ROUTINELY REPEATED HEAD CT AFTER BLUNT TRAUMA: DOES IT BENEFIT PATIENTS?

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Introduction: Although head CT scans (HCT) are an integral part of management of patients with blunt head trauma, the validity of repeated HCT for "follow-up", has not been defined.

Hypothesis: In the absence of clinical indications, data from routinely repeated HCT, even in patients with significant injury, do not contribute to patient care.

Methods: Retrospective review of trauma registry records, at a Level I Trauma Centre, from 6/97-6/01 was done. Patients with severe blunt head injury, (AIS $\geq$ 3), admitted to the ICU and having a routine follow-up, repeat HCT were included. Those who had initial craniotomy or repeat HCT >72 hours after admission were excluded. Among data recorded were age, time to initial (CT1) and repeat HCT (CT2), indications and findings of HCT. Additional data included interventions made, GCS (admission and at CT2), occurrence of hypotension, coagulopathy or elevated ICP and patient outcome.

Results: Entry criteria were met in 393 patients. Most were injured in MVC, the average age was 36 years, mean GCS was 9. Mean time to CT1 was 87 min, and to CT2 22.1 hours. Follow-up HCT showed worsening in 57 (14%). Ten patients had action taken because of the worsening HCT. Five had only another HCT. Three patients had ICP monitors placed, and one patient each had a ventriculostomy and craniotomy. All patients undergoing these interventions also had either history of coagulopathy, hypotension, ICP elevation or change in GCS from admission.

Conclusions: In the absence of clinical indicators or comorbidities, repeat HCT after blunt head injury does not alter patient management and could be omitted from routine practice.

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CEREBRAL HYPOXIA IN SEVERE BRAIN INJURED PATIENTS IS ASSOCIATED WITH ADMISSION GCS, CT SEVERITY, CPP AND SURVIVAL

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Objective: The study purpose was to determine the relationship of cerebral hypoxia with admission GCS, brain CT severity, CPP, and survival in patients with severe brain injury.

Methods: CPP and Somanetics' non-invasive, transcranial oximetry ($StcO_2$) were recorded hourly for six days in patients with GCS ≤8 and intracranial hemorrhage. CT score equaled midline shift (0/1) + abnormal cisterns (0/1) + SA14 (0/1), range 0-3.

Results: Brain CT: shift 10 (56%), abnormal cisterns 14 (78%), SAH 9 (50%), EDH 2 (11%), SDH - 11 (61%), contusion - 17 (94%). Craniotomy was performed in 10 (56%).

	Patients	Observations	ICP ≥ 20	CPP < 70	$StcO_2$ < 60
GCS 3-4	11	2354	32.6%	17.7%	26.5%
GCS 5-7	5	936	21.2%	13.5%	12.4%
GCS 8	2	432	0.0%	4.2%	2.8%
CT score 2/3	11	2319	33.1%	19.7%	26.4%
CT score 0/1	7	1403	14.1%	7.5%	10.0%
Died	3	731	41.0%	40.8%	36.1%
Lived	15	2991	22.2%	8.8%	16.3%

$StcO_2$ <60 rates were greater with decreasing GCS, higher CT scores, and death. Admission GCS, CT score, mortality, and discharge GCS were each independently associated with both $StcO_2$ and CPP (P <0.05). Rate of CPP <70: $StcO_2$ <60 - 33%; $StcO_2$ ≥ 60 - 10% (OR 4.3, P <.01). Despite CPP ≥ 70, $StcO_2$ <60 rate was 16%.

Conclusions: Cerebral hypoxia was more frequent with decreased admission GCS and more severe CT findings. Brain oxygenation was poorer with lower discharge GCS, death, and decreased CPP. Cerebral hypoxia was common despite CPP ≥70. $StcO_2$ values provide real-time, non-invasive, prognostic information independent of CPP.

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CEREBRAL CORTICAL OXYGENATION: A PILOT STUDY

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Introduction: Cerebral hypoxia ($P_{br}O_2$<20mmHg) monitored by direct measurement (Licox®-Boston, MA) has been shown in animal and small clinical studies to be associated with poor outcome. We present our preliminary results observing cerebral cortical oxygenation ($P_{br}O_2$) in patients with traumatic brain injury (TBI).

Methods: A prospective observational cohort study was performed. Institutional IRB approval was obtained. All patients with TBI who required measurement of intracranial pressure (ICP), cerebral perfusion pressure (CPP) and Pbr02 due to GCS <8 were enrolled. Datasets (ICP, CPP, $P_{br}O_2$, PEEP, P_aO_2, P_aCO_2) were recorded during routine manipulation. Episodes of regional cerebral hypoxia were compared to periods without. Results are displayed as mean±SEM. T-test, chi-square, and Fischer's exact test were used where appropriate.

Results: 181 datasets were abstracted from 20 patients. 35 episodes of regional cerebral hypoxia were identified in 14 patients.

	$P_{br}O_2$<20mmHg	$P_{br}O_2$≥20mmHg	P value
Datasets	35	146	
ICP	13.5±0.6	16.3±0.5	0.058
CPP	72.4±1.8	73.5±1.0	0.813
PEEP	8.8±0.7	7.1±0.3	0.002
P_aO_2	144±14	165±8.1	0.001
P_aCO_2	41±1.6	35±0.5	0.073

Using a univariate analysis, episodes of regional cerebral hypoxia were associated with P_aO_2 <100 mmHg and PEEP >5 ($p<0.05$), but not ICP >20, CPP <65 or P_aCO_2 <35.

Conclusion: Occult cerebral hypoxia may be present in the traumatic brain injured patient despite normal traditional measurements of cerebral perfusion.

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INITIAL HEAD COMPUTED TOMOGRAPHY (CT) CHARACTERISTICS HAVE A LINEAR RELATIONSHIP WITH INITIAL INTRACRANIAL PRESSURE (ICP) POST-TRAUMA

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Background: Despite current American Association of Neurological Surgeons (AANS) recommendations, advances in CT technology have led to the suggestion that increased ICP may be predicted by findings on admission head CT scan and patients without such findings do not require invasive ICP monitoring.

Hypothesis: A linear relationship exists between characteristics of admission head CT and initial ICP level, allowing for selective placement of invasive ICP monitor.

Methods: From 1997 to 2001, a retrospective review of patients admitted with a Glasgow Coma Score (GCS) <8 and head CT, who underwent ventriculostomy placement (VP) at our institution, was conducted. Patients undergoing craniotomy with evacuation of mass lesions prior to VP were excluded. Age, sex, mechanism of injury, initial GCS, osmotic treatment, and presence of drugs/alcohol were recorded. Initial head CTs were reviewed independently by two neuroradiologists who were blinded to ICP measurements, neurosurgical treatment, patient outcome, and each other's interpretation. Initial CTs were evaluated and scored on a 1 (normal) to 3 (abnormal) scale with respect to ventricle size (VS), basilar cistern size (BCS), sulci size (SS), degree of transfalcine herniation (TH), and gray/white matter differentiation (GW). Initial ICP readings and CT findings were compared to determine if a significant linear relationship existed between above CT findings and ICPs. ANOVA was used to compare averaged radiologist score vs. mean ICP at baseline.

Results:

Mean Score	VS ICP (n)	BCS ICP (n)	SS ICP (n)	TH ICP (n)	GW ICP (n)
1.0	16.19(42)	16.56(34)	16.86(29)	17.75(52)	18.57(63)
1.5	19.43(14)	20.13 (15)	15.36(14)	18.63(8)	19.31(13)
2.0	26.73(22)	20.72(18)	20.97(29)	27.90(20)	42.20(5)
2.5	37.00(4)	47.00(6)	33.33 (6)	29.00(2)	
3.0	---	18.67(9)	44.00(4)	---	---

(n) = number of patients at that score; ---- = no values at that score.

Conclusions: Initial CT characteristics show a linear relationship to baseline ICPs. These findings are associative, but not uniformly predictive. Therefore, current AANS recommendations should be followed.

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THE IMPACT OF HYPOXIA AND HYPERVENTILATION ON OUTCOME FOLLOWING PARAMEDIC RSI OF SEVERELY HEAD-INJURED PATIENTS

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Background: The reasons for previously documented increases in mortality associated with paramedic RSI of severely head-injured patients have been unclear. This analysis explores the impact of hypoxia and hyperventilation on outcome.

Methods: Adult severely head-injured patients (GCS 3-8) unable to be intubated without neuromuscular blockade underwent paramedic RSI using midazolam and succinylcholine; rocuronium was administered following confirmation of tube position. Standard ventilation parameters were used for most patients; however, one agency instituted use of digital end-tidal CO_2 ($ETCO_2$) and oxygen saturation (SaO_2) monitoring during the trial. Each patient undergoing digital $ETCO_2$/SaO_2 monitoring was hand-matched to three historical non-intubated controls based on age, gender, mechanism, and AIS scores for each of six body regions. Logistic regression was used to explore the impact of oxygen desaturation. during laryngoscopy and post-intubation hyperventilation and hypoxia on outcome. Trial patients and controls were also compared with regard to mortality and the incidence of "good outcomes" using odds ratio analysis.

Results: Of the 426 trial patients, a total of 59 underwent $ETCO_2$/SaO_2 monitoring; these were hand-matched to 177 controls. Logistic regression revealed an effect on mortality for post-intubation hyperventilation and hypoxia; oxygen desaturation during laryngoscopy did not appear to adversely affect outcome. Mortality was 41 % for trial patients vs. 22% for controls (OR 2.51, 95% CI 1.33-4.72; p=0.004); "good outcomes" were observed in 42% of trial patients vs. 58% of controls (OR 0.52, 95% CI 0.29-0.96; p=0.035).

Conclusions: Hypoxia and hyperventilation following paramedic RSI are associated with an increase in mortality; pre-intubation desaturations did not appear to affect outcome. RSI can be harmful though it is intended to do no harm.

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DECOMPRESSIVE LAPAROTOMY TO TREAT INTRACTABLE INTRACRANIAL HYPERTENSION AFTER TRAUMATIC BRAIN INJURY

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Introduction: Increases in intra-abdominal pressure (IAP) can cause increases in intracranial pressure (ICP). Recently, we noticed that abdominal fascial release could be useful in treating intra-cranial hypertension (ICH) after traumatic brain injury (TBI). We added this as an option in our treatment for TBI.

Methods: In our institution, ICH is treated with an algorithm using osmolar therapy, CSF drainage and barbituates. Patients with refractory ICH have routine measurement of IAP. If elevated, consideration is given to decornpressive laparotorny. We retrospectively reviewed all patients who had abdominal decompression to treat refractory ICH.

Results: From 11/01 to 12/02 10 patients underwent decornpressive laparotorny for intractable ICH. Nine were male and all sustained blunt injury. All had failed maximal therapy including 3 who had had decornpressive craniectomy. Mean ICP was 31.9mm Hg (range 26-40mmHg). No patients had evidence of abdominal cornpartment syndrome (ACS). Prior to decornpression mean IAP was 27.7mmHg (range 23 to 37mmHg). After abdominal decompression ICP dropped precipitously by at least 10mmHg to a mean of 13.1mmHg (range 10 to 19mmHg). 1 in 3 patients the decrease in ICP was transient. All died. The remaining 7 had sustained decreases in lCP. All survived, made neurologic progress and were discharged to a rehabilitation facility.

Conclusion: Decompressive laparotorny can be a Useful adjunct ill the treatment of ICH failing maximal therapy following TBI. More work will need to be done to precise the exact indications for this therapy.

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MINOR HEAD INJURY IN ANTICOAGULATED PATIENTS

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It has long been held that mortality from severe head injury (HI) is significantly higher in medically anticoagulated (AC) patients. Such is difficult to prove as AC utilization is especially prominent in those over 65 and advancing age is an extremely powerful predictor of poor outcome. Such, however, is not the case with minor HI - GCS 13-15.

A series of 110 prospectively studied AC head injured patients was collected from 1995-2002. Twenty-eight presented with a GCS 13-15, with ages from 40-75 years - mean 63. Twelve underwent head CT on initial emergency department evaluation, only two being abnormal both with traumatic subarachnoid hemorrhage. Seventeen were admitted for observation of their HI and/or treatment of other injuries. Within 8-18 hours - mean 12 hrs - of initial presentation all 28 deteriorated to a GCS <10. CT showed contusions in 21%, intracerebral hemorrhage in 39%, subdural hemorrhage in 28% and combined pathologies in 12%. INR's ranged from 2.9-9.5 - mean 4.6. Twenty patients had surgical evacuation of mass lesions. Mortality was 89%.

Minor HI and supratherapeutic AC may be a lethal combination even with an initially normal CT scan. In this setting consideration should be given to hospital admission for frequent neurological examinations, routine repeat CT scan within 12 hours of injury and reversing AC to therapeutic levels.

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CT ANGIOGRAPHY IS AN EXCELLENT SCREENING TEST FOR BLUNT CEREBROVASCULAR INJURY

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Background: Blunt cerebrovascular injury (BCVI) carries a high morbidity and mortality, especially when diagnosis is delayed. Recent studies have shown that increased recognition of these injuries is achieved with prompt screening, allowing for early treatment and better outcome. Controversy still exists, however, on the best screening test. This study was employed to evaluate the role of helical CT angiography of the carotid and vertebral arteries (CTACV) in the early screening of BCVI.

Methods: All patients deemed at risk for BCVI underwent CTACV within 24 hours of admission. Patients with a negative CTACV underwent no further radiological evaluation for the cerebral vasculature. Those patients with positive or equivocal CTACV underwent four vessel cerebral angiography as a confirmatory test. Data were collected on the radiological interpretation of all studies and patient clinical course.

Results: 403 patients met the criteria for screening and underwent CTACV. 12 patients were diagnosed with 14 BCVI during the period of study. There were 5 carotid injuries and 9 vertebral injuries. All 12 of these patients with BCVI were screened with CTACV. 11 patients were asymptomatic at the time of screening.

CTACV	Pts. w/ BCVI	Patients w/o BCVI	Total
Abnormal	12	29	41
Normal	0	362	362
Total	12	391	403

CTACV for BCI: Sensitivity=100%, Specificity=92.6%, Prevalence=3.0%, Positive Predictive Value=29.3%, Negative Predictive Value= 100%.

No patient with a negative CTACV was subsequently found to have a missed injury.

Conclusion: CTACV is an excellent test to screen for BCVI.

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THE INFLUENCE OF SIDE AIR BAGS ON THE RISK OF HEAD AND THORACIC INJURY FOLLOWING MOTOR VEHICLE COLLISIONS

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Background: Near-side impact motor vehicle collisions (MVQ are more lethal than other collision types. These collisions increase the likelihood of occupant contact with interior and exterior structures and the limit energy dissipation afforded by frontal collisions. Side air bags (SAB) were developed as an energy-absorbing barrier to protect specific occupant body regions. No population-based study has evaluated whether SAB actually reduce the risk of head or thoracic injury.

Methods: The National Automotive Sampling System Crashworthiness Data System (CDS); a national probability sample of passenger vehicles involved in police-reported tow-away MVC, was used to evaluate drivers and front-seated passengers in 1998 or newer vehicles involved in near-side impact MVC. The presence of an SAB was established by cross-referencing the make, model and year of vehicles in the CDS with a list of known vehicles with SAIB. Risk ratios (RR) and p-values were calculated comparing injury risk among occupants in vehicles with and without SAB while adjusting for age, seat belt use, and collision severity.

Results: Occupants in vehicles equipped with SAB had a 49% lower risk of head injury following near-side MVC; however this association was not of statistical significance (p=0.15). When stratified by magnitude of compartment intrusion, a statistically significant risk reduction was observed among vehicles with moderate (≥15 cm) (RR 0.21; p=0.02) but not minor (<15 cm) (RR 0.60; p=0.21) intrusion. With respect to thoracic injury, SAB availability in near-side MVC was associated with an 80% (p=0.01) reduction in injury risk regardless of the magnitude of compartment intrusion.

Conclusion: The results of this study suggest that in near-side collisions, SAB availability is associated with a reduced risk of head injury, particularly in collisions that produce significant intrusion, and thoracic injury. As SAB-equipped vehicles become an increasingly larger segment of the on-road vehicle fleet, the impact of head and thoracic injury following near-side impact MVC is likely to be reduced.

