

Abstracts of Papers to Be Presented at the Twenty-First Annual Scientific Meeting of the Eastern Association for the Surgery of Trauma

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TRAUMA ATTENDING PHYSICIAN CONTINUITY: DOES IT MAKE A DIFFERENCE?

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BACKGROUND: Trauma attending physician (TAP) continuity of care is important in achieving optimal outcomes in trauma patients, but the optimal length of the TAP rotation is unknown. We hypothesize that longer TAP rotations provide greater TAP continuity, and therefore improved outcomes.

METHODS: We conducted a retrospective review of two consecutive 6-month time periods during which we changed from a one-month TAP rotation (January – June 2006) to a one-week TAP rotation (July – December 2006). We then compared the following outcome variables to determine any outcome differences between the 2 time periods: Injury Severity Score (ISS), hospital length of stay (LOS), intensive care unit length of stay (ICU-LOS), morbidity, mortality, and violations of the standard of care (SOC). Statistical analysis consisted of the Wilcoxon rank sum test, and the chi-square test, with significance defined as $p < 0.05$.

RESULTS: 1959 patients were admitted to the Trauma Service over the 12-month study period. ISS, morbidity, mortality, % standard of care violations, and ICU-LOS were similar between the 2 groups, while the one-week TAP rotation was associated with a statistically significantly longer LOS (Table).

	One Month Rotation	One Week Rotation	p-value
# of patients	930	1029	
ISS	15.28	15.61	0.094
LOS (days)	7.86	8.30	0.002*
ICU-LOS (days)	2.61	2.64	0.491
Morbidity (%)	295 (31.7%)	292 (28.4%)	0.107
Mortality (%)	65 (7.0%)	73 (7.1%)	0.928
SOC Violations (%)	8 (0.9%)	9 (0.9%)	0.973

CONCLUSIONS: A one-week TAP rotation was associated with a statistically significantly longer LOS compared to a one-month TAP rotation, but overall quality of care (morbidity, mortality) was similar. We believe that the shorter TAP rotation may predispose to reduced TAP continuity, and therefore longer hospital lengths of stay.

THE ACOUSTIC RESUSCITATION MONITOR: A NEW TOOL FOR DIAGNOSING AND MONITORING HEMORRHAGIC SHOCK

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Objective: Early detection of hypovolemia is essential in reducing the morbidity and mortality of hemorrhagic shock. Noninvasive acoustic assessment of blood flow has shown promise as a diagnostic tool in studies of patients with traumatic brain injury. We hypothesized that acoustic monitoring might also be of value in acute hemorrhage, with turbulence of blood flow seen with increasing vasoconstriction in the arterial tree. We report on evaluation of an Acoustic Resuscitation Monitor (ARM) built to test this theory.

Methods: Patients presenting with suspected hypovolemic shock (SBP < 90mmHg) underwent acoustic measurement at the radial and digital arteries. ARM data and other demographic and physiologic parameters, including heart rate, blood pressure, serum lactate and calculated shock index (SI) were collected upon admission, at the end of active hemorrhage and at intervals up to 24 hours after admission. Collection of ARM data required less than 2 minutes per patient, and did not impede indicated care.

Results: Fifty-three eligible patients were enrolled, with mean age 42.9 ± 18.7 yrs. 45/53 (85%) were male. Average data from admission and at definitive control of hemorrhage are presented in the Table. Fingertip Acoustic Ratio is one of several ARM-derived variables: a higher value indicates stronger and more coherent arterial flow.

Parameter	Admission	End of Bleeding	t-test
Heart rate	99.1 ± 19.5	96.7 ± 19.8	0.368
Systolic blood pressure	111 ± 28.6	126 ± 23.6	0.018
Serum lactate	5.95 ± 3.3	3.12 ± 1.7	< 0.001
Shock index	0.932 ± 0.27	0.79 ± 0.02	0.003
Fingertip Acoustic Ratio	2.12 ± 0.79	2.71 ± 2.5	< 0.001

Conclusion: These data demonstrate a correlation between ARM derived vascular flow parameters and traditional markers for resuscitation. Return of acoustically-normal blood flow in the fingertip is a sensitive and easily monitored indicator of successful resuscitation. Further study of noninvasive acoustic technology in hemorrhaging trauma patients is warranted.

