Results: The mean duration of ventilatory support in prone position was 11 ± 5 hours a day. A mean of 7 ± 4 posture changes was applied per patient. The duration of ventilatory support did not differ significantly (30 ± 17 days in PG and 33 ± 23 days in SG). Worst case analysis (death and deterioration of gas exchange) displayed ventilatory support for 41 ± 29 days in the PG and 61 ± 35 days in the SG ($p = 0.06$). The PaO_2:FiO_2 ratio increased significantly more in the PG in the first 4 days ($p = 0.03$). The number of days with ARDS (2 ± 2 days in PG and 3 ± 1 days in the SG, $p = 0.07$), the number of days with ALI (PG: 8 ± 4 days; SG: 11 ± 5 days, $p = 0.03$) and the prevalence of ARDS following ALI (PG: 6 patients; SG: 12 patients, $p = 0.03$) was lower in the PG. Prone positioning reduced the prevalence of pneumonia significantly ($p = 0.048$). One patient in the PG and 3 patients in the SG died due to multi organ failure ($p = 0.27$). Pressure sores were observed in 19/21 patients of the PG and in 12/19 patients of the SG ($p=0.48$).

Conclusions: Intermittent prone positioning was not able to reduce the duration of mechanical ventilation. However the oxygenation improved significantly over the first 4 days of treatment and the prevalence of ARDS and pneumonia were reduced.

Session 1

Paper 7 9:50 am

USE OF NEAR-INFRARED SPECTROSCOPY IN EARLY DETERMINATION OF IRREVERSIBLE HEMORRHAGIC SHOCK

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Background: Progression to irreversible shock may not be clinically apparent until a patient has depleted stores of fluid and blood. Early identification of patients progressing to irreversible shock would allow appropriate triage. We investigated the use of near-infrared spectroscopy (NIRS) in hemorrhage and resuscitation as a tool for early detection of irreversible hemorrhagic shock. Methods: Twelve pigs underwent an established shock protocol including sedation, mechanical ventilation, splenectomy, and placement of Swan-Ganz and carotid artery catheters, an inferior vena cava cannula, and NIRS probes on the liver surface, stomach (via modified nasogastric tube), and hind limb (skeletal muscle monitoring). Shock was induced by 35% blood volume hemorrhage. Animals remained in shock for 90 minutes after which resuscitation began using lactated Ringer's (20 cc/kg) in four fluid boluses. Hemodynamic and NIRS variables were measured at baseline, every 30 minutes during shock, and after each resuscitative bolus. NIR measurements of tissue oxyhemoglobin saturation (StO_2) in the liver, stomach, and hind limb were compared at all time points between the six animals that expired during resuscitation (unresuscitatable) and six that survived all resuscitative steps (resuscitatable). Regression analysis was performed using death during resuscitation as the dependent variable. Results: All animals had similar weights and volumes hemorrhaged. After the first resuscitative step (resus1), both stomach and leg StO_2 differed significantly between resuscitatable and unresuscitatable animals. Alone, leg StO_2 obtained after the first resuscitative step (resus1) was a significant predictor of death despite resuscitation (r^2=0.72, p<0.005). Conclusions: Non-invasive monitoring of leg and stomach StO_2 with NIRS identifies unresuscitatable animals after the initial resuscitative bolus. Use of this potentially pocket-sized, non-invasive spectrometer may help guide appropriate use of resources and has potential point-of-care applications.

Table 1; mean±SD	Resuscitatable	Unresuscitatable	P value	Regression
Leg StO_2 (resus1)	58.8%±11.1%	24.6%±12.7%	0.002	Combined model: r^2=0.875
Stomach StO_2 (resus1)	59.8%±21.9%	13.7%±6.5%	0.019	

CYTOKINE-RELATED GENOTYPIC DIFFERENCES IN THE PEAK INTERLEUKIN-6 BLOOD LEVELS OF THE PATIENTS WITH SIRS AND SEPTIC COMPLICATIONS

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Introduction: Trauma is one of the major insults, causing systemic inflammatory response syndrome (SIRS) and septic complications. Pathophysiolosical background of SIRS is hypercytokinemia, and among various cytokines, tumor necrosis factor (TNF)-α, interleukin (IL)-1β and IL-6 play a pivotal role. On the other hand, cytokine gene polymorphisms are associated with alteration of the cytokine production *in vitro*. The aim of this study was to investigate whether the TNF, IL-1, and IL-6-related genotypic differences affect IL-6 production in the SIRS patients in the intensive care unit (ICU). **Methods:** Seven polymorphisms of TNF, IL-1 and IL-6-related gene in Japanese patients admitted to the ICU (n=160) were identified with an allele-specific polymerase chain reaction. One hundred and six of the 160 cases who were diagnosed to have developed SIRS and also whose sequential organ failure assessment (SOFA) score were of ≥ 5 at the time their daily measured IL-6 blood level showed the peak value during the ICU stay (IL-6 max) were examined. Mutant allele was indicated as allele*2 in each polymorphism, and IL-6 max was compared between carriers and non-carriers of allele*2 (allele*2(+) and *2(–)). IL-6 max was shown as log(IL-6(pg/mL))±SD. **Results:** [Genotypic distributions (%)] Single nucleotide polymorphism (SNP) at position –308 site of the *TNF-α* (TNFα-308)*2(–): *2 (+); 94.3: 5.7, TNFβ+250*2(–): *2 (+); 13.3: 86.7, IL-1β-511*2(–): *2 (+); 86.8: 13.2, *IL-1 receptor antagonist* intron 2 various number of tandem repeat polymorphism (IL1RN*2(–): *2 (+); 32.0: 68.0. A linkage disequilibrium was found for IL-1β-511 and IL1RN (p=0.0054) in total of 300 Japanese, adding the healthy control into this study subjects. In TNFα-238, IL-6-596 and IL-6-174, allele*2 frequency in Japanese was extremely lower than in the other races, hence we could not assess the genotypic differences in IL-6 max. [Comparison of IL-6 max] TNFα-308*2(–): *2(+); 3.7±1.2: 4.2±1.3 (p=0.34), TNFβ+250*2(–): *2(+); 3.7±1.2: 3.9±1.2 (p=0.39), IL-1β-511*2(–): *2(+); 3.3±0.96: 4.0±1.1 (p=0.006), IL1RN*2(–): *2(+); 3.7±1.2: 4.0±0.11 (p=0.44). Only IL-6 max of allele*2(+) in IL-1β-511 was significantly higher than that of allele*2(–) among all 4 polymorphisms. On the other hand, the comparison of IL-6 max and SOFA score at corresponding time revealed a significant positive correlation between IL-6 max and SOFA score (r=0.63, p<0.0001). **Conclusions:** *IL-1*-related polymorphisms may affect IL-6 production and severity in patients with SIRS and post-traumatic sepsis, and therefore we should apply critical care on carriers of these high-risk alleles.

Session 1

Paper 9 10:30 am

THE ROLE OF COMPUTED TOMOGRAPHY IN PATIENTS WITH GUNSHOT WOUNDS TO THE ABDOMEN SELECTED FOR NON-OPERATIVE MANAGEMENT

George C. Velmahos, MD*, Constantinos Constantinou, MD, Ali Salim, MD, George Kasotakis, MD, Carlos V. Brown, MD, Demetrios Demetriades, MD*

Background: Computed tomography (CT) is increasingly used in patients selected for non-operative management of abdominal gunshot wounds (AGSW). Its exact role and usefulness is unknown.

Methods: Patients who are evaluable, hemodynamically stable, and have no or only localized abdominal tenderness are given a trial of non-operative management in our center. From 5/02 to 2/04 such patients who were sent to CT (using only intravenous contrast) were collected prospectively. The effect of CT in management was recorded.

Results: Of 81 patients, 26 (32%) eventually underwent an operation in 4 hours on average (range: 40 minutes to 13 hours) following admission, which was non-therapeutic in 2. Following CT results, management was changed in 31 patients (38%): 16 had an operation instead of continued observation, 6 had the operation cancelled, and 9 were discharged instead of being admitted for observation. The CT showed a clearly extraperitoneal bullet trajectory in 24 patients (30%) and an intraperitoneal trajectory away from vital organs in an additional 4. None of these patients required an operation. In 8 patients free air was seen on CT (6 operated, 2 non-therapeutic) and in 1 extravasation of intravenous contrast from the liver (angiographically embolized). Of note, abdominal ultrasonograpy in the ED was false negative in 20 of 24 patients with significant findings on laparotomy (sensitivity: 17%) and false positive in 3 of 57 patients without abdominal injury (specificity: 95%). Four patients developed hypotension while on CT which was easily managed by fluids or resolved spontaneously. Two of these patients required an operation following CT.

Conclusions: Abdominal CT is a safe and useful adjunct to non-operative management of selected patients with AGSW. It allows early operation of patients who have not yet developed physical findings and early discharge of patients who have bullet trajectories away from vital organs.

Session 1

Paper 10 10:50 am

PREDICTORS OF SURVIVAL FOR TRAUMA PATIENTS RECEIVING CPR

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Objective*:* To determine whether prehospital clinical assessments are associated with the survival of traumatic cardiopulmonary arrest (TCPA) patients and to test recently issued clinical guidelines for prehospital cessation of resuscitative efforts published by the National Association of Emergency Physicians and the American College of Surgeons Committee on Trauma. **Methods:** A retrospective cohort study was done of all TCPA patients who were transported to a Level I trauma center by a municipal EMS provider between January 1, 1994 and April 1, 2001. Data regarding mechanism of injury, clinical assessments and care provided by EMS and the emergency department (ED), hospital care, survival, and neurological outcome were collected. **Results***:* 184 patients met inclusion criteria, with 14 (7.6%) surviving to discharge. Pupillary response to light, presence of a prehospital pulse or respiratory effort, a sinus electrocardiogram, and a Glasgow Coma Scale greater than three were all significantly associated with survival but were not exclusive (Table). 28.6% of patients admitted to the trauma center from the ED survived. There were frequent discrepancies between prehospital and ED clinical assessments. Several survivors met criteria for non-treatment according to the proposed clinical guidelines.

Variable	survivor (n=14) (%)	non-survivor (n=170) (%)	p value
Pulse present			
BLS	1 (7.1)	8 (4.7)	NS
ALS	4 (28.6)	6 (3.5)	<0.0001
Respiratory effort			
BLS	0 (0.0)	18 (18.2)	NS
ALS	6 (42.8)	27 (15.9)	0.01
Pupils responsive to light	3 (21.4)	3 (1.8)	<0.0001
GCS > 3	3 (21.4)	0	<0.0001
Revised Trauma Score = 0	7 (50.0)	139 (81.8)	0.05
Sinus EKG rhythm	7 (50.0)	43 (25.3)	0.01
EKG rate >40/min	8 (57.1)	39 (22.9)	0.001

Conclusions*:* Prehospital clinical assessments are not reliable for the triage of TCPA patients. Patients should be transported to the ED for further evaluation and care. The guidelines should not adopted until more thorough studies are conducted.

Session 2-A

Paper 11 1:00 pm

THE USE OF NEUROMUSCULAR BLOCKING AGENTS TO FACILITATE PREHOSPITAL INTUBATIONDOES NOT IMPAIR OUTCOME FOLLOWING TRAUMATIC BRAIN INJURY

Eileen M. Bulger, MD*, Michael K. Copass, MD, Daniel Sabath, Ronald V. Maier, MD*, Gregory J. Jurkovich, MD*

University of Washington

The role of neuromuscular blocking agents (NMBA) in facilitating prehospital intubation (aka Rapid Sequence Intubation, RSI) remains controversial and variably practiced, with at least one recent study suggesting RSI worsens outcome following traumatic brain injury (TBI). Our pre-hospital system affords the paramedics wide discretion on the use of RSI We sought to determine the effect of the use of NMBA to facilitate prehospital intubation on outcome following TBI within our system. **Methods:** All patients admitted to one Level I trauma center with a Head AIS score $\geq$ 3 were identified by the trauma registry (1/98 - 6/03). Patient records were matched with prehospital data from aeromedical service and regional fire departments. Patients were stratified based on prehospital Glasgow Coma Score (GCS) into mild (GCS14/15), moderate (GCS 9-13) and severe (GCS < 9) TBI. Outcome included mortality and good outcome (survival to discharge with a GCS 14/15). **Results:** 6208 patients were identified with 3052 transported directly from the field. Complete prehospital data was available for 2012 patients (66%). Of these, 920 were mild TBI (intubation rate: 17.4%,) 293 moderate TBI (intubation 57.7%), and 799 severe TBI (intubation: 95%). Overall, 72% of intubated patients received NMBA. There were no significant differences in demographics or ISS between the groups. Patients not receiving NMBA were more likely to be hypotensive and have CPR (p=0.001). The unadjusted mortality for the RSI patients was 25% vs. 37% for those without NMBA (p<0.001). When adjusted for confounding variables (age, ISS, shock, CPR, & GCS), patients in the RSI group were more likely to survive and have a good outcome than those in the no NMBA group. (Table) **Conclusion:** The value of prehospital intubation for TBI remains to be determined, however the use of NMBA does not worsen outcome.

		OR	95% CI	P
Mortality	All Patients	0.63	0.41-0.97	0.04
	GCS<=8	0.61	0.4-.98	0.04
Good Outcome	All Patients	1.7	1.2-2.6	0.006
	GCS<=8	1.6	1.0-2.5	0.04

Session 2-A

Paper 12 1:20 pm

HEMOSTATIC EFFICACY OF TWO ADVANCED DRESSINGS IN AN AORTIC HEMORRHAGE MODEL IN SWINE

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Introduction: An effective hemostatic agent that is capable of stopping severe arterial bleeding and sustains hemostasis over a prolonged time is required. The US Army recently distributed fibrin sealant (FSD, under an IND approved protocol) and chitosan dressings (CD) among deployed medics for treating severe external hemorrhage on the battlefield. We evaluated the ability of these dressings to provide both initial and sustained hemostasis after severe arterial injury, as compared to the standard Army field dressing (Gauze).

Methods: Anesthetized pigs were splenectomized and chronically instrumented for fluid/drug administration and continuous monitoring of blood pressure. An infrarenal aortotomy was created using a 4.4-mm aortic hole punch and free bleeding was allowed for 5 seconds. While still bleeding, a dressing was applied and pressed over the wound for 4 minutes occluding the distal flow. If hemostasis was not achieved, the dressing was removed and a second one (2 dressings per experiment) applied with subsequent 4-min compression. If hemostasis was obtained, the abdominal cavity was closed and the animal was monitored up to 96 hours. Data are expressed as mean ± SD and analyzed by Fisher's Exact and nonparametric ANOVA tests. **Results:** Five out of 6 pigs treated with FSD resumed normal activities and lived for the 96-hour experiment duration. All other animals died within 2.5 hours after the injury from exsanguination secondary to failure of the dressing to either achieve (Gauze) or subsequently maintain hemostasis (CD).

Treatment	%Initial Hemostasis	*P* Value	Duration of Hemostasis (hrs)	*P* Value
Gauze (n=6)	0 (0/6)	----	0	----
CD (n=7)	71 (5/7)	0.02 vs. G	0.81 ± 0.7	NS vs. G
FSD (n=6)	100 (6/6)	0.002 vs. G NS vs. CD	80.4 ± 38.2	< 0.001 vs. G <0.05 vs. CD

Conclusions: Both CD and FSD stopped the initial arterial bleeding that could not be controlled by the standard Army field dressing. However, the FSD secured hemostasis up to four days, while CD consistently failed within 1.6 hour (28-100 min) after application.

Session 2-A

Paper 13 1:40 pm

KUPFFER CELL ABLATION AMELIORATES PERTURBED HEPATIC MICROCIRCULATION AFTER TRAUMA AND SEPSIS

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F.H. "Sammy" Ross Jr. Trauma Center, Carolinas Medical Center, and Dept. of Biology, University of North Carolina at Charlotte, Charlotte NC

Introduction: Kupffer cells (KCs) have been shown to mediate mortality after trauma and sequential sepsis; yet the underlying mechanisms remain unclear. Recently, we found that sepsis and sequential stress perturb the hepatic microcirculation in response to the vasoregulator endothelin-1 (ET-1), resulting in liver injury. The purpose of this study was to assess the role of KCs in altering hepatic microcirculatory response to ET-1 after femur fracture (ffx) and cecal ligation and puncture (CLP).

Methods: Two groups of male Sprague-Dawley rats (200-300g) underwent sham, ffx, CLP (22-gauge) and ffx+CLP. To ablate KCs, animals in group 1 were treated with gadolinium ($GdCl_3$) 24 and 48 hours prior to the first surgery or sham operation; rats in group 2 did not receive $GdCl_3$. Hepatic microcirculation was assessed by intravital microscopy *in vivo* (sinusoidal volumetric flow), liver PO_2 was determined using ruthenium (Ru) fluorescence, and liver injury by plasma ALT. Differences among groups were compared using one-way ANOVA followed by Student-Newman-Keuls post hoc test.

Results: After 10 minutes of intraportal ET-1 infusion, $GdCl_3$ pretreatment reduced the microdynamic perturbations in response to ET-1 following CLP and ffx+CLP, resulting in enhanced perfusion, increased tPO_2, and decreased hepatocellular injury.

Group	Flow (pL/sec)	Ru (AU)	ALT (IU/L)
CLP	9 ± 2 *	190 ± 6 *	69 ± 3 *
$GdCl_3$+CLP	18 ± 2	137 ± 3	39 ± 4
ffx+CLP	5 ± 0.8 *	202 ± 7 *	74 ± 2 *
$GdCl_3$+ffx+CLP	13 ± 0.6	101 ± 10	41 ± 6

* $p < 0.001$ vs. $GdCl_3$ pretreated counterparts, (AU=Arbitrary units)

Conclusion: Our data suggest KCs contribute directly to hepatic microcirculatory disturbances and hepatocellular injury after inflammatory stress. Further, KC depletion ameliorates ET-1 induced perturbations to the hepatic microcirculation after trauma and sequential sepsis.

Session 2-A

Paper 14 2:00 pm

HEMORRHAGE CAUSES INTER-ALVEOLAR PERFUSION MAL-DISTRIBUTION IN THE LUNGS OF ANESTHETIZED RATS

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Bruce A. Harms, M.D.* University of Wisconsin

ARDS can be a consequence of hemorrhage, although why this happens is unknown. We hypothesized that a precipitating event may be the effects of blood loss on lung inter-alveolar perfusion distribution. To test this hypothesis, we measured inter-alveolar perfusion distribution in the lungs of anesthetized, spontaneously breathing rats subjected to blood losses of 0, 10, 20, or 30% of calculated blood volume. We assumed that blood volume was equal to 8% of body weight. A 50% blood volume loss is usually fatal. We measured inter-alveolar perfusion distribution using a method we recently developed (J. Appl. Physiol., 94:420-428, 2002). Our method is based on statistical analysis of the trapping patterns of 4 μm diameter fluorescent latex infused into the pulmonary circulation. A total of $2x10^8$ particles were infused into each animal 45 minutes after it had been bled. The lungs were then removed and air-dried. We used a confocal fluorescence microscope to image the particles in 8 sections of each lung (800 - 2,500 particles per image). Particle distributions in each image were analyzed using the statistical method of dispersion index (DI) analysis. A DI value of zero corresponds to a statistically random particle distribution. The more DI exceeds zero, the more the distribution is clustered or inhomogenous. DI data for each hemorrhage group are shown in the following table.

Blood Loss (n = 3 per group)	0% (control)	10%	20%	30%
D.I. (mean ± s.d.)	0.69 ± 0.41	0.57 ± 0.58	0.72 ± 0.34	1.39 ± 0.41

The 30% blood loss group had a DI value that was two-fold higher than that of the 20% group, and an unpaired t-test showed that DI values for the 30% group were significantly different from those of all other groups ($P < 0.0001$). Our results suggest that inter-alveolar perfusion distribution becomes markedly mal-distributed as blood loss approaches 30%. This degree of perfusion heterogeneity at the alveolar level almost certainly contributes to ventilation-perfusion mis-matching, and may be a precipitating event for ARDS. Treatment options that minimize this mal-distribution may also minimize the risk of ARDS. Such treatments remain to be identified. Supported by VA Merit Review.

Session 2-A

Paper 15 2:20 pm

DOLLARS AND SENSE: ATTRIBUTING VALUE TO A LEVEL 1 TRAUMA CENTER IN ECONOMIC TERMS

Linda Breedlove, RN, BSN, MBA, Administrative Director, ED/Trauma Services, Akron City Hospital and William F. Fallon, Jr., MD, MBA*, Director of Trauma, Critical Care, Burns and Metro Lifel FLight, Metro Health Medical Center, Cleveland, Ohio

Objective: Reliable, accurate, program-specific economic data for hospital product lines is often difficult to obtain. The purpose of this study was to determine the impact that trauma center status has on hospital net income when compared to other traditional hospital product lines.

Methods: Over a three year period, financial data was collected for 16 payor classes for all injury diagnoses, in-patient and outpatient. This data was analyzed by total charges, total direct costs, the contribution margin and net income. The results were then compared to the contribution margins of other major hospital product lines. A key assumption of this strategy is that while injury patients are treated at most hospitals, only trauma center status allows access to patients and provision of services that can contribute significantly to the bottom line.

Results: Over the three year period, the contribution margin increased for trauma patients (excluding Level 1 trauma), Level 1 trauma patients and the combined population of all trauma patients. The most significant portion of the increase resulted from patients seen as a result of trauma center status (Table One). The contribution margin achieved compared favorably with other hospital product lines (Table Two).

Table 1: Contribution Margin – Trauma (%)

Year	2001	2002	2003
Trauma w/o	11.3	17.9	23.2
Level 1	31.0	40.2	42.8
All Trauma	22.5	31.6	35.3

Table 2: Contribution Margin (%)

Trauma w/o Level 1	17.9
Level 1 trauma only	40.2
All trauma	31.6
Orthopedics	29.8
Oncology	26.3
Cardiac Services	15.6

Conclusion: The investment in resources necessary to achieve and maintain trauma center status is fiscally supported in that the trauma program contributes favorably to hospital net revenue.

Session 2-A
Paper 16 2:40 pm

IONIZED MAGNESIUM IN THE CEREBROSPINAL FLUID OF PATIENTS WITH HEAD INJURIES

Toshihisa Sakamoto, MD., Akira Takasu, MD.*, Daizoh Saitoh, MD., Naoyuki Kaneko, MD.*, Yoichi Yanagawa, MD., and Yoshiaki Okada, MD,
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Objective: It is known that ionized magnesium (iMg) has an important role in patients with cardiac, obstetric and neurologic disorders. Headrick reported that serum iMg (S-iMg) was lowered according to the severity of the head injury. However, the mechanisms of iMg in the neurological status and iMg responses in the cerebrospinal fluid (CSF, C-iMg) are still unclear. Adult C-iMg as well as ionized calcium in CSF (C-iCa) have not been measured even in normal subjects. In this study, we investigated the values of C-iMg as compared with other clinical parameters.

Methods: Serum and CSF were collected from patients with head injuries, and the samples were investigated in relation to Glasgow Coma Scale (GCS), in relation to intracranial pressure (ICP), and in relation to iCa, pH, lactate level in the serum and CSF. We selected other 8 alert patients without head injuries as control subjects. Values are expressed as mean±SD.

