Poster # 1

THREE SEQUENTIAL REBOA CATHETERS FOR VASCULAR EXCLUSION OF THE LIVER: A HEMORRHAGE CONTROL STRATEGY IN JUXTAHEPATIC VENA CAVA INJURIES

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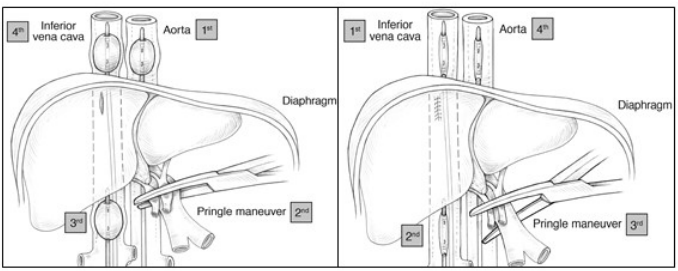
Introduction: Injuries to the retrohepatic inferior vena cava (RH-IVC) and juxtahepatic IVC (JH-IVC) have a mortality rate in the order of 80% despite several treatment options. Surgeons are confronted with a combination of challenges including hemodynamic instability, difficult exposure, and rapid exsanguination. Thus, temporary hemorrhage control is important prior to surgical exploration. There is evidence that hepatic vascular exclusion could potentially facilitate injury repair. The emergence of resuscitative endovascular balloon occlusion of the aorta (REBOA) resulted in renewed interest in the use of this technology to temporize traumatic hemorrhage. We hypothesized that sequential deployment of three REBOA devices, inserted in the aorta and in the inferior vena cava, and application of the Pringle maneuver would provide complete hepatic vascular exclusion.

Methods: Five swine underwent intravascular hemodynamic monitoring, cutdown of the femoral vessels, and splenectomy. Three REBOA devices were positioned under fluoroscopic guidance in the thoracic aorta, suprahepatic IVC, and infrahepatic IVC above the renal veins. Shock was induced by blood withdrawal to a target of 30% of the total blood volume in 20 minutes. Subsequently, complete hepatic vascular exclusion was performed in the following sequence: inflation of the aortic balloon, followed by Pringle maneuver, inflation of the balloon in the infrahepatic IVC, and ultimately inflation of the balloon in the suprahepatic IVC. Hemodynamic parameters and laboratory tests were recorded after 15 minutes of liver isolation. Afterward, hepatic revascularization was performed by: deflation of the balloon in the suprahepatic IVC, deflation of the infrahepatic IVC balloon, release of the Pringle, and deflation of the aortic balloon. Subsequently, hepatic vascular exclusion was performed again in the presence of an injury to the JH-IVC (Figure).

Results: Hepatic vascular exclusion by sequential inflation of three REBOA devices and Pringle maneuver effectively temporized the bleeding from the JH-IVC injury. Hepatic vascular exclusion significantly increased MAP compared to shock (40±3.7mmHg vs. 68.4 ±3.8mmHg, p 0.0001), and continued after the injury to the JH-IVC (66 ± 5.8mmHg, p 0.0001). Hepatic vascular exclusion did not aggravate shock assessed by pH, lactate and base excess, as well as additional hemodynamic parameters CVP and heart rate (p>0.05). Deflation of the balloons led to immediate exsanguination from the JH-IVC injury; MAP (10mmHg ± 7.5mmHg) at 1min after balloon deflation.

Conclusion: Sequential deployment of three REBOA devices combined with the Pringle maneuver enabled total vascular exclusion of the liver and effectively temporized hemorrhage from a juxtahepatic IVC injury. This procedure is potentially less invasive than other strategies previously described.



Hepatic Vascular Exclusion Hepatic Revascularization

Poster # 2

PREPERITONEAL PELVIC PACKING FOR THE TREATMENT OF HEMODYNAMICALLY UNSTABLE PELVIC TRAUMA: FIVE YEARS EXPERIENCE WITH A TIMELY AND EFFICIENT TOOL.

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Introduction: Hemodynamically unstable pelvic trauma has been a great challenge for a long time even in most experienced Trauma Centers. Most of them still consider angiography as the first option to treat these patients. Preperitoneal Pelvic Packing (PPP) is another option. In 2011 PPP was introduced in our Hospital as the first maneuver, with or without External Fixation (EF). Aims of this study are to review time to treatment and mortality in this group of patients.

Methods: A retrospective review of our database was performed from September 2011 to December 2016. Patients with hemodynamic instability (defined as Systolic Blood Pressure SBP < 90 mmHg at the arrival in the Emergency Department, ED, or during the initial phase of resuscitation) and a pelvic or acetabular fracture were included. Values were expressed in median and interquartile range (IR). Continuous variables were compared with Mann-Whitney test.

Results: In the index period, we treated 34 patients (25 males and 9 females). Median age was 51 years (40-65) and Injury Severity Score (ISS) 37 (34-43). SBP in the ED was 90 (67-99), heart rate was 115 (90-130), Base Excess -8 (-11.5/-4.8), pH 7.23 (7.20-7.27). First 24 hours transfusion rate was 13 U (8-18.8) of packed red blood cell, 9 U (4-15) of fresh frozen plasma and 2 U (1-3) of platelets. Length of stay in the ED was 58 min (30-130) and time to emergency treatment was 66 min (54-160). 31 (91.2%) patients underwent PPP, while in 2 external fixation was sufficient to control bleeding and in another one angiography was the only procedure. Time to PPP was 63 min (51-113). 17 patients (54.8%) underwent angiography after PPP for persistent instability and 11 of these (35.5%) underwent therapeutic embolization. Early mortality was 26.5%, (8 due to physiologic exhaustion and one to traumatic brain injury). All patients died within the first 24 hours from trauma. There were not significant differences between survivors and non-survivors groups. (Tab. 1)

	Survivors	Nonsurvivors	p
Age	51 (40-63)	62 (42-80)	0,25
Systolic blood pressure in the ED	90 (72-103)	70 (60-95)	0,16
Time in the ED (min)	59 (33-150)	48 (22-113)	0,42
Time to intervention	68 (59-187)	62 (50-115)	0,45
Injury Severity Score	38 (34-43)	36 (34-42)	0,87
First 24 hours PRBC Units	11 (7-18)	17 (9-20)	0,36

ED Emergency Department; PRBC Packed Red Blood Cells

Tab. 1 Characteristics of survivors and nonsurvivors

Conclusion: Hemodynamically unstable pelvic trauma remains a big challenge for trauma centers. In our experience PPP proved to be quick to achieve even by the single surgeon in charge. No death occurred from direct pelvic bleeding.

Poster # 3

AFTER THE EMBO: PREDICTING NON-HEMORRHAGIC INDICATIONS FOR SPLENECTOMY AFTER ANGIOEMBOLIZATION IN BLUNT TRAUMA PATIENTS

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Introduction: Successful non-operative management (NOM) of blunt splenic trauma has increased with the use of splenic angioembolization (SAE); however, patients may still require splenectomy (SPLEN) post-SAE for total splenic infarction and/or abscess. Prompt recognition of this complication may be challenging. We hypothesized that changes in laboratory values indicating complete splenic infarction may expedite the management of these patients.

Methods: Trauma patients admitted to an ACS verified Level 1 trauma center, from 1/07-1/17, who underwent SAE were identified from the trauma registry. Patients with successful NOM after SAE (SAE/NOM) were compared to those requiring splenectomy (SAE/SPLEN). Data included demographics, splenic injury grade, ISS, time to SAE and splenectomy, ICU and hospital LOS, and CBC values. Laboratory values were analyzed immediately post-SAE (time1), and day#5 post-SAE (or day of discharge) for SAE/NOM patients or day of splenectomy for SAE/SPLEN patients (time2). Data was analyzed using Mann Whitney U and Chi square tests with significance attributed to $p<0.05$.

Results: 116 patients underwent SAE; one patient with chronic lymphocytic leukemia and splenomegaly was excluded. 16 (14%) later required SPLEN for infarction/abscess, at a median of 5 days post SAE (IQR: 4-10 days). No differences existed between SAE/SPLEN and SAE/NOM patients in age, gender, ISS, or grade of splenic injury. SAE/SPLEN patients had longer hospital LOS (24 vs 10, $p = 0.001$). WBC, PLT, and PLT/WBC ratio did not differ between the groups at time1. At time2, WBC was higher and PLT/WBC ratio was lower in SAE/SPLEN patients.

	SAE / NOM (n = 99)	SAE / SPLEN (n = 16)	P value
ISS	23 ± 11	25 ± 13	NS
Spleen injury grade	3 ± 1	3 ± 1	NS
ICU admission	42 (42%)	10 (62%)	NS
WBC time2	12 ± 4	19 ± 8	< 0.001
PLT/WBC time2	23 ± 15	16 ± 10	0.003
Δ PLT (time2-time1)	51 ± 88	146 ± 175	0.037
Δ WBC (time2-time1)	-3 ± 7	3 ± 8	0.008

Conclusion: Patients requiring splenectomy for abscess/infarction after SAE develop significant leukocytosis and thrombocytosis, and the PLT/WBC ratio is indicative of total splenic infarction. Monitoring of these parameters allows for more prompt diagnosis and operative intervention.