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HEPATOCYTE GROWTH FACTOR IN POLYMORPHONUCLEAR LEUKOCYTES IS INCREASED IN PATIENTS WITH SIRS

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Background: Hepatocyte growth factor (HGF) has a significant regenerative effect on epithelial and endothelial cells, and numerous studies have shown the role of HGF in wound healing and organ regeneration. Recently it has been revealed that polymorphonuclear leucocytes (PMNLs) store HGF in their specific granules, and HGF can be degranulated in the inflammatory tissue where activated PMNLs are migrated. The objectives of this study were to evaluate the storage of HGF in PMNLs from patients with systemic inflammatory response syndrome (SIRS) and to examine the role of HGF from PMNLs in inflammatory process following severe insults.

Patients and Methods: Sixteen patients with SIRS (serum CRP 20.3±13.3 mg/dL) and 14 healthy volunteers were studied. HGF in PMNLs was measured by flow cytometry by using a monoclonal antibody to HGF. The Oxidative activity in PMNLs was also measured by flow cytometry. Serum HGF, IL-6, IL-8 levels in each patient were measured by ELISA.

Results: Immunocytochemistry under fluorescence microscopy revealed enhanced expression of HGF in the granules of PMNLs. HGF in PNMLs significantly increased in patients with SIRS compared with that in healthy volunteers. FMLP and LPS stimulation induced further increase of HGF fluorescence in PMNLs in patients. Oxidative activity in PMNL was also significantly enhanced in patients with SIRS.

Serum HGF (sHGF) and IL-6, IL-8 levels in patients positively correlated (sHGF and IL-6; γ=0.614, $p<0.05$, sHGF and IL-8; γ =0.782, $p<0.01$), but these values did_not correlate with HGF in PMNLs.

	HGF	+FMLP	+LPS	O_2 production
SIRS	163.4±26.2*	199.5±28.5*	196.4±28.5*	108.2±29.9**
Normal	127.4±13.7	164.5±13.6	159.5±11.0	80.3±25.8

(Fluorescence/cell) mean±SD, *$p<0.01$, **$p<0.05$ vs. normal

Conclusions: Activated PMNLs in SIRS patients store increased HGF in their granules. The release of HGF from migrated PMNLs in the inflammatory tissue may contribute to wound healing and organ regeneration following severe insults.

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PROTOCOL-DRIVEN VENTILATOR WEANING REDUCES USE OF MECHANICAL VENTILATION, RATE OF EARLY REINTUBATION AND VENTILATOR-ASSOCIATED PNEUMONIA

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Introduction: Mechanical ventilation is the defining event of intensive care unit management. To reduce utilization, a literature-based protocol was introduced to facilitate weaning. The effect of protocol-driven ventilator weaning on ventilator use, ventilator-associated pneumonia (VAP), and ICU length of stay (LOS) is described in a survey of two years activity in a multidisciplinary surgical ICU (SICU).

Methods: Data was gathered from April to September, 2000 and April to September, 2002 before and after introduction of nurse/therapist driven weaning. VAP was identified by chest x-ray, clinical presentation and cultures from tracheal aspirates or bronchoalveolar lavage. Infectious disease practitioners diagnosed VAP. Failed extubation was defined as reintubation within 72 hours.

Results: Overall, there was a 2:1 ratio of males to females. The total number of patients and days of mechanical ventilation increased but utilization ratio (ventilator days/ICU days) fell from 0.47 to 0.33. Patients failing extubation fell from 43 (2000) to 25 (2002). From these patients, 17 cases of VAP occurred in 2000 and 5 in 2002. Mean age (40 yrs). ISS (24) and ICU LOS (5.7 to 7.4 days; p=NS) were unchanged in injured patients. ICU discharge was frequently delayed due to need for subsequent respiratory care.

Conclusion: Protocol-driven weaning reduces utilization of mechanical ventilation and VAR Injured and general surgical patients show reduction in complications, but shorter ICU LOS depends on resources elsewhere in the healthcare system.

Patients	2000	VAP	2002	VAP
Trauma Δ	29	8	27	3
CHIΔ	54	12	63	6
Gen Surg*	51	12	58	2
N Surg	15	6	17	2
Cv	165	9	171	5
TOTAL*	314	47	336	18
Δ $p < 0.05$ for Trauma + CHI * $p < 0.02$				

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INJURIOUS MECHANICAL VENTILATION (IMV) PREFERENTIALLY DAMAGES THE NON-DEPENDENT LUNG

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Introduction: It is postulated that a disproportionate amount of each tidal breath is distributed to the non-dependent lung due to its high compliance, increasing its susceptibility to ventilator induced lung injury (VILI). We utilized in vivo microscopy and hypothesized that during IMV, the non-dependent lung will be preferentially damaged as evidenced by the development of alveolar recruitment/derecruitment (R/D). In addition, we hypothesized that positive end expiratory pressure (PEEP) would prevent R/D in both dependent and non-dependent regions.

Methods: Sprague-Dawley rats (n=15) underwent thoracotomy, were placed on IMV (Ppeak 45cmH_2O), and randomized into 4 groups with either Dependent or Non-dependent lung filmed: Dependent (D, n=4, PEEP 3cmH_2O), Dependent+PEEP (DP, n=3, PEEP 10cmH_2O), Non-Dependent (ND, n=5, PEEP 3cmH_2O), Non-dependent+PEEP (ND, n=3, PEEP 10cmH_2O). The area of individual alveoli was measured by computer image analysis at peak inspiration (I) and end expiration (E) at Baseline and at 90 minutes. Alveolar R/D was assessed by change in alveolar area during tidal ventilation, termed I-EΔ (high I-EΔ=R/D). Data were analyzed by ANOVA and reported as mean +/- SE.

Results: The ND and D groups developed a significant rise in I-EΔ compared to Baseline. At 90 minute, there was a significant increase in I-EΔ in ND compared to D which was prevented by the addition of PEEP (see table).

Conclusions: To our knowledge, this is the first study demonstrating that IMV preferentially damages the nondependent lung. Furthermore, PEEP protected the entire lung from the development of alveolar R/D.

Alveolar Stability (I-EΔ)		
	Baseline	90 Minutes
Non-Dependent (ND)	171±75 μm^2	5,021±521 μm^2 * †
Dependent (D)	315±124 μm^2	1,711±367 μm^2 *
Non-Dependent + PEEP (NDP)	200±106 μm^2	97±84 μm^2 #
Dependent +PEEP (DP)	317±122 μm^2	80±109 μm^2 #

* = p<0.05 vs Baseline; †=p<0.05 vs Low PEEP Dependent; #=p<0.05 vs. Both Low PEEP Groups

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DECREASING VENTILATOR ASSOCIATED PNEUMONIA IN A TRAUMA ICU

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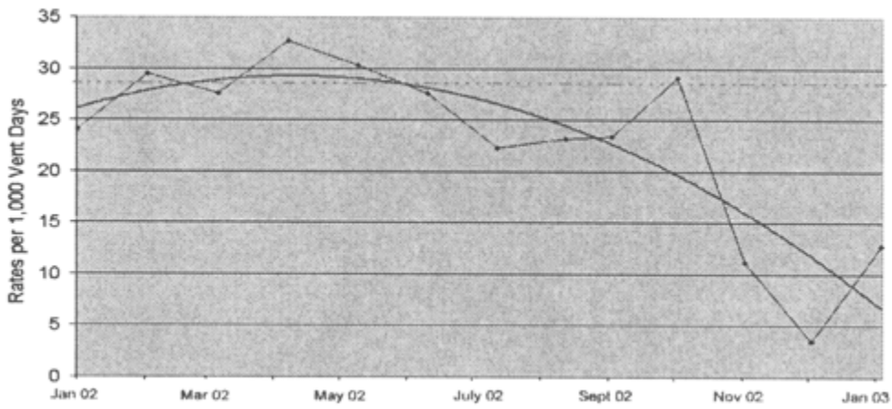
Ventilator-associated pneumonia (VAP) has been a continuing problem in our 20 bed Shock Trauma ICU situated in a busy, urban, level I trauma center. In June of 2002, we instituted a "Ventilator Bundle" (VB) which incorporates the CDC Guidelines for Prevention of Nosocomial Pneumonia and includes: head of bed elevation (ELE), endotracheal tube suctioning (ETS), hand washing (HW), peptic ulcer prophylaxis (PU), getting the patient out of bed (OOB), oral care (0Q, glove and non-permeable apron use (GA), use of sleeved Yankauers (SY), changing irrigation fluids daily (IF), chlorhexidine baths twice weekly (CHX) and strict glucose control (GC). Following failure of the VB to decrease VAP rates, we instituted a process measurement program in Sept 2002 that measured daily compliance with the VB. The STICU was given weekly compliance feedback and in-service education. The % of baseline/after intervention compliance for the VB elements were: ELE: 100/82.8, ETS: 33/44, HW: 100/48, PU:72/70, OOB:35/44, OC:37/79, GA 93/67, SY:65/90 and EF:36/39. Glucose control improved from 50% of fingerstick blood glucose >150mg/dL to 21%. After two months the VAP rates decreased from 23.4 to 11.2 episodes per 1000 ventilator days and stayed low at 3.5 in Dec 02 and 12.5 in Jan 03. Urinary tract and bloodstream infection rates also decreased.



Conclusion: process measurement programs that include continuous process measurement and feedback, as well as education, can decrease the rates of VAP and other nosocomial infections. Maintaining this improvement requires regular updates on compliance and education of new staff.

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THE APPROPRIATE DIAGNOSTIC THRESHOLD FOR VENTILATOR ASSOCIATED PNEUMONIA USING QUANTITATIVE CULTURES

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Introduction: The use of quantitative cultures of the bronchoalveolar lavage (BAL) effluent to distinguish between post-traumatic inflammatory response and ventilator associated pneumonia (VAP) is becoming more common. However, the diagnostic threshold of either 10^4 or 10^5 colonies/mL remains debatable. Since mortality from VAP is related to treatment delay, some have chosen a lower diagnostic threshold ($\geq 10^4$ colonies/mL). This may result in unnecessary antibiotic use with its sequelae: increased resistant organisms, antibiotic related complications, and increased costs. The purpose of this study is to determine the optimal diagnostic threshold for VAP diagnosis using quantitative cultures of the BAL effluent.

Methods: Data on patients with fiberoptic bronchoscopy (FOB) with BAL is maintained in a prospectively collected database at our Level I trauma center. This database was reviewed for timing and frequency of BAL and the colony counts of each organism identified. Indication for bronchoscopy was clinical evidence of VAP. VAP was defined as $\geq 10^5$ colonies/mL in the BAL effluent. A false negative BAL was defined as any patient who had $<10^5$ colonies/mL and developed VAP with the same organism up to 7 days after the previous culture.

Results: Over a 3 year period, 405 patients underwent 1077 FOB with BAL. 68% were male, 91% followed blunt injury, mean age and ISS were 42 and 28 respectively. Overall mortality was 15%. There were 1898 organisms identified (42% Gram+ and 58% Gram-). VAP was diagnosed in 38% of BAL. Overall, there were 36 isolates defined as being false negative (3%). There were 326 total isolates with 10^4 colonies that were present in 256 BAL. Of these 256 with 10^4, 88 (34%) had VAP due to other organisms, and 168 (66%) did not have VAR Of these 168, there were 4 defined as false negatives (2.4%). None had adverse outcome.

Conclusions: The VAP diagnostic threshold for quantitative BAL in trauma patients should be $\geq 10^5$ colonies/mL. Therapy for all patients with 10^4 organisms would result in unnecessary antibiotics in almost 98% of patients.

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ARDS CRITERIA IN TRAUMA PATIENTS: WHY THE DEFINITIONS DON'T WORK

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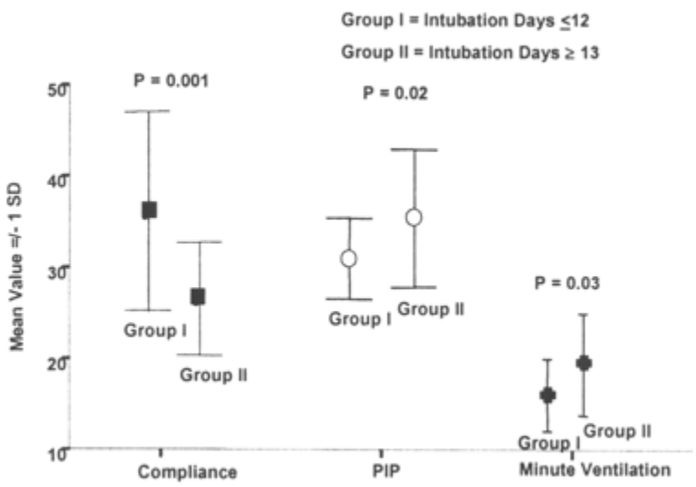
Introduction: The international consensus definitions for ARDS have formed the basis for recruitment into RCTs, and more recently, standardized the protocols for ventilatory treatment of acute lung injury. While possibly appropriate for sepsis-induced ARDS, these criteria may not be appropriate for post-traumatic ARDS if the disease patterns are widely divergent. This study tests the hypothesis that standard ARDS criteria applied to the trauma population will capture widely disparate forms of acute lung injury and are too non-specific to identify a population at risk for prolonged respiratory failure and associated complications.

Patients & Methods: Patients with ISS ≥16 ventilated for >12 hrs were prospectively enrolled. Clinical data including elements of cardiovascular, renal, hepatic, hematologic, neurologic, and pulmonary function were collected daily. 254 patients were enrolled over a 36 month period of which 70 met the consensus definitions of ARDS. Patients in whom support was withdrawn were excluded. The remaining 48 patients were divided into 2 groups based on the mean number of intubation days for all patients with ARDS (12±11) days.

Results: There was considerable disparity in severity and clinical course. A mild, limited form of ARDS was characterized by earlier onset (Group 1=2, Group 2=4 days, p=0.002), fewer intubation days (7 vs 23 days p=0.000) and less severe derangements in lung mechanics (See Figure 1). A significant difference between the 2 groups was also seen in WBC (13 vs 16 k, p=0.046).

Figure 1: Differences in Lung Mechanics



Conclusions: The criteria for ARDS, when applied to the trauma population, captures a widely disparate group and has poor specificity for identifying patients 'at risk'. Recruitment of trauma patients for ARDS studies or preemptive ventilatory management based solely on these criteria may be ill-advised.

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ARDS LEVELS OF HEAT SHOCK PROTEIN 60 MEASURED EARLY AFTER SEVERE INJURY CORRELATE WITH THE DEVELOPMENT OF ACUTE LUNG INJURY

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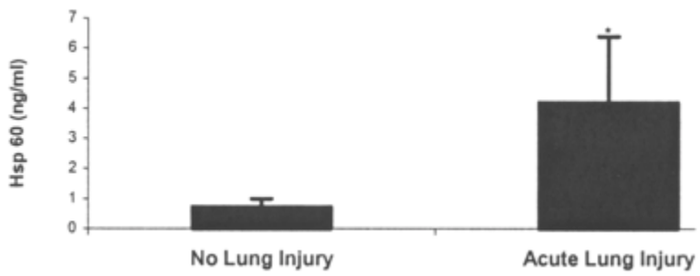
Previous studies have shown that heat shock protein 60 (Hsp 60) may be detected in the peripheral circulation of patients. Hsp 60 has also been identified as a danger signal for the immune system and appears to be a key endogenous inflammatory mediator generated in response to tissue injury, but no data are available for trauma patients. The purpose of this study was to determine whether Hsp 60 could be detected in the serum of patients early after severe trauma and whether its serum level might correlate with the development of acute lung injury (ALI) in trauma patients.

Patients & Methods: Clinical data were collected prospectively over a 12 month period for trauma patients mechanically ventilated for more than 24 hours who met the following inclusion criteria: ISS ≥16, age >18. Physiologic data for quantitative assessment of organ dysfunction were collected for each patient. Serum samples were obtained from severely injured trauma patients immediately after arrival in the ED and stored at -70ºC. Hsp 60 levels were measured by ELISA (Stressgen, Canada).

Results: Sixty-four patients with severe trauma were enrolled in the study. Eighteen patients developed ALI (28%). Fourteen patients died after trauma, five of them in the ALI group. Hsp 60 was detected in the serum of 61% of trauma patients with ALI and in 46% of trauma patients who did not develop ALI. Trauma patients who later developed ALI had a significantly higher serum values of Hsp 60 than those who did not (4.21±2.24 ng/ml versus 0.73±0.26ng/ml, $p<0.05$) (Mean±SE) (Figure).



