SELF-EXPANDING, HEMOSTATIC, CONFORMAL POLYMER REDUCES BLOOD LOSS AND IMPROVES SURVIVAL IN LETHAL, CLOSED-CAVITY, NONCOMPRESSIBLE GRADE V HEPATO-PORTAL INJURY MODEL

Ali Mejaddam, Michael Duggan, Upma Sharma, George Kasotakis, MD, Toby Freyman, Rany Bosuld, Greg Zugates, Adam Rago, George Velmahos*, M.D., Ph.D., Marc A. de Moya*, M.D., Hasan Alam*, M.D., Massachusetts General Hospital

Introduction: Intracavitary noncompressible hemorrhage remains a significant preventable cause of death. Two percutaneously injected and dynamically mixed liquids (polyol and isocyanate, 100cc each) were engineered to create a self-expanding, high expansion ratio, hydrophobic, poly(urethane urea) polymer to facilitate hemostasis in massive exsanguination. We hypothesized that intra-peritoneal injection of the polymer would improve survival in swine with lethal hepato-portal injury. **Methods:** Through strategic placement of percutaneous wires in the medial liver lobes and intrahepatic left portal vein of swine, a closed cavity, noncoagulopathic, noncompressible Grade V hepato-portal injury was created by wire distraction (T0). After 10 minutes (T10) of uncontrolled hemorrhage, animals received either fluid resuscitation plus percutaneous deployment of self-expanding polymer (n=10) or fluid resuscitation alone (n=10), monitored for 3 hours (T180), and euthanized. Intra-abdominal hemorrhage was quantified and all livers graded for injury consistency.

<u>Results:</u> All animals experienced severe hemorrhage and near-arrest (MAP at T10 mins = 23 ± 6 mmHg). Survival at T180 was 70% in the polymer group and only 10% in the control group (p<0.02). Mean survival time was longer in the polymer group (154±48 vs. 43±50 mins; p=0.0003) and the normalized blood loss was lower in the polymer group (0.5±0.4 vs 3.0±1.4 g/kg/min; p≤0.001). All hepato-portal injuries were anatomically similar and polymer had conformal contact with injured tissues.

<u>Conclusion</u>: A new, novel, percutaneously injected poly(urethane urea) polymer reduced blood loss and improved survival in a lethal, closed-cavity, Grade V hepato-portal injury model. Chronic safety and additional efficacy studies in other models are needed

A MULTI-INSTITUTIONAL VIEW OF EXTRA-PERITONEAL PELVIC PACKING

Ali Mejaddam, MD, Lawrence Lottenberg*, M.D., Tera Thigpin, Thomas M. Scalea*, M.D., Seeta Kallam, MBBS, Bilge Kaylon, MD, Kenji Inaba*, MD, Emre Sivrikoz, Bryan Cotton*, MD, MPH, Odeaa Al-Jabbari, MD, Marc A. de Moya*, M.D., Massachusetts General Hospital

Introduction: The appropriate management of hemodynamically unstable patients with a pelvic fracture is challenging and controversial. Extraperitoneal pelvic packing (EPP) has shown promise in reducing mortality. The variability in management of these patients between institutions is unknown.

<u>Methods</u>: Retrospective review of consecutive trauma patients who underwent EPP at five Level I trauma centers (January 2006-December 2010). Data was collected on demographics, clinical presentation, surgical and angioembolic interventions, blood product use, and in-hospital complications. The primary outcome was mortality.

<u>Results:</u> 54 patients underwent EPP during the study period (72% male, 45 ± 18 years old, and injury severity score 39 ± 13). Systolic blood pressure on arrival was 100 ± 37 mmHg and heart rate 110 ± 33 beats/min. Initial pH was 7.20\pm0.16 and lactate 6.4 ± 3.4 . Time to operation was 3.4 ± 5.2 hours and the mean duration of surgery was 2.5 ± 1.3 hours. 7 patients (13%) underwent concurrent bilateral internal iliac artery (IIA) ligation during EPP, and 27 (50%) patients underwent subsequent angioembolization. There was a significant difference between institutions regarding use of angioembolization (p=0.002). The mortality rate in the cohort was 57%, of which 32% was due to acute pelvic hemorrhage. There were no institutional differences regarding mortality (p=0.73).

<u>Conclusion</u>: Our multi-institutional study demonstrates 57% mortality in patients who undergo EPP for hemodynamically unstable pelvic fractures. There is significant inter-institutional variability regarding use of therapeutic angioembolization and guidelines are warranted.

THE ABILITY OF COMPUTED TOMOGRAPHY TO DIAGNOSE PLACENTAL ABRUPTION IN THE TRAUMA PATIENT

Tammy Kopelman*, M.D., Nicole Berardoni, MD, Maria Manriquez, Daniel Gridley, Sydney Vail, MD, Paola Pieri, Melissa Pressman, Patrick O'Neill, Maricopa Medical Center

Introduction: Fetal demise is a devastating complication of maternal blunt trauma. Our objective was to determine if abdominopelvic computed tomographic imaging (CT) can reliably assess for placental abruption (PA) when obtained to exclude associated maternal injuries.

<u>Methods</u>: Review of pregnant trauma patients ≥ 20 weeks gestation who underwent CT as part of their initial evaluation. A radiologist reviewed images and an obstetrician reviewed charts for evidence of PA.

<u>Results:</u> 176 patients met inclusion criteria. CT revealed PA in 61 patients (35%). As percentage of placental contrast enhancement decreased, patients were more likely to have strong clinical manifestations of PA. CT evidence of PA was noted in all patients requiring delivery for non-reassuring fetal heart tones.

٠

Results of CT	Clinical Evid	Required			
		Strong	Possible	No	Delivery
No Evidence of PA (n=115)		4(3%)	9(8%)	102(89%)	0(0%)
Evi	dence of PA (n=61)	21(34%)*	6(10%)	33(56%)	17(28%)*
% of Placental	>50% (n=38)	8(21%)	4(11 %)	26(68%)	6(16%)*
Ennancement	25-50% (n=13)	5(38%)*	1(8%)	7(54%)	3(23%)*
	<25% (n=10)	8(80%)*	1(10%)	1(10%)	8(80%)*

*Statistically significant when compared to no evidence of PA group

Conclusion: CT appears to accurately identify clinically significant PA.

PLANNED VENTRAL HERNIA FOLLOWING DAMAGE CONTROL LAPAROTOMY IN TRAUMA: AN ADDED YEAR OF RECOVERY BUT SIMILAR LONG-TERM OUTCOME

Katherine Kelly, Brenda Zosa, John J. Como*, MD, MPH, Jeffrey Claridge*, M.D., MetroHealth Medical Center

Introduction: We evaluated hospital and long-term outcomes of damage control laparotomy (DCL) for trauma managed with primary fascial closure (PFC) during the index hospitalization or discharge with a planned ventral hernia (PVH).

<u>Methods</u>: DCLs from 2005-2010 at a regional Level 1 trauma center were compared based upon whether they had PFC or a PVH.

Results: 121 patients had a DCL. 47% followed penetrating injuries. Mean age and injury severity score (ISS) were 40 and 25, respectively. Hospital mortality was 21%. 91 (75%) DCLs had PFC during the index hospitalization. Of these, 8 (9%) had their fascia re-opened. This was associated with a 25% mortality rate. 14 (12%) were discharged with a PVH. PFC and PVH patients were similar in age, gender, ISS, and mechanism. PVHs had more subsequent laparotomies (3.3 vs 1.5, p<0.001), hospital days (43 vs 27, p<0.05), need for tracheostomy (57% vs 31%, p=0.039), and intra-abdominal infections (57% vs 17%, p=0.003). The rate of enteric fistulas during the index hospitalization was similar. PVHs were discharged to home less often (14% vs 42%, p=0.045). 11 (76%) patients with a PVH had definitive reconstruction (mean days = 330). Once definitive closure was achieved, the two groups achieved similar rates of work clearance (71% vs 70%). The days to work clearance were also similar (190 vs 181). PFCs and PVHs had similar rates of hernia recurrence (15% vs 18%), intra-abdominal infection (10% vs 0%) and enteric fistulas (2% vs 0%) long term. Follow-up has been 21 months with an overall mortality rate of 25%.

Conclusion: Following DCL for trauma, patients with a PVH are set back approximately 1 year in their recovery as compared to patients with PFC. However, once definitive abdominal wall closure is achieved, patients with PFC or PVH do similarly well.

ANGIOEMBOLIZATION: AN INDEPENDENT PREDICTOR OF SURVIVAL IN HIGH-GRADE BLUNT LIVER INJURIES.

Pedro Teixeira, Emre Sivrikoz, Shelby Resnick, Kenji Inaba*, MD, Peep Talving*, MD, PhD, FACS, Demetrios Demetriades*, M.D., Ph.D., LAC+USC Medical Center Sponsor: Demetrios Demetriades*, M.D., Ph.D.

Introduction: Nonoperative strategies and damage control surgery have revolutionized the management of blunt hepatic trauma. The role of angioembolization (ANGIO) in high-grade liver injuries is not clear. Our aim was to investigate the role of ANGIO as an adjunct to the management of high-grade blunt liver injuries.

<u>Methods:</u> This National Trauma Data Bank (NTDB) study included patients with grades IV and V blunt liver injuries between 2002-2009. Patient characteristics included gender, age, admission vital signs and GCS, Injury Severity Score, associated injuries, laparotomy, and ANGIO. Primary outcome was in-hospital mortality. Logistic regression analysis adjusting for age, gender, hypotension, GCS, ISS, head AIS, chest AIS, extremity AIS, and laparotomy was performed to asses the effect of ANGIO on mortality, overall, in patients treated operatively and patients treated nonoperatively.

<u>Results:</u> During the 8-year study period, 5,192 patients with high-grade liver injuries were identified. Laparotomy was performed in 32% (1686) and nonoperative management in 68% (3506). Overall, 12.5% (647) of the patients underwent ANGIO. Mortality was significantly lower for patients who underwent ANGIO (18% vs. 28%, p<0.001). After stepwise logistic regression, ANGIO was found to be an independent predictor of survival (Adjusted Odds Ratio (AOR)=0.58 [0.44-0.76], p<0.001). In the group of patients managed operatively, ANGIO was independently associated with a lower mortality (24% vs. 40%, AOR=0.54 [0.39-0.75], p<0.001). Similarly, in the nonoperative group ANGIO was independently associated with a lower mortality (13% vs. 22%, AOR=0.60 [0.39-0.94], p<0.026).

<u>**Conclusion:**</u> Angioembolization is a significant adjunct in the management of high-grade blunt liver injuries and reduces mortality after operative or nonoperative management.

POSTER WITHDRAWN

THE SWINGING PENDULUM: A NATIONAL PERSPECTIVE OF NON-OPERATIVE MANAGEMENT IN SEVERE BLUNT LIVER INJURY

Patricio Polanco, Joshua Brown, Juan Carlos Puyana*, M.D., Jason Sperry*, Andrew Peitzman **, University of Pittsburgh Sponsor: Andrew Peitzman **,

Introduction: Despite a shift toward non-operative management (NOM) of blunt liver trauma, severe injuries require operative management (OM). Our objective was to examine current trends of NOM for severe blunt liver injury. **Methods:** Subjects with blunt AIS \geq 4 liver injury and no other major solid organ injury or pelvic fracture were identified in the NTDB 2002-08. Attempted NOM was defined as no surgery \leq 6hrs. Failed NOM was defined as surgery \geq 6hrs. Cox regression evaluated the association of NOM outcome with 30d mortality after controlling for injury severity and center. Logistic regression was used to define independent predictors of failed NOM. Attempted and failed NOM rates were compared over the study period.

Results			
ixcourto.	Died <6hr no surgery	234 (7%)	90'T
3 627	Early OM	738 (20%)	80
5,027	Attempted NOM	2639 (73%)	
subjects	Failed NOM	165 (7%)	70
J	OR only	125 (76%)	% 60 ¹
were	OR + HAE	40 (24%)	- Altempted NOM
: dantified	Successful NOM	2474 (93%)	10-
Identified	Died ≥6hr no surgery	167 (7%)	
with a	Survived no surgery	2236 (90%)	a
with a	HAE	71 (3%)	2002 2003 2004 2005 2006 2007 2008
median			Year

ISS 29 (20-38) and 20% mortality. Table shows initial and final management. Failed NOM was an independent predictor of mortality (HR 1.7; 1.1-2.6, p=0.01). Increasing age, male sex, increasing ISS, decreasing SBP and GCS, and hepatic angioembolization (HAE) were predictors of failed NOM. The rates of attempted and failed NOM increased over the study period (p<0.01, Fig).

<u>Conclusion</u>: NOM for isolated severe blunt liver injury is increasing nationally with similar increment in failure. Failed NOM was associated with higher mortality. Hypotension independently predicted failed NOM, suggesting better patient selection may improve outcome.

THE SURGICAL MANAGEMENT OF SEVERE PENETRATING LIVER TRAUMA: A DYNAMIC APPROACH ACCORDING TO INITIAL RESPONSE TO THERAPY

Carlos Ordoñez, Juan Salamea, Juan Carlos Puyana*, M.D., Magda Cepeda, Marisol Badiel, John Loaiza, Michael Parra, Luis Pino, David Scavo, Wilmer Botache, Ricardo Ferrada*, M.D., Universidad del Valle. Fundación Valle del Lili Sponsor: Juan Carlos Puyana*, M.D.

Introduction: Penetrating Liver Trauma (PLT) can be a major technical challenge in the operating room albeit most blunt liver injuries are managed non-operatively. Furthermore, deep penetrating liver injuries may not always respond to common damage control techniques such as Pringle Maneuver and Packing (PMP). Our objective is to describe our approach for patients with severe PLT according to their initial response or lack thereof to PMP. **Methods:** We reviewed 146 patients with PLT managed at a Regional Level I Trauma Center, from 01/2003 to 12/2011 using a stepwise approach that rapidly moves toward exposure of deep intra-hepatic structures and major vessel ligation (VL) in those patients not responding to PMP.

<u>Results:</u> Fifty-eight patients had superficial liver lacerations that required no treatment; PMP was required in 88/146. GSW occurred in 78/88 (88.6%). The overall median age was 30 years. Fifty-five responded to PMP alone whereas 33 continued to bleed despite PMP. These patients underwent immediate intra-hepatic vessel exposure and vessel ligation (PMP+VL). Ten patients required ligation of major intra-hepatic branches which included the supra-hepatic veins (n=4), portal vein (n=4), retro-hepatic cava (n=1) and hepatic artery (n=1). The remaining 23 patients required VL of smaller intra-hepatic vessels, combined with other hemostatic techniques such as topical agents and/or hepatorrhaphy.

Conclusion: PMP is an effective first line therapy for hemorrhage control for most patients with severe PLT. For those patients that fail to respond to PMP, immediate intra-hepatic exploration and major vessel ligation is required.

Clinical Outcomes in Severe PLT	PMP alone, n=55	PMP + VL, n=33	P
Intra-Operative Bleeding, cc, Median (IQR)	1500 (1000-2500)	2500 (1500-4000)	0,006
Associated injuries, n(%)	37(62,7)	24(72,7)	0,591
Complications, n(%)	25 (46,3)	19 (57,6)	0,307
Mortality, n(%)	2 (3,6)	12 (36,4)	0,001

DO WE REALLY RELY ON FAST FOR DECISION-MAKING IN THE MANAGEMENT OF BLUNT ABDOMINAL TRAUMA?

Jeffrey Carter, Mark Falco, Michael Chopko, William J. Flynn, Jr.*, M.D., Charles E. Wiles, III*, M.D., Weidun Guo*, University at Buffalo

Introduction: The Focused Assessment with Sonography in Trauma examination (FAST) is use as a screening modality for blunt abdominal trauma, but limited by low sensitivity and operator variability. This study evaluated the efficacy of FAST to obviate computerized tomography. **Methods:** We performed a retrospective chart review of blunt abdominal trauma patients 7/2009-11/2010. FAST was performed by ED residents and was considered positive with free intra-abdominal fluid. Abdominal CT, or surgery were used as confirmation of intra-abdominal injury.

<u>Results:</u> A total of 148 patients were confirmed to have blunt abdominal injuries. Table 1 shows the specific injuries that FAST exam appropriately detected or missed. In 116 hemodynamically stable patients, FAST was positive in 26 patients, with a sensitivity of 22.4%. In 32 hemodynamically unstable patients, FAST was positive in 9 patients, with a sensitivity of 28.1%. A multivariate regression model revealed that a positive FAST (p=0.005) is one of the independent predictors for an emergent exploratory laparotomy.

Table 1. Intr	raabdo	ominal i	njuries docu	imente	d with C	T scan, o	r intraoperative	findings
	Liver	Spleen	Pancrease	Bowel	Free fluid	Vascular	Pelvic hematoma	Kidney
FAST(+) n=35	9	23	1	2	26	2	7	11
FAST(-) n=111	28	46	4	12	50	7	16	22

<u>Conclusion</u>: Although a positive FAST is a predictor of laparotomy, it has a very low sensitivity. In hemodynamically stable patients, a negative FAST without a CT may result in missed injuries, while in hemodynamically unstable patients, with clear physical findings, the decision of exploratory laparotomy should not be distracted by a negative FAST.

COMPARISON BETWEEN LAPAROTOMY FIRST VERSUS ANGIOGRAPHIC EMBOLIZATION FIRST IN PATIENTS WITH PELVIC FRACTURE AND HEMOPERITONEUM

Morihiro Katsura, MD MPH, Shin Yamazaki, PhD, Shingo Fukuma, MD, Kazuhide Matsushima, MD, Toshimitsu Yamashiro, MD, Shunichi Fukuhara, MD DMSc, Okinawa Prefectural Hokubu Hospital, Kyoto University Sponsor: Matthew C. Indeck*, M.D.

Introduction: The purpose of this study was to describe the practice patterns in Japan for patients with pelvic fracture and hemoperitoneum and to examine the association between initial therapeutic intervention (laparotomy or transcatheter arterial embolization (TAE)) and in-hospital mortality. <u>Methods:</u> Cohort study using the Japan Trauma Data Bank between 2004 and 2010 including patients with pelvic fracture and positive Focused Assessment with Sonography in Trauma (FAST). Eligible patients were restricted to those patients who underwent laparotomy or TAE/Angiography as initial therapeutic intervention. Crude and adjusted odds ratio (AOR) for mortality were determined, using TAE first group as the reference group. Logistic regression analysis was used to adjust for clinically relevant confounders, including the severity of injury.

<u>Results</u>: Of all 317 participants, 123 patients underwent laparotomy first and 194 patients underwent TAE first. The two groups were similar regarding age, however, laparotomy first group had a higher mean ISS, a higher mean abdomen AIS, a lower mean pelvic AIS and a lower mean SBP. Half of patients who were hypotensive (SBP < 90 mmHg) on arrival underwent TAE first. Laparotomy first group had a significantly higher crude mortality (41% vs. 27%). After adjusting for confounders, a choice of initial therapeutic intervention was not associated with a significant increase risk of mortality (AOR, 1.20; 95% CI, 0.61-2.39). In the subgroup of hypotensive patients (SBP 66-89 mmHg and SBP < 65 mmHg subgroup), the effect was similar (AOR, 1.50; 95% CI, 0.56-4.05 and AOR, 1.05; 95% CI, 0.44-3.03). **Conclusion:** In Japan, laparotomy and TAE were equally chosen as an initial therapeutic intervention regardless of the hemodynamic stability. No significant difference in in-hospital mortality was seen between laparotomy first group.

ACUTE APPENDICITIS: A DISEASE SEVERITY SCORE FOR THE ACUTE CARE SURGEON

Geoffrey Garst, Ernest E. Moore*, M.D., Monisha Banerjee, David Leopold, Clay Cothren Burlew*, M.D., Denis Bensard*, Walter Biffl*, M.D., Carlton Barnett, Jeffrey L. Johnson*, M.D., University of Colorado Denver Sponsor: Ernest E. Moore*, M.D.

Introduction: Analogous to organ injury scales (OIS) developed for trauma, a scoring system is needed for acute care surgery. In addition to research uses, this system is needed for anticipated changes in reimbursements. Thus, the purpose of this study is to develop a disease severity score (DSS) for acute appendicitis, the most common surgical emergency.

Methods: Based on a literature review, we developed the following DSS for acute appendicitis grade 1 = inflamed, grade 2 = gangrenous, grade 3 = perforated, grade 4 = perforated with a regional abscess and grade 5 = perforated with diffuse peritonitis. To test the validity of this DSS, we examined the records of 1000 consecutive acute appendectomy patients from 1999 and 2009. We examined the mean length of hospital stay and the incidence of in-hospital and post-discharge complications between DSS grades. **Results:** Of the 1000 patients we reviewed, 85 were excluded due to negative or interval appendectomy or incomplete medical records. The case distribution was Grade 1: 58.2%, Grade 2: 11.6%, Grade 3: 17.7%, Grade 4: 4.1%, Grade 5: 1.4%. The remaining results are listed on the table below.

DSS Grade 1	Number of Cases 573	Mean Length Of Stay (Days) 1.23	Postoperative Wound Infection 3.84%	Intra-abdominal Abscess 2.09%	Post-Discharge Small Bowe Obstruction 0.52%
2	114	1.98	17.50%	2.63%	1.75%
3	174	4.95	32.10%	16.67%	1.70%
4	40	7.13	52.50%	32.50%	8.00%
5	14	10.71	42.80%	57.14%	14.20%

<u>Conclusion</u>: The DSS for acute appendicitis appears to be valid for this single institution study, though further investigation at outside institutions is required. This DSS may be useful for designing therapeutic modalities, planning resource utilization, as well as determining reimbursements.

DIFFERENT TYPE OF ACUTE APPENDICITIS, OCCLUSIVE VS. NON-OCCULUSIVE: A POSSIBLE IMPLICATION FOR EARLY PERFORATION

Narong Kulvatunyou, Randall S. Friese*, M.D., Donald Green, Lynn Gries, Bellal Joseph, MD, Terence O'Keeffe, MB ChB, Peter Rhee*, MD, MPH, FACS, FCCM, Andrew Tang, M.D., Julie Wynne, University of Arizona - Tucson Sponsor: Peter Rhee*, MD, MPH, FACS, FCCM

Introduction: Several clinicians contend that acute appendicitis (AP) can be treated nonoperatively, but clinical and epidemiologic evidence suggests that different types of AP might exist. We hypothesized that 2 types of AP (occlusive vs. nonocclusive, based on the presence of fecalith) might exist, and that the natural history of progression may be different.

<u>Methods:</u> Using Acute Care Surgery registry, we reviewed charts of patients who had AP from October'09, through September'11. We defined AP as occlusive (OC-AP) if radiologic or pathologic evidence indicated the presence of fecalith; as nonocclusive (NOC-AP) if not. We collected demography, patient time(PT)(time from abdominal symptom onset to arrival in the emergency department [ED]), in-hospital time(HT)(time from arrival in the ED to arrival in the operating room), and total time (TT)(PT+HT). For the perforation rate, we performed regression, adjusting for age, gender,PT(>or <1day),HT(>or<6hours),and AP type.

Non-OC AP (n=258) OC-AP (n=74) Non-perf Perf. p Non-perf Perf p	
n = 221 n = 37 n = 49 n = 25	
PT, day(s) <u>+</u> SD 1.3 <u>+</u> 1.9 1.8 <u>+</u> 2.4 0.06 0.9 <u>+</u> .9 2 <u>+</u> 1.4 < .001 HT, hour(s) <u>+</u> SD 11.5 <u>+</u> 6 14 <u>+</u> 14 0.55 11.5 <u>+</u> 6 12 <u>+</u> 5 0.64 SD 41 <u>+</u> 33 50 <u>+</u> 30 0.03 34 <u>+</u> 22 61 <u>+</u> 36 < .001	Total time, hour(s) <u>+</u>

<u>Results:</u> During the study period, 332 patients had AP. Of these, 258 (78%) had NOC-AP;74 (22%) had OC-AP. OC-AP had a higher perforation rate (34% vs. 14%, p<.001)than NOC-AP. Table detailed time according to AP type.Regression showed OC -AP was the significant predictor of perforation (odds ratio, 3.0; 95% confidence interval, 1.6 to 5.5, p < .001).

Conclusion: Our study showed that most APs were associated with PT and not HT delay. OC-AP is a risk factor for perforation. Explaining how or why AP perforates may help us better understand why patients may not respond to non-operative management.

THE ROLE OF SURGERY IN THE MANAGEMENT OF "BODY PACKERS"

Laura Alvarez-Llano, Cristina Rey-Valcarcel, Juan Carlos Puyana*, M.D., Yusef Al-lal, Maria Dolores Perez-Diaz, Fernando Turegano-Fuentes, Hospital General Universitario Gregorio Marañon Sponsor: Juan Carlos Puyana*, M.D.

Introduction: Our main goal was to analyze the results of conservative treatment of body-packers, surgical indications and postoperative morbidity. **Methods:** A retrospective observational study of patients admitted to our hospital from 2000 to 2011 with a diagnosis of body-packer. Diagnostic protocol included and abdominal X-ray and a urinalysis for toxic substances. Only patients with gastrointestinal symptoms, signs of intoxication or a positive urinalysis were admitted for observation to our special unit, under custody. Conservative management included bowel rest and serial imaging tests.

<u>Results:</u> 763 body packers were admitted, and 45% had a positive urinalysis. 18 patients were admitted to the ICU. All 763 patients were initially treated conservatively, and 47 developed complication (5.9%): 28 bowel obstruction, 3 perforations, and 16 poisoning. Of those 47 patients, 28 required surgical intervention (19 obstructions, 2 perforations and 7 poisoning), 16 were successfully managed non operatively, and 3 patients died before surgery. Two of the deaths resulted from acute toxicity, one of them with acute onset and negative urinalysis, and 1 patient died of bowel perforation. Postoperative complications occurred in 57%: 9 wound infections, 2 suture dehiscence, 1 bowel ischemia, 2 intraabdominal fluid collections, 1 pneumonia, and 1 central line infection.

<u>Conclusion</u>: There is no gold standard screening test when a diagnosis of body packer is suspected; urinalysis maybe negative in cases of acute toxicity. Conservative management is safe in most cases. Our protocol was effective in 95% of the cases. Surgery was required in 58% of patients who did not respond to conservative management. The postoperative morbidity is high. Mortality is rare and, when it occurs, it is usually associated with severe cocaine poisoning from a ruptured packet.

BENCHMARKING QUALITY IN ACUTE CARE AND ELECTIVE SURGICAL PRACTICE: THE NEED FOR SEPARATION

Robert Becher, Jared Gallaher, Michael Chang*, M.D., Lucas Neff, J. Wayne Meredith*, M.D., Wake Forest University School of Medicine

Introduction: Publically reported outcome measures are currently not adjusted for a surgeon's case mix of elective versus emergency operations. We hypothesized that the reported outcomes of elective surgeons would be improved after the creation of an acute care surgery (ACS) service. **Methods:** Patients undergoing open bowel resections by non-ACS surgeons over 3 years were studied. Demographics and outcomes were compared before and after the formation of an ACS service. Univariate and multivariable regression models were used to predict mortality and complications.

<u>Results:</u> 717 patients operated on by non-ACS surgeons were studied, 386 pre-ACS and 331 post-ACS. The elective caseload of non-ACS surgeons increased significantly with the implementation of an ACS service, from 80% of all cases to 94% (p<0.0001). Over this same time period, mortality and hospital length of stay (LOS), two major quality outcome metrics, decreased significantly: mortality from 11% to 6% (p=0.0121) and LOS from 17 to 13days (p=0.0010). Surgical complications, such as anastomotic leaks, sepsis, and wound disruptions, were unchanged post-ACS. Emergency laparotomies significantly increased the odds of mortality compared to elective cases (Odds Ratio 4.8, p<0.0001), which independently explained the drop in mortality for elective surgeons.

<u>Conclusion</u>: Removing emergency laparotomies from the practice scope of non-ACS surgeons drastically improves their reported quality measures, while true surgical outcomes do not change. In the era of public disclosure, this is an important side benefit to non-ACS surgeons of an ACS service. Separate quality benchmarks should be developed that account for the presence or absence of emergency surgical patients in one's practice.

ANGIOGRAPHY AND EMBOLIZATION FOR LOWER GASTROINTESTINAL BLEEDING

William Yi, Jack A. Sava*, M.D., Washington Hospital Center Sponsor: Jack A. Sava*, M.D.

Introduction: Angioembolism has been used therapeutically for bleeding control, but there is limited data on its efficacy. This study was designed to evaluate the efficacy of angiography and embolization for localizing and treating lower gastrointestinal bleeding (LGIB).

Methods: Retrospective descriptive review of all patients undergoing mesenteric angiography at a tertiary hospital over an 8-year period. Clinical data were recorded including patient demographics, causes of bleeding, procedures, and outcomes. Definitive control of bleeding was the primary endpoint. Complications and mortality were also documented. **Results:** 189 angiograms were performed on a 170 patients. Angiographic localization was successful in 25% of patients. Definitive angiographic control of bleeding was achieved in 10% of patients. 42% of patients who had an attempted embolization ultimately required an operation. One patient developed post embolization ischemia requiring laparotomy. There were no other angiographic complications. There were 15 mortalities with 7 due in part to hemorrhagic shock. 6 of these patients were never localized, while the 1 localized patient died intraoperatively due to bleeding.



Conclusion: Angiographic localization of LGIB is successful in only 25% of patients. Definitive angiographic hemostasis occurred in 10% of patients who underwent angiography for LGIB. Angiographic localization and treatment of LGIB are useful in a minority of case, but usually are unsuccessful.

ARE EMERGENCY GENERAL SURGERY PATIENTS MORE WORK THAN TRAUMA PATIENTS? CHARACTERIZING SURGEON WORK IN AN ACUTE CARE SURGERY PRACTICE

Michael Parent, Karina McArthur, Jack A. Sava*, M.D., Washington Hospital Center

Introduction: Many trauma surgery groups have embraced emergency general surgery (EGS) as part of their practice. This practice pattern takes advantage of the trauma surgeon's 24 hour presence in the hospital. However, differences in quantity and timing of work between EGS and trauma patients affect demands on resources and staff.

<u>Methods</u>: Hospital trauma, financial, pharmacy, and medical records of 100 successive trauma and 50 successive EGS patients were reviewed. Work performed by our service was quantified using RVUs, operations, complications, and lab tests/imaging/medications ordered and the events organized by time intervals after contact by the acute care surgery service.

<u>Results:</u> Our estimators of surgeon work per patient,



totaled over all studied time intervals, showed EGS exceeding trauma patients by 59% (lab tests) to 470% (operations) (all but one p<0.01). The exception was that trauma patients required more imaging studies per patient (4.25 vs. 2.48, p<0.01). Trauma patients had a mean time to primary diagnosis of .9 hours, compared to 4.3 hours in EGS patients.

<u>**Conclusion:**</u> In this pilot effort we found that EGS patients required more diagnostic effort initially, and generated more RVUs, operations, lab tests, and new medication orders and had more complications over the course of their care. Addition of EGS patients to a trauma service consumes more per patient resources than trauma patients.

POSTER WITHDRAWN

FECAL DIVERSION FOR SEVERE ACUTE PERIANAL SOFT TISSUE INFECTION: WHERE, WHEN, WHO, WHY.

Laurie Punch, Sharon Henry*, M.D., Mansoor Khan, Lynn Stansbury, Thomas M. Scalea*, M.D., University of Maryland Medical Center

Introduction: Severe perianal acute soft tissue infection (PASTI) occurs in proximity to the rectum. We sought to characterize the technique, timing and outcome of patients presenting with PASTI treated with and without fecal diversion.

Methods: We retrospectively reviewed all patients with PASTI requiring surgical debridement from 2006-2009. Patient demographics, type and extent of infection, method of fecal diversion, and complications were abstracted. **Results:** Of 174 patients presenting with PASTI, 70 (40%) underwent fecal diversion. Indications included exposure of the external sphincter, circumferential perianal wound, and ongoing fecal soiling. Age, BMI, diabetes and cardiac history were equivalent between those who underwent diversion and those who did not. Those undergoing diversion were more likely (p<0.05) to be males presenting with ischiorectal necrosis. Renal failure, respiratory failure, vasopressor dependent shock, and death occurred more commonly in the diversion group also. Of the 14 patients who died after fecal diversion, 3 had post-operative complications directly related to abdominal surgery. Wound healing time was equivalent between the two groups. Ostomy reversal was performed for 23 (33%) patients an average of 10 months post-diversion.

p<0.05	Age	Morbid Obesity	Diabetes	Cardiac	Male	lschiorectal abscess*	Renal failure*	Respiratory failure*	Shock*	Death*	Wound Closure*	Wound healing
Diversion	54	43 (41%)	61 (58%)	23 (22%)	54 (77%)	34 (44%)	22 (31%)	26 (37%)	17 (24%)	14 (20%)	39 (56%)	34 (60%)
No diversion	52	27 (39%)	36 (51%)	13 (19%)	66 (64%)	16 (15%)	18 (17%)	15 (14%)	12 (11%)	3 (3%)	85 (82%)	72 (69%)

<u>Conclusion</u>: Fecal diversion is often part of management of PASTI but is associated with higher morbidity and mortality. Future research must focus on methods to correctly identify the subgroups of these very ill patients in which diversion is or is not appropriate.

HEMOSTATIC PERFORMANCE OF GUARDACAREXR SURGICAL IN TWO IN VIVO SURGICAL INJURY MODELS IN SWINE

Barbara McGrath, Jennifer Jenco, Sam Kuhn, Hua Xie, HemCon Medical Technologies, Inc. Sponsor: Raul Coimbra*, M.D., Ph.D.

Introduction: HemCon GuardaCareXR Surgical is an advanced hemostat for the temporary control of severely bleeding wounds such as surgical wounds. These studies demonstrate the efficacy of GuardaCareXR Surgical in two swine models: a capsular strip spleen injury, and an anticoagulated X-pattern liver injury.

<u>Methods</u>: Two swine splenic injury studies were conducted. The controls were a Lap Pad or QuikClotED (kaolin hemostat). Splenic capsular stripping injuries (10mmLx10mmWx3mmD) were created and the bleed rates measured. In the anticoagulated (heparin) X-pattern liver swine model, injuries (2.5cmLx2.5cmWx2.5cmD) were created. Test and Control (Kendall VistecGauze) were packed into the injury. After 2min application the bleed rate was measured, success determined at continuous hemostasis at 15min. <u>Results</u>: GuardaCareXR Surgical achieved hemostasis for the splenic injury in significantly less time and lower mean blood loss. In the liver model, immediate hemostatic efficacy of the Test dressings was significantly greater than the Control. Table below summarize these results.