Results: The subjects were 15 adults (average age 52±21 y.o.) and their GCS was 8.7 ±4.5. C-iMg in the control group was 0.84±0.11 mmol/*l*, which was close to the value reported in infants. S-iMg fell parallel to their GCS scores ($p=0.028$), although C-iMg decreased without relation to GCS. S-iMg didn't have any relation to C-iMg, as relation between S-iCa and C-iCa. C-iMg had a close relationship to C-iCa ($R=0.67$, $p<0.0001$). Neither S-iMg nor C-iMg were related to ICP, lactate nor pH in either environment.

Conclusions: C-iMg in patients with head injuries fell as well as S-iMg without any relationship, and also had no relation to GCS. These data suggest that a blood-brain barrier exists in the movement of iMg. There is a possibility that the connection between GCS scores and S-iMg level in patients with head injuries resulted not from level of the C-iMg but from level of the C-iCa.

Session 2-A

Paper 17 3:00 pm

ADJUVANT EFFECT OF METFORMIN AND INSULIN ON MUSCLE PROTEIN KINETICS FOLLOWING BURN INJURY

Dennis C. Gore, M.D. University of Texas Medical Branch *
David N. Herndon, M.D. University of Texas Medical Branch *
Robert R. Wolfe, Ph.D. University of Texas Medical Branch

Objective: Metformin has recently been shown to attenuate hyperglycemia and reduce net muscle protein catabolism post-burn. The purpose of this study was to compare the metabolic effects of metformin to insulin in severe burn patients.

Methods: Six adult patients with burns greater than 40% body surface area underwent metabolic evaluation utilizing isotopic dilution of phenylalanine and glucose, femoral arterial and venous blood sampling, and sequential leg muscle biopsies. Following baseline measurements (Pre), insulin was infused into the femoral artery at 0.45 mIu/min/100ml (Pre Ins). Patients were then given metformin (850mg q 8hrs x 7days) and the metabolic evaluation repeated (Met plus Met Ins).

Results:

	Pre	**Pre Ins.**	**Met**	**Met Ins.**
ven. insulin conc. (uIU/ml)	40 ± 12	119 ± 47 *	31 ± 8	126 ± 34 +
art. glucose conc. (mmol/L)	13.4 ± 1.2	12.4 ± 1.2	9.4 ± 0.9 *	7.5 ± 0.9 +
glucose clearance (ml/kg/min)	4.6 ± 0.8	4.4 ± 1.0	4.3 ± 0.6	4.9 ± 0.7
fractional synthetic rate (%/hr.)	0.12 ± 0.02	0.14 ± 0.01	0.16 ± 0.03 *	0.20 ± 0.05 +
muscle protein synthesis (nmol/min/100 ml)	54 ± 12	68 ± 14 *	94 ± 24 *	110 ± 31

Mean ± SD, * p<0.05 comparison to Pre, + p<0.05 comparison to Met

Conclusions: This study demonstrates significant increases in muscle protein synthesis rate with metformin and a modest increase with insulin. Metformin significantly reduced arterial glucose concentration with an adjunct effect from insulin. These results suggest a comparable response on muscle protein kinetics with both metformin and insulin and a possible synergistic effect with both anabolic agents thereby suggesting a metformin-induced improvement in insulin sensitivity to muscle protein.

Session 2-A

Paper 18 3:20 pm

BLOOD TRANSFUSION IS AN INDEPENDENT PREDICTOR OF INCREASED MORTALITY IN NONOPERATIVELY-MANAGED BLUNT HEPATIC AND SPLENIC INJURIES

William P. Robinson III, MD, Arvilla Stiffler, MA, Edmund J. Rutherford, MD*, Jeongyoun Ahn, MS, Harry Hurd, PhD, Christopher C. Baker, MD*, Anthony A. Meyer, MD, PhD*, and Preston B. Rich, MD

From the Department of Surgery, University of North Carolina School of Medicine (W.P.R., A.S., E.J.R, C.C.B., A.A.M, and P.B.R) and Department of Biostatistics (J.A., H.H), University of North Carolina

Background: Nonoperative management strategies for blunt solid viscus injuries often include blood transfusion. However, transfusion has previously been identified as an independent predictor of mortality in unselected trauma admissions. We hypothesized that transfusion would adversely affect mortality and outcome in patients presenting with blunt hepatic and splenic injuries after controlling for injury severity and degree of shock.

Methods: We retrospectively reviewed records from all adults with blunt hepatic and/or splenic injuries admitted to a Level I Trauma Center over a four year period. Demographics, physiologic variables, injury severity, and amount of blood transfused were analyzed. Univariate and multivariate analysis with logistic and linear regression were used to identify predictors of mortality and outcome.

Results: One hundred forty-three (45%) of 316 patients presenting with blunt hepatic and/or splenic injuries received blood transfusion within the first 24 hours. Two hundred thirty-eight patients (75%) were selected for nonoperative management of whom 81 (34%) required transfusion in the first 24 hours. Transfusion was an independent predictor of mortality in all patients (odds ratio [OR], 4.8; 95% confidence interval [CI], 1.4-16.4; p= 0.014) and in those managed nonoperatively (odds ratio [OR], 8.5; 95% confidence interval [CI], 2.0-36.5; p=0.0043) after controlling for indices of shock and injury severity. The risk of death increased with each unit of packed red blood cells transfused (OR, 1.16; 95% CI, 1.10-1.24; p<0.0001). Blood transfusion was also an independent predictor of increased hospital length of stay (Coefficient, 5.5; 95% CI, 1.6-9.2; p=0.005).

Conclusion: Blood transfusion is a strong independent predictor of mortality and hospital length of stay in patients with blunt liver and spleen injuries after controlling for indices of shock and injury severity. Mortality risk was highest in the subset of patients managed nonoperatively. Prospective examination of transfusion practices in treatment algorithms of blunt hepatic and splenic injuries is warranted.

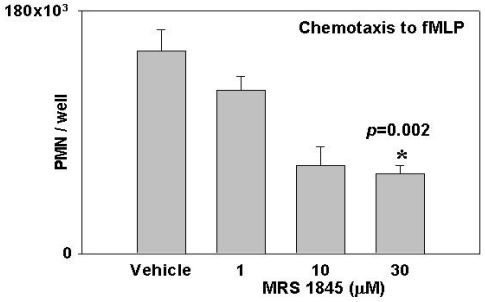
Session 2-A

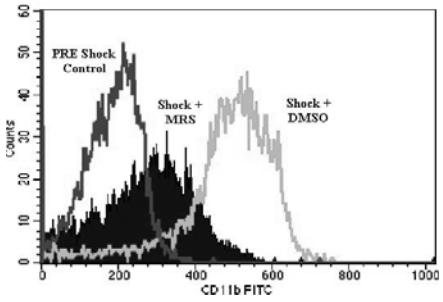
Paper 19 3:40 pm

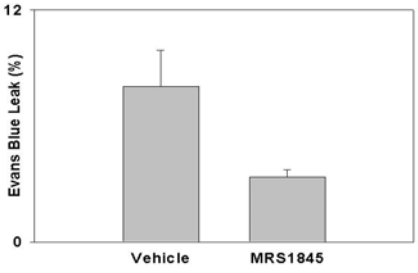
STORE-OPERATED CALCIUM CHANNEL INHIBITION ATTENUATES NEUTROPHIL FUNCTION AND POST-SHOCK ACUTE LUNG INJURY

Cindy Lee, MD
Da-Zhong Xu, MD
Eleanora Feketeova, MD
K.B. Kannan, PhD
Edwin A. Deitch, MD*
David H. Livingston M.D.*
Carl J. Hauser M.D.*

Background: PMN functions depend on cell calcium so Ca^{2+} channel blockade could limit inflammation. L-type Ca^{2+} channel blockers would exacerbate shock but Ca^{2+} enters PMN via store-operated Ca^{2+} channels (SOCC). Thus we hypothesized SOCC blockade might suppress PMN function and lessen ALI without v
chemotaxis (CTX) was studied in modified Boyd
SOCC. Rats underwent trauma (laparotomy) & hemorrhagic shock (MAP 30-40mmHg x 90min [T/HS]). 30μM MRS or vehicle was given IP at laparotomy. CD11b (flow cytometry) and lung injury (% Evans Blue dye leak [EBD]) were studied 3h post resuscitation. Shed blood volume was recorded. **Results:** MRS caused dose-depend
suppression of PMN CTX *in vitro* (top fig). *In vivo*, MRS decreased post-shock PMN CD11b expression (397±93 vs 268±39 MFU, $p<0.05$ (middle fig). MRS had no noticeable effect on BP or shed blood volume (26±2 ml/kg vs. 27±3 ml/kg, *NS*). MRS decreased lung permeability to EBD (3.4±0.1% vs. 8.1±1.9%, $p<0.05$, bottom fig). **Discussion.** Blocking Ca^{2+} entry via SOCC inhibits PMN function *in vitro* and *in vivo*. SOCC blockade ameliorates T/HS-induced lung injury without worsening shock. The specificity of SOCC blockade for "non-excitable" immune cells like PMN may make it a valuable form of chemoprophylaxis for control of the inflammatory pulmonary consequences of hemorrhagic shock in trauma patients.







Session 2-A

Paper 20 4:00 pm

PHARMACOKINETICS OF ENOXAPARIN IN MULTIPLE TRAUMA PATIENTS

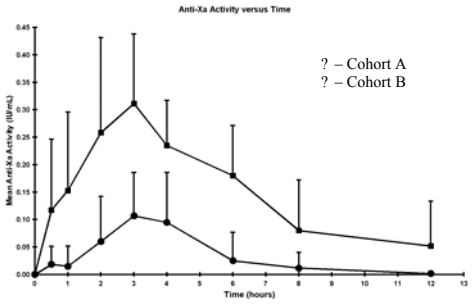
Curtis E. Haas, Pharm.D., Krishnan Raghavendran, M.D., William Mihalko, M.D., Ph.D., Joseph Beres, B.S., Lydia Lin, Pharm.D. Candidate, William Flynn, M.D. Sponsor: Roger Seibel, M.D.
Affiliations: School of Pharmacy and Pharmaceutical Sciences and School of Medicine and Biomedical Sciences, University at Buffalo, Buffalo, NY.

Hypothesis: The bioavailability of SC enoxaparin for DVT prophylaxis in multiple trauma patients will be affected by the presence of peripheral edema.

Objective: To describe the pharmacokinetics (PK) of enoxaparin in multiple trauma patients following subcutaneous (SQ) administration, and to evaluate the impact of peripheral edema on enoxaparin PK parameters. **Methods**: Three cohorts were enrolled in this study; A (Trauma, ISS>10, non-edematous), B (Trauma, ISS>10,edematous- defined by presence of peripheral edema and increase in body weight of ? 10 kg) and C (Elective arthroplasty). We are reporting data from 7 subjects in cohort A and six in cohort B (on going study). All patients had received at least 4 doses of enoxaparin 30 mg SQ q12h. Blood samples were then collected before and 0.5, 1, 2, 3, 4, 6, 8, and 12 hours following an AM dose. Plasma anti-Xa activities were determined by chromogenic factor Xa inhibition assay (Chrom Z). Standard non-compartmental PK analysis was performed using WinNonlin. PK parameters were compared by Mann Whitney Rank Sum test.

Results: The $AUC_{0\text{-}12}$ and maximal anti-Xa activity (A_{max}) were significantly lower in the edematous trauma patients ($p < 0.05$). Four of the 6 edematous patients had barely detectable anti-Xa results. Activity levels were too low to reliably estimate the terminal slope and half-life ($T_{1/2}$) for Cohort B. **Conclusion**: The standard dose of enoxaparin recommended for multiple trauma patients provides unreliable and highly variable anti-Xa activity, and is strongly affected by the presence of significant peripheral edema. The data is consistent with a markedly reduced bioavailability of enoxaparin with peripheral edema.

Cohort	A	B
$AUC_{0\text{-}12}$	1.92 ± 1.19	0.42 ± 0.41
$T_{½}$ (h)	4.8 ± 2.6	N/A
A_{max} (IU/mL)	0.32 ± 0.12	0.15 ± 0.07
T_{max} (h)	2.71 ± 0.76	2.67 ± 0.82



Session 2-A

Paper 21 4:20 pm

COMPARISONS OF SURVIVAL PREDICTIONS USING SURVIVAL RISK RATIOS BASED ON ICD9 AND AIS TRAUMA DIAGNOSIS CODES

John R. Clarke, M.D.*, Andrew V. Ragone, Lloyd Greenwald, Ph.D.,
Drexel University

Objectives: We did a comparison of methods for predicting survival using survival risk ratios (SRR), including new comparisons based on ICD9 vs. AIS 90 6-digit codes.

Methods: From the Pennsylvania Trauma Centers' Registry, all direct trauma admissions were collected through 6/30/99. Patients with *no* co-morbid medical diagnoses and *both* ICD9 and AIS injury codes were used for comparisons based on a single set of data. SRRs for ICD9 and then for AIS diagnoses were each calculated 3 ways: from the survival rate of patients (a) with each diagnosis, (b) when each diagnosis was an isolated diagnosis, and (c) after the survival rate for each diagnosis was adjusted for the deaths attributable to associated diagnoses using an incremental method based on improvements in the squares of the differences between observed and expected outcomes. Probabilities of survival for the cohort were calculated using each set of SRRs by both the multiplicative ICISS and the minimum SRR method. These prediction sets were then internally validated against actual survival by the Hosmer-Lemeshow goodness-of-fit statistic (HL). The HL statistic of the cohort for the probabilities of survival calculated using TRISS was used as a benchmark.

Results: The 41,364 patients had 1224 different ICD9 codes in 32,261 combinations and 1263 corresponding AIS codes in 31,755 combinations, ranging from 1-27 injuries/pt. All conventional ICD9 combinations of SRRs and methods had better HL fits than their AIS counterparts. The multiplicative ICISS method using SRRs adjusted for deaths attributable to associated diagnoses produced an HL statistic of 386, the only one better than the TRISS benchmark of 887. All others ranged from 5596-56,246.

Conclusions: Predictions of survival based on anatomic injury alone can be done using ICD9 codes, with no advantage from extra AIS coding. A multiplicative ICISS model using SRRs adjusted for deaths from associated diagnoses surpassed all other SRR/ICISS methods, using the same data, and bested the external TRISS benchmark.

Session 2-A

Paper 22 4:40 pm

THE USE OF THYROID HORMONE IN BRAIN-DEAD ORGAN DONORS INCREASES THE NUMBER OF ORGANS AVAILABLE FOR TRANSPLANTATION

Ali Salim, MD, Mathew Martin, MD, Carlos Brown, MD, Howard Belzberg, MD, George Velmahos*, MD, PhD, Demetrios Demetriades*, MD, PhD
Division of Trauma and Critical Care, University of Southern California Keck School of Medicine and the Los Angeles County+University of Southern California Medical Center

Background: The shortage of transplantable organs has become a national crisis, with numerous public, private, and governmental agencies attempting to find ways to increase the donor pool. The aggressive management of brain-dead (cadaveric) donors has been shown to increase organs available for transplantation. Some centers utilize hormone therapy with thyroid hormone (T4) in selected potential organ donors. The purpose of this study is to evaluate the effects of T4 on organs available for transplantation.

Methods: A policy of aggressive donor management was adopted at our trauma center in 1998, involving aggressive resuscitation with fluid, in all, and vasopressors in hemodynamically unstable potential organ donors. T4 therapy is reserved for the hemodynamically unstable donors who require vasopressor support. The records of all patients who successfully donated organs between Jan. 2000 and Dec. 2003, were reviewed. Donors were patients who sustained unsurvivable head injuries either from traumatic causes (Trauma Donor) or medical causes (Nontrauma Donors). Data regarding age, sex, diagnosis, injuries, ISS, number of organs donated, and whether or not T4 was used was examined for each organ donor.

Results: There were a total of 85 organ donors during the 3-year period, 53 trauma donors and 32 nontrauma donors. The table below compares the number of organs donated per patient with and without T4.

	All Donors (n=85)	**Trauma Donors (n=53)**	**Nontrauma Donors (n**
T4	3.8 ± 1.8* (n=59)	4.2 ± 1.6 (n=39)	2.9 ± 1.9* (n=20)
No T4	2.7 ± 1.9 (n=26)	3.8 ± 1.5 (n=14)	1.3 ± 1.3 (n=12)

Data expressed as mean ± SD
* - $p < 0.05$ when compared to the No T4 group

Conclusion: Despite the fact that T4 was utilized in only unstable donors, its use was associated with an increase in the number of organs donated per patient. We believe that T4 should be considered in all donors, including hemodynamically stable ones, for it may be a simple method that will increase the number of available organs in this time of an organ shortage crisis.

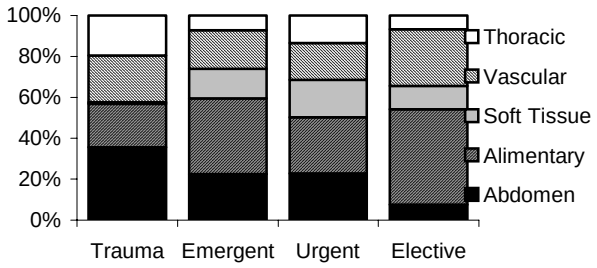
Session 2-B

Paper 23 1:00 pm

THE ACADEMIC TRAUMA CENTER IS THE MODEL FOR TRAINING IN EMERGENCY SURGERY

David J Ciesla MD, Ernest E Moore MD*, Clay C Cothren MD, John B Moore MD, Jeffrey L Johnson MD, Jon M Burch MD*
Denver Health Medical Center and University of Colorado School of Medicine

Background: The AAST has charged an ad hoc committee to define the evolving field of emergency surgery that encompasses emergency trauma surgery, general surgery and critical care. The purpose of this study was to characterize the spectrum of surgical emergencies that could serve as the model for training the emergency surgeon. **Methods:** We reviewed the surgery operative logs for 2002 and 2003 at our urban academic level 1 trauma center. Six surgeons participate equally in call that covers trauma and non-trauma general surgical, thoracic, and vascular emergencies. Cases were classified as emergent when operation was required immediately, urgent when during the indexed hospital admission, and elective when performed following outpatient evaluation. **Results:** We performed 4046 operations during the study period of which 41% were elective, 40% were urgent, and 19% were emergent. Standard general surgery cases were excluded and remaining operations categorized according to the American Board of Surgery case reporting system (figure). Among non-elective procedures were 112 thoracotomies and 70 limb salvage procedures. Emergent operations occurred with equal frequency throughout the week while trauma was more prevalent on weekends. Peak operative times were between 6:00 and 10:00pm for emergency surgery and 12:00mn and 4:00am for trauma surgery. **Conclusions:** The addition of nontrauma emergency surgery increases the trauma surgeon's operative potential. Based on the spectrum of operations, emergency surgery education must include specialty training in thoracic and vascular surgery. The overlap of case spectrum and different peak operating times between emergency general surgery and trauma surgery allows the emergency surgeon to manage both trauma and non trauma surgical emergencies.



Session 2-B
Paper 24 1:20 pm

COMPUTED TOMOGRAPHY AND SELECTIVE LAPAROSCOPY IN THE DIAGNOSIS OF BLUNT BOWEL INJURY : A PROSPECTIVE STUDY

Kitano M. MD#, Sasaki J. MD#, Nagashima A.MD#, Doi M.MD#, Hayashi S.MD#, Egawa. T.MD#, Yoshii H,MD#,

From the Department of Surgery, Saiseikai-kanagawaken Hospital.

Purpose: We prospectively evaluated whether computed tomography (CT) and selective laparoscopy (LP) in the diagnosis of blunt bowel injury (BBI) can prevent nontherapeutic laparotomy and delayed diagnosis. Patients and Methods: From April 1994 to May 2002, hemodynamically stable patients suspected to have BBI were enrolled in this study. Patients with hemodynamic instability or solid organ injury with hemoperitoneum were excluded. All patients underwent physical examination and contrast CT on admission and then again 12(6-24) hrs after admission. LP was performed under general anesthesia in patients who had local peritoneal signs and indirect signs on CT (bowel thickening, mesenteric hematoma or isolated intraperitonel fluid) or in whom abdominal pain or tenderness increased or intraperitoneal fluid on repeat CT increased. The indications for celiotomy were diffuse peritonitis, pneumoperitoneum on abdominal CT, or bowel perforation on LP. Results: During the study period, 230 of 1074 patients admitted with blunt torso injury were enrolled in this study. Eleven patients underwent emergency celiotomies and 11 LP immediately after emergency department admission. There was one non-therapeutic laparotomy among the patients who underwent celiotomy. LP revealed seven bowel perforations and one mesenteric laceration. After repeat CT, three and seven patients underwent laparotomy and LP respectively. Four bowel perforations were found by LP. The remaining 198 patients were treated conservatively, and had no complication related to delayed diagnosis of BBI. Conclusion: CT and selective LP can prevent nontherapeutic laparotomy and delayed diagnosis in patients with suspected BBI.

Session 2-B

Paper 25 1:40 pm

EVALUATION OF THE APPLICABILITY, EFFICACY, AND SAFETY OF A THROMBOEMBOLIC EVENT PROPHYLAXIS GUIDELINE DESIGNED FOR QUALITY IMPROVEMENT OF THE TRAUMATICALLY INJURED PATIENT

Douglas J.E. Schuerer, MD; Robb R. Whinney, DO; Bradley D. Freeman, MD, Julie Dobbs, RN, BSN; Sandip Prasad; Maxwell Krem; John E. Mazuski, MD,PhD*; Timothy G. Buchman, PhD,MD*. Burn, Trauma, Critical Care Section, Department of Surgery, Washington University in St. Louis

Introduction: Thromboembolic events (TE) such as deep venous thrombosis (DVT) and pulmonary embolism (PE) are common after trauma. Our Trauma QI Committee developed an evidence based DVT/PE prophylaxis guideline using a modified Delphi approach in order to standardize care and to reduce TE rates. Our objective was to evaluate the applicability, efficacy, and safety of this guideline in the traumatized patient, especially those admitted first to the ICU. **Methods:** We reviewed the records of patients in our database for 2 months to determine historical rates. We then developed a risk-stratified DVT/PE prophylaxis guideline using specific injuries, pertinent history and physiologic parameters, favoring aggressive therapy in those at highest risk of dying from a PE. We prospectively collected data from this guideline in all patients admitted to the Trauma or Ortho-Trauma services that were expected to stay for more than 48 hours from March through December, 2003. Data collected included: DVT, PE, prophylaxis level chosen, IVC filters placed, admission service and location, TRISS scores, LOS, outcomes, adverse events, and specific risk factors. Patients on the Neurosurgical service did not participate in the guideline, but are included in the totals. **Results:** Completed sheets were collected for 55% of the targeted population. We found the overall TE rate dropped from 3.6% in the historical controls to 2.4% in the guideline period. More significantly, the ICU admitted population had a drop from 9% to 3%. No bleeding events were noted due to prophylactic anticoagulation, and 1 death occurred due to IVC filter complications. Nine of the TE's occurred in guideline patients with spine or closed head injury, who had delayed chemical prophylaxis; no patients in the control group with a TE had those injuries.

	Pre- Guideline	Post-Guideline	P value
TE Rate Trauma ICU Pts.	**9% (5/58)**	**3% (12/395)**	**p<.05**
TE Rate All Trauma Pts.	**3.6% (5/138)**	**2.4% (20/850)**	**p=.14**

Conclusion: Form-based, risk-adjusted prophylaxis against TE leads to lower TE rates in a general and orthopaedic ICU trauma population. Protocol compliance should be enforced.