LUNG INJURY IS POTENTIATED FOLLOWING ENTEROCYTE EXPOSURE TO ALCOHOL, BACTERIA AND SHOCK CONDITIONS IN VITRO

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Introduction: Acute ethanol (EtOH) intoxication, a frequent underlying condition in trauma patients may increase infectious complications and exacerbate pulmonary failure in these patients. Gut ischemia/reperfusion insults are likely in severe trauma; when combined with EtOH these insults may act synergistically to cause pulmonary failure and post-traumatic ARDS. We studied this possibility using human pulmonary microvascular endothelial cells (HMVEC) exposed to supernatants from Caco-2 enterocyte cultures held under varying conditions *in vitro*.

Methods: Polarized Caco-2 monolayers were challenged with *E. coli* C-25 (EC), 0.1% EtOH under normoxia (21%O₂) or with hypoxia (5%O₂) followed by reoxygenation (H/R). Basal chamber supernatants were collected and used to treat confluent HMVEC monolayers (confluence measured by transmembrane epithelial electrical resistance or TEER). HMVEC apoptosis was determined by staining with Hoechst 33258 and confirmed using Flow cytometry. Monolayer integrity was assessed by permeability to FITC-dextran (10,000mw) and the change in TEER (ΔT) measured at T=0 min. and T=90 min.

Results: (mean \pm SD, N=4)

Group	% Apoptosis (Hoechst)	% Apoptosis (Flow cytometry)	% Permeability	TEER (ohms) ΔT
Caco-2 Cells only	4.0 \pm 0.3	4.1 \pm 0.3	20.1 \pm 1.8	2 \pm 1.5
Caco-2 sup+EC	8.9 \pm 0.6#	9.0 \pm 0.4#	28.4 \pm 1.4#	11 \pm 2.5#
0.1% EtOH+EC	12.1 \pm 0.7#	13.0 \pm 0.3#	29.2 \pm 2.1#	15 \pm 1.8#
H/R sup	10.4 \pm 0.7#	11.1 \pm 0.4#	24.5 \pm 1.3#	12 \pm 2.2#
H/R sup+EC	13.5 \pm 0.5#	15.9 \pm 0.7#	30.6 \pm 1.7#	16 \pm 3.4#
0.1%EtOH+H/R+EC	32.5 \pm 1.6*	34.1 \pm 0.9*	90.6 \pm 3.2*	33 \pm 4.5*

*p<0.001 vs. All groups, #p<0.001 vs. Caco-2 cells only

Conclusion: A synergistic effect of EtOH and enterocyte H/R on lung injury was noted. The presence of bacteria representative of normal gut flora led to further lung injury in this model. Elucidation of the interaction of this triad may contribute to a better understanding of lung failure in this setting.

TASER® X26 DISCHARGES IN SWINE: CARDIAC RHYTHM CAPTURE IS DEPENDENT ON DISCHARGE VECTOR

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Objectives: Our previous studies indicate that TASER X26 stun devices can acutely alter cardiac function in swine. We hypothesized that all trans-cardiac discharge vectors, and even some vectors that do not traverse the heart, would capture cardiac rhythm causing ventricular tachycardia (VT) and sometimes fibrillation (VF). **Methods:** Using an IACUC approved protocol, 4 Yorkshire pigs (25-36 kg) were anesthetized, paralyzed with succinylcholine (2 mg/kg), and then exposed to 5-10 sec discharges from a police-issue TASER X26. For each vector studied, the barbed darts were pushed manually through the skin to their full depth (~3/8") and were arranged in either trans-cardiac (a straight line connecting the darts would traverse the heart) or non-trans-cardiac vectors. A total of 13 different vectors were studied. For each, the current emitting dart was shifted so that discharges from each dart were tested. Thus, the location of the current emitting dart relative to the heart was changed and the direction of current flow during the discharge was reversed without physically moving either dart. Echocardiography, ECGs, and vital signs were monitored **before, during, and after** all discharges. P values < 0.05 were considered significant. **Results:** ECGs were unreadable during discharges due to electrical interference, but echo images showed that cardiac rhythm was captured immediately in 47% (25 of 53) of the ventral discharges but in none (0 of 8) of the dorsal discharges. Echo showed capture of the ventricular rhythm with rapid ventricular contractions consistent with VT/ventricular flutter during the entire discharge. A total of 25 discharges were administered with trans-cardiac vectors and capture occurred in 21 of these (84% capture rate). A total of 28 ventral discharges were administered such that the heart was **not** interposed between the darts and capture was seen in 4 of these (14% capture rate). **VF was seen with 2 vectors, both trans-cardiac.** In the remaining animals that showed capture, VT occurred post-discharge until sinus rhythm was regained spontaneously. **Conclusions:** In swine, trans-cardiac TASER X26 vectors were far more likely to **immediately** capture myocardial rhythm than were non-cardiac or dorsal vectors. This capture sometimes degenerated into VF. Myocardial capture must be considered to be a potential factor in some of the TASER-associated sudden deaths occurring in humans.