	# animals: 5; 60	Spleen # animals: 1; 40kg			# animals: 2; 35-45kg		
	1) GuardaCareXR 2) Control- La	Surgical p Pad	1) Guard 2) C	daCareXR Control- Q	Surgical C ED	1) GuardaCareXF 2) Control- Viste	R Surgical
Sample 'n'	1) 18 2) 17			1) 10 2) 7	- î	1) 11 2) 13	
Injury Bleed rates (g/min), mean +/- stdev	1) 9.1 +/- 5.6 2) 8.0 +/- 3.9	NS	1) 9.1 2) 8.5	+/- 1.9 5 +/- 3.7	NS	1) 54.7 +/ 27.8 2) 61.8 +/ 22.2	NS
Hemostasis Assessment, %	@ 5min 1) 72% 2) 18%	p<0.01	@ 2min	1) 100% 2) 100%	NS	@immediate 1) 55% 2) 8%	p<0.05
Total blood loss (g) @ 10 min, mean +/- stdev	1) 3.0++3.0 2) 10.5++8.9	p<0.01	1) 2.7 2) 5.2	+/-1.9 +/-2.7	~0.05		

<u>Conclusion</u>: Some surgical bleeding could benefit from a more effective hemostatic agent over traditional techniques. GuardaCareXR Surgical is a gauze-based hemostat that quickly and effectively achieves hemostasis in surgical wounds.

EXPERIENCE WITH 161 CASES OF ANTERIOR EXPOSURE OF THE THORACIC AND LUMBAR SPINE IN AN ACUTE CARE SURGERY MODEL: MORBIDITY, MORTALITY, AND FINANCIAL IMPACT

Hani Seoudi*, M.D., Matthew Laporta, Margaret Mary Griffen*, M.D., Anne G. Rizzo*, M.D., Ranjit Pullarkat, Inova Fairfax Hospital

Introduction: Access to the anterior elements of the spine allows a more definitive management of a variety of pathologies. Most spine surgeons enlist the assistance of other surgeons to provide the anterior approach to the thoracic and lumbar spine. We hypothesized that a dedicated acute care surgery service can perform those operations with acceptable morbidity and mortality.

<u>Methods</u>: A retrospective chart review of 161 trauma and non-trauma patients was performed. All cases were performed at a Level I trauma center with a dedicated acute care surgery service. In-hospital morbidity and mortality were evaluated. The sum of relative value units (RVU) earned by performing those operations was determined.

<u>Results:</u> Of the 161 subjects 59 (36%) were trauma patients. Ninety three patients (58%) had anterolateral retroperitoneal exposure of the thoracic and lumbar spine. Sixty eight patients (42%) had anterior retroperitoneal midline exposure of the lumbar spine. Total morbidity was 9.3% (7.4% for trauma patients and 1.8% for non-trauma patients). Morbidity was highest in patients who had anterolateral retroperitoneal exposure of the thoracic and lumbar spine (6.8%). Morbidity in patients who had midline exposure of L4 to S1 was 0%. Total mortality was 1.2% (3.3% for trauma patients and 0% for non-trauma patients). The acute care surgery service gained 3141 RVU's by performing those operations.

<u>Conclusion</u>: Anterior exposure of the thoracic and lumbar spine both for trauma and non-trauma related indications can be performed with acceptable morbidity and mortality by a dedicated acute care surgery service. Morbidity and mortality are higher in trauma patients and those who underwent thoracolumbar procedures. Patients who had midline exposure of L4 to S1 for degenerative disc disease had the least morbidity.

A MULTICENTER EVALUATION OF RAPID THROMBELASTOGRAPHY (rTEG) IN PREDICTING LARGE VOLUME TRANSFUSIONS

Bryan A. Cotton*, M.D., Mitchell Jay Cohen*, M.D., Elizabeth Camp, MSPH, Tim Welch, NREMT-P, Britt Redick, BA, Ryan Stucke, BS, Jeanette Podbielski, BSN, John B. Holcomb*, M.D., Martin Schreiber*, M.D., University of Texas Health Science Center-Houston

Introduction: The purpose of this multicenter study was to (1) describe transfusion patterns predicted by Rapid Thrombelastography (rTEG) and (2) define those rTEG values predictive of large volume transfusions.

<u>Methods</u>: 14-month, prospective, observational trial at three ACS-verified, level-1 trauma centers. Inclusion: highest-level trauma activation and arrival within 6 hours of injury. Exclusion: <18 years of age, incarcerated, and burns >20% TBSA. Massive transfusion (MT): \geq 10U RBC in 24 hours. Substantial bleeding (SB): \geq 5 U RBC in the first 4 hours. Regression model variables were chosen a priori and included age, gender, race, mechanism, and arrival weight Revised Trauma Score.

Results: 1242 patients were enrolled with median age of 38, median ISS of 21, 75% blunt mechanism. rTEG values correlated with 0-3 hour RBC, plasma, and platelet transfusions (all <0.05). Linear regression confirmed this association for k-time, angle, mA, and LY30% (all <0.05). Logistic regression identified "trigger" values for k-time >1.9 min (OR 0.27, 95% CI 0.10-0.69, p=0.01), angle <67 deg (OR 3.4, 95% CI 1.27-9.05, p=0.02), mA <62 mm (OR 3.7, 95% CI 1.24-10.80, p=0.02), and G-value <8 dynes/cm2 (OR 5.1, 95% CI 1.45-17.92, p=0.01) in predicting MT. However, all rTEG values were independent predictors of SB: r-value >0.8 min (OR 0.33, 95% CI 0.16-0.66, p=0.002), k-time >1.9 (OR 0.50, 95% CI 0.26-0.97, p=0.04), angle <67 (OR 2.4, 95% CI 1.24-4.81, p=0.01), mA <62 (OR 2.0, 95% CI 1.07-3.65, p=0.03), G-value <8 (OR 2.6, 95% CI 1.33-5.09, p=0.01). **Conclusion:** This multicenter study demonstrated admission rTEG provides valuable information in predicting subsequent transfusions. rTEG values identity patients likely to receive large volume transfusions. However, the trajectory of transfusion patterns was best captured when SB was used as a surrogate of hemorrhage rather than the traditional MT definition.

LOW RATIO OF INTRAVENOUS FLUID ADMINISTRATION TO PACKED RED BLOOD CELL IS ASSOCIATED WITH IMPROVED SURVIVAL IN TRAUMA PATIENTS: A PROPENSITY ANALYSIS

Kunihiko MAEKAWA, M.D., Kohei Kato, M.D., Hirotoshi Mizuno, M.D., Keigo Sawamoto, M.D., Shuji Uemura, M.D., Katsutoshi Tanno, M.D., Ph.D, Kazuhisa Mori, M.D., Ph.D., Yasufumi Asai*, M.D., Ph.D, Sapporo Medical University Sponsor: Yasufumi Asai*, M.D., Ph.D

Introduction: Recent studies have suggested a survival advantage in trauma patients who received higher ratio of fresh frozen plasma (FFP) to packed red blood cell (PRBC) and restrictive intravenous fluid (IVF). However, the relationship between the ratio of IVF volume to PRBC and outcomes was not fully examined. We hypothesized that trauma patients who received low ratio of IVF to PRBC (low ratio group) have higher survival rate than patients who received high ratio of IVF to PRBC (high ratio group).

<u>Methods</u>: We conducted an observational cohort study over 6 years (2006-2011). Adults blunt trauma patients were eligible for inclusion if they were admitted to our ICU, administered one or more units of PRBC and FFP during first 24 hours, and survived 24 hours or longer. The directions of IVF and transfusion were dependent on the attending doctors. We defined low ratio of IVF to PRBC as less than 1L of IVF per unit of PRBC during 24 hours. We used propensity-score matching to adjust for differences between low ratio group and high ratio group. Primary endpoint was survival to discharge.

<u>Results:</u> Of 112 eligible patients, 41 were enrolled in low ratio group and 71 were enrolled in high ratio group. The propensity-score matching process selected 14 patients each from both groups. Matched groups were similar in demographics, injury severity, admission vitals, blood component requirements and the ratio of FFP to PRBC during 24 hours. Matched low ratio group had less IVF (4.1L vs. 7.8L, p=0.0003) and lower ratio of IVF to PRBC (0.8L vs. 1.3L per unit of PRBC, p<0.0001) during 24 hours. In Kaplan-Meier analysis, there was a significant survival difference favoring low ratio of IVF to PRBC (92.9% vs. 57.1%, log-rank p=0.032). **Conclusion:** Less than 1L of IVF per unit of PRBC was associated with improved survival in trauma patients.

PROSPECTIVE EVALUATION OF THE IMPACT OF HYPERCOAGULABILITY IN TRAUMA PATIENTS

Bernardino Branco, Resident, Kenji Inaba*, MD, Crystal Ives, Obi Okoye, Research fellow, Ira Shulman, Janice Nelson, Peter Rhee*, MD, MPH, FACS, FCCM, Demetrios Demetriades*, M.D., Ph.D., University of Arizona - Tucson Sponsor: Kenji Inaba*, MD

Introduction: The purpose of this study was to determine the impact of hypercoagulability after trauma on the need for blood transfusion, in particular plasma, and mortality.

<u>Methods</u>: Patients meeting our Level I trauma center's highest activation criteria had a TEG performed at admission, +1 hr, +2 hrs, and +6 hrs using citrated blood. Hypercoagulability was defined as any TEG parameter in the hypercoagulable range; hypo as any in the hypocoagulable range.

<u>Results:</u> A total of 118 patients were enrolled. Of those, 77.1% were male, mean age 36.9 years (range 8-91), mean ISS 13.8 \pm 11.7, 51.7% penetrating. On admission, 26.3% (n=31) were hypercoagulable, 55.9% (n=66) had a normal TEG profile and 17.8% (n=21) were hypocoagulable. After hospital admission, 4 (12.9%) hypercoagulable patients and 11 (16.7%) patients with normal TEG profile developed hypocoagulability (time to coagulopathy was 1:56 \pm 1:41 h). Hypercoagulable patients were less likely to require uncrossmatched blood (11.1% for hyper vs. 20.4% for normal vs. 45.7% for hypo, Adj p=0.01). Hypercoagulable patients required less blood products, in particular, plasma at 6 hours (0.1 \pm 0.4 U vs. 0.7 \pm 2.0 U vs. 4.3 \pm 6.3 U, Adj p<0.01) and 24 hours (0.2 \pm 0.6 U vs. 1.1 \pm 2.9 U vs. 8.2 \pm 19.3 U, Adj p<0.01). Hypercoagulable patients had lower 24-hour mortality (0.0% vs. 5.5% vs. 27.8%, Adj p<0.01) and less bleeding related deaths (0.0% vs. 1.8% vs. 27.8%, Adj p<0.01).

<u>**Conclusion:**</u> Approximately a quarter of trauma patients presented in a hypercoagulable state. Hypercoagulable patients required less blood products, in particular plasma. They also had a lower 24-hour mortality, and lower rates of bleeding related deaths. Further evaluation of the mechanism responsible for the hypercoagulable state and its implications on outcome are warranted.

RESVERATROL ATTENUATES ADVERSE EFFECTS OF ETHANOL DURING HYPOXIC CELL INJURY IN VITRO

Elizabeth Brandon-Warner, Ashley Lakner, Jacob Swet, Iain McKillop, Toan Huynh*, M.D., Susan Evans, Carolinas Medical Center Sponsor: Toan Huynh*, M.D.

Introduction: Multiple organ dysfunction syndrome (MODS) following hemorrhagic shock-reperfusion (HSR) accounts for >50% of trauma related deaths. Ethanol intoxication is a factor in nearly half of all trauma related injuries. Restoration of fluid volume alone often fails to prevent progressive injury during HSR. The liver is a key organ involved in MODS and, as the primary site of ethanol metabolism, is particularly vulnerable during HSR. The aim of this study was to determine if Resveratrol attenuated oxidative stress and cell death in hepatic cells exposed to ethanol prior to hypoxic injury. Methods: Rat (WBF344, GP7) and human (HepG2) cells were exposed to ethanol (E, 25 mM – 2Hrs) prior to hypoxic challenge (24Hrs). On reversal of hypoxia cells were exposed to Resveratrol (R, 75 µM). Cell counts and viability were determined using a trypan blue exclusion assay. Cell lysates analyzed for cytochrome C by WB (apoptosis), and lactate dehydrogenase (LDH) assayed (cell lysis). Oxidative stress was assessed by MDA, GSH, catalase and SOD activity, and mitochondrial superoxide (O2-.) by fluorescent probe. Effects of R on mRNA were determined by gRT PCR. **Results:** Cell survival was significantly increased (p<0.05) in cells treated with R following hypoxia in the absence (79.3%) or presence (83.3%) of E. This was confirmed by decreased cytoplasmic cytochrome C and reduced LDH in cells exposed to R after hypoxia. MDA levels were significantly reduced (p<0.05), while GSH levels in R treated cells were similar to that of control. Decreased superoxide was identified in R treated cells +/- E. R, +/- E significantly altered stress, pro-, and anti-apoptotic gene expression. Conclusion: Resveratrol blunted oxidative stress, maintained antioxidant capacity, and altered stress and survival pathways in liver cells exposed to ethanol prior to hypoxic insult. These data suggest that R may protect from cellular dysfunction that contributes to organ dysfunction and MODS.

Withdrawn

THE SURVIVAL IMPACT OF PLASMA TO RED BLOOD CELL RATIO IN MASSIVELY TRANSFUSED NON-TRAUMA PATIENTS

Pedro Teixeira, MD, Efstathios Karamanos, MD, Kenji Inaba*, MD, Peter Rhee*, MD, MPH, FACS, FCCM, Ira Shulman, Janice Nelson, Dimitra Skiada, MD, Demetrios Demetriades*, M.D., Ph.D., LAC+USC Medical Center Sponsor: Kenji Inaba*, MD

Introduction: For trauma patients undergoing a massive transfusion, increased ratios of Plasma to Packed Red Blood Cells (FFP:PRBC) have been shown to confer a survival advantage. The impact of this strategy in massively transfused non-trauma patients is unclear. We hypothesized that a high FFP:PRBC ratio would significantly improve survival in this population. Methods: This was a retrospective analysis of all non-trauma patients admitted to a surgical service requiring massive transfusion from Nov/2003-Sep/2011. Deaths in the first 24 hours after initiation of transfusion were excluded. Stepwise logistic regression was performed to identify independent predictors of mortality. Patients were then stratified according to the FFP:PRBC ratio received using two different cut-offs (1:2 and 1:3) and adjusted mortality was derived using multivariate analysis. **Results:** During the 8-year study period, 29% (260/908) of the surgical patients requiring massive transfusion were non-trauma patients. Mean age was 44.2±17.2, 72% were male. The average number of transfused units was 22±1 PRBCs [10, 182] and 12±1 FFPs [0, 74]. A stepwise decrease in mortality was observed with increasing FFP:PRBC ratios (45% for patients with ratio $\leq 1:8$, 33% for ratio > 1:8 and $\leq 1:3$, 27% for ratio > 1:3 and $\leq 1:2$ and 25% for ratio >1:2). Increasing FFP:PRBC ratio was an independent predictor of survival (Adjusted Odds Ratio (AOR): 1.91; 95% CI: 1.35, 2.71; p<0.001). Patients achieving a ratio of >1:2 had significantly improved survival [AOR (95% CI): 3.98 (1.35, 11.77), p = 0.012]. Conclusion: In non-trauma patients undergoing a massive transfusion, an

Conclusion: In non-trauma patients undergoing a massive transfusion, an increasing plasma to red blood cell ratio was associated with improved survival. Achieving a ratio > 1:2 significantly improved the probability of survival. Further prospective validation is warranted.

EARLY TRANSFUSION OF BLOOD PRODUCTS IN PATIENTS WITH SEVERE BLEEDING IN PENETRATING ABDOMINAL TRAUMA

Carlos Ordoñez, Marisol Badiel, Magda Cepeda, Marcela Granados, John Loaiza, Carmenza Macia, Luis Pino, Wilmer Botache, David Scavo, Juan Carlos Puyana*, M.D., Universidad del Valle. Fundación Valle del Lili Sponsor: Juan Carlos Puyana*, M.D.

Introduction: Patients with severe intra-abdominal bleeding after penetrating trauma require immediate surgical intervention. The decision to initiate blood product transfusion (BPT) with all four components (PRC, FFP, Plat. and Crio) should be made as early as possible to avert trauma induced coagulopathy (TIC). We compared the rate of transfusion of all four components given in a 1:1:1:1 ratio during the first 2 hours of surgery between survivors and non-survivors. We hypothesized that earlier initiation of all 4 components is associated with better outcome.

<u>Methods</u>: Of 574 patients with penetrating injuries admitted to our level one trauma center between 2003 and 2011 we identified 125 with severe penetrating abdominal trauma defined by PATI>30 and initial hemo-peritoneum at laparotomy > 1500cc.

<u>Results:</u> The rate of BPT during surgery (all 4 components combined) is depicted in the graph below. Survivors received PT earlier and at a slower rate. BPT was given at a higher rate but initiated later during surgery in non-survivors. The two groups were not significantly different regarding Apache, PATI, ISS, NISS and time of surgery (see table).

Conclusion: Early and steady rate of four components BPT during the initial surgery is associated with improved outcome. Late initiation of BPT in these patients even if provided at a faster rate appear to be less effective and may be an inefficient strategy to avert TIC

				Figure1. Rate of blood products transfusion during surger
Table 1. Baseline characteristics	Survivors, n=107	Deaid, n=18	Р	40 ⁴
Age, yr, median (IQR)	26 (21-35)	38 (28-43)	0.001	Y
NISS, n, (%)	40 (27-5)	42 (34-52)	0.3	
iśś, n, (%)	25 (16-3)	26 (22.5-34)	0.1	
PATI, n, (%)	39 (34-51.5)	42 (33-60.5)	0.7	1 E.m.
APACHE II, mediam (IQR)	18 (10-22)	20 (16-24)	0.1	
Surgical time, min, median (IQR)	90 (60-130)	120 (80-170)	0.1	a- 7 Deed
		8		2 17 87 40 60 71 10 105 120 Terr (rei)

LESS IS MORE: LOW-DOSE PROTHROMBIN COMPLEX CONCENTRATE EFFECTIVE IN ACUTE CARE SURGERY PATIENTS

Jacob Quick, Jennifer Meyer, Jeffrey Coughenour, Stephen L. Barnes*, M.D., University of Missouri

Introduction: Optimal dosing of prothrombin complex concentrate (PCC) has yet to be defined and varies widely from 3-100IU/kg. Thrombosis risk increases at higher doses, while lower doses may be ineffective. We hypothesized a dose of 15 IU/kg actual body weight of a three-factor PCC would effectively correct coagulopathy in acute care surgery patients. **Methods:** Retrospective review of 41 acute care surgery patients over 36 months who received 15 IU/kg (+/- 10%) actual body weight PCC for correction of coagulopathy. Demographics, laboratory results, PCC dose, amount of FFP utilized during correction period, 24-hour PRBC requirements and thrombotic complications were analyzed. Vitamin K usage was also examined.

<u>Results:</u> Mean age was 69 years (18-94 years), with 29 (71%) taking prehospital warfarin. Thirty (73%) trauma patients, 8 (20%) emergency surgery patients, 2 (5%) burns and 1 (2%) non-trauma neurosurgical patient were included. Mean PCC dose was 1305.4 IU (14.2 IU/kg actual body weight). Mean initial PT and INR were 28.5 sec. and 2.52. Average PT and INR were 18.64 sec. and 1.42 after PCC. Success (INR <1.5) was seen in 78% of patients after a single dose of PCC. Treatment failures had a higher mean initial INR (4.3, p 0.02) and mean post treatment INR (1.84, p 0.002). Mean units of FFP transfused was 1.46. Mean 24-hour blood (PRBC) transfusion was 1.61 units. Twenty (20, 49%) patients received no FFP in addition to PCC, while 25 (61%) patients received no PRBC transfusion. No statistical differences were seen with those who received Vitamin K (n=12). One thrombotic event occurred.

<u>Conclusion</u>: Administration of low-dose PCC, 15 IU/kg actual body weight, effectively corrects coagulopathy in acute care surgery patients with a low risk of thrombotic events.

A, B, C, D, ECHO. LIMITED TRANSTHORACIC ECHOCARDIOGRAM (LTTE) IS A USEFUL TOOL TO GUIDE THERAPY FOR HYPOTENSION IN THE TRAUMA BAY

Paula Ferrada, Rahul Anand, Luke Wolfe, Poornima Vanguri, James Whelan, Therese M. Duane*, M.D., Rao R. Ivatury*, M.D., Virginia Commonwealth University

Introduction: Limited Transthoracic Echocardiogram (LTTE) has recently been introduced as a teachable technique to direct resuscitation in ICU trauma patients. Our hypothesis is that LTTE can provide meaningful information to guide therapy for hypotension in the trauma bay.

<u>Methods</u>: LTTE was performed on hypotensive patients in the trauma bay. Views obtained included parasternal (PS) long and short, apical (A), and subxyphoid (SX). Results were reported regarding contractility (good vs. poor), fluid status (flat IVC=hypovolemia vs. fat IVC=euvolemia), and pericardial effusion (present vs. absent). Need for surgery, ICU admission, FAST exam results and change in therapy as a consequence of LTTE findings were examined.

Results: 148 LTTEs were performed from January to December 2011. Average age was 46. Admission diagnosis was 80% blunt trauma, 16% penetrating trauma and 4% burn. Volume was assessed in all cases via IVC visualization in the SX window. Contractility was assessed in 91%. PS and A windows were obtained in 96.5% and 11% respectively. Flat IVC was associated with an increased incidence of ICU admission (p<0.0076) and therapeutic operation (p<.0001). 27/148 (18%) of patients had LTTE results indicating euvolemia. The diagnosis in these cases was: head injury (n=14), heart dysfunction (n=5), spinal shock (n=4), pulmonary embolism (n=3), and stroke (n=1). 121 patients had LTTE results indicating hypovolemia. 28 hypovolemic patients had a negative or inconclusive FAST exam (n=18 penetrating, n= 10 Blunt), with 60% having blood in the abdomen confirmed at operation. Therapy was modified as a result of LTTE in 41% of cases. Strikingly, in patients older than 65, LTTE changed therapy in 96% of cases **Conclusion:** LTTE is a useful tool to guide therapy in hypotensive patients in the trauma bay.

FALSE ALARM IS BETTER THAN DELAY: TIMING AND CLINICAL ACCURACY OF MASSIVE TRANSFUSION

Matthew Kutcher, Raja Narayan, Vivian Curd, Aaron Daley, Ryan McCreery, Leslie Cachola, Ian Crane, Molly Greenberg, Mary Nelson, Eberhard Fiebig, Mitchell Jay Cohen*, M.D., University of California, San Francisco Sponsor: Mitchell Jay Cohen*, M.D.

Introduction: Massive transfusion (MT) is a poorly standardized practice, with multiple predictive scores and institution-specific protocols. We hypothesized that delay in MT protocol activation would be associated with poor outcomes.

<u>Methods</u>: From 7/09 to 6/11, data was prospectively collected on 140 patients with activation of the institutional MT protocol (MTP) at an urban Level I Trauma Center. MTP activation was at the discretion of the attending trauma surgeon. We evaluated timing of MTP and commonly used prediction scores in all patients at the time of MT, using area under the receiver-operator curve (AUC) to determine clinical utility.

<u>Results:</u> Mean ISS was 28.7 ± 16.2 , base deficit -9.7 ±6.7 , and median INR 1.3 (1.2-1.6); mortality was 34.3%. Median time to activation was 39.5min from ED arrival; of activations, 40.0% did not receive >10 U RBC within 24h ('false alarms'). The ABC score had 59.0% sensitivity for MT (AUC 0.535), and



TASH had 40.0% sensitivity (AUC 0.701); the McLaughlin score had an AUC of 0.686. Delay of activation >1h occurred in 40.4% and was significantly associated with mortality (Figure; p=0.019). Delay of MTP activation until >4 U RBC were administered was noted in 38.5%, but this did not correlate with poor outcomes.

Conclusion: Delay in MTP activation is associated with worse outcomes. Current clinical predictive scoring systems are insufficiently sensitive to drive MTP activation, and their use does not warrant potential delay in MT protocol activation.

PROCOAGULANT ACTIVITY INCREASES AFTER TRAUMATIC INJURY: A CASE-CONTROL STUDY

Myung Park, Barbara Owen, Robert Litwiller, Ailing Xue, William Harmsen, Donald H. Jenkins*, M.D., John Heit, Mayo Clinic Sponsor: Donald H. Jenkins*, M.D.

Introduction: Trauma is an independent risk factor for venous thromboembolism (VTE; odds ratio ~12) and better methods are needed to stratify VTE risk. In a case-control study, we tested the hypothesis that higher peak thrombin activity (Peak) and shorter time to peak thrombin activity (ttPeak; both reflecting a hypercoagulable state) are associated with acute blunt trauma and correlate with injury severity score (ISS).

<u>Methods</u>: Venous blood collected in the emergency department from acute trauma patients (cases; n=25) and from healthy volunteers (controls; n=37) was processed to citrated platelet-poor plasma for assay of plasma thrombin generation by calibrated automated thrombinogram (CAT) modified to be sensitive to patient plasma procoagulant phospholipid (1pM tissue factor), PT and aPTT, all expressed as median and interquartile range (IQR).

<u>Results:</u> The median (IQR) for patient age and ISS were 49 (22-64) years and 9 (2-17), respectively. Compared to cases, controls were significantly younger [33 (21-57) vs. 49 (19-95) years; P<0.01] with a higher prevalence of females (62 versus 28%; P<0.01). Peak and ttPeak differed significantly among cases and controls, both univariately (Table) and after adjusting for

age and sex (Peak r2=0.67, P<0.0001; ttPeak r2=0.37, P<0.0001), while the PT and aPTT did not. Peak and ttPeak did not correlate with ISS.

Conclusion:

Blunt trauma is associated with a hypercoagulable

Peak Thrombin Activity (nM) 25.9 (12.8 – 59.5) 76.8 (25.6 -16	
	6.4) <0.0001
ttPeak Thrombin Activity (minutes) 20.6 (16.3-28.6) 14.9 (97.6-23.	9) <0.0001

state, as reflected by a higher peak and shorter time to peak thrombin activity. In an ongoing prospective cohort study, we are investigating the hypothesis that Peak and ttPeak are predictors of VTE after trauma.

ABNORMAL PLATELET FUNCTION ASSAYS AS A RISK FACTOR FOR INTRACRANIAL HEMORRHAGE AND MORTALITY

Meghann Kaiser, M.D., Matthew Whealon, B.S., Cristobal Barrios, M.D., Allen Kong, M.D., Michael Lekawa, M.D.*, Matthew Dolich, M.D.*, University of California, Irvine

Introduction: Use of antiplatelet agents such as acetylsalicylic acid (ASA) or clopidogrel may increase bleeding in blunt trauma patients. However, an accurate medication history is often difficult in the acute trauma setting. Platelet function assays (PFAs), including the Collagen/ Epinephrine (CE) assay, have varying sensitivities to antiplatelet medications. The objective of this study was to correlate abnormally elevated PFAs with the use of antiplatelet medication, intracranial hemorrhage (ICH), and mortality.

<u>Methods</u>: The trauma registry at an urban, Level I trauma center was reviewed over 3 years (1/1/2009 - 12/31/2011). Critically injured blunt trauma patients (defined as those with neurologic deficit and/ or unstable vital signs) underwent PFAs and were included. We excluded pregnant patients and those <18 years old.

<u>Results:</u> 576 patients underwent PFA testing at time of presentation. Of these, 41 (7.1%) had inconclusive results. In 272 (47%), antiplatelet medication use could not be ascertained in the trauma bay. In patients for whom a clear medication history was obtainable, use of ASA was associated with significantly higher CE PFA (143s vs 108s, p = 0.036) and use of clopidogrel trended toward higher CE PFA(169s vs 110s, p = 0.062). CE>150s was a significant risk factor for mortality (O.R. 17.9, p<0.001), with 28% ultimately expiring. CE>250s was associated with ICH (O.R. 3.9, p = 0.049). ASA use was also a risk factor for mortality (O.R. 13.4, p <0.001), and conferred a 30% risk of death. However, no statistically significant association existed between ASA use and ICH. Clopidogrel use did not significantly predict ICH or mortality.

<u>Conclusion</u>: Elevated PFAs correlate with use of antiplatelet agents and are a reliable means of determining platelet dysfunction in trauma patients. High PFAs predict ICH and death, and may be useful for guiding interventions.

ROTEM RADICALLY ALTERS TRANSFUSION IN COMBAT CASUALTY RESUSCITATION

Andrew Cap, Philip Spinella, Christopher White, Lorne Blackbourne*, Joseph DuBose*, United States Army Institute for Surgical Research

Introduction: Damage control resuscitation (DCR) is built on empiric transfusion of blood components in a 1:1:1:1 ratio of platelets:plasma:red cells:cryoprecipitate in an attempt to replace shed whole blood. ROTEM guided DCR may optimize resuscitation. We present the effects of using ROTEM into DCR practices at a US hospital in Afghanistan.

<u>Methods</u>: Transfusion practices in all trauma patients were compared between the periods Aug to Oct 2011 and Nov 2011 to Feb 2012 (pre- and post-ROTEM periods). Patient demographics, total blood products transfused as well as mean ratios are presented. Apheresis platelet units were multiplied by 5 in calculating the PLT/RBC ratio. Means compared by t-test.

<u>Results:</u> 135 and 83 patients were transfused in the pre and post-ROTEM periods respectively. Patient demographics were similar between time periods with 20% having an ISS >15 and 55% with penetrating injury. Average per-patient transfusions are in Table 1.

Blood Products	Pre- ROTEM	Post- ROTEM
RBCs	3.38	3.34
FFP	2.02	2.94
CRYO	0.28	3.33
aPLT	0.69	1.75
RBC:FFP:CRYO:aPLT	1.0:0.6:0.1:1.0	1.0:0.8:0.5:2.5

Data presented as mean (units), p<0.05 for all comparisons Conclusion: Incorporation of ROTEM into DCR protocols were associated with a dramatic increase in per-patient transfusion of platelets (2.5X), plasma (33%), and cryoprecipitate (5X) as normalized to RBCs. This suggests that even 1:1:1:1 empiric DCR may underestimate the need for platelets and cryoprecipitate.

IN EMERGENTLY VENTILATED TRAUMA PATIENTS, END-TIDAL CO2 AND CARDIAC OUTPUT ARE ASSOCIATED AND DECREASE WITH HEMORRHAGE, BRAINSTEM DYSFUNCTION, AND DEATH

Thomas Chirichella, MD, C. Michael Dunham*, M.D., Brian Gruber, Jonathan Ferrari, Joseph Martin, Brenda Luchs, Barbara Hileman, Renee Merrell, St. Elizabeth Health Center

Introduction: In trauma patients undergoing emergency surgery, end-tidal CO2 (PetCO2) has been associated with hypotension, RBC transfusion, and death. Yet, no study describes the relationship of PetCO2 with cardiac output (CO) in intubated trauma patients during early resuscitation. Methods: This is a study of emergently intubated trauma patients with prospective documentation of PetCO2 and non-invasive CO (NICOM®) in the emergency department. The aim was to determine the relationship of PetCO2 with CO and identify conditions influencing their levels. Results: From the end of March through August 2011, 73 patients had 318 pairs of PetCO2 (mm Hg) and CO (L/min.) values. Group data included PetCO2 29.9 \pm 10, CO 6.0 \pm 2.6, lactate 4.4 \pm 3.5 mmol/L, GCS 6.4 \pm 4.6, ISS \geq 15 in 65.2%, major blood loss in 23.3%, and death in 34.3%. PetCO2 was associated with CO (p < 0.0001). PetCO2 decreased ($p \le 0.0012$) with ISS > 20, hypotension, bradycardia, major blood loss, abnormal pupils, cardiac arrest, and death. CO decreased ($p \le 0.0059$) with ISS > 20, hypotension, bradycardia, major blood loss, abnormal pupils, cardiac arrest, and death. With PetCO2 \leq 25 (15.9 \pm 8.0), systolic blood pressure was 77 \pm 69, CO was 3.2 ± 3.0 , cardiac arrest was 60.4%, and mortality was 84.9%. Conclusion: During emergency department resuscitation, PetCO2 is associated with noninvasive cardiac output in emergently intubated trauma patients. Decreasing PetCO2 and decreasing NICOM cardiac output are related to hemorrhage, brainstem dysfunction, and death. PetCO2 and cardiac output monitoring may be useful to optimize cardiac function and organ perfusion in critically injured trauma patients.

PANCREATIC ENZYME INHIBITION BY ENTERAL TRANEXAMIC ACID IMPROVES CLINICAL OUTCOMES IN A PORCINE HEMORRHAGIC SHOCK MODEL

Allen Kong, Madhukar Patel, Earl Steward, Tony Le, William Pinette, Geert Schmid-Schonbein, David B. Hoyt*, M.D., UC Irvine Medical Center

Introduction: Intraluminal pancreatic enzymes play a major role in the initiation of the inflammatory cascade by the gut after hemorrhagic shock. A previous study demonstrated improved clinical outcomes in a porcine model of hemorrhagic shock after enteral administration of the protease inhibitor, nafamostat mesilate. The objective of this study was to assess whether enteral delivery of a more readily available protease inhibitor, tranexamic acid (TA), would yield similar results.

<u>Methods</u>: Twenty-five Yucatan minipigs underwent controlled hemorrhage of 25 mL/kg plus mesenteric clamping for further gut ischemia. They were randomly allocated to four groups: (1) shock + GoLYTELY (GL) as a carrier (control, n = 6), (2) shock + GL + TA(10mg/kg) (n = 7), (3) shock + GL + TA(15mg/kg) (n = 5), (4) shock + GL + TA(20mg/kg) (n = 7). The animals were resuscitated, recovered from anesthesia, observed for 3 days, and graded daily using a 4-point clinical scoring system.

<u>Results</u>: The magnitude of hemorrhagic shock was similar in each group. Compared to the control group, pigs in TA(15mg/kg) and TA(20mg/kg) treatment groups had a statistically higher average postoperative clinical score indicative of essentially normal behavior.

	Shock + GL	TA(10mg/kg)	TA(15mg/kg)	TA(20mg/kg)
N	6	7	5	6
Lowest Mean Arterial Pressure (mm Hg)	17.7 ± 2.1	20.0 ± 1.6	18.8 ± 3.8	16.4 ± 3.8
Largest Base Deficit Change From Baseline	14.5 ± 3.6	17.0 ± 4.2	15.4 ± 2.3	14.0 ± 4.0
Average Postoperative Clinical Score	2.4 ± 1.4	2.5 ± 1.3	3.8 ± 0.4*	3.5 ± 0.9*
* denotes statistical signi	ficance (p<0.05)		

<u>Conclusion</u>: The inhibition of intraluminal pancreatic enzymes after hemorrhagic shock by TA significantly improved clinical outcomes.