Poster # 4

LEAKY LIVERS? ROUTINE HIDA AS A SCREENING TOOL FOR BILIARY LEAK IN HIGH-GRADE LIVER LACERATIONS

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Introduction: Bile leak is a serious complication of major liver injury that can result in substantial morbidity and even death. Our Level 1 Trauma Center instituted early (48-72 hours post-injury) routine HIDA scans in grade 4-5 liver lacerations to screen for bile leaks. We hypothesized that routine HIDA scans would identify subclinical bile leaks that could be prospectively managed to minimize complications.

Methods: The trauma registry was used to retrospectively identify all patients (pts) with grade 4-5 liver lacerations from blunt trauma between July 2011 and Dec 2016. Medical records were reviewed to identify pts who underwent screening HIDA scans. Total bilirubin, Injury Severity Score (ISS), interventions, and length of stay (LOS) were recorded. Pts with positive HIDA scan (HIDA+) were compared to those with negative HIDA scan (HIDA-). Mean and standard deviation (SD) were calculated. Statistical analysis was performed by Student t-test or Chi-square.

Results: We identified 35 pts with blunt grade 4-5 liver lacerations during the study period. Seven pts were excluded (4 required emergent exploratory laparotomy, 1 left AMA, 2 pts did not get screening HIDA), leaving 28 pts who met inclusion criteria. Study pts were severely injured, with a mean ISS of 27. HIDA scans were completed on median post injury day 3. Of the 28 HIDA scans performed, 5 (17.8%) were positive for bile leak. All 5 pts with HIDA+ underwent ERCP, 4 also had laparoscopic washout, and 2 required IR drainage. No HIDA- pts required additional interventions. HIDA+ pts had significantly higher total bilirubin and a greater hospital LOS.

	N (%)	ISS (± SD)	T Bili (± SD)	LOS (± SD)
HIDA-	23 (82.1%)	26.5 ± 8.3	1.1 ± 1.1	8.1 ± 6.2
HIDA+	5 (17.8%)	30.4 ± 8.7 #	2.7 ± 1.6 *	17 ± 6.0*

p = NS, * p < 0.05 vs HIDA-

Conclusion: We showed that HIDA scans were a useful tool in high-grade blunt liver lacerations to aid in early identification of bile leak. Patients with HIDA+ were able to undergo ERCP, biliary stenting, washout, and/or IR drainage prior to overt clinical signs of biliary leak or bile peritonitis. We also found that early negative HIDA scans seemed to reliably identify patients without bile leak after high grade liver trauma.

Poster # 5

SPLENIC INJURY MANAGEMENT OUTCOMES FROM TQIP = SOS - SAVE OUR SPLEENS!

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Introduction: The non-operative (NOM) management for splenic injury is now the preferred choice by virtue of its feasibility in almost all splenic injuries as well as of the avoidance of short term and long term splenectomy complications. The efficacy of non-operative management in less severely injured patients is clear, however its feasibility in more severely and multiply injured patients is unclear. We sought to determine the outcomes of the current splenic injury management schema based on injury severity.

Methods: We retrospectively analyzed patients admitted with a splenic injury between 2006 and 2016 in the Trauma Quality Improvement Program (TQIP) database. They were stratified into three groups based on their injury severity scores (ISS) and grouped based on their treatment modalities (NOM, immediate splenectomy and delayed splenectomy). Immediate splenectomy was determined as being initiated within two hours of ED admission and delayed as more than two hours after ED admission. Statistical significance ($p< 0.05$) was established through the Kruskal-Wallis H test for continuous data and the Pearson's Chi-Square test for nominal data.

Results: 1868 subjects were included, of those, 798 were in the first stratum (ISS of 25 or below), 972 were in the second stratum (ISS of 26-50) and 98 were in the third stratum (51-75). The first stratum had an overall mortality rate of 1.5%, the second a rate of 10.2% and the third with a rate of 28.4%. Within the first stratum, the NOM had a lower mortality rate when compared to immediate splenectomy and delayed splenectomy (1.1% vs 7.1% vs. 8.7%, $p=0.005$) as well as the lowest complication rate (8.6% vs 42.9% vs 34.8% $p<0.001$) and lowest average length of stay (5.3 vs 9.9 vs 8.8 days, $p<0.001$). In the second stratum (ISS 26-50), NOM has a lower mortality (7.2% vs 20.8% vs 18.1%, $p<0.001$), average length of stay (12.5 vs 17.5 vs 17.4 days, $p<0.001$) and incidence rate of total complications (40.3% vs 92.9% vs 81.9%, $p<0.001$). A statistical significance was not established for the analyses performed on the third stratum (ISS 51-75).

Conclusion: This data demonstrates that non-operative management of splenic injury with an ISS of 50 or less is not only feasible but is beneficial. The NOM populations for both the lower severity and the multiply/severely injured have lower rates of mortality, lower incidence rates of complications and lower average lengths of stay when compared against patients undergoing immediate splenectomy. Employing the TQIP dataset encompassed all non-operative treatment algorithms short of splenectomy. While we recognize that there are a subset of patients in whom splenectomy is needed for resuscitation, this implies every effort to avoid splenectomy should be employed in all others even with severe associated injuries. Our data set has small sample sizes of delayed splenectomy patients making that data of limited value, however the robust populations of NOM and immediate splenectomy patients support these conclusions. We however could not define a benefit for NOM in the highest severity patients from this dataset.

Poster # 6

REFINING INDICATIONS FOR SPLENIC EMBOLIZATION: DID WE OVERDO IT?

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Introduction: Non-operative management (NOM) of splenic lacerations in hemodynamically stable patients has become the standard of practice. Splenic embolization (SE) has been a useful adjunct to NOM but the frequency of its use varies by trauma center. There has been debate on which patients may actually benefit from SE as observation (OBS) alone may be sufficient. We established a SE protocol in 1999 and after a 6 year review, the protocol was revised in attempt to identify those patients most likely to benefit from SE. This study compared SE results between two cohorts of patients pre- and post- SE protocol revision.

Methods: All traumatic splenic injury patients seen at one urban Level II Trauma Center were reviewed. We compared results with SE during two time periods, 1999-2005 (Grp I) and 2010-2015 (Grp II). Our SE protocol during 1999-2005 included patients with splenic laceration (SpLac) on CT with contrast extravasation (CE) and patients with SpLac on CT with moderate to large hemoperitoneum without CE were discussed with the Interventional Radiologist with selective SE. The SE protocol excluded patients with SBP < 100mmHg in the Trauma Room. From 2010-2015, the protocol excluded patients with large hemoperitoneum and no CE from the splenic injury. Medical records were reviewed for demographics and outcome data. Treatments groups were defined as Operative (Op) if they had splenectomy (SP) or splenorrhaphy (SY); NOM if they had OBS alone or SE.

Results: There were similar number of patients in each group with similar breakdown in OP and NOM. There were significantly less patients undergoing primary SE in Grp II (41 patients in Grp II vs. 77 patients in Grp I, $p<0.0001$) with similar splenic salvage rate for NOM (93.7% in Grp I vs. 96.8% in Grp II, $p=0.1683$). Failed SE requiring splenectomy was similar between groups (7.9% for Grp I vs. 10.0% for Grp II, $p= 0.7559$).

Table. Comparison of groups.

	Grp I	Grp II
N	261	277
Mean Age in years	34.3	42.7
Percent Males	72%	66%
Mean ISS	21.5	23.7
Mean LOS in days	10.0	10.5
OP (number of patients)	56	56
NOM (number of patients)	205	221
Primary OBS	128	180
Primary SE	77	41
Failed OBS requiring SP	6	2
Failed OBS requiring SE	12	9
Failed SE requiring SP	7	5
TOTAL SE	89	50
PRBCs transfused in 1st 24 hrs for SE	1.7 Units	2.2 Units
Deaths in SE group	3	2

Conclusions: Despite decreasing the use of primary SE from 37.5% to 18.6% for NOM of splenic injuries we were able to maintain a high splenic salvage rate with no difference in mortality. Refining the indications for SE resulted in a similar splenic salvage rate.

Poster # 7

MODERN MANAGEMENT OF PANCREATIC INJURIES IN THE CANADIAN TRAUMA SYSTEM

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Introduction: Pancreatic injuries are rare, can be difficult to diagnose, and - despite multiple guidelines – often complex to manage. The literature consists of small, single centre case series, providing low levels of evidence. This study was therefore undertaken to evaluate the contemporary diagnosis and management of pancreatic trauma in multiple centres across Canada.

Methods: Multi-center retrospective cohort study. Data were collected from review of medical records at eight lead trauma hospitals across Canada for the period 2009 - 2014. Data collected included: demographics; injury characteristics; and details of diagnosis, management, and follow up of pancreatic injuries. All patients with a discharge diagnosis of blunt or penetrating pancreatic trauma were included.