Session 2-B

Paper 26 2:00 pm

COMPUTED TOMOGRAPHY FOR THE DIAGNOSIS OF CERVICAL, THORACIC, AND LUMBAR SPINE FRACTURES: ITS TIME HAS COME.

Jared L. Antevil, MD - Naval Medical Center San Diego
Carlos V.R. Brown, MD - Naval Medical Center San Diego
Michael J. Sise, MD* - Scripps Mercy Hospital San Diego
Dan Sack, BS - Scripps Mercy Hospital San Diego

Background: The traditional method of diagnosing spine fractures (SF) has been plain radiography, but Spiral Computed Tomography (SCT) is being used with increasing frequency. Our institution adopted SCT as the primary modality for the diagnosis of SF. The purpose of this study was to determine if SCT scan can be used as a stand-alone diagnostic modality in the evaluation of SF. **Methods:** Retrospective review of all blunt trauma patients over a two year period (1/01 – 12/02). Patients with neck/back pain or spine tenderness underwent SCT of the symptomatic region. Patients who were unconscious or intoxicated underwent screening SCT of the entire spine. SCT was performed using 3mm axial cuts with three-dimensional reconstructions in sagittal and coronal planes. Patients with a discharge diagnosis of cervical, thoracic, or lumbar SF were identified from the trauma registry by ICD-9 codes. **Results:** There were 3,537 blunt trauma patients evaluated, with 233 (6.6%) sustaining a cervical, thoracic, or lumbar SF. 45 patients (19%) sustained a SF in more than one anatomic region. SCT missed SF in two patients.

Fracture Location	n	Missed by SCT	SCT Sensitivity
Cervical Spine	100	1 (1.0%)	99.0%
Thoracic Spine	66	1 (1.5%)	98.5%
Lumbar Spine	112	0 (0%)	100%
Entire Spine	278	2 (0.7%)	99.3%

The cervical SF missed by SCT was a compression fracture identified by magnetic resonance imaging and was treated with a rigid collar. The thoracic SF missed by SCT was also a compression fracture identified on plain radiographs and required no treatment. **Conclusions:** SCT of the spine identified 99.3% of all fractures of the cervical, thoracic, and lumbar spine, and those missed by SCT required minimal or no treatment. SCT is a sensitive diagnostic test for the identification of SF. Routine plain radiographs of the spine may not be necessary in the evaluation of blunt trauma patients.

Session 2-B

Paper 27 2:20 pm

CYCLIC NUCLEOTIDE SECOND MESSENGERS (CAMP AND CGMP) PLAY A CENTRAL ROLE IN SIGNAL TRANSDUCTION AND REGULATION OF MESENTERIC POSTCAPILLARY FLUID LEAK

Authors - Terry J. Chong MD, Brian Curran BS, Gregory P. Victorino MD - UCSF East Bay Surgery Department, Alameda County Medical Center, Oakland, CA

Sponsor - James M. Betts MD

Introduction: The dominant site of post-injury/sepsis fluid extravasation is the postcapillary venules. The endothelial cell receptors involved in this process are coupled to G-proteins that stimulate production of cGMP and cAMP. **We hypothesize that cGMP and cAMP are endothelial cell second messengers that control postcapillary fluid leak.** The purposes of this series of experiments are to determine fluid leak under the following conditions: 1) decreased cGMP production, 2) cGMP accumulation, 3) decreased cAMP production, and 4) cAMP accumulation.

Methods: Rat mesenteric venules were cannulated, and fluid leak was determined by measuring hydraulic permeability (L_p, units $x10^{-7}cm \cdot sec^{-1} \cdot cmH_2O^{-1}$). L_p was measured at 5 minute intervals during continuous perfusion with 1) a cGMP synthesis inhibitor (LY83583), 2) an inhibitor of cGMP degradation (Zaprinast), 3) a cAMP inhibitor (2',5'-dideoxyadenosine), and 4) an inhibitor of cAMP degradation (Rolipram). L_p is represented as mean ± standard error.

Results: Compared to baseline L_p (1.14 ± 0.06), cGMP synthesis inhibition decreased L_p by over 50% (0.503 ± 0.59, $p<0.001$) (n=6), while cGMP accumulation increased L_p by over 2-fold (0.912 ± 0.09 to 2.26 ± 0.15, $p<0.001$) (n=6). The inhibition of cAMP synthesis increased L_p from 0.949 ± 0.59 to 3.85 ± 0.76 ($p<0.01$) (n=6), and cAMP accumulation decreased L_p from 1.14 ± 0.05 to 0.593 ± 0.10 ($p<0.002$) (n=4).

Conclusion: The second messengers, cGMP and cAMP, control fluid movement across the microvascular endothelial barrier; cGMP increases fluid leak, while cAMP decreases fluid leak. Endothelial cell cyclic nucleotide second messengers are accessible pharmacologically and may be targeted during post-injury/sepsis-associated microvascular leak.

Session 2-B

Paper 28 2:40 pm

RESUSCITATION WITH A HEMOGLOBIN-BASED OXYGEN CARRIER AFTER SEVERE BRAIN TRAUMA

David R. King, M.D., Stephen M. Cohn, M.D.*, Kenneth G. Proctor, Ph.D.

Traumatic brain injury (TBI) is excluded in nearly every clinical trial involving hemoglobin-based oxygen carriers (HBOCs). Furthermore HBOCs are vasoactive, and pressor use in hemorrhagic shock is generally contraindicated. The purpose of this investigation was to examine low volume resuscitation with a vasoactive HBOC [hemoglobin glutamer-200(bovine), BioPure Inc., Cambridge, MA] after TBI and hemorrhage. **METHODS:** Anesthetized swine received TBI and hemorrhage (30±2ml/kg, n=15). From 30 to 60 min, unlimited lactated Ringer's (LR, n=5), unlimited HBOC (n=5), or 10ml/kg LR+unlimited HBOC (n=5) was titrated to systolic blood pressure?100mmHg. From 60 to 90 min, fluid was titrated to mean arterial pressure (MAP)?70mmHg and heterologous whole blood (RBCs, 10ml/kg) was transfused for hemoglobin (Hb)<5g/dl. From 90 to 390 min, 1g/kg mannitol was given if intracranial pressure (ICP)?20 mmHg, LR if cerebral perfusion pressure (CPP)<70mmHg, and RBCs if Hb<5g/dl. **RESULTS:** LR+HBOC reduced fluid requirements (30±12ml/kg vs 280±40 with LR+mannitol+RBCs, $p<0.05$) and eliminated need for RBC transfusions and mannitol. LR+HBOC attenuated ICP (12±1 vs 33±6mmHg with LR+mannitol+RBCs) and improved brain tissue pO2 (34.2±3.6 vs 16.1±1.6mmHg, all $p<0.05$). Cerebrovascular reactivity and intracranial compliance were also improved with LR+HBOC ($p<0.05$). Lactate and base excess corrected faster with LR+HBOC despite a 40% reduction in cardiac index. With HBOC and LR+HBOC, MAP and HR rapidly corrected, however with HBOC alone lactate failed to clear and systemic O2 extraction increased. **CONCLUSIONS:** 1. HBOC with initial crystalloid bolus was superior to standard of care (LR+mannitol+RBCs) following TBI. This may represent a new indication for HBOCs. 2. HBOC eliminated the need for RBC transfusions. 3. The vasoactive effect of HBOCs, especially when used alone, can lead to significant under-resuscitation despite restoration of MAP and HR. This suggests that MAP and HR are inadequate resuscitation endponts with HBOC use.

Session 2-B

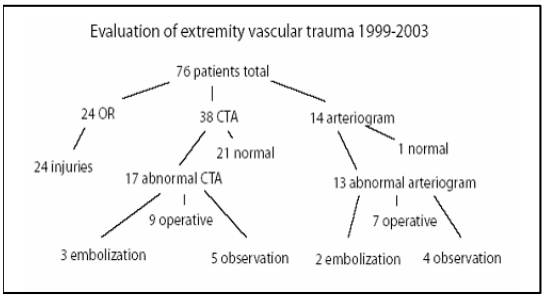
Paper 29 3:00 pm

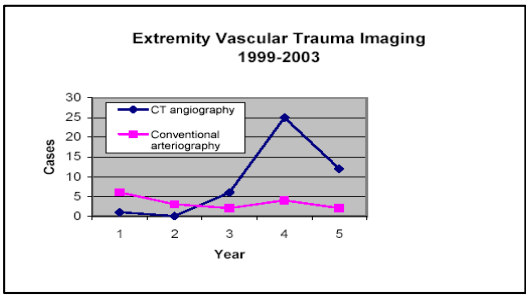
CT ANGIOGRAPHY EFFECTIVELY EVALUATES EXTREMITY VASCULAR TRAUMA

Peter D. Peng MD, Rochelle A. Dicker MD, David A. Spain MD*, Monika Tataria MD, Geoffrey D. Rubin MD, and Susan I. Brundage MD*

Stanford University

Background: Conventional arteriography is the traditional diagnostic modality for arterial injury evaluation. Recent technological advances have resulted in multi-detector, fine resolution computed tomographic angiography (CTA). This study examines CTA of extremity vascular trauma compared to conventional arteriography. Our hypothesis is CTA provides accurate and timely diagnosis of peripheral vascular injuries and challenges the gold standard of arteriogram. **Methods:** Traumatic extremity injuries from 1999 to 2004 were identified from a Level I Trauma Center registry. The registry and the digital radiology database were analyzed. Information collected included mechanism of injury, imaging modality, confirmed vascular injuries, management, and follow-up. Indications for extremity vascular imaging were: ABI<0.9, history of significant bleeding, hematoma, and proximity. **Results:** 2,251 patients were identified with extremity trauma. 24 patients were taken directly to the OR. 76 underwent vascular imaging. 14 patients had conventional arteriograms with 13 abnormal studies: 7 were managed operatively, 2 embolized, and 4 observed. 38 patients underwent CTA with 17 abnormal scans: 9 were managed operatively, 3 embolized, and 5 observed. There were no false negatives or missed injuries.





Conclusion: CTA provides accurate peripheral vascular imaging and offers advantages in noninvasiveness and immediate availability. CTA has rapidly supplanted arteriography for evaluation of peripheral vascular injuries at our institution. This study supports CTA as an effective alternative to conventional arteriography in assessing extremity vascular trauma.

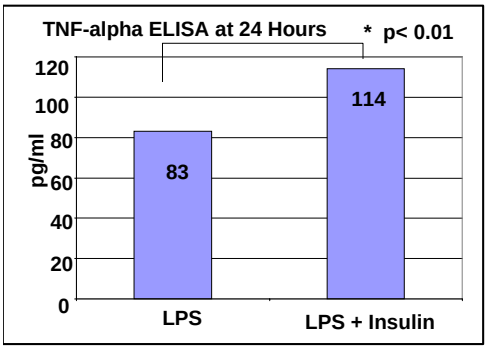
Session 2-B

Paper 30 3:20 pm

INSULIN INCREASES THE RELEASE OF PRO-INFLAMMATORY MEDIATORS

Susan I. Brundage MD,* Nathan A. Zautke BS, Jason C. Lam BS, Rochelle A. Dicker MD, and David A. Spain MD*

Introduction: Strict glucose control with insulin infusions is associated with decreased mortality in a mixed patient population in the intensive care unit. Controversy exists regarding the relative benefits of glucose control versus a direct advantageous effect of insulin. As a combined medical/surgical population differs significantly from the critically injured patient primed for secondary insult, our purpose was to determine the influence of insulin on activated macrophages. Our hypothesis was that insulin would directly abrogate the inflammatory cascade. **Methods:** Differentiated human monocytic THP-1 cells were stimulated with endotoxin (LPS, 100 ng/ml) for 6 hrs. Cells were treated +/- 10^{-7} insulin for 1 and 24 hrs. Total RNA was isolated and gene expression for TNF-alpha and IL-6 performed using Q-RT-PCR. (Absolutely RNA Miniprep Kit/Mx3000*p*, Stratagene, La Jolla, CA) Supernatants were assayed for TNF-alpha and IL-6 by ELISA. **Results:** Gene expression of TNF-alpha and IL-6 was not different in LPS stimulated macrophages with and without insulin treatment at both 1 and 24 hrs. Likewise, at 1 hr TNF-alpha production as measured by ELISA was not different (p=0.16). However, at 24 hrs macrophages treated with insulin produced significantly increased TNF-alpha protein levels compared to controls, (114±6.54 pg/ml vs. 83±2.02 pg/ml; p<0.01).



Conclusion: Contrary to our hypothesis, insulin does not have direct anti-inflammatory properties. In fact, our data shows that insulin increases pro-inflammatory cytokine protein levels and suggests that the beneficial effects of insulin administration are likely secondary to glucose control. This data suggests clinicians should exercise caution in the liberal use of continuous insulin infusions in critically ill patients without a clear indication for strict control of hyperglycemia.

Session 2-B

Paper 31 3:40 pm

MICROCHIMERISM IN TRANSFUSED TRAUMA PATIENTS IS ASSOCIATED WITH DIMINISHED DONOR-SPECIFIC LYMPHOCYTE RESPONSE

John T. Owings, MD,* Garth H. Utter, MD, Teresa G. Paglieroni, PhD, Tzong-Hae Lee, MD PhD, William F. Reed, MD, Robert C. Gosselin, MT, Paul V. Holland, MD, Michael P. Busch, MD PhD

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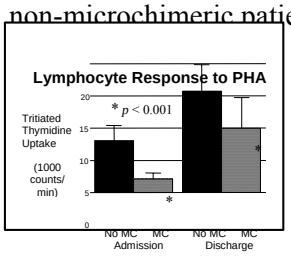
Background: Blood transfusions only rarely result in long-term survival of donor leukocytes (microchimerism). We, however, have previously found evidence of this phenomenon in over half of a group of transfused trauma patients. Microchimerism was not associated with injury severity, number of transfusions, or timing of transfusion.

Purpose: To define the immune state of the trauma patient that allows for the occurrence microchimerism through the comparison of antigen-specific in vitro lymphocyte activity.

Methods: We prospectively enrolled injured patients transfused ? 2 units of blood. We tested blood sampled at hospital discharge for microchimerism with quantitative PCR for non-recipient HLA DR alleles. We assessed lymphocyte response to phytohemagglutinin (PHA) upon admission (before transfusion) and discharge. We performed one-way mixed leukocyte cultures (MLC) with pre-transfusion recipient specimens to assess recipient lymphocyte response to mitomycin-C treated donor cells and vice versa.

Results: Out of 45 patients, 24 had PCR evidence of microchimerism. Lymphocyte response to PHA in microchimeric patients was lower at admission and discharge than in non-microchimeric patients. Microchimeric patients more frequently had a diminished lymphocyte response to a single blood donor on MLC.



MLC results	Non-microchimeric	Microchimeric
Normal response with all donors	20	13
Hyporesponsive to single donor	1	11

$p<0.005$

Follow-up HLA typing has confirmed that the microchimeric cells in the recipients are those of the donor which was shown not to stimulate an MLC response.

Conclusions: The immune dysfunction in trauma patients who develop microchimerism is based in part on a diminished lymphocyte response to mitogen challenge. These patients also have a diminished **donor-specific** lymphocyte response to one of the blood donors that predates transfusion and corresponds to the donor responsible for the microchimeric cells.

Session 2-B
Paper 32 4:00 pm

BILOMA INCREASES THE RISKS OF PSEUDOANEURYSM AFTER BLUNT HEPATIC INJURY

Akiyoshi Hagiwara, MD; Takehiko Tarui, MD; Atsuo Murata, MD; Takeaki Matsuda, MD; Hiroharu Matsuda, MD; Shuji Shimazaki, MD* Kyorin University, School of Medicine, Department of Traumatology and Critical Care Medicine

Object: To clarify the association of biloma with pseudoaneurysm complicated after severe hepatic injury. **Materials and Methods:** Angiography was performed in all the patients with hepatic injury of ≥ grade III by AAST classification on contrast CT. When contrast extravasation was observed, transarterial embolization (TAE) was performed. Following TAE, 99mTc Pyridoxyl-5-Methyl-Triptophan cholescintigraphy was performed to observe the possible co-existence of biloma. Follow-up angiography was performed when up-take image (biloma) was observed on the cholescintigraphy. **Results:** A consecutive 80 patients (64 males and 16 females at the age of 31.2 ± 16.6 years) received angiography during a period of 7 years. After angiography, five patients died. The remaining 75 patients underwent cholescintigraphy. All the 11 patients who had biloma showed angiographic evidence of contrast extravasation on admission. The frequency of biloma was significantly higher in patients with grades IV and V than in those with grade III ($p = 0.0195$). Follow-up angiography revealed pseudoaneurysm in 7 of these 11 patients. All 6 patients who received only an injection of gelatin sponge pledgets as embolic materials had pseudoaneurysms. Among them, 2 patients showed massive intra-abdominal hemorrhage. By contrast, only one of 5 patients who received injections of both gelatin sponge pledgets and stainless steel coils, which generated permanent embolization of injured arteries, had pseudoaneurysm. In this one patient, pseudoaneurysm was formed in the peripheral part of collateral vessels. All these patients with pseudoaneurysm underwent TAE again and were uneventfully discharged from hospital. **Conclusions:** The existence of bile slows the healing process of injured tissues. Therefore, pseudoaneurysm will be developed because biloma retards the healing process of injured vessels. This hypothesis might be supported by the fact that pseudoaneurysms were formed in all the patients who received an injection of only gelatin sponge pledgets, which were absorbed in approximately one week.

Session 2-B

Paper 33 4:20 pm

ALTERATIONS IN THE SYSTEMIC INFLAMMATORY RESPONSE FOLLOWING EARLY TOTAL CARE AND DAMAGE CONTROL PROCEDURES FOR FEMORAL SHAFT FRACTURE IN SEVERELY INJURED PATIENTS.

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H.-C. Pape*, MD, Hannover

Introduction - Damage control orthopaedics (DCO), attempts to limit the magnitude of the 'second hit' insult resulting from operative treatment after trauma, deferring complex reconstructive work until a later stage. For femoral shaft fracture, initial external fixation (EF), and subsequent conversion to an intramedullary nail (IMN) is performed. We sought to quantify the inflammatory response to initial surgery and conversion and link this to subsequent organ dysfunction.

Methods - Patients with femoral shaft fracture, were identified. Patients with New Injury Severity Score =>20 were selected. Data was retrospectively collected every 12 h for 4 days on admission and at exchange procedure (EF to IMN) to allow calculation of the systemic inflammatory response (SIRS) and Marshall multi-organ dysfunction scores, (MOD).

Results - 174 patients met the inclusion criteria. The patients in the DCO group had significantly more severe injuries (NISS 25.4 vs. 36.2, $p<0.0001$) and a significantly higher incidence of head and thoracic injuries ($p<0.0001$). The mean SIRS score was significantly higher in the IMN group, from 12 hours until 72h post-operatively ($p<0.05$ or better). A higher incidence of pneumonia and mortality (significant $p=0.02$), ARDS and MOF (n.s.) was observed in the DCO group. The mean peak post-op SIRS score was higher in the IMN group than in the DCO group, at primary procedure and conversion, as was the time with SIRS score >1 ($p<0.0001$). At conversion from EF to IMN, the pre-op SIRS score correlated with post-op peak SIRS score and MOD score ($p<0.0001$), though ,on average, no significant rise in the MODS score occurred following the conversion procedure.

Discussion - Despite having more severe injuries, patients in the DCO group had a smaller, shorter postoperative systemic inflammatory response and did not suffer more pronounced MOF. They did suffer more complications, only significant for pneumonia and this could be attributable to the incidence of head and thoracic injury. DCO patients undergoing conversion whilst SIRS score was raised suffered the most pronounced inflammatory response and rise in MODs.

Conclusion - According to this data, DCO treatment was associated with a lesser systemic inflammatory response than early total care for femur fractures. This is in agreement with previous studies that illustrate the influence of initial surgical intervention on post-traumatic inflammatory response. The inflammatory status of the patient may be a useful adjunct in clinical decision making regarding the timing of conversion to intramedullary device.

Session 2-B

Paper 34 4:40 pm

A PROSPECTIVE RANDOMIZED TRIAL OF NEBULIZED MORPHINE COMPARED TO PCA MORPHINE IN THE MANAGEMENT OF ACUTE THORACIC PAIN

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Purpose: Successfully managing pain for the trauma patient decreases morbidity, improves patient satisfaction, and is an essential component of critical care. Utilizing PCA morphine to control pain may be complicated by concerns of respiratory depression, hemodynamic instability, addiction, urinary retention, and drug induced ileus. Morphine is rapidly absorbed by mucosal surfaces including the respiratory tract; however, less than 20% is systemically absorbed. The purpose of this study was to evaluate the safety, efficacy, and utility of Nebulized morphine in patients with post traumatic thoracic pain.

Methods: This double blinded, prospective study randomized patients with severe post traumatic thoracic pain into two groups. The experimental group (NMS) received nebulized morphine every 4 hours and normal saline by PCA. The control group (PCA) received PCA morphine and nebulized saline every 4 hours. Dose adjustments were made based on patient response to treatments using a 10 point visual analog scale (VAS) for pain. Pulmonary function, pain relief (VAS), level of sedation (0-3), total drug administered, and systematic side effects were recorded.

Results: 44 patients were randomized (22 per group). 770 observations were made. The mean 4 hour dose of morphine was 11.96 $\pm$ 3.4 mg for NMS and 6.22 $\pm$ 4.7 mg for PCA ($p < 0.001$). Patients with NMS had lower HR compared to PCA (79 $\pm$ 11 vs. 92 $\pm$ 12 [$p<0.001$]) and were less sedated (0.33 $\pm$ 0.7 vs. 0.56 $\pm$ 0.9; $p=0.03$). The mean pain level VAS was 3.38 $\pm$ 1.8 for NMS and 3.84 $\pm$ 2.7 for PCA ($p = 0.2$). There was no difference between pre and post dosing pain levels. There were no differences between groups with respect to BP, respiratory rate, vital capacity, $MFEV_1$, spirometric volumes, or SaO_2.

Conclusions: Nebulized morphine can be safely and effectively used to control post traumatic thoracic pain. Pain can be successfully managed while vital capacity, $MFEV_1$, and spirometric volumes are maintained. Compared to PCA morphine, nebulized morphine is equiefficacious with less sedative effects.

Session 4

Paper 35 8:00 am

RAPID WARFARIN REVERSAL IN ANTICOAGULATED TRAUMA PATIENTS WITH INTRACRANIAL HEMORRHAGE REDUCES HEMORRHAGE PROGRESSION AND MORTALITY

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Felicia A. Ivascu, MD
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Fredrick S. Junn, MD
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Background: A prospective cohort study at our institution demonstrated a 48% mortality rate in warfarin anticoagulated trauma patients sustaining intracranial hemorrhage (ICH) compared to a 10% mortality rate in non-anticoagulated patients with traumatic ICH. 40% of patients demonstrated progression of their ICH, despite anticoagulation reversal, with a resultant 65% mortality rate. 71% of these patients initially presented with a GCS ? 14 and a "minor" ICH. We postulated that early diagnosis of ICH and rapid anticoagulation reversal would reduce ICH progression rates and mortality.

Methods: All anticoagulated patients with known or suspected head trauma are entered into the "Coumadin protocol." The protocol ensures immediate triage and physician evaluation, head CT scan, and fresh frozen plasma administration in patients with documented ICH.