CHEST COMPUTED TOMOGRAPHY PERFORMED ON ADMISSION PREDICTS THE SEVERITY OF SMOKE INHALATION INJURY

Hitoshi Yamamura, MD, Schinichirou Kaga, MD, Kazuhisa Kaneda, MD, Yasumitsu Mizobata*, M.D., Ph.D., Osaka City University, Graduate School of Medicine Sponsor: Yasumitsu Mizobata*, M.D., Ph.D.

Introduction: Smoke inhalation injury is a major cause of mortality in burn patients, and it is important to determine the severity of the injury. The objective of this study was to evaluate whether chest computed tomography (CT) can be used as an early predictor of severity in patients with smoke inhalation injury.

<u>Methods</u>: We evaluated 37 patients who had sustained smoke inhalation injury and had undergone chest CT within a few hours of admission. The right bronchial wall thickness (BWT) was measured and data on the total number of ventilation days, duration of intensive care unit (ICU) stay, pneumonia development, and patient outcome were collected. Data are shown as mean \pm SD.

<u>Results:</u> The mean age of the patients was 62.8 ± 17.6 years; 83.8% patients were male and the mortality rate was 10.8%. The causes of death were smoke inhalation (n = 1), hemorrhage (n = 1), and other causes of sepsis (n = 2). The time interval between smoke inhalation and CT examination was 79 ± 37 min. The initial carboxyhemoglobin level was $12.5\% \pm 14\%$ (range, 1-50). The correlation coefficient for BWT vs total number of ventilation days was 3.26 (R2 = 0.56, P < 0.05) and for BWT vs duration of ICU stay was 2.64 (R2= 0.17, P = 0.94). Receiver operating characteristic curve analysis showed that a BWT cutoff value of above 3.0 mm predicted pneumonia development with a sensitivity of 79%, specificity of 96%, positive predictive value of 91%, and negative predictive value of 88%.

<u>Conclusion</u>: Bronchial wall thickness measured using chest CT scans obtained within a few hours of admission was predictive of the total number of ventilation days and pneumonia development in smoke inhalation injury patients.
INDIRECT BRAIN INJURY FROM SEVERE REMOTE BURNS RESULTS IN ESTROGEN INDUCED INCREASES IN BRAIN LEVELS OF SONIC HEDGEHOG (SHH), A SIGNALING PROTEIN **CONTROLLING DIVISION OF ADULT STEM CELLS**

Jane Wigginton, Paul Pepe*, M.D., M.P.H., Joshua W. Gatson, PhD, James Simpkins, David Maass, Kareem R. AbdelFattah, MD, Ahamed Idris, Victoria Warren, Joseph P. Minei*, M.D., University of Texas Southwestern Medical Center Sponsor: Joseph P. Minei*, M.D.

Introduction: Studies note that severe burn patients with may suffer neurocognitive changes. Recent data from our lab reveal a substantial, rapid and sustained pattern of rat brain injury following burns that is significantly blunted by a single post-burn dose of estrogen. Sonic hedgehog (Shh), a signaling protein, controls and directs differentiation of neural stem cells (NSCs), influencing brain regeneration and repair by generating new neurons throughout life. As estrogens exert influence on a variety of stem cells, we hypothesized that estrogens might alter levels of Shh in the post-burn rat brain.

Methods: 44 male rats were randomized into 3 groups: 1) sham/burn (n=4); 2) burn/placebo (n=20); 3) burn/17B-estradiol (E2) (n=20). Burned rats received a 40% 3° TBSA dorsal burn, fluid resuscitation and one dose of E2 or placebo (0.5 mg/kg IP) 15 minutes post-burn. 8 animals from each of the two burn groups (burn/placebo; burn/E2) were sacrificed at 24 hours and 7 days (sham group at 7 days only), with 4 each of the two burn groups sacrificed at 45 days. Brain tissue samples were analyzed by

ELISA for Shh. 1400 CONTROL BRAIN **Results:** 1200 BURN/PLACEBO BRAIN BURN/17β ESTRADIOL BRAIN Hedge Hog (pg/mg) ** 4 200ic 1 200ic 200 0 24 HOUR 45 DAY



burn injury significantly elevated levels of Shh in brain tissue. This may represent an extremely novel and important pathway for neuroregeneration and neuroprotection in burn patients.

FACTORS ASSOCIATED WITH DEVELOPMENT OF INTRAABDOMINAL HYPERTENSION DURING THE INITIAL RESUSCITATION OF SEVERELY BURNED PATIENTS

Jorge Reguero Hernandez, John T. Schulz, III*, M.D., Nabil A. Atweh*, M.D., Roselle Crombie, Alisa Savetamal, Paul Possenti, Bridgeport Hospital

Introduction: The purpose of this study is to determine factors associated with development of IAH in patients with severe burns during the initial 24 hours of resuscitation.

<u>Methods</u>: Patients with 20% total body surface (TBSA) burned or greater admitted between 2009 and 2011 were retrospectively analyzed in a case-control study. Twelve patients who developed IAH during the initial 24 hours of resuscitation were matched one-to-one to subjects with normal IAP and similar weight and TBSA burned. Matched pair t-test and odds ratio were used for the statistical analysis.

Results: Patients with IAH matched to patients with normal IAP and similar TBSA (39.7±16.7 vs 40.8±17.8 %) and weight (84.3±12.9 vs 82.9±13.3 Kg) had significantly different 24 hours mean bladder pressures (BP) (18.7±5.4 mmHg vs 7.8±3.1 mmHg, p<0.001) and abdominal perfusion pressures (APP) (62.1±6.7 vs 72.5±9.7 mmHg, p=0.003). Even though patients with IAH seem to have received more intravenous fluids (IVF) over the first 24 hours, this was not statistically significant (283.7±136.6 vs 235.0±68.4 mL/Kg, p=0.166), (7.4±3.1 mL x Kg x TBSA vs 6.3±2.1 mL x Kg x TBSA, p=0.215). However, there was a linear correlation between mean BP and IVF administered in that period (y = 0.037 x + 3.647, R2 = 0.332, p=0.003), 225 mL/Kg corresponding to a BP of 12 mmHg and 442 mL/Kg to 20 mmHg. Abdominal burns were more likely to be present in patients with IAH (OR=6.6, 95% CI 1.4-31.1). Moreover, patients receiving more than 6 mLxKgxTBSA of fluids and concomitantly suffering from abdominal burns were 11.7 times more likely to develop IAH (95% CI 1.2-110.9). Conclusion: A substantial amount of fluids required during the initial resuscitation along with the restrictive effect attributed to abdominal burns increase the risk of developing IAH in severely burned patients.

BEHAVIOR OF SCALE-INVARIANT METABOLIC NETWORKS DURING HEMORRHAGIC SHOCK

Elizabeth Lusczek, PhD, Nancy Witowski, Kristine Mulier, Daniel Lexcen, PhD, Gregory Beilman*, M.D., University of Minnesota Dept of Surgery Sponsor: Gregory Beilman*, M.D.

Introduction: Hypoxia from hemorrhagic shock results in drastic changes in metabolism. Cellular metabolism and metabolic rate possess scale-invariant qualities as a result of the structure of mammalian cardiovascular systems and oxygen requirements. Scale invariance, a property of fractal systems, is demonstrated in metabolic networks by power law behavior of the network's degree distribution with slope γ , where -3< γ <-2. We wished to test if these properties are preserved in metabolic networks constructed from muscle samples in a porcine trauma and hemorrhagic shock model.

<u>Methods</u>: Fasted male Yorkshire pigs (n=25) were subjected to a standard protocol consisting of a laparotomy, splenectomy, pulmonary contusion, liver crush injury, and 35% hemorrhage. Nuclear magnetic resonance spectroscopy and Chenomx software were used to profile concentrations of 49 metabolites in muscle samples collected at six timepoints. These data were used to construct a network for each timepoint with the Weighted Correlation Gene Network Analysis package for R software. The degree distribution of each network was evaluated for scale invariance.

<u>Results:</u> Only the network constructed from the timepoint at 48 hours post-resuscitation was consistent with the characteristics of scale invariance described above. Scale invariance was not present in the network immediately after hemorrhage. For baseline (post-laparotomy/splenectomy, pre-shock) and the three resuscitation timepoints, power law behavior in degree distribution was present, but we found that $-2 < \gamma < -1$.

<u>Conclusion</u>: Loss of scale invariance indicates that trauma from surgery and hemorrhage induces alterations in metabolism and fundamental disruptions to metabolism as a whole. We suggest that the loss of scale invariance in these networks after hemorrhage reflects severe changes in oxygen delivery. Further analysis may highlight mechanisms of morbidity and mortality.

GROWTH HORMONE LEVELS AFTER TRAUMA AND BURN

Claire Isbell, X Wu, Michael Perez, John Oh, MD, Michelle Leas, Kevin Chung, Christopher White, Stephen M. Cohn*, M.D., Scott and White Hospital Sponsor: Stephen M. Cohn*, M.D.

Introduction: Little is known about the production or impact of growth hormone (GH) in the critically ill trauma and burn population. Recent reports have suggested that ventilator dependent patients may improve when acute GH deficiency is treated. We monitored levels of GH, insulin-like growth factor 1 (IGF-1), and insulin-like growth factor binding protein (IGFBP-3) as a result of injury, to determine the natural history and peripheral response of these hormones.

<u>Methods</u>: Five healthy controls and 20 severely injured trauma (injury severity score \geq 15, n=18) and burn patients (total body surface area burn \geq 20%, n=2) were assessed. Blood samples for GH, IGF-1, and IGFBP-3 testing were collected weekly for up to 28 days.

<u>Results:</u> Six of 20 patients (30%) remained in the hospital for 14 days. For all patients, ICU days were 7 (4.5, 13) and ventilator days were 2 (0, 7.5) [median and interquartile ranges (IQR)]. Growth hormone levels remained significantly elevated after severe injury in the critically ill during the first three weeks of hospitalization. IGF-1 was not different compared to controls during this period of time; however, IGFBP-3 was lower than that of controls for days 1 and 7.

<u>**Conclusion:**</u> Our data shows that in the setting of severe trauma and burn, patients demonstrate mild peripheral resistance to GH as demonstrated by normal levels of IGF-1 in the presence of elevated GH levels. Low levels of IGFBP-3 suggest that insulin-stimulated glucose uptake is also impaired during the first two weeks of hospitalization.

OCCULT HYPOPERFUSION DOES NOT PREDICT PULMONARY COMPLICATIONS IN MULTIPLE TRAUMA PATIENTS WITH A FEMORAL SHAFT FRACTURE TREATED WITH EARLY TOTAL CARE

Justin Richards, Sean Griffin, Daniel Koehler, Oscar D. Guillamondegui*, MD, Michael J. Bosse*, M.D., William Obremskey, Jason Evans, Vanderbilt University Medical Center

Introduction: Previous literature suggests that occult hypoperfusion (OH) at the time of femoral fracture fixation is associated with increased complications. We investigated OH and pulmonary complications in multiple trauma patients treated with Early Total Care (ETC). Methods: Retrospective investigation over a 5-year period from two Level-1 trauma centers. Inclusion criteria: age>18 years, Injury Severity Score (ISS) >17. femoral shaft fracture treated within 24 hours with a reamed IMN. Demographic, injury characteristics, and hospital course data as well as preoperative serum lactate values were collected. OH: preoperative lactate \geq 2.5mmol/L. Time to fracture fixation: >12 hours or \leq 12 hours. Primary outcome was pulmonary complications (PC): mechanical ventilation >4 days, pneumonia and tracheostomy. Initial 24-hour packed red blood cells (PRBC), IMN estimated operative blood loss (EBL), and total vent days were identified. **Results:** 73 patients with a mean ISS of 25.7 (range 17-50). 17/73 (23.3%) had occult hypoperfusion at fracture fixation. No difference in ISS and OH (26.2±7.2 vs. 24.11±7.2, p=0.24). 38 patients (52.1%) underwent fixation \leq 12hrs; those with a reamed IMN in \leq 12hrs were more likely to have OH (13/17, 76.5% vs. 25/56, 44.6%; p=0.02). No difference in ED GCS scores and OH (12.4 \pm 4.7 vs. 10.9 \pm 5.2, p=0.29) or fracture fixation \leq 12hrs (11.2 \pm 5.3 vs. 11.3±4.9, p=0.93). No difference in OH and PC (2/17, 11.8% vs. 12/56, 21.4%; p=0.38), PRBC (2.3±3.6 vs. 1.4±2.4, p=0.22), IMN EBL (352.9±191.0 vs. 300.9±181.7, p=0.31), or vent days (2.1±4.7 vs. 2.5±4.0, p=0.68).

<u>Conclusion</u>: Use of ETC with a reamed IMN in polytraumatized patients with a femoral shaft fracture was not associated with increased pulmonary complications despite evidence of OH.

THE MAYO CLINIC EXPERIENCE WITH THE MOREL-LAVALLÉE LESION (CLOSED DEGLOVING INJURIES): THE DEVELOPMENT OF A PRACTICE MANAGEMENT GUIDELINE

Terry Nickerson, Donald H. Jenkins*, M.D., Henry Schiller*, MD, Martin Zielinski, Mayo Clinic Sponsor: Henry Schiller*, MD

Introduction: Morel-Lavallée Lesions, or closed degloving injuries, are associated with significant morbidity in the trauma patient. There is lack of consensus regarding the proper management of these lesions. Management options include conservative therapies along with percutaneous and operative techniques. We sought to define the factors associated with failure of percutaneous aspiration so that we could better identify those patients requiring immediate operative management.

Methods: Retrospective review from 2004 through 2011. Treatment methods included Conservative Management (compression or observation), aspiration, or operative management with incision/drainage or formal debridement. The treatment groups were compared with univariate analysis with chi squared. Results: There were 78 patients identified with 86 Morel- Lavallée lesions in the setting of trauma. Male to female ratio was 1:1. No difference was observed between groups in gender, BMI, diabetes mellitus, smoking or days to diagnosis. Aspirated lesions were significantly smaller (Area 60 cm2 v 161 cm2, p=0.006) and more likely to recur (52% v 15%, p=0.006) than those managed operatively. Greater volumes of fluid aspirated were associated with greater recurrence. Aspiration of more than 50 mL of fluid was associated with a higher recurrence rate than < 50 mL aspiration. (73% vs 12%, p = 0.005) Gender, BMI, days to diagnosis, days to treatment, and size of lesion demonstrated no statistically significant difference in rate of recurrence. Conclusion: Aspiration of more than 50 ml of fluid from Morel- Lavallée lesions was associated with a greater than 70% rate of treatment failure. We therefore recommend that aspiration of more than 50 ml of fluid from a Morel- Lavallée lesion should prompt operative intervention. We have now adopted this as a practice management guideline.

MANAGEMENT OF EXTREMITY FASCIOTOMY SITES: PROSPECTIVE RANDOMIZED EVALUATION OF TWO TECHNIQUES

Laura Johnson, Chad Ball*, Assistant Professor, Mitchell Chaar, Christopher J. Dente*, M.D., David V. Feliciano*, M.D., Jeffrey M. Nicholas*, M.D., Grace S. Rozycki*, M.D., M.B.A., Amy D. Wyrzykowski*, M.D., Emory University

Introduction: Chronic morbidity associated with the treatment of extremity compartment syndrome is underappreciated and includes unsightly wounds and the need for skin graft coverage. Overall, primary closure rates have historically been less than 50%. While multiple techniques to assist closure have been developed, no randomized comparisons have been performed to assess the effectiveness of these techniques.

<u>Methods:</u> A randomized non-blinded prospective study was performed involving patients who met standard institutional indications for undergoing an extremity fasciotomy following trauma. Initial fasciotomy sites were dressed with wet to dry dressings. Consent for randomization was subsequently obtained from the patient or surrogate. Patients returned to the OR at 72 hours; if primary closure could not be performed, they were then randomized to one of two closure techniques. Shoelace wounds were strapped with vessel loops under tension and VAC wounds were treated with a standard KCI VAC dressing. After randomization, patients returned to the OR every 96 hours until primarily closed or skin grafted.

<u>Results:</u> 21 patients were consented for randomization with 11 (52%) successfully closed at the first re-operation. Therefore, 10 patients with a total of 14 wounds were successfully randomized. After interim analysis the study was closed early with 5/5 (100%) of wounds treated with the shoelace technique closed primarily and only 1/9 (11%) of VAC wounds closed primarily (p=0.003). Overall primary closure was achieved in 74% of patients. **<u>Conclusion:</u>** While this study is limited by low enrollment, it is apparent that aggressive attempts at wound closure lead to an increased unassisted early closure rate. For wounds that remain open after the first re-operation, a simple shoelace technique is more successful than a wound VAC for achieving primary skin closure.

CAN WE PREDICT INTRA-PELVIC MAJOR ARTERIAL BLEEDING IN PATIENTS WITH STABLE PELVIC FRACTURE FROM THE SIZE OF RETROPERITONEAL HEMATOMA ON ENHANCED CT SCANS?

Yuki Onishi, NOBUYUKI SAITO, TAKANORI YAGI, YOSHIAKI HARA, Hisashi Matsumoto, Susumu Okada, Kunihiro Mashiko*, M.D., Hiroyuki Yokota, Chiba Hokusoh Hospital, Nippon Medical School Sponsor: Kunihiro Mashiko*, M.D.

Introduction: Stable pelvic fracture (SPF) typically involves little bleeding, but major arterial bleeding is occasionally encountered. Few reports exist on the predictors of major bleeding in SPF patients on enhanced computed tomography (CT) scans except in relation to extravasation. This study aimed to determine whether a predictor of intra-pelvic arterial bleeding can be determined from CT scans in patients with SPF.

<u>Methods</u>: This retrospective study was conducted from January 2006 to December 2011. Of 3821 adult trauma patients admitted in our hospital during the study period, 105 had SPF injuries(defined as an Abbreviated Injury Scale score of <3). We measured the length of craniocaudal retroperitoneal hematomas (LCRHs) from fractures in each patient. We divided the 105 patients into two groups, the arterial bleeding (AB) group requiring embolization and the control(C) group not requiring embolization, and compared their data.

<u>Results:</u> Seventeen patients were assigned to the AB group and 88 to the C group. Median LCRH(cm) was longer and incidence of extravasation on enhanced CT was higher in the AB group(12.7:3.8 and 94.1%:12.5%, respectively; both P=0.001). Multivariate regression analysis revealed the predictors for embolization were LCRH(cm)(odds ratio [OR]: 1.33, 95% confidence interval [CI]: 1.15–1.54; P<0.001), sBP<90 mmHg (OR: 8.6, CI: 1.2–57.8; P=0.027), and hematocrit <30% (OR: 32, 95%CI: 3.1–115; P=0.001). The area under the curve of the receiver operating characteristics curve for arterial bleeding in LCRH was 0.845 (95% CI: 0.75–0.93; P<0.001). The cutoff value for LCRH from the sensitivity-specificity curve for arterial bleeding was 8 cm. Sensitivity was 82.4% and specificity 70.5%. **Conclusion:** LCRH on enhanced CT scans was an independent predictor for intra-pelvic arterial bleeding.

TRAUMA RADIOLOGIST: CAN THE TRAUMATOLOGIST SAFELY INTERPRET ADMISSION EXTREMITY X-RAYS?

Usman Waheed, Nasim Ahmed*, M.D., Tasnim Bensaad, Felix Garcia-Perez, Niveen Hanna, Jersey Shore University Medical Center Sponsor: Nasim Ahmed*, M.D.

Introduction: Care of the injured extremity in an injured trauma patient requires rapid interpretation of x-ray films. Our group has independently read initial extremity x-rays for 10 years. The purpose of this study was to evaluate whether a trauma surgeon could interpret extremity films without a radiologist's input in a safe, efficient, and cost effective manner. **Methods:** A retrospective review was conducted of patients with multisystem trauma evaluating demographics, ISS, GCS, delayed or missed diagnoses, diagnostic errors and need for operative intervention. These data were compared with published literature using .2 tests. Results: The study (2006-2010) included 2493 extremity x-rays of 1495 consecutive trauma patients. The average extremity film was read by a radiologist about 37 hrs after being taken while the trauma surgeon interpretation occured at the point of testing. Missed injury or delayed diagnosis resulted from either a failure to identify an extremity as injured on physical exam or a diagnostic error(DE) in reading of the film. The rate of DE was significantly better than published radiologist rates of DE 0.76% vs 2.0% (p<.001).Medicare was charged \$880,000 for the study period Conclusion: Radiographic examination of extremity films by trauma surgeons resulted in a lower rate of diagnostic error compared to published radiologic standards. Evaluation of inital extremity films by traumatologists results in rapid delivery of appropriate care in a cost-effective manner

	Age (AVE)	Gender (M/F)	Upper Extemity	Lower Extremity	GCS (AVG)	ISS (AVG)	Needed Interv- entions	Total # of Injuries Missed/ Delayed	Total # of Patients	p value	kappa
All Trauma Films	41	949M/ 546F	152	235	13.9	11.6	N/A	N/A	1495		
Diagnostic Errors	38.5	9F/ 10M	7	12	14.3	9.61	1	19	19	<0.001	-0.12 [-0.019, -0.006]

DALTEPARIN VERSUS ENOXAPARIN IN THE PREVENTION OF VENOUS THROMBOEMBOLIC EVENTS IN TRAUMA PATIENTS (THE DEVTT STUDY)

Obi Okoye, MD, Margarita Bass, MD, Pedro Teixeira, MD, Kenji Inaba*, MD, Linda Chan, PhD, Demetrios Demetriades*, M.D., Ph.D., LAC+USC Medical Center

Introduction: The use of low molecular weight heparin (LMWH) for chemoprophylaxis of VTE in trauma is supported by Level 1 evidence. Because enoxaparin was the agent used in most of the studies, it remains unclear if dalteparin provides equivalent effect. This study aims to establish non-inferiority or equivalence of dalteparin for VTE prophylaxis in trauma. **Methods:** Trauma patients receiving VTE chemoprophylaxis in the SICU from 2009 (Enoxaparin) to 2010 (Dalteparin) were included. The primary outcome was incidence of clinically significant VTE. Secondary outcomes included heparin induced thrombocytemia (HIT), major bleeding and drug acquisition cost savings. Equivalence margins were set between -5% and 5%.

<u>Results:</u> 602 patients (270 enoxaparin, 332 dalteparin) were included. The two study groups did not differ significantly: blunt trauma 66.7% vs 62.3%, p=0.305, mean ISS 16.3 \pm 9.9 vs 15.8 \pm 9.7, p=0.335, APACHE II 16.5 \pm 9.4 vs. 16.9 \pm 9.5, p=0.675, time to first dose LMWH 68.4 \pm 98.2 h vs. 65.4 \pm 66.8 h, p=0.661. The rates of DVT (4.8% vs.



3.9%, p=0.688), PE (1.9% vs. 1.2%, p=0.524) and overall VTE (6.3% vs. 5.1%, p=0.596) were not significantly different. The absolute risk reduction associated with dalteparin use was 0.9% (-2.4% to 4.5%), which was within the predefined equivalence margins. There were no significant differences in the frequency of HIT or major bleeding. The estimated total cost reduction with the use of dalteparin was \$107,778.

<u>Conclusion</u>: Dalteparin was equivalent to enoxaparin for VTE prophylaxis in trauma patients and can be safely used in this population with no increase in complications and possible cost benefits.

LONG-TERM RESULTS OF THORACIC ENDOVASCULAR AORTIC REPAIR FOR BLUNT AORTIC INJURY

Yoshihiko Kurimoto, Tetsuya Koyanagi, Toshiro Ito, Nobuyoshi Kawaharada, Tetsuya Higami, Kunihiko Maekawa, Katsutoshi Tanno, Yasufumi Asai, Sapporo Medical University

Introduction: Satisfactory early results of thoracic endovascular aortic repair (TEVAR) for blunt aortic injury (BAI) have been reported. However, long-term results should be also important if considering relatively young age of patients with BAI.

<u>Methods</u>: Since 2001, the patients who were given a diagnosis of BAI in our facility have been treated by emergency TEVAR and the patients transferred from other hospitals have been treated by elective TEVAR. TEVAR was performed using mainly hand-made stent-grafts. These patients with BAI excluding 2 patients resulted in early death due to associated brain injury were the subjects and long-term results were evaluated.

<u>Results:</u> Thirty-one patients with BAI were mean age of 58.6 years old and consisted of 20 male. There was one aorta-related late death. A 71-year-old female died following 2nd–time open repair for endoleak at 61 months after elective TEVAR. There were 2 non-aorta-related late deaths. Both 74-year-old and 83-year-old females died due to pneumonia at 5 and 22 months after emergency TEVAR. Survival rates at 5 and 10 years were 92.5% and 84.8%, respectively. Aorta-related-death free rates at 5 and 10 years were 100% and 91.7%, respectively. There were 3 aorta-related events, open conversion in 2 and reTEVAR in 1. Aorta-related event free rates at both 5 and 10 years were 90.1%. Emergency TEVAR (n=16) were performed in mean 7.1 hours after injury and elective TEVAR (n=15) performed in median 10 days. There was no significant difference in late results in terms of timing of TEVAR. **Conclusion:** Long-term results of TEVAR for BAI were also satisfactory until 10 years after TEVAR. However, it is necessary to follow up the patients periodically to reveal adverse events following TEVAR.

SELECTIVE PELVIC EMBOLIZATION IS ASSOCIATED WITH FEWER COMPLICATIONS THAN NONSELECTIVE EMBOLIZATION IN BLUNT TRAUMA PATIENTS

Britani Hill, Hernando Avila-Zuccardi, Laura Johnson, MD, Amy D. Wyrzykowski*, M.D., Grace S. Rozycki*, M.D., M.B.A., Ravi Rajani, Emory University/Grady Memorial Hospital

Introduction: Transcatheter angioembolization (TAE) has become an important modality for the management of bleeding in severe pelvic fractures. The long-term relationship between TAE and the development of clinically significant pelvic ischemia remains unknown.

<u>Methods:</u> A retrospective review of all patients with a pelvic fracture undergoing pelvic TAE from 2003-2011 was performed. Data obtained included demographics, injury severity score (ISS), TAE details (selective or nonselective), and outcomes including survival, disposition and complications. Ischemic complications were defined as buttock claudication, gluteal tissue loss, or failure of orthopedic wound healing.

<u>Results:</u> Fifty-one patients met inclusion criteria. Overall, patient mortality was 47% and the average ISS was 33.4. Thirty-eight patients underwent selective TAE, 13 underwent nonselective TAE. There were 15 deaths within 48 hours of admission. Of the remaining 36 patients, 2 developed severe pelvic ischemia, including rhabdomyolysis and gluteal tissue loss. Both of these patients had a nonselective TAE. Twenty-four patients underwent operative orthopedic intervention for their pelvic fractures, of which 5 (21%) developed wound complications. Three of these patients underwent selective TAE and two underwent nonselective TAE. Overall, the incidence of pelvic ischemia was 10% following selective TAE and 33% following nonselective TAE (p > 0.05).

<u>Conclusion</u>: Trauma patients with pelvic fractures who require transcatheter angioembolization are critically ill and have high mortality. The risk for clinically significant pelvic ischemia appears to be low following selective angioembolization. Nonselective embolization should be reserved for rare cases in selected critically ill patients.

PROSPECTIVE EVALUATION OF ENOXAPARIN DOSING IN COMBAT EXTREMITY INJURIES

Bradley Putty, MD, Neil Jones, MD, Gerald Fortuna, MD, David Zonies, MD, MPH, Lesa Owens, MSN, Stewart McCarver, MD, John Oh, MD, Clayne Benson, MD, Sean Riley, MD, Brian Delmonaco, MD, Bryan Szalwinski, MD, Shawn Nessen, MD, Stephen Silvey, MD, Landstuhl Regional Medical Center Sponsor: Joseph DuBose*,

Introduction: Deep venous thrombosis (DVT) chemoprophylaxis remains a common problem in the modern theater of war. While enoxaparin 30mg twice daily represents a standard, dosing is reduced to 40mg daily with regional pain catheter use, and large open wounds and amputations common to wounded warriors from Operation Enduring Freedom (OEF) may further alter drug distribution, possibly leading to DVT or bleeding complications.

<u>Methods</u>: OEF trauma patients treated with enoxaparin were prospectively followed with anti-Xa trough and peak levels drawn with \geq 4th or 2nd dose in twice or once daily dosing, with values of 0.1-.2 IU/mL considered therapeutic. Aggregate size of open wounds was considered large if requiring at least 1 large KCI® vacuum sponge equivalent (VSE) to dress, and anti-Xa levels were compared between groups based on wound burden and enoxaparin dose. Patients were screened for DVT and prospectively followed for peri-operative bleeding complications.

<u>Results:</u> In an interim analysis of the first 24 patients, 7 had ≥ 1 amputation, and 13 had large wound burden (1-6 VSE). The most common mechanism was dismounted blast (41.7%), followed by gunshot wound and mounted blast (20.8% each). Large wounds were associated with lower anti-Xa peaks (.20 vs .31, p=.035) while troughs were not different (.09 vs .12, p=.15). Once daily dosing was associated with decreased trough values (.075 vs .12, p=.02), but not peak values (.26 vs .22, p=.48). 23 patients had operations on enoxaparin without medication withholding. 2 patients experienced bleeding complications: 1 in the small wound group with a high peak (.48 IU/mL) had non-surgical bleeding intra-operatively, and 1 in the large wound group with a low peak (.10 IU/mL) had operative transfusion and hypotension.

<u>Conclusion</u>: In combat wounded, large wound burden and once daily dosing are associated with reduced anti-Xa peak and trough levels, respectively.

THE STANDARD DOSE OF PROPHYLACTIC LOVENOX PROVIDES INADEQUATE ANTI XA LEVELS IN OBESE TRAUMA PATIENTS

Paul Phillips, Larry C. Martin*, M.D., Naveed Ahmed*, M.D., University of Mississippi Medical Center

Introduction: Despite aggressive pharmacoprophylaxis with low molecular weight herparin (LMWH) thromboembolic complications remain commonplace. Using the standard prophylactic dose of Lovenox (30 mg/12 hrs) may be inadequate especially in obese patients

<u>Methods</u>: We conducted a retrospective review of Anti Factor Xa levels in trauma patients in whom Lovenox was administered using standard dosing. Circulating Anti Factor Xa levels were obtained following the third dose of Lovenox. Patients were stratified by BMI and renal function to determine the impact of these factors on anti Xa levels.

<u>Results:</u> 141 patients were evaluated. Patients with normal BMI (<25) reached therapeutic Anti Factor Xa levels (>0.25IU/mL) more frequently (86.5% vs 57%, p<0.05) than those with



BMIs greater than normal. Chart 1 shows the distribution of anti Xa levels by BMI. Overall, 12.5% of normal BMI patients failed to reach adequate Anti Xa levels (>0.25) while 42.6% above normal BMI did not (p<0.05). There was no significant difference in renal function for any group. There was one pulmonary embolism in a patient with a Anti Xa level of 0.3 IU/ml.

<u>Conclusion</u>: The standard dosed of Lovenox under doses high-risk obese trauma patients and may not provide adequate prophylaxis. We recommend monitoring Anti Xa levels in high-risk patients with increased BMI when low molecular weight heparin is used.

X-RAY EXPOSURE IN THE TRAUMA BAY: RESULTS OF A RADIATION FIELD ANALYSIS

Jacob Quick, Gary Lewis, Jeffrey Coughenour, Stephen L. Barnes*, M.D., University of Missouri

Introduction: The magnitude of radiation risk to providers during the care of trauma patients is not well-defined. We aimed to gather exposure data from dosimeters placed at fixed points within the trauma bay to act as surrogates for personal radiation exposure.

<u>Methods:</u> Forty-four (44) radiation dosimeters were placed throughout a single trauma bay in a University Level 1 trauma center. After a six-month period, dosimeters were removed and analyzed. For practical analysis, dosimeters were sorted by location zones. Patient injury data and number and type of X-rays taken were recorded.

<u>Results:</u> Radiation data following evaluation of 417 patients was evaluated.



A total of 2,107 plain X-rays were completed (mean 5.1). No measurable dose was identified with the dosimeter controls. Mean shallow dose equivalents (SDE 289.4 mrem (155-483 mrem) and deep dose equivalents (DDE 245.6 mrem (129-431 mrem) were highest among dosimeters placed directly above the patient. The second highest mean SDE and DDE were seen to the patient's left at waist level (SDE 129.8 mrem (57-276 mrem), DDE

106.5 mrem (38-242 mrem). The remainder of the dosimeter zones had mean doses less than 75 mrem.

<u>Conclusion</u>: While personal shielding remains important, none of the dosimeters registered radiation doses greater than the maximum annual allowance for healthcare providers. This supports minimal radiation risk to providers in the trauma bay.

A HUMAN FACTORS APPROACH TO FLOW DISRUPTION IN CIVILIAN AND MILITARY TRAUMA CARE

Eric Ley, Ken Catchpole, Douglas Wiegmann, Daniel Shouhed, Jennifer Blaha, Renaldo Blocker, Sacha Duff, Ben Starnes, Cathy Karl, Richard Karl, Bruce Gewertz, Cedars-Sinai Medical Center Sponsor: Ali Salim*, M.D.

Introduction: We postulated that observational methods based on human factors principles would identify additional risks during trauma care. **Methods:** Providers at one civilian and one military trauma center completed standard safety attitude surveys and focus groups on barriers to optimal performance. Then trauma teams activated for 90 high level traumas were studied prospectively by trained observers to identify flow disruptions (FD) using a validated tablet data collection tool.

<u>Results:</u> Survey results suggested positive attitudes towards safety. Focus groups identified coordination and protocol deviations as primary sources of FD. Observers noted 1844 FD in 90 cases and identified poor team coordination (31%), communication breakdowns (20%), and patient related delays (14%) as common causes. FD impact was characterized as none to minimal delay (86%), moderate delay (12%) and full case cessation (2%). Although most FD caused minimal disruption, 63 of 90 cases (70%) experienced at least one moderate delay or full case cessation; high impact FD were generally due to poor coordination (47%).

<u>Conclusion</u>: These findings indicate that objective observations based on human factors principles facilitate a better understanding of the severity and nature of FD than surveys and focus groups alone.



APPLICATION TO THE TRIAGE IN ER WITH A SIMPLE MOBILE INSTRUMENT TO MEASURE BLOOD LACTATE CONCENTRATION

Y. Inoue, H. Suginaka, N. Hayashi, Y. Sumi, S. Matsuda, K. Okamoto, H. Tanaka, Department of Emergency and Critical Care Medicine Juntendo University, Urayasu Hospital

Introduction: Simple triage and rapid treatment (START) triage is commonly used at the time of disaster and mass casualty incident. However, even a trained medical stuff cannot carry it out accurately and easily at the disaster scene. Therefore, the decision of priority should be depend on personal experiences and intuition especially within the same triage level. We have induced a mobile instrument (Lactate Pro®) taking a drop of blood at a finger tip within a minute and evaluated the severity of patients in ER. The purpose of this study is whether blood lactate concentration could complement START triage, and could be applied as an objective triage tool in ER.