Results: Two hundred and seventy nine patients were included in the analysis. Mean age was 32 (SD 15.4), 72% were males and mean Injury Severity Score (ISS) was 29 (SD 15.3). The majority suffered from blunt trauma (79%). With respect to grade of pancreatic injury, 133 (57%) patients were low grade (I/II), 77 (33%) were grade III, 18 (8%) grade IV and 6 (2%) grade V. Eighty nine percent of patients were diagnosed with pancreatic injury within the first 24 hours post admission. Two hundred and thirty three had diagnostic imaging performed, the vast majority of whom (214, 92%) were evaluated with computed tomography (CT). Of the other initial imaging modalities, 42 (18%) underwent ultrasound, 28 (12%) magnetic resonance pancreatography (MRCP) and 11 (5%) endoscopic retrograde pancreaticography (ERCP). The initial imaging was diagnostic in 81% of patients, most commonly CT. One hundred and twenty patients (51% of the initially imaged patients) required repeat imaging. Out of the 113 patients initially observed, 107 were successfully managed non-operatively, with only 6 requiring a therapeutic ERCP. One hundred and seventy two (61.6%) underwent an operative intervention. The most common intervention performed was a distal pancreatectomy (88 patients: 51 with splenectomy, 37 spleen-preserving). Sixteeen percent of grade III and 22% percent of grade IV injuries were managed non-operatively. Median time to operating room (OR) was 0 days (IQR 0-1), 77% of patients undergoing their surgical intervention in the first 24 hours post admission. A delay of more than 24 hours to OR tripled the risk of pancreatic fistula (46.2% VS 15.4%; p=0.007). Six patients suffered from pancreatic dysfunction, two requiring referral to an endocrinologist. The overall mortality rate was 11.5%.

Conclusion: This is the largest national multicenter study on pancreatic trauma. While we found that a large proportion of patients were diagnosed promptly with CT, half required more than one imaging modality. Sixty percent of patients were managed operatively, most of them within 24 hours of admission. A significant proportion of patients with grade III and IV pancreatic injuries were managed non-operatively. This reinforces the fact that the management of pancreatic trauma is not standardised despite published guidelines, and further work is needed on the topic.

Poster # 8

VALIDITY OF PUBLISHED APPROPRIATENESS INDICATIONS FOR USE OF DAMAGE CONTROL LAPAROTOMY AT A HIGH-VOLUME TRAUMA CENTER IN THE ERA OF DAMAGE CONTROL RESUSCITATION

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Introduction: Recent studies have reported consensus-based indications for use of damage control laparotomy (DCL) in trauma patients. However, it remains unknown whether these indications reflect idealized rather than actual practices. We sought to determine the predictive validity of published appropriateness indications for use of DCL in the era of damage control resuscitation.

Methods: We conducted a retrospective cohort study of the predictive validity of a set of published indications that experts and practicing surgeons previously agreed appropriately indicated use of DCL. We included consecutive adults (≥16 years-of-age) that underwent emergent laparotomy for trauma (laparotomy performed immediately after transfer of the patient from the Emergency Department to the operating room) between 2011 and 2016 at an urban level 1 trauma center. Multivariable logistic regression was used to estimate adjusted odds ratios (ORs) with surrounding 95% confidence intervals (CIs).

Results: In total, 1,192 young [median=33 years; interquartile range (IQR)=24-47] patients that were predominantly (57%) injured by blunt mechanisms underwent emergent laparotomy during the 6-year study period. The patients were severely injured [median Injury Severity Scale (ISS) score=19; IQR=10-32) and abdominal Abbreviated Injury Scale (AIS) score=3; IQR=2-4]. Published preoperative indications independently associated with an increased odds of performing DCL over definitive laparotomy included: 1) a concomitant severe traumatic brain injury (OR=1.9; 95% CI=1.1-3.4); 2) ISS score >25 (OR=3.2; 95% CI=2.1-4.9); or 3) systolic blood pressure (SBP) <90 mmHg upon arrival to the trauma bay (OR=3.6; 95% CI=2.2-5.9). Published intraoperative indications independently associated with an increased odds of performing DCL included: 1) an abdominal vascular injury and a major associated hollow viscus (OR=4.4; 95% CI=2.5-7.7) or blunt abdominal organ injury (OR=3.6; 95% CI=2.3-5.8); 2) devascularization or disruption of the pancreas, duodenum, or pancreaticoduodenal complex requiring pancreaticoduodenectomy (perfectly predicted use of DCL); 3) administration of >10 units of packed red blood cells across the pre- and intraoperative settings (OR=1.3; 95% CI=1.2-1.3); or 4) a SBP <90 mmHg (OR=2.0; 95% CI=1.3-2.9) or pH<7.2 (OR=4.7; 95% CI=3.3-6.9) at the beginning of operation. The odds of undergoing DCL instead of definitive laparotomy were 11.7 (95% CI=1.5-90.7) times higher when the SBP of the patient was persistently <90 mmHg during operation and 7.0 (95% CI=2.1-23.7) times higher when the pH was persistently <7.2 during operation (instead of only at the beginning of operation).

Conclusion: This study suggests that previously published indications determined by survey and expert opinion accurately predict use of DCL over definitive laparotomy in practice. They also suggest that surgeons more frequently perform DCL when physiological derangements persist during laparotomy.

Poster # 9

Contemporary Acute Management of Bladder Trauma: Results from the American Association for the Surgery of Trauma (AAST) Genitourinary Trauma Study.

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Introduction: Bladder trauma is an uncommon urologic injury. The rarity of bladder injury limits its study in single institutional studies and development of evidence based guidelines. Our goal is to understand current epidemiology and management of traumatic bladder injury in a large multi-institutional setting.

Methods: From 2014 to 2016, data on bladder injury were collected from 14 participating trauma centers. Data were gathered on demographics, injury characteristics, acute management (within the first 4 days of admission), and need for delayed intervention. Descriptive statistics were used to report management patterns of bladder trauma during this period.

Results: A total of 119 cases of traumatic bladder injury were recorded. Patient and injury characteristics are summarized in Table-1. Mean age was 40.7 years (SD:17.2). 99 (83%) had associated injuries, including pelvic fracture in 77 (65%), gastrointestinal injury in 45 (38%), solid organ injury in 23 (20%), and major vascular injury in 19 (16%). Blunt injury occurred in 84 (71%). 8 (7%) patients died. Bladder injuries were intraperitoneal (IP), extraperitoneal (EP), and both IP+EP in 43 (36%), 56 (47%), and 20 (17%), respectively. In patients with IP or IP + EP injuries, all bladder injuries were operatively repaired at a median of 2.8 hours (interquartile range: 1.2 – 7.9 hours) after admission. EP injuries were repaired in 25 (45%) patients in a median of 5.7 hours (interquartile range 2.9 - 17.4 hours) from admission. The three leading reasons for EP repair were: severity of the injury, injury found during laparotomy, and concerns about pelvic hardware contamination. 27/42 (64%) of blunt EP injuries were managed conservatively while 2 of these needed delayed bladder surgery (after 6 and 20 days) due to concerns for infected pelvic hematoma and persistent hematuria in one patient, and persistent leakage due to bone fragments in bladder in another patient. 3/14 (21%) of penetrating EP injuries were conservatively managed. Rate of death was not different between types of bladder injury.

Conclusion: Most bladder traumas occur after blunt injury and are EP. About half of EP bladder injuries were managed operatively in the setting of multiple trauma.

Table-1 Demographics and management of traumatic bladder injury

	Total (N=119)	IP or IP+EP (N=63)	EP (N=56)	P-value *
Age, mean (SD), y	40.7(17.2)	37.6 (14.7)	44.1 (19.2)	0.07
Male sex, No. (%)	81 (68%)	41 (65%)	40 (71%)	0.56
Type of injury				0.37
Blunt	84 (71%)	42 (67%)	42 (75%)	
Penetrating	35 (29%)	21 (33%)	14 (25%)	
ISS, mean (SD)	27.0 (14.0)	29.6 (15.2)	24.0 (12.0)	0.05
Associated injuries, No. (%) [1]	99 (83%)	52 (83%)	47 (84%)	0.84
Length of stay, mean (SD), d	15.1 (14.2)	16.0 (15.1)	14.1 (13.1)	0.38
Initial Management, No. (%)				**<0.001**
Conservative	32 (27%)	0 (0%)	21 (48%)	
Bladder repair	87 (73%)	63 (100%)	23 (52%)	
Mortality	8 (7%)	5 (8%)	3 (5%)	0.72

IP, intraperitoneal; EP, extraperitoneal; SD, standard deviation

* comparisons made between "IP or IP+EP" and "EP" bladder injuries

[1] Defined as presence of any concomitant injury, including: solid organ, gastrointestinal, spinal cord, major vascular, and pelvic fracture.

Poster # 10

SAVING KIDNEYS: 20-YEAR RENAL GUNSHOT WOUND EXPERIENCE IN AN URBAN LEVEL ONE TRAUMA CENTER

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Introduction: Renal trauma management has changed in recent years. In penetrating injuries, kidney preservation and reconstruction are not always prioritized. The purpose of this study is to analyze the presentation, management and outcomes of renal gunshot wounds (GSW).

Methods: This is an IRB approved, retrospective review of all patients ≥ 14 years of age with penetrating renal trauma (from a GSW) from 1994-2015 at an urban Level 1 Trauma Center. Patients who died in the first 24 hours were excluded. The Trauma Registry and medical records were reviewed for the patient presentation, management, and outcomes. Evaluation was via descriptive statistics.