Results: To date, 68 patients have been entered into the protocol with ICH documented in 11(16%). 8/11 patients (73%) presented with GCS ? 14. Median INR for treated patients was 2.9 vs. 2.7 for the 57 patients without ICH ($p = 0.546$). Mean time to CT scan for protocol patients was 61 minutes vs. 121 minutes for patients treated prior to protocol implementation ($p < 0.001$). Mean time to initiate warfarin reversal was 1.7 hours for protocol patients versus 4.3 hours for pre-protocol patients ($p < 0.001$). No protocol patients have shown ICH progression ($p<0.001$). 1/11 (9%) protocol patients with ICH died. However, this patient presented >10 hours after injury with a GCS of 7 and a moribund ICH. This 9% mortality rate is significantly less than the 48% mortality rate noted in patients treated prior to protocol implementation ($p < 0.001$).

Conclusion: Neither the initial GCS nor INR, in anticoagulated trauma patients, reliably identifies patients with ICH. Rapid confirmation of ICH with expedited head CT scan combined with prompt reversal of warfarin anticoagulation with FFP, decreases rates of progression of ICH and reduces mortality.

Session 4

Paper 36 8:20 am

HYPERCOAGULABILITY IS MOST PREVALENT EARLY AFTER INJURY AND IN FEMALES

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Oregon Health & Science University

Introduction: Hypercoagulability following injury is a major source of morbidity and mortality. Recent studies indicate that there is a gender specific risk in trauma patients. The etiology of this risk has not been defined. This study was performed to determine the course of coagulation after injury and to determine if there is a difference between males and females. We hypothesized that hypercoagulability would occur early after injury and that there would be no difference between males and females. **Methods:** This was a prospective cohort study. Inclusion criteria were admission to the intensive care unit, Injury Severity Scale score (ISS) > 4 and the ability to obtain consent from the patient or a relative. A Thrombelastograph® (TEG), routine coagulation parameters and thrombin-antithrombin complexes (TATs) were measured within 24 hours of injury and then daily for 4 days. Categorical data were compared using chi-squared analysis or Fisher's exact test when appropriate; means were compared using a t-test. **Results:** 63 patients met criteria for entry into the study. Their mean age was 45+/-19 years and their mean ISS was 24+/-15. 42 patients (67%) were male. The prevalence of a hypercoagulable state by TEG was 62% on day 1, 39% on day 2, 27% on day 3 and 23% on day 4 ($p < 0.01$). Females were significantly more hypercoagulable on day 1 than males as measured by the time to onset of clotting: females 3.1+/-0.2 minutes, males 3.9 +/-0.2 minutes ($p = 0.04$, normal 3.7 - 8.3 minutes). These values did not differ between males and females after day 1. Mean platelet counts, International Normalized Ratios and partial thromboblastin times were within normal limits throughout the study. Thrombin activation as measured by TATs decreased from 34 +/- 15 μg/L on day 1 to 18 +/- 8 μg/L ($p < 0.01$) on day 4 consistent with the prevalence of hypercoagulability by TEG. **Conclusions:** Hypercoagulability following injury is most prevalent during the first 24 hours. Females are more hypercoagulable than males early after injury. The TEG is more sensitive than routine coagulation assays for the detection of a hypercoagulable state.

Session 4

Paper 37 8:40 am

MILD HYPOTHERMIA IMPROVES SURVIVAL AFTER PROLONGED, TRAUMATIC HEMORRHAGIC SHOCK IN PIGS

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Introduction: The American Heart Association recommends therapeutic hypothermia for resuscitation after cardiac arrest. Studies in rats suggest that mild hypothermia improves survival from hemorrhagic shock (HS). Yet, the effects of hypothermia during HS are unclear since clinical studies suggest detrimental effects in trauma victims. We hypothesized that hypothermia induced with intravenous cold saline would improve survival in a clinically-relevant pig model of trauma and prolonged HS.

Methods: Domestic swine were used. After laparotomy, venous blood (75 ml/kg) was continuously withdrawn over 3 h (no systemic heparin). At HS 35 min, the spleen was transected. At HS 40 min, pigs were randomized into 3 groups (n=8, each): Group-1, normothermia (38°C) with warmed saline, Group-2, hypothermia (34°C) induced with 2°C i.v. saline and surface cooling, and Group-3, hypothermia (34°C) with 24°C i.v. saline and surface cooling. Fluids were given when mean arterial pressure (MAP) was <30 mmHg. At HS 3 h, shed blood was returned and splenectomy was performed. Intensive care, including mechanical ventilation and hemodynamic monitoring, was continued to 24 h.

Results: At 24 h, there were 2 survivors in Group-1, 4 in Group-2, and 7 in Group-3 ($p<0.05$ vs Group-1, Log Rank). Time required to achieve 34°C was 17±9 min in Group-2 and 15±4 min in Group-3 (NS). Compared to Group-3, Group-2 required less saline during HS (321±122 vs 571±184 ml, $p<0.05$). Group-2 also had a transiently higher MAP and higher lactate levels ($p<0.05$).

Conclusion: Mild hypothermia improves survival in a clinically relevant model of HS and trauma. However, administration of very low temperature (2°C) resuscitation fluid may have detrimental effects, possibly due to induced vasoconstriction and resultant MAP overshoot. During HS, infusion of 24°C saline and surface cooling are safe and effective.

Session 4

Paper 38 9:00 am

MANAGEMENT STRATEGY FOR ASYMPTOMATIC PENETRATING INJURY TO THE THORAX: A PROSPECTIVE COMPARISON OF COMPUTERIZED AXIAL TOMOGRAPHY VERSUS CHEST RADIOGRAPH AND SIX-HOUR OBSERVATION PERIOD

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James D Tesar, MD -Orlando Regional Medical Center
Philip A Giordano, MD -Orlando Regional Medical Center

Background: A prospective study was undertaken to update the management strategy for patients with asymptomatic penetrating injuries to the thorax. The efficacy and efficiency of CT of the thorax was compared to the time honored six-hour observational approach.

Methods: 35 consecutive patients with asymptomatic penetrating injuries to the thorax were studied from May 2003 to December 2003. All patients underwent the time-honored evaluation, an immediate chest radiograph and then monitored for 6 hours with repeat radiographs. All patients had an immediate CT of the thorax within 30 minutes of the initial chest radiograph. Results were blinded to the primary management team. Endpoints were length of stay and accuracy of CT versus plain chest radiograph.

Results: Average length of stay for patients was ten hours. Correct diagnosis was made 100% of the time at one hour with CT. 23 (66%) patients had a normal CT at 30 minutes. None had delayed findings at six hours. The remaining 12 (34%) patients would have benefited from an immediate correct diagnosis and management plan. 3 patients with normal chest radiograph refused to stay the six-hour observation, all had normal CT's at 30 minutes. The remaining 9 patients with normal initial chest radiograph had significant life threatening findings on CT. These abnormalities not identified on initial plain radiographs were, 3 patients with pneumomediastinum, 2 with pneumothorax, 1 pulmonary contusion, and 1 intrathoracic hematoma. Two remaining patients evaded chest tubes as they were incorrectly diagnosed with pneumothorax on plain chest radiograph which were not evident on CT or repeat plain radiograph at six hours.

Conclusion: For the asymptomatic patient with penetrating trauma to the thorax an initial chest radiograph followed by an immediate CT of the thorax is more accurate, efficacious, and efficient than the time honored six-hour observational approach. There seems little justification to continue with an outdated management approach in light of newer and more productive technology.

Session 4

Paper 39 9:20 am

ACTING UPSTREAM AND DOWNSTREAM FROM PROTEIN KINASE C IS IDEAL TO MODULATE THE INFLAMMATORY RESPONSE: ROLE OF HPTX A NOVEL RESUSCITATION STRATEGY.

Raul Coimbra MD, PhD*, William Loomis BS, Heidi Melbostad BS, Rafael D. Porcides MD, Maria Tobar, David B.Hoyt MD*.
Division of Trauma, University of California San Diego

Hypertonic saline (HS) and pentoxifylline (PTX) have been shown to modulate PMN functions after shock and sepsis. We hypothesized that a combination of HS and PTX (HPTX) would downregulate PMN functions and inflammatory mediator synthesis more effectively than each alone, possibly by acting at different steps of the signaling pathways, ultimately leading to an additive effect of both drugs.

Whole blood from healthy volunteers was stimulated with LPS (100 μg/ml), fMLP(1μM) and PMA (1μg/ml). Baseline oxidative burst was measured by flow cytometry. Two different concentrations of NaCl to achieve increases of 10mM (HS10) and 40 mM (HS40) above isotonicity, simulating increases in sodium levels seen after infusion of 3% HS and 7.5% HS were used. PTX (2 mM), HS10, HS40, HPTX10, and HPTX40 were added to whole blood concomitantly to the activators. PMN CD14 and CD11b expression were measured by flow cytometry and TNF-α levels by ELISA in LPS-stimulated whole blood. Data is presented as % of stimulant ±SEM. $p<0.05$ is significant.

	PTX	HS10	Hs40	HPTX10	HPTX40
Ox Burst LPS	36±2*	93±4	58±11*	27±4*	23±6*
Ox Burst fMLP	63±11*	84±12	65±11*	54±11*, ?	55±8*
Ox Burst PMA	23±2*	124v3	138±11	30±4*, ?	54±9*, #
CD11b	79±5*	115±4	118±3	82±7?	68±7*, #
TNF-α	6.5±0.5*	110±5	83±9	7±0.6*, $	6±0.7*, #

*, $p<0.05$ vs. activator; ?, $p<0.05$ HPTX10 vs HS10; #, $p<0.05$ HPTX40 vs HS40

The combination of PTX with HS10 or HS40 markedly decreased LPS-, fMLP-, and PMA-induced PMN oxidative burst, TNF-α production, and CD11b expression when compared to HS10 or HS40 alone. Additive effects were observed combining PTX and HS. HPTX acts at steps upstream and downstream from PKC activation. HPTX may have significant applications as a novel fluid resuscitation strategy.

Session 4

Paper 40 9:40 am

IDETIFICATION OF RISK FACTORS AND INDICATIONS FOR A COMPUTED TOMOGRPHIC SCAN IN A PATIENT WITH MINOR TRAUMATIC BRAIN INJURY

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Background: Indications for obtaining a computed tomographic (CT) scan in a patient with Glasgow coma scale (GCS) of 14-15: minor traumatic brain injury (TBI), are still under discussion. In order to establish the indications, we clarify risk factors for head CT scan abnormalities and neurosurgical interventions. **Methods:** Between January 2001 and December 2002, **1321** consecutive patients with minor TBI, who were brought into our emergency department by ambulances, were enrolled in this study. We retrospectively reviewed medical records of the patients For statistical analysis, logistic regression was used. **Results:** Among the 1321 patients, 1021 (77.3 %) patients underwent head CT scan. Six (**0.45 %**) required neurosurgery, and one of them (0.078 %) died. Five of them had ingested alcohol at the accidents. Among the 1021 patients with head CT scan, 54 (**5.3 %**) had positive findings. Positive rate was increased with any of the following 9 factors; skull fractures {odds ratio (OR)=185, $p<0.0001$}, GCS score 14 (OR=4.97, $p<0.0001$), age>60 (OR=4.76, $p<0.0005$), the mechanism like traffic accidents (OR=4.37, $p<0.005$), history of neurosurgery (OR=6.85, $p<0.005$), vomit (OR=4.02, $p<0.05$), headache (OR=2.99, $p<0.055$), transient loss of consciousness (OR=1.73, $p<0.19$), any neurological findings (OR=2.09, $p<0.5$). Any one of the 10 risk factors (the above 9 factors and alcohol ingestion) gave 100% sensitivity of predicting head CT scan abnormalities or the needs for neurosurgery. **Conclusions**: Indications for obtaining a head CT scan in a patient with minor TBI can be safely limited to one with any of the above 10 risk factors.

Session 4

Paper 41 10:00 am

QUALITY OF LIFE AND FUNCTIONAL OUTCOME AFTER PEDIATRIC TRAUMA

Andrea L. Winthrop MD, Karen J. Brasel MD MPH*, Linda Stahovic MSW, Justin Paulson, Benjamin Schneeberger, Evelyn Kuhn PhD, Stephanie Frisbee MSc. Divisions of Pediatric Surgery and Trauma/Critical Care, Department of Surgery, Medical College of Wisconsin and Outcomes Research Department, Children's Hospital of Wisconsin.

Purpose: To determine the time-dependency of quality of life and functional outcome during recovery from injury in pediatric trauma patients.

Methods: We conducted a prospective longitudinal study of children (ages 1-18 yrs) with blunt injury (ISS $\geq$ 9), excluding head/spinal cord injury. Children were evaluated at hospital discharge (baseline), and 1, 6, and 12 months post-injury, using the Children's Health Questionnaire (CHQ PF28) and Wee Functional Independence Measure (WeeFIM). Analysis was by paired t test (significance at $p \leq 0.05$) for change in scores over time, and for comparison of scores to normative data.

Results: Baseline, 1 and 6 month data are included in this analysis. To date, 162 children have been enrolled (mean age 9.3$\pm$5.3; mean ISS 14.3$\pm$7.4) Injury cause was motor vehicular-related 43%, falls 22%, sports/recreation 20%, burns 9% and other 6%. Femur fracture represented the most common injury (54.8%).

	Baseline+	1month+	6 month+
CHQ Psychosocial		44.3$\pm$13.0*	51.2$\pm$10.6
CHQ Physical		20.6$\pm$16.2*	44.0$\pm$15.1*
WeeFIM self care	4.6$\pm$1.6*	5.6$\pm$1.7*	6.8$\pm$0.8
WeeFIM mobility	3.3$\pm$2.1*	4.9$\pm$2.2*	6.8$\pm$0.7**
WeeFIM cognition	6.4$\pm$1.2*	6.6$\pm$1.1*	6.9$\pm$0.5
WeeFIM total	4.8$\pm$1.4*	5.7$\pm$1.5*	6.8$\pm$0.7

(mean$\pm$SD; *p <0.001 comparison to normative data; **p<0.05 comparison to normative data; +p<0.05 comparison baseline - 1month and 1month - 6month scores)

There was a significant improvement in all scores between baseline and 1 month, and between 1 and 6 months post-injury. Patients with femur fractures had significantly lower WeeFIM scores at baseline and 1 month, but no difference in scores at 6 months, when compared to those without femur fractures (4.2 vs 5.2, 5.0 vs 6.2, 6.8 vs 6.8 respectively)

Conclusion: Children demonstrate a rapid recovery of function and quality of life after blunt injury. However, physical function remains lower than age-matched norms.

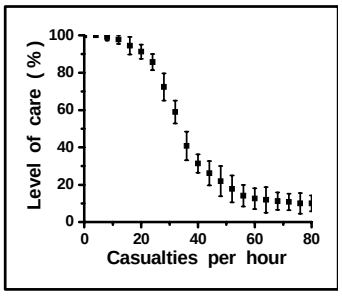
Session 4

Paper 42 10:20 am

HOW DOES CASUALTY LOAD AFFECT TRAUMA CARE IN URBAN BOMBING INCIDENTS ? A QUANTITATIVE ANALYSIS

Asher Hirshberg*, MD, Bradford G Scott, MD, Thomas Granchi, MD, Matthew J. Wall, Jr., MD*, Kenneth L. Mattox, MD*, Michael Stein, MD*‡, Department of Surgery, Baylor College of Medicine, Houston, Texas and Trauma Services, Rabin Medical Center, Petach Tiqva, Israel‡

Introduction: The maximal casualty load a hospital can handle during an urban bombing incident without compromising the care of severely injured patients has never been defined. This study analyzes how casualty load affects quality of trauma care during such incidents. **Methods:** The disaster plan of a US Level 1 trauma center was translated into a computer model that assigned teams and facilities to casualties of a simulated urban bombing incident. The clinical profiles of 223 patients from 22 bombings treated at an Israeli hospital were used to model incoming casualties. Twenty six percent of admitted casualties had ISS>=16, with an over-triage rate of 28%. The model calculated the level of initial trauma care for each critical casualty based on the composition of the treating trauma team and the availability of a shock room, CT scanner and operating room. Routine daily level of care for a single patient was denoted as 100%. Levels of care of individual patients were summed to compute a global value for a wide range of scenarios. The model was implemented using the Monte Carlo simulation method. **Results:** The model predicts that the hospital disaster plan will maintain trauma care at $\geq$90% of the routine daily level for up to 20$\pm$4 casualties (5 critical casualties) per hour (Figure). Adding staff surgeons shifts the curve to the right up to a maximum of 28$\pm$7 casualties/hour beyond which the number of shock rooms becomes the limiting factor. Shortening shock room times by 20% increases capacity from 5 to 7 critical casualties/hour. Increasing over-triage to 50% shifts the curve to the left, decreasing capacity to 4 critical casualties/hour. **Conclusion**: This model is a first attempt to quantitatively correlate caseload with level of care during multiple casualty incidents, and to define the realistic capacity of a trauma center. The study analyzes the implications of disaster planning on the quality of trauma care, and offers a new tool for improving hospital emergency preparedness.



Session 4

Paper 43 10:40 am

IMPROVING THE ABILITY TO PREDICT MORTALITY AMONG BURN PATIENTS

Gerald McGwin, Jr., M.S., Ph.D., Richard L. George, M.D., M.S.P.H., James M. Cross, M.D., Loring W. Rue, III, M.D.* Section of Trauma, Burns, and Surgical Critical Care, Department of Surgery, and Department of Epidemiology, University of Alabama at Birmingham

Background – Early efforts to predict death following thermal injury focused on age and burn size; more recent work incorporated inhalation injury and pneumonia. Gender, co-existing diseases, and concomitant trauma have been implicated in burn mortality but have not been incorporated into mortality equations. **Methods** – The National Trauma Data Bank (NTDB) of the American College of Surgeons contains data from over 200 voluntarily participating trauma and burn centers across the United States. For the purposes of this study, only patients with burn injury were selected. Logistic regression was used to model the odds of mortality with respect to age, gender, % body surface area burned (BSAB), coexistent trauma, inhalation injury, pneumonia and pre-existing medical conditions. Their predictive ability was assessed using receiver operating characteristic (ROC) curves; greater the area below the curves demonstrates better discrimination. **Results** – The NTDB data yielded 14,442 patients with burn injuries. For the univariate models, % BSAB yielded the largest area under the ROC curve (0.69) followed by age and co-morbid chronic medical conditions (both 0.63). The values for inhalation injury, gender, pneumonia, coexistent traumatic injury were 0.60, 0.53, 0.53, and 0.53, respectively. Combining all seven variables into a single model significantly improves discrimination (area under ROC curve 0.87). This multivariate model provided significantly better discrimination than any refined model containing a subset of the seven variables. **Conclusion** – The results of this study suggest that a comprehensive model of burn mortality incorporating variables not previously considered in other equations provides superior predictive ability.

Session 5

Paper 44 8:20 am

THE INVISIBLE TRAUMA PATIENT: EMERGENCY DEPARTMENT (ED) DISCHARGES

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Background: As the malpractice and financial environment has changed**,** injured patients evaluated by the trauma team and discharged from the ED are now commonplace. The evaluation, care, and disposition of this population has become a significant workload component, yet is not reported to accrediting organizations, is poorly reimbursed, and is relatively invisible to hospital administrators. **Objective:** To quantify and begin to qualify the evolving picture of the trauma ED D/C population as a work component of trauma service function in an urban, Level I Trauma Center with an aeromedical program.

Methods: Trauma registry (contacts, mechanism, transport, injuries, and disposition) and hospital databases (ED closure, occupancy rates) were queried for a five-year period (1999 – 2003). Trend analysis provided statistical comparisons for questions of interest.

Results: Presented as mean ± SEM where appropriate. (* $p < 0.05$ for trend over 5 years)

	1999	**2000**	**2001**	**2002**	**2003**
CONTACTS *	2220	2154	2251	2422	2622
Admits	1672 (75.3%)	1483 (68.8%)	1495 (66.4%)	1534 (63.3%)	1544 (58.9%)
ISS	11.5 ± 0.3	11.4 ± 0.3	11.7 ± 0.3	12.0 ± 0.3	11.9 ± 0.3
ED Deaths	67 (3.0%)	62 (2.9%)	51 (2.3%)	74 (3.1%)	64 (2.4%)
ED Transfer Out	8 (0.4%)	26 (1.2%)	17 (0.8%)	16 (0.7%)	14 (0.5%)
ED D/C *	473 (21.3%)	583 (27.1%)	688 (30.6%)	798 (32.9%)	1000 (38.1%)
% Helicopter *	12.3%	22.5%	16.0%	27.6%	29.2%
% Urban *	57.1%	50.3%	59.2%	53.5%	48.1%
ISS *	2.7 ± 0.1	2.7 ± 0.1	2.7 ± 0.1	3.3 ± 0.1	3.3 ± 0.1
ED LOS (min)*	248 ± 8	264 ± 9	267 ± 7	252 ± 6	297 ± 6
ED Closure (hrs)	52	596	261	218	522
Hosp Occupancy	84.2%	79.5%	82.1%	87.0%	89.2%

Conclusions: The total number, relative percent, and injury severity of patients evaluated by the trauma team and discharged from the ED has significantly increased over the last five years, representing nearly 5000 patient care hours in CY 2003. Systems to care for these patients in a cost and resource efficient fashion should be put in place. The impact of this growing population of patients on the workload of the trauma center should be recognized by accrediting agencies, hospital administration, and EMS.

Session 5

Paper 45 8:40 am

IMPROVED SURVIVAL IN MICE GIVEN SYSTEMIC GENE THERAPY IN A GRAM NEGATIVE PNEUMONIA MODEL

MR Hemmila MD, MH Fan MD, J Kim PhD, JM Sun BS, KQ Gong MD, S Arbabi MD MPH, RM Minter MD, DG Remick MD, GL Su MD, SC Wang* MD PhD
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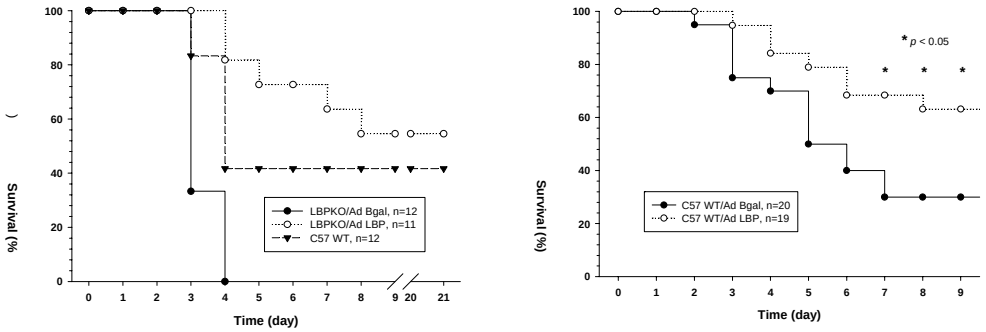
Objective: We previously demonstrated an essential role for lipopolysaccharide binding protein (LBP) in the pulmonary immune response to Gram-negative bacterial infection. LBP knockout (KO) mice had significantly higher mortality (100% vs. 58%), greater rates of bacteremia, and higher counts of viable bacteria in their lungs at sacrifice compared with wild-type (WT) controls. We postulate that systemic LBP gene therapy will reconstitute the innate immune system of LBPKO mice and that over expression of LBP in WT mice may offer a survival advantage. **Methods:** 12-16 week old female C57BL/6 WT mice and age matched LBPKO mice were given $5x10^9$ pfu of recombinant adenovirus containing either the gene for LBP or the irrelevant control protein β-galactosidase by tail vein injection. 72 hours later each mouse was administered 1 x 10^3 CFU/mouse of *Klebsiella pneumonia* (KP) by intratracheal injection. **Results:** Administration of LBP by systemic gene therapy to LBPKO mice improved survival from KP to the level of WT mice exposed to the same dose of bacteria (55 vs. 42%, $p = 0.3$, Cox regression). WT mice given the LBP gene therapy demonstrated increased 7 day survival when compared to controls treated with β-galactosidase (68 vs. 30%, $p = 0.03$).