<u>Methods</u>: The lactate concentration of ER patients in our university affiliated hospital was measured by Lactate Pro during 4 months in 2011-2012. These patients were classified by a triage level with vital signs and chief complaints using START triage. The correlations between the lactate concentration, the triage level, and the prognosis were evaluated retrospectively.

<u>Results:</u> 233 patients (64 ± 20 years old, male: female 129:104) were included in this study. The diagnosis in ER was internal disease in 143, trauma in 56, and CPA in 34. Patients were triaged as red in 25, yellow in 139, green in 35, and black in 34. There was a significant correlation between START triage level and blood lactate concentration in each group(p<0.0001). Among 43 patients who died after admission in hospital, 8 patients were triaged in red and 2 in yellow. These 2 dead patients had higher lactate level in ER than the average in yellow group.

<u>Conclusion</u>: Our study suggests that the blood lactate concentration is a sensitive tool for reinforcing triage level and assigning priority for treatment and transportation in the same triage level. Especially at the disaster scene, Lactate Pro® may be very useful for its mobility and simplicity to decide a triage level.

IDENTIFYING COMPLICATIONS ASSOCIATED WITH HIGHER MORTALITY AND COST: A FIRST STEP TO SAVING LIVES AND MONEY

Adil Haider*, MD, MPH, Mehreen Kisat, David T Efron*, MD, Elliott Haut*, MD, Augustine Obirieze, Eric Schneider, PhD, Peter Pronvost, Ellen J. MacKenzie*, Ph.D., Edward E. Cornwell, III*, M.D., Johns Hopkins School of Medicine

Introduction: Hospital quality improvement (QI) processes have become a prominent aspect of clinical care but the effort needs to be focused. Our objective is to estimate the independent effect of specific complications on mortality and cost after injury to help prioritize QI initiatives. **Methods:** Blunt Trauma Patients (aged 18-65; with length of stay \geq 72 hours) were identified in the Nationwide Inpatient Sample (NIS) 2008 using ICD-9-CM codes. Patients with an isolated complication were matched to controls without complications based on age, gender, Insurance, Injury Severity Score, Head AIS and Charlson co-morbidity index using Coarsened Exact Matching. Multivariate regression modeling was then used to estimate the effect of each complication on mortality and cost (using cost:charge ratios) with further adjustment for hospital location, size, teaching status and local wage index. Sensitivity analyses were performed on patients with multiple complications and after censoring for death.

<u>Results:</u> 87,613 trauma patients met inclusion criteria. 33% had one or more complications. Different complications have varying impact on outcomes.

	Number of patients with Complication n (%)	*Odds of Mortality compared to matched patient without complication (95% CI)	*Relative increase in cost associated with complication (95% CI)
Surgical Site Infection	6247 (7.99)	0.27 (0.14-0.51)	1.01 (0.96-1.06)
Pneumonia	4041 (5.17)	2.16 (1.62-2.88) ↑	1.60 (1.09-1.25) ↑
UTI	3451 (4.42)	0.36 (0.21-0.61)	1.09 (1.03-1.15) ↑
ARDS	1742 (2.23)	1.54 (1.16-2.06) ↑	1.84 (1.7-1.99) ↑
Renal failure	1670 (2.14)	2.72 (1.73-4.30) ↑	1.17 (1.17-1.49) ↑
Sepsis	517 (0.66)	9.76 (3.84-24.80) ↑	1.84 (1.57-2.17) ↑
Pulmonary Embolism	431 (0.55)	3.85 (1.27-11.69) ↑	1.32 (1.7-1.99) ↑
Stroke/CVA	410 (0.52)	3.02 (1.40-6.52) ↑	1.24 (1.1-1.39) ↑
Myocardial Infarction	347 (0.44)	4.21 (1.7-10.44) ↑	1.73 (1.51-1.99) ↑
*adjusted for patient, injury a	and hospital characteristic	6	

<u>Conclusion</u>: Complications such as Sepsis, Myocardial Infarction, Pulmonary Embolism and Stroke, which have the highest impact on mortality and cost, should be prioritized for QI interventions.

HIGH UNDER-TRIAGE RATES IN THE ELDERLY: DOES IT MATTER?

Kristan Staudenmayer, Renee Hsia, M.D., M.Sc., N. Clay Mann, David A. Spain*, M.D., Craig Newgard, Stanford University Sponsor: David A. Spain*, M.D.

Introduction: It has recently been shown that the there are high rates of under-triage in the elderly. The impact of this under-triage from a population perspective is unknown. We hypothesized that under-triage would be associated with unacceptably high mortality.

<u>Methods</u>: This was a population-based, retrospective cohort study of all injured elderly adults from six counties in California and Utah (2006-2008) transported by 48 EMS agencies to 37 hospitals. Pre-hospital data for injured patients were linked to trauma registry data, state-level discharge data, ED records, and death files. The primary outcome was 60-day mortality. Elderly patients (\geq 55 years) treated at a trauma centers were compared to those treated at non-trauma centers. Under-triage was defined as an ISS>15 with transport to a non-trauma center.

<u>Results:</u> There were 5,966 patients in the analysis. Patients in trauma centers were younger (mean age 72 vs. 80, p<0.01), more severely injured (ISS>15 in 6.5% vs. 2.4%, p<0.01) and had lower admission GCS (14.2 vs. 14.7, p= p<0.01). The under-triage rate was 35% and increased with age. Overall 60-day mortality for patients with an ISS>15 was 17%, with no difference in 60-day mortality between trauma and non-trauma centers (17% vs. 15%, p=0.70). There was also no difference in mortality between trauma centers and non-trauma centers after adjusting for injury and patient characteristics (OR 1.16, p=0.84). Hospital length of stay was shorter for patients with an ISS>15 at trauma centers (7 vs. 10 days, p=0.03).

<u>Conclusion</u>: This is the first population-based analysis to study the impact of under-triage in the elderly. We have shown despite high rates of under-triage, elderly patients do not have worse outcomes. We should evaluate whether our triage guidelines should be revised, or whether we need to invest more heavily in improving geriatric care at our trauma centers.

AUTOPSIES DO MATTER: THE INFLUENCE OF AUTOPSY DATA UPON FINAL INJURY SEVERITY SCORE CALCULATIONS

Bryce Robinson, Erika O'Neal, Kelly Besl, Dennis Hanseman, Angelica Nguyen, Shelley Akin, William Ralston, Peter Muskat*, M.D., University of Cincinnati

Introduction: Injury severity scores (ISS) are commonly used in statistical modeling and in risk-adjusting outcomes for providers and centers. We hypothesized that autopsy data significantly impacts final ISS thus modifying accurate outcome data

<u>Methods:</u> All trauma fatalities during 2010 were retrospectively reviewed. Demographic, injury and autopsy data were collected from available medical records by the institutional trauma registrars. ISS and Abbreviated Injury Scores (AIS) were calculated before and after the inclusion of autopsy data. Multivariate logistic regression was used to identify characteristics of patients likely to have a change in ISS.

<u>Results:</u> 163 deaths occurred, of which 149 (91.4%) received an autopsy (5.4% view only, 11.4% preliminary report, 83.2% full report). The 48% of patients with an increase in ISS after autopsy data had a mean change of 10 ± 17 . Taking account of autopsy findings resulted in an increased mean ISS (32 vs. 22, p < 0.0001), proportion ISS ≥ 25 (77% vs. 54%, p < 0.0001), chest and abdomen mean AIS (2.0 vs. 1.2, p = 0.0005; 1.2 vs. 0.6, p = 0.004) and proportion chest and abdomen AIS ≥ 3 (49% vs. 31%, p = 0.001; 23% vs. 12%, p = 0.01). Multivariate analysis identified a full autopsy report (OR 4.6), death occurring in the emergency department (OR 12.6) and hospital length of stay ≤ 1 day (OR 2.7) as variables associated with an increase in ISS after autopsy data inclusion.

Conclusion: Autopsy results significantly increase final ISS calculations. In order to have proficient institutional, state and national process improvement programs, accurate ISS are necessary.

VISUALIZATION OF METABOLIC NETWORK DISTURBING AFTER SEVERE TRAUMA: A SYSTEM BIOLOGICAL MODEL

Hua Jiang, PhD, Jin Peng, Bin Cai, Hao Yang, Zhi-Yuan Zhou, Charles Lu, Mitchell Jay Cohen*, M.D., Jun Zeng, META-LAB, Sichuan Provincial People's Hospital, Sichuan Academy of Medical Sciences Sponsor: Mitchell Jay Cohen*, M.D.

Introduction: Spinal cord injury (SCI) is a severe trauma that starts processes which jeopardize human health and life. Understanding the malfunctions of metabolism networks of these processes is crucial for clinical monitoring and intervention.

<u>Methods:</u> We build SCI model in SD rats and collected plasma samples for 1H NMR analysis by a 600 MHz NMR spectrometer. After NMR spectra were obtained, we used principle component analysis (PCA) and partial least square (PLS) for data dimension reduction and multi-variant analysis. VIP (variable importance for the projection) value was used for metabolites screening. For establishing visualized picture that exhibited impact between metabolites and related enzymes and gene paths, gene ontology (GO) analysis and KEGG analysis was used as a tool kits.

<u>Results</u>: Combing metabolome, gene and metabolic network analytic tools, we created a comprehensive and easy to read presentation that integrated 46 major metabolites, a set of metabolic regulatory paths and 291 genes. After SCI occurred, nuclear acids pathways disturbances and spermidine present patterns that characterized injury over time. Along with urea cycle, neural transmitter disturbances and skeleton muscle breakdowns presented a scenario that characterizes the severity of injury. Locomotive ability recovery was also marked by a set of metabolites and metabolic paths.

<u>Conclusion</u>: This is the first system biological study that integrates metabolomics and gene ontology analysis to visualize complex mechanism of SCI. The model can be used to develop a new evaluation and outcome predict tool for severe trauma. It could provide substantive improvements to diagnosis and intervention monitoring for patients suffering from SCI. We feel that combining the computer pattern recognition, metabolomics and genomics is an effective tool kits for trauma research.

CUMULATIVE RADIATION DOSE IN TRAUMA PATIENTS IN EMERGENCY DEPARTMENT

Je Sung You, Yonsei University College of Medicine Sponsor: Raul Coimbra*, M.D., Ph.D.

Introduction: To estimate the cumulative effective dose(cED) of trauma patients in emergency department and to calculate the lifetime attributable risk (LAR) of cancer incidence and mortality.

Methods: Between February 2010 and February 2011, Patients who visited the emergency department of single tertiary hospital due to trauma were included in this study. The cED for each patients were calculated by adding radiation exposure during both conventional X-ray and CT. LAR of cancer incidence and cancer mortality were assessed based on Biological Effects of Ionizing Radiation VII models. The cED and LAR were compared between younger patients less than 20 years by independent sample t-test. **Results:** Of 11,872 patients (mean age: 28.1 years, male:female = 6,786:5,086), 8815 patients (74.3%) were undertook conventional X-ray and 4199 patients(35.6%) were performed CT. Total radiologic examination counts were 78,882 (X-ray: CT = 92.1%:7.9%). The total cED was 407,473 mSv and 99% (403,546 mSv) of that was resulted from CT. The mean LAR of cancer incidence and mortality were 0.3% (0-86.2%) and 0.2% (0-43.7%). Although the mean cED for patients younger than 20-years (n=4917, 19.8 mSv) were smaller than patients older than 20-years (n=6955, 44.6 mSv) (P<0.001), LAR cancer incidence were significantly higher in patients younger than 20-years (0.38%) than that of patients older than 20-years (0.27%) (P=0.019)

<u>Conclusion</u>: Although the number of CT exam were very small compared to conventional X-ray, most of the cED of trauma patients in emergency department were result from CT. The LAR cancer incidence is relatively higher in younger patients than patients older than 20 years.

STANDARDIZING HANDOVER OF CRITICALLY INJURED TRAUMA PATIENTS -MORE THAN JUST A CHECKLIST

Tanya Zakrison, Eman Leung, Simon Kitto, Amanda McFarlan, Brittany Rosenbloom, Alexandra Jovicic, St Michaels Hospital, University of Toronto Sponsor: Sandro Rizoli*, MD

Introduction: Critically injured trauma patients frequently undergo handover during transfer from the Emergency Department (ED) to the Intensive Care Unit (ICU). Important clinical information generated prior to handover may be lost during the process. Our aim was to investigate if information discrepancies occurred during handover and to create a grassroots, inter-professional, Standardized Handover Checklist (SHC) tool to reduce communication errors.

<u>Methods</u>: A mixed methods research approach was used. Quantitative measures were used to determine if initial Trauma Team Leader (TTL) information was missed on initial ICU admission records by randomly selecting 50 trauma patient charts. Six qualitative focus groups were conducted with 6-8 participants each. Three groups involved ED frontline nurses and an additional three groups involved ICU nurses.

<u>Results:</u> Chart audits over the past year indicated that 24% of patients had injuries noted on the initial TTL note that were missing from the ICU admission record. Discrepancies occurred in 48% of patient information overall. Emergent themes from focus groups indicated that the formalization of handover would be a positive improvement. The SHC tool was seen as one way to standardize this process but risked causing further 'checklist burnout'. Differences in unit cultures and communication needed to be addressed to improve the system prior to the implementation of one out of many communication tools. Nurses felt that they must be among the key players in the development of a culture of safety and communication.

Conclusion: Important trauma patient information is frequently lost during handover from the ED to the ICU. An inter-professional approach is needed to improve the culture of safety and communication prior to the development and implementation of communication tools for quality improvement.

TEEN MOTOR VEHICLE CRASHES: IMPACT OF A UNIQUE PREVENTION INITIATIVE

Nirav Patel*, Trauma Director, Kimberly Lombard, Michelle Mathiason, Thomas H. Cogbill*, M.D., Gundersen Lutheran Health System

Introduction: While teenagers comprise only 7% of all licensed drivers, they account for 20% of reported motor vehicle crashes (MVC) and 14% of MVC-related fatalities. Current driver education programs focus primarily on rules of the road and basic vehicle operation with little emphasis on driving techniques. Our objective was to examine the effect of a Teen Car Control Clinic (TCCC) as a MVC prevention initiative at an American College of Surgeons verified Level II Trauma Center.

Methods: Data from four consecutive TCCCs (2009-2011) was reviewed. Participants were required to have a driver's permit or license, a roadworthy vehicle and be accompanied by a parent or guardian. TCCCs consisted of didactic and "hands on" exercises. Written surveys were completed pre and post-TCCC. Telephone interviews were conducted at 6 months post-TCCC. Variables included demographics, driving confidence, changes in driving patterns, application of techniques learned, MVC, and fatalities. Results: 159 teenagers participated in TCCCs. Complete data were available for 140 (88%). 49% were male. Mean age was 16.3 years (range 15-22). 75% of participants reported no exposure to TCCC techniques during driver education. "Very confident driving" level increased from 28% pre-TCCC to 67% immediately post-TCCC. Of the 109 (78%) participants with 6 month follow-up data, 95 (87%) reported changes in driving patterns based on topics covered at the TCCC and 42 (39%) encountered situations that required application of a technique taught. Overall MVC rate was 6%, with no associated fatalities.

<u>Conclusion</u>: TCCC participation resulted in improved driving confidence, application of techniques and a low incidence of MVC. Given the magnitude of death and disability associated with MVC involving teenagers, it is imperative that trauma centers play a lead role in crash prevention initiatives.

SERUM INFLAMMATORY CYTOKINE MARKERS OF INVASIVE FUNGAL INFECTION IN PREVIOUSLY IMMUNOCOMPETENT BATTLE CASUALTIES

Jason Radowsky, Trevor Brown, Felipe Lisboa, Carlos Rodriguez, Doug Tadaki, Eric Elster, Naval Medical Research Center Sponsor: James Dunne*, MD

Introduction: Invasive fungal infection (IFI) is increasingly described in individuals experiencing high-energy military trauma. Hallmarks of successful treatment involve aggressive surgical débridement and early initiation systemic anti-microbial therapy. Currently, anti-fungal therapy is commenced based on appearance of wounds and patient's clinical course. While some clinical protocols exist to predict which wounded should receive anti-fungal therapies, there are no established serum markers associated with IFI. Our hypothesis is that serum inflammatory cytokines do exist that can assist in identifying individuals at risk for IFI.

Methods: This is a retrospective case control study at a single institution. Four patients with IFI (Saksenaea vasiformis, Aspergillus, Mucor, and Alternaria sp.) following battlefield trauma were matched to individuals with similar injury patterns who were IFI negative. The percent change in serum inflammatory cytokines between the 1st and 2nd débridements was examined with Luminex proteomic analysis. Significance defined as p < 0.05. **Results:** Both groups had similar ISS scores (med \pm SD) (13.5 \pm 9.2 vs. 15.5 ± 14.3 , p=0.665). There was a statistically significant increase at the 2nd debridement in IL-1b in the ISI group with a decrease in the controls (med%± SD) (425 ± 192 vs. 71 ± 69 , p=0.026). The finding was similar with IL-5 (117±38.6 vs. 64±31, p=0.045). A similar trend was seen with IL-1a, IL-7, and TNFa, but did not reach statistical significance. The Receiver Operating Characteristic of IL-5 and IL-1b revealed sum areas of 0.875. Conclusion: IL-1b is an inflammatory cytokine and IL-5 has a well-established role in pulmonary aspergillosis and Alternaria infections. Persistent elevation in serum inflammatory cytokines, especially the eosinophil-enhancing IL-5, demonstrates the potential of future rapid testing to augment clinical suspicion.

NEUTROPHIL DYSFUNCTION IMPAIRS ANTIMICROBIAL CAPACITY IN BACTERIAL PNEUMONIA AFTER ENDOTOXIN TOLERANCE

Kendra Iskander, David Stepien, Rituparna Moitra, Daniel Remick, Boston University Medical Center Sponsor: Suresh K. Agarwal, Jr.*, M.D.

Introduction: Prior exposure to endotoxins such as lipopolysaccharide (LPS) may result in transient immune refractoriness to subsequent challenge known as tolerance. Tolerance is thought to be a protective mechanism limiting excessive inflammation and organ injury, but it may impair the host's ability to combat ensuing bacterial infection. We investigated whether tolerance with intratracheal LPS prior to inducing Pseudomonas aeruginosa pneumonia will alter neutrophil recruitment, cytokine production, and the antimicrobial capacity of the murine lung.

<u>Methods:</u> Mice were given 100ng LPS or normal saline by hypopharyngeal instillation under anesthesia. Forty eight hours later, all mice received Pseudomonas aeruginosa in 50uL HBSS by repeat intratracheal instillation. After four hours, bronchoalveolar lavage (BAL) fluid was collected to measure cytokine levels and cytospins were prepared for differential counting. Right lungs were harvested for myeloperoxidase assay and left lungs for bacterial culture. BAL neutrophils were used in a novel killing assay to assess phagocytic cell function.

<u>Results:</u> TNF-alpha levels in BAL were significantly decreased in tolerant vs. nontolerant mice (p=0.018). LPS also locally downregulated BAL neutrophil chemoattractants CXCL1 (p=0.045) and CXCL2 (p=0.006) in tolerant mice without affecting systemic levels. No reduction was seen in BAL neutrophil numbers or myeloperoxidase activity. Tolerant mice had at least a 2-fold increase in bacterial load at 24 hrs in BAL and lung homogenate. BAL neutrophils from tolerant mice had impaired bacterial killing ability (p=0.018). **Conclusion:** While endotoxin tolerance with LPS significantly attenuates the host inflammatory cytokine response, it reduces bacterial clearance. Defective neutrophil function appears to play a mechanistic role.

A RAPID PCR ARRAY FOR THE IDENTIFICATION OF BACTERIAL PATHOGENS IN SUSPECTED VAP ISOLATES

Gregory Thomas, Leonard Rael, Charles Mains, Denetta Sue Slone*, M.D., David Bar-Or, Swedish Medical Center Sponsor: Denetta Sue Slone*, M.D.

Introduction: Ventilator associated pneumonia (VAP) is a frequently occurring clinical problem that arises in mechanically ventilated patients. Rapid and appropriate intervention can affect both morbidity and mortality. Current diagnostic practices can take up to three days to identify the causative pathogens from patient isolates. The primary aim of this study was to develop a rapid, PCR based assay to expedite the identification of the bacteria involved in VAP.

<u>Methods</u>: Genomic DNA was isolated from excess bronchoalveolar lavage (BAL) fluid received from the lab and subjected to quantitative real-time PCR analysis utilizing an array developed in house consisting of primer pairs for 85 specific targets.

<u>Results:</u> In as little as 3 hours, qRTPCR analysis was able to identify potentially pathogenic organisms in BAL fluid with greater accuracy, sensitivity, and specificity than traditional culturing techniques. We also found that several bacterial groups were being under reported such as Streptococcus, Neisseria, and Mycoplasma.

<u>Conclusion</u>: These data suggest that our PCR array can quickly and accurately identify microorganisms present in BAL fluid.

Lab ID (CFU#)	Array ID (PCR cycle#)
Mixed Flora (>10,000)	Strep (20), Mycoplasma (24), Neisseria (25)
Mixed Flora (few)	S.maltophilia (26), S.marcescens (27)
S.aureus (>10,000)	S.aureus (20)
P.aeruginosa (>10,000)	P.aeruginosa (15), Fungal 18s (26), Myco (24)
Yeast (10,000)	Fungal 18s (24), MRSA (28)

QUANTITATIVE ANALYSIS OF DYNAMIC CHANGES IN THE EXPRESSION OF NEUTROPHIL EXTRACELLULAR TRAPS IN ACUTE RESPIRATORY INFECTIONS

Tomoya Hirose, Shigeto Hamaguchi, Naoya Matsumoto, Taro Irisawa, Masafumi Seki, Osamu Tasaki, Hideo Hosotsubo, Kouji Yamamoto, Kazunori Tomono, Takeshi Shimazu*, M.D., Osaka University Graduate School of Medicine Sponsor: Takeshi Shimazu*, M.D.

Introduction: Neutrophil extracellular traps (NETs) are structures composed of DNA and granular proteins, which rapidly trap and kill pathogens. The purpose of this study was to evaluate quantitatively dynamic changes in the expression of NETs in acute respiratory infections.

<u>Methods</u>: We examined the sputum collected from the intubated patients admitted to our ICU during the period April to June 2011. Samples were planned to collected at the onset of acute respiratory infection (= day0), day1, day3-5, and day6-8 thereafter. To identify NETs, DNA and histone H3 which are the components in NETs were simultaneously visualized by immunohistochemistry. The quantification of NETs length was performed using Neurolucida software.

<u>Results:</u> Ten patients eventually met the criteria for this research. There was significant difference between measure points by ANOVA for repeated measures (p<0.001) (Figure). The lengths of the NETs at day1 after the onset of infection were significantly



longer than those at the onset (p<0.001). The lengths of the NETs at day 6-8 were significantly shorter than those at day3-5 (p=0.025). Neutrophils abundantly released NETs following respiratory infection, and the number of NETs was decreased and the fibers became fragmented after the infection was controlled.

<u>Conclusion</u>: NETs may play an important role in the defense against bacteria in patients with acute respiratory infection. This is the first report, to our knowledge, to quantify the dynamic change in the expression of NETs in acute respiratory infection using human sputum samples.

MAXIMAL CHEMILUMINESCENT INTENSITY ASSESSED BY ENDOTOXIN ACTIVITY ASSAY IS A VALUABLE INDEX OF INNATE IMMUNITY REFLECTING NEUTROPHIL OXIDATIVE ACTIVITY AND COUNTS IN PATIENTS WITH SEPSIS.

Takeyuki Kiguchi, M.D., Yasushi Nakamori, M.D., Kazuma Yamakawa, M.D., Daiki Wada, M.D., Taichin Koh, B.S., Hiroshi Ogura*, M.D., Yasuyuki Kuwagata, M.D., Takeshi Shimazu*, M.D., Satoshi Fujimi, M.D., Osaka General Medical Center

Introduction: We recently focused on maximal chemiluminescent intensity (CI max) in response to LPS assessed by Endotoxin Activity Assay, and reported that low CI max on admission day closely correlated with poor outcome in patients with sepsis. The reason why CI max decreased in septic non-survivors, however, has not been clarified. The objective of this study was to evaluate the relation between CI max and neutrophil oxidative activity or counts in patients with sepsis.

<u>Methods</u>: A total of 133 patients with sepsis were included in this study. Within 12 h after admission, a whole blood sample was collected, and CI max was measured by Endotoxin Activity Assay in each patient. Neutrophil oxidative activity was measured by flow cytometry in 19 patients of all.

<u>Results:</u> In 133 patients, CI max was identified as an independent predictor for the probability of 28-day mortality by Cox regression analysis. In 19



patients, CI max significantly correlated with neutrophil oxidative activity (r=0.637, p<0.01), and neutrophil counts (r=0.465, p=0.04). Non-survivors showed low CI max, low neutrophil oxidative activity and low counts compared with survivors (16160 ± 16282 vs. 122390 ± 133053 RLU/sec, p<0.01; 309 ± 53 vs. 196 ± 29 fluorescence/cell, p<0.01; 1907 ± 2049 vs. 10205 ± 8390 /microL, p<0.01, respectively).

<u>Conclusion</u>: CI max, a significant predictor for the probability of 28-day mortality, closely correlated with neutrophil oxidative activity and counts in septic patients. Therefore, CI max is a valuable index of innate immunity for microbicidal activity.

INHIBITORY EFFECTS OF COMBINED NITRIC OXIDE SYNTHASE AND REACTIVE OXYGEN SPECIES IN EXPERIMENTAL SEPTIC SHOCK

Marie-Francoise Doursout, Sharina Iraida, Yang Yan Liang, Emil Martin, University of Texas Health Science Center-Houston

Introduction: Sepsis is a major cause of morbidity and mortality in intensive care. Nitric oxide (NO) is cytotoxic and may cause direct tissue injury and contribute to sepsis-induced multiple organ failure. Because excessive production of nitric oxide (NO) and reactive oxygen species (ROS) in sepsis modulates different cell functions, we assess the inhibitory effects of nitric oxide synthase using NG-Nitro-L-arginine (L-NAME) and oxidative stress using a conventional inhibitor N-acetylcysteine in rats subjected to lipopolyssacharide (LPS)-induced septic shock.

Methods: Under isoflurane anesthesia, 18 rats were instrumented to record arterial mean blood pressure (MAP) and heart rate (HR). At least 5 days after surgery, animals received LPS at 20 mg/kg IV over 5 min. L-NAME (N=6) and NAC (N=6) were administered 30 min following LPS injection, either alone or combined (N=6). Hemodynamic parameters (MAP, HR) were recorded at baseline, at the end of LPS and 30 min, 1 hr, 2 hr, 3hr following LPS and/or drug administrations. Simultaneously with hemodynamic measurements, blood samples were collected to further record nitrate production and markers of oxidative stress. Data were analyzed using ANOVA for multiple comparisons. P<0.05 was considered significant. **Results:** LPS induced a significant decrease in MAP at 1 hr and 2 hr by 41% and 14% respectively. Concomitantly to LPS-induced hemodynamic changes, nitrate and reactive oxygen species (ROS) increased significantly by 70 % and returned to baseline within 3 hr. Although L-NAME and NAC inhibited MAP by 20% when administered alone, combined treatments abolished LPS-induced decrease in blood pressure.

<u>Conclusion</u>: Our data suggest that LPS-induced decrease in blood pressure is due to combined NO and ROS production as predicted by L-NAME and NAC inhibition.

THE RELATIONSHIP BETWEEN PERIPHERAL BLOOD HEMATOCRIT AND RED BLOOD CELL VOLUME

Jeremy Stone, B.A., David Inouye, Michael Hayashi, Kevin Pei, Uy Vu, Danny Takanishi, Mihae Yu*, M.D., University of Hawaii and The Queen's Medical Ctr

Introduction: Hematocrit (Hct), defined as red blood cell volume (RBCV)/total blood volume (BV), has traditionally been used to judge the appropriateness of blood transfusion. Peripheral blood Hct is affected by hemoconcentration and hemodilution which can confound the clinical estimation of RBCV. In our study, we investigate if peripheral blood Hct provides a reliable assessment of RBCV and the utility of peripheral Hct as an indication for blood transfusion in critically ill patients.

<u>Methods</u>: This study was a planned side arm of a larger prospective randomized controlled trial of critically ill surgical patients with sepsis, cardiovascular collapse and ARDS [YuM.Shock2011;35(3):220-8]. BVA-100 (Daxor Corp, NY, NY) uses I-131 tagged albumin to determine plasma volume (PV) and calculate BV based on peripheral blood Hct measured at the time of each analysis. A normalized Hct was reported as the RBCV divided by ideal BV based on the patient's height and % deviation from optimum weight. Peripheral blood Hct was compared to normalized Hct with a significant deviation defined as > $\pm 3\%$ difference between the two values (TakanishiD,AnesthAnalg2008;106:1808).

<u>Results:</u> One hundred patients contributed 675 data points; age 61 ± 16 , APACHE II 26±3 and mortality 17%. Bland-Altman analysis assessing agreement between peripheral and normalized Hct showed a mean difference of 4.6±7.3, with 95% CI 4.1-5.2 and 95% limits of agreement ±14.4 Hct % points. Peripheral blood Hct was lower than the normalized Hct in 394 (58.4%), higher in 61 (9.0%) and equivalent in 220 (32.6%).

<u>Conclusion</u>: Peripheral blood Hct may not agree with normalized Hct in critically ill surgical patients. This disagreement may affect the clinical estimation of RBCV and subsequent need for blood transfusion based on peripheral blood Hct.

LPS-INDUCED SEPSIS DOES NOT ALTER CONTROL OF PULMONARY MICROVASCULAR PERFUSION IN RAT LUNGS

Robert Conhaim, Bruce A. Harms*, M.D., Kal Watson, University of Wisconsin Sponsor: Bruce A. Harms*, M.D.

Introduction: Sepsis causes marked perfusion mal-distribution among lung microvessels (Crit. Care Med., 36: 511-17, 2008). We wondered if this was due to the effects of sepsis on the control of lung microvascular perfusion, and consequent changes in lung microvascular diameters.

<u>Methods</u>: We perfused lungs harvested from male Sprague-Dawley rats that were heparinized (500 U/kg) and infused with LPS (30 mg/kg, IV) 90 min. before lung removal. Each lung was perfused with a hetastarch-fluorescein solution to which we added red fluorescent latex microspheres (diams 1, 2, or 3 μ m (n=3 at each diameter). We also prepared control lungs (n=2 at each diameter). We froze the lungs in liquid nitrogen, and prepared tissue sections for confocal microscopy. We measured latex particle (red) and tissue (green) fluorescences within individual microvessels, and from these calculated microvessel diameters. We repeated these experiments in lungs perfused with 3 μ m particles, and air-dried (n=2 LPS; n=2 control) to quantify overall particle trapping patterns.

<u>Results:</u> Perfusate flows through LPS lungs averaged 4.74 ± 0.53 ml/min, and 5.02 ± 0.99 ml/min through controls (n.s.). Microvessel diameters averaged 12 ± 2 µm in LPS and control lungs (n.s.). Particle trapping patterns in air-dried lungs had a dispersion index (logDI) value of 1.04 ± 0.66 in LPS lungs, and 1.13 ± 0.29 in controls (n.s.). (LogDI is a measure of particle trapping randomness; lower values imply greater randomness).

<u>**Conclusion:**</u> LPS had no effect on lung microvascular control or perfusion distribution, unlike agents such as serotonin, bradykinin and angiotensin-II that affect that control (J. Appl. Physiol, 112: 48, 2012). Our results imply that the pulmonary microvascular perfusion mal-distribution known to be caused by sepsis is most likely due to obstruction of lung microvessels by microthrombi and neutrophils, and not to alterations in microvascular control.

PATHOGENESIS OF ORGAN FAILURE AFTER TRAUMA IN THE OBESE: ADIPOCYTES SERVE AS A SOURCE OF INFLAMMATORY MEDIATORS

Lawrence N. Diebel*, M.D., David Edelman, M.D., David Liberati, MS, John Weber, M.D., Wayne State University

Introduction: Obesity is associated with a higher risk of organ failure and other significant morbidities after severe trauma. Morbid obesity is also associated with a low grade chronic inflammatory state. We hypothesized that there would be an augmented inflammatory response in adipocytes under stress conditions. The systemic release of these proinflammatory mediator(s) may then lead to remote organ injury. This was studied in an in vitro model. **Methods:** Adipose derived stem cells (ADSC) behave as mature adipocytes under standard culture conditions. ADSC were incubated with physiologic (physio) and stress concentrations of epinephrine (epi; 10-6 and 10-3 μ M respectively) and/or cortisol (cort; 500nM and 8,000nM respectively). Cell culture supernatants were obtained at 12hrs. for TNF α and IL-6 determination and co culture experiments performed with confluent human lung microvascular endothelial cells (HMVEC). HMVEC permeability (FITC-dextran), percent apoptosis (%apo), and ICAM-1 expression (MFI) were then determined.

<u>Results</u>: mean \pm S.D., N = 4 for each group.

			HMVEC			
	ADSC TNF I	(pg/ml) L-6	Perm. (nmol.cm ⁻² .hr ⁻¹)	%apo ICAM		
ADSC	24.8±1.2	17.7±1.2	0.35±0.02	4.8±0.1	10.2±0.2	
ADSC+cort(physio)	29.6±1.3	15.5±1.5	0.38±0.02	8.6±0.3	11.5±0.3	
ADSC+cort(stress)	61.6±3.7*#	37.9±2.6*#	0.92±0.04*#	28.9±0.9*#	40.6±0.8*#	
ADSC+epi(physio)	29.5±1.7	22.6±1.5	0.36±0.01	6.8±0.5	10.9±0.4	
ADSC+epi(stress)	42.6±2.6*#	57.3±1.5*#	0.67±0.03*#	20.4±1.0*#	31.6±0.9*#	
ADSC+epi+cort(stress)	70.5±4.8*#	61.3±4.6*#	0.81±0.04*#	24.8±0.7*#	36.5±1.1*#	
ADSC+epi(stress) ADSC+epi+cort(stress)	42.6±2.6*#	61.3±1.5*#	0.67±0.03*# 0.81±0.04*#	20.4±1.0*# 24.8±0.7*#	31.6±0.9*	

*p<0.001 vs. ADSC, #p<0.001 vs.physio group. There were no differences in HMVEC parameters in control vs. cells directly exposed to stress levels of epi and cort.

Conclusion: Adipose tissue is a source of inflammatory mediators which may promote lung/remote organ injury under stress conditions; the magnitude of which is likely dependent on patient body mass index.

LC/ESI-MS/MS METABOLOME DETECT ANTI-INFLAMMATORY FATTY ACID OXIDATION IN THE RODENT GUT ISCHEMIA/REPERFUSION INJURY FEEDING WITH EICOSAPENTAENOIC ACID, GAMMAILINOLENIC ACID AND ANTIOXIDANT FORMULA.