Results: 253 patients (258 renal injuries) were identified with a mean patient age of 30.1 years and a mean injury severity score (ISS) of 20.1. The renal injury was diagnosed by CT in 66 patients, IVP in 16 patients, and intra-operatively in the remaining 171 patients. Pre-operative imaging was performed in 30% (n=76) of patients. Injury to non-renal organs was present in 98% (n=247) of patients, with >1 non-renal organ involved in 79% (n=199). Liver, colon, small bowel, and diaphragm injuries were the most commonly associated injuries. Using the AAST grading system, there were 25 – grade 1 (G1), 36 – G2, 78 – G3, 70 – G4, and 49 – G5 injuries. 101 renal injuries underwent repair, with a renal salvage rate of 73% (n=188). The total number of nephrectomies was 70. The most common complications associated with renal surgery were peri-renal or intra-abdominal abscess (n=17) and urine leak/urinoma (n=14). Post injury follow-up was limited with imaging obtained in only 44% of patients. Furthermore, there were 16 cases of post-injury hypertension documented. Overall survival was 91% (n=229).

Management	**G1**	**G2**	**G3**	**G4**	**G5**
Observation only	15	19	20	5	0
Exploration only	10	7	5	5	0
Renorrhaphy	0	10	44	19	1
Omental Patch	0	1	3	6	0
Peritoneal Patch	0	1	1	2	0
Embolization	0	0	2	2	0
Vascular Repair	0	0	1	10	0
Partial Nephrectomy	0	0	7	15	0
Total Nephrectomy	0	0	0	22	48
TOTAL INJURIES	**25**	**36**	**78**	**70**	**49**

Conclusion: This series represents the largest number of renal injuries resulting from GSW. Patients sustaining renal GSW often present with multi-organ trauma and high grade renal injury. Despite the high-grade injuries, the renal salvage rate is > 70%, with a complication rate < 20%.

Poster # 11

TREATMENT OF ABDOMINAL TRAUMA FROM THE TRAUMA SURGEON'S POINT OF VIEW - RESULTS OF AN ONLINE SURVEY

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Introduction: The classic general surgery and trauma surgery in Germany, Austria and Switzerland has undergone notable changes during the last years. Curricula and treatment situation are different within all three countries. Whereas the general surgery dissolved into visceral surgery in Germany, the trauma surgery abandoned thoracic and abdominal interventions to a varying extent. We therefore aimed to obtain the current treatment situation to identify structural adaptations that need to be made.

Methods: A cross-sectional study, based on an online survey, including 175 Austrian, Swiss and German trauma surgeons, was carried out over a period of 8 months in 2015. With regard to structural country-specific differences, members of the Swiss association for surgery as well as the Austrian and German association for trauma surgery were contacted.

Results: In 43% of the participating departments, a visceral/general surgeon is part of the team in the emergency room, in addition to the trauma surgeon. As a consequence, 61%of the trauma surgery departments, performed surgery on only 1-24 patients with abdominal injury/year. Regarding non-operative abdominal trauma, 30% of trauma departments treat 25-49 cases/year. A separation into the level of trauma center showed that the majority of level-I trauma centers operated on 50-100 patients. A similar development can be observed regarding the estimated general surgical competence that was stated with 100% for the clinical director, 50% for the attending/specialist and 0%among the residents. Asked for their personal opinion, 47% aspire to have at least theoretical competence and partial independent operative competence in abdominal trauma. 73% want to be able to carry out an emergency laparotomy, 66% a splenectomy and 54% a small bowl segment resection/suture. On the contrary, 12% believe that a trauma surgeon does not need any visceral surgical skills.

Conclusion: Currently, abdominal trauma in Germany, Austria and Switzerland seems already to be treated mainly by the visceral surgery department, leading unavoidably to limited training in abdominal trauma for the junior trauma surgeon. A majority of the participants believe, having competence in abdominal trauma surgery, is a necessary skill for trauma surgeons. Therefore, it is essential that adaptations need to be made to teach basic skills of visceral surgery.

Poster # 12

EFFECTIVENESS AND SAFETY OF CONTINUOUS NEUROMUSCULAR BLOCKADE IN TRAUMA PATIENTS WITH AN OPEN ABDOMEN: A FOLLOW-UP STUDY

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Introduction: Following damage control laparotomy (DCL), fascial closure is recommended within 7-8 days to decrease the risk of complications. Chemical paralysis with neuromuscular blocking agents (NMBA) after DCL has been shown to decrease time to primary fascial closure. Changes in resuscitation and fluid use over the last decade bring this practice back into question. We sought to evaluate the effect of continuous NMBA on abdominal closure rates and time to closure in DCL patients. We hypothesized that continuous NMBA following DCL would be associated with earlier fascial closure compared to management without neuromuscular blockade.

Methods: A retrospective cohort study was conducted at an ACS-verified level 1 trauma center. All adult patients who underwent DCL within 24 hours of admission to the trauma service between 2009 and 2015 were included. Patients with ICU length of stay <48 hours or who expired prior to closure were excluded. The study group (NMBA+) included patients who received continuous NMBA within 24 hours of DCL and was compared to a control group (NMBA–) that did not receive NMBA. Data collected included demographics, resuscitative fluids and blood products (over initial 48 hours), length of stay, mortality, and the occurrence of complications. The primary outcome was time to primary fascial closure. Secondary outcomes included closure by day 7, length of stay, mortality, and the incidence of complications. Categorical and continuous data were analyzed with the χ^2 and Mann-Whitney U tests, respectively. Ordinal logistic regression analysis was used to determine factors associated with abdominal closure.

Results: There were 222 total patients included in the study. The NMBA+ group included 125 patients and the NMBA– group included 97 patients. Demographics were similar between groups, including median age (NMBA+ 36 vs NMBA– 39 years), ISS (29 vs 34), and mechanism of injury (46% vs 33% penetrating). There was no difference in time to abdominal closure between groups (NMBA+ median 2 days, IQR 1–2.5; NMBA– 2 days, IQR 1–2; p=0.503). Closure was achieved by day 7 in 98% of all patients in the cohort (NMBA+ 98.4%; NMBA– 96.9%; p=0.457). The incidence of complications was similar between g roups (NMBA+ 64%; NMBA– 59%; p=0.426). Ordinal logistic regression (see table) revealed that NMBA exposure was not associated with time to abdominal closure.

Factors Associated with Time to Abdominal Closure

Variable	Odds Ratio	95% Confidence Interval
Exposure to NMBA	1.105	0.668 – 1.829
Female Gender	2.483	1.379 – 4.469
Injury Severity Score	1.014	0.995 – 1.032
Age (years)	1.021	1.001 – 1.037
Fluid Intake (over 48 hours)	1.000	1.000 – 1.000
Blood Products (over 48 hours)	1.000	1.000 – 1.000

Conclusion: In adult trauma patients requiring DCL, continuous NMBA did not affect the time to abdominal closure or the incidence of complications. Nearly all patients now achieve fascial closure within 7 days. Routine use of NMBA in trauma patients after DCL may not be necessary with current resuscitation and management strategies.

Poster # 13

CHARACTERISTICS OF 171 COMBAT-ASSOCIATED SMALL BOWEL INJURIES

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Introduction: Although there are multiple studies regarding the management and outcomes of colonic injuries incurred in combat, the literature is limited in regards to small bowel injuries. This study seeks to address that void by providing the largest reported review of the characteristics of combat-associated small bowel injuries.

Methods: The Department of Defense Trauma Registry was queried for members of the United States Armed Forces who sustained hollow viscus injuries in the years of 2007 to 2012 during Operations Enduring Freedom, Iraqi Freedom, and New Dawn. Patients with other backgrounds (i.e. North Atlantic Treaty Organization troops, local nationals) were excluded. Service members with injuries of the small bowel were identified by diagnosis codes, and concomitant injuries, procedures, and complications were delineated. After summarizing the data, Fisher's exact test was used to analyze the relationship of bowel injury pattern to rates of repeat laparotomy, fecal diversion, and complications.

Results: One hundred seventy-one service members had small bowel injuries. The mean age was 25.8 ± 6.6 years with a mean injury severity score of 27.9 ± 12.4. The majority of injuries were penetrating (94.2%, n=161) as a result of explosive devices (61.4%, n=105). The median blood transfusion requirement in the first 24 hours was 6.0 units (IQR, 1.0-17.3); 48 patients received at least 10 units. The most frequent concomitant injuries were large bowel (64.3%, n=110), pelvic fracture (35.7%, n=61), perineal (26.3%, n=45), liver (20.5%, n=35), and pelvic organ (19.9%, n=34). Fifty patients (29.2%) had a colostomy, and 9 patients (5.3%) had an ileostomy. 62.6% (n=107) of soldiers underwent more than one laparotomy. The mortality rate was 1.8% (n=3). Median length of stay was 13 days (IQR, 5-38). The most common complications were pneumonia (15.2%, n=26), deep vein thrombosis (14.6%, n=25), wound infection (14.6%, n=25), and pulmonary embolus (12.9%, n=22). The need for repeat laparotomy and fecal diversion (ileostomy and/or colostomy) were found to be significantly associated with injury pattern (p= 0.00052 and p=<0.0001 respectively) (Table 1).

Table 1. Repeat laparotomy, fecal diversion, and complications with respect to injury pattern.