Conclusion: Systemic gene therapy with intravenous adenoviral vector transfer of LBP significantly improves survival in LBPKO mice. Over expression of LBP in wild-type mice improves survival from *Klebsiella pneumonia*. Gene therapy with LBP in the setting of Gram-negative pneumonia may be of important clinical relevance.

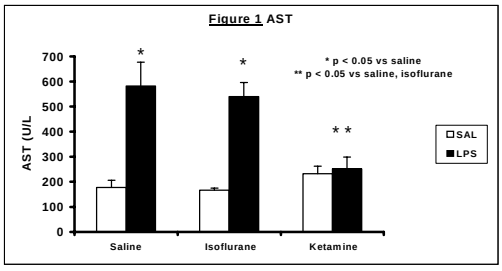
Session 5

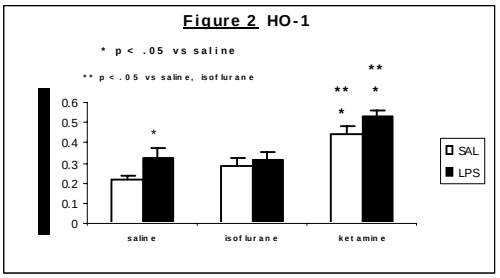
Paper 46 9:00 am

KETAMINE ATTENUATES ENDOTOXIN INDUCED LIVER INJURY: ROLE OF HEME-OXYGENASE 1 (HO-1)

James W. Suliburk MD, Ken S. Helmer MD, David W. Mercer, MD* - The Univeristy of Texas at Houston Medical School, Department of Surgery

Introduction: The liver is both a source and a target of inflammatory and anti-inflammatory mediators during shock. The inflammatory mediator iNOS has been shown to play a role in hepatic injury during endotoxemia and its expression is differentially modulated by various anesthetics. The protein heme-oxygenase-1 (HO-1) has been shown to play a protective role in a number of tissues including the liver. We hypothesized that HO-1 expression would be modulated by different anesthetics. **Methods:** Adult rats were given no anesthesia (saline), continuous isoflurane inhalation, or intraperitoneal injection of ketamine (70 mg/kg). One hour later, saline or LPS (20 mg/kg IP) was given for 5 hours. Rats were killed, serum prepared for determination of aminotransferases, and the liver assessed for HO-1 by Western immunoblot. Data are mean ± SEM ($n \geq 5$; ANOVA).





Results: Rats receiving LPS showed higher levels of AST (ALT similar, data not shown) as compared to saline rats (fig 1). Rats receiving ketamine not only showed attenuated levels of AST, but also showed increased levels of HO-1 protein expression (figure 2). In contrast, rats receiving isoflurane showed no difference compared to no anesthesia (saline) treated animals in expression of liver transaminases or HO-1. **Conclusion:** The anesthetic ketamine attenuates liver injury and promotes the expression of the anti-inflammatory mediator HO-1. This expression of HO-1 may possibly be the mechanism by which the ketamine exerts its hepatoprotective effects. Ketamine may be a beneficial anesthetic adjunct in the treatment of bacteremic patients. (Supported by NIGMS 38529).

Session 5

Paper 47 9:20 am

HEMODYNAMIC AND OXYGENATION RESPONSES TO VOLUME REPLACEMENT DURING EXPERIMENTAL HEMORRHAGIC SHOCK (HS) WITH AND WITHOUT TRAUMATIC BRAIN INJURY (TBI)

Fernando G. Pinto, MD; Antonio Capone-Neto, MD,PhD; Ricardo Prist, PhD; M. Rocha e Silva, MD, PhD.

Sponsoring Member: Luis F. Poli de Figueiredo, MD, PhD

***Introduction*:** The deleterious effects of hypotension on head trauma morbi-mortality are well known as well as that 20% of the head injuried patients also present shock. Some experimental studies have demonstrated that elevated intracranial pressure (ICP) impairs the protective mechanisms against blood loss and hypotension and the use of hypertonic saline solution (HSS) for volume replacement decreases the incidence of elevated ICP. This experimental study evaluated the hemodynamic and oxygenation responses to volume replacement during the acute phase of HS associated with TBI. ***Methods*:** 15 dogs were randomized to one of 3 groups: Group 1=HS+TBI, treated with 3% HSS (n=5), Group 2 = HS+TBI, treated with lactated Ringer's solution (LR) (n=5), Group 3=HS only, treated with LR (n=5). All groups received whole blood to hematocrit of 30%. Treatment simulated pre-hospital and early hospital phases. HS was induced by hemorrhage to MAP=40mmHg and TBI by fluid percussion (4atm). MAP, Cardiac Output (CO), ICP, Cerebral Perfusion Pressure (CPP), Portal Vein Flow, Renal Vein Flow, Cerebral and Systemic Lactate, Cerebral and Systemic Oxygen Extraction, Volume Infused to restore MAP and Blood Loss were measured or calculated. ***Results*:** There was no significant difference between groups in baseline parameters. ICP was higher and CPP lower in group 2. Although ICP and CPP were worse in group 2, there was no difference between groups in cerebral lactate or cerebral oxygen extraction. CO was lower and Systemic Oxygen Extraction and Lactate were higher in the groups with TBI, but the difference was not statistically significant. There was no significant difference in all other parameters between groups. ***Conclusions*:** In this experimental model of hemorrhagic shock and TBI, we could not demonstrate any influence of TBI on hemodynamic and oxygenation parameters during the shock period and early resuscitation phase or any improvement in cerebral oxygenation parameters using hypertonic saline solution.

Session 5

Paper 48 9:40 am

THE ROLE OF EDARAVONE ON THE IMPAIRMENT OF ENDTHELIAL BARRIER FUNCTION INDUCED BY ACUTE OXIDATIVE STRESS IN CULTURED HUMAN UMBILICAL VEIN ENDOTHELIAL CELLS MONOLAYER

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INTRODUCTION : It has recently been proposed that reactive oxygen spices might play an essential role in endothelial barrier dysfunction. However, reliable antioxidant therapeutics in the clinical setting are still unknown. Present study used in vitro models of endothelial monolayer with cultured human umbilical vein endothelial cells (HUVECs). To determine the effects of a novel free radical scavenger "edaravone", 3-methyl-1-phenyl-2-pyrazoline-5-1, against the endothelial barrier dysfunction induced by acute oxidative stress in cultured HUVECs. **METHODS** : HUVECs were grown as monolayer on 24-well Transwell chambers. Twenty mU/mL of xanthine oxidase and 0.25 mM of xanthine (XO+X group) or saline (control group) were administered into the basal chambers. Another set of chambers were treated with XO+X and 0.6 mg/mL of edaravone (ED group). To estimate the integrity of HUVECs monolayer, transendothelial electrical resistance (TEER) were measured for 3 hours. We investigated the permeability change of the monolayer by measuring the transendothelial passage of fluoresces isothiocyanate-labeled dextran (FITC-Dx) and estimated the degree of oxidative stress by measuring the concentration of hydrogen peroxide (H_2O_2) in the basal chambers. **RESULTS** : The TEER changes in the both XO+X and ED group were significantly lower than the control group ($p < 0.001$). The concentration of FITC-Dx in the XO+X group was significantly higher than the control group at three hours (Fig.) ($p < 0.001$). In the XO+X group, the concentration of H_2O_2 was higher than the control and ED group significantly ($p < 0.001$ each). Thus edaravone treatment improved the disturbed endothelial barrier function induced by acute oxidative stress. **CONCLUSION** : The permeability increase induced by acute oxidative stress was prevented by free radical scavenger edaravone significantly iv vitro. This synthesized radical scavenger may potentially have clinical application for endothelial barrier dysfunction.

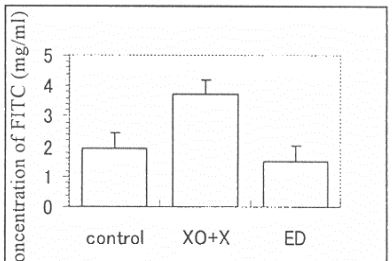

Fig. The permeability change of monolayer.

Session 5

Paper 49 10:00 am

PREHOSPITAL ENDOTRACHEAL INTUBATION AND POSITIVE PRESSURE VENTILATION ARE ASSOCIATED WITH HYPOTENSION AND DECREASED SURVIVAL IN HYPOVOLEMIC TRAUMA PATIENTS: AN ANALYSIS OF THE NATIONAL TRAUMA DATA BANK.

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Purpose: Studies of prehospital endotracheal intubation (ETI) from single EMS systems have shown contradictory results, which may represent local differences in paramedic training and experience. An alternative hypothesis is that prehospital ETI causes hypotension and reduced survival in trauma patients, as positive pressure ventilation (PPV) has been associated with hypotension in hypovolemic states. **Methods:** A national rather than local sample was analyzed (National Trauma Data Bank, 1994-2002). Inclusion criteria were early ETI, prehospital Glasgow coma scale ? 8 (most likely to warrant early ETI) and ISS ? 16 (most likely to be hypovolemic). Patients were divided into those who underwent ETI at the scene (prehospital group, n=871), or in the emergency department (ED group, n=6581). To determine if prehospital ETI was an independent predictor of hypotension and mortality, logistic regression was used to control for potential confounders, including age, ISS, body region injured, AIS scores, prehospital IV fluids, and other variables. Physiologic variables were not used, as they may be influenced by ETI and PPV, and were therefore considered outcomes, rather than covariates. **Results:** Groups were comparable in age, gender, anatomic distribution of injuries, likelihood of at least one severe injury (AIS >3) and other variables, except for head injury (ED 83%, prehospital 71%, p<.001) and ISS (ED 33±0.2, prehospital 36±0.6, p<.001). The prehospital intubation group was more likely to be hypotensive upon ED arrival (SBP ? 90 mm Hg; ED 33%, prehospital 54%, p<.001), and had worse survival (ED 45% vs. prehospital 24%, p <.001). Even after controlling for potential confounders, prehospital ETI was still an independent predictor of ED hypotension (OR 1.7, 95% CI 1.46 – 2.09, p<.001) and decreased survival (OR 0.51, 95% C.I. 0.43 - 0.62, p<.001). **Conclusions:** Prehospital endotracheal intubation in trauma patients is associated with hypotension and decreased survival. This may be mediated by the effect of positive pressure ventilation during hypovolemic states.

Session 5

Paper 50 10:20 am

PROLONGED LOW VOLUME RESUSCITATION WITH HBOC-201 IN A LARGE ANIMAL SURVIVAL MODEL OF CONTROLLED HEMORRHAGE

Colleen M. Fitzpatrick‡, MD, Kristen L. Biggs‡, MD, Fonzie J. Quance-Fitch‡, DVM, B. Zane Atkins‡, MD, Stephanie A. Savage‡, MD, Donald H. Jenkins‡, MD, and Jeffrey D. Kerby§, MD, PhD Wilford Hall Medical Center‡, Lackland Air Force Base, Texas and University of Alabama at Birmingham§, Birmingham, Alabama. Sponsoring AAST member: Peter C. Muskat*, MD, Wilford Hall Medical Center, Lackland Air Force Base, Texas

Objective: Military guidelines call for two 500 cc boluses of Hextend for resuscitation in forward field environments. This study compared a hemoglobin based oxygen carrier (HBOC-201; Hemopure®, Biopure Corp.) to Hextend when used to treat hemorrhagic shock in situations of delayed definitive care military operations. **Methods:** Yorkshire swine (55-65kg) were hemorrhaged to mean arterial blood pressure (MAP) of 30 mm Hg. Hypotension was maintained for 45 minutes followed by resuscitation with either Hextend (HEX) (n=8) or HBOC-201 (HBOC) (n=8). Over 8 hours, animals received up to 1000cc of either fluid to a MAP of 60 mmHg. At the end of 8 hours, HEX animals received 2L of lactated Ringers (LR) followed by shed blood. HBOC animals received 4L of LR only. Animals were survived and necropsied on post-procedure day 5. Hemodynamic data was collected during shock and resuscitation. Complete blood counts, amylase, lactate, coagulation studies, and renal and liver function were measured throughout the experiment. **Results:** Equivalent volumes were hemorrhaged from each group (HBOC 44.3±2.2cc/kg, HEX 47.4±3.0cc/kg). The HBOC group achieved the goal MAP (HBOC 60.0±2.3mmHg, Hex 46.4±2.3mmHg, $p<.01$) and needed less volume during the initial 8 hours (HBOC 12.4±1.4cc/kg, HEX 17.3±0.3cc/kg, $p<.01$). The HBOC group had lower SVO_2 (HBOC 46.3±2.4%, HEX 50.7±2.5%, $p=.12$) and cardiac output (HBOC 5.8±0.4L/min, Hex 7.2±0.6L/min, $p=.05$), but higher SVR (HBOC 821.4±110.7dynes·s·cm^{-5}, HEX 489.6±40.6dynes·s·cm^{-5}, $p=.01$). Base excess, pH, lactate, and urine output did not differ between groups. HEX group survival was 50% (4/8) versus 88% for the HBOC group (7/8). All animals survived the initial 8 hours. Animals surviving 5 days displayed no clinical or laboratory evidence of organ dysfunction in either group. **Conclusion:** HBOC-201 more effectively restored and maintained perfusion pressures with lower volumes, and HBOC-201 allowed for improved survival. These data suggest hemoglobin based oxygen carriers are superior primary resuscitation fluids for use in far forward military operations.

Session 5

Paper 51 10:40 am

IMMUNE ENHANCING AGENTS DIFFERENTIALLY MODULATE THE EARLY PRO-INFLAMMATORY TRANSCRIPTION FACTORS MEDIATING GUT ISCHEMIA/REPERFUSION

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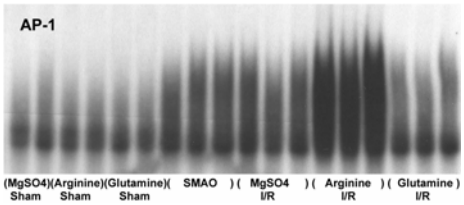
Recent reports suggest that enteral diets enriched with arginine (arg) may be harmful by enhancing inflammation. This is consistent with our gut ischemia/reperfusion (I/R) model where arg was shown to induce the pro-inflammatory mediator iNOS and result in injury and inflammation while glutamine (glut) was protective through induction of the anti-inflammatory mediator PPARγ. We now hypothesize that arg and glut differentially modulate the early pro-inflammatory transcription factors activated by gut I/R. **Methods**: Jejunal sacs were created in rats at the time of laparotomy and filled with either 60 mM glut, arg, or MgSO4 (nonabsorbable osmotic control) or no sac followed by 60 min of superior mesenteric artery occlusion (SMAO) and 6 hrs of reperfusion. Jejunum was harvested and NFKB and AP-1 measured by electrophoretic mobility shift assay and c-jun and c-fos (AP-1 family) by supershift. ANOVA with Tukey post hoc, mean ± SEM, n=5-6/group. Means with different superscripts are significantly different. **Results**: Summary densitometry for NFKB and AP-1 protein expression are shown below. Shams were similar and therefore results combined for analysis.

Group	NFKB	AP-1
Sham	8,832,602 ± 29,270 a	17,070,879 ± 94,424 a
SMAO alone	12,831,122 ± 50,874 b	21,965,584 ± 577,541 b
MgSO4 I/R	12,763,147 ± 79,009 b	23,091,503 ± 904,823 b
Arginine I/R	12,731,978 ± 101,667 b	35,779,063 ± 1,737,619 c
Glutamine I/R	12,475,452 ± 37,424 b	19,181,146 ± 307,492 a



Both NFKB and AP-1 were activated by gut I/R. Arg and glut had no differential effect on NFKB while AP-1 expression (c-jun but not c-fos) was markedly enhanced by arg and significantly lessened by glut. **Conclusion**: Arg and glut exerted no differential effect on NFKB but rather modulated the early pro-inflammatory transcription factor AP-1. This represents a novel mechanism by which arg may be harmful when administered to critically ill patients.

Session 6-A

Paper 52 1:00 pm

THE RISK BENEFIT RATIO FAVORS THE USE OF INTRAVENOUS CONTRAST IN TRAUMA PATIENTS PRESENTING WITH HIGH SERUM CREATININE

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Objective: Assess the risks and benefits of intravenous (*iv*) contrast in trauma patients who present with an elevated serum creatinine (Cr).

Background: CT scan with *iv* contrast is the test of choice in many trauma centers to rapidly assess for life threatening injuries. Contrast nephropathy (CNP), however, is associated with increased morbidity and mortality. While the incidence of CNP has been reported to be as high as 38% in certain patients, no data exists on the incidence of CNP in trauma patients presenting with an elevated Cr. This poses a difficult dilemma for the physician who must balance the risks & benefits of proceeding with an *iv* contrast study versus the risks of missed injuries/ delay in diagnosis. As such, we undertook this review.

Methods: A 2 year (2002-03) retrospective chart review of all trauma patients presenting with an elevated Cr ($\geq$1.3 mg/dL or $\geq$115 umol/L). Demographics, serial Cr, procedures, complications and outcome were recorded. Results are mean ± sd ($p < 0.05$ significant).

Results: Ninety-five patients (7% of our Level 1 trauma admissions; age 51±23yrs; ISS 28.5±15.6; hospital stay 29±32 days; mortality 9%) presented with a Cr ? 1.3 mg/dL (31 had Cr ?1.7; three were already dialysis dependent). Sixty percent (57) were given contrast(C+), of which only 2 (3%) had a transient rise of 25% in Cr within 48 hrs vs. 6 (16%) of patients not exposed to contrast(C-). No C+ patient developed CNP requiring dialysis. Of the 57 undergoing C+ tests, 17 had injuries requiring urgent surgery identified; 15 had injuries that were managed nonoperatively, and 25 had serious injuries ruled out. There was no difference in mortality (C+ 5% vs. C- 16%; p=0.15). Of the 38 C- patients, a C+ study was not indicated in 22 - however, of the remainder: 9 had indeterminate CT's; 2 had missed injuries (both died); and 2 had no injuries found at celiotomy.

Conclusion: This study suggests the risk of CNP in trauma patients presenting with an elevated Cr is small, and thus, the risk-benefit ratio is favorable for proceeding *prn* with *iv* contrast in most trauma patients. A larger study is needed to confirm these findings.

Session 6-A

Paper 53 1:20 pm

CLINICALLY RELEVANT OSMOLAR STRESS INHIBITS PRIMING INDUCED PMN NADPH OXIDASE SUBUNIT TRANSLOCATION

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Purpose of Study: The plasma membrane NADPH oxidase is responsible for the external generation of superoxide by PMNs. The oxidase is multicomponent, active only when all subunits are translocated to, and assembled at the membrane. We have recently demonstrated that PAF priming translocates the cytosolic subunit p67^{phox} to the membrane. Osmolar stress attenuates PAF priming of the oxidase. Mechanistically, we hypothesize that clinically relevant osmolar stress inhibits PAF priming induced p67^{phox} translocation. **Methods:** Isolated human PMNs were incubated at 37°C for 5 min in buffer or 180 mMol hypertonic-saline (HTS) followed by 3 min incubation ± 2μM PAF (Resting, PAF, HTS-PAF). Subcellular fractions were prepared and membrane translocation was determined by protein electrophoresis. Resting cytosol fractions were immunodepleted of p67^{phox} and NADPH oxidase activity measured using p67^{phox} deficient SDS cell-free oxidase assays: resting, PAF or HTS-PAF membrane (1μg) was combined with immunodepleted resting cytosol (25 μg). **Results:** Membrane p67^{phox} by protein electrophoresis: PAF induced membrane translocation of p67^{phox} was prevented by osmolar stress (HTS-PAF),

Figure 1

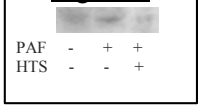

Figure 2

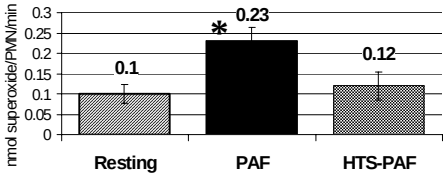

Figure 1. Cell-free oxidase assay: Following PAF stimulation, the membrane content of p67^{phox} induced significant oxidase activity as compared to resting and HTS-PAF membrane (0.1 ± 0.02, 0.23 ± 0.04, 0.14 ± 0.04, respectively, P<0.01); resting vs. HTS-PAF = no difference, *Figure 2*. **Conclusion:** PAF priming of the PMN oxidase involves translocation of p67^{phox} to the plasma membrane. Clinically relevant osmolar stress prevents PAF induced translocation of the p67^{phox} oxidase subunit. This finding provides new insight into the mechanisms responsible for osmolar control of PMN priming.

Session 6-A

Paper 54 1:40 pm

LONG-TERM PTSD PERSISTS AFTER MAJOR TRAUMA IN ADOLESCENTS: NEW DATA ON RISK FACTORS AND FUNCTIONAL OUTCOME

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Introduction: Little is known about long-term psychological outcomes after major trauma in adolescents, a leading cause of death and preventable morbidity in this age group. A prospective epidemiologic study was conducted to examine quality of life (QoL) and post-traumatic stress disorder (PTSD) outcomes in injured adolescents. The specific objectives of the present report are to describe long-term PTSD and to identify risk factors for long-term PTSD and the impact of PTSD on QoL.

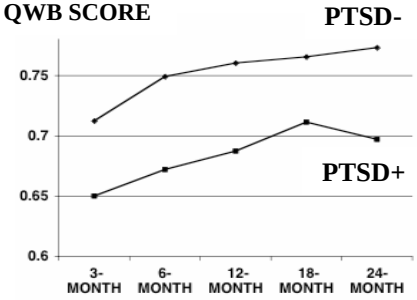
Methods: 401 trauma patients were enrolled (Age 12-19; ISS >= 4). QoL was measured using the Quality of Well-being Scale (QWB). PTSD was diagnosed with the Impact of Events Scale Revised (24+ = PTSD+). Patient outcomes were assessed at discharge and at 3, 6, 12, 18, and 24 months after discharge.

Results: The rate of long-term PTSD was 24%, with high rates over the follow-up.

TRP-A PTSD RATES

Discharge (N)	3-Month (N)	6-Month (N)	12-Month (N)	18-Month (N)
40% (401)	29% (204)$^{\delta}$	19% (344)$^{\delta}$	15% (297)$^{\delta}$	10% (252)$^{\delta}$

$^{\delta}$Totals vary due to incomplete IES-R coding or follow-up status.



Risk factors for long-term PTSD were perceived threat to life (OR = 2.9, P < 0.001.); no control over event (OR = 2.0, P < 0.05). Long-term PTSD was associated with marked QoL deficits as shown in the Figure (P < 0.001).