Conclusions: This new data suggests that Hsp 60 can be detected in the serum of at least 50% of severely traumatized patients very early after injury. High early serum levels of Hsp 60 correlate with the development of ALI in these trauma patients making it a potential early marker for subsequent inflammatory lung injury.

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THERAPEUTIC POTENTIAL OF EXOGENOUS UBIQUITIN DURING RESUSCITATION FROM SEVERE TRAUMA

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Ubiquitin (Ub) is a 8.5 kDa highly-conserved protein with essential intracellular functions. Recent studies from animals and humans have demonstrated that extracellular Ub has cytokine-like, anti-inflammatory properties in a variety of conditions, including endotoxemia, sepsis and trauma. Initial observations suggest a therapeutic potential after endotoxemia, but its actions after trauma are unknown. Therefore, we studied the effect of iv Ub in a clinically relevant experimental model.

Methods: Anaesthetized, mechanically ventilated swine (4151kg) were instrumented with jugular vein, femoral and pulmonary artery catheters. After stable baseline conditions (t=0), bilateral femur fractures were produced by a captive bolt gun followed by hemorrhage (811±80 ml) to a mean arterial pressure (MAP) of 25±1 mmHg for 40 min. At t=40 min, 1.3mg Ub/kg (n=5) or albumin (Alb; n=5) was administered iv followed by Lactated Ringer's to maintain MAP $\geq$ 70 mmHg. An additional control group (n=4) received an iv bolus of Ub (1.3mg/kg) without trauma/hemorrhage. The immunomodulatory capacity of serum was assessed by measuring its effect (30% v/v) on LPS-evoked (100 ng/mL) TNFα production in normal whole blood *ex vivo*. TNFα and Ub were quantified with ELISA.

Results: After trauma/hemorrhage, iv Ub produced peak serum levels of 4168±1095 ng/mL with a half life of 1-2 hr. These levels produced no major effect on any hemodynamic variable without injury. However, after injury, the lactated Ringer's required to maintain MAP was significantly reduced with Ub vs Alb.

*:p<0.05 vs. Alb	0min	40min	70min	100min	130min	160min	220min
Ub iv fluid (mL/kg)	0	0	36±14	54±19	62±18*	71±19*	87±22*
MAP (mmHg)	88±3	25±0.8	69±6	70±2	75±3	73±3	75±4
Alb iv fluid (mL/kg)	0	0	54±19	107±24	137±24	166±25	218±36
MAP (mmHg)	77±4	25±0.4	68±2	72±2	70±4	70±2	72±3

As expected, after trauma/hemorrhage (t=40 min), serum reduced LPS-evoked TNFα production by 40-50%. With Ub, this response remained depressed for 100-160 min ($p<0.05$). In contrast, with Alb, the inhibitory serum activity fully recovered to baseline ($P>0.05$ vs. t=0 min for serum from t=70-220 min).

Conclusion: A single Ub bolus following bilateral femur fracture reduced diffuse capillary leak and modified leukocyte reactivity. These data further affirm the potential for Ub as an immunomodulatory therapy after severe injury.

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MICROVASCULAR PERFUSION ANALYSIS OF VITAMIN C AND E PROTECTION AFTER BURN INJURY VIA LASER DOPPLER IMAGING

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Introduction: Future improvements in resuscitation from burn injuries will transcend simply optimizing delivery and type of fluids. Pharmacologic manipulation of the host response to burned tissues can significantly reduce inflammation-derived cellular injury. Such an approach might prevent burn depth conversion during the period of resuscitation and diminish inflammation-related dysfunction in distant organs. Vitamin C and E appear to have different anti-inflammatory mechanisms when examined by measurement of burn wound microvascular perfusion with laser Doppler scanning.

Methods: The four arms in this study included burn injury with and without intravenous vitamin C, and with and without topical vitamin E treatments. A 30% TBSA rat model with graduated burn depths (n=40) was resuscitated with lactated Ringers at 4cc/kg/%TBSA. Serial laser Doppler imager scanning of perfusion at direct contact burns (zone of coagulation) and "watershed burns" (zone of stasis) was performed. Punch biopsies of both burn types were examined for histologic evidence of wound protection by the antioxidants.

Results: Both vitamin C and E histologically demonstrated burn wound protection during the experimental period. With respect to microvascular perfusion, their effects (mechanisms of action) differed: vitamin C and vitamin E diminished blood flow to direct contact burns ($p<0.05$ for 1-sec contact+vit. E, and for 8-sec.contact+vit. C). Vitamin C had little effect on watershed burn perfusion while vitamin E increased it.

Conclusion: 1) Both vitamin C and E provided histologic burn wound protection in this rat model. 2) Treatment with vitamin C or vitamin E lowered blood flow to direct contact burns. 3) Watershed burns treated with vitamin E demonstrated increased perfusion; vitamin C did not. 4) Differing microvascular mechanisms of action between vitamin C, vitamin E, and other as yet unstudied antioxidants may permit synergistic protection if employed together after burn injury.

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PRE-HOSPITAL INTUBATION SHOULD NOT MANDATE TRAUMA SURGEON'S PRESENCE UPON PATIENT'S ARRIVAL TO THE EMERGENCY DEPARTMENT

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Introduction: Current ACS/COT criteria for major resuscitation include pre-hospital respiratory compromise/obstruction/intubation or GCS<8 and mandate attending trauma surgeon's presence upon patient's arrival to the Emergency Department. A significant number of trauma patients arrive intubated with no physiologic compromise other than altered mental status, which is often influenced by intubation. We hypothesized that prehospital respiratory compromise and GCS<8 in the absence of other major criteria does not predict severe injury requiring major resuscitation.

Methods: Using prospectively collected data from our trauma registry, we identified all injured patients intubated in the field or upon arrival to the ED over an 12 month period ending Aug 2002. Patients meeting other ACS/COT criteria for major resuscitation (SBP<90, GSW to neck/chest/abdomen, transferred patients requiring blood transfusion to maintain vital signs and Emergency Physician discretion) were excluded.

Results: 2971 trauma patients were admitted to the ED during the study period; 338 were intubated of whom 283 met major criteria other than airway compromise or GCS<8. One was pronounced dead, and three were up-graded to major resuscitations upon arrival. Of the remaining 51 patients, 15 were intubated in the field, 30 in the ED, and 6 not recorded. Thirty four patients were found to have a field GCS<8, (+8 not recorded), 29 had an initial ED GCS<8 (+6 not recorded). Only one patient became hypotensive after admission as a result of an isolated GSW to the head. Three others required operations, two for head injury and one for intraabdominal injuries; the rest were admitted to the SICU.

Conclusions: Three patients required urgent care by a neurosurgeon but only one required urgent care by a trauma surgeon. Pre-hospital evidence of airway compromise in the absence of other major criteria rarely leads to major resuscitation or operation and alone should not mandate attending trauma surgeon presence upon patient arrival to the ED.

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OPINIONS OF TRAUMA PRACTITIONERS REGARDING PREHOSPITAL INTERVENTIONS IN CRITICALLY INJURED PATIENTS

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Introduction: We surveyed trauma surgeons regarding the appropriateness of field interventions in management of the airway and of shock.

Methods: A questionnaire describing clinical scenarios was mailed to a random sample of 345 members of the American Association for the Surgery of Trauma.

Results: Completed surveys were returned by 182 surgeons (52.7%). The surgeons predominantly practice general/trauma surgery (85.7%) in an academic setting (70.9%).

Scenario	Choice of Treatment	Choice of Treatment
Traumatic Brain Injury, GCS=7, <15 min from trauma center (TC)	Bag-valve-mask and transport: 32.4%	Attempt intubation at least once: 64.3%
Traumatic Brain Injury (TBI), GCS=7, 20-40 min from TC	Bag-valve-mask and transport: 5.5%	Attempt intubation at least once: 83%
Suspected TBI	Monitor pulse ox: 100%	
GSW torso, decompensated shock	Perform spinal immobilization: 34.1%	No spinal immobilization: 65.9%
GSW torso, decompensated shock, 20-40 min from TC	IV fluid to maintain patient normotensive (SBP 100-120):31.9%	IV fluid but maintain patient relatively hypotensive: 66%
Pelvic fracture (fx), decompensated shock, <15 min from TC	Apply and inflate PASG: 23.6%	No specific treatment for pelvic fx: 60%
Pelvic fx, decompensated shock, 20-40 min from TC	Apply and inflate PASG: 52.2%	No specific treatment for pelvic fx: 11%
Appropriate indication for prehospital use of PASG	No indication for use of PASG: 18.7%	Pelvic fx with decompensated shock: 77%

Conclusions: The majority of trauma surgeons believe that EMS providers should: 1) attempt intubation for a patient with a traumatic brain injury (GCS=7); 2) refrain from performing spinal immobilization for penetrating torso trauma; 3) treat decompensated shock with IV fluids in a patient with penetrating torso trauma, but maintain the patient in a relatively hypotensive state; 4) provide no specific treatment for a suspected pelvic fracture with decompensated shock if less than 15 minutes from a TC, but apply and inflate the PASG if 20-40 minutes from a TC. While there was some lack of consensus, current PHTLS guidelines were favored by a majority of trauma surgeons.

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FALLING DOWN AND 'FALLING OUT': MANAGEMENT AND OUTCOME ANALYSIS

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Objectives: Elderly patients who fall secondary to syncope frequently are admitted to the trauma service and require a syncope workup. This study compares patients <65 years old vs ≥65 with syncope-related falls to answer: 1) Are syncope workups are being correctly performed? and 2) Do the results change management?

Methods: The charts of all patients who fell over a 14 month period were reviewed. A complete syncope workup consists of six diagnostic tests: EKG, enzymes, cardiac monitoring, ECHO, carotid duplex and ±EEG. Outcome variables were mortality, hospital and ICU lengths of stay (LOS) and management change.

Results: Sixty-one of 387 patients who fell had reported syncope: 6.1% (n=14) were <65 and 29.9% (n=47) were ≥65. There was no difference in ISS, GCS, mortality, or ICU and hospital LOS between the younger and older cohorts. Patients who fell secondary to syncope had the following number of diagnostic tests: 0 tests = 4 (6.6%); 1-3 tests = 24 (3 9.3%); 4-6 tests = 33 (54. %). Nineteen tests in the <65 group and 79 tests in the ≥65 patients had abnormal results.

	<65 years(%)	**≥65 years(%)**	***p* value**
Abnormal EKG	45.5	76.7	0.043
Abnormal ECHO	22.2	62.5	0.032
Abnormal EEG	0	23.8	0.010
Abnormal carotid	0	8.7	NS

Overall 37.7% of patients had specific interventions performed due to abnormal test results. These included changes in medication, treatment of unstable angina and acute MI, pacemaker placement and cardioversion.

Conclusion: Syncope workups were erratically performed in both groups and resulted in abnormal findings that required intervention in 37.7%. Therefore, we suggest the creation of standardized protocols to assure complete assessment of trauma patients who fall for unknown reasons.

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PHARMACOKINETICS OF ENOXAPARIN IN CRITICALLY ILL TRAUMA AND SURGICAL PATIENTS

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Low-molecular-weight heparins (LMWH) are safe and effective for the prevention of venous thromboembolism in routine surgical patients. To date there have been no studies to assess the efficacy of the prophylactic dose in high-risk trauma and surgical patients in the intensive care unit.

Objective: To determine an optimal prophylaxis dose of enoxaparin for prophylaxis in high risk surgical and trauma patients.

Methods: Eighteen patients admitted to the surgical intensive care unit after major surgery or trauma were started on the regimen of 40 mg of enoxaparin injected subcutaneously once daily. To determine the efficacy, peak Anti-factor Xa activity was measured from blood samples obtained 4 hours after the third dose of enoxaparin and the trough was measured just before the fourth dose. Any adverse events were also recorded.

Results: Mean peak anti-factor Xa activity was 0. 19 IU/ml in patients without renal failure and mean trough was 0.039 IU/mI. Mean peak activity was 0.31 IU/ml and trough was 0.075 IU/ml in two patients with renal impairment. Peak activity was 0. 12 IU/mI but the trough was 0.02 IU/ml in the one morbidly obese patient (BMI >40). The trough was not detectable in four of the ICU patients including one with renal failure. No adverse bleeding complications occurred in any of the patients. The only documented thrombosis occurred in one of the renal failure patients, despite an elevated trough.

Conclusion: Because of the frequent subtheraputic troughs, daily dosing may not be adequate for patients in the intensive care unit, and twice a day doses may be required. Dosing in renal failure patients and morbidly obese patients requires further study.

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THYROID AND ADRENAL ABNORMALITIES IN SEPTIC AND HEMORRHAGIC SHOCK STATES.

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Objective: To evaluate the incidence of simultaneous abnormal thyroid and adrenal dysfunction in critically ill patients with septic or hemorrhagic shock.

Design: Prospective observational study.

Setting: Surgical intensive care unit (SICU), university affiliated tertiary medical center.

Patients: Surgical patients admitted to the SICU with septic or hemorrhagic shock requiring pulmonary artery catheterization (PAC).

Interventions: Hormonal replacement was instituted in patients found to have abnormalities.

Measurements and Main Results: 25 patients were studied. Average age was 61±18 years, APACHE II scores of 20±7, 6/25 (24%) were in hemorrhagic shock, 19/25 (76%) were in septic shock, 12/25 (48%) required pressors and 3/25 (12%) were on inotropic support. Thyrotropin (TSH) concentration was obtained. If it was abnormal, total T4 was measured on the same specimen. Baseline cortisol concentration was measured at 4 AM, followed by injection of 250 μg of corticotrophin. Cortisol concentration was again measured one hour after corticotrophin stimulation. Four of 25 (16%) patients had abnormal thyroid function.. Ten of 25 patients (40%) had adrenal insufficiency and additional 5 patients (20%) had both abnormal thyroid function and adrenal insufficiency.

Conclusion: Both abnormal thyroid function and adrenal insufficiency has been well documented in critically ill patients but the simultaneous occurrence of these endocrine abnormalities have not been well studied. Given the 20% incidence of simultaneous thyroid and adrenal abnormalities found in this study, routine testing of both thyroid and adrenal function on admission to the SICU may be indicated.

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PATTERNS IN MICROBIOLOGY AFTER INTRA-ABDOMINAL PACKING FOR TRAUMA

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Introduction: Prolonged intra-abdominal packing is associated with higher mortality and infections. It is unknown if the packs are the source of subsequent infections or if they are only "bystanders" in patients who suffer infections independent of the packs. This study tracks the microbiology of packs and subsequent infections in patients who survived to reoperation after intra-abdominal packing for trauma.

Methods: The investigators cultured the peritoneum and abdominal packs in 29 of 35 patients who survived to re-operation and collected results for subsequent cultures during the hospital stay. They also recorded the number of packs, total time packed, number of operations, subsequent infections, and survival.

Results: 22 patients suffered penetrating trauma, and 13 suffered blunt trauma. Ages ranged from 17 to 54 years, mean 30.5 years. There were 5 women, and 30 men. Data for 291 cultures were collected, mean 9 per patient. Total pack time ranged from 27 to 222 hours, mean 81 hours. Days in the ICU ranged from 3 to 89 days, mean 22 days. Pack cultures were negative (9), Staphylococcus species (8), Acinetobacter (6), other Gram-positive (2, microaerophilic and Group D *Streptococcus),* or other Gram-negative (4, *E. coli, Citrobacter, Pseudomonas, Bacteroides.)* 28 patients survived to discharge. 7 patients died. 14 patients had no post operative infections. 5 had intra-abdominal abscesses. 21 had pneumonia, 3 had urinary tract infections, 2 had line infections, and I had a wound infection. All 9 patients with negative pack cultures, and all 8 patients with *Staphylococcus* on their pack cultures survived. 2 patients with *Acinetobacter*, 1 patient with other Gram negative organism, and both patients with other Gram positive organism on their pack cultures died.

Conclusions: Intra-abdominal packs are contaminated with common skin and gut flora. These contaminants, however, do not contribute to subsequent infections. Organism cultured from subsequent infections were typical for ICU infections. The organisms, however, did not match the organisms cultured from the packs.

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CHANGES IN TISSUE ENERGETICS PREDICT EARLY MORTALITY IN A PORCINE MODEL OF SEVERE HEMORRHAGIC SHOCK

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Background: An important determinant of eventual survival after severe traumatic injury is survival to definitive resuscitation, which can be prolonged in rural settings or in a military situation. To evaluate predictors of survival in a field setting, we evaluated hemodynamic and laboratory values and measures of tissue energetics in a porcine model of severe hemorrhagic shock. Previous observations of tissue energetics identify an increased phosphomonoester (PME) component of the total phosphorus signal during severe shock, representing an increase in glycolytic intermediates.