NORIO SATO, Nahoko Endo, Tetsuyuki Kobayashi, Takayuki Asakura, Takayuki Irahara, Yuta Moroe, Takao Suzuki, Masahiko Okamura, Kaoru Koike*, M.D., Ph.D., FACS, FCCM, Kyoto University Hospital Department of Primary care and Emergency Medicine Sponsor: Kaoru Koike*, M.D., Ph.D., FACS, FCCM

Introduction: Enteral feeding in the critically ill patients is crucial. Eicosapaentaenoic acid (EPA) is one of the immunonutrients which has been known as anti-inflammtory properties, especially metabolite to Resolvins which is from 18-HEPE. Enteral feeding with EPA, gamma-linolenic acid (GLA) and antioxidant is recommended to ALI/ARDS patients, and also has benefit for septic patients from the literature, however there are unsupportive data recently. We are not sure whether EPA, GLA and antioxidant is benefit for intestine or not, especially exposed to ischemia/reperfusion insult. To purpose of this study is to investigate the effect of enteral nutrition with or without EPA, GLA and antioxidant formula in a rodent gut ischemia/reperfusion (I/R) injury.

<u>Methods</u>: Rats underwent duodenal feeding tubing and were infused continuously enteral nutrition with or without EPA, GLA and antioxidant formula for 3 days. Rats were subjected to 45 minutes of superior mesenteric artery occlusion (SMAO) and 4 hours of reperfusion. Ileum was harvested for histology, myeloperoxidase (MPO), cytokines and LC/ESI-MS/MS Metabolome.

<u>Results:</u> Fatty acid composition in the ileum was changed by feeding with EPA, GLA, antioxidant formula. Feeding with EPA, GLA, antioxidant formula was significantly lessened gut I/R mucosal injury, but was not associated with MPO activity and cytokines production compared to control feeding. LC/ESI-MS/MS metabolome analysis detected fatty acid oxidation and 5-HEPE, 12-HEPE, 18-HEPE, PGE3 was higher than control feeding and LTB4 was less than control feeding in the ileum after gut I/R.

Conclusion: The protective role against gut ischemia/reperfusion injury with EPA, GLA and antioxidant might be related anti-inflammatory fatty acid oxidation rather than cytokines.

GEOGRAPHIC VARIATION IN SUSCEPTIBILITY TO VENTILATOR-ASSOCIATED PNEUMONIA AFTER INJURY

Ben L. Zarzaur*, M.D., MPH, Teresa Bell, Martin Croce*, M.D., Timothy C. Fabian*, M.D., University of Tennessee Health Science Center - Memphis

Introduction: Emphasis on prevention of healthcare-associated infections (HAI) including ventilator-associated pneumonia (VAP) has increased as hospitals are beginning to be held financially accountable for such infections. HAIs are often represented as being avoidable; however, the literature indicates that complete preventability may not be possible. The vast majority of research on risk factors for VAP concerns individual level factors. No studies have investigated the role of the patient's environment prior to admission. In this study we aim to investigate the potential role pre-hospital environment plays in VAP etiology.

<u>Methods</u>: In a retrospective cohort study, a sample of 5,031 trauma patients treated with mechanical ventilation between 1996-2010 was analyzed to determine the effect of neighborhood on the probability of developing VAP. We evaluated the effect of zip code using multilevel logistic regression analysis adjusting for individual level factors associated with VAP.

<u>Results:</u> Three zip codes had rates of ventilator-associated pneumonia that differed significantly from the mean. Logistic regression indicated that zip code, age, gender, race, injury severity, paralysis, head injury, and number of days on the ventilator were significantly associated with



VAP. However, median zip code income was not.

<u>Conclusion</u>: Spatial factors that are independent of health care quality may potentiate the likelihood of a patient developing VAP and possibly other types of healthcare acquired infections. Un-modifiable environmental patient characteristics may predispose certain populations to developing infections in the setting of trauma.

LONG-TERM COMPLICATION RATES ARE EQUIVALENT BETWEEN OPEN AND PERCUTANEOUS TRACHEOSTOMY

William Kettunen, M.D., Stephen Helmer, Ph.D., James Walker, M.D., James Haan*, M.D., The University of Kansas School of Medicine – Wichita and Via Christi Hospital

Introduction: Percutaneous tracheostomy is becoming the procedure of choice for elective tracheostomy in trauma patients. While numerous studies document equivalent early complication rates between open and percutaneous tracheostomy, there is little late complication data. The purpose of this study was to compare the incidence of, and factors contributing to, tracheal stenosis following percutaneous or open tracheostomy in trauma patients.

Methods: A ten-year retrospective review of all trauma patients undergoing tracheostomy at a single ACS-verified Level I trauma center was conducted. Data on demographics, injury severity, tracheostomy type, complications related to tracheostomy creation, hospital stay and disposition were collected and comparisons made between patients receiving percutaneous or open tracheostomy as well as those that did or did not develop tracheal stenosis. Results: Of 627 patients undergoing tracheostomy formation, 276 (44%) were completed open and 351 (56%) percutaneously. Median ISS was higher for percutaneous than open tracheostomy patients (26 vs. 24, P=0.010). Overall tracheostomy complication rate was not different (Perc=2.3% vs. Open=3.3%, P=0.452). There was 1 (0.3%) tracheoinnominate fistula in the percutaneous group and 0 (0%) from the open group (P=1.00). There were 9 reported incidences of tracheal stenosis, 4(1.1%) from the percutaneous group and 5 (1.8%) from the open group (P=0.517). Age, ICU days, ventilator days, and hospital length of stay were not associated with increased risk of developing tracheal stenosis.

<u>Conclusion</u>: Percutaneous tracheostomy was associated with a low incidence of tracheal stenosis and compared favorably to that observed with open tracheostomy. The risk of tracheal stenosis should not impact the decision of whether to perform an open or percutaneous tracheostomy in trauma patients.
NON-ENGLISH SPEAKING PATIENTS HAVE AN INCREASED RISK FOR SELF EXTUBATION IN THE SURGICAL INTENSIVE CARE UNIT

Robin Lee, Stephen Gale, Vicente H. Gracias*, M.D., Robert Wood Johnson Medical School

Introduction: Unplanned extubation (UE) in the ICU results in serious complications. Despite protocolized management, it remains a persistent problem. Several risk factors for UE have been studied including sedation, use of restraints, male sex, and level of consciousness. We hypothesized that non-English speaking patients may also be at higher risk for UE.

<u>Methods</u>: A retrospective review of 542 ventilated patients was conducted in two University hospital SICUs between January and December 2011. The charts were reviewed to identify patient's primary language as documented in their admission data. Risk of UE was compared between English and non-English speaking patients using Fisher's exact test.

<u>Results:</u> One hundred percent of all UE were self extubations. Twenty episodes of self extubation occurred in 542 patients (3.69%) over a 12 month period. Sixty five percent of these patients were receiving sedatives at the time of extubation. Ninety percent of patients (18/20) were restrained. Ninety percent of UE occurred in males. English was not the primary language in 9% (49) of all SICU patients. However, of the patients who had an UE, 40% were non-English speaking (p< 0.0002.) All non-English speaking patients were restrained at the time of UE vs only 67% (8/12) of the English speaking patients. And, all non-English speaking patients with UE were male vs 83% of English speaking patients.

Conclusion: Despite the use of adequate restraints, sedation and efforts for timely extubation, non-English speaking patients are at an increased risk for UE when compared to their English speaking counterparts in the SICU.

END TIDAL CARBON DIOXIDE MONITORING FOR OVER SEDATION UNCOVERS PREVIOUSLY UNANTICIPATED RESPIRATORY PATHOLOGY

B. Larsen, B. Dwenger, P. O'Malley, L. Denlinger, C. Smith, C. Rawe, C. Connelly, J. Gmeiner, A. Wale, J.M. Saxe*, Wright State University Boonshoft School of Medicine

Introduction: The mandate for pain as the fifth vital sign has led to the unintended consequence of over sedation in some patients, especially the elderly. The PI process at a level-one trauma center identified issues with over sedation in patients requiring patient controlled analgesia (PCA). In order to capture the early decline in respiratory status in patients requiring significant narcotic and sedative medications we studied end tidal CO2 (EtCO2) monitoring as a method of early detection.

<u>Methods:</u> : An IRB approved prospective six week study on a single in-patient unit in all patients requiring PCA for pain control. Data collected included: Age, gender, diagnosis, length of stay, co-morbidities, EtCO2, Respiratory Rate, FiCO2 SpO, mortality, transfer to ICU, and all PCA, and ETCO2 monitoring events.

<u>Results:</u> During the study period there were no adverse events, no deaths and none of the study patients required transfer to the ICU. 4,066 alarm events were recorded. In 30% (20/70) of patients, high respiratory rate (RR) was noted. High RR alarms coincided with 40% (8/20) of patients with low ETCO2 alarms. 790 alarm events for low respiratory rate (RR< 5/minute). Low RR caused 180 PCA recorded pause alarms and average of 3.6 events per patient. High RR and low ETCO2 indicated a large percentage of high-risk patients had either under appreciated pulmonary pathology or pain not well controlled despite PCA analgesia.

<u>**Conclusion:**</u> ETCO2 monitoring appears to be effective in monitoring and identifying over sedation during PCA therapy. ETCO2 also appears to effectively uncover underlying respiratory pathology although the possibility of inadequate pain management must also be considered. This data would support recommending the use of ETCO2 monitoring in all high risk patients requiring PCA analgesia.

A MATURE TRAUMA INTENSIVIST MODEL IMPROVES ICU EFFICIENCY BUT NOT MORTALITY

John Lee, MD, FACS, Frederick B. Rogers*, M.D., Amelia Rogers, B.S., Michael Horst, PhD, Roxanne Chandler, RHIA, CTR, CSTR, Jo Ann Miller, RN, CCRN, Lancaster General Hospital

Introduction: Although the Leap Frog intensivist model study has been shown to improve outcomes in the ICU, to date, no one has examined the effect of an intensivist model in a dedicated trauma ICU. With stricter adherence to evidence-based protocols and 24 hour availability, we hypothesized that a mature intensivist model in a trauma ICU would decrease mortality.

Methods: Level II trauma center trauma ICU admissions 2006 to 2011. ICU care provided by a six trauma intensivists. Two periods were compared: EARLY ('06-'08) and MATURE ('09-'11). Patients matched on age, ISS, pre-existing conditions, etc. in a univariate analysis, with significant variables placed in a logistic regression model, with mortality as the outcome. **Results:** A total of 3527 patients (2999 excluding DNR status) were reviewed. Age \geq 65 (OR 2.38, p <0.001), ISS \geq 17 (OR 3.3, p<0.001), coagulopathy (OR 1.64, p=0.004), and anemia (OR 1.73, p=0.02) were independent predictors of mortality. Multivariate logistic model encompassing these factors, found no statistically significant differences in mortality across the six year period. ICU efficiency and throughput showed significant improvements, in terms of ventilator days, decreases in consultant use and increase number of procedures done at the bedside.

	EARLY('06-'08)	MATURE('09-'11)	Increase/Decrease	P-value
ICU LOS > 2 Days	35.2%	32.8%	-6.8%	0.139
Vent Days	30.1%	24.4%	-18.9%	< 0.001
Consultant Use (mean/pt ±SD)	0.55(±0.85)	0.40(±0.74)	-27.3%	<0.001
Bedside Procedures (mean/pt ±SD)	0.09(±0.48)	0.21(±0.75)	+133%	<0.001

Conclusion: Our mature intensivists staffing model shows improvement in ICU throughput, in the forms of vent days, ICU days, decreased consultant use and increased bedside procedures but no survival benefit. Further improvements in overall trauma mortality may lie in the resuscitative and operative phase of patient care.

VENTILATOR ASSOCIATED PNEUMONIA IN SEVERE TRAUMATIC BRAIN INJURY: THE CLINICAL SIGNIFICANCE OF ADMISSION CHEST COMPUTED TOMOGRAPHY FINDINGS

David S. Plurad*, M.D., Scott Bricker, MD, Angela Neville, M.D., Frederic S. Bongard*, M.D., Brant Putnam*, MD, Harbor-UCLA Medical Center

Introduction: Ventilator Associated Pneumonia (VAP) in Severe Traumatic Brain Injury (sTBI) is a significant morbidity. Bilateral dependent consolidation (BDC) is common on admission Chest Computed Tomography (CCT) in sTBI. While nonspecific, we hypothesize that this



finding is associated with VAP having a predictable microbial signature. <u>Methods:</u> Utilizing our registry, sTBI patients surviving >48 hours over a 3 yr period were analyzed. sTBI was identified by an admission GCS Score \leq 8. VAP was defined as an elevated WBC count, new infiltrates on CxR and a (+) respiratory culture in a patient ventilated for > 48 hours. Early VAP was defined by onset < 4 days of admit. Admission CCT results and culture data were obtained. BDC (+) and BDC (-) patients were compared. **Results:** Eighty-three patients with 81 (97.6%) blunt injuries were studied.

Mean ISS = 32.7 ± 16.6 . There were 31 (37.3%) cases of VAP where mean ISS [41 ± 16.4 vs. 27.8 ± 15 , <.01] and ICP monitoring [67.7% vs. 42.3%, p =.02] were significantly greater. VAP was markedly increased in BDC (+) group [60.9% vs. 28.3%, <.01]. Adjusting for injury severity and patient demographics, BDC independently predicted VAP [4.55 (1.49-13.87),<.01]. Gram (-)'s were present in 83.9% (26/31). Most were Enterobacteracea (48.4%). S. aureus and Acinetobacter isolates followed(22.6% both). Resistant organisms were present in 19.4%. Cultures did not differ between the early vs. late VAP or BDC (+) vs. (-) groups.

Conclusion: VAP is common after sTBI. While CCT findings are predictive, there is no predilection for specific pathogens. Tight prevention measures and increased vigilance is essential in sTBI. Diagnosis and treatment of VAP in sTBI patients should include admission CCT findings in risk assessment.

SCINTIGRAPHIC DIAGNOSIS OF ACUTE BONE INFECTION: IS THE RED CELL SCAN NECESSARY?

Stephen Becher, Merry Barrette-Grischow, MA, MPH, David V. Feliciano*, M.D., Bruce Ziran, MD, Atlanta Medical Center

Introduction: Scintigraphic diagnosis of acute bone infection centers on red (R) and white (W) cell scans. Recently, colloid marrow scan (M) has been advocated as a useful addition, but its value has not been documented. The present study uses all three scans to evaluate acute bone infection. The hypothesis in the study was that the R scan is of little value when diagnosing acute bone infections, and a M/W scan is equal to or better than a R/W scan. Methods: All patients with a presumptive diagnosis of infection had three bone scans (R/W/M). Infection was determined by a combination of: 1) microbiology, 2) pathology, or 3) frank purulence. Outcomes were evaluated for a minimum of 1 year. Blinded scintigraphy readings were performed by an experienced nuclear radiologist using a random presentation of three scan pairs: (R/W) scan, (W/M) scan, and all three. Scan interpretations were compared with the benchmark outcomes to compare each scan combination. A receiver operating characteristic (ROC) analysis was also performed. **Results:** 72 scan sets from 24 patients were obtained. Negative predictive values for R/W, W/M, and R/W/M scans were 0.46, 0.31, and 0.31 respectively. Positive predictive values for R/W, W/M, and R/W/M scans were 0.73, 0.91, and 0.91 respectively. The performance of an R/W scan pair was inferior to that of a W/M pair and R/W/M combo. Areas under the ROC curve for W/R, W/M, and W/R/M were 0.59, 0.61, and 0.61, respectively. **Conclusion:** Scintigraphy was poor for screening the presence of infection but good for decision to treat. The traditional R/W pair of scans were inferior to scans that included a M scan. Most importantly, a red cell scan added little to the W/M scan pair, implying that it is not needed. Low areas under ROC curve were a result of low sensitivity and suggest that scintigraphy alone may not be the most accurate method to rule out osteomyelitis.

BLEEDING FROM DABIGATRAN IN ELDERLY PATIENTS: THE TIP OF THE ICEBERG

Gail T. Tominaga*, M.D., Kathryn B. Schaffer, M.P.H., Kimberly Tallian, Pharm.D., Frank Coufal, M.D., Imad S. Dandan*, M.D., Scripps Memorial Hospital La Jolla

Introduction: Dabigatran, approved by the FDA in Oct 2010, has gained popularity due to the ease of use and no requirement of blood monitoring. It has less drug reactions and reported to have a similar or lower bleeding risk than warfarin. However, the lack of an effective reversal agent is a major problem. This study reviews one hospital's experience with dabigatran use. Methods: Inpatients on dabigatran on admission or during hospitalization from Feb-Dec 2011 were identified through Pharmacy and Health Information at one Community Level II Trauma Center. Demographics, precipitating trauma or procedure, admission diagnosis, bleeding, need for transfusions, length of stay (LOS), and outcome were reviewed. **Results:** 57 patients (pts) were identified with bleeding episodes in 12 pts (21%). Average age of those without bleeding was similar to pts with bleeding complications (80.3yrs vs. 81.6yrs). LOS was shorter in those without bleeding complications (6.3days vs. 11.4days). Five pts had spontaneous GI bleeds and 3 pts had spontaneous airway bleeds. One pt had a hemothorax following cardiac pacemaker placement requiring 7 Units PRBCs. Three pts had minor falls, one occurring 2 months prior, with retroperitoneal hemorrhage in 1 and intracranial bleeding in 2 pts. One pt had a SAH and one pt had a SDH requiring craniotomy). All but one patient required blood transfusions. Five pts were discharged home, 2 went to an Acute Rehab Hospital, 3 went to a SNF, 1 to Hospice and 1 died. Conclusion: Bleeding while on dabigatran can occur after minor falls or procedures requiring blood transfusions. We had patients sustaining minor trauma with significant bleeding events. The possibility of major bleeding or death can occur following major trauma. Without a reversal agent, the risk of ongoing hemorrhage and death can occur. The risk-benefit of dabigatran should be seriously considered prior to starting patients on this drug.

CLINICAL SIGNIFICANCE OF MOLD CULTURE POSITIVITY IN COMBAT TRAUMA

Carlos Rodriguez, Amy Weintrob, James Dunne*, MD, Francoise Seillier-Moiseiwitsch, Debra Malone, Allison Weisbrod, Bradley Lloyd, Tyler Warkentien, Justin Wells, Clint Murray, Ping Li, William Bradley, Lakisha Gaskins, Jinesh Shah, David Tribble, Walter Reed National Military Medical Center Sponsor: James Dunne*, MD

Introduction: Invasive fungal infections (IFI) are seen in complex blast injuries sustained in Afghanistan. Distinguishing IFI from environmental contamination is often difficult. To guide future therapy, we sought to compare differences in outcomes between IFI and suspected contamination. Methods: From Jun 09-Aug 11, prospective data were obtained on 1530 casualties. IFI defined as: proven [histopathology (HP) with angioinvasion], probable (HP with fungal elements), or possible (cultures with fungal growth and recurrent wound necrosis) were compared to a suspect group (SG)positive fungal cultures without evidence of IFI. Demographics, treatment strategies, and resource utilization were compared between groups. Outcomes included HLOS, OR visits, and mortality. Data presented as medians (IQR). Results: 77 (5.0%) pts met criteria for IFI. 19 pts were identified as SG. IFI Group (IFIG) and SG were male with a median age of 23 and ISS of 21. Most IFI and SG pts were injured by blast (99% vs 100%) while dismounted (88% vs 74%) in Southern Afghanistan (96% vs 74%). 83% of the IFIG had amputations vs 63% in SG. IFIG pts presented with lower SBP [99 (79,125) vs 130 (103,147), p=0.02], greater acidosis [7.24 (7.12-7.30) vs 7.30 (7.25,7.34), p=0.03], received more PRBCs [29 (15,38) vs 17 (7,31), p=0.04] and more FFP [27 (16,37) vs 17 (7,31), p=0.03] in the 1st 24 hrs. 75% of IFIG received amphotericin and triazole. In SG, 15.7% received amphotericin and 5.3% received triazole. SG pts underwent fewer operations [8 (5,11) vs 14 (8,18), p=0.02], had shorter HLOS [45 (35,56) vs 56 (42,80), p=0.02], and experienced no mortality difference (0% SG vs 5% IFIG, p=0.58). **Conclusion:** IFI pts received significantly more blood products in the first 24 hours and had greater resource utilization compared to SG pts. This study supports sending both cultures and HP to aid in the diagnosis of IFI. Future studies are warranted to determine the need for anti-fungal therapy in SG pts.

IMPACT OF THE MIDDLE LATENCY AUDITORY EVOKED POTENTIAL INDEX FOR DIGITIZING THE DEGREE OF CONSCIOUSNESS OF COMATOSE PATIENTS.

Junya Tsurukiri, Naoyuki Kaneko*, M.D., Jun Oda*, M.D., Tetsuo Yukioka*, M.D., Department of Emergency and CCM, Tokyo Medical University

Introduction: Digitizing the degree of consciousness is a universal challenge in emergency department (ED) and intensive care units. The middle latency auditory evoked potentials index (MLAEPi) monitor (aepEX plus®, Audiomex, Glasgow, UK) is the first mobile MLAEP monitor. We hypothesized that the MLAEPi can predict the degree of consciousness for the patients with disturbance of consciousness (DOC) upon arrival at the ED. **Methods:** After obtaining approval, MLAEPi from the patients with DOC, those from the patients with cardiopulmonary arrest (CPA), and those from healthy volunteers (control group) entered this study. The patients with DOC were defined as initial Glasgow Coma Scale (GCS) score less than 8 at the ED. The patients with CPA arrived at the ED did not show restoration of spontaneous circulation after resuscitation at the scene.

<u>Results:</u> We identified 40 patients with DOC, 35 patients with CPA, and 40 volunteers. The MLAEPi was significantly higher in control group than that of the patients with DOC and with CPA. The initial MLAEPi at the ED was significantly increased in patients with DOC compared with CPA. Among the patients with DOC, the initial MLAEPi was correlated with the GCS score (pearson r = 0.75, 95% CI = 0.50-0.83, p < 0.001). The ROC curve of the initial MLAEPi for predicting the degree of consciousness showed an area under the curve of 0.90 (95% CI = 0.82-0.97, p < 0.001).

Conclusion: Although our

study size is small, it is advocated that initial MLAEPi represented by

Variables	DOC n=40	CPA n=35	Control n=40
MLAEPi	52 ± 21 ^a	27 ± 7 b,c	86 ± 12
	a p<0.001 vs. control	^b p<0.001 vs. control	^c p<0.001 vs. DCD

simple numerical values can be used to initially evaluate the degree of consciousness for the patients with DOC and with CPA at the ED.

ICU BOUNCE BACK: AN ANALYSIS OF UNPLANNED RETURNS TO THE INTENSIVE CARE UNIT

Samir M. Fakhry*, M.D., Stuart Leon, MD, Chris Derderian, MD, Hasan Al Harakeh, MD, Pamela Ferguson, PhD, Medical University of South Carolina

Introduction: Discharging patients from the intensive care unit (ICU) often requires complex decision making to balance patient needs with available resources. Unplanned return to the ICU ("bounce back", BB) has been associated with increased resource utilization and worse outcomes but few data on trauma patients are available. The goal of this study was to review ICU BB and define ICU discharge variables that may be predictive of BB. **Methods:** Adults admitted to ICU and discharged alive to a ward from 11/04 to 9/09 (interval with no changes in coverage) were selected from our trauma registry. Patients with unplanned return to ICU (BB cases) were matched 1:2 with controls on age, ISS and duration of post-ICU stay. Charts were manually abstracted. Data were analyzed with univariate and conditional multivariate techniques.

<u>Results:</u> 1971 of 8835 hospital admissions (22.3%) were discharged alive from ICU to a ward. 88 patients (4.5%) met our criteria for BB (male 75%, mean age 52.9 + 21.9, mean ISS 23.1 + 10.2). Most (71.6%) occurred within 72 hours. Mortality for BB cases was high (19.3%). Regression analysis showed that male gender, GCS<9, higher FiO2, discharge during day shift (7am-5 pm) and presence of co-morbidities were predictive of BB (Table).

	Male	GCS<9	Each 1% incr. in FiO2	Discharge day shift	1 co-morbidity	2 co-morbidity	3 co-morbidity
Odds Ratio	3.9	33.8	1.067	7.8	12.1	18.8	21.4
p value	0.0026	0.0015	0.0213	<0.0001	0.0012	0.0002	0.0001

Conclusion: In this study, BB rate was 4.8% and associated mortality was 19.3%. At ICU discharge, male gender, a GCS <9, higher FiO2, discharge on day shift and presence of co-morbidities were the strongest predictors of BB. A multi-institutional study is needed to validate and extend these results.

MOVED TO ORAL PAPER SLOT 27

STRESS-HYPERGLYCEMIA IS ASSOCIATED WITH SURGICAL SITE INFECTION: A PROSPECTIVE OBSERVATIONAL STUDY OF NON-DIABETIC, NON-CRITICALLY ILL ORTHOPAEDIC TRAUMA PATIENTS

Justin Richards, Julie Hutchison, A Jahangir, Hassan Mir, Jason Evans, Aaron Perdue, William Obremskey, Manish Sethi, Addison May*, M.D., Vanderbilt University Medical Center

Introduction: We evaluated the relationship of hyperglycemia and surgical-site infection (SSI) in non-critically ill, non-diabetic orthopaedic trauma patients.

<u>Methods</u>: Prospective observational study. Inclusion criteria: age >17 years, orthopaedic injuries requiring operative intervention. History of diabetes, corticosteroids, multisystem injuries, or admission to the ICU were excluded. Demographics, medical co-morbidities, body mass index (BMI), open fractures, and number of operations were collected. Fingerstick glucose values were ordered twice daily for each patient and recorded. Hyperglycemia: fasting glucose value ≥ 125 mg/dL or random value ≥ 200 mg/dL on more than one occasion. Only glucose values prior to the diagnosis of infection were considered. Hemoglobin A1C (Hgb A1C) was obtained from hyperglycemic patients; occult diabetes was considered for Hgb A1C \geq 6.0 and was excluded from final study analysis. SSI: confirmed positive intraoperative cultures within 30-days of the index operation.

<u>Results:</u> 171 patients enrolled. 40/171 (23.4%) hyperglycemic; 7/40 (17.5%) with Hgb A1C \geq 6.0 were excluded. Final population=164 patients; 33/164 hyperglycemic (20.1%). 12/163 (7.3%) SSI's. No significant association with age, gender, race, medical co-morbidities, obesity (BMI>29), tobacco use, or the number of operative procedures and the primary outcome. Patients with hyperglycemia were more likely to develop SSI (7/33, 21.2% vs 5/131, 3.8%; p=0.001). Open fractures (6 Type I, 22 Type II, 22 Type III) were also associated with SSI (7/50, 14% vs. 5/114, 4.4%; p=0.03). However, no association with open fractures and hyperglycemia (10/50, 20.0% vs. 23/114, 20.2%; p=0.98).

<u>**Conclusion:**</u> Stress-hyperglycemia was associated with SSI in non-diabetic, non-critically ill orthopaedic trauma patients.

ICU DELIRIUM IN TRAUMA PATIENTS: A PROSPECTIVE STUDY OF RISK FACTORS AND OUTCOMES

Amy Hildreth*, MD, Annie Shepler, BS, Nathan Mowery*, MD, R Martin, Preston R. Miller*, M.D., Wake Forest University School of Medicine

Introduction: Intensive care unit (ICU) delirium has been linked to adverse outcomes in mixed ICU populations. ICU delirium has not been thoroughly explored in the trauma ICU population. Our study examines risk factors for and outcomes of ICU delirium.

<u>Methods</u>: We performed a prospective observational study from July 2010 to February 2011 of patients admitted to the trauma ICU at a Level I trauma center. We excluded those with preexisting neurologic deficit and severe brain injury as well as those with an ICU length of stay (LOS) less than 24 hours. Univariate and multivariate analyses were used to determine risk factors for and consequences of ICU delirium.

<u>Results:</u> 86 patients met inclusion criteria; 58% of patients had evidence of delirium during their ICU stay. Using multivariate logistic regression analysis, independent predictors of delirium development were found to be elevated admission blood alcohol (O.R. 5.22, C.I. 1.02-26.78; p<0.05), elevated admission venous lactate (O.R. 1.78, C.I. 1.09-2.91; p<0.05), and age (O.R. 1.09, C.I. 1.03-1.15; p<0.05). The presence of delirium was associated with increased hospital and ICU LOS as well as death.

<u>**Conclusion:**</u> ICU delirium is common in trauma patients and is associated with increased LOS, ICU LOS, and death. Increased age, admission blood alcohol and lactate are important predictors. The etiology of ICU delirium is clearly multifactorial, and future study should focus on multimodal approaches to its prevention and treatment to avoid associated morbidity and mortality.

FEMORAL VENOUS PRESSURE IS AN ADEQUATE MEASURE OF CENTRAL VENOUS PRESSURE FOLLOWING LAPAROTOMY

Brian Boone, Nikia Tucker, Scott Gunn, Raquel Forsythe*, University of Pittsburgh

Introduction: Central venous pressure (CVP) is useful for monitoring volume resuscitation when used in the appropriate clinical setting. CVP is traditionally measured through subclavian (SC) or internal jugular (IJ) central catheters, however a number of patients who could benefit from CVP monitoring have only femoral lines, especially during early trauma resuscitation. While a limited number of small studies have compared femoroilliac venous pressure (FVP) to CVP, no study has specifically evaluated these measurements in surgical patients following laparotomy. . **Methods:** This was a single institution, prospective study approved by the Institutional Review Board. Patients who had both IJ or SC lines and femoral lines already in place for various clinical indications were eligible for the study. Pressure measurements from both lines were taken in addition to measurement of bladder pressure, mean arterial pressure, and peak airway pressure if the patient was on the ventilator. Data was evaluated using Pearson's correlation coefficient, and paired t-test.

<u>Results:</u> Measurements were obtained from 20 patients, 9 of which had laparotomy during the admission. CVP ranged from 3 to 23. The correlation coefficient between FVP and CVP was 96% (p<0.0001). The mean difference between measurements was 1.6 mm Hg. 82% of patients had a measurement difference of \leq 3 mm Hg. There was no correlation between FVP accuracy and bladder pressure, mean arterial pressure, or peak airway pressure. There were no significant differences between patients who had laparotomy and nonsurgical patients (p=0.40).

<u>Conclusion</u>: FVP is an adequate measure of central venous pressure, even in surgical patients who have had recent laparotomy. Measurement of FVP to guide resuscitation is encouraged in patients who have only femoral venous catheter access.

ACUTE KIDNEY INJURY (AKI) IS SURPRISINGLY COMMON AND IS A POWERFUL PREDICTOR OF MORTALITY IN SURGICAL SEPSIS

Laura White, M.D., Heitham Hassoun, MD, Azra Bihorac, M.D., R. Matthew Sailors, B.E., Bruce McKinley, Ph.D., Laura Moore*, MD, Frederick Moore*, M.D., The Methodist Hospital, Dept of Surgery

Introduction: Despite advancements in renal replacement therapy, AKI harbors a grave prognosis in hospitalized patients. Many arbitrary definitions of AKI exist; however when defined by consensus criteria, a recent study in trauma patients identified a high incidence of AKI associated with an increased risk of mortality. In our unique prospective surgical sepsis database, we aimed to identify the incidence of AKI utilizing defined consensus criteria and hypothesized that AKI predicts an increased risk of mortality in surgical sepsis.

<u>Methods:</u> Our database stratifies patients by consensus criteria for sepsis, severe sepsis and septic shock and includes patient demographics, APACHE II score, baseline indices of organ dysfunction, ventilator/ICU-free days, secondary infections and discharge disposition. Groups were queried for AKI defined by RIFLE (Risk-Injury-Failure-Loss-Endstage renal disease) creatinine criteria, excluding those with chronic kidney disease, urosepsis, and renal transplantation. A multivariate logistic regression analysis was performed to identify significant predictors of mortality.

	All	Se	psis	Severe	Sepsis		Septic Shock	
	Surgic	(n=	(n=44)		(n=143		(n=59)	
	AKI	NoAKI	AKI	NoAKI	AKI	NoAKI	AKI	
	(n=164)	(n=18)	(n=26)	(n=57)	(n=86)	(n=7)	(n=52)	
Ventilator-Free Days (±SEM)	18±1**	25±2	21±2	25±1	19±1**	23±4	15±2	
ICU-Free Days (±SEM)	15±1**	21±2	19±2	21±1	16±1**	19±3	11±1*	
Mortality (%)	24**	6	8	0	19**	14	40	
Discharged to LTAC/SNF (%) [†]	58*	35	46	35	56	50	74	
**p<0.001, *p<0.05 for AKI vs. no AKI by student's t-test or Chi-squared test; [†] n=205; LTAC=Long Term Acute are facility: SNF=Skilled Nursing Facility								

Results: Of note, AKI occurred in 59%, 60%, and 88% of surgical patients with sepsis, severe sepsis, and septic shock, respectively. For all surgical sepsis, patients with AKI had fewer ventilator-free days, fewer ICU-free days, a much higher mortality rate, and were more likely to be discharged to a LTAC or SNF instead of home (Table 1). AKI was found to be a strong predictor of mortality (OR 10.6, 95% CI 1.3-87.4, p=0.03) in patients after adjusting for demographics, emergent operative status, APACHE II score, sepsis category, and sepsis source.

Conclusion: AKI is a frequent complication in surgical sepsis that is associated with poor outcomes and serves as powerful independent predictor of mortality. Although reported in trauma, this is the first report identifying AKI in surgical sepsis defined by consensus criteria. Research efforts should be directed at preventing AKI and understanding the mechanisms by which AKI contributes to bad outcomes after surgical sepsis.

EXPERIMENTAL INTRA-ABDOMINAL PRESSURE SYMMETRICALLY INFLUENCES BLADDER PRESSURE AND AIRWAY PLATEAU PRESSURE

Gustavo Cortes Puentes, Alexander Adams, John Marini, David Dries*, Regions Hospital Sponsor: David J. Dries*, M.S.E., M.D.

Introduction: Bladder pressure is routinely measured in the clinical setting to estimate intra-abdominal pressure (IAP). Elevated IAP also affects standard airway pressure measurements. In a porcine model of controlled intra-abdominal hypertension (IAH), we evaluated the fidelity of the standardized bladder pressure measurement and airway plateau pressure changes over a range of IAPs.

<u>Methods</u>: Eight (n=8) deeply anesthetized swine were mechanically ventilated at VT=10 ml/kg, f=15, I:E=1:2 and PEEP=1 and 10 cmH2O. After surgical placement of airway tubing in the peritoneal cavity, different levels of IAP (5, 10, 15, 20 and 25 mmHg) were applied via a CPAP system. Bladder pressure and airway pressure were each measured after 10 minutes of stabilization at each level of IAP and during PEEP= 1 and 10 cmH2O.