GLUCOSE LEVELS AND ENTERAL SUPPLEMENTATION WITH B-HYDROXY-B-METHYLBUTYRATE, ARGININE AND GLUTAMINE IN CRITICALLY ILL TRAUMA PATIENTS

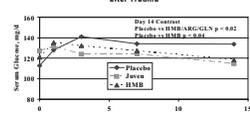
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Objective: Enteral supplementation with B-hydroxy-B-methylbutyrate (HMB) and a combination of HMB, arginine (ARG) and glutamine (GLN) has previously been shown to improve nitrogen balance in critically injured adult trauma patients compared to those who received a placebo supplement (PLAC). The purpose of this study was to determine the impact of HMB and the commercially available combination of ARG/GLN/HMB on glucose levels in critically injured trauma patients. We hypothesized that patients supplemented with HMB and HMB/GLN/ARG would have lower glucose levels than those supplemented with PLAC.

Methods: 100 adult trauma patients with ISS>18 were enrolled in this prospective, randomized, blinded study. All patients received standard tube feeds and one of three isonitrogenous, isocaloric supplements: HMB, HMB/ARG/GLN or PLAC for 28 days. Glucose levels and insulin administration were measured on Study Days 0, 1, 3, 7 and 14.

Results: The three groups were similar in age, gender, mechanism and severity of injury with an average ISS of 31.9. Using covariant (ISS) repeated measure (days 0-14) mixed model (SAS) analysis, there was a significant treatment effect for HMB/ARG/GLN (p<0.02) and for HMB (p<0.04) on serum glucose levels. When adjusted for the presence or absence of insulin administration, the treatment effect for HMB/ARG/GLN remained (p<0.04) and for HMB alone did not reach statistical significance (p<0.09).

Effect of HMB or HMB/ARG/GLN Supplements on Serum Glucose after Trauma



Conclusion: In critically ill adult trauma patients, those who received HMB or HMB/ARG/GLN supplements had lower serum glucose levels than control patients. When adjusted for insulin administration, the treatment effect was maintained for the HMB/ARG/GLN group.

INCREASING RESIDENT RESPONSIBILITY: THE IMPACT ON TRAUMA PATIENTS

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Objective: Each academic year there is a graduated increase of resident responsibility in leadership, managerial, and educational roles. The greatest change occurs in transition from junior to senior resident in terms of leading a service. No formal education is provided and these roles are learned through experience. Therefore what impact does this have on patients on a busy, resident-managed, attending supervised trauma service? **Methods:** A retrospective review from 2001-06 was performed using the NTRACS database at a University Level I Trauma Center. On July 1 of each academic year PGY3 residents matriculate to PGY4. The majority of PGY3s spend the year in the lab and PGY4s spend six months on the trauma/critical care service where they provide the main leadership, managerial, and educational roles. Attending staff and a PGY6 provide guidance and assist with patient care. Trauma patients admitted July-September (early) were compared with those admitted April-June (late). Demographics, admission characteristics, hospital course, morbidity and outcomes were examined. Chi square and Student's t-test were utilized to demonstrate significance. **Results:** From 2001-06 a total of 2,120 patients were admitted early and 2,268 late. Age, gender, mechanism of injury, admission GCS, injury severity score and ICU admissions were similar between groups. Morbidities including respiratory failure, pneumonia, urinary tract infection, decubitus ulcer, acute renal failure, sepsis, deep venous thrombosis/pulmonary embolism and central line infection were statistically similar as well. Mortality rates did not differ either. While hospital lengths of stay were similar, vent days and ICU days were shorter in the late period (7.73 +/- 13.18 vs. 6.80 +/- 9.72; p = .008) and (6.70 +/- 10.1 vs. 5.85 +/- 7.73; p = .0019) respectively. **Conclusion:** Despite no formal educational process, with attending and chief resident guidance there are no significant effects on the morbidity and survival of trauma patients as resident responsibility is increased. With experience ventilator and ICU days can be reduced.