Methods: Pigs (n=36) were subjected to 35 % blood volume hemorrhagic shock for 90 minutes in a 1.5 T nuclear magnetic resonance (NMR) magnet after splenectomy and placement of monitors. Variables measured included base deficit, cardiac output, oxygen consumption/delivery, near-infrared spectroscopic measurement of liver, stomach, peripheral muscle tissue oxyhemoglobin saturation (StO_2), and NMR spectroscopy measurements of high-energy phosphates of liver and skeletal muscle. Variables were compared between 90 minute survivors and nonsurvivors using independent samples t-test. Linear regression analysis was performed using survival as the dependent variable.

Results: Mortality at 90 minutes was 25% (9/36). Regression analysis identified baseline PME levels, 30-minute base deficit, and 30-minute stomach StO_2 as predictors of mortality within 90 minutes (r^2=313).

Variable	Survivors (avg±SD)	Non-survivors (avg±SD)	p value
Baseline PMEs (%total phosphorus)	7.5+3 . 2	9.9+1.7	0.018
Baseline base deficit (mmol/L)	-0.5+4.8	2.9+4.0	0.076
30-minute stomach StO_2 (% Hgb sat)-	56.3+28.4	18.5+21.6	0.020
30-minute base deficit (mmol/L)	3.9+5.3	10.7+4.9	0.006
90-minute base deficit (mmo AL)	9.1+7.1	17.7+4.6	0.058

Conclusions: Early elevation in PME levels, low NIRS measurement of stomach StO_2, and high base deficit predict mortality in an animal model of severe hemorrhagic shock. Early transition to anaerobic glycolysis after traumatic injury may be predictive of mortality.

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HYPERTONIC SALINE PREVENTS INFLAMMATION AND IMPAIRED INTESTINAL TRANSIT AFTER GUT ISCHEMIA/REPERFUSION BY INDUCING HEME OXYGENASE 1 (HO-1) ENZYME

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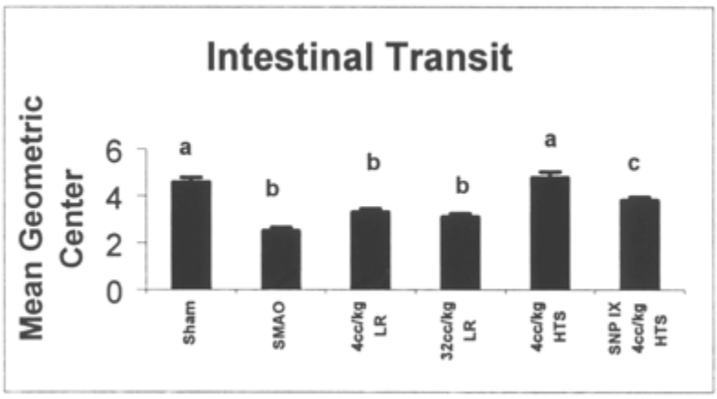
Background: We have shown that HTS resuscitation prevents inflammation and impaired intestinal transit after gut I/R. Interestingly, it also induced HO-1, which is protective in other LIR models. We therefore hypothesized that HTS prevents inflammation and impaired transit by inducing HO-1.

Methods: Rats underwent 60 min of superior mesenteric artery occlusion (SMAO) then were resuscitated with 4cc/kg

HTS, equal volume lactated Ringer's (LR, LL isomer) or equal salt LR (32cc/kg). Controls included SMAO alone or sham lap. A separate group was pretreated with the HO-1 blocker SN Protoporphyrin (SNP), 25μmol/kg ip 1hr prior to SMAO+HTS. At 6hrs reperfusion, transit was determined by quantitating the % tracer in 10 segments of small bowel (mean geometric center) and ileum harvested for HO-1 by western blot and inflammation by myeloperoxidase (MPO). Data are expressed as mean ± SEM, ANOVA, 6/group mean with different superscripts are significantly different.

Results: Intestinal transit (figure) was severely impaired after SMAO, improved with LR (not significant) but returned to sham with HTS. Pretreatment with SNP abrogated this protective effect. Similarly, MPO activity was significantly increased by SMAO (2.3±0.3 SMAO^{b}, 0.4±0.05 sham^{a}), lessened by LR (1.5±0.3 4cc/LR^{c}, 1.7±0.4 32cc/kg^{c}) but returned to sham with HTS (1.0±0.02 HTS^{a}). MPO activity with SNP pretreatment was also increased (4.04±0.8^{d}) HO-1 increased with SMAO (0.33±0.02^{b}), 4cc/kg LR (0.32± 0.03^{b}) , and 32 cc/kg LR (0.37±0.4^{b}) but further increased with HTS (0.49±0.04^{c}).



Conclusion: HTS resuscitation protects against inflammation and impaired intestinal transit following gut I/R in part by inducing HO-1. This is a novel mechanism of HO-1 protection.

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PUTATIVE MECHANISM OF HEMORRHAGE-INDUCED LEUKOCYTE HYPORESPONSIVENESS: INDUCTION OF SUPPRESSOR OF CYTOKINE SIGNALING (SOCS)-3

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We, and others, have previously demonstrated that following hemorrhagic shock (a common component of traumatic injury), macrophages (MΦ) are less responsive to LPS in regards to cytokine production and receptor expression. However, mechanism(s) responsible for this change are poorly understood. SOCS proteins are cellular proteins that block receptor-mediated signaling through a variety of mechanisms, most commonly associated with the inhibition of the JAK-STAT pathway. SOCS-3 has been found to play a prominent role in LPS tolerance and cytokine desensitization in MΦ. Therefore, the purpose of this study was to determine whether SOCS-3 was induced by hemorrhagic shock (HEM). To test this, male C3H/HeN mice were subjected to HEM (30±5mmHg for 90 min) or sham-HEM. 24 hr after each procedure, the lung, spleen, and peritoneal leukocytes were harvested, the cells were processed for protein, and expression of SOCS-3 was examined by Western Blot analyses. Western blots were quantitated by densitometry.

Tissue	Sham-HEM*	HEM*	p-value
Lung	3097±912	5444±704	0.015 (n=4)
Spleen	1536±349	16660±3991	<0.001 (n--6)
P. Leukocytes	3093±608	7698±175	<0.001 (n--6)

Data presented as OD/CM^2, mean ± SEM.

Our data show that SOCS-3 is upregulated in each tissue, most prominently in the spleen. While the exact cell type (MΦ or non- MΦ) expressing SOCS-3 is yet to be determined, these data suggest that cytokines or other inflammatory mediators present in mice during the first 24hr after the induction of shock have the ability to induce tolerance to LPS or cytokines and suppress the function of immune cells by upregulating SOCS-3. (Supported by NIH GM46354).

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TRAUMA AND EMERGENCY SURGERY: AN EVOLUTIONARY DIRECTION FOR TRAUMA SURGEONS

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Introduction: The success of non-operative management has diminished the operative experience of trauma surgeons. To enhance operative experience, our trauma surgeons began caring for all surgical emergencies. Our objective was to characterize the experience of our surgeons.

Methods: We reviewed records to determine case diversity and complexity, time of operation (after hours defined as 2200-0630), and need of ICU care for patients treated by University affiliated Trauma/Emergency Surgeons (TES) and elective practice General Surgeons (ELEC) at a Level I trauma center.

Results: During the 6 month study period, TES and ELEC surgeons performed 129±34 and 121±20 operations, respectively (p=0.59). TES surgeons admitted more patients and performed more after hours operations than their ELEC colleagues.

	Admissions	Operations	ICU care	After hours	Age
TES (n=6)	2144	775*	21%*	18%*	41
ELEC (n=8)	1068	970	9%	0.3%	51

* p <0.0001 (Chi-squared)

Both groups of surgeons had a mix of cases that was diverse and complex.

			Extraperitoneal		Abdominal		
	Vascular	Thoracic	Routine	Complex	Routine	Complex	Other
TES	23	21	227	76	374	37	17
ELEC	0	2	386	72	287	210	13

Conclusion: In our experience, combining the care of patients with trauma and general surgery emergencies resulted in a breadth and scope of practice for the TES surgeons that compared well with that of the ELEC Surgeons. Furthermore, many patients with surgical emergencies required ICU care and may have benefited from the expertise of surgeons with critical care training and experience.

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LEGAL PROSECUTION RATES OF ALCOHOL-IMPAIRED DRIVERS ADMITTED TO A LEVEL I TRAUMA CENTER

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Despite harsh legislation, driving under the influence of alcohol (DUI) is exceedingly common, and alcohol-related motor vehicle crashes (MVCs) account for significant morbidity, mortality, and economic loss. Legal sanctions can keep offenders off the road (protecting other drivers and pedestrians) and ensure compliance with treatment programs (reducing recidivism). However, even with clear evidence of a transgression, the law seems to be inconsistently enforced among trauma patients. The purpose of this study was to measure the rate of legal prosecution among impaired drivers admitted to a trauma center following MVC, and to determine the recidivism rate among these individuals.

Methods: Our trauma registry was queried to identify intoxicated drivers admitted during an 18-month period. Court records identified patients who had been charged with traffic offenses, including prior (2 years) and subsequent (1 year) charges.

Results: Blood alcohol concentration (BAC) was measured in 387 (74%) of 525 drivers, of whom 137 (35%) had BAC ≥100 mg/dL. Of 113 state residents, 22 (19%) were charged with an offense related to the MVC. Of 12 charged with DUI, 10 were convicted, for an overall DUI conviction rate of just 9%. 7 (32%) of those who were charged had prior or subsequent charges. Of 91 patients not charged for the index event, 31 (34%) had prior or subsequent charges.

Conclusion: Alcohol is involved in a large percentage of MVCs in our region. The infrequency of prosecution for DUI despite property damage and/or personal injury, and the high recidivism rate, are significant social concerns. These data suggest the need for processes to facilitate legal prosecution- possibly including revision of legislation involving reporting of BACs.

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TRANSFUSION INDUCED LEUKOCYTE IL-8 GENE EXPRESSION IS AVOIDED BY THE USE OF HUMAN POLYMERIZED HEMOGLOBIN

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Background: Red blood cell (pRBC) transfusion is an independent risk factor for multiple organ failure (MOF); a maladaptive immuno-inflammatory response is implicated. Interleukin-8 (IL-8) is one putative mediator of this response. We previously observed that injured patients resuscitated with pRBCs have increased plasma IL-8 compared to those given human polymerized hemoglobin (POLY). To further elucidate the mechanisms responsible for this difference in IL-8, we devised an ex-vivo transfusion model.

We hypothesize that IL-8 gene expression is induced by pRBCs and avoided by POLY.

Methods: Human volunteer blood was incubated alone (B) or with a major transfusion (50% exchange) of either leukoreduced O- pRBCs (B+pRBC) or POLY (B+POL) for 30 min at 37ºC. Whole blood leukocyte (WBL) or polymorphonuclear leukocyte (PMN) IL-8 mRNA was isolated and quantified. Results are reported as amol mRNA/μg total RNA ± SEM. Stats: ANOVA with Bonferroni/Dunn post hoc analysis.

Results: Simulated transfusion of pRBCs increased WBL IL-8 mRNA (B=0.28±0.10amol/μgRNA, B+pRBC= 2.24±0.25amol/μgRNA, p<0.01) whereas POLY did not (13+POLY=0.82+_0.30amol/μgRNA). POLY IL-8 mRNA was less than pRBC transfused (p=0<0.01). *Fig 1* In PMNs, simulated transfusion of pRBCs increased IL-8 mRNA (l3=3.17±1.05amol/μgRNA, B+pRBC= 7.60±1.79amol/μgRNA, p<0.01), whereas POLY did not (B+POL=4.53±1.64 amol/μgRNA). *Fig 2*

Conclusions: Stored pRBCs induce WBL and PMN IL-8 gene expression, whereas human polymerized hemoglobin, in lieu of pRBCs, does not. These experimental results corroborate our previous clinical studies and further encourage the study of POLY as a resuscitation strategy to decrease post-injury MOF.

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BLOOD TRANSFUSION IS ASSOCIATED WITH DONOR LEUKOCYTE MICROCHIMERISM IN TRAUMA PATIENTS

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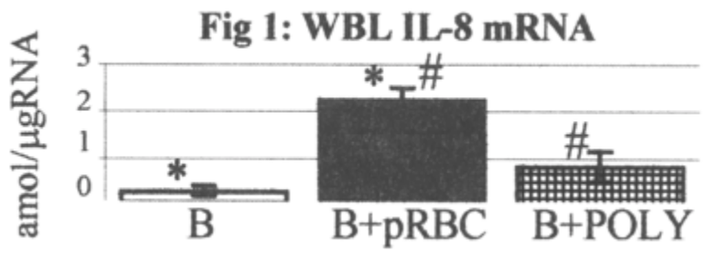
Introduction: Blood transfusion can result in survival of donor leukocyte subpopulations in the recipient. Persistence of donor leukocytes in the transfusion recipient is termed microchimerism (MC). Microchimerism likely reflects engraftment with donor hematopoietic stem cells and is uncommon with transfusion for sickle-cell, thalassemia, and HIV. We have found, however, that MC may be more common in trauma patients.

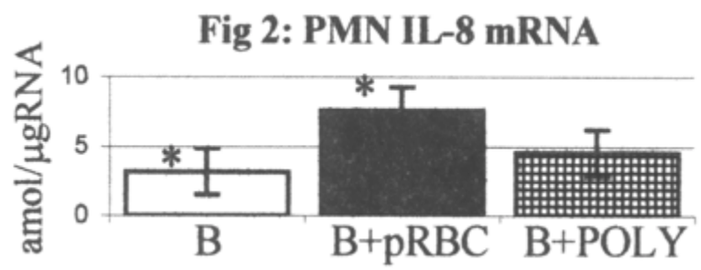
Objective: To determine how frequently transfusion after trauma is associated with MC Methods: We prospectively enrolled 45 trauma patients who were transfused ≥2 units of PRBCs. We sampled blood prior to hospital discharge and determined MC by polymerase chain reaction (PCR) analysis of specimens using HLA DR probes to non-recipient alleles. Data are shown as mean ± SEM. Results: Patients had an age of 42±3 years, ISS of 23.0±2.1, and mortality of 7%. 78% were men; 84% had blunt trauma. Patients received 14.0±2.7 (2 to 87) units of PRBCs.

	N	Age (yrs)	Male (%)	Iss	Spleen removed (%)	Units of PRBCs transfused	Mean time: transfusion to blood draw (days)
MC	24	40±4	19 (79)	24.3±3.2	3(12)	17.1±4.4	13.0±3.8
No MC	21	45±5	16 (76)	21.5±2.7	5(24)	10.5±2.7	7.5±1.6
P	-	0.34*	0.81†	0.67*	0.42t	0.26*	0.77*

*Mann- Whitney U test; †Chi Square test

Twenty-one of the 24 patients with MC had only 1 or 2 non-recipient DR alleles identified by PCR.





Conclusions: Transfusion after trauma is associated with over half of recipients having evidence of MC. Age, sex, ISS, and splenectomy of the recipient and the number of transfused units did not correlate with MC. Because the mean time from transfusion to sampling for PCR analysis was shorter in the group without MC, it is unlikely MC is due merely to failure of the recipient to clear transfused donor leukocytes. In most recipients who developed MC the responsible leukocytes came from individual blood donors.