Outcome	n (%)	p value
Repeat Laparotomy		0.00052
SB	21 (39.6)	
SB+LB	65 (71.4)	
SB+Rect	6 (75.0)	
SB+LB+Rect	15 (78.9)	
Fecal Diversion		<0.0001
SB	3 (5.7)	
SB+LB	36 (39.7)	
SB+Rect	5 (62.5)	
SB+LB+Rect	13 (68.4)	
Complications		0.089
SB	16 (30.2)	
SB+LB	46 (50.5)	
SB+Rect	4 (50.0)	
SB+LB+Rect	10 (52.6)	

SB, small bowel. *LB*, large bowel. *Rect*, rectum.

Conclusion: The characteristics of combat-associated small bowel trauma have not previously been reported. We found that two-thirds of service members with small bowel injuries also had a large bowel injury. One-third of the patients in this study required diversion, and two-thirds required at least one repeat laparotomy. The pattern of bowel injury significantly impacted need for repeat laparotomy and fecal diversion. Further investigation is warranted to elucidate how patients with small bowel injuries compare to those with other hollow viscus trauma and how different methods of operative management affect outcomes.

Poster # 14

CROSS SECTIONAL IMAGING OF THE TORSO REVEALS OCCULT INJURIES IN ASYMPTOMATIC BLUNT TRAUMA PATIENTS

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Introduction: The triggers to obtain a CT of the chest, abdomen, and pelvis of the trauma patient remain controversial. Some suggest a low threshold to order a complete CT C/A/P in all trauma patients. A number of recent studies have suggested a more selective approach. The reasons for selective imaging include: theoretical risks of radiation exposure, potential ill-effects from IV contrast use, and cost. Currently there is a lack of clear pre-scan criteria to aid in determining the effectiveness of torso CT. The purpose of this study is to review the CT indications, findings, and complications in patients with low ISS to determine the utility of CT in this patient cohort.

Methods: A retrospective review of non-intubated, adult blunt trauma patients with an initial GCS of 14 or 15 evaluated in an ACS verified level 1 trauma center from July 2012 to June 2015 was performed. Data was obtained from the trauma registry and chart review and included: age, sex, injury type, ISS, physical exam findings, all injuries recorded, injuries detected by torso CT, missed injuries, and complications.

Results: 2306 patients were determined eligible for review from the registry. The mean ISS was 8. Initial chest exam was normal in 1571 (68%). 52% of these patients received a CT Chest, and 18% of these patients were found to have an occult chest injury. 61% of patients that had an initial CXR also received a CT Chest. 35% of patients with a negative CXR who also had a CT Chest had occult injuries detected. 56% of patients with a negative abdominal exam had a CT A/P. 19% of these patients were found to have an occult injury on CT. 43% of the patients with normal C/A/P exams received a CT C/A/P. 34% of these patients demonstrated occult injuries by CT. No consistent pre-scan criteria were identified to accurately rule out CT as an effective adjunct to the work-up. No incidents of contrast-induced complications were noted in the study period.

Conclusion: A significant number of occult injuries were detected in stable adult blunt trauma patients with a GCS of 14/15. A negative physical exam combined with a normal CXR do not rule out the presence of occult injuries and the need for torso imaging. In this series, 30% of stable adult blunt trauma patients with GCS of 14/15 and normal physical exams were found to have occult injuries detected by CT. In blunt trauma patients with normal sensorium, physical exam and CXR, the practice of obtaining cross sectional imaging would appear to be beneficial. Identification of occult injuries in this cohort outweighs the small risk associated with CT scan.

Poster # 15

NON-OPERATIVE MANAGEMENT OF BLUNT SPLENIC TRAUMA IS MORE SUCCESSFUL IN PATIENTS WITH TRAUMATIC BRAIN INJURY

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Introduction: Preventing secondary insult to the brain is essential in the management of patients with traumatic brain injury (TBI). Although the presence of a TBI does not preclude patients with splenic injuries from a trial of nonoperative management (NOM), development of hypotension in this setting may be detrimental and could therefore lead trauma surgeons to a lower threshold for operative intervention and a potentially higher risk for failure of NOM (FNOM). We hypothesized that the presence of a TBI in patients with blunt splenic injury would lead to a higher risk for FNOM.

Methods: Patients 16 years or older, with a splenic injury secondary to a blunt mechanism were selected from the National Trauma Data Bank research datasets 2007-11. We excluded subjects who were transferred, died in the emergency department, those with unknown timing of the spleen-related procedure, and those with unknown AAST-OIS grade of splenic injury or unknown head abbreviated injury scale (AIS) score. TBI was defined as AIS head ≥ 3 and FNOM as patients who underwent a spleen-related surgical procedure after 2 hours from their admission. TBI patients were compared to those without TBI and the primary outcome was FNOM. A logistic regression model was utilized to adjust for differences between the two groups.

Results: Of the 76,557 subjects with blunt splenic injury, 47,713 met inclusion criteria. Of those, 9,390 (19.7%) underwent immediate laparotomy and the remaining 41,436 (80.3%) underwent a trial of NOM. TBI was present in 8,166 (19.7%) of those selected for NOM. Compared to their counterparts with no TBI, TBI patients were more likely to be older than 65 years (10.4% vs. 9.6%, $p=0.04$), have a severe thoracic injury (AIS ≥ 3: 70.0% vs. 48.5%, $p<0.01$), and be admitted with hypotension (11.8% vs. 6.8%, $p<0.01$). In addition, TBI patients were more likely to have a concomitant kidney (15.1% vs. 11.8%, $p<0.01$) and liver injury (25.0% vs. 16.6%, $p<0.01$) with similar AAST-OIS grade. FNOM was identical between the two groups (10.6% vs. 10.8%). After adjusting for confounding factors, TBI patients had significantly lower adjusted odds for FNOM (AOR: 0.66, $p<0.01$), even among those with a high-grade (III-IV-V) splenic injury (AOR: 0.68, $p<0.01$). The timing for FNOM was similar between both groups (median 5 hours, $p=0.85$), even for those with a high-grade injury (median 4 hours, $p=0.20$). When comparing TBI patients with FNOM to those with no FNOM, no difference in adjusted mortality was noted (22.6% vs. 18.9%, AOR: 1.01, $p=0.95$).

Conclusion: Despite the presence of additional solid organ injuries, nonoperative management of blunt splenic trauma in patients with traumatic brain injury has higher adjusted odds for success, independent of the grade of the splenic injury. The higher odds for successful non-operative management in these patients could be related to interventions targeting prevention of secondary insults to the brain. Further studies are required to identify those specific practices that lead to a higher success rate of nonoperative management of splenic trauma in traumatic brain injury patients.

Poster # 16

REVERSAL OF ILEOSTOMIES AND COLOSTOMIES IN TRAUMA PATIENTS

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Introduction: The management of traumatic small bowel and colon injuries in many patients requires ileostomies and colostomies due to intraabdominal bleeding, contamination, or extensive intraabdominal damage. The ostomy reversal rate, barriers to reversal, and presenting factors that influence later reversal are not well characterized. We sought to determine the factors that contribute to ostomy reversal following creation of ostomies for trauma.

Methods: This was a retrospective review of all trauma patients who required an ileostomy or colostomy as a result of trauma who presented to one level one and one level two trauma center from 1/1/2006 to 12/31/2015. Data regarding the initial trauma and subsequent admissions, clinic appointments, and Emergency Department visits were collected and then analyzed using SPSS.

Results: 208 patients (pt) met inclusion criteria with an average age of 33 years (range 14-80). Cause of injury was penetrating in 194 pt and blunt in 14 pt. The average Injury Severity Score (ISS) was 17 (range 9-50). Sixty-two percent (n= 128) needed one operation during the initial trauma admission, whereas 38% (n=80) required multiple operations. Fourteen patients died prior to consideration of ostomy reversal and eight were lost to follow up. Of the 186 patients for whom data was complete, reversal was completed in 143 pt (77%). Ostomy reversal was more likely to be attempted in patients who had a shorter length of stay (LOS) during the initial trauma (18d v 29d, p=0.009), and the attempt was more likely to be completed if there was a lower presenting heart rate at the time of trauma (HR; 96 bpm v 116 bpm, p=0.029). Age, type of trauma (blunt vs penetrating), ISS, initial operative time, need for multiple trips to the operating room, number of abdominal operations following trauma, ostomy type (ileostomy vs colostomy), access to ostomy supplies, dehydration or acute kidney injury secondary to ostomy output, nor insurance status revealed any correlation to ostomy reversal.

Conclusion: The majority of patients went on to ostomy reversal. Shorter initial length of stay and lower presenting heart rate were associated with successful ostomy closure. Age, type of trauma (blunt vs penetrating), ISS, initial operative time, need for multiple trips to the operating room, number of abdominal operations following trauma, ostomy type (ileostomy vs colostomy), access to ostomy supplies, dehydration or acute kidney injury secondary to ostomy output, nor insurance status revealed any correlation to ostomy reversal. A prospective trial to further elucidate the factors associated with successful ostomy closure and to identify barriers to reversal is warranted.