<u>Results:</u> Bladder pressure changed in parallel with IAP. When IAP is >10 mmHg, a mean underestimation of 3.25±0.83 mmHg was observed. Airway plateau pressure also increased with IAP (figure). Bladder pressure was not affected by PEEP (1



and 10 mmHg) or the ventilatory cycle in this air-based model. <u>Conclusion:</u> Our model confirms the reported role of bladder pressure measurement in identifying IAH. Minimal underestimation is noted (3-4 mmHg after IAP>10 mmHg); probably due to incomplete pressure transmission. During mechanical ventilation, airway plateau pressure is directly influenced by IAP as estimated by bladder pressure.

INFLUENCE OF GENDER ON THE INCIDENCE, MAGNITUDE, AND MORTALITY OF MULTIPLE ORGAN DYSFUNCTION SYNDROME (MODS) IN CRITICAL SURGICAL ILLNESS (CSI)

Philip Barie*, M.D., M.B.A., Soumitra Eachempati*, M.D., Lynn Hydo, M.B.A., Jesse Poganik, Jian Shou, M.D., Weill Cornell Medical College

Introduction: The MODS is the leading cause of death during CSI. A common predisposition to the development of MODS is severe sepsis/shock, but controversy exists as to whether female gender lessens mortality due to sepsis. Hypothesis: Female gender reduces the risk of death from MODS. Methods: Consecutive patients in the surgical ICU of a urban university tertiary-care center (level I trauma center) from 1993-2009 were identified for prospective data collection in ongoing studies of MODS, including calendar year, age, gender, admission APACHE III score (AIII), cumulative MOD score (0-24 points) and component scores (6 organs, 0-4 points each). Analysis: chi2, analysis of variance, logistic regression, X+/-SEM. α =0.05. **Results:** Among 11,247 patients analyzed, 4,467 (39.7%) were female. OD developed in 43.8% of patients. There were 1,092 deaths (9.7%), but mortality among 1,078 MODS patients was 21.8% compared with negligible (0.02%) mortality absent any OD (relative risk [RR] 125.8, 95% confidence interval [CI] 74.1-213.5). For males the RR of death with MODS was 115.2 (CI 59.5-222.9), and higher for females (RR 143.2, CI 59.3-346.5). Among patients with OD, the overall MOD score was 6.33+/-0.08 points (males, 6.45+/-0.10; females, 6.16+/-0.11, p=0.07). Females had less renal/hepatic dysfunction (both p<0.01). By logistic regression adjusted for illness severity, the odds ratios for death were renal: 1.155 (CI 1.088-1.226); hepatic: 2.107 (CI 1.906-2.329), and female: 1.268 (CI 1.052-1.528). Model chi2 297.5, p<0.001. Hosmer-Lemeshow p=0.074 (adequate calibration). **Conclusion:** Critically ill surgical patients were 125-fold more likely to die if OD supervened, and 143-fold more likely to die with MODS if female. Females had nearly 27% excess MODS-related mortality compared with males. Female gender is not protective of death associated with MODS.

IMPLEMENTATION OF CODE SEPSIS REDUCES DELAY IN ANTIBIOTIC ADMINISTRATION IN CRITICALLY ILL FLOOR PATIENTS

Matthew Bloom, Heather Jones, Jeff Borenstein, Jim Mirocha, Kimberly Snodgrass, Tram Cat, Anuj Ohri, Aasin Tareen, Marko Bukur, Daniel Margulies*, Ali Salim*, Eric Ley, Cedars-Sinai Medical Center Sponsor: Daniel Margulies*,

Introduction: We determined the effectiveness of a comprehensive sepsis treatment protocol, Code Sepsis (CS), at reducing antibiotic administration time.

<u>Methods</u>: In-patients with severe sepsis/septic shock treated with CS were compared to matched historical controls. The primary endpoint was the time required for antibiotic administration after written order. The secondary endpoint was mortality.

<u>Results:</u> During the CS protocol, average time to antibiotic administration was reduced from 184 minutes to 47 minutes ($p \le 0.0001$). 85% of CS patients received antibiotics within 60 minutes, compared to only 6% of historical controls. 100% of CS patients v. 13% of controls received antibiotics within 90 minutes. Mortality for CS patients was 15.4% compared to 34.1% for historical controls (p=0.22).

<u>Conclusion</u>: A dedicated Code Sepsis protocol can significantly reduce in-patient antibiotic delivery times.

Code Sepsis Patient Characteristics							
Variable	All Patients n = 98	Code Sepsis n = 13	No Code Sepsis n = 85	p			
Age, yrs	68.4	69.1	68.3	0.79			
Male gender, %	56.1%	92.3%	50.6%	0.006			
GCS	13.3	12.6	13.4	0.094			
SBP, mmHg	102.3	116.8	100.1	0.093			
HR, beats/min	94.5	94.8	94.4	0.76			
Temp, [°] F	98.8	100.8	98.5	0.0002			
RR, breaths/min	21.4	23.2	21.1	0.23			
WBC, per mm ³	13.4	13.5	13.3	0.74			
Hemoglobin, mg/dL	10.0	10.1	10.0	0.91			
Platelets, per mm ³	179.1	215.8	173.4	0.49			
Creatinine, mg/dL	1.7	2.0	1.7	0.117			
Apache IV score	14.9	18.2	14.4	0.59			
LOS, days	21.4	26.1	20.7	0.129			
ICU LOS, days	8.2	7.5	8.3	0.52			
Antibiotic Delay, min	165.6	46.9	183.8	< 0.0001			
Mortality, %	31.6%	15.4%	34.1%	0.22			

DELIRIUM IS PREVALENT IN THE ICU: A CALL FOR IMPLEMENTATION OF EVIDENCE-BASED DELIRIUM PREVENTION BUNDLES

Randeep Jawa, Joseph C. Stothert, Jr.*, M.D., Ph.D., William Thorell, Michele Balas, UNMC

Introduction: There is strong evidence that delirium, sedation, and ventilator management are closely interrelated and that multidisciplinary strategies such as the Awakening-Breathing Coordination, Delirium Monitoring/Management & Early Mobility (ABCDE) bundle are needed to improve outcomes in critically ill adults. We examined the frequency that ICU patients receive interventions to reduce delirium and weakness.

<u>Methods</u>: This prospective observational cohort IRB approved study was conducted at a university-affiliated hospital. Patients were eligible to participate if they were admitted to an ICU, managed by the medical or surgical critical care service, age =>19 years, and had an surrogate who could provide informed consent. Trained personnel performed comprehensive medical record reviews and daily ICU delirium screening. Items measured daily included administration of a spontaneous breathing trial (SBT), spontaneous awakening trial (SAT), a physical therapy consult, and if they were out of bed.

<u>Results:</u> There were 146 medical or surgical patients; 54% were male. Mean age was 59+/-16 years, mean APACHE II score was 21+/-8.9, and hospital mortality rate was 21%. Average ICU length of stay was 8.1+/-9.7 days; 64% were mechanically ventilated, with an average duration of 6.8+/-7.3 days. Delirium occurred in 66% during their ICU stay, with average duration of 4.6+/-5.1 days. Further, 28% of patients were deeply sedated or unarousable. While 47% of the patients received a continuous sedative infusion, only 27% received continuous narcotic infusion. Of those eligible, 68% received a SBT and 52% received a SAT. ICU PT consult rate was 71%; 46% got out of bed. **Conclusion:** The incidence of delirium was substantial in our ICU patients. The use of evidence based guidelines to reduce delirium is needed. We are implementing the ABCDE bundle to fulfill this need.

CT FOR ALL OR SELECTIVE APPROACH? WHO REALLY NEEDS A CERVICAL SPINE CT AFTER BLUNT TRAUMA

Therese M. Duane*, M.D., Andrew Young, Julie Mayglothling, Sean Wilson, William Weber, Luke Wolfe, Rao R. Ivatury*, M.D., Virginia Commonwealth University

Introduction: CT is the standard to screen blunt trauma patients for cervical spine (c-spine) fractures yet there remains a reluctance to scan all trauma team activations because of radiation exposure and cost. The purpose of this study was to identify predictors of positive CT in an effort to decrease future CT use without compromising patient care.

<u>Methods</u>: Prospective study in which we documented 18 combined NEXUS and Canadian c-spine criteria on 4256 patients prior to CT comparing those with and without fractures to identify predictors of injury. Clinical exam was considered positive if any of the 18 criteria were positive.

Results: There were 262 patients with a

fracture for an incidence of 6.2%. Fracture patients were older (yrs) $(43\pm19$ vs. 38 ± 17 , p<0.001) with a lower GCS $(13.5\pm3.5$ vs. 14.3 ± 2.3 , p<0.001) than non fracture patients. CE had a 100% (262/262) sensitivity, 0.63% (25/3994) specificity, 6.2% (262/4231) PPV, 100% (25/25) NPV. 77.8%(14/18) criteria were significantly associated with fracture by univariate analysis, 9 of which were independent predictors of fracture by logistic regression (table).

Predictors of Fracture	Odds Ratio	95% CI	p value
TTP midline	3.094	2.336-4.097	<0.0001
GCS<15	2.525	1.872-3.405	<0.0001
ETOH intoxication	1.389	1.034-1.865	0.0.290
Age > 65 years	2.261	1.530-3.341	<0.0001
Paresthesias	2.499	1.589-3.929	<0.0001
High speed MVC	1.362	1.019-1.822	0.0371
Rollover MVC	1.771	1.319-2.376	0.0001
Patient ejected	1.814	1.245-2.642	0.0019
Pt not sitting in ED	4.576	2.588-8.091	<0.0001

<u>Conclusion</u>: Although sensitive, the standard clinical criteria used to determine patients who need radiographs lack specificity. Based on these results more narrow criteria should be validated in an effort to limit the number of cervical spine CT's while not compromising patient care.

EARLY VENOUS THROMBOEMBOLISM PHARMACOLOGIC PROPHYLAXIS IS SAFE IN PATIENTS UNDERGOING OPERATIVE FIXATION OF TRAUMATIC SPINE INJURIES

Dennis Kim, Leslie Kobayashi, Dale Fortlage, Raul Coimbra*, M.D., Ph.D., University of California, San Diego Sponsor: Raul Coimbra*, M.D., Ph.D.

Introduction: Spine fractures are a known risk factor for venous thromboembolism (VTE). The level of injury, timing of operative fixation, and institutional VTE prophylaxis patterns as well as screening protocols may have an impact on the development and detection of this potentially preventable complication. We sought to determine if early administration (≤48 hours) of pharmacologic VTE prophylaxis is safe and effective post-spine surgery.

<u>Methods</u>: A 5 year retrospective review of a Level 1 trauma center registry to identify all patients that underwent operative fixation of spinal fractures. Patient demographics, injury patterns, timing and initiation of VTE prophylaxis including inferior vena cava (IVC) filter insertion, and timing and type of surgery were recorded. Multivariate analysis was used to identify independent predictors of VTE.

<u>Results:</u> 1,432 patients were admitted with spine fractures, of which 209 (14.6%) underwent operative fixation. 14 (6.7%) of these patients developed VTE. 127 (60.8%) of patients received pharmacologic prophylaxis within 48 hours following surgery. There were no significant differences in complications (bleeding, need for transfusion, epidural hematoma, progression of neurologic insult) between patients receiving early versus late VTE prophylaxis. Independent predictors of VTE included increasing age, cervical spine fractures, and associated spinal cord injury.

<u>Conclusion</u>: Early pharmacologic prophylaxis following spine surgery for traumatic injuries is safe and not associated with an increased risk of bleeding complications. Prospective evaluation of these findings may be warranted.

"TO TQIP, OR NOT TO TQIP: THAT IS THE QUESTION"

Jiselle Heaney, MD MPH, Chrissy Guidry, DO, John P. Hunt*, M.D., Peter Meade, MD MPH, Norman McSwain, Jr.*, MD., Juan Duchesne, MD, Tulane School of Medicine

Introduction: Trauma Quality Improvement Program (TQIP) reports that their current model for mortality prediction is feasible. We hypothesize that our institution's patient characteristics may differ from TQIP aggregate data questioning its national benchmark applicability.

<u>Methods</u>: One-year retrospective analysis at a Level 1 Trauma Center of all trauma activations for 2007. Data was analyzed using TQIP methodology for development of a mortality prediction model with multiple logistic regression. Patients were divided into three groups using TQIP methodology: blunt single system, blunt multi-system, and penetrating. Patient characteristics were compared to TQIP data.

<u>Results:</u> 457 patients met TQIP inclusion criteria of 1,351 trauma activations. Regarding TQIP mortality predictors, the OR for firearm injuries was a predictor of mortality which is inconsistent with our OR; 4.3 (CI 90% 3.2-5.7) vs 0.8 (CI 90% 0.3-1.9).

		•	
Characteristic	Index Institution	TQIP Aggregate	p value
Patients, N	457	15,801	
Age (yr), N (%)			
>65	17(3.7)	4,147 (26.2)	<0.01
Gender, N (%)			
Male	394(86.2)	10,402 (65.8)	<0.01
ISS, N (%)			
>24	92(20.1)	2461(15.6)	<0.01
Injury Type, N (%)			
Blunt	174 (38.0)	14,563 (92.2)	<0.01
Penetrating	283 (61.9)	1.238 (7.8)	< 0.01

Patient Characteristics Compared to TQIP Data

Conclusion: TQIP methodology from the pilot study may not be applicable to all institutions. TQIP needs to take into consideration region-specific trauma center profiles for more accurate mortality prediction.

EFFECT OF A DALTEPARIN PROPHYLAXIS PROTOCOL USING ANTI-FACTOR Xa CONCENTRATIONS AND DOSAGE ADJUSTMENTS ON VTE RATES IN TRAUMA PATIENTS

Bryce Robinson, D.Min, MFT, Kelly Besl, Dennis Hanseman, Jennifer Lemmink, Elizabeth Kramer, Helen Hancock, Krishna Athota, Peter Muskat*, M.D., Neil Ernst, Shaun Keegan, David Lutomski, Eric Mueller, University of Cincinnati

Introduction: Low anti-factor Xa concentrations may be associated with an increase risk of venous thromboembolism (VTE) in trauma patients receiving low-molecular weight heparin. We hypothesized a clinical VTE prophylaxis protocol utilizing anti-Xa concentrations and associated dalteparin dosage adjustment would reduce VTE rates.

Methods: Patients were followed prospectively 6 months pre (PRE) and post-protocol (POST) implementation. Patients with a risk assessment profile (RAP) score \geq 5 received dalteparin 5000 U daily. Lower extremity ultrasonography was performed on hospital day 4 and weekly thereafter. POST patients had anti-Xa concentrations collected 12-hrs after initial dalteparin dose. Anti-Xa <0.1 U/mL was defined as subtherapeutic and prompted every 12-hr dosing of dalteparin. Protocol groups were compared. Results: 432 PRE and 356 POST patients were identified. Age, gender, penetrating injury rate, ISS, chest, abdomen, and extremity AIS, RAP \geq 5 rate, PRBC transfusion rates, and mortality did not differ between groups. POST patients had a median ICU stay of 2 vs.1 days (p = 0.03) and a mean head AIS of 0.9 vs. 0.7 (p = 0.04). 72% of indicated POST patients had an anti-Xa collected; 51% were subtherapeutic. Among all patients, total VTE (7% vs. 13%, p = 0.009), acute VTE (7% vs. 12%, p = 0.02), deep vein thromboses (DVT) (6% vs. 12%, p = 0.007), and above-knee DVT rates (2% vs. 6%, p = 0.01) were lower in the POST group. Multivariate logistic analysis demonstrated younger age (OR 0.97) and higher weight (OR 1.02) as risks for anti-Xa <0.1 U/mL.

Conclusion: A significant proportion of high-risk trauma patients were subtherapeutic with the use of daily dalteparin. A protocol adjusting dalteparin dosage based on anti-Xa concentration was associated with reduced VTE rates.

EVIDENCE FOR THE OPTIMAL MULTIVARIABLE RISK ADJUSTMENT MODEL FOR PREDICTING TRAUMA MORTALITY: SETTING THE STANDARD FOR ANALYSIS OF DATA IN THE NTDB

Adil Haider*, MD, MPH, Zain Hashmi, Syed Nabeel Zafar, Renan Castillo, Elliott Haut*, MD, Eric Schneider, Edward E. Cornwell, III*, M.D., Ellen J. MacKenzie*, Ph.D., David T Efron*, MD, Johns Hopkins School of Medicine

Introduction: Lack of a standardized approach to develop multivariable risk adjustment models has led to wide variations in the quality of research published from the National Trauma Data Bank (NTDB). Our objective is to identify a minimal essential combination of variables that would yield an accurate multivariable mortality prediction model in the NTDB.

<u>Methods:</u> Independent associations between mortality and 109 unique variables in NTDB 2009 were tested using simple regression. Those with significant associations were then introduced into multivariable logistic regression models with mortality as the outcome. The most discriminating model was identified using the Area Under the Receiver Operator Curves (Au-ROC). Bootstrapping with 500 repetitions was used to obtain 95% confidence intervals. Backwards stepwise regression was then used to trim variables and identify a reduced model with statistically equivalent Au-ROC. All analyses reproduced in NTDB 2010. Utility of multiple imputation for missing data and clustering for center effects was also investigated. <u>Results:</u> 661,728 patients analyzed. 59 variables were associated with mortality. Table below presents the best prediction and "trimmed" models:

Model with best possible AuROC = 0.961 (95% Cl: 0.959, 0.962)	Age, Gender, Race, Injury Type, Injury Mechanism, Hypotension, GCSmotor, Pulse, ISS, Length of stay, Admission to ICU, Need for Ventilator support, Trauma Center Level, Insurance & Any Inpatient Complication			
Equivalent Trimmed model AuROC = 0.960 (95%Cl:0.958, 0.961)	Age, hypotension, GCSmotor, Pulse, ISS, Ventilator support			
Multiple Imputation did not significantly improve model performance, however clustering by facility did. Model Perfomance was identical in NTDB 2010				

<u>Conclusion</u>: A 6 variable model that includes pulse and ventilator support predicts mortality as well as more comprehensive models. These data suggest a minimal set of variables that are integral while analyzing the NTDB.

TIMING OF ENOXAPARIN AFTER BLUNT LIVER AND SPLEEN INJURIES: A MULTI-INSTITUTIONAL REVIEW

Jon Simmons, Justin Manley, Jack Rostas, Naveed Ahmed*, M.D., Sid Brevard, Richard Gonzalez*, M.D., John M. Porter*, M.D., University of South Alabama Sponsor: John M. Porter*, M.D.

Introduction: : Anti-coagulation is routinely given to all trauma patients due to the high incidence of thrombotic complications. However, the timing of administration of anticoagulation is not clearly defined when patients have blunt spleen or liver injuries due to the high risk of hemorrhage. **Methods:** : A multi-institutional retrospective chart review was performed of all blunt trauma patients who suffered blunt liver or spleen injuries during the 5-year period. Data was collected for all patients receiving non-operative therapy for these injuries while also receiving routine prophylactic anti-coagulation with enoxaparin. Patients were separated into groups based on the initiation of enoxaparin therapy after injury: early (<48 hrs), mid (48-72 hrs) and late (>72 hrs). Primary outcomes were designated as: need for operative intervention secondary spleen or liver hemorrhage by grade of injury, number of transfusions, and other hemorrhagic and thrombotic complications.

<u>Results:</u> Two-hundred seventy-two patients were identified. Patients in the early, mid, and late group received an average of 0.9, 0.93, and 1.55 units of blood after the initiation of enoxaparin, respectively. Average spleen and liver grades were not significantly different among the three groups. There was one pulmonary embolism (PE) in the early group, and three thombotic complications in the late group (one DVT and 2 PE's). There were no enoxaparin-related hemorrhages necessitating operative intervention, or other significant hemorrhagic complications.

<u>Conclusion</u>: There are currently no standards for the initiation of prophylactic anti-coagulation in trauma patients with blunt liver and spleen injuries. Early administration may be safe and may reduce the incidence of thrombotic complications in blunt spleen and liver injuries. Prospective studies in this area are warranted.

BODY MASS INDEX AS DOSE-DEPENDENT RISK FACTOR FOR POOR OUTCOMES IN OBESE TRAUMA PATIENTS

Fan Yang, medical student, Jason Sperry*, Louis Alarcon*, Raquel Forsythe*, Gregory Watson, Timothy R. Billiar*, M.D., Andrew Peitzman*, Mazen Zenati, University of Pittsburgh Sponsor: Andrew Peitzman*,

Introduction: Obesity affects many aspects of injury and the care of trauma patients, but current understanding of these effects is incomplete and conflicting. This study investigates body mass index (BMI) as an independent predictor for poor clinical outcome in obese trauma patients. Methods: A retrospective analysis over ten years was performed. Data were analyzed in groups as normal/overweight, obese and morbidly obese based upon BMI. Multivariate logistic and negative binomial regressions were used. Results: There were 1307 patients (49.4% males; mean age 50.7±17.2; ISS 12.6±10.1), labeled as obese in our trauma registry. According to BMI records (mean; 39.4±9.3), 160 patients were found normal/overweight (BMI>20 &<30), 595 were obese (BMI \geq 30 &<40), and 522 were morbidly obese (BMI≥40). There were significant differences in age, gender, and ISS between these categories (p<0.05 for each). Overall mortality was 3.83% (n=50) with significant differences (7.5% vs. 2.9% vs. 3.8%, p<0.05). Upon adjusting for age, sex, and ISS a dose dependent effect of BMI on mortality has been observed in the total cohort and in group of BMI≥30. (BMI>20: OR 1.037, p<0.05; BMI>30: OR 1.07, p<0.001). Similarly with ICU length of stay BMI>20: IRR 1.02, p<0.005; BMI>30: IRR 1.02, p<0.05. No significant effects were observed between BMI and number of in-hospital complications, or total procedures performed. However, increasing BMI was associated with decreased of abdominal procedures (IRR 0.96, p<0.001) and increased orthopedic procedures (IRR 1.01, p<0.05).

Conclusion: BMI is an independent risk factor for increased mortality and ICU length of stay in obese trauma patients. BMI may contribute to poor outcomes through affecting injury severity, injury response, pre-admission management, or in-hospital care. BMI has a considerable health care burden in obese trauma patients.

ONCE VERSUS TWICE WEEKLY DEEP VENOUS THROMBOSIS SURVEILLANCE IN THE INTENSIVE CARE UNIT: A COMPARATIVE STUDY

Ajai Malhotra*, M.D., Laura McLay, Stephanie Goldberg, Nancy Malhotra, Michel B. Aboutanos*, M.D., M.P.H., Therese M. Duane*, M.D., Julie Mayglothling, James Whelan, Christopher Borchers, Rao R. Ivatury*, M.D., Virginia Commonwealth University

Introduction: The benefits and cost-effectiveness of deep venous thrombosis (DVT) surveillance in the intensive care unit (ICU) are debated. Previously we presented data showing that twice weekly surveillance (TWS) increases DVT detection, reduces pulmonary embolism (PE) and is cost effective (AAST 2008). The current study tests the hypothesis that once weekly surveillance (OWS) is as effective as TWS.

<u>Methods</u>: All traumatized ICU patients underwent OWS by lower extremity duplex examination (2008-11). The rates of DVT and PE were recorded and compared with rates observed with TWS (2004-07) and no surveillance (NS: 2001-03). Additionally, total per patient cost (diagnostic, therapeutic and surveillance) in the 3 periods was compared.

<u>Results:</u> Results: A total of 7558 patients were evaluated (NS – 1422; TWS – 2812; OWS – 3324). The rate of detection of DVT was significantly higher with TWS (78/2812 – 2.8%) and OWS (91/3324 – 2.7%) as compared to NS (18/1422 – 1.3%) – p<0.05 for both. The incidence of PE was significantly lower with TWS (21/2812 – 0.7%) as compared to NS (22/1422 – 1.5%) – p<0.05. With OWS,



while the PE rate was lower (33/3324 - 1.0%) than with NS, it did not reach statistical significance (p>0.05). The per patient cost was \$222 (NS), \$483 (TWS) and \$281 (OWS).

<u>**Conclusion:**</u> The current study suggests that, as compared to TWS, OWS is less expensive, equally effective in increasing DVT detection but NOT as effective in reducing PE incidence.

SURGICAL TRIAGE OF THE 'FOUND DOWN' PATIENT

Matthew Kutcher, Abigail Evans, Britt Redick, Alicia Privette, William P. Schecter*, M.D., Mitchell Jay Cohen*, M.D., University of California, San Francisco Sponsor: William P. Schecter*, M.D.

Introduction: Rational use of trauma center resources requires careful triage, particularly in patients with an unclear mechanism of injury. We investigated the epidemiology of patients 'found down' to assess current triage practices. **Methods:** We retrospectively identified 121 patients found unresponsive with no clear mechanism of injury ('found down') from 10/07–7/11 using emergency department (ED) triage logs. Injuries, medical diagnoses, and outcomes were identified by chart review and confirmed by billing codes.

<u>Results:</u> In 121 patients found down, 33.3% had prehospital signs of trauma and 48.1% had ED-identified injuries; 7.4% required urgent surgery. Prior ED visits, homelessness, and psychiatric disease were strikingly common. Trauma patients were younger, more

commonly male, and more likely intoxicated (Table). Medical patients had higher mortality and more common cardiac and respiratory arrests in the field. 16.9% of medical patients

	Trauma	Medical	P-value
	(N=25)	(N=96)	
Age*	45.1±19.8	57.2±17.4	0.008*
Male gender*	88.0%	57.3%	0.005*
Prior ED visits	56.0%	55.8%	1.000
Homeless	16.7%	25.0%	0.590
Psychiatric history	29.2%	36.0%	0.631
Alcohol use*	71.4%	18.9%	<0.001*
Substance use	9.5%	27.4%	0.098
Signs of trauma*	95.7%	16.5%	<0.001*
Traumatic injury	85.7%	38.8%	<0.001*
Urgent surgery	12.0%	6.2%	0.390
Cardiac arrest*	4.2%	24.1%	0.040*
Respiratory arrest*	4.2%	29.2%	0.013*
Mortality*	8.0%	37.5%	0.004*

required trauma consultation and 6.0% were admitted to the trauma service. 18.2% of trauma patients required medical consultation and 11.8% were admitted to a medicine service. Triage and admitting service were discordant in 7.1% of admissions. Overall, 27.3% of patients had injuries requiring trauma admission or consultation.

Conclusion: 27.3% of 'found down' patients had clinically significant injury, with 7.4% requiring urgent surgery. Triage flexibility and early trauma consultation are critical to avoid missed injury in this population.

EFFICIENCY OF A FOUR-ITEM PTSD SCREEN IN TRAUMA PATIENTS

Jessica Hanley, Terri deRoon-Cassini, Ph.D., Karen J. Brasel*, M.D., M.P.H., Medical College of Wisconsin

Introduction: One of the most common barriers identified by physicians who fail to screen for PTSD is time constraint. We hypothesized the 4-question PC-PTSD was an efficient screening alternative.

<u>Methods</u>: Consecutive trauma patients admitted to a Level I trauma center were given the PCLC at time of hospitalization. The 4 questions of the PC-PTSD are contained within the PCLC. A positive PC-PTSD screen was described as an endorsement of least 3 of the 4 questions. A positive PCLC screen was defined as an overall score >44 (PCLC >44) or endorsement of questions corresponding to DSM IV criteria (PCLC-DSM). In both PC-PTSD and PCLC-DSM, endorsement was defined at two unique cutoffs: a PCLC answer ≥ 2 or ≥ 3 . Comparisons were made between the PCLC >44, PCLC -DSM, and PC-PTSD using the cutoffs of 2 and 3.

<u>Results</u>: Data were collected from 1347 patients. PCLC-DSM with a cutoff of 2 identified the largest number of patients with PTSD symptoms (27.25%), compared to PC-PTSD with a cutoff of 2 (17.22%) and PCLC >44 (16.10%). PC-PTSD analyzed at 2 had similar specificity when compared to PCLC >44 and PCLC-DSM with a cutoff of 3. However, sensitivity was diminished overall when a cutoff of 3 was used for PC-PTSD.

Hospitalization	PCLC>	44 (%)	PCLC-DSM* (%) PCLC-DS		SM# (%)	
(n=1347)	Sensitivity	Specificity	Sensitivity	Specificity	Sensitivity	Specificity
PC-PTSD *	72.35	93.36	55.04	96.94	72.99	93.13
PC-PTSD#	54.84	98.32	34.60	99.08	54.84	86.76
* Endorsement defined as PCLC answer ≥ 2 # Endorsement defined as PCLC answer ≥ 3						

<u>Conclusion</u>: In trauma patients prior to discharge, PC-PTSD is comparable to the PCLC >44 using a cutoff of 2. Although some sensitivity is lost, this may be offset by an increased frequency of administration.

IMPACT OF PERCEPTION OF INJURY SEVERITY ON QUALITY OF LIFE

Angie Geiger, Terri deRoon-Cassini, Ph.D., Karen J. Brasel*, M.D., M.P.H., Medical College of Wisconsin Sponsor: Karen J. Brasel*, M.D., M.P.H.

Introduction: Patient's perception of injury severity differs significantly from assigned Injury Severity Scores (ISS). The purpose of this study was to assess how perceived injury severity relates to quality-of-life (QoL).

<u>Methods</u>: Prior to discharge, 119 consecutive trauma patients rated the severity of their injury and provided a reason, which was categorized as optimistic, pessimistic, or neutral. Patients were also given the Post-traumatic Stress Disorder Checklist (PCL-C), SF-36, and perceived threat-to-life questions. Data were analyzed using ANOVA, and Spearman's correlation coefficient.

<u>Results:</u> Perceived injury severity was classified as mild by 10.8%, moderate by 21.7%, severe by 46.7%, and very severe by 20.8%. ISS did not correlate with perceived injury severity (p = 0.054). Pessimistic appraisers and patients with higher perceived injury severity scores had significantly poorer mental QoL, higher PCL-C scores, and higher perceived threat-to-life scores.

	Pessimistic	Neutral	Optimistic	F/χ ²	p-value
PCL-C Mean	33.2	30.1	24.6	5.711	0.005
Mental QoL Mean	48.1	48.6	56.3	5.281	0.008
Threat-to-Life Mean	7.4	6.3	4.8	5.48	0.006

<u>Conclusion</u>: Perceived injury severity can be used to identify potentially modifiable risk factors to improve quality of life.

RESUSCITATIVE THORACOTOMY FOLLOWING WARTIME INJURY

Jonathan Morrison, Lorne Blackbourne*, Jeff Garner, Mansoor Khan, Mark Midwinter, Henrietta Poon, US Army Institute of Surgical Research

Introduction: The evidence for resuscitative thoracotomy (RT) in trauma patients following wartime injury is limited; its indications and timings are less defined in battle injury. The aim of this study is to analyze survival, the causes and times of death in patients undergoing RT within the context of modern battlefield resuscitation.

Methods: A retrospective cohort study was performed on consecutive admissions to a Field Hospital in Southern Afghanistan. All patients undergoing RT were identified using the UK Joint Theatre Trauma Registry (JTTR). The US JTTR was also used to obtain complete follow-up on US patients. The measured primary outcome was 30-day mortality at and secondary data points included location of cardiac arrest, time from arrest to thoracotomy and proportion achieving a return of spontaneous circulation. **Results:** Between April 2006 to March 2011, 65 patients underwent RT with 14 survivors (21.5%). Ten (15.4) patients arrested in the field with no survivors, 29 (44.6%) arrested en-route with 3 survivors and 26 (40.0%) arrested in the Emergency Department (ED) with 11 survivors. There was no difference in injury severity scores (ISS) between survivors and fatalities (27.3 \pm 7.6 vs 36.0 \pm 22.1; p = 0.636). Survivors had a significantly shorter time to thoracotomy than fatalities (6.15 \pm 5.8 mins vs 17.7 \pm 12.63 mins; p < 0.001).

<u>Conclusion</u>: RT following combat injury will yield survivors. Best outcomes are in patients who arrest in the ED or on admission to the hospital.

CREATION OF A QUALITY IMPROVEMENT TOOL FOR THE PREVENTION OF UNPLANNED INTUBATIONS IN TRAUMA PATIENTS

Dennis Kim, Leslie Kobayashi, David Chang, Dale Fortlage, Raul Coimbra*, M.D., Ph.D., University of California, San Diego Sponsor: Raul Coimbra*, M.D., Ph.D.

Introduction: The development of respiratory failure requiring an emergent unplanned intubation (UI) is a potentially preventable complication associated with increased morbidity and mortality. It has been suggested that UI may serve as an outcome measure for quality improvement and patient safety initiatives, and UI is currently tracked by the Trauma Quality Improvement Program (TQIP). We developed a clinical risk index to predict UI among stable trauma patients.

Methods: We performed a 3 year retrospective analysis of our Level 1 trauma center registry. Patients intubated in the field or upon arrival were excluded. Patients in the UI group were compared to those never requiring intubation to identify risk factors for UI. An additive risk index was created based on logistic regression using readily available data including patient demographics, comorbidities, and injury pattern. A threshold value for UI was identified as the score at which gain of certainty was maximized. **Results:** Of 7,552 patients analyzed, 967 (12.8%) patients required intubation. Of these, 55 (5.7%) patients underwent UI. The final index was composed of 10 risk factors with a score range between 0 and 12: age 55-64; age \geq 65; male sex; admission GCS 9-13; seizure disorder; COPD; TBI; \geq 4 rib fractures; spine fractures; and long bone fractures. The index has a c-statistic of 0.868 (95% CI 0.820-0.928). The threshold for an unplanned intubation was 4. The sensitivity and specificity of the index using a cutoff value of 4 are 86.0% and 76.6%.

<u>Conclusion</u>: A simple, user friendly bedside risk index derived from readily available clinical data can identify patients at risk for UI. Patients with a score \geq 4 are at a high risk for respiratory failure and may benefit from more intense observation, the institution of aggressive measures to optimize pulmonary function, and a low threshold for early intubation.

Poster 104 POSTER WITHDRAWN

MAINTAINING SIGNS OF LIFE FROM FIELD TO TRAUMA CENTER: A KEY LINK IN THE CHAIN OF SURVIVAL

Catherine Velopulos, MD, Jason Norman, Eric Schneider, PhD, Nikhilesh Ray-Mazumder, BS, David T. Efron*, M.D., Adil Haider*, MD, MPH, Elliott Haut*, MD, Johns Hopkins University School of Medicine Sponsor: Elliott Haut*, MD

Introduction: Debate continues over prioritizing time versus interventions in the pre-hospital setting. We examine the impact of pre-hospital time and interventions on Emergency Department (ED) arrival with signs of life (SOL) among severely injured urban penetrating trauma patients. **Methods:** We retrospectively reviewed all penetrating trauma deaths from January 2009 to July 2011, using our trauma registry, chart review of prehospital data, Morbidity and Mortality minutes, and autopsy results. **Results:** Of the 138 total penetrating trauma deaths, 35 (25%) had SOL documented on EMS arrival. Patients who maintained SOL to the ED had a 30% shorter scene time, significantly fewer interventions, and were significantly more patients maintained SOL (94% vs. 35%, p=0.0009) when scene time was shorter than vs. longer than ten minutes.