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GENETIC PREDISPOSITION FOR A COMPROMISED IMMUNE SYSTEM AFTER SEVERE TRAUMA

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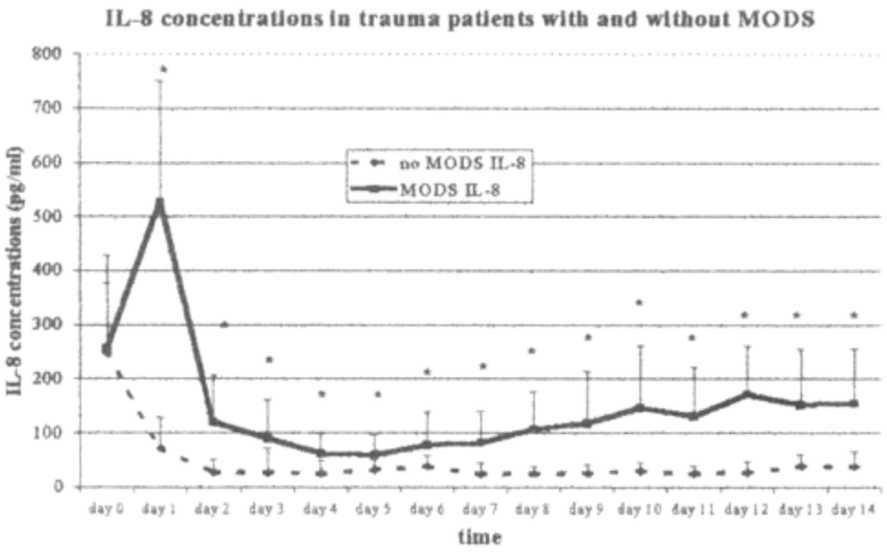
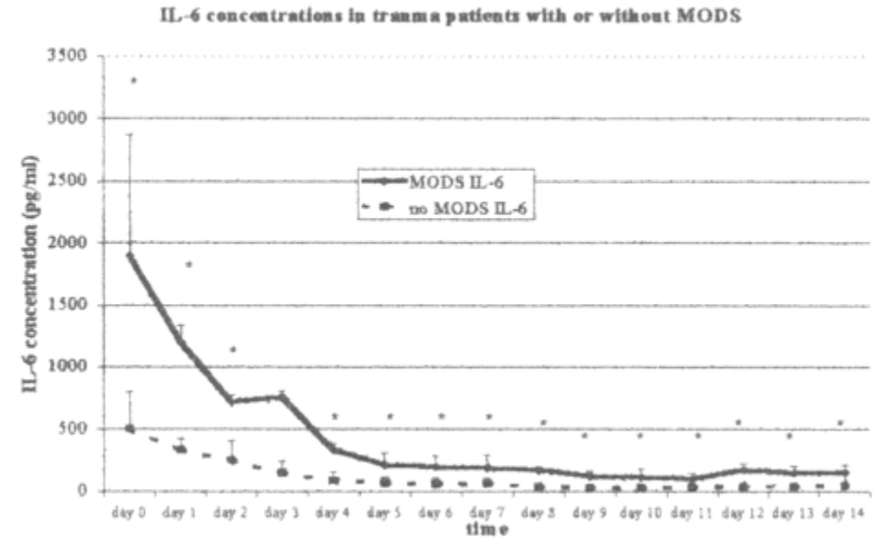
Introduction: MODS continues to represent the major cause of late death after severe trauma. Various immunologic changes have been described to be associated with the development of MODS. However, despite similar injury severities, unexpected outcomes in regards to the development of MODS occur, which may be due a patient predisposition. It was discussed whether genetic variations may play a relevant role in this respect.

Patients and methods: Patients were consecutively included in this prospective study between 1999 and 2002. Inclusion criteria: Injury Severity Score (ISS): >16, age: 18-60 years, survival: >48 hours. Over a 14 day observation period, blood samples were drawn once daily for determination of cytokine concentrations. DNA was separated from blood cells. Single-Nucleotide-Polymorphisms (TNF-α (TNF1/2), IL-Iß (Taq1), IL-6 (SfaNI) and IL-8 (IL-8-251A)) were determined by Polymerase-Chain-Reaction using specific primers. The clinical course was recorded once daily, MODS was evaluated using the Marshall-Score (MODS: >12 points on 2 consecutive days or on ≥3days over the observation period).

Results: 109 severely injured patients were included in this study (ISS.25.4±7.9; age: 31.2±14.8). Patients were divided in two groups, according to the development of MODS (-MODS: 86 patients/+MODS: 23 patients), Comparing both groups, the genotype distribution of IL-6-SfaNI and IL-8-251A was significantly different, with a higher *incidence in the +MODS group. In addition, IL6 and IL-8 concentrations were significantly higher in this group (figure 1+2). Genotype distribution of TNF1/2 and IL-ß-Taq 1 was not significant different between both groups MODS/+MODS, with no differences in serum concentrations over the observation period.





Discussion: It is known that proinflammatory cytokines (IL-6 and IL-8) seem to be of utmost importance regarding the development of posttraumatic MODS. In our study, polytraumatized patients, demonstrated IL-6-SfaNI and IL-8-251 A polymorphism within the IL-6 and IL-8 gene that seemed to be associated to the development of posttraumatic MODS, and with concomitant significantly higher IL-6 and IL-8 serum concentrations. The data suggest that a genetic predisposition of the immune response after severe blunt trauma occurs that may exert an impact on outcome.

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INTERLEUKIN-6 INFUSION BLUNTS PRO-INFLAMMATORY CYTOKINE PRODUCTION WITHOUT CAUSING SYSTEMIC TOXICITY IN A SWINE MODEL OF UNCONTROLLED HEMORRHAGIC SHOCK

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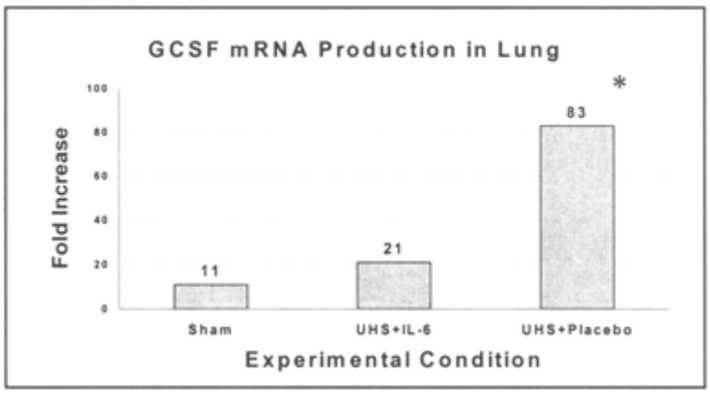
Introduction: Serum elevations of Interleukin-6 (IL-6) correlate with multiple organ dysfunction syndrome (MODS) and mortality in critically injured trauma patients. Data from rodent models of controlled hemorrhage suggest that IL-6 infusion protects tissue at risk for ischemia/reperfusion injury. Exogenous IL-6 administered during shock appears to abrogate inflammation providing a protective rather than deleterious influence. To examine this paradox, our objective was to determine whether recombinant IL-6 decreases inflammation in a clinically relevant large animal model of uncontrolled hemorrhagic shock (UHS) and to investigate the mechanism of protection.

Methods: Swine were randomized to four groups (n=8 each): 1) Sacrifice, 2) Sham: Splenectomy followed by hemodilution and cooling to 33ºC, 3) IL-6 infusion: UHS (Sham + UHS by grade V liver injury with packing and resuscitation) + blinded infusion of IL-6 (10mcg/kg), and 4) Placebo: UHS + blinded vehicle. After 4 hours, blood was sampled, estimated blood loss (EBL) determined, animals sacrificed, and lung harvested for RNA isolation. GCSF mRNA levels were assessed using quantitative RT-PCR. Serum levels of IL-6 and TNFα were measured by ELISA.

Results: Compared to Placebo, IL-6 infusion in UHS did not increase EBL or white blood cell counts, nor decrease hematocrit or platelet levels. Compared to Sham, lung GCSF mRNA production in UHS + Placebo increased 8 fold (*p<0.05). In contrast, IL-6 infusion + UHS blunted GCSF mRNA levels which were not significantly increased compared to Sham (p=0.1). IL-6 infusion did not increase final serum levels of IL-6 nor TNFα compared to Sham and Placebo.



Conclusion: Exogenous IL-6 blunts lung mRNA levels of the proinflammatory cytokine GCSF. Additionally, IL-6 infusion does not appear to cause systemic toxicity.

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IMPACT OF SHOCK AND FLUID RESUSCITATION ON THE MORPHOLOGY AND APOPTOSIS OF BONE MARROW: AN EXPERIMENTAL STUDY

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Background: An impairment of bone marrow function has been described after shock, trauma and resuscitation. Recently, apoptosis (Programmed cell death) has been given a defined role in hematopolesis regulation.

Objective: To assess morphological alterations and apoptosis in bone marrow after hemorrhage shock and resuscitation.

Methods: Under pentobarbital anesthesia, wistar rats underwent femoral vessels cannulation. Randomly, they were assigned to groups: Sham, shock/ lactated ringer's (LR) or shock/ hypertonic saline (HS). The hemorrhagic shock model involved a controlled retrieval of blood, maintaining mean blood pressure at 40±5mmHg during 60 minutes. During the resuscitation period, lactate ringer's (2x shed blood volume) or NaCl 7.5% (4ml/Kg) was infused, followed by the total blood. Bone marrow was collected through left femoral puncture. Morphology was assessed by Leishmann stained smears, and apoptosis through TUNEL test. During the first phase of the experiment, animals were sacrificed 24, 72 and 120 hs. after shock, in order to analyze morphological changes in bone marrow. In a second phase, morphology and apoptosis were compared between LR and HS resuscitation.

Results: During the first phase, LR animals demonstrated an increase in the percentage of myeloid precursors together with a decrease in the lymphoid series, detected 72hs. after shock. In the second phase, both LR and HS groups presented an increase in apoptosis when compared to the sham group (Table). LR resuscitation determined a increase in the percentage of myeloid and a decrease in lymphoid precursors.

Group	Myeloid	Lymphoid	Monocyte	Apoptosis
Sham (n=6)	31.1+2.4	51.0+0.9	4.8+0.9	6.4+0.5
LR (n=6)	47.6+4.0*	23.9+4.6*	6.6+1.7	14.4+0.9
HS (n=6)	33.6+3.0	45.6+5.5	2.7+0.7	13.0+1.1

*p<0.05 (RL vs. Sham and HS)

Conclusion: The resuscitation of hypotensive animals with LR resulted in a trend towards myeloid differentiation and a decrease in lymphoid precursors when compared to sham and HS. Shock increased bone marrow apoptosis independently of the fluid resuscitation.

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LACTATE INDUCES PULMONARY APOPTOSIS BY RESTRICTING PHOSPHORYLATION OF BAD PROTEIN ON SERINE 136, BUT NOT ON SERINE 112, IN A RAT MODEL OF HEMORRHAGIC SHOCK

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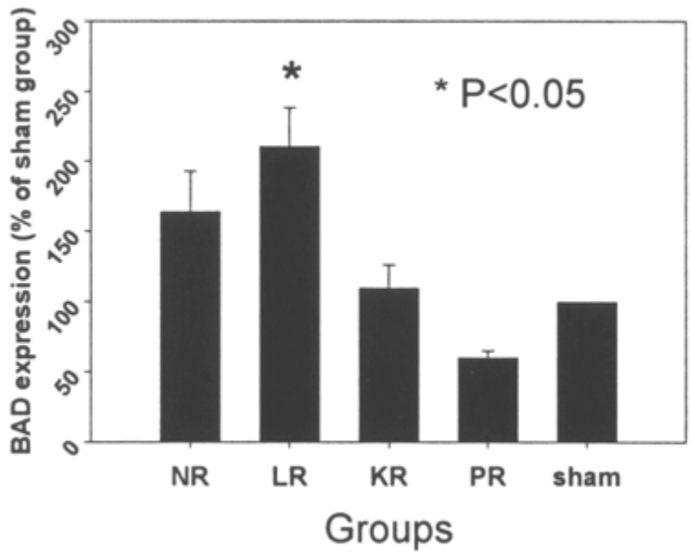
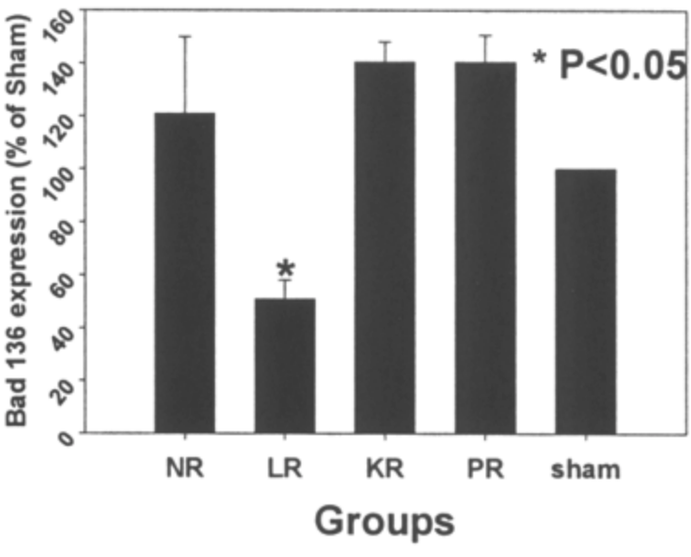
We have previously shown that recemic lactated Ringer's (LR) solution induces pulmonary apoptosis, and that substitution of lactate with ketone (P-hydroxybutyrate, BHB) attenuates this injury without altering the expression of apoptotic genes. The precise mechanism by which lactate causes apoptosis remains unknown. We postulated that lactate induces post translational modification of apoptotic proteins through selective phosphorylation.

Methods: Male Sprague Dawley rats (n=25, 5/group) were subjected to a three stage, modified volume controlled hemorrhage and randomized to the following groups. 1) No hemorrhage (Sham); 2) Hemorrhage and no resuscitation (NR); 3) Resuscitation with 3x volume of LR (LR); 4) Resuscitation with 3x volume of ketone Ringer's (KR); 5) Resuscitation with 3x volume of pyruvate Ringer's (PR). KR and PR solutions were identical to LR except for equimolar substitution of lactate for BHB and pyruvate respectively. Lung tissue was obtained 2 hours later and subjected to Western Blotting for pro-apoptotic protein Bad. The same membranes were then probed for phosphorylated Bad at serine 136 (specific target for pro-survival PI3K/Akt pathway) and serine 112 residues.

Results: Resuscitation with lactated Ringers solution caused a significant increase in total bad expression. The levels of phosphorylation on serine 112 were identical. However, LR caused a decrease in phosprolylation at serine 136 compared to KR and PR.





Conclusion: Recemic lactate induces pulmonary apoptosis by modulating P13KJAkt pathway and thus restricting specific phosphorylation of Bad protein on serine 136 residue.

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FACTOR VIIA FOR CORRECTION OF ACQUIRED COAGULOPATHY

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Introduction: Activated factor VIIa (FVIIa) was developed for use in hemophiliacs with antibodies to factor VIII. FVIIa initiates thrombin formation by binding with exposed tissue factor on platelets. Anecdotal reports have documented FVIIa efficacy in correction of coagulopathy from trauma, cirrhosis, and major surgery, but no North American series exists. We present twenty-nine non-hemophiliac patients with acute coagulopathy treated with FVIIa.

Methods: Use of FVIIa was restricted to active hemorrhage with clinical coagulopathy unresponsive to component therapy, and required approval by a senior physician. In each case, we recorded the cause of coagulopathy, dose of FVIIa administered, pertinent laboratory values, effect on clinical coagulation, and patient outcome.

Results: Causes of coagulopathy were diverse, and included acute traumatic hemorrhage (15 patients), sepsis (5), traumatic brain injury (4), coumadin use (2), and underlying hematologic defects (3). Hemorrhage visibly decreased in all cases, with an average reduction in PT from 17.5+/-6.0 to 9.3+/-2.6 ($p<0.001$). INR fell to an average of 0.58 following FVIIa administration. There were fifteen long-term survivors (7/15 traumatic hemorrhage, 2/5 sepsis, 1/4 TBI, 2/2 coumadin, 3/3 coagulation defect). Patients who died suffered from irreversible shock, sepsis, or fatal brain injury. Two of the TBI patients that died became eligible for organ harvest once bleeding was controlled.

Conclusion: An immediate decrease in prothrombin time occurred in every patient, with the majority achieving supranormal coagulation. Consistent with the observation that exposed tissue factor is required for FVIIa-mediated clotting, we found no evidence of thrombus formation remote from the site of bleeding. We conclude that FVIIa is a viable treatment option, and should be considered in any case of life-threatening coagulopathic hemorrhage, particularly when conventional plasma therapy has failed or poses a risk of acute fluid overload. FVIIa appears particularly efficacious in reversal of coumadin-induced coagulopathy and congenital factor deficiency.

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INHIBITION OF ENTERAL ENZYMES BY ENTEROCLYSIS WITH NAFAMOSTAT REDUCES NEUTROPHIL ACTIVATION AND TRANSFUSION REQUIREMENTS FOLLOWING HEMORRHAGIC SHOCK

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Introduction: The gut origin of inflammatory response has been difficult to define. "In vivo" generation of neutrophil activating factors by gut proteases may be a cause of multi-organ failure after hemorrhagic shock. Serine proteases are inhibited by nafamostat (Futhan®). The objective of this study was to determine the effect of nafamostat given by enteroclysis on enteric serine protease activity, neutrophil activation and transfusion requirements during hemorrhagic shock.