Poster # 17

IMPACT OF OPERATIVE VERSUS NON-OPERATIVE MANAGEMENT ON OUTCOME FOR AAST GRADE III AND IV PANCREATIC INJURY: A TRAUMA QUALITY IMPROVEMENT PROGRAM (TQIP) DATABANK ANALYSIS

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Introduction: High-grade traumatic pancreatic injuries are associated with significant mortality. Need for operative management of such injuries is controversial. The present study evaluates outcomes following operative versus non-operative management of severe pancreatic injury.

Methods: Patients were recruited from the TQIP databank between 1/2010 to 12/2014. Patients with a pancreatic injury grade III and IV according to the AAST Organ Injury Scale classification were included in the study. Patients' demographics, vital signs on admission, Abbreviated Injury Scale (AIS) for each body area, Injury Severity Score (ISS), blood transfusion, and therapeutic modality were extracted. Mortality and hospital length of stay were stratified according to the severity of pancreatic injury and treatment modality. Operative management was defined as any form of pancreatic resection.

Results: During the study period, a total of 4085 patients had a pancreatic injury of which 17% (n=702) had a grade III and 7.2%
(n=295) grade IV pancreatic injury. Of these 93% were due to penetrating injury. 43% of grade III and 41% of grade IV injuries were managed operatively, respectively. The total LOS was longer in the operative arm irrespective of the pancreatic injury severity (Table 1). Mortality was not significantly higher in the non-operatively managed patients, 6.5% vs. 3.3% (p=0.06) for grade III and 8.6% vs. 4.2%(p=0.14) for grade IV injuries.

Conclusion: An operative approach for managing grade III and IV pancreatic injury is not associated with a significant decrease
in mortality but is associated with an increase in hospital LOS.

Table 1. Demographic and outcomes.

	AAST Grade III Pancreatic Injury (n = 702)			AAST Grade IV Pancreatic Injury (n = 295)		
	Operation (n = 305)	No-operation (n = 397)	p	Operation (n = 120)	No-operation (n = 175)	p
Age (SD) years	33.1 (13.7)	33.8 (14.4)	0.84	32.4 (13.1)	33.7 (13.8)	0.29
Male	86.9 (265)	86.9 (345)	0.99	86.7 (104)	88 (154)	0.73
Penetrating mechanism (%)	95.1 (290)	91.2 (363)	0.05	95.8 (115)	90.9 (159)	0.10
ISS ≥ 16 (%)	74.4 (227)	74.1 (295)	0.93	71.7 (86)	75.4 (132)	0.47
Head AIS ≥ 4 (%)	0 (0)	1.8 (7)	0.68	2.5 (3)	2.3 (4)	0.18
Thorax AIS ≥ 4 (%)	4.6 (14)	5.3 (21)	0.68	1.7 (2)	4.6 (8)	0.18
Abdomen AIS ≥ 4 (%)	13.8 (42)	13.8 (55)	0.99	14.2 (17)	14.3 (25)	0.98
Extremity ≥ 4 (%)	0 (0)	0 (0)	-	0 (0)	0.6 (1)	0.41
ICU LOS, mean (SD)	10.8 (10.8)	10.9 (14.3)	0.60	14.5 (16.7)	11.9 (12.5)	0.42
Median (LQ,UQ)	7 (3,15)	5 (2,13)		8 (3,20)	7 (3,18)	
Hospital LOS, mean (SD)	22.2 (19.2)	16.7 (21.8)	0.003	26 (23.9)	18.2 (21.4)	0.010
Median (LQ,UQ)	17 (9,30)	10.5 (1,21)		20 (10,38)	14 (1,31)	
Mortality (%)	3.3 (10)	6.5 (24)	0.055	4.2 (5)	8.6 (14)	0.142

Poster # 18

MOVING THINGS ALONG: A PILOT STUDY INVESTIGATING PROBIOTIC THERAPY FOLLOWING EXPLORATORY LAPAROTOMY IN TRAUMA PATIENTS

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Introduction: Polytrauma patients are at an increased risk of developing prolonged ileus or other nosocomial infections, particularly after open-abdominal surgery such as laparotomy, because of disruption to the normal gastro-intestinal (GI) flora. Enteral probiotic therapy administration has been suggested to restore gut permeability and function, as well as aid in the prevention of infection; however, studies elucidating results in trauma patients post open-abdominal surgery are scarce. The purpose of this study is to examine patient outcomes following the administration of probiotics post-exploratory laparotomy.

Methods: This was a retrospective observational study between 2014-2016 at a Level II Trauma Center. Consecutively-admitted adult (≥18yrs) trauma patients were included who had undergone an exploratory laparotomy. We compared patients who received probiotic treatment within 3 days of surgery to those who received no probiotics. Study outcomes were days until return of normal bowel function (>5d vs. ≤5), hospital length of stay (≥7 vs. <7), intensive care unit (ICU) LOS stay (≥2 vs <2), days on ventilator support, (≥2d vs. <2d), and in-hospital mortality. Patients were compared univariately using chi-squared tests, fisher's exact tests, and Wilcoxon tests as appropriate.

Results: There were 188 patients admitted over three years who had an exploratory laparotomy, and 17% received a daily dose of Lactobacillus acidophilus or rhamnosus by mouth or nasogastric tube. 59% were treated in 0-1 days and 41% were treated in 2-3 days following surgery over a median (IQR) of 9 (3.5-18) days. Patients treated with probiotics had a median (IQR) age of 36 (29-55), a larger proportion were diagnosed with ventilator-associated pneumonia (VAP, 22% vs. 8%, p=0.02), and a diagnosis of wound infection (6% vs. 0.6% p=0.02). There was a significantly greater proportion of patients treated with antibiotics (97% vs. 79%, p=0.02) in the probiotic group, than in the no probiotic group. There were significantly fewer deaths in the probiotic group, compared to the no probiotic group (Table 1). Overall and ICU LOS were trending towards significance with 63% having a LOS < 7 days and ICU LOS <2 days (Table 1).

Conclusions: These pilot data suggest that probiotics may decrease hospital and ICU LOS, and in-hospital mortality in poly-trauma patients undergoing exploratory laparotomy; we believe we would achieve significance with more patients. While other studies have reported inconclusive results for probiotics in trauma patients, most did not explore days until return to normal bowel function. Future studies should investigate the efficacy of other probiotic regimens in decreasing the time until normal bowel function.

Table 1. Probiotics and Patient Outcomes

Outcomes, n (%)	Probiotics	No Probiotics	P
Mortality	0 (0%)	33 (21%)	**0.004**
Prescribed Antibiotics N (%)	31 (97%)	124 (79%)	**0.02**
Antibiotic days[a]			
0-7	12 (39%)	71 (57%)	0.06
≥7	19 (61%)	53 (43%)	
Days until return to bowel function[b]			
0-5	24 (75%)	89 (78%)	0.71
>5	8 (25%)	25 (22%)	
Duration of Stay			
Overall LOS			
0-7 days	20 (63%)	72 (46%)	0.09
≥7 days	12 (38%)	84 (54%)	
ICU LOS			
0-2 days	20 (63%)	68 (44%)	0.05
≥2 days	12 (38%)	88 (56%)	
Days in mechanical ventilation			
0-2	22 (69%)	97 (62%)	0.48
≥2	10 (31%)	59 (38%)	

a=Missing 32 in the no probiotic group; denominators are shown.
b=Missing 42 in the no probiotic group; denominators are shown.
LOS=length of stay; ICU=intensive care unit

Poster # 19

EXAMINING THE IMPACT OF SMALL BOWEL RESECTION PROCEDURE TIMING IN PATIENTS WITH BLUNT TRAUMATIC INJURY: A PROPENSITY MATCHED ANALYSIS

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Introduction: Blunt mechanisms of injury can lead to many internal organ injuries, including small bowel injuries. The American College of Surgeon (ACS) recommends that if an abdominal procedure is to be performed emergently, it should be done within 4 hours of hospital arrival to decrease the risk of further morbidity or mortality. In the majority of cases, small bowel injuries can be detected upon initial clinical evaluation or through imaging studies, and can lead to timely intervention. However, in certain cases, bowel injuries may not be easily diagnosed during the initial assessment which results in a delay in intervention. Therefore, the purpose of this study was to evaluate the impact of the timing of small bowel resection in small bowel injury on patients' outcomes.

Methods: The study was performed using data from the National Trauma Data Bank (2007-2010). Patients who sustained blunt injuries, and who underwent a small bowel resection (SBR) within 24 hours of arrival to the hospital were eligible for inclusion in the study. The patients' characteristics and outcomes were compared between two groups: SBR within 4 hours (Group 1) and SBR between 4-24 hours (Group 2). Initial patient measures and outcomes were compared between the two unmatched groups using Chi-Square, Fisher Exact, and Wilcoxon Rank Sum tests. However, in an attempt to better balance the groups, propensity score matching was also performed using baseline characteristics and a follow-up paired analysis was performed using McNemar, Stuart Maxwell, and paired Wilcoxon Rank Sum tests.