	Maintained to ED	Lost prior to ED	P value
Distance (miles)	1.54 +1.08	2.06 +1.42	0.240
Scene Time (minutes)	10 +5.22	15 <u>+</u> 3.69	0.0059
Total Prehospital Time (min)	21 <u>+</u> 6.90	28.8 +4.83	0.0017
155	29 <u>+</u> 13.6	31 <u>+</u> 16.3	0.670
ED Thoracotomy	43% (N=10)	58% (N=7)	0.6315
Location of Death			
ED	22% (N=5)	75% (N=9)	0.0038
OR	43% (N=10)	8% (N=1)	0.0552
ICU	35% (N=8)	17% (N=2)	0.4340
Isolated Brain Injury	22% (N=5)	25% (N=3)	1.0000
Brain Death in ICU	80% (N=4/5)	67% (N=2/3)	1.0000
Field Procedures:			
Intubation Attempted	22% (N=5)	67% (N=8)	0.0134
≥3 Failed IV Attempts	13% (N=3)	75% (N=9)	0.001
Spine Immobilization	65% (N=15)	42% (N=5)	0.3297

<u>**Conclusion:**</u> For urban penetrating trauma victims, small increases in scene time correlate with large increases in loss of signs of life prior to ED arrival. This delay may decrease the chance of patients proceeding to definitive therapy in the operating room or ICU, potentially breaking a key link in the chain of survival for severe penetrating trauma patients.

VALIDATION OF A NEW TRAUMA SPECIFIC QUALITY OF LIFE MEASURE

Karen J. Brasel*, M.D., M.P.H., Terri deRoon-Cassini, Ph.D., Medical College of Wisconsin

Introduction: Optimal quality of life (QoL) measurement requires both a generic and disease specific measure of QoL, but no disease specific QoL measure exists for traumatic injury. We describe the development and pilot of a trauma-specific QoL instrument.

<u>Methods</u>: Instrument questions were developed from structured focus groups with trauma survivors. Common themes were identified from transcripts. Questions were generated from the themes. The final 59-item questionnaire was piloted in a cross-sectional cohort study of 247 community level 1 trauma center survivors. Exploratory factor analysis (EFA) was used to evaluate and validate the items and measure.

<u>Results:</u> Participants were mostly male (64%) and Caucasian (76%). The EFA identified 7 primary domains explaining 58% of the variance (50 items retained), providing the most parsimonious model of the data.

Domains	# of It Items	e <u>fræctor</u> Loading	<u>Representativeltem</u>
Psychological distress	20	.56 (.3077)	My mood is worse
Work	6	.89 (.6396)	I have lost my job
Trauma event	7	.58 (.3172)	I felt fear when injured
Coping	4	.60 (.3572)	I have been able to handle my limitations
Pain	3	.76 (.7577)	Pain limits what I do
Dependence	5	.47 (.3658)	I need help walking
Posttraumatic growth	5	.43 (.3648)	I have forgiven what caused the injury

Conclusion: This disease-specific measure covers 7 unique domains identified by patients as important aspects of post-injury QoL that are not assessed with generic QoL measures. The results of this analysis support the initial use of a new trauma QoL measure specific to injured patients.

ADMISSION VENOUS LACTATE MEASUREMENTS IN GERIATRIC TRAUMA PATIENTS SIGNIFICANTLY REDUCES MORTALITY THROUGH EARLY RECOGNITION OF OCCULT HYPOPERFUSION

Kristin Salottolo, Patrick Offner*, Charles Mains, Alessandro Orlando, Pamela Bourg, David Bar-Or, St. Anthony Hospital Sponsor: Patrick Offner*,

Introduction: Optimal triage and care of the elderly trauma patient remains difficult with frequent failure to appreciate injury severity and its physiologic consequences. Measuring admission venous lactate may facilitate recognition and early treatment of occult hypoperfusion (OH) and shock. We instituted a geriatric trauma resuscitation protocol that used serial lactates and early trauma surgeon involvement. Our study objective was to determine if implementing the geriatric protocol decreased mortality in patients with OH. **Methods:** All trauma patients age ≥ 65 admitted to our level 1 trauma center from 10/1/2008 - 9/30/2011 were identified (n=1,949). OH was defined as elevated lactate ≥ 2.5 mMol with normal SBP (> 90 mm Hg) and HR (< 120 bpm) in the ED. We examined quarterly mortality rates post-geriatric protocol using a simple linear regression model fitted with a polynomial term to determine the effect of early recognition of OH on mortality.

<u>Results:</u> Overall mortality was 4.5%. Admission venous lactate was collected in 73.0% of patients; 14.5% had OH and 58.5% had normal perfusion status. In patients with OH, a significant decrease in mortality was observed by quarter after the protocol was implemented (r2=0.59, p=0.02). A similar decrease in quarterly mortality rates in patients with normal perfusion status was not seen (r2=0.14, p=0.50), corroborating that early identification and treatment of OH resulted in reduced mortality post-protocol. The absolute risk reduction of mortality post-protocol in patients presenting with normal SBP and HR was 3.6%, equating to a number need to treat of 28 geriatric trauma patients to prevent one death.

<u>Conclusion</u>: Early identification and treatment of OH in elderly trauma patients using venous lactate significantly decreases mortality. We recommend incorporating admission venous lactates to improve the care of geriatric trauma patients.

IS CAROTID ULTRASOUND FOR SYNCOPE WORTH THE COST?

Jonathan Scott, Jonathan Gates, Marie Gerhard-Herman , Joaquim Havens, Brigham and Womens Hospital Sponsor: Edward Kelly*, M.D.

Introduction: Syncope is a common precipitating factor for trauma. Syncope related US hospitalizations cost an estimated \$2.4 billion annually. Carotid artery duplex ultrasound (CDUS) is often a part of the initial work up of syncope, although several studies suggest a low diagnostic yield for this indication. We aim to determine the potential cost savings attributable to better patient selection for CDUS in the setting of syncope.

<u>Methods:</u> We retrospectively reviewed all CDUS performed for syncope at our Level I trauma center from 2006 through 2010. Chart reviews were then performed to identify symptoms attributable to carotid artery stenosis at presentation and associated risk factors. Primary end points were surgical intervention for stroke risk reduction (endarterectomy or stenting). Secondary endpoints were changes in medical risk reduction therapy.

<u>Results:</u> Among the 388 patients identified who underwent CDUS for syncope, 46 (11.9%) presented with symptoms attributable to the anterior cerebral circulation, 92 (23.7%) had risk factors that met SVS guidelines for screening, 28 (7.2%) had a history of carotid stenosis, and 222 (57.2%) underwent CDUS for syncope without other criteria. The incidence of stenosis >50% among each subgroup was 23.9%, 25.0%, 57.1%, and 8.1%, respectively. Among the 222 patients with 'syncope alone', 4 had their medications adjusted and 1 patient underwent endarterectomy for asymptomatic carotid stenosis. Applying the current charge of \$1,728 per ultrasound, the cost required to encounter one patient in the 'syncope alone' subgroup who would benefit from carotid endaretectomy was \$383,616. <u>**Conclusion:**</u> Performing carotid ultrasound for the indication of syncope without other risk factors represents a significant allocation of health care dollars with minimal patient benefit. Careful selection criteria for patients that could benefit from CDUS could improve care and reduce expenses.
IMPACT OF EARLY INITIATION OF ANTITHROMBOTIC THERAPY FOR BLUNT CEREBROVASCULAR INJURY ON OUTCOME IN PATIENTS WITH CONCOMITANT TRAUMATIC BRAIN INJURY OR SOLID ORGAN INJURY

Ashley Hendrix, M.D., Louis J. Magnotti*, M.D., Jordan Weinberg*, M.D., John Sharpe, M.D., Timothy C. Fabian*, M.D., Martin Croce*, M.D., University of Tennessee Health Science Center - Memphis

Introduction: Few injuries have caused as much debate with respect to management as blunt cerebrovascular injury (BCVI). In fact, optimal management of BCVI in the presence of concomitant traumatic brain injury (TBI) or solid organ injury (SOI), specifically with respect to the use of antithrombotic (antiplatelet or heparin) therapy (AT), remains controversial. The purpose of this study was to evaluate the impact of early initiation of AT on outcome in patients with both BCVI and TBI and/or SOI.

<u>Methods</u>: Patients with BCVI and concomitant TBI and/or SOI over 4.5-years were identified. AT (aspirin and/or clopidogrel or heparin) was instituted in all patients after diagnosis of BCVI. Cessation of AT, worsening TBI, need for delayed operative intervention, ischemic stroke and mortality was recorded and compared.

<u>Results:</u> 86 patients (58 TBI, 17 SOI and 11 combined) with 112 BCVI were identified: 59 carotid, 44 vertebral and 9 combined injuries. 13 (14%) patients had strokes present at arrival. 51% were treated with heparin drips (PTT 40-60 s). 72% received aspirin and 53% clopidogrel. No patient required cessation of AT. There was no difference in risk of worsening TBI (12% vs 10% with no BCVI) or need for delayed operative intervention for SOI (10% vs 7% with no BCVI). One patient with TBI required delayed operative intervention. 2 (2.1%) patients developed strokes after BCVI diagnosis. Mortality was 11%.

<u>Conclusion</u>: Initiation of early AT for patients with BCVI and concomitant TBI or SOI is appropriate. AT does not risk worsening of either TBI or SOI in patients with BCVI. In fact, prompt treatment with either antiplatelet or heparin therapy remains the mainstay for prevention of stroke-related morbidity and mortality in these patients.

IMPACT OF AIRLINE TRAVEL ON OUTCOME IN NHL AND NFL PLAYERS IMMEDIATELY POST CONCUSSION: INCREASED RECOVERY TIMES

David Milzman, Dave Weiner, Georgetown University

Introduction: Air travel may be associated with unmeasured neurophysiological changes that may impact post-concussion recovery. No study has compared impact of commercial air travel on acute concussion injuries despite rather obvious decreased oxygen tension and increased dehydration impact on acute mTBI. Objectives: Is air travel within 4-6 hours of concussion associated with increased recovery time in professional (NHL) (NFL) players.

<u>Methods</u>: Prospective cohort study of all active-roster NHL and NFL players during the 2010-2011 seasons. Internet website review of League sites for injury identification of concussive injury and when player returned to play solely for mTBI. Team schedules and flight times included only players who flew immediately following game (within 4-6 hr).

<u>Results:</u> In the 2010-2011 seasons, 223 players experienced a concussion:NFL-122(7.2%) and NHL-101(13.0%) (percent of total players). Of these, 68 NFL (57%) and 39 NHL (39%) concussed players flew within 6 hours of the incident injury. Mean distance flown was shorter for NFL: 850 miles(SD 576) VS. NHL 1060(SD 579). Mean games missed for NFL and NHL players who traveled by air immediately after concussion was increased by 29% and 24% (respectively) than those who did not travel by air: NFL-Fly 3.8 games missed(SD 2.2) VS. No Fly 2.6(SD 1.8) and NHL-Fly 16.2 games missed(SD 22.0) VS.No Fly 12.4 (SD 18.6); p < 0.03.

<u>Conclusion</u>: This is initial report of an increased rate of recovery in terms of more games missed. The obvious changes of decreased oxygen tension , decreased humidity with increased dehydration and duress of travel accompanying pressurized airline cabins all likely increase the concussion penumbra in acute mTBI. Early air travel post concussion should be further evaluated and likely postponed 48-72 hr. until initial symptoms subside.

EXOGENOUS GHRELIN TREATMENT PREVENTS NEURONAL DEGENERATION AND IMPROVES NEUROCOGNITIVE FUNCTION FOLLOWING TRAUMATIC BRAIN INJURY

Nicole Lopez, M.D., Lindsey Gaston, Todd Costantini, M.D., Brian Eliceiri, PhD, Ann-Marie Hageny, B.S., Raul Coimbra*, M.D., Ph.D., Vishal Bansal*, M.D., University of California, San Diego

Introduction: Recent clinical trials have administered hormones, such as progesterone, to modulate the post-TBI inflammatory response. The hormone ghrelin has been shown to be neuroprotective following TBI. We have shown that ghrelin following TBI prevents neuronal injury, blood brain barrier dysfunction and apoptosis 24 hours after injury. We hypothesize that ghrelin will prevent neuronal degeneration and improve neurocognitive function following TBI.

<u>Methods</u>: A weight drop model was used to create severe TBI. Balb/c mice were divided into 3 groups: Sham, TBI and TBI + Ghrelin ($20 \mu g$). Brain tissue was harvested at 1 hour, 1 day and 7 days post-TBI. H&E was used to evaluate injury and cortical volume loss. Neuronal degeneration was assayed using Fluoro-Jade B. Using a beam-walk test, measuring foot-faults, neurocognition was assessed on post-injury days 1, 3, and 7.

<u>Results:</u> Compared to sham, TBI animals had cortical volume loss of 71.4 \pm 31.4 mm3 at day 7. Ghrelin treatment prevented volume loss compared to TBI alone (19.4 \pm 9.8 mm3; p<0.05). TBI brains had increased Fluoro-Jade B staining for neuronal degeneration, with maximum difference at day 1. TBI + G animals had staining patterns similar to sham. Compared to sham (0), TBI animals had an increase in foot faults (2.8 \pm 0.4) in all days with the greatest difference at day 1 and continued deficits at day 7 (p<0.001). TBI + G animals had decreased foot faults (0.4 \pm 0.6) compared to TBI on day 1 with continued protection up to day 7 (p vs. TBI <0.001; p vs. sham=NS). **Conclusion:** Ghrelin treatment prevented post-TBI cortical volume loss, neurodegeneration and improved neurocognitive function. The mechanisms is unclear, however a combination of ghrelin's anti-apoptotic and inflammatory modulatory effects may play a role. Further studies delineating these mechanisms are warranted.

TIMING OF INTRACRANIAL HYPERTENSION FOLLOWING SEVERE TRAUMATIC BRAIN INJURY

Deborah Stein*, Megan Brenner, Peter Hu, Xian Shu Zhu, Lynn Stansbury, Bizhan Aarabi, Thomas M. Scalea*, M.D., R Adams Cowley Shock Trauma Center

Introduction: Intracranial hypertension (ICH) and cerebral hypoperfusion (CH) worsen outcome after severe traumatic brain injury (sTBI). There is little objective data that describe when these occur. We objectively evaluated the timing of ICH and to see if there were differences in patients with good vs. poor outcome.

Methods: Patients with head AIS>3, age>14 years, and need for intracranial pressure (ICP) monitoring were prospectively enrolled over 2 years. Continuous, automated, digital data was collected every 6 seconds and 5 minute means were calculated for the duration of monitoring. ICPs were captured over 12-hour time periods from admission through hospital day 7. Outcome was measured by Extended Glasgow Outcome Scale (GOSE) or dichotomized functional evaluations at least 3 months after injury. **Results:** 207 patients were enrolled. Mean age was 39 years (range 16-84), mean admission GCS 6.8 \pm 3.6, mean head AIS 4.3 \pm 0.7, and mean Marshall score 2.6 \pm 0.8. The in-hospital mortality was 21.7%, with 29 (14%) dying from sTBI. Of the 162 survivors, 123 had functional evaluations. 95 had good functional outcome (77%). Mean highest PTD (Pressure Time Dose) >20 and >30 occurred at 0-12 (26.9 mmHg*h, 9.6), 84-96 (28.4, 10.3), and 144-156 (33.1, 16.2) hours. When stratified by functional outcome, survivors demonstrated dramatically different temporal patterns of ICP elevation, with the first 84 hours being nearly indistinguishable between the 2 groups. Conclusion: Although early ICH occurs, ICPs are highest later in the hospital course than traditionally described. Patterns of ICP elevation are the same in the first 3-4 days but then differ significantly based on outcome. Understanding the temporal nature of secondary insults has significant implications into developing more evidenced-based management approaches.

ARRIVAL HYPEROXEMIA DOES NOT EFFECT MORTALITY IN INTUBATED PATIENTS WITH TRAUMATIC BRAIN INJURY

Keir Warner, Joseph Cuschieri^{*}, M.D., Daniel Davis, Ronald V. Maier^{*}, M.D., Giye Choe, Eileen M. Bulger^{*}, M.D., University of Washington

Introduction: Emerging evidence suggests that hyperoxemia is associated with worse outcome in traumatic brain injury (TBI). We hypothesized those patients with hyperoxemia and TBI would have worse outcome compared to those with normoxemia.

<u>Methods:</u> We analyzed prospective data characterizing oxygen levels (Hypoxemia [PaO2<110mmHg], Normoxemia [110-487mmHg] and Hyperoxemia [>487mmHg]) in intubated head injured patients transported directly to our trauma center. Logistic regression was used to adjust for differences between the groups and elicit independent predictors of mortality after TBI.

<u>Results:</u> Univariate analysis of 449 patients demonstrated a higher mortality rate in hypoxemia (47%), compared to normoxemia (27%) or hyperoxemia (11%) (p<0.01). Independent predictors of mortality included age, ISS, systolic hypotension (SBP <90mmHg), hypocapnea, and hypercapnea. While hypoxemia was associated with increasing mortality, hyperoxemia was not.

Logistic Regression for Mortality				Table 1
Variable	N=	Odds Ratio	95% CI	p-value
Age	n=499	1.04	1.03-1.05	p<0.001
Injury Severity	n=499	1.05	1.03-1.07	p<0.001
ER Hypotenstion	n=178	2.14	1.32-3.46	p=0.002
Targeted Ventilation	n=194	0.41	0.25-0.68	p=0.001
Hypoxemia	n=92	1.83	1.05-3.19	p=0.032
Hyperoxemia	n=35	0.58	0.18-1.88	p=0.359

<u>Conclusion</u>: The presence of hyperoxemia on arrival to the trauma center was not associated with worsened outcomes after TBI in patients who were intubated prior to arrival.

LONG-TERM FOLLOW UP OF A NON-TRANSFER PROTOCOL FOR MILD TRAUMATIC BRAIN INJURY WITH SMALL INTRACRANIAL HEMORRHAGE

Alessandro Orlando, Andrew Levy, Kristin Salottolo, Patrick Offner*, David Bar-Or, St. Anthony Hospital

Introduction: Recent literature examining mild traumatic brain injury (mTBI) has suggested that small intracranial hemorrhage (ICH) does not always necessitate transfer to a higher level trauma center with neurosurgical capabilities. The purpose of this study was to investigate long-term patient outcomes following implementation of a non-transfer protocol for mTBI patients in a Level III Trauma Center without neurosurgical capabilities. **Methods:** In 2007, a non-transfer protocol was implemented at a Level III Trauma Center. Under the non-transfer protocol, adult patients with mTBI (GCS 13-15) and computed tomography (CT) showing small ICH and no coagulopathy had their CT scans reviewed by the on-call neurosurgeon at a Level I Trauma Center; consensus was obtained on the suitability for non-transfer. We examined patients from 2007-2010 who met these criteria. Long-term follow-up data on post-discharge seizures, Extended Glasgow Outcome Scale (GOS-E) scores and readmissions were collected via telephone interviews.

<u>Results</u>: Total N=58. The median hospital LOS was 1d (IQR=1d). No patient required a neurosurgical intervention or post-admission transfer to a Level I facility. There were no in-hospital deaths, and all patients were discharged home. Follow-up data were collected on 18 (31%) patients. The median follow-up time was 2.90 (IQR=1.80) years. The post-discharge seizure rate was 0%. One patient was readmitted (unclear if TBI-related). According to the GOS-E, 15 patients had good recovery and 3 had upper moderate disability (1 non-TBI related disability).

Conclusion: All patients had a quick, safe recovery and were discharged home without the need of an inter-hospital transfer. Non-transfer protocols for mTBI patients with small ICH leads to a more efficient use of hospital resources while providing safe, effective and economical healthcare.

DETERMINANTS OF UNPLANNED RETURN ED VISIT AFTER MILD TBI

Latha Stead, MD, Aakash Bodhit, MBBS, Keith Peters, MD, Lawrence Lottenberg*, M.D., University of Florida - Gainesville Sponsor: Lawrence Lottenberg*, M.D.

Introduction: Mild TBI is most often discharged directly from the ED. In contrast to acute coronary syndrome or stroke, evaluation and management of mild TBI is not standardized. Most discharged paints do well; a fraction however, will develop post concussive syndrome, and return to the ED shortly after discharge. In this study we investigated potential explanations for such unplanned return ED visits within 72 hrs.

<u>Methods</u>: The medical records of all persons with mild TBI during the study period were reviewed. From these, data on demographics, clinical factors, and occurrence of repeat visits were abstracted. Amongst those that returned within 72 hours, specific detail regarding why these repeat visits occurred was further sought.

<u>Results:</u> A total of 477 mild TBIs were seen during the study period. 40% were admitted, with a median length of hospital stay of 2 days (IQR 1-4, range 1-33). 64% (n=305) were discharged directly from the ED. All patients had a GCS of either 14 (6%) or 15 (94%), with a repeat GCS of 15 at discharge. Amongst these, 4% returned for an unplanned visit (table 1).

	unplanned return visit within 72 hrs (n=15)	no unplanned return visit (n=290)	p-value (NS= non-isgnificant)
age	mean = 40.1 SD= 19.0	mean= 38 SD=18.4	NS
male	73%	56%	NS
vomiting	7%	3%	NS
seziure	7%	1%	p=0.451.95% CI= .0013 to .1187
LOC	40%	44%	NS
AOC	13%	16%	NS
PTA	20%	22%	NS
fracture on CT	0%	0%	NS
bleed on CT	13%	0%	p<0.0001. 95%CI = .0886 to .1714

<u>Conclusion</u>: These preliminary data suggest that the ED usage for an unplanned return visit after mild TBI not insignificant. The presence of a bleed on CT or occurrence of seizure at the time of TBI are significant predictors. Future studies that target interventions to decrease unplanned visits, would potentially be useful.

PROTHROMBIN COMPLEX CONCENTRATE (PCC) SHORTENS TIME TO ANTICOAGULATION REVERSAL IN HEAD INJURED PATIENTS AND DECREASES FRESH FROZEN PLASMA (FFP) ADMINISTRATION

Mathew Edavettal, MD, PhD, Amelia Rogers, B.S., Michael Horst, PhD, Wichitah Leng, PharmD, John Lee, MD, FACS, Daniel Wu, DO, Tracy Evans, MD, Frederick B. Rogers*, M.D., Lancaster General Hospital

Introduction: PCC has the potential advantage of shortening anticoagulation reversal in patients with head injured with intracranial bleed (HI) in that unlike FFP it does not require thawing or crossmatch. Further, the small volume required for PCC would minimize the potential for circulatory overload in these patients, compared to FFP. We hypothesized that PCC would decrease the time required for anticoagulation reversal in severely HI patient.

<u>Methods:</u> PCC (25 IU/kg) was instituted for reversal of warfarin induced coagulopathy in November 2011. These patients were compared to a matched control group of patients selected in a 1:3 ratio of patients treated prior with only Vitamin K and FFP. PCC group and FFP group compared using Student's t-test for continuous variables and Fisher's Exact for discontinuous variables. Significance p<0.05.

<u>Results</u>: There were 12 patients in the PCC group and 34 in the FFP only group.

	PCC + FFP Group Mean (std. dev.)	FFP only Group Mean (std. dev.)	P-Value
Age	80.8 (12.3)	77.2 (12.8)	NS
Initial INR	3.1 (0.8)	3.2 (1.7)	NS
Time INR _{initial} to INR _{<1.5} (min)	484 (242)	959 (1192)	0.036
Amount of FFP given (units)	1.3 (1.0)	3.3 (1.5)	<0.001
GCSadmit	12.9 (3.8)	14.3 (2.2)	NS
GCSdischarge	13.7 (3.4)	12.4 (4.4)	NS
Change in GCS	0.8 (2.0)	2.0 (3.8)	0.004
Rate Neurosurgical Intervention	8.3%	23.5%	NS
Mortality	8.3%	14.7%	NS

Conclusion: PCC shortens the time to anticoagulation reversal in severe HI and decreases the amount of FFP administered. Anticoagulation reversal with PCC was associated with a smaller change in GCS from admission to discharge after HI. There was a trend towards improved mortality and decreased neurosurgical intervention with PCC. PCC is the most efficient and efficacious method of anticoagulation reversal in the severely HI patient.

EFFECTS OF PRE-INJURY OMEGA-3 FATTY ACID DIETARY SUPPLEMENTATION ON RECOVERY OF COGNITIVE FUNCTION IN A RAT MODEL OF MILD TRAUMATIC BRAIN INJURY

Brian Gavitt, Tao Wang, Kevin Grayson, Ken Van, Bruce Lyeth, Kullada Pichakron, David Grant USAF Medical Center Sponsor: Lynette A. Scherer*, MD

Introduction: Traumatic brain injury (TBI) is a major military and public health concern. Studies to date have not assessed whether preemptive dietary supplementation with omega-3 fatty acids would hasten recovery and improve functional outcomes in a rat model of multiple mild bilateral TBIs. **Methods:** 32 Sprague-Dawley rats were assigned to experimental (6% fish oil) and control (soybean oil) diets. Each group consumed the same number of calories. After four weeks, both groups received mild bilateral TBIs on two sequential days. Pre-injury diets were resumed, and the animals were monitored for two weeks. On post-injury days 10-14, Morris Water Maze testing was performed to assess spatial learning and cognitive function. Animals were sacrificed at 14 days post-injury to obtain specimens for neurohistopathology.

<u>Results:</u> There was no difference in pre-injury weight gain between groups. Post-injury, animals on the fish oil diet lost less weight and recovered their weight significantly faster (Figure 1; p<0.01), and by 14 days, they also performed significantly faster in the water maze (Figure 2; p=0.03). Post-mortem neurohistopathology identified a non-significant trend toward a higher density of hippocampal neurons in the experimental group (p=0.13).



<u>Conclusion</u>: Pre-injury dietary supplementation with omega-3 fatty acids may have a neuroprotective effect and improves recovery of spatial learning and cognitive performance in a rat model of multiple mild TBIs.

RELATIONSHIP BETWEEN CEREBRAL PERFUSION PRESSURE AND PROGNOSIS IN CONSECUTIVE 143 SEVERE TRAUMATIC BRAIN INJURY PATIENTS WITH MILD HYPOTHERMIA FOR REFRACTORY INTRACRANIAL HYPERTENSION

KOICHI HAYAKAWA, MD, Kazuhisa Yoshiya, Osamu Tasaki, M.D.*, jiro iba, tadahiko shiozaki, Hiroshi Ogura*, M.D., Yasuyuki Kuwagata, M.D., Satoshi Fujimi, MD,PhD, Takeshi Shimazu, Department of Traumatology and Acute Critical Medicine Osaka University Graduate School of Medicine

Introduction: We previously reported that mild hypothermia had no effects on patients with low intracranial pressure (J Neurosurg, 2001), but some beneficial effects in those with intracranial hypertension (ICH) (J Neurosurg, 1993). Therefore, we have performed ventricular drainage, barbiturate therapy, therapeutic mild hypothermia (HT) in sequence, and then we performed decompressive craniectomy for severe traumatic brain injury patients with refractory ICH. Recently, optimal timing of decompressive craniectomy has been discussed, we have to decide therapeutic strategy according to intracranial pressure (ICP) or cerebral perfusion pressure (CPP). The purpose of this study was to clarify the relationship between ICP, CPP and prognosis in severe head trauma patients who underwent hypothermia. Methods: Consecutive 143 patients treated with HT for ICH in two trauma centers were included in the study. ICP monitor was inserted in each patient if Glasgow coma scale was less than 8 points. Which measured after CT scan was defined as initial ICP and CPP. If there was extra-cranial hematoma to evacuate, that measured after operation was defined as initial ICP and CPP. Outcome was assessed at 6 months according to Glasgow outcome scale. Univariate analysis was performed to evaluate the relationship between prognosis and initial ICP, CPP, respectively.

<u>Results</u>: There was no significant correlation between prognosis and initial ICP. On the other hand, there was significant correlation between prognosis and initial CPP. All 42 patients who had initial CPP less than 40mmHg were vegetative state or death in prognosis.

<u>Conclusion</u>: We may not expect a favorable outcome from the patient initial CPP less than 40mmHg in our therapeutic strategy. It indicated that we have to perform decompressive craniectomy for those patients promptly if there is possibility of favorable outcome.

HYPERTONIC SALINE IS SUPERIOR TO MANNITOL IN SEVERE TRAUMATIC BRAIN INJURY FOR HOURLY CORRECTION OF ICP, CPP BUT NOT BRAIN OXYGENATION

Jose Maria Alvarez Gallesio, Daniel Holena, MD*, Jiayan Huang, Carrie Sims*, MD, MS, Joshua Levine, MD, Gui-shuang Ying, Jose Pascual, MD, PhD, Hospital of the University of Pennsylvania Sponsor: Carrie Sims*, MD, MS

Introduction: Mannitol (MTL) and hypertonic saline (HTS) are used routinely in patients with severe traumatic brain injury (sTBI) to normalize intracranial pressure (ICP). Equipoise exists among published studies about which agent should be used first and preferrentially.

<u>Methods</u>: All ICU sTBI patients with ICP monitors admitted from 2001 to 2010 were queried from a neurosurgical registry of a Level 1 trauma center and the following data was abstracted: demographics, ISS, APACHE II and mean hourly change (MHC) in cerebral hemodynamics (ICP, cerebral perfusion pressure [CPP], brain oxygenation [PbtO2]). The generalized linear model was used for comparisons of cerebral hemodynamics.

Results: 3988 hourly measurements for each intracranial hypertension episode were analyzed in 36 patients who received a single dose of HTS or MTL. Mean (SD) age [43(14.6)], ISS [30(9.3)] and APACHEII [22(6.6)] were similar in both groups as was male proportion [66.7%]. For each episode, initial treatment with HTS instead of MTL better corrected ICP [MHC(SE):-5.9(1.3) vs. +2.7(1.4) mmHg, p=0.009] and CPP [MHC(SE): +4.2(1.8) vs. -1.3(1.3) mmHg, p=0.04] but not PbtO2 [MHC(SE) +1.0(2.9) vs. -0.9(2.3) mmHg, p=0.6]. If MTL was used first and HTS used after MTL failure (as is the standard in many ICUs), HTS corrected ICP more than MTL [-8.2(1.7) vs. +3.2(2.3) mmHg, p=0.01] but not CPP [+5.9(4.1) vs. -2.2(4.0)mmHg, p=0.3] nor PbtO2 [-2.4(3.0) vs. 4.4(4.4), p=0.2] **Conclusion:** Hourly ICP correction is better achieved by HTS whether used

as first line therapy or after MTL failure. This benefit is not necessarily seen in the correction of CPP and PbtO2. A well powered blinded randomized comparison trial is necessary to establish which osmotherapy should be the first line agent in sTBI patients amenable to both agents.

DOES PLATELET TRANSFUSION REVERSE PLATELET INHIBITION IN PATIENTS ON ANTIPLATELET THERAPY WITH TRAUMATIC BRAIN INJURY?

Steven Chang, Benjamin Shadle, Jonathan Grotts, Samantha Yim, Sharon Granoff, Stephen Kaminski, Kenneth S. Waxman*, M.D., Santa Barbara Cottage Hospital Sponsor: Kenneth S. Waxman*, M.D.

Introduction: To evaluate platelet function following platelet administration in traumatic brain injured (TBI) patients with intracranial hemorrhage (ICH) on pre-injury antiplatelet therapy (i.e. Aspirin and/or Clopidrogel) **Methods:** Prospective cohort study analyzing platelet function using a platelet function analyzer on TBI patients admitted to a Level II trauma center during a 2-year period on preinjury antiplatelet therapy (i.e. Aspirin and/or Clopidrogel). Platelet function was analyzed at arrival to the trauma center and again in 6-8 hours for patients receiving platelets and/or DDAVP for significant TBI with ICH.

<u>Results:</u> 97 patients with closed head injuries on antiplatelet therapy were hospitalized during a 2 year period. 26 were found to have significant traumatic brain injury with intracranial hemorrhage seen on head CT. There 26 had administration of platelets. 50% of patients had measured platelet inhibition reversed by administration of platelets/and or DDAVP (p<0.001). Age, sex, injury severity scores,lab values, and discharge disposition were not found to be different between those reversed and those not reversed after administration of platelet and/or DDAVP.

<u>Conclusion</u>: Reversal of platelet inhibition in traumatic brain injured patients following platelet transfusion can occur in patients on antiplatelet therapy. Further study needs to be done to determine why platelet function improved in some patients and not others, and also to assess if this reversal of inhibition translates to clinical benefit.

POSTER WITHDRAWN

ELIMINATION OF TOTAL-BODY CT IN ALERT PEDIATRIC TRAUMA PATIENTS

John Green*, MD, A. Christmas*, M.D., Nora Raynor, RN, MSN, Samuel Ross, MD, MPH, Ronald F. Sing*, D.O., Carolinas Medical Center

Introduction: Despite normal mental status, hemodynamic stability, and reliable physical exam, computed tomography of the brain, cervical spine, chest, abdomen and pelvis (panCT) is often performed based solely on mechanism of injury. In an effort to minimize radiation exposure, we hypothesized that selective CT (selCT) guided by physical exam (PE) is equivalent to panCT in evaluation of these patients.

<u>Methods</u>: We conducted a retrospective review of trauma patients aged 0 to 12 years admitted over a 26-month period. Data included age, minor or major mechanism of injury (MOI), reliability of physical exam, types of CT obtained, ultrasound (FAST) results, injuries and delayed diagnosis of injury (DDx).

<u>Results:</u> We identified 285 patients by inclusion criteria (64 panCT, 150 selCT, 71 noCT). Forty panCT patients had positive findings, including 3 with +FAST. The only DDx was prompted by PE on the following day. Two other +FAST led to panCT, both identifying isolated abdominal injuries managed nonoperatively. The 83 patients in the positive selCT group had 4 +FAST, one leading to splenic embolization, and no DDx while 67 selCT patients with negative scans had no +FAST or DDx. The No CT group had 2 +FAST and one DDx. Both +FAST led to operation based on PE findings the following day. The average ages of panCT, selCT and no CT were similar. Major mechanism of injury was present in 82.8% of panCT, while in only 56.7% selCT and 53.5% of the no CT group (p<0.001). PanCT patients were significantly more likely to have major MOI, though no more likely to have a delayed injury diagnosis.

<u>Conclusion</u>: There is no difference between panCT, selective CT and no use of CT in the incidence of delayed injury diagnosis in this population. Further, major mechanism of injury is not an indication for total-body CT.