Methods: 8 pigs (21-26kg) were divided into control and treatment groups. A laparotomy was performed under anesthesia and catheters placed in the duodenum, mid-jejunum and in the terminal ileum. Pigs were bled 30ml/kg over 30 minutes and maintained at a MAP of 30 torr for 60 minutes. Shed blood was used to maintain a MAP of 45 torr for three hours. Treated animals received 10ml/kg of 0.37mM nafamostat in GoLYTELY® via the duodenal catheter at I liter/hr. Control animals received GoLYTELY® only. Samples of enteral content and blood were taken at baseline, after shock and at 30 minute intervals during resuscitation. Animals were euthanized after 3 hours of resuscitation. Enteral trypsin-like activity at the three gut sites was measured by spectrophotometry. Activation of naive human neutrophils by pig plasma was measured by percentage of cells having pseudopods >1μg on microscopy.

Results:

		Controls	Treated Pigs	p value
Reduction in protease activity (% of baseline)	Duodenum	56%	97.2%	p=0.007
	Jejunum	89.5%	99.7%	P=0.01
Neutrophil Activation (# activated/# counted x100%)	2 hours resus.	43%	31%	P=0.028
	3 hours resus,	47.30%	32.6%	P=0.041
Transfusion Requirement			18.1 ml/kg	p=0.026

Conclusion: Nafamostat given via enteroclysis with GoLYTELY® significantly reduces enteral protease levels, leukocyte activation and transfusion requirements during resuscitation from hemorrhagic shock. This strategy may have clinical promise.

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DIRECT PERITONEAL RESUSCITATION (DPR) FROM HEMORRHAGIC SHOCK: EFFECT OF TIME DELAY IN INITIATING THERAPY

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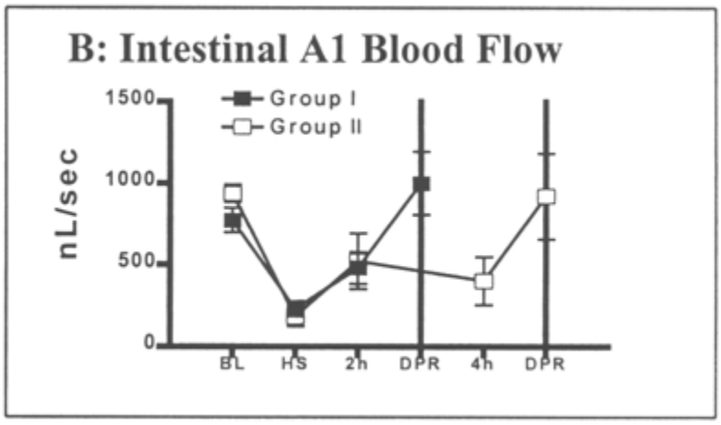
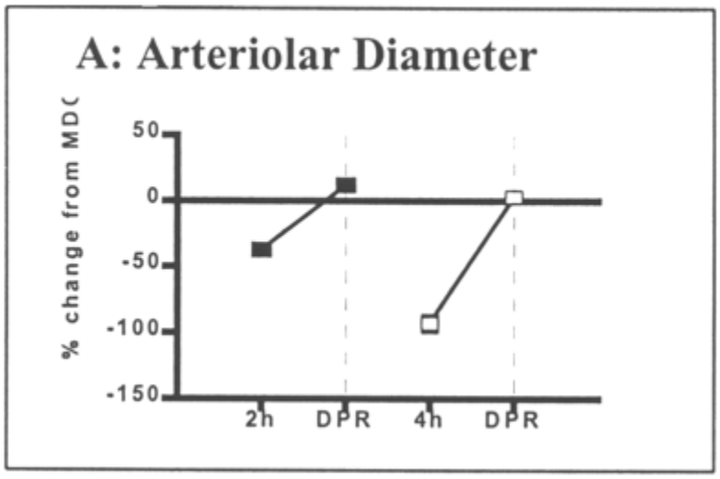
Conventional resuscitation (RES) from hemorrhagic shock (HS) is associated with progressive post-RES intestinal microvascular vasoconstriction and hypoperfusion. Recently, we demonstrated that initiation of DPR simultaneously with RES from HS, changes the post-RES vasoconstriction. to sustained dilation, and enhances intestinal perfusion by > 65% of its pre-HS value. The purpose of this study is to investigate if delayed DPR produces the same effects reported for the simultaneous therapy.

Methods: Anaesthetized nonheparinized rats were monitored for hemodynamics, and the terminal ileum was studied with intravital microscopy. HS was to 50% of mean arterial pressure (MAP) for 60 min. RES consisted of reinfusion of shed blood plus 2 volumes of saline. Initiation of DPR was delayed to 2 hours post-RES (group I, n=8), or to 4 hours post-RES (group II, n = 4).

Results: Data from the two groups are shown in the graphs.

RES restored and maintained HR and MAP to baseline during the entire post-RES period in both groups. Post-RES vasoconstriction and hypoperfusion, respectively, were significantly (*p<0.1*) worse in group II (-92.9±6.3%, -51%) compared to group I (-37.3±4.1%, -38%), indicating a progressive event over time. Delayed therapy with DPR effectively reversed vasoconstriction and tissue hypoperfusion (A and B) (*p<0.001*), without adverse effects on hemodynamics.





Conclusions: Conventional RES from HS that restore and maintain hemodynamics is associated with progressive splanchnic vasoconstriction and hypoperfusion. Initiation of DPR simultaneously with RES, not only reverses these derangements, but also produces a sustained dilation associated with perfusion above that at baseline. Delayed initiation of DPR to 2 or 4 hours after conventional RES from HS reverse the post-RES intestinal derangements and maintain normal tissue perfusion. DPR has no adverse effects on hemodynamics.

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BETA-BLOCKERS AND OUTCOMES IN ADULT BURN PATIENTS

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There is no direct evidence that beta-blockers (βB) improve mortality in burn victims. βB attenuate hypermetabolic states in burned children, and perioperative use in elective adult cases has beneficial effects, which suggests that βB may also improve burn outcomes. However, βB decrease cardiac output and may decrease oxygen delivery, and theoretically may increase mortality. What is the effect of βB on healing time and mortality in burn patients?

Methods: We identified three cohorts of adult burn patients between 1996-2001: 1) all who were on βB before their injury (PMHβ) 2) all who were initiated on βB during their hospitalization for management of hypertension or tachyarrhythmia (HOSPβ), and 3) control who were never treated with βB (CTL). For each patient in PMHβ and HOSPβ, two patients were placed in CTL cohort by matching age and TBSA burn. Premorbid conditions such as diabetes, hypertension, cardiac disease, renal insufficiency, and diuretic and calcium channel blocker use were analyzed. Multivariate regression models were used to identify independent modifiers.

Results: There were 21 PMHβ, 22 HOSPβ, and 86 CTL patients. All PMHβ remained on their βB regimen in the hospital. HOSPβ patients were initiated on βB at a mean of 8.8 days post injury. There were no differences in age (mean 58±17), TBSA (mean 14±12), and mechanism of injury among the cohorts. The mortality rate was 5% PMHβ, 27% HOSPβ, and 13% for CTL. The mean healing times (days) were 51±29 PMHβ, 79±54 HOSPβ, and 60±39 CTL. In multivariate analyses, PMHβ was associated with a significant decrease in fatal outcome and healing time ($p \geq 50.05$ compare to CTL). Independent risk factors associated with increased healing time were higher TBSA, renal disease, diuretic use, mechanism, and respiratory status.

Conclusions: βB have the potential to improve burn outcomes. Post injury treatment should be studied in a randomized clinical trial.

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THE EFFECT OF OXANDROLONE ON HEPATIC ACUTE PHASE REACTANT PROTEINS IN BURNED CHILDREN

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Introduction: Oxandrolone, all anabolic steroid has shown to have a positive effect oil burn wound healing in children. In this study we have determined the long term effect of oxandrolone on hepatic acute phase reactant proteins.

Methods: 32 children were prospectively randomized to receive oxandrolone at 0.1mg/kg given orally twice daily or to receive placebo. Tile treatment period was from the second post-operative day to one year post burn. Levels of hepatic acute phase proteins were measured at baseline (before the drug was administered) at discharge and 6, 9,12 months post burn. Statistical analysis used 2-way ANOVA. Values are expressed as Means±SEM. Significance was set at $p<0.05$.

Results: Children receiving drug or placebo were similar in age and burn size. Albumin showed a significant increase from baseline to 6 months (1.9±0.07 vs 4±0.2) for those receiving oxandrolone. Prealbumin increased over time in both drug and placebo, but was statistically significant only in tile oxandrolone treated at 12 months. Transferrin was $p<0.05$ at 6 (214+17 controls vs 264+25 oxandrolone) and 9 (214±11 controls vs 267±38 oxandrolone) months postburn. Retinol Binding Protein increased in both groups over time, but was significantly different between groups only at 9 months (2.4+0.2 vs 3.4+0.4) postburn. C-Reactive Protein and alpha amyloid globulin showed a significant reduction in the first six months in both the drug and placebo. Alpha 2 Macroglobulin actually increased post burn ill both groups.

Conclusion: In severely burn victims oxandrolone increased constitutive proteins with minimal effect on acute phase reactant proteins. Acute phase proteins returned to normal values by 6 months after burn.

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USEFULNESS OF TRANSCATHETER ARTERIAL EMBOLIZATION IN PATIENTS WITH BLUNT POLYTRAUMA SHOWING TRANSIENT RESPONSE TO FLUID RESUSCITATION

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Object: To determine whether non-surgical management using Transcatheter arterial embolization (TAE) is safe in hemodynamically unstable patients with blunt polytrauma who transiently respond to initial fluid resuscitation.

Materials and Methods: Contrast CT was performed in patients with blunt abdominal injuries excluding those who did not respond to fluid resuscitation. Angiography was performed in patients who had injuries with contrast extravasation or solid organ injury of AAST grade ≥3 on CT. TAE was performed when angiography showed arterial extravasation. The protocol was abandoned in any patient who showed signs of peritonitis.

Results: 269 patients with blunt abdominal injuries underwent TAE immediately after admission between January 2000 and December 2002. 41 of the patients had injuries in at least 2 regions and underwent TAE for these regions. Among them, 231 patients were hemodynamically stable or showed rapid response to fluid resuscitation, and the non-surgical treatment was successful in all cases. The remaining 19 patients (ISS: 37.3±8.2) showed transient response and were the subjects of this study. 15 patients underwent TAE for 2 regions (13 had pelvic fractures, 7 splenic injuries, 6 hepatic injuries, 3 facial bleeding, and 1 renal injury). 4 patients underwent TAE for 3 regions (4 had splenic injuries, 3 hepatic injuries, 2 renal injuries, 2 pelvic fractures, and 1 facial bleeding). TAE was successfully performed in all patients. The systolic blood pressure and shock index before TAE were 74.7±14.4 mmHg and 1.46±0.42, respectively, and those after TAE were 120.6±19.3 and 0.87±0.16 ($p<0.001$). The rate of fluid administration required after TAE (226.9±226.5 mL/hr) significantly decreased compared with that required before TAE (1244.2±347.1 mL/hr, ranging from 632 to 1728 mL/hr) ($p<0.001$). Two patients who were classified as non-preventable death on the TRISS methods died (probability of survival = 0.13 and 0.03).

Conclusion: Non-surgical management using TAE could be safely performed even in those patients with blunt polytrauma who were in hemorrhagic shock, when their hemodynamics were improved by resuscitation with 1 to 2 L of fluid.

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UNSTABLE PELVIC FRACTURE AND FREE INTRAABDOMINAL FLUID IS LAPAROTOMY ALWAYS NECESSARY?

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Objective: In. unstable pelvic ring fractures free abdominal fluid on ultrasound (US) may be caused by the passing of retroperitoneal hematoma into abdominal cavity or by an additional intraabdominal lesion. In this study a clinical pathway for the therapy of eventually combined lesions was analyzed.

Patients and methods: All patients treated in the ER for severe trauma (level I urban trauma center) underwent basic sonographic-radiological diagnostics within 15 min. of admission. Data were prospectively documented. According to the treatment protocol unstable pelvic ring fractures with initial free fluid on US underwent laparotomy. Patients with stable vital conditions had abdominal CT-Scan before surgery.

Results: 1472 consecutive severely injured patients (ISS 20/39 years) were included in the study. 80 subjects had sustained type B (47) or C (33) pelvic ring fracture. 49 of those didn't have early free abdominal fluid on US. 4 persons in this group required coeliotomy later in the course (after ICU admission): 1 two-timed splenic rupture, 1 continuous mesenterial bleeding, 1 abdominal compartment, 1 diaphragmatic rupture (not detected on initial CT). In 31 cases free fluid was present, and all underwent laparotomy. Only one patient showed retroperitoneal hematoma alone, while all others had one or more significant lesions (rupture) that required surgical repair (tab.). Simultaneously with laparotomy pelvic stabilization was performed by external (17) or internal (6) fixation. In all cases with massive pelvic hemorrhage and free fluid in US (12) bleeding was controlled by internal tamponade and external fixation.

Spleen	liver	bowel	diaphragm	V. cava	mesenterium	rectum	bladder	urethra
n=12	n=7	n=6	n=3	n=2	n=3	n=4	n=14	n=4

Conclusion: Unstable pelvic ring disruptions are a result of massive external trauma. The finding of intraperitoneal fluid in early US in the emergency department correlates strongly with an significant intraabdominal lesion. Early laparotomy appears indicated in these cases. Shock control in pelvic bleeding is achieved by internal tamponade an external fixation.

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A PROSPECTIVE EVALUATION OF ULTRASONOGRAPHY DIAGNOSIS OF PENETRATING ABDOMINAL INJURY

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Background: Ultrasound (US) is commonly used for the diagnosis of hemoperitoneum after blunt abdominal trauma, the value of US as an aid for identification of operative lesions after penetrating trauma is not well documented. The purpose of this study was to determine the accuracy of US for the evaluation of penetrating torso trauma and to assess the impact of this information upon patient management.

Methods: A prospective cohort study of consecutive penetrating torso patients at a level I trauma center.

Results: During the 3 month study period there were 100 victims of penetrating torso trauma assessed by our trauma teams. 48 stab wounds, 51 gunshot wounds, and 1 puncture wound. All 21 patients with positive US had an exploratory laparotomy or thoractomy. This resulted in 18 therapeutic aparotomy/thoracotomy and 3 non-therapeutic laparotomies. There were 79 negative US exams, 16 underwent celiotomy for worsening abdominal pain. Ten of these 16 patients had a therapeutic operation and 6 had a negative exploration. The overall accuracy of the US examination in penetrating torso trauma was 87%, with a sensitivity of 64% and a specificity of 96%. The positive predictive value was 86% and negative predictive value was 87%. There were only 3 patients who had their initial management altered by a positive US examination.

Conclusion: The US examination lacks sensitivity to be used alone in determining operative intervention after gunshot or stab wounds. Rarely does US information contribute to the management of patients with penetrating abdominal injuries.

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SURGICAL TREATMENT OF LIVER INJURY WITH MICROWAVE TISSUE COAGULATION: AN EXPERIMENTAL STUDY

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Objective: To examine whether microwave tissue coagulation (MTQ therapy was capable of stopping bleeding from severe liver injury in pigs.

Methods: Ten pigs (38±4 kg) underwent a 30ml/kg isovolemic exchange transfusion with 3% low molecular dextran to produce dilutional coagulopathy and then a through and through laceration injury measuring approximately 8cm in length was induced in the right hepatic lobe (imitating a blunt injury grade IV). Immediately after inflicting the injury, the animals were randomly divided into two groups: *Group A* (n=5, MTC was repeated along the liver laceration at intervals of 2.0cm with manual compression) or *Group B* (n=5, the injured lobe was manually compressed without MTC therapy for 1 min). All animals received lactated Ringer's (LR) solution to maintain the mean arterial pressure (MAP) = 75 mmHg for 1 hour after the abdominal closure. The intra-peritoneal blood loss, MAP, volume of LR solution, and hematologic variables were compared between the groups. For further laboratory evaluation, three additional experimental animals were treated with the MTC therapy after grade IV injury and then were allowed to survive for 14 days. '

Results: MAP declined from a mean value of 88±10 (range, 75-107) mmHg to 62±3 (range, 50-75) mmHg after the induction of liver injury. The total blood loss in *Group A* was 192±58 (range, 120-250) g, which was lower ($p<0.01$) than that of 448±138 (range, 260-650) g in *Group B.* The resuscitation fluid volume of *Group A* animals was 304±204 (range, 100-600) mL, which was lower ($p<0.01$) than that of 1320 t 654 (range, 900-2250) mL in *Group B.* At 14 days, all 3 animals that were treated in the additional study were found to be in good health. Their necropsies showed no evidence of intrahepatic abscess, hematoma, or biloma.