Results: A total of 1,774 patients qualified for the study and of those, 1,292 (72.8 %) patients underwent SBR within 4 hours and 482 (27.2 %) underwent SBR between 4-24 hours after arrival. There were significant baseline differences between the two groups regarding Injury severity score (ISS) [Median [IQR]:19.0 [10.0, 29.0] vs. 14.0 [9.0, 25.0],$P<0.001$], Glasgow Coma Scale (GCS) [15.0 [13.0, 15.0] vs. 15.0 [15.0, 15.0],$P<0.001$] and the number of patients with an initial systolic blood pressure (SBP) < 90 mmHg (18.3% vs. 8.7 %, $P< 0.001$). Given these clear differences, 482 patients from each group were pair-matched using propensity score matching on age, sex, race, ISS, GCS, and SBP. Afterward, there were no significant differences observed between the two groups in the matching variables and there was more than 90% improvement in the standardized mean differences. After matching, there were no significant differences observed in patient mortality (8.3 % vs 7.9%, P=0. 90) or discharge disposition (home with no services: 63.1% vs 64.9 %, P=0.90); however, there was a significantly shorter hospital length of stay for those patients in Group 1 compared to Group 2 (9 [6, 15] vs 10 [7, 19], P=0.03).

Conclusion:More than two-thirds of the patient cases examined underwent SBR within 4 hours of hospital arrival per ACS guidelines. However, there were no significant differences identified in the mortality rate or the discharge disposition regardless of the timing of the SBR ($\leq$ 4 vs > 4-24 hours). However, the patients whose SBR was performed within 4 hours of arrival had a lower hospital length of stay when compared with those whose procedure was delayed.

Poster # 20

OUTCOMES OF TRAUMATIC DIAPHRAGM INJURIES

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Introduction: Traumatic diaphragm injuries (TDI) are rare but can be deadly and management can pose a challenge to trauma surgeons. Hence, we sought to determine factors that contribute to adverse outcomes following diaphragm injury and repair in our local population.

Methods: This was a retrospective review of all trauma patients who presented to one level one and one level two trauma center from 1/1/2000 to 12/31/2015 with TDI found using ICD9 codes 862.0 and 862.1 and ICD10 codes S27.802A - S27.809D. Data regarding the initial trauma and subsequent visits were collected and then analyzed using SPSS.

Results: Over the 16-year study period, 425 patients (82 males, 43 females) with thoracoabdominal trauma met inclusion criteria with an average age of 30.8 years. Ninety-one percent (n=389) had penetrating trauma and 9% (n=37) had blunt trauma. The average Injury Severity Score (ISS) was 18 (range 8-75). Seven patients were managed conservatively and 418 patients were managed operatively. All patients who underwent an operation had open repair although three patients had laparoscopic/thoracoscopic converted to open management. Ninety-one percent (n=387) of the injuries were found intraoperatively, and 9% (n=38) were found on imaging. Computed tomography was more likely than radiography to show injury (p=0.000). There were 38 mortalities (9% mortality rate), 24 of which were intraoperatively. Other outcomes measured included pneumonia (n=45), empyema (n=15), requiring mechanical ventilation for $>$ 48 hours (h; n=68), Arrhythmia (n=9), surgical site infection (SSI, n=9), and breakdown of diaphragm repair (n=2). There were no cases of hemidiaphragm paralysis. Patients who presented with higher heart rate (HR; $>$ 110 bpm) and lower systolic blood pressure (SBP; $<$ 106 mmHg) were associated with intraoperative complications and mortality, postoperative empyema, and requiring mechanical ventilation $>$ 48h. Increased age, blunt trauma, intubation in the ED, pneumonia, and empyema were associated with requiring mechanical ventilation for >48h (p=0.034, p=0.047, p=0.000, p=0.000 and p=0.000). ISS was associated with intraoperative complications (p=0.000) but not mortality (p=0.625).

Conclusion: The most common adverse outcome following traumatic diaphragm injury in our population was requiring mechanical ventilation for more than 48 hours, followed by pneumonia and mortality. Injury Severity Score was not related to mortality although this has been shown in other retrospective reviews. In our study, patients who survived to discharge did well with no long-term affects of adverse outcomes.

Poster # 21

TRANSCATHETER ARTERIAL EMBOLIZATION FOR MAXILLOFACIAL FRACTURES WITH LIFE-THREATENING HEMORRHAGE

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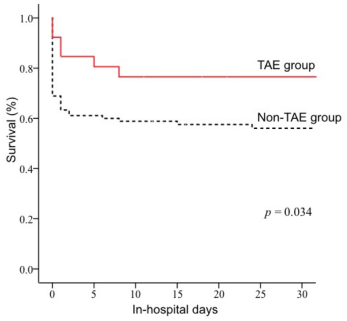
Introduction: Severe maxillofacial fracture is occasionally associated with life threatening hemorrhage, and the surgical procedures to control such hemorrhage can be a challenge. Recently, transcatheter arterial embolization (TAE) has become an important step in the management algorithm for maxillofacial fractures with life-threatening hemorrhage (MFH). We evaluated the effectiveness of TAE for MFH based on a large amount of data from the Japan Trauma Data Bank (JTDB).

Methods: Patients were identified from JTDB entries for the years 2004 to 2014. Inclusion criteria for MFH were defined using the Abbreviated Injury Scale (AIS) code 250810.4 (Maxilla fracture, LeFort III, blood loss > 20%). Patients were excluded if they were dead on arrival, younger than 16 years of age, if they had sustained injuries with an AIS score of 6 for any region of the body, if their hospital discharge disposition was unknown, or if they had penetrating injuries. On the basis of this strategy, patients were classified as either patients who had undergone TAE (TAE group) or patients who had not (non-TAE group). Comparative analyses of demographics, injury characteristics, and outcomes were performed.

Results: Among 198,744 trauma victims documented in the JTDB, 183 patients had MFH. After applying our exclusion criteria, a total of 118 patients were found to be eligible for the study, and 26 of these patients (22.0%) had received TAE. When comparing injury characteristics, only median Glasgow Coma Scale (GCS) scores were significantly lower in the TAE group than in the non-TAE group (7.0 [3.8–10.3] vs 11.0 [6.0–13.0], $p = 0.019$). All other characteristic variables did not differ significantly between the two groups. Overall, the in-hospital mortality rate was 39.8%, and the median hospital length of stay (LOS) was 21.0 days (0.0–53.5 days). The in-hospital mortality rate was significantly lower in the TAE group than in the non-TAE group (23.1% vs 44.6%; odds ratio [OR], 0.37; 95% confidence interval [CI], 0.14–1.02; $p = 0.048$). However, patients in the TAE group had a longer median hospital LOS (39.5 [7.3–53.5] vs 13.0 [0.0–55.0] days, $p < 0.062$), but the difference was not statistically significant. In the logistic regression model, the use of TAE was identified as an independent predictor for a better outcome after adjusting for potential confounders (OR, 0.24; 95% CI, 0.07–0.83; $p = 0.024$). Age, systolic blood pressure, and GCS were also independently associated with mortality with an OR of 1.03, 0.97, and 0.87, respectively.



Conclusion: MFH is rare, but the mortality is very high. The strategy using TAE appears to increase successful outcomes in patients with MFH. Further studies are required to confirm the efficacy of the procedure, and to evaluate its indications and associated complications.

Poster # 22

THE AMERICAN ASSOCIATION FOR SURGERY OF TRAUMA (AAST) SEVERITY GRADING PREDICTS CLINICAL OUTCOMES FOR SKIN AND SOFT TISSUE INFECTIONS

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Introduction: Skin and soft tissue infections (SSTI) are included in the AAST Emergency General Surgery grading system, ranging from simple cellulitis to necrotizing fasciitis and myonecrosis. The grading system for SSTI has not yet been validated. This study aims to assess whether the AAST grade corresponds with SSTI severity and important clinical outcomes.

Methods: Single center review of patients ≥ 18 years admitted with a diagnosis of SSTI during 2012-2016 was performed. Patients with surgical site infections were excluded. Patient demographics, Laboratory Risk Indicator for Necrotizing Fasciitis (LRINEC) score, AAST grade, and outcomes including operation type, duration of inpatient antibiotic therapy, hospital stay, and complications were recorded. Two independent reviewers evaluated each case using AAST grade definitions for cross-sectional imaging and operative criteria. Summary, univariate, and inter-rater agreement using the kappa statistic were calculated.

Results: There were 197 patients identified (mean ±SD age of 55±16 years, 56% male), of whom 41.8% underwent preoperative cross-sectional imaging (CT or MRI), and 79.2% underwent incision and drainage/debridement (I&D). Kappa coefficient comparing imaging and operative criteria for AAST grades was 0.70. SSTI culture for pathogenic bacteria included: negative culture (48, 24.4%), positive for single microbe (74, 37.6%), and polymicrobial (75, 38.1%). The readmission rate was 24.9% and 90-day mortality rate was 6.6%. Increased AAST grade was associated with higher LRINEC score, increased operative interventions, and greater need for critical care interventions (table 1). Increased AAST grade was also associated with higher Clavien-Dindo complication grades, prolonged duration of hospital stay and inpatient antibiotic therapy (fig1).