Conclusions: High rates of long-term PTSD persist after major trauma in adolescents. Injury-events such as perceived threat to life and control over the event are strongly associated with PTSD risk. Prolonged PTSD severely impacts QoL outcomes. Early identification and treatment of risk factors for long-term PTSD will be important in order to improve outcomes in injured adolescents.

Session 6-A

Paper 55 2:00 pm

ENDOTHELIAL CELLS DECREASE INFLAMMATORY MEDIATOR-INDUCED PERICYTE APOPTOSIS

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James G. Tyburski, M.D.*
Robert F. Wilson, M.D.*
Christopher P. Steffes, M.D.*

Introduction: The purpose of this study was to determine the effects of the inflammatory mediators, tumor necrosis factor-alpha (TNF), interleukin-1 (IL-1), and interleukin 6 (IL-6), on pericyte apoptosis in the presence and absence of endothelial cell co-culture.
Methods: Rat lung microvascular pericytes and endothelial cells were harvested and grown in culture. A semipermeable membrane separated the pericytes and endothelial cells grown in co-culture. The cells were then exposed to the various mediators at a concentration of 50 μg/cc for 12, 24, and48 hours. Lysed cells were then examined by Western blot for products of apoptosis.
Results: Pericyte exposed to TNF demonstrated increased levels of p11 and p17, activated fragments of the cysteine effector protease caspase-3, involved in cleaving cytoskeletal and nuclear proteins during apoptosis. Pericytes grown in endothelial cell co-culture demonstrated reduced levels of p11 and p17 and increased levels of Bcl-X_L, an anti-apoptotic protein which protects mitochondrial integrity, prevents cytochrome c release, and subsequent caspase-9 activation. Il-1 showed increased levels of p17 in pericytes alone compared with pericytes in co-culture. Il-6 administration resulted in higher detection of p11 and p17 in pericytes alone vs. pericytes in co-culture.
Conclusion: The presence of microvascular endothelial cells appears to have an anti-apoptotic effect on lung microvascular pericytes exposed to inflammatory mediators. As pericytes and endothelial cells together comprise the capillary basement membrane, their supportive relationship suggests that *in vitro* studies of altered microvascular permeability in the setting of inflammation are best studied in a co-culture system. Future studies are needed to determine if pericyte apoptosis is an important mechanism in altered capillary permeability.

Session 6-A

Paper 56 2:20 pm

TRAUMATIC RETROPERITONEAL HAMATOMA EXTENDS THROUGH THE INTERFASCIAL PLANES.

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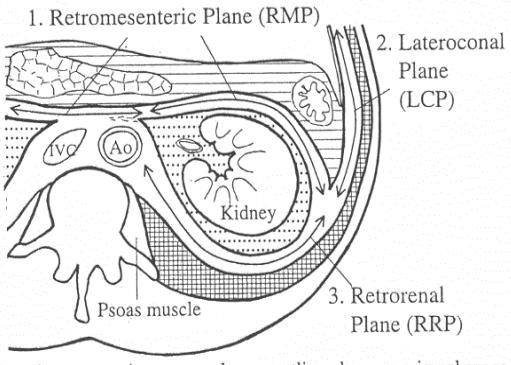
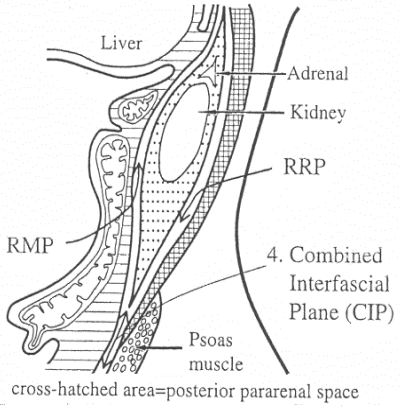
Background: It is well known that retroperitoneum (RP) is divided into three compartments (CPs) but the pathways of extension of traumatic retroperitoneal hematoma (TRH) have not been fully investigated, which might be one of the reasons of the still high mortality. Recently, a new anatomic concept of RP has been advocated. (*AJR* 2000;175:363-70) The theory regards renal fascia or lateroconal fascia not only as a barrier between the CPs but also as potential space, interfascial plane (IP), which communicates with the CPs. (Fig 1, Fig2) The objective of this study is to clarify the pathways of TRH. **Patients and Methods :** This is a retrospective review of 455 patients with blunt trauma who were admitted to our trauma center and underwent abdominal or pelvic CT scan between 1999 and 2003. The distribution and the volume of TRH were estimated by their CT scans. **Results:** TRH was positive in 119 patients (26.2 %). The underlying injuries were 68 of pelvic fracture, 29 of renal injury, and others. In 100 patients (84.0 %), TRH extended into IPs beyond the original CP. The positive rate of hematoma was 52 % in RMP, 34 % in LCP, 55 % in RRP, and 53 % in CIP. Thirty-one of the patients had massive TRH spreading from upper RP to pelvis via CIP, whose mortality was 54.8 %. The volume of the TRH was totally 896±265 ml and that in the part of IPs accounted for 78±9 % of all. **Conclusion:** TRH spreads via IPs. Massive TRH is mainly present in IPs. These findings are essential for the therapeutic tactics for massive TRH.

Fig 1. Interfascial Planes in RP



stripped area=anterior pararenal space; stlipped area=perirenal space

Fig 2. Longitudinal plane of RP



cross-hatched area=posterior pararenal space

Session 6-A

Paper 57 2:40 pm

REPEAT HEAD CT AND NEUROSURGICAL CONSULTATION FOR MINOR TRAUMATIC HEAD INJURY IS NOT INDICATED IN NEUROLOGICALLY STABLE PATIENTS WITH GCS OF 14 OR 15

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Background: Trauma patients with suspected head injury receive computed tomography of the head (CT-H). Although many of these are positive for acute injury and receive a neurosurgical (NS) consult, the only recommendation is repeat CT (rCT-H) to confirm stability of the injury. With the increasing diagnostic sensitivity of CT, smaller traumatic brain injuries are being identified and subsequently rescanned without clinical benefit.

Objective: Patients presenting with GCS of 14 or 15, stable neurological status, and CT-H findings of minor intracranial injury do not require rCT-H. For small contusions and bleeds, NS consultation is recommended only for select groups based on neurologic exam.

Method: Retrospective review of the trauma registry between 1996-2003 at a level 1 trauma center. With 85% blunt trauma and 3100 annual admissions, 2830 patients with acute head injury from a database of 24,000 were reviewed. 1237 patients met the GCS inclusion criteria. Mechanism of injury, neurologic exam, radiological findings, NS intervention, treatment recommendations, readmissions, and outcomes were analyzed.

Results: 821 patients presented with GCS of 15 and a positive CT-H finding. Patients without neurological deterioration had negative rCT-H for injury progression. Positive rCT-H correlated with observed neurological changes. There were similar findings for the 416 patients with GCS of 14. NS intervention would not have differed if consultation was obtained upon identification of neurologic deterioration. Of the 1237 patients, 15 were readmitted for neurologic indications with 4 clinically significant events.

Conclusions: Trauma patients presenting with and maintaining GCS of 15 despite CT-H for an injury do not need rCT-H. We advocate that these patients may be safely monitored with neurological exam. Furthermore, these patients do not require NS consult on initial presentation; consultation should be obtained if injury progression is indicated by change in mental status or exam. The NS treatment pathway and time course remain unaffected; however, the number of excessive consultations would be dramatically reduced.

Session 6-A

Paper 58 3:00 pm

LIFE AFTER 80 HOURS: THE IMPACT OF RESIDENT WORK HOURS MANDATES ON TRAUMA AND EMERGENCY EXPERIENCE AND WORK EFFORT FOR SENIOR RESIDENTS AND FACULTY

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Objective: To evaluate the impact of work hours mandates on: 1) senior resident (PGY 4/5; n = 5/month) experience in Trauma and Emergency Surgery; and 2) faculty (n = 8) work effort.

Methods: We measured resident and faculty work on the Trauma and Emergency Surgery services at our Level I Trauma Center during two comparable six-month periods. Period 1 (7/01-12/31/2002) had no call restrictions, separate Trauma and Emergency service resident call and some overlap of faculty call responsibilities. Period 2 (7/01-12/31/2003) had resident work hours compliance and complete integration of resident and faculty Trauma and Emergency call. Work hours were measured by surveys for faculty and residents. All data were collected prospectively.

Results:

Parameter	Period 1	Period 2
Trauma admissions	1550	1550
Emergency surgery admissions	541	480
Trauma/Emergency ICU admits	528	592
Trauma/Emergency OR cases	260	258
% OR cases done by PGY 4/5	82%	82%
Call days/PGY 4/5-month	12.3	6.1*
Call days/faculty-month	4.8	3.8
Work hours/PGY 4/5-week	95.0	76.7*
Work hours/faculty-week	60.4	59.4

*p< 0.05, Period 1vs. Period 2 (Mann-Whitney test)

Total faculty OR volume (elective + emergency cases) and faculty work relative value units (RVUs) both increased 2% from Period 1 to 2.

Conclusions: Work hours compliance resulted to a 50% reduction in PGY 4/5 call and a 19% decrease in work hours with no significant change in Trauma/Emergency patient care exposure or OR case load. Service call amalgamation reduced faculty call by 20% but did not result in a corresponding change in work hours, OR volume, or work RVUs.

Session 6-A

Paper 59 3:20 pm

DECREASED TRANSFUSION UTILIZATION AND IMPROVED OUTCOME ASSOCIATED WITH THE USE OF RECOMBINANT FACTOR VIIA AS AN ADJUNT IN TRAUMA

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Brian Warren MD
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Peter Iau MD

Introduction Uncontrolled bleeding is a leading cause of death and morbidity in trauma. We assessed the efficacy and safety of recombinant activated coagulation factor VII (rFVIIa) as adjunctive therapy for control of severe traumatic hemorrhage.

Methods Patients with blunt or penetrating trauma and blood loss, requiring transfusion of 8 units RBC, were entered in a multi-center, double-blind, prospective, randomized, placebo-controlled trial with rFVIIa. Three infusions of rFVIIa, 200µg/kg, 100µg/kg and 100µg/kg or placebo were administered at entry, at 1 hr, and 3 hr in addition to local standard surgical treatment. Patients were intensively monitored for 48 hours with a 30-day follow-up. Primary endpoint was transfusion requirement. Secondary endpoints were death and organ failure.

Results 301 trauma patients were entered of which 277 (143 blunt and 134 penetrating) were analyzed. In blunt trauma (ISS 33±13SD), when early deaths were excluded, there was a significant ($p<0.05$) decrease in the number of red blood cell transfusions within 48 hours and a trend to reduced MOF and ARDS. In the penetrating trauma group, there was only a trend to a reduction in RBC transfusion. No safety issues were identified in either group.

30 days outcome	**Blunt trauma**			**Penetrating trauma**		
	Placebo (N=74)	**rFVIIa** (N=69)	p	**Placebo** (N=64)	**rFVIIa** (N=70)	p
MOF and/or ARDS n (%)	17 (23%)	7 (10%)	0.07	11 (17%)	5 (7%)	0.11
Death n (%)	22 (30%)	17 (25%)	0.58	18 (28%)	17 (24%)	0.69
ICU-free days median (min-max)	8 (0-29)	13 (0-30)	0.18	20 (0-30)	24 (0-30)	0.26
Ventilator-free days median (min-max)	14 (0-30)	17 (0-30)	0.44	22 (0-30)	26 (0-30)	0.17

Conclusions rFVIIa decreased RBC transfusion requirements in major traumatic hemorrhage while showing a good safety profile in high-risk patients. The trends seen towards reduced MOF and ARDS were noted but not statistically significant.

Sponsored by Novo Nordisk A/S

Session 6-A

Paper 60 3:40 pm

INTESTINAL EPITHELIAL CELLS MODULATE PMN ACTIVATION AND APOPTOSIS FOLLOWING BACTERIAL AND HYPOXIC CHALLENGES

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Objective: The post-ischemic gut may serve as a priming bed for neutrophils for the subsequent development of multiple organ failure (two-hit phenomenon). The gut contains a vast array of immunocompetent cells and intraluminal bacteria and other toxins which may interact to impact this response. However, the initiating event which may trigger this immunoinflammatory cascade from the gut is unknown. Recent studies have indicated that intestinal epithelial cells (IEC) play an integral role in generating and transmitting signals between luminal bacteria and the host cells in the underlying gut tissues. The purpose of this study was to investigate the ability of IEC to modulate PMN responses to bacteria and/or hypoxia/reoxygenation (H/R) challenges *in vitro*.

Methods: Caco2 cell monolayers were established in a two-chamber cell culture system. Neutrophils from normal human volunteers were placed in the basal chamber and the cell co-culture exposed to either apical bacteria (*E. coli*) and/or H/R challenge. PMN apoptosis (Apo), and percentage of CD11b expression, as well as elastase and SOD release were subsequently quantitated.

Results: (n = 4 in each group)

	% Apo	% CD11b
PMN control	2.5 ± 0.7	65.2 ± 3.2
PMN + H/R	17.4 ± 2.2*	78.9 ± 5.4#
PMN + *E. Coli*	28.2 ± 1.1*	122.6 ± 3.9#
PMN + *E. Coli* + H/R	29.0 ± 0.8*	129.1 ± 3.1#
PMN + *E. Coli* + Caco2	5.9 ± 1.8	232.0 ± 6.9#$
PMN + *E. Coli* + Caco2 + H/R	4.5 ± 1.4	297.0 ± 8.8#$

* $p < 0.001$ vs. control, # $p < 0.001$ vs. control, $p < 0.001 vs. all groups

SOD and elastase production from PMNs was greatest following *E. coli* challenge.

Conclusion: IEC modulate PMN response to bacteria and H/R insults. This results in the production of activated neutrophils with an exaggerated lifespan which may promote remote organ failure. Attempts to modulate this response may be useful in preventing multiple organ failure following severe traumatic shock.

Session 6-A

Paper 61 4:00 pm

TRISS FOR EVERYONE - INCORPORATING RECENT ADVANCES TO MAKE TRAUMA OUTCOME SCORING UNIVERSALLY AVAILABLE

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Patrick Kilgo, MS, Wake Forest School of Medicine
Preston Miller, MD, Wake Forest School of Medicine*
Jason Hoth, MD, Wake Forest School of Medicine*
Micheal Chang, MD, Wake Forest School of Medicine*
Jonathan Hundley,MD, Wake Forest School of Medicine

Background: The Trauma and Injury Severity Score (TRISS), used to garner predictions of survival from the Injury Severity Score (ISS, for injury severity), the Revised Trauma Score (RTS, for physiologic reserve) and age (a surrogate for pre-existing comorbidities), is difficult for many trauma facilities to compute because it requires 10 variables and ISS depends on the specialized Abbreviated Injury Scale (AIS) rather than the more universal International Classification of Diseases, 9th revision codes (ICD-9). It's been shown that a patient's worst injury is a powerful predictor of survival (regardless of coding type, AIS vs. ICD-9) and that the Glasgow Coma Score (GCS) motor component contains the majority of the information found in the full GCS score. This study hypothesized that TRISS could be made more predictive and efficient (fewer variables) by incorporating these advances.

Methods: A total of 317,000 National Trauma Data Bank patients with non-missing TRISS variables were subset. Logistic regression was used to model mortality as a function of anatomic, physiologic, and comorbid (using age) variables. Model 1 used traditional TRISS variables - ISS, RTS, age and mechanism to predict mortality. Model 2 used the survival risk ratio corresponding to the patient's worst ICD-9 coded injury, the GCS motor component and age. Models 1 and 2 were compared using the area under the ROC curve (AUROC, a measure of model discrimination, the ability to distinguish survivors and non-survivors) and the pseudo-R^2 statistic (the proportion of variance explained by the model).

Results: The table below gives a comparison of the models' performance and features:

Model	Number Of Variables Required	AUROC	Pseudo-R^2
Model 1 (TRISS)	10	.9516	.5083
Model 2 (New TRISS)	3	.9556	.5438

Conclusions: Recent advances in anatomic and physiologic scoring markedly simplify TRISS-type models at no cost to prediction. Model 2 uses routinely available data, requires 7 fewer terms, and predicts as well as the original TRISS. These findings will increase the availability of accurate trauma scoring tools to smaller trauma and critical care facilities.

Session 6-A

Paper 62 4:20 pm

REDISTRIBUTION OF ADMISSIONS: REDUCES WORKLOAD WITHOUT INCREASING RISK

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INTRODUCTION: The era of the 80 hour resident work week mandates new approaches to reducing the workload on busy services. Given the improved reliability of CT scanning as a screening tool, the long standing policy of 24-48 hour observation on the trauma service to avoid missed injuries may be obsolete. In July 2003 we instituted a policy of direct admission to sub-specialty surgical services for adult patients with a negative trauma evaluation and single system injury or one major injury with accompanying injuries of AIS ? 2. Our hypotheses are that this policy 1) decreases the trauma resident workload and 2) does not increase the rate of missed or delayed diagnoses.

METHODS: Retrospective review of the trauma registry of a level I trauma center and the Surgical Activity Tracking System (SATS) database. Number of adult trauma admissions, mean ISS, mean age, mechanism, gender distribution and admitting service were obtained for 6 month periods from July 2001 through December 2003. Missed injury data were reviewed from July 1999 through December 2003. Fisher's exact and student's t-test were used for statistical analysis.

RESULTS: There was no statistically significant difference between comparable six nonth periods with respect to mean ISS, mean age and gender distribution.

Admissions	TRAUMA	OTHER	TOTAL	Missed Injuries	
				Trauma	Other
Jul-Dec 2001	225 (46%)†	270 (55%)†	495	8†	3†
Jul-Dec 2002	252 (47%)†	288 (53%)†	540	4†	0†
Jul-Dec 2003	148 (31%)‡	327 (69%)‡	475	2†	0†

† *no statistically significant difference*

‡ *statistically significant to $p < 0.001$*

CONCLUSIONS: Direct admission of trauma patients to sub-specialty surgical services following a complete trauma evaluation is both safe and efficient. Our preliminary data show a decrease in resident workload by approximately 15% with no increase in the number of delayed or missed diagnoses.

Session 6-A

Paper 63 4:40 pm

THE INFLUENCE OF ESTRADIOL AND DIHYDROTESTOSTERONE ON POST-TRAUMATIC INFLAMMATORY CYTOKINE LEVELS

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OBJECTIVE: Experimental findings support the hypothesis that estrogens are beneficial whereas androgens are detrimental in animal models of trauma-hemorrhage (TH) and sepsis. However, clinical research evaluating the association between sex hormones and cytokines following trauma is limited. The present study sought to test for an association between sex steroid hormones and inflammatory cytokines in trauma patients. METHODS: A prospective study of a general trauma patient population was conducted at a Level I trauma center. Admission and daily blood samples were assayed for cytokines (interleukin (IL)-1, IL-6, IL-10) and sex hormones (Estradiol (E2), Dihydrotestosterone (DHT)). Injury Severity Score (ISS) was categorized (<10, 10-15, >15); cytokine levels (pg/ml) were log transformed and regressed on ISS. The association between IL-1 and IL-10 levels and initial E2 or DHT levels was calculated using generalized estimating equations in order to account for the longitudinal nature of the data, adjusting for age and race. RESULTS: Of the 175 eligible patients, 64% were enrolled; 71% were male and 64% were Caucasian; mortality was 1%. Higher ISS was associated with admission values of higher IL-1 ($p<0.003$), higher IL-10 ($p<0.04$), but not IL-6 ($p=0.27$). In the ISS 10-15 group, higher DHT levels were associated with higher IL-1 levels ($p<0.0001$); higher E2 levels were inversely associated with higher IL-1 levels ($p<0.05$) and with higher IL-10 levels ($p=0.01$). Such relationships were not evident in the remaining ISS groups. CONCLUSIONS: Elevated pro-inflammatory IL-1 levels are associated with higher DHT and inversely associated with higher E2 levels. The results of this pilot study are consistent with experimental data in animal models showing exaggerated pro-inflammatory responses in male animals and attenuated responses in female animals or E2 treated males sustaining TH. The lack of correlation between IL-6 and ISS is likely related to the early time post-injury that samples were collected. These findings suggest that in a subset of trauma patients sex steroid levels at the time of injury influence the inflammatory response and, therefore, potentially outcome.

Session 6-B
Paper 64 1:00 pm

OUTCOME OF CARDIAC ARREST AFTER ACCIDENTAL DEEP HYPOTHERMIA AND INDICATION FOR CARDIO PLUMONARY BYPASS

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Purpose: CPB is effective for resuscitation for in cases of cardiac arrest after accidental deep hypothermia (ADH), but the indications for CPB have not yet been cleared properly. The purpose of this study was to investigate the outcome of cardiac arrest after ADH and to clarify the indications for CPB by a retrospective review.
Methods: Out of 69 patients carried to our ER between 1990 and 2004, there were 15 for whom CBP was performed for resuscitation from ADH with circulatory arrest. We reviewed the prognostic factors (cause of ADH, the medical histories, body temperature, electrocardiography, cardiac arrest time, to introduce CPB, time to restart heart beat, and complications, prognosis). Neurological prognosis was measured by the Glasgow Outcome Scale (GOS) at the time of discharge from hospital.
Results: The average age of the patients was 45.7+/-20.5 years, 8 were male and 7 were female. The causes of ADH were 7 drowning, 3 mountaineering, 4 drug and alcohol abuse. The body temperature was 23.3+/-3.9 C. electrocardiography finding were 7 Vf, 7 asystole, 1 PEA. The mean interval from discovery of patients to carrying to ER was 37.0+/-25.6 minutes. The mean interval from admission to rewarming with CPB was 37.0+/-25.6 min, and 13 of the 15 patients obtained spontaneous heart beats, and the mean interval from CPB to the restart of heart beat was 31.9+/-29.5 min. Eight patients had neurological recoveries, and neurological prognoses were 5 GR, 1 MD, 1VS, and 8 dead. Six patients had severe lung complications, and one patient died of multiple organ failure. The findings of ECG and body temperature at admission did not relate to prognosis at the time of discharge. Prognoses of drowning patients were bad, and the prognoses of the patients of drug and
Conclusion: CPB improved prognosis of ADH, and was particularly benefited for patients that AHD caused by drug and alcohol abuse.

Session 6-B

Paper 65 1:20 pm

TRIAL RESULTS FOR THE TREATMENT OF TRAUMATIC VASCULAR INJURY WITH A COVERED STENT

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Objective: Evaluate the efficacy of endovascular deployment of the Wallgraft® Endoprosthesis for the treatment of traumatic arterial lesions, in a prospective, multi-center trial. Endpoints are exclusion success, patency, and freedom-from-bypass at 12 months, and major adverse events.

Methods: A total of 65 patients (age 62±18) were treated with the Wallgraft stent-graft for traumatic injuries to the following vessels: 36 iliac, 11 femoral, and 18 subclavian/axillary arteries. The indication for treatment was perforation/rupture in 46 patients, AV fistula in 16 patients, and dissection in 3 patients. Iatrogenic injuries accounted for 72% of all lesions. Exclusion of the injury and patency were assessed using duplex ultrasound, CT, arteriography or MRA immediately post-procedure and at one-year. Using analysis of the literature, major adverse event rates were compared to those for the surgical intervention of arterial trauma.