Conclusion: MTC therapy was thus found to provide simple, rapid and definitive hemorrhage control in cases of severe liver injury without the need for a re-operation.

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ROUTINE FOLLOW-UP IMAGING IS UNNECESSARY IN THE MANAGEMENT OF BLUNT HEPATIC INJURY

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Objective: Nonoperative management of hemodynamically stable blunt hepatic injuries has become the standard of care over the past decade. However, controversy regarding the role of in-hospital follow-up CT scans as a part of this nonoperative management scheme is ongoing. While many institutions, including our own, have advocated routine in-hospital follow-up scans, others have suggested a more selective policy. The rationale for follow-up CT has been to delineate worsening of the injury, evidence of active bleeding, pseudoaneurysms or biloma formation; or other complications requiring intervention. Over time, we have perceived a low yield from follow-up studies. Thus, the hypothesis for this study is that routine follow-up imaging of asymptomatic patients is unnecessary.

Methods: All patients selected for nonoperative management of blunt hepatic injury were evaluated for utility of follow-up CT scans over a 4-year period.

Results: There were a total of 530 stable patients with injury on admission CT in which follow-up scans were obtained within a week of admission. All injuries were classified according to the revised AAST Organ Injury Scale: 102 (19.2%) Grade 1, 181 (34.1%) Grade 11, 15 8 (29.8%) Grade 111, 74 (13.9%) Grade IV, and 15 (2.8%) Grade V. This table illustrates the outcome of their follow-up scans:

	Grade I	Grade II	Grade III	Grade IV	Grade V
Unchanged	44(43.1%)	97(53.6%)	89(56.3%)	39(52.7%)	6(40.0%)
Improved	23(22.5)%	58(32.0%)	63(39.9%)	31(41.9%)	9(60.0%)
Resolved	34(33.3%)	24(13.3%)	3(l.9%)	3(4.0%)	None
Worse	1(1.1%)	2(l.1%)	3(l.9%)	1(l.4%)	None
Intervention	None	None	None	3(4.0%)	None

Utilizing follow-up scans as a trigger, only 3 patients underwent intervention: 2 patients had arteriography, (1 with therapeutic embolization), and 1 had percutaneous drainage. Each of those 3 patients had clinical signs or symptoms that were indicative of ongoing hepatic pathology.

Conclusion: This data demonstrates that, regardless of injury grade, routine in-hospital follow-up scans are not indicated as part of the nonoperative management of blunt liver injuries. Follow-up scans are indicated for patients who develop signs or symptoms suggestive of hepatic pathology.

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278 BLUNT DUODENAL INJURIES FROM A LARGE MULTI-INSTITUTIONAL STUDY: INCIDENCE, DIAGNOSIS, AND OUTCOME

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Purpose: Define the incidence, diagnosis, and outcome of blunt duodenal injury (BDI).

Methods: Data from the EAST Multi-institutional Blunt Hollow Viscus Injury Study for 1999-2001 were analyzed. Three groups were compared: perforated (P)-BDI, non-perforated (NP)-BDI w/lap, and blunt trauma with nontherapeutic lap (NL) as a control.

Results: Of 227,972 blunt trauma admissions, 278 (0.12%) had BDI: 76 (0.03%) P-BDI, 202 (0.09%) NP-BDI. Complications (but not mortality) were increased for BDI (35%) vs control (23%). Of P-BDI repaired >24 hrs after injury, 4/8 (50%) developed abscesses vs 5/68 (7%) repaired <24 hrs ($p<0.001$). Most P-BDI (89%) were repaired in <24 hrs. All patients with repair delayed >24hrs (n=8) survived. Injury and repair of the pancreas were more frequent in P-BDI vs NP-BDI (24% vs 17%, $p=.04$). Amylase levels were higher in P-BDI. No diagnostic methods individually or in combination were predictive of BDI and CT was normal in 5% of P-BDI.

FINDINGS	Perf. BDI		Nonperf BDI		Nontherap.	
(*=p<.05 vs. Perforated BDI)	n		n		n	
Concomitant abd. injuries (mean)	72	1.8	127	1.7	357	0.5*
Abdominal tenderness	76	76%	133	61% *	378	55%
Peritoneal signs	76	41%	133	21% *	378	19%
Amylase: no pancreas inj. (mean)	28	149	59	94*	168	85*
CT: free air	57	49%	104	7%*	275	7%*
CT: p.o. or i.v. contrast leak	33	15.2%	93	4.3%	155	6.6%
CT: free fluid no solid organ inj.	57	30%	104	23%	275	57%
Any complication	76	34%	133	35%	378	23%
Intra-abdominal abscess	76	12%	133	4% *	378	3% *
ARDS	76	12%	133	12%	378	5%*
Length of stay (mean days)	76	18.7	133	19.2	378	13.1
ISS (mean)	75	24.6	131	23.9	378	21.2
Mortality	76	16%	133	16%	378	18%

Conclusions: BDI is a rare entity associated with an increase in morbidity and length of stay but not mortality. Delay in repair of P-BDI is infrequent and does not influence mortality but is associated with an increased rate of intra-abdominal abscess. Current diagnostic methods are inadequate to exclude P-BDI.

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PHYSICAL AND MENTAL HEALTH, FUNCTIONAL RECOVERY, AND LONG-TERM OUTCOME FOLLOWING ABDOMINAL DECOMPRESSION

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Introduction: Massive incisional hernias are a consequence of abdominal decompression for critical illness. The long-term physical and mental health as well as functional recovery of such patients has not been described.

Methods: Between 10/95 and 4/02, 223 patients underwent abdominal decompression. 79 patients were discharged with a split-thickness skin graft (STSG) or skin-only closure with intent for subsequent definitive repair. The SF-36 Health Survey (Quality Metric Inc.) was mailed to 67 patients for whom an address was available. 30 patients (45%) returned completed surveys. Descriptive data are presented as mean ± standard deviation. The normalized Physical Component Health Summary (PCS) score is 50.0 (95%C1 45.2-54.8) and the Mental Component Health Summary (MCS) score is 50.0 (95%Cl 43.5-56.5) for the US general population.

Results: Patient age was 36±13 years. 87% were male. 70% were traumatically injured. Admission SAPS-2 was 0.670±0.281, ISS 26±11, and APACHE-2 19±7. 22 patients were closed using STSG and 8 using skin-only. At the time of survey (34.0±18.1 months post-decompression), 11 patients (37%) remain "open" (5 refused repair) while 19 (63%) have undergone definitive abdominal reconstruction. Of patients employed at time of injury, 78% have returned to work. The average normalized PCS score was 39.0 (95%Cl 34.5-43.5) demonstrating significantly decreased physical health while the average MCS score was 45.6 (95% Cl 41.0-52.2) suggesting no difference in mental health compared to the US general population.

Conclusions: Massive incisional hernias as a result of abdominal decompression for critical illness decrease patient perception of physical health, but do not decrease perception of mental health, preclude subsequent abdominal closure, or prevent return to gainful employment.

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IS PEDIATRIC TRAUMA STILL A SURGICAL DISEASE? PATTERNS OF URGENT OPERATIVE INTERVENTION IN THE INJURED CHILD

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Background: The trend toward non-operative management of many pediatric injuries has generated debate as to whether surgeons need to be involved in the early assessment and management of pediatric trauma. The purpose of this study is to examine the frequency of urgent operative intervention among injured children.

Methods: Pediatric (age<18) trauma patients were identified from the National Trauma Data Bank. ICD-9 procedure codes were used to classify operative interventions by specialty (neurosurgery ([NS], orthopedic surgery [Ortho], general surgery [GS], other). Time to operative *intervention was classified as emergent (<4 hrs), urgent (4-24 hrs) or elective (>24 hours) and the proportion of children requiring intervention by specialty are presented. The relative risks (RR) of death among children requiring operative intervention within each time frame compared to all other patients are presented along with their 95% confidence intervals.

Results: 66,962 children were identified over 8 years. Overall 30.9% required operative intervention. A large proportion of those needing operative intervention required surgery emergently (57.3%) or urgently (37.9%) (Table). Mortality was significantly greater in patients requiring emergent GS or NS intervention.

Conclusion: A significant proportion of high risk pediatric trauma patients require operative intervention within hours of admission. These data support the continued involvement of surgeons in the initial assessment and management of the injured child.

	Emergent		Urgent		Elective	
	Patients	Mortality	Patients	Mortality	Patients	Mortality
	(%)	(RR)	*(%)*	(RR)	*(%)*	(RR)
All	57.3	1.5 (1.3-1.6)	37.9	0.4 (0.3-0.5)	24.9	0.4 (0.3-0.5)
Ortho	50.1	1.4 (1.2-1.5)	34.4	0.3 (0.2-0.4)	20.5	0.3 (0.3-0.4)
GS	19.1	3.1 (2.7-3.4)	7.0	1.1 (0.8-1.4)	9.0	0.5 (0.3-0.7)
NS	6.9	3.1 (2.7-3.6)	3.5	1.4 (1.0-2.0)	4.4	0.8 (0.5-1.1)
Other	5.0	1.1 (0.8-1.5)	3.1	0.2 (0.1-0.4)	3.3	0.2 (0.1-0.4)

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INCIDENCE OF ASYMPTOMATIC PULMONARY EMBOLUS IN MODERATELY TO SEVERELY INJURED TRAUMA PATIENTS

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Background: Chest computed tomography (CT) is being used more frequently to evaluate symptomatic patients for pulmonary embolus (PE). The incidence of PE diagnosed by helical CT in asymptomatic patients is unknown.

Methods: Trauma patients with an Injury Severity Score ≥9, no pulmonary symptoms and no symptoms of deep venous thrombosis were studied post-injury day 3 to 7. Contrast-enhanced helical CT images of the chest, pelvis, and lower extremities were obtained using a standard PE protocol. Clot burden was assessed using an anatomic graded scoring system. Age, ISS, mechanism and type of injury, blood transfusion, and use of thromboembolic prophylaxis were analyzed with stepwise logistical regression.

Results: 90 patients were enrolled. Of these, 22 patients (24%) were diagnosed with PE. 18 patients had minor clot burden. Four had major clot burden, including one patient with a saddle embolus. Significant risk factors for asymptomatic PE include age, head injury, chest injury, lower extremity injury, and need for transfusion.

	Odds ratio (95% Cl)	p value
Age (years)	1.04 (1.00, 1.08)	0.04
Blood transfusion	3.42 (1.06, 11.02)	0.04
Head AIS>2	6.78 (1.42, 32.45)	0.02
Chest AIS>2	4.51 (1.09, 18.75)	0.04
Lower extremity AIS>2	5.03 (1.14, 22,12)	0.03

Sixty-one patients were receiving some type of thromboembolic prophylaxis. Twelve patients (55%) with asymptomatic PE were receiving pharmacologic prophylaxis.

Conclusion: Helical CT shows a 24% incidence of asymptomatic PE in moderately to severely injured trauma patients. Age, head, chest, and lower extremity injury are associated with an increased risk of asymptomatic PE. Standard thromboembolic prophylaxis is not reliably protective.

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IS CT A RELIABLE METHOD TO DIAGNOSE PULMONARY EMBOLISM IN CRITICALLY INJURED PATIENTS? A PROSPECTIVE COMPARISON WITH PULMONARY ANGIOGRAPHY

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Background: Spiral computed-tomographic pulmonary angiography (CTPA) is gaining an increasing role in pulmonary embolism (PE) diagnosis because it is more convenient and less invasive than conventional pulmonary angiography (PA). Encouraging reports of CTPA's reliability on medical patients have prompted widespread use despite the fact that its value in critically injured patients has been inadequately explored. Hemodynamic and respiratory issues of critical illness may interfere with CTPA's diagnostic accuracy. Objective: To compare CTPA with PA for PE diagnosis in critically injured patients.

Methods: Over 30 months (8/99-2/02), 37 critically injured patients with clinical suspicion of PE were enrolled prospectively. CTPA and PA were independently read by 4 radiologists (2 for each test) blinded to each others interpretation. Clinical suspicion for PE was classified as high, intermediate, or low based on predetermined criteria. PA was considered as the standard of reference for PE diagnosis.

Results: PE was found in 15 (40%) patients by PA; central PE in 8 and peripheral PE in 7. CTPA and PA findings were different in 11 patients (30%); CTPA was false negative in 9 patients and false positive in 2.

CTPA	**Central PE**	**Peripheral PE**	**All PE**
Sensitivity	50%	28%	40%
Specificity	100%	93%	91%

There were no differences in risk factors or clinical characteristics between patients with and without PE. The level of clinical suspicion was identical in the two groups. The independent reviewers disagreed on CTPA or PA interpretations in 9% of the readings.

Conclusions: PA remains the gold standard for diagnosis of PE in critically injured patients. CTPA should be explored further before universally accepted. Clinical criteria are unreliable to detect PE in this population and therefore, a high index of suspicion should be maintained.

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SURGEON-PERFORMED ULTRASOUND FOR PNEUMOTHORAX IN THE TRAUMA SUITE

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Background: Surgeon-performed ultrasound has become ubiquitous in the trauma suite for the detection of fluid in the peritoneal and pericardial spaces. Ultrasound is easy to learn and provides instant results with proven efficacy in the hands of surgeons and surgical residents. Initial reports have suggested that ultrasound may be used for the rapid detection of pneumothorax in the trauma suite. It has been demonstrated in previous reports that the visceral-parietal pleural interface can be documented sonographically in normal physiology and that a pneumothorax will obscure the "sliding lung" sign present in normal anatomy. The purpose of this study is to evaluate the efficacy of ultrasound for the detection of pneumothorax compared to standard chest x-ray findings.

Methods: A prospective analysis of 328 consecutive trauma patients at a single, ACS-verified Level I trauma center was undertaken. Thoracic ultrasound was performed at the second or third intercostal space in the mid-clavicular line in each patient. The presence or absence of a "sliding lung" sign was documented in each case and comparison was made to the chest radiographic finding. A multifrequency (2.5-4.0 MgHz) phased array transducer was utilized.

Results: Of 328 evaluations, there were 312 true negatives, 12 true positives, 1 false negative, and 3 false positives. False negative and false positive results were easily explained by the clinical scenario.

Sensitivity	Specificity	Accuracy	Pos. Predictive Value	Neg. Predictive Value
92.3%	99.0%	98.8%	80.0%	99.7%

Conclusion: Ultrasound is a reliable modality to rule-out pneumothorax in the evaluation of the trauma patient. This modality may serve as an adjunct or precursor to routine chest radiographic studies.

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THORACIC CT SCAN: THE NEW GOLD STANDARD FOR THE DIAGNOSIS OF BLUNT AORTIC INJURY

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Introduction: Studies have shown thoracic CT scans (CT) to be an excellent screening tool for blunt aortic injuries (BAIs) with aortography considered the "gold standard" for definitive diagnosis. The new generation multi-sliced CT technology can accurately diagnose BAI without confirmation with aortography prior to treatment. This has obvious temporal and cost saving implications.

Purpose: The current study examined whether changes in CT technology over the past few years would support CT as being considered the current "gold standard" in the diagnosis of BAL Methods: A six-year retrospective review of all aortograms performed to evaluate for potential BAI was compared with the results of CT as well as operative findings. BAIs definitively diagnosed by CT were also studied.

Results: 105 aortograms were done from 7/1/96-6/30/02, 20 BAIs were confirmed by aortography with 85 negative aortograms. After 1997, all patients suspected of BAI underwent CT. The technologic evolution of CT paralleled a reduction of the use of aortography in BAI evaluation. [*% of all blunt trauma patients]

Year	Aortography (%)*
1996	1.89
1998	1.91
2000	0.66
2002	0.41

CT and aortograms congruently diagnosed BAI in 15 cases with one CT suspicious for BAI having a negative aortogram. 17 BAIs were diagnosed with CT scans as the only diagnostic modality. 10 were managed operatively with operative findings matching those of the CT. 7 were treated medically due to age, co-morbid conditions, severity of injury or in cases of small intimal defects.