ABSENCE OF CLINICAL FINDINGS RELIABLY EXCLUDES UNSTABLE CERVICAL SPINE INJURIES IN CHILDREN ≤5 YEARS OF AGE

Diane Hale, Timothy Vreeland, Colleen Fitzpatrick, John Doski, Ronald M. Stewart*, M.D., Deborah Mueller, San Antonio Military Medical Center

Introduction: Increased accessibility and rapidity of computed tomography (CT) has led to increased utilization and radiation exposure to pediatric trauma patients (pts). The thyroid is radiosensitive and radiation exposure occurs during cervical spine (CS) CT. Pre-elementary trauma pts (\leq 5 years old) with CS injury have different injury patterns than older children. This analysis aims to determine which pre-elementary trauma pts warrant CS CT by defining incidence and clinical characteristics of pre-elementary CS injury. **Methods:** This was an IRB approved retrospective review of pre-elementary trauma pts from 1998-2010 with CS injury admitted to a Level I Trauma Center. Pts were identified from the trauma registry using ICD9 codes and reviewed for demographics, mechanism of injury, clinical presentation, injury location/type and outcome.

<u>Results:</u> 2972 pre-elementary pts were identified. Twenty-two pts (0.74%) had CS injury confirmed via radiographs or autopsy. Eleven (50%) pts were male and the mean age was 3 years (\pm 1.7). The most common mechanism of injury was motor vehicle collision (n=16, 73%). All pts had clinical findings suggestive of CS injury; 18 (82%) had abnormal neurologic exam, 2 (9%) had torticollis and 2 (9%) had neck pain. The majority (59%) were in extremis and 12 (55%) arrived intubated. The median Glasgow Comma Scale was 3 (Interquartile Range [IQR] 3-10); median Injury Severity Score was 33 (IQR 17-56). Nineteen (76%) injuries were C4 and higher. The mortality rate was 50%.

<u>Conclusion</u>: Incidence of CS injury in pre-elementary pts was consistent with previous reports. There is a low risk of missing unstable CS injuries in asymptomatic pre-elementary aged pts. Limiting CS CT to symptomatic pre-elementary pts would decrease unnecessary radiation exposure to the thyroid.

VALIDATION OF HEAD CT GUIDELINES IN THE YOUNGEST TRAUMA PATIENTS: A CALL TO LIMIT RADIATION EXPOSURE

Bryan Harvell, Stephen Helmer, Ph.D., Jeanette Ward, B.A., Elizabeth Ablah, Ph.D., MPH, Raymond Grundmeyer, III, M.D., James Haan*, M.D., The University of Kansas School of Medicine – Wichita and Via Christi Hospital

Introduction: Recent studies have provided guidelines on the need and use of head computed tomography (CT) scan in pediatric trauma patients. The purpose of this study was to verify the validity of these guidelines when applied to concussed pediatric patients.

<u>Methods:</u> A 7-year retrospective review of patients less than or equal to 4 years of age with a concussion from blunt trauma was conducted. Demographics, injury severity, head injury characteristics and symptoms, clinical indicators for head CT scan (severe mechanism, physical exam findings of basilar skull fracture, nonfrontal scalp hematoma, GCS score, loss of consciousness, neurologic deficit, altered mental status, prolonged vomiting, severe headache, amnesia, irritability, behavioral changes, seizures, lethargy), CT scan results, hospital course characteristics and discharge disposition were collected.

<u>Results:</u> Of the 170 patients meeting inclusion criteria 37 (21.8%) underwent simple overnight observation without sequelae. One-hundred thirty-three patients (78.2%) received a head CT scan; 7 of which contained fractures and/or bleeds. One patient's CT was initially read as negative with observation of hemotympanum. Follow-up CT demonstrated a small extradural hematoma and resolving subdural hematoma. All children found to have head fractures and/or bleeds had one or more of the clinical indicators present on arrival, with no neurosurgical procedures necessary and no deaths occurring among this population.

<u>Conclusion</u>: The presence of any two of these clinical indicators proves to be very sensitive in identifying fractures and/or head bleeds in children at or under the age of 4 and consequent need for head CT. Those patients without clinical indicators can be safely discharged to home after a brief period of observation without undergoing head CT.

Withdrawn

PEDIATRIC CT SCAN RADIATION EFFECTIVE DOSAGES FOR TRAUMA

Charles Hartin, Robert Doiron, Kaveh Vali, Philip Glick, Doruk Ozgediz, Kathryn Bass*, MD, FAAP, Women and Children's Hospital of Buffalo

Introduction: An inverse relationship between tissue radiosensitivity and body size has been implicated during Computed tomography (CT). This is the first study to report the CT scan effective dosage on different body sizes of the most common diagnostic imaging for pediatric trauma.

<u>Methods</u>: Diagnostic images for trauma evaluation from 2008 to 2011 were retrospectively reviewed for patients presenting to a pediatric trauma center. CT effective dosages were calculated using the dose length product method and phantom model cofactors for five different body sizes.

<u>Results:</u> The figure demonstrates the CT effective dosage per scan for different body sizes of 1159 patients. Of 1407 CT scans, CT head was the most common in all body size groups followed by CT abdomen and pelvis and CT cervical spine.



<u>Conclusion</u>: Evaluating physicians should be familiar with radiation exposure in pediatric trauma. As CT scans of the abdomen and pelvis account for more radiation than all other imaging studies combined (in all groups), strategies to reduce exposure should include thoughtful utilization of this resource especially in the smallest of children.

APPROPRIATE PEDIATRIC TRAUMA TEAM TRIAGE RESULTS IN SHORTER TIMES TO THE OPERATING ROOM AND INTENSIVE CARE UNIT

Jillian McCagg, Suzanne Moody, Eileen King, Richard A. Falcone, Jr.*, MD, MPH, FAAP, Cincinnati Children's Hospital Medical Center

Introduction: Activation of trauma teams is resource intensive and requires justification of its value. The potential benefits include prompt treatment and rapid transfer to the operating room (OR) or intensive care unit (ICU). This study analyzed the impact of activation level on time to OR or ICU, variations among institutions and impact of refined activation criteria.

<u>Methods</u>: During the study period 656 injured children evaluated at 9 pediatric trauma centers were analyzed. Patients were stratified according to the activation level, center and time to OR or ICU. The potential impact on times and triage level according to refined activation criteria were also examined.

<u>Results:</u> Median age was 8.1 years (0-20) and median injury severity score (ISS) of 14 (0-75). 147 children were taken directly to the OR and 284 went directly to the ICU. The highest level of activation patients

	Highest	Mid	None	р
Time to OR (min)	57.82	77.07	123.55	<0.0001
Time to ICU (min)	71.95	150.41	194.55	<0.0001
Median ISS	17.24	10.23	6.04	<0.001

were transferred the most rapidly (Table). The average institutional time to the OR was 31.8 - 109.9 minutes and time to ICU was 53.6 to 114.1 minutes. If all centers utilized the refined activation criteria, an additional 20 children requiring the OR and 7 children needing ICU care would have been highest level activations, potentially reducing the time to the OR by up to 92 minutes and the time to the ICU by up to 141 minutes.

<u>Conclusion</u>: Activation of the highest level trauma team leads to faster transfer to the OR or ICU. Despite rapid transfer times overall, substantial variation among centers is present, and a potential for all centers to improve exists. In addition, use of evidence based standardized criteria could result in more appropriate triage, improved timeliness of care and improvements in outcome.

ADMISSION COAGULOPATHY IS ASSOCIATED WITH HIGHER MORTALITY AFTER TRAUMA INJURIES IN CHILDREN ADMITTED TO A LEVEL 1 TRAUMA CENTER

Brent Whittaker, Jeffrey Kerby*, M.D., Ph.D., Margaret Winkler, Mike Chen, MD, Jessica Altice, Al Bartolucci, Jean-Francois Pittet, MD, University of Alabama-Birmingham

Introduction: In adult trauma patients, early coagulopathy is independently associated with increased mortality. Similar results have been reported in pediatric patients suffering from war-related injuries, although the incidence of early coagulopathy after civilian pediatric trauma is unknown. **Methods:** We performed a retrospective review of all trauma patients admitted to a level 1 pediatric trauma hospital from January 1, 2001 to December 31, 2010. Coagulopathy was defined as an INR > 1.3 and cellular shock as a base deficit > 6. Laboratory values were measured immediately after admission to the Emergency Department. Primary outcome was mortality. Results: 1063 consecutive patients were evaluated. 827 patients had complete data for analysis. The mean age was 8.7 + 5.0 years with 92% sustaining blunt trauma. The overall incidences of early coagulopathy and cellular shock were 26.9% and 21.3%, respectively. Early coagulopathy was associated with a significant increase in mortality at both low severity (ISS ≤ 15) and higher severity (ISS >15) of trauma. Furthermore, the presence of a cellular shock in patients with coagulopathy significantly increased the mortality rate (49.1% vs 26.2%) and cellular shock was associated with a higher incidence of coagulopathy and worse outcome (p < 0.05).

<u>Conclusion</u>: Early coagulopathy is present in a quarter of the children with civilian trauma and is associated with higher incidence of mortality.

INFANT HEAD INJURY RELATED TO FALLS AND NON-ACCIDENTAL TRAUMA: DOES INJURY PATTERN DETERMINE MECHANISM?

Elizabeth M. Pontarelli, MD, Aaron R. Jensen, MD, Kari M. Komlofske, FNP, David W. Bliss, MD, Childrens Hospital Los Angeles Sponsor: Jeffrey S. Upperman*, M.D.

Introduction: Children falling from short distances rarely sustain significant injuries. Most studies looked at children 0-5 years old, however, infants are less often ambulatory and may present differently. Non-accidental trauma (NAT) carries a higher mortality rate in infants, and falls are commonly given as an explanation. We hypothesized that infant head injuries associated with NAT have a distinct injury profile compared to falls.

<u>Methods</u>: The hospital trauma registry and patient records were reviewed from 2004 to 2008. Infants (<12 months old) admitted for head injury, defined by having at least one head CT were included.

<u>Results:</u> 99 infants Met study crtieria. Falls and NAT were the most common mechanism of injury (78 patients). Most falls were from low height, and on average had lower injury severity scores (ISS). Abbreviated Injury Scales (AIS) showed NAT patients had injuries to face, chest, abdomen, or extremities much more often. Head CT more commonly demonstrated isolated intracranial hemorrhage (ICH) in NAT versus isolated fracture in falls. Outcomes for the NAT group were worse, with longer ICU stays, longer hospital stay, and more intracranial operations.

<u>Conclusion:</u> Our results indicate a possible injury pattern to distinguish NAT from falls. High ISS, associated extracranial injuries, and presence of ICH without skull fracture warrant suspicion of NAT. While this is a small retrospective study, it suggests an injury profile that may improve identification of NAT in head injured infants.

	ISS	AIS Face,	Head CT Findings		ICU days	Hospital	
		Abdomen, Chest, Extremities	ICH	Fracture	ICH plus Fracure		days
Fall (n=67)	5 (4-26)	2/67 (3%)	14/64 (22%)	23/64 (37%)	15/64 (23%)	0 (0-1)	1 (0-5)
NAT (N=21)	17 (5-38)	13/21 (62%),	12/20 (60%)	1/20 (5%)	7/20 (35%)	3 (0-11)	7 (1-28)
p	< 0.001	< 0.001	0.002	0.005	0.23	< 0.001	< 0.001
		Data ex	coressed as median ((range) or frequency ('%).		

Comparisons by Mann-Whitney U (continous variables) or two-tailed Fisher's Exact Test (frequencies)

HEMODYNAMIC VARIABLES PREDICT OUTCOME OF EMERGENCY THORACOTOMY IN PEDIATRIC TRAUMA

Andrew Bozeman, M.D., Melvin Dassinger, M.D., Austin Porter, R. Todd Maxson*, M.D., University of Arkansas for Medical Sciences/ Arkansas Children's Hospital Sponsor: R. Todd Maxson*, M.D.

Introduction: We seek to better define the presenting hemodynamic parameters that predict survival for pediatric patients undergoing emergency thoracotomy (ET).

<u>Methods:</u> We reviewed from the National Trauma Database (2007-2010), pediatric (age <18) ETs performed within one hour of hospital arrival. Mechanism of injury and hemodynamic parameters were analyzed. Hypotension and tachycardia, defined by the American Heart Association, were stratified by age.

<u>Results:</u> We identified 123 patients (N= 38 blunt; N= 85 penetrating) who underwent ET. Of those, 34% (42/123) survived to reach hospital discharge. There were no survivors of ET when presenting Emergency Department (ED) pulse rate ≤ 60 or systolic blood pressure (SBP) ≤ 30 mmHg. When stratified by mechanism, there were no survivors when pulse ≤ 80 or initial SBP of \leq 80 mmHg for blunt injuries.



<u>Conclusion</u>: This study represents the largest national review of ET for pediatric trauma. When ET was performed for a SBP \leq 30 mmHg or a pulse \leq 60 there were no survivors. As SBP and pulse increased, a statistically significant survival advantage was seen for penetrating compared to blunt injuries, suggesting ET may have limited benefit in a select group of patients.

ASYMPTOMATIC PRECORDIAL STAB WOUNDS. IS A CT SCAN ENOUGH TO GET A GOOD NIGHT'S REST?

Ronen Elefant, Hank Hirsch, J. Simon Ivey, Senthil Jayarajan, Jay Dujon, John Gaughan, Joseph F. Rappold*, M.D., Thomas A. Santora*, M.D., Abhijit S. Pathak*, M.D., Amy J. Goldberg*, M.D., Lars Ola Sjoholm, Temple University Hospital Sponsor: Amy J. Goldberg*, M.D.

Introduction: Hemodynamically stable patients with penetrating chest wounds present a diagnostic dilemma. Our protocol for asymptomatic precordial stab wounds (PSW) with negative CXR and FAST is to obtain a cardiologist-interpreted ECHO and a second CXR 3 hours post presentation. If all imaging studies are negative, the patient may be safely discharged. Given the increased use of contrast enhanced CT in trauma, we investigated its use in recognizing pericardial intrusion as compared to ultrasound (US). Methods: A retrospective review of our trauma registry from 2006-2011 for patients who presented with PSW was performed. US (ECHO and/or FAST) and CT were reviewed for pericardial fluid. The reference standard was pericardial window or safe discharge following negative imaging. Sensitivities, specificities and predictive values were calculated. Results: During the 5 year study period 110 patients presented with asymptomatic PSW. 22 (20%) patients underwent a pericardial window due to positive imaging, 88 (80%) were observed. 100 (91%) had an US while 70 (64%) had a CT. In the US group, there were 4 true-positive (TP), 89 true-negative (TN), 2 false-negative (FN) and 5 false-positive (FP) results. For CT scan, there were 2 TP, 67 TN, 0 FP and 1 FN. The one patient with FN CT scan did go to the OR based on CT trajectory. No difference between US and CT in terms of sensitivity (0.666 vs 0.666, p=0.453) and specificity (0.947 vs 1, p=0.145) was found.

<u>Conclusion</u>: US imaging has inherent disadvantages. FAST is a rapid, but operator dependent modality. ECHO is often not readily available and real-time interpretation is difficult to obtain. CT scan has the advantage of being readily available and quickly interpreted at any hour. While limited by small sample size, the study suggests that CT may be equivalent to US in the diagnosis of PSW. Further studies are needed.

SURGICAL STABILIZATION OF RIB FRACTURES: EXPANDING THE INDICATIONS

Sarah Majercik, MD, MBA, Don VanBoerum, MD, Tom White, MD, Steve Granger, MD, Steven Bernards, PA-C, Mark Stevens, MD, Intermountain Medical Center Sponsor: Raul Coimbra*, M.D., Ph.D.

Introduction: In recent years, there has been increased interest in surgical stabilization of rib fractures (SSRF). Indications for the procedure are not well defined, however. The purpose of this study was to describe our experience and outcomes of 84 SSRF at a single institution.

<u>Methods</u>: All patients who underwent SSRF from June 2009-February 2012 were identified. Patient demographics, injury mechanism, ISS, ICU/hospital LOS, surgical data, ventilator days, complications, and follow up information were collected from the medical record and trauma registry.

Results: 84 patients underwent SSRF during the study period. 63 (75%) were male, mean age was 57 ± 1.8 years (range 20-100), mean ISS was 20.5 ± 1.20 . SSRF was performed at a mean of 4.61±1.0 days from injury. Indications for surgery were flail chest (FC) (66%), intractable pain without FC (20%), displacement without FC (7%), retained hemothorax (5%), and nonunion (2%). Mean ICU LOS, hospital LOS, and ventilator days postoperatively were 3.10±0.57, 8.84±0.61, and 1.30±0.34, respectively. 59(70.2%) patients were never on a ventilator. Patients who had SSRF within 48 hours of admission had a shorter hospital LOS than those who had SSRF after 48 hours (10.2 vs. 14.2 days, p=0.006), despite similar ISS. Complications included pneumonia (10.7%), DVT (7.1%), surgical site infection (3.6%), hardware removal (3.6%), and delayed hemothorax (2.4%). 60 (71%) patients had >60 day follow-up. 53 were off narcotics at a mean of 21.8 ± 1.6 days. Conclusion: SSRF is a safe treatment for patients with FC, intractable pain, or displaced rib fractures, whether they are mechanically ventilated or not. Patients with SSRF within 48 hours of injury had shorter hospital stays than those that waited longer. Prospective trials should explore whether SSRF is superior and/or cost-effective as compared to non-operative treatment.

AVERAGE CHEST WALL THICKNESS AT TWO LOCATIONS IN TRAUMA PATIENTS

Elizabeth Schroeder, MD, Andres Krauthamer, Carrie Valdez, MD, Nadia Khati, Kathleen Brindle, Jessica Rasmus, Babak Sarani*, M.D., George Washington University

Introduction: Needle thoracostomy is the initial treatment for tension pneumothorax. The most effective location for needle decompression remains controversial due to a high failure rate using standard 4.5 cm catheters. No previous study has directly compared chest wall thickness (CWT) at the 5th intercostal space (ICS) to the 2nd ICS in the same, live subjects. We hypothesize that a 4.5 cm catheter is too short irrespective of which ICS is used.

<u>Methods:</u> A retrospective study of 201 consecutive trauma patients (102 male, 99 female) who underwent chest CT scan in an urban trauma center in 2011 was performed. Images were reviewed by an attending radiologist. CWT was measured at the 2nd ICS mid-clavicular line and the 5th ICS anterior axillary line. Statistical significance was assessed using the student t-test and Mann-Whitney-U test as appropriate.

<u>Results:</u> The average patient age and body mass index (BMI) were 42 ± 18 years old and 26 ± 7 , respectively, with no significant differences between genders. Mechanism of injury was blunt force in 93% of patients. The CWT at the 2nd ICS was significantly less in males than in females $(3.9 \pm 1 \text{ cm v} 4.3 \pm 1.7 \text{ cm}, p=0.02)$. No difference was noted between genders at the 5th ICS (males $4.5 \pm 1.4 \text{ cm v}$ females $4.6 \pm 1.9 \text{ cm}, p=0.58$). CWT was greater than 4.5 cm at the 2nd ICS in 25% of men and 34% of women and was greater than 4.5 cm at the 5th ICS in 46% of men and 44% of women. **Conclusion:** Our study is the first to compare the 2nd ICS compared with females, but a 4.5 cm catheter is still too short in 25% of men. A standard catheter is also too short in 34% of women at the 2nd ICS and in nearly half of men and women at the 5th ICS. Longer catheters are needed for needle thoracostomy irrespective of patient gender or procedure location.

WINDOW SHOPPING ISN'T ALWAYS FREE: THE HIDDEN COST OF DIAGNOSTIC PERICARDIAL WINDOWS.

Travis Polk, MD, Joseph Sakran, MD, Daniel Holena, MD*, Patrick Reilly*, M.D., University of Pennsylvania

Introduction: Diagnostic pericardial window (DPW) has a role in the triage of the pericardium in the setting of high-suspicion thoracoabdominal wounds. Our hypothesis was that enteric contamination (EC) would be associated with increased complication rates in DPW and that subxiphoid approach (SPW) would be associated with lower complication rates than by transdiaphragmatic approach (TDW).

Methods: A retrospective chart review was performed from 2004-2011. All adult patients who underwent a negative DPW were included; those who underwent emergent thoracotomy/sternotomy were excluded. Primary outcomes were DPW-related complications (pericardial effusion, thickening, or tamponade on echocardiogram; or, arrhythmia or pericarditis on EKG) and major pericardial complications (requiring operative or interventional drainage procedures). Evidence of EC from bowel, pancreatic or biliary injury was abstracted. Chi(2) or Fisher's exact test were used, as appropriate. Results: 116 patients met study criteria (87 TDW and 29 SPW). There were no attributable deaths. Total and major DPW-related complications were 23% and 7%, respectively, and did not differ between SPW and TDW. EC was associated with increased total complications (16% vs. 32%, p=0.040), but not with increased major complications (6.3% vs 7.5%, p =1.000). One cardiac arrest with hypoxic brain injury occurred due to bilious cardiac tamponade after a negative SPW. There were 3 wound complications (0.8% overall, 1 TDW and 2 SPW).

<u>**Conclusion:**</u> The rates of pericardial complications following DPW are not trivial and clinicians are advised to remain vigilant in these patients. While EC may increase overall risk of complication, its effect on major complications appears minimal. SPW and TDW appear to have equivalent complication rates.

ULTRASOUND CAN REPLACE CHEST RADIOGRAPHY FOR TUBE THORACOSTOMY REMOVAL

Michael Soult, MD, Jay N. Collins*, M.D., Leonard J. Weireter, Jr.*, M.D., L.D. Britt*, M.D., M.P.H., Eastern Virginia Medical School

Introduction: An ultrasound (US) exam can be easily and rapidly performed at the bedside to aide in clinical decisions. In this study we sought to demonstrate that US was as safe and accurate as CXR for the evaluation PTX associated with thoracostomy tube (TT) removal.

<u>Methods:</u> Patients were followed who had TT managed by the surgical team between September 2011 and February 2012. Bedside US was performed by two experienced surgeon sonographers before and after TT removal. CXR was obtained before and after TT removal with sonographers blinded to CXR findings. Data collected included demographics, indication for TT, TT size, interval for imaging after TT removal and clinical significance of findings. **Results:** Seventy three TTs were placed in 54 patients during the study period. Average age was 45 years and 41 patients (76%) were male. TT was placed for PTX in 43 (59%) patients, a hemopneumothorax in 18 (23%), hemothorax in 9 (13%) or a pleural effusion in 3 (5%). Exclusion of 19 patients occurred secondary to having incomplete imaging. The remaining 54 TT had water seal and post pull US performed while six did not have a water seal US. US was able to detect all clinically significant PTX seen on CXR (p= 0.0072). US was able to successfully predict the safe TT removal and

discharge post pull.

Conclusion:

The use of bedside US can be safely and accurately used to replace CXR



for the discontinuation of TT. We have now eliminated water seal and post pull CXRs for the removal of TTs and are routinely using US for this evaluation.

THE VALUE OF LOWER EXTREMITY DUPLEX SURVEILLANCE TO DETECT DEEP VEIN THROMBOSIS IN TRAUMA PATIENTS

Jesse Bandle, M.D., Steven R. Shackford*, M.D., Jessica Kahl, B.A., C. Beth Sise, J.D., R.N., Richard Y. Calvo, M.P.H., Meghan C. Shackford, Michael J. Sise*, M.D., Scripps Mercy Hospital Trauma Service

Introduction: Venous duplex surveillance (VDS) is commonly used in trauma patients considered at risk for deep venous thrombosis (DVT). To date, economic evaluations of VDS have not addressed the quality of either the process or the outcome. We sought to determine the value (quality/cost) of VDS in trauma patients stratified by risk for DVT.

<u>Methods:</u> We reviewed records of all trauma patients from 7/2006–12/2010 who received at least weekly VDS exams to assess for DVT in the lower extremities. Prophylaxis was provided according to the American College of Chest Physicians (ACCP) recommendations. Patients were stratified by risk of DVT per ACCP criteria as moderate, high, or highest. "Value" of VDS was defined as the quality of the outcome (Qo:# DVT events) and the quality of the process (Qp: mean # sites visualized per exam; optimal=12/exam) divided by cost. Cost was defined as the average time (0.5 hours) for our certified vascular technologists to perform an exam.

<u>Results:</u> 2,169 patients met inclusion criteria. New or propagated DVT occurred most often in the highest risk group (p<0.001; Table). Qp was not significantly different between groups.

	Risk Group	Moderate	High	Highest
	Patients (n)	220	1173	776
	ISS (mean)	5.3	14	21.1
	VDS exams	249	1762	2346
	Positive exams	1.2%	4.6%	7.1%
t	New BK DVT	2	55	101
	New AK DVT	1	21	59
	Propagated DVT	0	5	7
	Qual.Process (Qp)	11.6	11.3	11.1
	Qual.Outcome(Qo)	3	81	167
	Value (Qo/Qp)/cost	0.5	7.2	30.1

Conclusion: VDS had significantly greater value in the highest risk group. VDS for DVT in trauma is warranted in patients at highest risk, has less value in the high risk, and is of minimal value in the moderate risk group.

DONOR SAID "YES," FAMILY SAYS "NO." DONOR-FAMILY CONFLICT AND DONOR DESIGNATION

Robert R. Quickel*, M.D., Paul Stahler, M.D., Mark Hill, M.D. Ph.D., Susan Mau Larson, Susan Gunderson, MHA, Chad J. Richardson*, M.D., Hennepin County Medical Center

Introduction: Donor designation refers to the laws and process for documentation and validity of a citizen's wishes regarding organ donation should that citizen become eligible for donation at death. The 2006 Anatomical Gift Act (AGA) has been passed by 45 states, and compels organ procurement organizations (OPOs), hospitals and caregivers to honor the wishes of the deceased potential donor. Donor-family conflict arises when a designated donor's family attempts to rescind the donor's consent to donate. Little guidance exists in the current literature.

<u>Methods</u>: The Upper Midwest OPO, LifeSource, was queried to find cases of donor-family conflict within the past 10 years. Hospital public relations offices and OPO records were queried to assess the incidence of legal action and adverse media coverage. Public legal records were searched for civil actions involving the hospitals at which these conflicts occurred. Family feedback to the OPO regarding these cases was examined.

<u>Results:</u> Fourteen cases of donor-family conflict were identified. Organ procurement proceeded in 9/14 (64%). A total of 37 organs were recovered from these 9 donors (mean 4.1/donor). For those 9 cases, mean follow-up time was 50 months. No lawsuits were filed, and no adverse news items were reported. Family feedback was favorable towards the OPO in 7/9 (78%) of cases and unfavorable in 2/9 (22%).

<u>Conclusion</u>: The 2006 Anatomical Gift Act compels hospitals and OPOs to pursue donation regardless of family wishes in cases of brain death in designated donors. When a donor's family attempts to rescind the donor's consent, the donor's wishes, not the family's, should be honored. Fears of legal action and adverse media coverage are unfounded. Clinicians, OPO staff and hospital administrators should strive to understand state donor designation law, and create a plan for managing this conflict should it arise.

THE ACUTE CARE SURGEON SHORTAGE: AN ECONOMIC PERSPECTIVE OF A CRISIS

Jeffrey Carter, Daryhl Johnson, Assistant Professor, Anthony A. Meyer*, M.D., Ph.D., George F. Sheldon*, M.D., Preston B. Rich*, M.D., University of North Carolina

Introduction: The eroding availability of emergency surgical care is a crisis. The Institute of Medicine and others have identified lack of access to emergency surgical care as a major risk to patients. The Acute Care Surgery (ACS) fellowship was developed in part to address this problem. Our goals were to examine the economic impact of pursuing a fellowship in ACS and consider possible solutions to this national crisis.

<u>Methods</u>: Standard financial methodology was used to compare the economic value of careers in surgical specialties. Net present values (NPV) and internal rates of return (IRR) were calculated based on salary data from AAMC and MGMA. Included in the calculations were deductions for medical graduate debt, federal income tax, and opportunity costs of surgical fellowships relative to General Surgery practice.

<u>Results:</u> Fellowship training in Cardiac, Pediatric, Plastic, and Thoracic surgery adds financial value over the course of a career when benchmarked to General Surgery (Cardiac +19.7%, Plastic +15.6%, Pediatric +8.1%, Thoracic +26.4%). Fellowship training in Vascular Surgery and ACS results in a relative reduction in economic value (Vascular -8.1%, ACS -12.0%). The magnitude of the reduction in ACS career value is equivalent to the assumed medical school debt burden.

Conclusion: ACS training does not provide a return on educational investment. If availability of programs such as the National Health Service Corps scholarship program - offered now only to primary care physicians - were made available to those pursuing training in surgery, financial disincentives could be rectified. Transparently addressing the root causes of our nationwide crisis in emergency surgical care will help to break down barriers to the appropriate alignment of patient needs with physician resources.

A NOVEL SIMULATION TRAINING MODEL: THE MANGLED EXTREMITY SURGICAL SKILLS COURSE

Timothy D. Browder*, M.D., Edward Kwon, M.D., Shawn Tsuda, M.D., Deborah A. Kuhls*, M.D., John J. Fildes*, M.D., University of Nevada School of Medicine

Introduction: There is increasing evidence supporting the benefit of surgical skills practice in the simulation setting. Complex and infrequently performed surgical procedures, such as management of the mangled extremity, are particularly suited for simulated skills acquisition. A perfused extremity model was created to evaluate the skills of vascular shunt placement, external bone fixation and vascular anastomosis. The purpose of our study was to validate this simulation model.

<u>Methods:</u> 4 trauma surgeons, 4 ACS Fellows and 11 surgery residents participated. Participants attended a 30-minute didactic session followed by a written test. Learners used the mangled extremity simulator to demonstrate vascular control, vascular shunt placement,



spanning knee external fixation, shunt removal and definitive vascular repair. Guided tutorial then provided 3 repetitions of each skill before participants repeated the simulation. Procedures were video recorded and timed. Performance was tested before and after the lab using the Objective Structured Assessment of Technical Skills (OSATS) tool. Reaction surveys were administered.

<u>Results:</u> Knowledge acquisition was demonstrated by improvement in written test scores (44.8% vs 88.7%, P<0.0001). Guided skills practice resulted in score improvement on the OSATS scale (21.9 ± 3.6 vs 29.2 ± 2.7 , P<0.001) and faster times to completion of the skill set (1,754 sec vs 1,266 sec, P=0.002). Participants reported improved confidence in the management of a mangled extremity.

<u>Conclusion</u>: This initial pilot study shows the validation of a novel mangled extremity simulation model. Further study will be required to evaluate the longevity and transfer to the operating room of the skills acquired in this lab.

HELP IS IN YOUR POCKET: SMARTPHONE BASED REMOTELY GUIDED RESUSCITATIVE TELE-SONOGRAPHY

Innes Crawford, Paul McBeth, Corina Tiruta, Michael Shuster, Leslie Sewell, Nova Panebianco, David Lautner, Savvas Nicolaou, Chad Ball*, Assistant Professor, Mike Blaivas, Christopher J. Dente*, M.D., Amy D. Wyrzykowski*, M.D., Andrew Kirkpatrick, University of Aberdeen

Introduction: Ultrasound (US) examination has many uses in resuscitation, but to use it to its full effectiveness requires a trained and proficient user. We sought to employ informatic (IT) advances to remotely guide US-naive examiners (UNEs) through mentored examinations using simply a Smartphone.

<u>Methods:</u> UNEs (5 tactical EMTs, 10 Ski-Patrollers, 4 Nurses) were guided to perform partial or complete EFAST examinations on both a healthy volunteer and on an ultrasound phantom, while being mentored by a remote examiner who viewed the US images over an iPhone with an inlaid depiction of the US probe and the "patient", derived from a video-cam mounted on the UNE's head. Examinations were recorded as still images and over-read from a website by 7 separate expert reviewers (ERs: 3 surgeons, 2 emergentologists, 2 radiologists). Examination goals were: identifying lung sliding (LS) documented by color power Doppler (CPD) in the human, and to identify intra-peritoneal (IP) fluid in the phantom.

<u>Results:</u> All UNEs were successfully mentored to easily and clearly identify both LS (19 determinations) and IP fluid (14 determinations), as assessed in real time by the remote mentor. ERs confirmed IP in 95 of 98 readings (97%), with 100% of ERs perceiving clinical utility for the FAST. Based on single still CPD images, 70% of ERs agreed on the presence or absence of LS. In 16 out of 19 cases, over 70% of the ERs felt that the EFAST exam was clinically useful.

<u>Conclusion</u>: UN examiners can confidently be guided to obtain critical findings using simple IT resources, based upon the receiving/transmitting device found in most trauma surgeon's pockets. Global US mentoring requires only internet connectivity and initiative.

SMARTT TEAM TRAINING IMPROVES AD-HOC TRAUMA TEAM DYNAMICS

John Sutyak*, M.D., Nicole Roberts, Cathy Schwind, Christopher McDowell, David Griffen, Jarrod Wall, Christopher D. Wohltmann*, M.D., Hilary Sanfey, M.D., Audra Chestnut, Reed Williams, Ph.D., Southern Illinois University School of Medicine

Introduction: Trauma teams frequently form ad hoc, with limited familiarity among members, creating a milieu for communication lapses. This study created and analyzed a brief communication and leadership intervention. **Methods:** Analysis of simulated & real team activities revealed gaps in organization, efficiency & information exchange. The SMARTT Step Back (Situation, Management, Activity, Rapidity, Troubleshoot, Talk to me) communication protocol was created for information exchange. PGY 3-5 GS residents led 9 teams with PGY 1-2 GS & EM residents, ED RN's, EMT's & RT's. Each group attended a didactic program between pre and post-test simulations. Retention post test occurred at 3 wks. Two independent blinded raters scored videos using a 5 point Likert scale covering surgical NOTECHS items & other team activity. 49 participants served as own controls. Statistical analysis: ANOVA, t-test, Chi square, significance p ≤0.05.

Results: 43 of 44 responding participants

agreed SMARTT improved efficiency,

safety, communication, awareness, and support. Team improvements & SMARTT usage were maintained over 3 weeks (p=NS for 3 wks vs. Post1).

Category	p Post1 v. Pre	p 3 wk v. Pre
Organized	<0.001	0.001
Efficiency	0.005	0.013
Mutual Support	0.01	0.12
Listened to Info	0.005	0.03
Instructions Performed	0.003	0.04
NOTECHS		
Leadership	<0.01	0.26
Cooperation	<0.001	0.02
Communication	<0.001	0.02
Decision Making	0.09	NS
Awareness/Stress	0.02	0.12

<u>Conclusion</u>: Team dynamics significantly improved on the majority of items including communication, mutual support, information transfer, & leadership following a brief training activity. Institution of the SMARTT Step-Back is easy & significantly improves ad hoc team communication.