Results: Immediate post-procedure exclusion of the injured artery was achieved in 94% (61/65) of patients receiving the Wallgraft Endoprosthesis. There were no device or procedure-related deaths. One-year exclusion of the target vessel was 91.8% within iliacs, 70.1% within femoral , and 90.0% for subclavian/axillary. One-year primary patency was 72.2% within iliac arteries, 85.7 % within femoral arteries, and 80.0% within subclavian /axillary arteries. Freedom-from-bypass was achieved in 74.6% of iliac arteries and 100% in femoral and subclavian/axillary segments. Analysis of the literature revealed the rate and severity of complications is less than those associated with surgical repair.

Major Adverse Events	
Acute occlusion (<30	5 (8%)
Stenosis (>50%)	3 (5%)
Late occlusion	1 (2%)
Infection	2 (3%)
Bleeding req. transfusion	1 (2%)
Puncture -site PA	1 (2%)
Pseudoaneurysm	1 (2%)
Arm Swelling	1 (2%)
Total Adverse Events	**14 (22%)**

Conclusion: Use of the endovascular Wallgraft Endoprosthesis for the exclusion of traumatic vascular injuries offers a promising alternative to conventional surgical repair with comparable patency and less major morbidity and mortality.

Session 6-B

Paper 66 1:40 pm

ADMISSION SERUM LACTATE LEVELS DO NOT PREDICT MORTALITY IN THE ACUTELY INJURED PATIENT

Authors: Jay D. Pal MD, PhD, Gregory P. Victorino MD, Patrick Twomey MD, Terrence H. Liu MD, Alden H. Harken MD

Sponsor: James M. Betts MD

Introduction: The conventional view that admission lactate levels predict outcome in trauma patients stems from simple comparisons of mean blood levels between groups and small sample sizes. To better address this question we performed more rigorous statistical analyses of lactate in a larger patient sample.

Methods: We prospectively collected data on injury severity (ISS), admission lactate, and outcomes in 5995 patients admitted to an urban, university-based trauma center. The ability of admission lactate to predict mortality was assessed by logistic regression, calculation of positive predictive values (PPV), and measurement of areas under receiver operating characteristic (ROC) curves.

Results: Differences between survivors and non-survivors in means of most proposed prognosticators was again demonstrated. However the large overlap in these variables between survivors and non-survivors prevented clinically useful predictions. The overall PPV of elevated lactate was only 5.4%.

Logistic regression showed that ISS accounted for nearly all the variability in predicted survival. Even in severely injured patients, (ISS>20; mortality 23%), lactate level added only 4% to the predictive ability of ISS alone. ROC analyses found no useful sensitivity threshold overall nor after stratification by age, gender, GCS, revised trauma score, or mechanism of injury. After accounting for ISS, lactate levels contributed little or nothing to prognosis in any subgroup.

Conclusions: Previous reports proposing usefulness of lactate level suffered from inadequate sample size and low predictive accuracies. Our examination of a larger number of trauma patients fails to support such utility. We conclude that admission lactate has limited usefulness for prognostication or triage of trauma patients.

Session 6-B

Paper 67 2:00 pm

HALO VEST IMMOBILIZATION IN THE ELDERLY: A DEATH SENTENCE

Sarah Majercik MD (Brown University Department of Surgery), Walter Biffl MD* (Brown University Department of Surgery), Robert Tashjian MD (Brown University Department of Orthopedics), David Harrington MD*, William Cioffi MD* (Brown University Department of Surgery)

C-spine fractures (CSF) in elderly patients are increasingly common on the trauma service. In many centers, halo vest immobilization (HVI) is the treatment of choice. Our anecdotal experience suggested that elderly patients with HVI had frequent bad outcomes. The purpose of this study was to compare the outcomes of elderly and younger CSF patients as related to treatment (HVI, surgery, or hard collar). **Methods:** Registry data from our level I trauma center were reviewed to identify patients admitted with CSF during an 80-month period. We excluded those with admission GCS=3, brain death, or death within 24 hr of admission. Patients were grouped as OLD (age?66) or YNG (18-65). Data were compared using chi-square, with $p<.05$ considered statistically significant. **Results:** 132 OLD (age 80±1) and 289 YNG (age 38±1) patients met study criteria. ISS was higher in YNG (19±1 vs 15±1, $p<.05$) and GCS was the same (11±1) in both, but mortality was higher in OLD patients (23% vs 5%, $p<.05$). Treatment and mortality rates for each group were:

	HVI		**Surgery**		**Hard Collar**	
	Total	Deaths	Total	Deaths	Total	Deaths
OLD	33	13 (39%)*	19	2 (11%)	80	15(19%)
YNG	59	1 (2%)	65	1 (2%)	165	13 (8%)

Among OLD patients, age, ISS, and GCS were the same for each treatment subgroup. Despite this, mortality for the HVI subgroup was higher than either surgery or hard collar ($p<.05$). Of the 13 OLD HVI patients who died, 11 died of pneumonia and/or respiratory failure, and 1 had cardiac arrest. YNG patients treated with hard collar had higher ISS and lower GCS than either the HVI or surgery subgroups, suggesting more severe injury, and the mortality was slightly higher in this subgroup ($p=.06$) **Conclusions:** OLD patients with CSF have higher mortality than YNG. HVI in OLD patients is associated with the worst outcomes, irrespective of injury severity, and should be considered a last resort. Further study is warranted to determine the optimal treatment for CSF in OLD patients.

Session 6-B

Paper 68 2:20 pm

THE RATE OF RE-WARMING FROM HYPOTHERMIC ARREST DETERMINES THE OUTCOME IN A SWINE MODEL OF LETHAL HEMORRHAGE

Hasan B. Alam, MD*, Peter Rhee, MD, MPH*, Kaneatsu Honma, MD, PhD, Elena Koustova, PhD, Nanna Ariaban, BS, Kevin Toruno, BS, Caroline Engel, BS, and Zhang Chen, MD, PhD.

Rapid induction of profound hypothermic arrest (suspended animation) can provide valuable time for repair of complex injuries and improve survival. The optimal rate for re-warming from a state of profound hypothermia is unknown. This experiment was designed to test the impact of different warming rates on survival and organ functions in a swine model of complex vascular injuries.

METHODS: Uncontrolled lethal hemorrhage was induced in 40 swine (80-120 lbs) by creating an iliac artery and vein injury, followed 30 minutes later (simulating transport time) by laceration of the descending thoracic aorta. Through a thoracotomy approach, a catheter was placed in the aorta and hyperkalemic organ preservation solution was infused on cardiopulmonary bypass to induce profound (10 C) hypothermia rapidly (2 C/minute). Vascular injuries were repaired during 60 minutes of hypothermic arrest. The groups were: normothermic controls (NC), or re-warming from profound hypothermia at rates of: 0.25 C/min (slow), 0.5 C/min (medium) or 1 C/min (fast) (n=10/group). Hyperkalemia was reversed during the arrest period and blood was infused for resuscitation during re-warming. After discontinuation of cardiopulmonary bypass, the animals were recovered and monitored for six weeks for neurologic deficits, cognitive function (learning new skills), and organ dysfunction. Detailed examination of brains was performed at 6 weeks.

RESULTS: All the normothermic animals died, whereas survival rates for slow, medium and fast re-warming from hypothermic arrest were 50%, 90% and 30% respectively ($p<0.05$,slow and medium warming vs. NC). All the surviving animals were neurologically intact, displayed normal learning capacity, and had no long-term organ dysfunction.

CONCLUSION: Rapid induction of hypothermic arrest maintains viability of brain during repair of lethal vascular injuries. Survival is influenced by the rate of reversal of hypothermia, with the best outcome following re-warming at 0.5C/minute.

Session 6-B

Paper 69 2:40 pm

MONOCARBOXYLATE CONTAINING RESUSCITATION FLUIDS ACTIVATE ASTROCYTES AND MICROGLIAL CELLS IN RAT BRAINS FOLLOWING HEMORRHAGIC SHOCK.

Tom Lin, MD, Elena Koustova, PhD, Peter Rhee, MD, MPH*, John R. Kirkpatrick, MD*, and Hasan B. Alam, MD*.
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Endogenous monocarboxylic acids (MC), such as lactate, pyruvate, and beta-hydroxybutyrate, are easily utilized by the central nervous system (CNS) as alternative fuels. However, it is unknown whether the brain retains the capacity to utilize exogenously administered MC during resuscitation from hemorrhagic shock. This study was designed to find out if resuscitation with MC containing fluids would:1) upregulate the expression of monocarboxylate transporter-1 (MCT1), and 2) activate CNS astrocytes and microglial cell.

METHODS: Sprague Dawley rats (n=25, 5/group) were subjected to volume-controlled hemorrhage and randomized as follows: 1) sham hemorrhage 2) hemorrhage and no resuscitation 3) resuscitation with ketone (beta-hydroxybutyrate) Ringer's (KR) 4) sodium pyruvate Ringer's (PR), 5) lactated Ringer's (LR). Two hours later, brains were stained for glial fibrillary acidic protein (GFAP, astrocytes marker) and Ia antigen (marker for activated microglia), and analyzed quantitatively for micro and astrogliosis (activation). Expression of MCT1 in different areas of the brain was similarly studied.

RESULTS: Resuscitation with MC containing fluids increased the expression of MCT1 in microvascular endothelium. There was no evidence of astrocytic hyperplasia, but MC based resuscitation induced astrocyte hypertrophy (increased area, density and complexity), especially in areas sensitive to ischemia (hippocampus, frontal cortex and caudate putamen). Baseline microglial activation (25% in sham) was significantly increased by MC resuscitation (KR 80%, PR and LR 75%).

CONCLUSIONS: This study demonstrates that hemorrhaged animals retain the capacity to upregulate brain MCT1 expression in response to exogenous MC. Resuscitation with MC based fluids alters neuronal microenvironment by stimulating astrocytes and microglial cells. This up-regulation of MC trafficking can be utilized to enhance the supply of energy substrates to neurons during periods of hypoperfusion.

Session 6-B

Paper 70 3:00 pm

THE EARLY WORK-UP FOR ISOLATED LIGAMENTOUS INJURY OF THE CERVICAL SPINE: DOES CT-SCAN HAVE A ROLE?

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Oscar D. Guillamondegui, M.D. Division of Trauma & Surgical Critical Care

OBJECTIVE: Helical CT scan (HCT) is the preferred modality for screening the cervical spine (CS) for fracture in blunt trauma. We hypothesize that HCT can be used as a screening tool for isolated ligamentous injury (LI) in blunt trauma. **METHODS**: A prospective, consecutive series, study design was utilized to include patients that could not have their cervical spine cleared clinically. All patients underwent HCT (occiput-T1) and plain radiographs (PR) with 5 views of the CS. Patients with clinical or radiographic abnormalities without fracture underwent cervical MRI. Demographic and outcome data were collected. Attending radiologist interpretation was used for clinical management. 3 Neuro-radiologists in a blinded fashion re-reviewed studies (HCT, PR, and MRI) of the MRI subgroup. **RESULTS**: 1,577 patients met study criteria with a mean ISS 21 and a GCS 13.2. Of 1299 (82%) patients who had no fracture, 85 (6.5%) required an MRI. The mean time from admission to MRI was 4 days and 3 days for LI. Of these, 21/85 (25%) had LI by MRI. 7/21 (33.3%) patients had an abnormal HCT vs. 3/21 (14.3%) had an abnormal PR. 4/85 (4.7%) had spinal cord injury without radiographic abnormality. One (1.2%) patient required surgical stabilization of LI and seen on all studies.

Modality	Sensitivity	Specificity	PPV	NPV
PR	16.0%	100%	100%	77.8%
CT	32.0%	100%	100%	77.8%

Measurements of interrater agreement for MRI, HCT and PR had kappa values of .60, .14, and .41 respectively.

CONCLUSION: 1) HCT is not an effective modality for screening of cervical LI.

2) MRI is clearly superior to HCT and PR.

3) Indications for MRI include: Findings on HCT, Clinical neurological findings, Symptomatic cervical pain or tenderness, or Clinical inability to clear the CS (obtunded patient).

4) Reliability between initial reads and re-review panel is poor for HCT and PR.

Session 6-B

Paper 71 3:20 pm

VENTILATOR-ASSOCIATED PNEUMONIA IN THE INJURED PATIENT: DO YOU TRUST YOUR GRAM'S STAIN?

Kimberly A. Davis MD*, Matthew J. Eckert BS, R. Lawrence Reed II MD*, Thomas J. Esposito MD MPH*, John M. Santaniello MD, Stathis Poulakidas MD, and Fred A. Luchette MD*

Introduction: The results of sputum or bronchoalveolar lavage (BAL) Gram's stain have been used to guide empiric antibiotic therapy for ventilator associated pneumonia (VAP) in injured patients, despite variability in sensitivity, specificity, positive predictive value, negative predictive value and accuracy.

Study Aim: To evaluate the utility of Gram's stain in the diagnosis of VAP.

Methods: Retrospective chart review of all mechanically ventilated (>24hrs) trauma patients over a 5 year period in whom Gram's stain and final culture data was available.

Result: 155 records with complete data sets were reviewed. 85 intubations were for emergent indications (prehospital or ER) and 70 as inpatients. VAP was diagnosed by CDC criteria in all patients. BAL and quantitative culture was used to confirm the diagnosis in 74% of patients. Gram's stain results included: Gm- 50%, Gm+ 20%, and mixed 30%. Overall accuracy of Gram's stain in diagnosing VAP for any organism was 88% (137 true positives). When assessed for the ability to accurately predict an organism, the results were as follows:

	Gram negative (Gm-)	Gram positive (Gm+)
Positive predictive value	78%	66%
Negative predictive value	38%	81%
Sensitivity	45%	56%
Specificity	71%	88%
Accuracy	63%	72%
ROC area under the curve	0.62 ± 0.05	0.74 ± 0.04

Conclusions: The absence of a Gm+ organism on Gram's stain excludes Gm+ VAP in 80% of patients. All trauma patients should be covered empirically for Gm- organisms, as they encompass 70% of infections, but are not reliably identified by Gram's stain. As 88% of VAP can be identified by the presence of <u>any</u> organism on Gram's stain, it may be useful in the early diagnosis of VAP but cannot reliably be used to guide empiric therapy.

Session 6-B

Paper 72 3:40 pm

ILIAC VEIN INJURIES IN HEMODYNAMICALLY UNSTABLE PATIENTS WITH PELVIC FRACTURE DUE TO BLUNT TRAUMA

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Objective: A major pelvic venous injury secondary to blunt trauma can be a difficult problem in diagnosis and management. Those injuries recorded are uncommon and associated with a high mortality. This study aimed to elucidate the clinical significance of iliac vein injuries demonstrated by venography in patients with blunt pelvic injuries who remained unstable even after transcatheter arterial embolization (TAE).

Methods: We reviewed the records of 72 patients with unstable pelvic fracture who presented with shock at our center following blunt trauma from 1999 through 2003. The average injury severity score (ISS) was 34.3 in this study population.

Results: TAE was the first method of choice to control bleeding from pelvic fracture in sixty-one patients. Thirty-six patients recovered from shock following TAE. Eighteen of 25 who did not recover from shock, died. In 11 of these 25, transfemoral venography with a baloon catheter was performed, revealing significant venous extravasation in 9: common iliac vein in 5 and internal iliac vein in 4. The average ISS of patients with iliac vein injury was 45.8. Treatments for venous injuries were laparotomy for hemostasis (n = 1, survivors = 0), retroperitoneal gauze packing (n = 3, survivors = 1), and angiographic stent-placement (n = 3, survivors = 3). Two patients suffered from cardiac arrest before treatment for venous injuries. External fixations were performed according to fracture type.

Conclusions: The iliac vein injury is the principal cause of hemorrhagic shock in some patients with unstable pelvic fractures following blunt trauma. Venography is useful for identifying iliac vein injuries.

Session 6-B

Paper 73 4:00 pm

ATTENUATED HSP-27 NEUTROPHIL RESPONSES IN POST-INJURY MOF PATIENTS

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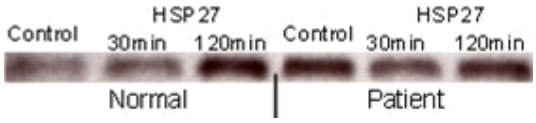
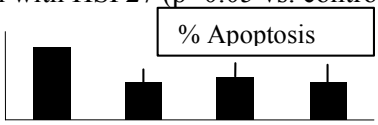
Heat Shock Proteins have recently been identified as extra-cellular mediators of inflammation in addition to their intracellular chaperone functions. Heat Shock Protein 27 (HSP27) is released following tissue injury and has been shown to activate neutrophils (PMN); however, the effect of trauma and post-injury organ dysfunction on HSP 27 activation of PMN is unknown. We hypothesize that HSP27 signaled activation of PMN is altered following major injury and multiple organ failure (MOF).

Human PMNs were isolated from the blood of 8 trauma patients with MOF (>2 organ failures) and age matched healthy volunteers by gradient centrifugation and dextran sedimentation. PMN activation was determined by measuring apoptosis (annexin V staining and flow cytometry) and activation of the ERK and p38 Mitogen-Activated Protein kinases (MAPK). Cultured PMN were stimulated with HSP27 (1 mcg/ml). Western blots of cell lysates for phosphorylated p38 and ERK was performed following 30 and 120 minutes. A representative experiment for p38 or ERK (n=3) is shown below. Unstimulated trauma patient PMN had significantly increased baseline p38 and ERK phosphorylation ($p<0.05$ vs. uninjured control, figure) Uninjured volunteer PMN p38 and ERK activation increase significantly after stimulation with HSP27 ($p<0.05$ vs. control);





Con Trauma HSP Tra+HSP

however, HSP 27 had no significant effect on the activation of both p38 and ERK in post-injury MOF patients. (figure) HSP-27 signals delayed PMN apoptosis in normals but has no additive effect in trauma patients. ($p<0.05$). We conclude that the HSP-27 response in PMN from trauma patients with MOF is attenuated. These results identify another mechanism contributing to altered host defense following injury that is associated with MOF.

Session 6-B

Paper 74 4:20 pm

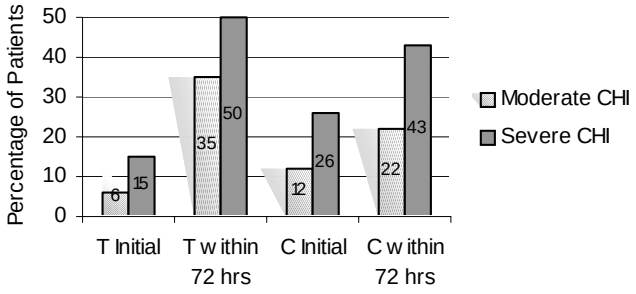
SUBSEQUENT DEVELOPMENT OF THROMBOCYTOPENIA AND COAGULOPATHY IN MODERATE AND SEVERE HEAD INJURY: SUPPORT FOR SERIAL LABORATORY EXAMINATION

Matthew M. Carrick, M.D. - Texas Tech University Health Sciences Center - El Paso
Alan H. Tyroch, M.D., F.A.C.S.* - Texas Tech University Health Sciences Center - El Paso
Cortney A. Youens, B.S.- Texas Tech University Health Sciences Center - El Paso

Objective: To demonstrate the development of thrombocytopenia (T) and coagulopathy (C) in moderate and severe head injury patients not only on admission but also within the subsequent 72 hours.

Methods: 200 blunt trauma patients with moderate or severe CHI and an extra-cranial AIS <3 were retrospectively reviewed from 1/01-6/03. Data collection included initial (on admission) and subsequent (within 72hrs) PT, PTT, & platelet values, as well as GCS, LOS, ISS, age, gender, and disposition. T was defined as a platelet count <150,000/μL. C was defined as a PT value >14.2 s or a PTT value >38.4s.

Results: On initial evaluation, T was present in 13% and C in 23% of patients. By the 3rd day, the percentage of patients with T & C had markedly increased to 46% & 37%, respectively. Fifty-four percent of patients developed T &/or C in the first 72 hours. Patients in the severe group were twice as likely to have T or C (see table). Of patients who died, 70% had T and 64% had C.



Conclusion: This study demonstrates that patients with moderate & severe head injuries are at risk for thrombocytopenia & coagulopathy not only on admission but also on subsequent laboratory examination. Thrombocytopenia & coagulopathy are associated with increased mortality and should be minimized to prevent secondary brain injury. Repeat laboratory examination is warranted due to the percentage of patients who develop thrombocytopenia & coagulopathy after initial evaluation. The large number of patients with thrombocytopenia supports the American College of Surgeon's new requirement of platelet availability within 45 minutes of admission.

Session 6-B

Paper 75 4:40 pm

SUTURE LINE FAILURE IN INTRA-ABDOMINAL COLONIC TRAUMA: THE EFFECT OF SEGMENTAL VARIATIONS IN BLOOD SUPPLY ON OUTCOME.

Christopher J. Dente, MD, David V. Feliciano, MD, FACS*, Grace S. Rozycki, MD, FACS*, Ankit Patel BS. Emory University School of Medicine

Purpose: Suture line failure (SLF) after injury to the intra-abdominal colon is rare but carries a high mortality. Risk factors for SLF are poorly defined, and few studies have examined the effect of the colon's segmental anatomy with its associated variations in blood supply on outcome.

Methods: Data from patients diagnosed with penetrating intra-abdominal colonic trauma admitted to a level I trauma center were reviewed. Demographics, hemodynamic data, trauma severity scores, segmental anatomy and management of the colonic injury were recorded to define a group at high risk for SLF.

Results: From 1997-2002, 217 patients (89% male; mean age 30 years) sustained penetrating intra-abdominal colonic injuries. There were 152 suture lines created including 130 primary repairs (PR) and 22 resections with anastomosis (RA) while 65 patients (30%) had diverting ostomies and were not included in further analysis. Of the 152 suture lines, there were 27 injuries to the ascending, 16 to the descending, 88 to the transverse and 21 to the sigmoid colon. There were 7 SLF (5%) with a resultant mortality of 43% (3/7). Three patients had undergone PR while four patients had RA (2% vs. 18% SLF, p=.02). Three anastomoses were colo-colostomies and one was an ileo-colostomy. In patients with SLF, no significant differences were noted in any demographic or hemodynamic data with the following two exceptions: initial transfusion requirements were significantly higher in patients with SLF (9.4 vs. 3.3 units, p=.016) and all SLF occurred in the transverse colon. Upon specific review of operative notes of patients with SLF, all injuries were to the distal transverse colon in the area of the splenic flexure.

Conclusions: 1) SLF occurred in 5% of patients in this series and was associated with a 43% mortality. 2) Large transfusion requirements were a marker for SLF. 3) RA, especially in the form of colo-colostomy is associated with a higher SLF rate. 4) Suture lines performed in the region of the splenic flexure are at high risk for SLF.

Session 7

Paper 76 8:20 am

HEALING AND NEOVASCULARIZATION OF WOUNDS IMPLANTED WITH DERMAL SUBSTITUTES AND FIBRIN GLUE IN NUDE MICE

M. M. Loor, MD (Rush University Medical Center, John Stroger Hospital of Cook County), A.-T. Truong, MD (Metropolitan Hospital Group), A. Kowal-Vern, MD (John Stroger Hospital of Cook County), B. A. Latenser, MD* (John Stroger Hospital of Cook County), D. E. Wiley, MD (John Stroger Hospital of Cook County), R. J. Walter, PhD (John Stroger Hospital of Cook County)

Objective: Dermal substitutes implanted into full-thickness skin wounds reduce wound contracture and improve cosmesis. These improvements depend upon the development of optimal dermal vascularization. We hypothesized that dermal substitutes having native dermal composition would achieve such neovascularization more rapidly than would synthetic dermal substitutes. To further understand the progress of neovascularization, we immunostained skin biopsies taken at weekly intervals from nude mice that had been implanted with different dermal substitutes and evaluated blood vessel ingrowth.