Conclusions: Current CT technology has evolved to allow the definitive diagnosis of BAI, which directed further management including operative repair. Aortography, with its increased cost and nephrotoxic dye load risk, should be reserved for CT findings suggestive of BAI in atypical locations.

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OUTCOME OF TRACHEOBRONCHIAL INJURIES: A LONG-TERM PERSPECTIVE

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Purpose: To present long-term outcome data on patients with major tracheobronchial injuries requiring operation by a single surgeon. Few outcome data are available on these injuries.

Clinical Material: Patients requiring operations for laryngotracheal, trachea, and mainstem bronchus injuries. Deaths within 48 hours were excluded.

Results: Sixty patients were operated on within 26 years: laryngotracheal (6), tracheal (27), and mainstem bronchus (27). Follow-up ranged from I to 27 years. Laryngotracheal injuries required diverse multispecialty treatment; only 2 had good outcomes. Five trachea wounds were treated by direct suture repair; one required a subsequent resection; 22 treated by resection and end-to-end anastomosis had no stenosis (mean follow-up 4 years). Two required bronchoscopic treatment for granulation tissue. Mainstem, bronchial GSWs uniformly required pneumonectomy (6 patients) with 4 deaths. Seven patients had early pneumonectomy for irreparable blunt injury. Bronchial stump leaks/empyema occurred in 3 patients. Despite good outcome for several years, 3 post-pneumonectomy patients have developed cor pulmonale at 13, 17, 18 years. Ten patients had mainstem bronchial repair; 2 developed bronchial stenosis requiring delayed pneumonectomy.

Conclusion: Despite the obvious limitations of this report with the biases of a single surgeon's experience, it presents long-term outcomes of a large series. Laryngotracheal injuries often had bad outcomes. Tracheal injuries amenable to resection and end-to-end anastomosis had excellent long-term outcomes. Mainstem bronchus injuries offer challenges in the short- and long-term perspective. Pneumonectomy for penetrating wounds had a high mortality early, even if patients survived the hemorrhage. Stump leaks and empyema were common. Long term, pulmonary hypertension was a major problem. Bronchial repair is preferable when feasible, but 2 patients developed late stenosis requiring subsequent pneumonectomy. These data should be useful in counseling patients/families and planning follow-up strategies for those with tracheobronchial injuries.

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DELAYED REPAIR FOR BLUNT THORACIC AORTIC INJURY: IS IT REALLY EQUIVALENT TO EARLY REPAIR?

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Objective: To evaluate the outcome of delayed repair (DR) for blunt thoracic aortic injury (BTAI) compared to early repair (ER). In addition, to assess the effectiveness of a protocol for medical control of systolic blood pressure and heart rate in those patients whose repair was delayed.

Methods: A retrospective review of prospectively collected data was performed on medical record and trauma registry data for 94 patients from 1/1/1992 through 2/28/2003 at our level I trauma center. ER was defined as initiating operative repair within 16 hours from the time of injury. Patients were excluded from the analysis if they died in the ED, had support withdrawn <16 hours after injury, or if they died prior to diagnosis of BTAI. The two groups were compared using Student's t-test and multivariate regression analyses where appropriate.

Results: There were 46 patients in the DR group, 32 patients in the ER group and 16 patients met exclusion criteria.

	N	Age (yrs)	ISS	Head AIS	GCS	Time to Repair (hrs)	Mortality	LOS
Delayed Repair	46	44±3	41±2	2.6±0.2	8.9±0.8	422±89	9 (19.6 %)	33±2.2
Early Repair	32	38±3	39±2	1.9±0.3	12.0±0.7	11±0.5	3 (9.4 %)	22±3.2
p-Value	--	NS	NS	0.05	0.007	0.0003	NS	0.005

In a multivariate analysis after adjusting for age, ISS, head AIS, and GCS, the odds ratio for death from DR compared to ER was 1.2 (p=0.9). For patients in whom repair was delayed, target systolic blood pressure (≥ 120 mmHg) and heart rate (≥100 bpm) were achieved for 75 % and 70 % of the hourly measurements recorded prior to operation.

Conclusions: Delayed aortic repair is equivalent to early repair in terms of mortality. Patients whose aortic repair is delayed have an increased LOS and worse evidence of head injury. The use of medical antihypertensive therapy in BTAI patients allows repair of aortic injuries to be delayed so that severe pulmonary, abdominal, orthopedic and neurologic injuries can be treated without increasing the overall risk of death.

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EARLY ENTERAL NUTRITION DOES NOT DECREASE HYPERMETABOLISM ASSOCIATED WITH BURN INJURY

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Introduction: Despite evidence that early enteral feeding after burn injury may have a number of beneficial effects, it remains controversial whether the timing of enteral nutrition has an impact on the associated hypermetabolic response. To address this issue, we report the results of our prospective, randomized study on the metabolic effects of early versus late enteral feeding following burn injury.

Methods: We prospectively randomized 27 burn patients (age: 5-81 years) to receive enteral feedings either within 24 hours (EARLY, N=14) or seven days (LATE, N=13) of injury. Basal energy expenditure (BEE) was calculated from Harris-Benedict equation; resting energy expenditure (REE) was obtained from weekly indirect calorimetry measurements. To account for differences in age, gender, and body mass, average daily energy expenditure (DEE) was determined as REE/BEE. Data were analyzed by fitting a log-linear model, with significance defined as $p<0.05$.

Results: Average age (EARLY: 44±74 SD, LATE: 49±19 SD), burn size (EARLY: 36±14 SD, LATE: 43±28 SD) and infections (EARLY: 3.4±2.4 SD, LATE: 3.4±3.2 SD) were similar between both groups. Mortality between groups was similar (EARLY: 29%, LATE: 39%) and not influenced by inhalation injury in this study. Surprisingly, the EARLY group had a significantly increased, rather than decreased average DEE, with an average calorie consumption 0.16 kcal/day less than the LATE group ($p=0.026$).

Conclusion: Early enteral feeding compared to late enteral feeding does not decrease the average energy expenditure associated with burn injury. Further studies are needed to validate whether early enteral feeding is associated with increased energy consumption. Nonetheless, this study suggests that as alternative methods to modulate the hypermetabolic response to injury are developed, a better understanding of the complex relationship between enteral feeding and the metabolic response to injury is also required.

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DIAGNOSIS OF BLUNT BLADDER INJURY (BBI): A **PROSPECTIVE COMPARATIVE STUDY OF COMPUTED TOMOGRAPHIC CYSTOGRAPHY (CTC) AND CONVENTIONAL RETROGRADE CYSTOGRAPHY (CRC)**

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Background: CTC, performed in conjunction with screening computed tomography (CT), is increasingly being utilized to diagnose B131. The current study prospectively evaluates the accuracy of CTC for diagnosing BBI and compares it to CRC.

Methods: Stable blunt trauma patients, at high risk for bladder injury (gross hematuria and/or anterior pelvic fracture), during the 8 year study period ending 09/02, underwent CTC at the time of CT. In the early part of the study, all patients had follow-up CRC. Recently, follow-up CRC was done only for high index of suspicion and negative CTC. Data was prospectively recorded. Sensitivity (SE), specificity (SP), positive (PPV) and negative (NPV) predictive values of CTC and CRC were compared for extraperitoneal (EP) and intraperitoneal (IP) bladder injury.

Results: 215 patients underwent both CTC, in conjunction with CT, and CRC. 20 of these had bladder injury (EP-14; IP-3; EP&IP-3). CTC and CRC each missed 1/17 EP injuries. CTC was falsely negative in 2/6 IP injuries (only EP injury seen in patients with EP&IP) and falsely positive in 4 (EP&IP seen, in patients with EP alone).

	CTC				CRC			
	SE	SP	PPV	NPV	SE	SP	PPV	NPV
Bladder injury (n=20)	95	100	100	99	95	100	100	99
Extraperitoneal (n=17)*	94	99	94	99	94	100	100	99
Intraperitoneal (n=6)*	67	98	50	99	100	100	100	100
*3 patients had EP&IP								

An additional 235 patients underwent CTC only. 25 of these had bladder injury (EP-13; IP-8; EP&IP-4). There was 1 false positive IP injury (similar to above). Majority of the falsely interpreted CTCs were in the early part of the study. In all, 45 of the 450 patients evaluated by CTC, had bladder injury. The SE, SP, PPV and NPV of CTC for diagnosing BBI for the whole group were 97%, 100%, 100%, and 99% respectively.

Conclusions: Results of this large prospective comparative study demonstrate that the accuracy of CTC in diagnosing BBI is equivalent to that of CRC. CTC can be performed at the same time as the screening CT, obviating the need for additional radiological study.

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SEXUAL DYSFUNCTION FOLLOWING BILATERAL INTERNAL ILIAC ARTERY EMBOLIZATION: A **REASON TO WORRY?**

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Background: The short-term safety of bilateral internal iliac artery embolization (BIIAE) is proven by our and other groups but there is no evidence on its long-term sequelae. Intestinal, urinary, or sexual dysfunction could become evident long after discharge.

Hypothesis: BIIAE causes sexual dysfunction due to ischemic damage of pelvic nerves.

Methods: 16 male trauma patients with BIIAE for bleeding from pelvic fractures (Group BIIAE) were matched for age, ISS, and pelvic AIS with 16 patients not requiring BIIAE (Group $CONTROL_1$) and 16 patients with no pelvic trauma but requiring embolization in other parts of their body for unrelated reasons (Group $CONTROL_2$). On average 21 months after injury, the patients took a telephonic survey based on a validated 32-item questionnaire to identify objective problems and perceptions about their sexual function.

Results: 44% of BIIAE and 50% of $CONTROL_1$ patients reported significant sexual dysfunction compared to 6% of $CONTROL_2$ patients. The responses of groups BIIAE and $CONTROL_1$ were similar. The responses of both groups were different than group $CONTROL_2$- Comparisons of incidences are reported by stepdown bootstrap p-values:

	BIIAE vs $CONTROL_1$	*BIIAE vs $CONTROL_2$*	*$CONTROL_1$ vs $CONTROL_2$*
Have erection	0.99	0.01	0.001
Maintain erection	0.99	0.01	0.004
Abnormal ejaculation	0.99	0.83	0.28
Satisfaction w/ sex life	0.98	0.003	0.002

Sexual drive was severely diminished or absent in 25% and 3 1 % of BIIAE and $CONTROL_1$ patients respectively (p=0.72) but in none of $CONTROL_2$ patients ($p<0.01$ compared to the other two groups).

Conclusions: Severe pelvic fractures are associated with a significant degree of sexual (predominantly erectile) dysfunction, which is not exacerbated by BIIAE. These findings offer additional support to the growing evidence on the safety of BIIAE. The anatomic and psychological causes of sexual dysfunction after pelvic trauma need further research.

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EARLY SURGERY FOR THORACOLUMBAR SPINE INJURIES DECREASES COMPLICATIONS

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Background: Traumatic spine injuries are common. Early surgery for cervical spine injuries has been shown to be safe and is associated with improved neurological outcomes and fewer complications. Few studies compare time to surgery with outcomes in thoracolumbar (TL) spine injuries.

Purpose: To correlate time to stabilization with total, respiratory, and infectious complications in severely injured patients with TL spine injuries.

Methods: The trauma registry of a Level I trauma center was queried for patients with TL spine injuries from January 1994 to July 200 1. To account for the potential of concurrent severe injuries delaying surgery, patients were divided into two groups based on injury severity score (ISS) (ISS ≥15; ISS <15). Groups were then divided based on time of injury to time of surgery (Early, <72 hours; Delayed, >72 hours). Outcomes were determined by the treating physician's assessment. (* indicates P <0.05 within ISS group)

Results:	Low ISS (<15)		High ISS (≥15)	
Patient Data	Surgery <72 hrs	Surgery >72 hrs	Surgery <72 hrs	Surgery >72 hrs
N	32	26	37	51
Avg. ISS	10.0	10.6	25.8	29.1
% males	**84.4%**	**65.4%***	64.9%	66.7%
Mean age (years)	**34.3**	**46.2***	29.9	35.7
Anterior fusion	**21.9%**	**41.2%***	27.0%	27.5%

Outcome Data				
Infectious complication	3.1%	7.7%	16.2%	33.3%
Respiratory failure	6.3%	7.7%	13.5%	17.6%
All complications	37.5%	30.8%	**40.5%**	**66.7%***
Length of stay	**8.1**	**15.5***	**11.5**	**20.7***
ICU Length of stay	2.9	4.7	**4.1**	**10.5***

Conclusion: Early surgery in severely injured patients with thoracolumbar spine trauma is associated with fewer complications and a resultant shorter ICU and hospital length of stay.

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TEN YEAR EXPERIENCE OF BURN, TRAUMA, AND COMBINED BURN/TRAUMA INJURIES COMPARING OUTCOMES

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Purpose: Percent total body surface area (TBSA) burn, inhalation injury (INH), and age have all been shown to be independent predictors of burn mortality. Little is known regarding patients sustaining combined thermal and mechanical trauma in relation to either injury type sustained in isolation or with regard to these variables. This descriptive study profiles the ten-year experience of a single American Burn Association/American College of Surgeons verified Level I trauma and burn center.

Methods: A retrospective review of all burn and trauma patients admitted between 1990 and 2000. Patients were divided into three groups, Burn only (B), Trauma only (T), and Burn plus Trauma (B/T). Groups were compared with respect to age, TBSA, length of stay (LOS), Injury Severity Score (ISS), INH, and mortality. These groups were then compared to B, B/T and T patients from the NBR1 and NTDB . Student's t test and chi square tests were performed. P <0.05 was considered significant.

Results: 24,093 patients were identified through our trauma/burn registry (T=22,284, B=1717, and B/T=92). The predominant mechanism of burn injury was flame in both B and B/T groups.

	NTDB-B N=1665	NTDB-T N=427,005	NTDB-Brr N=1880	NBR N=54,451	NBR-B/T N=3162	B N=1717	T N=22,284	B/T N=92
Age (years)	38.2	40.1	33.4	28.6	35.9	31.0	35.1	40.1 *
TBSA (%)	N/A	N/A	N/A	12.9	19.5	17.5	N/A	20.8
LOS (days)	5.5	5.5	11	11.8	23.3	13.7	5.3	18.0 *
ISS (mean)	7.5	9.5	11.7	N/A	N/A	12	5.5	23 *
INH (%)	N/A	N/A	N/A	9.3	22.8	11.0	N/A	44.5 *
Mortality (%)	6.4	5.1	7.0	4.8	11.6	9.8	4.3	28.3 *

*P <0.05, 1 = National Burn Repository, 2 = National Trauma Data Bank

Conclusion: B/T comprises a rare injury pattern with a synergistic effect. Physicians should be aware of a 2-3 fold increased INH in this population, and a significant increase in mortality, despite similar percent TBSA burns when compared to B alone.

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BEDSIDE PLACEMENT OF REMOVABLE VENA CAVA FILTERS UNDER "REAL-TIME" INTRAVASCULAR ULTRASOUND GUIDANCE

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Objective: Several published reports have demonstrated the benefit of prophylactic inferior vena cava filter(IVCF) placement to prevent pulmonary embolism in major trauma patients. Contrast venography with fluoroscopic guided placement has been the standard surveillance technique. The purpose of this report was to evaluate the potential for the bedside placement of a *removable* IVCF under "real-time" intravascular ultrasound (IWS) guidance.

Design Of Study: 20 major trauma patients underwent intensive care unit placement of a *removable* IVCF with "real-time" IVUS guidance. All patients had colorflow ultrasonography of the femoral veins after filter placement to rule out post-procedure femoral vein thrombosis and plain radiographs of the abdomen to identify filter location.

Results: 19 of 20 IVCFs were placed without complications at approximately the L2 level as verified by x-ray. One patient had a large IVC(34mm) and underwent bilateral common iliac IVCF placement under IVUS. Within three weeks of placement, 12 patients had the filters retrieved after a negative lower extremity venous duplex. Of the other eight patients, six had indications for permanent implantation, two had contralateral DVTs, and one ipsilateral DVT and the IVCFs were uneventfully left in place.

Conclusion: IVUS accurately measured the IVC diameter, localized the renal veins, allowed for exact placement of IVCFs, and avoided the need for contrast agents and the transport of critically ill patients. Bedside insertion of a *removable* IVCF with IVUS guidance and its removal is simple, safe, and accurate. Further assessment of this technique is warranted.

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