Methods: Full-thickness skin wounds were created on the dorsum of nude mice. A dermal matrix was implanted followed by a mix of fibrin glue (FG) with human keratinocytes (KC). Groups were as follows: Integra, Alloderm, acellular dermal matrix (ADM), Dermalogen, Dermagraft, KCs+FG only, and FG only. Gross wound measurements and biopsies were taken weekly for 4 weeks. Routine H&E and immunostaining for laminin and for endoglin (CD105) were done. Vessel counts were performed on immunostained sections in the superficial and deep dermis, in three regions: wound center, wound margin, and unwounded dermis.

Results: The amount of vascularity seen in fully healed wound dermis was the same as that seen in unwounded dermis. However, extensive vascularity was seen at all time points in implanted Dermagraft and Dermalogen. Alloderm showed limited vascularity within the first 2 weeks but this normalized by day 28. ADM and Integra showed rapid but controlled ingrowth of vessels from both the wound base and margins. Each dermal substitute decreased wound contracture, but Alloderm and ADM did so significantly compared to the control.

Conclusions: From this, we conclude that Dermagraft and Dermalogen underwent extensive granulation, whereas Alloderm underwent delayed vascularization. Alloderm, Integra, and ADM underwent progressive vessel ingrowth that was conducive to normal dermal regeneration, reepithelialization, and minimal wound contraction.

Session 7

Paper 77 8:40 am

NONOPERATIVE MANAGEMENT OF THE INJURED SPLEEN: A PROSPECTIVE STUDY FROM THE AAST MULTI-INSTITUTIONAL TRIAL COMMITTEE

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Objective: To assess the impact of a structured practice guideline for nonoperative management of blunt splenic injuries in adults in AAST-member trauma centers.

Methods: A structured practice guideline for patients > age 15 with blunt injury to the spleen documented on a helical CT was offered to AAST-member trauma centers. The guideline included absolute bed rest for all patients for 5-7 days, a pre-discharge follow-up CT at 5-10 days for patients with Grade III/IV/V injuries, and out-of-hospital follow-up with repeat CT, if possible, in this latter group. Data were collected concurrently in AAST-member trauma centers and forwarded to the principal investigator for collation and analysis.

Results: From November, 2001 - February, 2004, 300 patients (60.7% male; mean age 33.6) were entered into the study. The admission CT grades of the splenic injuries based on the AAST Organ Injury Scale were as follows: Grade I-27.3% (#82); Grade II-30% (#90); Grade III-23.4% (#70); Grade-IV 18.0% (#54); and Grade V-1.3% (#4). Failure of nonoperative management of the injured spleen occurred in 10 patients (3.3%), 9 of whom (Grade IV-#2; Grade 3-#5; Grade I-#2) had continuing or delayed hemorrhage mandating laparotomy at a mean of 4.3 days postinjury (range 2-11 days). Seven of these 9 patients had intraperitoneal blood on the original CT, while early posttrauma repeat CTs on days 1 and 2 performed in 6 of the 9 patients were abnormal in 5. 8 other patients (2.6%) underwent delayed laparotomies not involving the splenic injury at a mean of 5.9 days postinjury (range 2-17 days).

Conclusions: 1. Using a structured practice guideline, nonoperative management of the injured spleen was successful in 94% of adults; however, only 9 of the 18 patients undergoing delayed laparotomy had bleeding from the spleen as the indication. 2. Failure of nonoperative management when splenic bleeding is the cause usually occurs on the fourth postinjury day and is most commonly treated with splenectomy in adults.

Session 7

Paper 78 9:00 am

AN OPEN LABEL STUDY TO EVALUATE THE SAFETY AND EFFICACY OF TISSUE PLASMINOGEN ACTIVATOR (TPA) IN THE TREATMENT OF SEVERE FROSTBITE

John A. Twomey, MD Hennepin County Medical Center, George A. Peltier*, MD Hennepin County Medical Center, Richard T. Zera, MD, PhD Hennepin County Medical Center

Objective: To evaluate the effect of tissue plasminogen activator (TPA) and heparin in limb and digit preservation in patients with severe frostbite. **Methods**: Intra-arterial (IA, 6 patients) or intravenous (IV, 12 patients) TPA and IV heparin were used in patients with severe frostbite. Inclusion criteria were all patients between 1-1-1989 and 12-1-2003 with severe frostbite not improved with rapid re-warming , with absent Doppler pulses in distal limb and /or digits and without perfusion by Technetium 99m 3-phase bone scan, and no contraindication to TPA use. Dosage initially began at 0.075 mg/kg/hr IA for 6 hours but was escalated to 0.15 mg/kg/hr IV for 6 hours. Efficacy was assessed on the basis of predicted digit amputation prior to therapy, given the clinical and TC scan results, and actual digits, or portions thereof, removed. **Results:** The safety of IV TPA was apparent with no bleeding complications in this highly selected group. One patient with IA TPA had his treatment discontinued prematurely because of bleeding at arterial puncture sites. One other patient developed hematuria and TPA was stopped but restarted with the full dosage delivered. There were no other toxicities attributable to the therapy. There were 174 digits at risk for amputation in 18 patients and 33 were amputated (10 toes included in the single patient with bilateral below knee amputations: no other limb loss). **Conclusions**: The use of IV TPA and heparin after rapid re-warming is safe and reduced the need for amputation. Patients with no response to thrombolytic therapy were those with greater than 24 hours of cold exposure, warm ischemia times greater than 6 hours and/or evidence of multiple freeze-thaw cycles prior to seeking care. Our algorithm for treatment of severe frostbite now includes use of IV TPA for those patients without contraindications

Session 7

Paper 79 9:20 am

PERSISTENT HYPERGLYCEMIA IS PREDICTIVE OF OUTCOME IN TRAUMA PATIENTS. A PROSPECTIVE STUDY

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Purpose: Our objectives were to determine whether persistent hyperglycemia was predictive of outcome in critically ill trauma patients. **Methods**: Prospective data was collected daily on 942 consecutive trauma patients admitted to the ICU over a 2-year period. Patients were stratified by serum glucose level from day 1 to day 7 (low = 0-139 mg/dl, medium = 140-219 mg/dl, and high >220 mg/dl) age, gender, and ISS. Patients were further stratified by pattern of glucose control (all low, all moderate, all high, improving, worsening, highly variable (HV). Outcome was measured by ventilator days, infection, hospital (HLOS) and ICU (ILOS) length of stay and mortality. Multiple linear regression models were used to determine level of significance. **Results**: 71% were victims of blunt trauma. The majority (74%) were male with a mean ISS of 20.4 ± 15. 41% of patients acquired an infection. Patients with medium, high, worsening, and highly variable hyperglycemia were found to have increased ILOS, HLOS, ventilator days, infection rate and mortality by univariate analysis ($p<0.001$).* When controlling for age, ISS, and glucose pattern, patients with high, worsening and HV hyperglycemia were most predictive of increased ventilator days, ILOS, HLOS, infection and mortality. ($p<0.001$)

	Ventilator days	ICU Days	Hospital Days	Mortality
Low	8.6 ± 7.5	10.3 ± 7	14.9 ± 10	6.8%
Medium	14 ± 8.8*	15.2 ± 8*	20.8 ± 9*	20.5%*
High	16.2 ± 22*	14 ± 12*	22 ± 23*	31%*
Improving	12.1 ± 10	12.6 ± 9	17.5 ± 11	12.4%
Worsening	16.3 ± 11*	16.9 ± 11*	22 ± 12*	25.3%*
HV	17.1 ± 14*	17.6 ± 13*	23 ± 18*	21.5%*

Conclusion: Trauma patients with persistent hyperglycemia have a significantly greater degree of morbidity and mortality. A prospective randomized controlled study instituting aggressive hyperglycemic control is warranted.

Session 7

Paper 80 9:40 am

THE BALANCE BETWEEN EXPRESSION OF INTRANUCLEAR NF-κB AND GLUCOCORTICOID RECEPTOR IN POLYMORPHONUCLEAR LEUKOCYTES IN SIRS PATIENTS

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Backgrounds: We have reported the enhanced expression of nuclear factor kappa B (NF-κB) in activated polymorphonuclear leukocytes (PMNLs) from SIRS patients. However, inflammatory response is not only regulated by stimulatory transcriptional factors. Glucocorticoid receptor (GR) has been recently reported to play an important role in anti-inflammatory signal transduction. The objective of our study is to evaluate the balance between intranuclear NF-κB and GR in PMNLs from SIRS patients. **Patients and Methods**: (**Study 1**) Twenty-nine patients with SIRS and 15 healthy volunteers were included. The expressions of intranuclear NF-κB and GR in PMNLs were measured by flow cytometry, using each antibody to NF-κB subunit p65 and GR. PMNL oxidative activity and plasma concentrations of IL-6, IL-8, IL-10, and cortisol were also measured. (**Study 2**) Thirteen patients with trauma (ISS>15) were included. We measured the serial changes of intranuclear NF-κB and GR expressions in days 0 to 2, 3 to 6, and 7 to 14 after injury. **Results**: In study 1, the expressions of intranuclear NF-κB and GR in PMNLs were significantly enhanced in SIRS patients in comparison to those in healthy controls. There was a strong correlation between these two transcriptional factors (r = 0.78). The PMNL oxidative activity was enhanced and plasma concentrations of IL-6, IL-8, IL-10, and cortisol were also elevated in SIRS patients. No significant correlation was found between transcriptional factors and cytokines. In study 2, the expressions of both NF-κB and GR in PMNLs were markedly elevated with significant correlation in days 3 to 6, and serially changed holding the balance.

(Study 1)	NF-κB	GR	IL-6	IL-8	IL-10	cortisol
SIRS	238.9±34.5*	233.5±31.5*	97.4±88.2	54.6±45.5	11.8±8.4	64.8±25.9
Normal	181.0±13.5	179.8±16.1	<4.0	<12.5	<7.8	<20.0

mean±SD; *p<0.05 vs control; NF-κB, GR (fluorescence / cell); IL-6, 8, 10 (pg/ml); cortisol (μg/dl)

(Study 2)	Day 0 to 2	Day 3 to 6	Day 7 to 14
NF-κB	196.9±20.0	222.3±28.3	216.3±28.3
GR	199.8±25.2	214.2±27.7	206.3±33.8
Correlation (r)	0.48	0.82	0.85

Conclusions: In SIRS patients, intranuclear NF-κB and GR in activated PMNLs were simultaneously elevated with strong correlation. In trauma patients, NF-κB and GR in PMNLs changed holding the balance. The balance between expression of intranuclear NF-κB and GR may control PMNL activation and inflammatory response following severe insults.

Session 7

Paper 81 10:00 am

EXTRACORPOREAL SUPPORT FOR ORGAN DONATION AFTER CARDIAC DEATH

JF Magliocca MD, JD Arenas MD, SM Rowe MD, MT Gravel RN, RH Chenault, RM Merion MD, JD Punch MD, RH Bartlett* MD, MR Hemmila MD

Objective: To evaluate the outcome of a protocol and technique (extracorporeal perfusion) for donation of solid organs for transplantation after cardiac death (DCD). Parameters for study included increase in number of donors, types and numbers of organs harvested, and viability of kidneys transplanted. **Methods:** An IRB-approved retrospective review of prospectively collected data was performed on medical record data for 19 DCD donor candidates. We also collected data on 63 brain dead organ donor patients during the same 40 month time period ending 1/31/2004 at a single center. **Results:** Nineteen patients met the criteria for DCD and attempted donation of organs. Fifteen patients completed the donation protocol, 3 failed to expire within the prescribed 60 minutes after withdrawal of life support, and one patient's organs were deemed unsuitable for transplantation. Thirteen (68%) of the DCD donor patients originated on the trauma service and six (32%) were from other clinical services. The DCD program increased the donor pool by 30.2% (63 vs. 82 patients) and the number of kidneys procured and available for transplantation by 22.4% (125 vs. 153) at our institution. A total of 22 kidney, 5 liver, and 1 pancreas transplants were performed with these procured organs. Thirteen of the kidneys were transplanted at our center and 9 were sent to other institutions. Four of the 13 (30.8%) had delayed graft function defined as any need for dialysis in the first week following transplantation. This compares favorably with published rates for delayed graft function of 42% in non-heart beating and 23% in heart beating cadaveric organ donors. There was only one episode of acute cellular rejection in a kidney during the initial 30 day follow-up period.

Conclusion: The implementation of a DCD protocol using extracorporeal perfusion increased the potential organ donor pool at our institution by 30%. This was accomplished without any short term adverse effect on organ function compared to kidneys transplanted from brain dead deceased donors.

Session 7

Paper 82 10:20 am

WHAT PRICE FOR GENERAL SURGERY?

Lewis J. Kaplan, MD - Yale University School of Medicine, Department of Surgery, Section of Trauma, Surgical Critical Care, and Surgical Emergencies
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Joseph Portereiko, DO - Yale University School of Medicine, Department of Surgery, Section of

Introduction: This study aims to determine the cost benefit analysis of adding a full Emergency General Surgery (EGS) arm to a Trauma/Critical Care (TCC) service with limited EGS activity in a Level I trauma center.

Methods: Data on the composition, activity and billings of a TCC were collected and compared before (Jan 1, 2002-June 30, 2003) and after (July 1, 2003-December 31, 2003) it assumed the care of all unassigned EGS patients. These included patient volume and demographics, service, procedures, on-call/service activity, and professional billings and collections. Data are means ± SD or percents. Intergroup comparisons were by *t*-test or Chi-square as appropriate; significance assumed for $p < 0.05$.

Results: Data for each time period are displayed below.

Conclusions: Integrating a full EGS into a TCC service encumbers increased unscheduled clinical time and cases, augmenting both emergency and elective surgery while reducing nonclinical time. Deploying an EGS service arm also increases outpatient clinic activity, and accelerates operative billing. Financial benefits, however, accrue at the expense of individual time, creating significant implications for service organization, structure and function.

* = $p < 0.01$ vs Pre-EGS

Variable	Pre-EGS *18 months*	Post-EGS *6 months*
Staff [total/on service per day]	5/2	6/3
Δ Coverage Weeks	0	+ 52*****
EGS + Elective OP operations / month	28.7	60*
Trauma operations / month	8.2	10.3
% EGS consults leading to operation	80.5%	64%*****
On-call nonclinical time (hours)	3.15±0.85	1.1±0.8*****
OR days / month post-call for EGS	1.73±1.4	3±0.9*****
OP clinic visits / month	68.6	91.1*****
% Elective OR on "off service" time	22.3%	76%*****
Billings (OR/ICU/OP); % Δ from Pre-EGS	baseline	+44.8/+12.5/+48.7%
Personnel costs (%Δ from Pre-EGS)	baseline	+14%

Session 7

Paper 83 10:40 am

DECOMPRESSIVE CRANIECTOMY DECREASES REFRACTORY INTRACRANIAL HYPERTENSION

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Purpose: To determine the impact of decompressive craniectomy (DC) on intra-cranial pressure (ICP) management and outcome in patients with severe traumatic brain injury (TBI). **Methods:** A retrospective analysis was performed on 92 consecutive patients with severe traumatic brain injury who underwent DC for elevated ICP. All patients were initially managed medically as per the AANS guidelines. Prospective data was collected over the following 3 ½ years to determine long term functional outcome as measured by the Glascow coma outcome Score (GOS). **Results**: All 92 patients were admitted due to blunt injury (MVC =64, falls = 16, assault = 8, and industrial accident = 4). The majority (64 or 70%) of the patients were male with a mean age of 29.5 years, Injury Severity Score = 31.4, and GCS = 6.5. Thirty-three patients (36%) had an abnormal pupillary response on admission. There were an equal percentage of patients with either diffuse brain injury (46 patients or 50%) or mass lesion (46 patients or 50%) identified by admission CT scan. Ninety-one of 92 patients had parenchymal or ventricular ICP monitoring. Standard medical management failed in all 92 patients. 37 patients were placed into pentobarbital coma as a second tier therapy which also failed. In 46 patients, DC was performed within 48 hours and between days 3-14 in the other 46 patients. The mean ICP decreased significantly from 23.6 (Pre-DC) to 14.1 mm Hg (12 hours Post-DC $p< 0.001$). Patients requiring early DC were more likely to die (43.5% vs. 24% $p<0.05$). Mortality was higher in patients with increased age (age 16-25 (22%), 26-45 (43.5%), 45-55 (50%) and >55 (67%) $p<0.05$), and decreasing GCS (44% GCS = 3-5, 27.5% GCS = 6-8, $p<0.05$). Pentabarbital coma was not associated with any difference in outcome. Despite severe TBI and refractory intra-cranial hypertension, 36 of 59 (61%) survivors (2 patients lost to follow-up) had good long term neurologic outcome (GOS = 4 or 5). **Conclusion:** DC significantly reduced ICP in patients with intra-cranial hypertension refractory to standard medical management and may have improved long term outcome.

Session 7

Paper 84 11:00 am

TRAUMA/CRITICAL CARE SURGEON: A SUBSPECIALIST GASPING FOR AIR

JL Rodriguez MD*, AB Christmas MD, GA Franklin MD*, FB Miller MD*, JD Richardson MD*

Objective: Over the last 10 years the practice of trauma/critical care has become less attractive as a general surgery subspecialty due to the decreasing surgical caseload, the increasing and nocturnal work hours, and the economics of the practice. Yet, during the same period of time the number of verified Level I Trauma Centers has significantly increased. We undertook this study to assess the economic drive behind this dichotomy.

Methods: Over a 12-month period we collected the direct cost (DC) and reimbursement (RIMB) for patients admitted to a Level I Trauma Center and also calculated the ratio of reimbursement to cost (rR/DC). We compared these to the billings (BILL) and reimbursement (RIMB) of the trauma/critical care surgeon caring for the same patient load and also calculated the ratio of reimbursement to billings (rR/B). Student t test was utilized for statistical analysis and a $p < 0.05$ was significant.

Results: 1907 trauma patients were admitted of which 55% had commercial insurance, 21% had governmental insurance, and 24% had no insurance. Comparing the economic data of the institution to that of the trauma/critical care surgeon demonstrates:

	INSTITUTION			TRAUMA/CRITICAL CARE SURGEON		
INSURANCE	DC	RIMB	rR/DC	BILL	RIMB	rR/B
Commercial	$11,258,011	$19,072,590	$1.69	$2,824,627	$974,696	$0.35*
Government	$6,053,628	$8,158,142	$1.34	$2,472,803	$609,982	$0.24*
None	$3,967,965	$291,562	$0.07	$1,752,920	$118,461	$0.07

* P = < 0.05 comparing rR/DC vs. rR/B

Conclusions: The economic dichotomy that exists between Trauma Centers and trauma/critical care surgeons is significant. It drives institutional growth and, at the same time, discourages surgeons from entering the subspecialty. As the number of uninsured patients grows and physician reimbursement decreases, this economic dichotomy will amplify. Over the next ten years, without significant financial institutional commitment for trauma/critical care surgeons, the subspecialty is in danger of extinction.

Session 7

Paper 85 11:20 am

THE ROLE OF TRANS-ESOPHAGEAL ECHOCARDIOGRAPHY IN THE OPTIMIZATION OF FLUID RESUSCITATION IN THE CRITICALLY ILL PATIENT

Justin Burns, MD, Ronald Sing, DO* , Mark Sturdevant, MD, Toan Huynh, MD*, David Jacobs, MD*, William Miles, MD, Michael Thomason MD*

Introduction: The goal of resuscitation is to correct the mismatch between oxygen delivery and the cellular demands of oxygen consumption during shock. Hemodynamic stability is most readily attained after volume resuscitation yields an adequate ventricular filling. Pulmonary artery catheters (PAC) are frequently used to measure the adequacy of resuscitation and guide therapy. The purpose of this study was to evaluate the role of trans-esophageal echocardiography (TEE) in ongoing shock despite massive resuscitation.

Methods: A retrospective review was performed for patients undergoing TEE during acute resuscitation from hemorrhagic shock. TEE was performed on patients with sub-optimal hemodynamic parameters despite the appearance of adequate preload based on PAC measurements after initial fluid resuscitation. Endpoints included hemodynamic parameters, PAC data, pre-procedural volume resuscitation and vasopressor requirements. The impact of TEE findings on therapeutic decisions was recorded. **Results:** Twenty-two patients underwent a TEE, 15 (68%) had an indwelling PAC with a mean PAOP of 19mmHg (range 13-28). Cardiac indices (CI) varied from 1.9 to 4.2 L/min/m2 (mean 2.9). 14 patients (64%) had ongoing inotropic/vasopressor requirements for hypotension. Fluid resuscitation within 6 hours prior to TEE included a mean of 6 liters of crystalloid, 7 units of Packed Red Blood Cells, and 6 units of fresh frozen plasma. TEE revealed left ventricular hypovolemia in 12 patients (55%). Therapy was altered in14 patients (64%) and included additional volume (n=12), addition of an inotrope (n=4) and addition of a vasodilator (n=1). Significant mitral valve regurgitation and wall motion dyskinesis was noted in two studies, but no clinically relevant pericardial effusion was identified.

Conclusions: TEE altered resuscitation management in almost two-thirds of patients. Many patients with acceptable PAOP parameters may in fact have inadequate left ventricular filling. In addition, TEE offers the advantage of direct assessment of cardiac valve abnormalities and myocardial wall dyskinesis.

Session 7

Paper 86 11:40 am

ECONOMIC IMPACT OF MOTORCYCLE HELMETS: FROM IMPACT TO DISCHARGE

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Objective: The economic impact of helmet use remains controversial. Previous studies of injured motorcyclists suggest a marginal inpatient hospital cost difference between helmeted and unhelmeted riders. The purpose of this study was to expand the economic analysis of motorcycle helmet utilization from the point of injury.

Methods: Prehospital motorcycle crash data were collected from the National Highway Transportation Safety Administration (NHTSA) General Estimates System (GES) database from 1994-2002 with respect to helmet use, injury severity, and transport to a hospital. A focused literature search yielded the hospital admission rates of helmeted and unhelmeted motorcyclists evaluated in the emergency department. The National Trauma Data Bank (NTDB) was queried from 1994-2002 to collect data including helmet use and hospital charges for injured motorcyclists. Statistical comparisons between groups were performed using ANOVA and chi-squared analysis.

Results: The NHTSA GES database yielded 5,688 sample patients. 1,991 patients (35%) were unhelmeted and 3,697 (65%) were helmeted. Transport to a hospital was required of 78.6% of unhelmeted and 73.3% of helmeted patients. Of motorcyclists evaluated in the emergency department, 39.9% of unhelmeted and 32.8% of helmeted patients required hospital admission. NTDB analysis of injured motorcyclists from the concomitant interval yielded 5,343 patients for whom all data was available. Unhelmeted motorcyclists incurred charges of $36,164/injury; whereas, helmeted motorcyclists incurred charges of $32,598/injury. Extrapolating the mathematical analysis derived a charge of $10,092/unhelmeted and $5,094/helmeted motorcyclist for every crash.

Conclusion: With an estimated 30,000 motorcycle crashes/year, the differential economic burden between unhelmeted and helmeted motorcyclists is approximately $150,000,000/year and underscores the need for improved legislation to improve motorcycle helmet utilization.