Outcome	AAST I N=11	AAST II N=23	AAST III N=99	AAST IV N=43	AAST V N=21
LRINEC score* median [IQR]	2 [1-4]	2 [2-4]	2 [1-4]	5[3-6]	4 [4-6]
No of I&D* procedures median [IQR]	1 [1-1]	2 [1-4]	1 [1-2]	4 [1-1-5]	5 [3-7]
ICU admission* %	9.1%	26.1%	13.1%	48.8%	76.2%
Pressor use* %	9.1%	4.4%	4.0%	30.2%	38.1%
Ventilation* %	0%	4.4%	5.1%	30.2%	47.6%

Table 1 Clinical Outcomes for SSTI Patients per AAST Severity Grade; p <0.0001

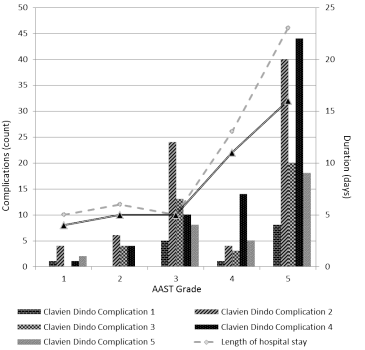

Figure 1 Clavien-Dindo grade, duration of hospital stay and inpatient antibiotic therapy across the AAST 5-grade scale (p <0.0001).

Conclusion: The AAST grade corresponds to important clinical outcomes and may allow the equitable comparison of outcomes between operators, hospitals and systems. Further study to assess the external validity of this AAST grading scale is necessary.

Poster # 23

WELL, THAT'S NOT NORMAL: A SIMULATION STUDY ON THE EFFECTS OF TESTING INJURY SEVERITY SCORE WITH PARAMETRIC STATISTICS

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Introduction: A study's statistical methods can be as important as its procedures. An important point to consider when selecting statistics is whether the data are normally distributed (i.e., form a bell curve), as parametric statistics (e.g., t-tests) can be inaccurate if data are non-normal. Despite this, 72.7% of PubMed listed trauma publications (1981-2016) and 43% of accepted AAST abstracts (2015-2016) treated Injury Severity Score (ISS) as normally distributed, even though ISS is inherently non-normal. This study examines the accuracy of parametric statistics when testing ISS between two groups.

Methods: Using 5.58 million ISS observations from the National Trauma Data Bank, random samples of six total sample sizes and four group size ratios (GSRs; the proportion of observations in one group) were tested using parametric (Student's and Welch's t-tests) and nonparametric statistics (Wilcoxon's rank sum test and Mood's median test). Each sample size by GSR condition was repeated 10,000 times. Type I (false positive) and Type II (false negative) error rates were calculated.

Results: Mood's test had the lowest overall Type I rate (3.59%), followed by Student's (4.74%). The lowest overall Type II rates were seen with Wilcoxon's test (82.77%), then Mood's (82.90%). Full results are shown in the heat-mapped table.

Type I and Type II error rates by statistic and condition

Condition		Type I error				Type II error			
N	GSR	Student	Welch	Wilcoxon	Mood	Student	Welch	Wilcoxon	Mood
25	0.1	5.34%	10.63%	4.06%	0.79%	92.19%	91.92%	94.70%	98.52%
25	0.25	4.49%	6.28%	4.22%	1.62%	93.17%	95.27%	94.38%	97.53%
25	0.33	4.63%	4.89%	4.56%	3.24%	93.28%	95.75%	93.86%	96.01%
25	0.5	4.30%	3.93%	4.71%	4.58%	94.41%	94.87%	94.12%	94.48%
50	0.1	4.71%	10.75%	4.45%	1.70%	92.13%	92.98%	94.25%	96.60%
50	0.25	4.62%	6.53%	4.58%	3.39%	92.07%	95.52%	92.75%	94.80%
50	0.33	4.34%	4.98%	4.63%	3.03%	92.22%	94.93%	92.36%	94.68%
50	0.5	4.56%	4.49%	4.90%	3.48%	93.16%	93.41%	92.94%	94.47%
100	0.1	4.70%	9.79%	4.76%	2.83%	91.76%	94.49%	92.78%	95.12%
100	0.25	4.49%	5.85%	4.96%	3.17%	90.39%	94.59%	90.77%	92.73%
100	0.33	4.19%	4.76%	4.72%	3.44%	90.59%	93.42%	90.45%	92.36%
100	0.5	5.21%	5.14%	5.30%	4.12%	91.00%	91.16%	90.25%	91.83%
250	0.1	4.57%	7.42%	4.94%	3.49%	89.16%	94.05%	89.92%	91.09%
250	0.25	4.85%	5.29%	5.15%	4.36%	85.46%	90.18%	84.87%	85.31%
250	0.33	5.18%	5.28%	5.28%	4.52%	85.55%	88.85%	84.02%	83.57%
250	0.5	4.74%	4.76%	5.01%	3.79%	84.85%	84.85%	82.82%	82.37%
500	0.1	5.23%	6.14%	5.08%	4.17%	85.26%	91.87%	84.63%	84.85%
500	0.25	4.72%	5.29%	4.83%	4.28%	78.44%	83.23%	75.02%	73.40%
500	0.33	4.57%	4.77%	4.62%	4.31%	76.93%	79.86%	73.86%	71.20%
500	0.5	4.61%	4.65%	4.62%	4.36%	73.63%	73.91%	69.14%	66.41%
1000	0.1	4.86%	5.68%	4.74%	3.80%	77.87%	84.99%	75.71%	73.41%
1000	0.25	4.80%	4.70%	5.05%	4.40%	62.25%	66.27%	55.85%	50.99%
1000	0.33	5.03%	5.07%	5.19%	4.56%	58.35%	60.47%	50.95%	46.78%
1000	0.5	5.07%	5.05%	4.90%	4.69%	54.13%	54.37%	46.17%	41.15%
Overall		**4.74%**	**5.92%**	**4.80%**	**3.59%**	**84.09%**	**86.72%**	**82.77%**	**82.90%**

Conclusion: The most appropriate test of ISS appears to be Wilcoxon's test. Student's t had less Type II error for $n < 100$, but this benefit was negated by additional Type I error. Mood's test was preferable for $n \geq 250$. Parametric testing of ISS and other non-normal variables (e.g., length of stay) should be avoided due to the increased risk of false results. Researchers and clinicians should be wary of results that report means for non-normal variables, as this is indicative of parametric testing. Regardless of these results, researchers should avoid reporting means and standard deviations (SDs) of ISS. This is because the mean ± SD of ISS is 9.4 ± 8.7 thus, much more than one standard deviation below the mean is negative, which is impossible. Instead, researchers should report medians and interquartile intervals (i.e., the 50th, 25th, and 75th percentiles), which are 9 [4, 11], as this better describes non-normal data.

Poster # 24

OUTCOMES FOR ELDERLY PATIENTS DISCHARGED TO SKILLED NURSING FACILITIES AFTER BURN-RELATED HOSPITALIZATION

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Introduction: Older adults represent a growing number of burn-injured patients. Recovery from burn injuries can be prolonged. Current data predict many older adults will discharge to a skilled nursing facility (SNF) after acute hospitalization. Little is known about the subsequent fate of these patients. We hypothesized that many may never return home and that their mortality remains high.

Methods: We performed a retrospective descriptive and case-control study of the Medicare Provider and Analysis Review (MedPAR) data for hospitalized burn patients, 65 and older, subsequently discharged to SNFs from January 2007 to December 2009 in five states - California, Florida, New York, Texas, and Washington. MedPAR was linked to the Minimum Data Set (MDS) for nursing home resident assessment to obtain subjects' medical conditions at SNF admission and discharge disposition. Subject characteristics, one-year mortality, and three-year mortality were described overall and by first SNF discharge disposition. Univariate and multivariate logistic regressions were performed to examine impacts of demographic and clinical factors on three outcomes: one-year mortality, re-hospitalization and failure to discharge home. All analyses were adjusted for clustering effect at facility level. Five iterations of multiple imputation using chained equations (MICE) were conducted to generate plausible values for records with missing data.

Results: A total of 720 patients were identified (mean age 78.6 [8.3]; 55.8% females). The majority (67.2%) had burn severity/size less than 10%. Nearly half of subjects, 42.6%, were discharged home from their first SNF admission. Mortality during index SNF admission was 3.6%, while 27.2% died one year following SNF admission, and 43.1% died within three years after SNF admission. The proportion readmitted to an acute care hospital was 34.7%. After controlling for clinical factors (age, sex, Charlson Comorbidity Index, burn severity/size, and hospitalization factors), each accumulated point on the Activities of Daily Living (ADL) score was significantly associated with higher risk of 1-year mortality OR 1.28 [1.06, 1.55], hospital readmission OR 1.23 [1.07, 1.41], and failure to discharge home OR 1.24 [1.08, 1.43]. Tube feeds were significantly associated with 1-year mortality OR 5.75 [2.24, 14.74]. Neither burn severity/size nor age showed association with outcomes.

Conclusions: For older adult burn patients discharged to SNF, many will return home. Functional status reflected in the ability to perform ADLs was the best predictor of outcome. Long-term post-SNF discharge outcomes are more dependent on surrogates of underlying frailty than severity of injury. This has implications for improving prognostic discussions with elderly burn patients.

Poster # 25

A NOVEL, PRESSURIZED-CADAVER SIMULATION MODEL FOR LIMB TOURNIQUET TRAINING IN MILITARY MEDICS

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Introduction: Exsanguinating extremity hemorrhage is a significant cause of preventable deaths on the battlefield and can often be controlled with application of standard limb tourniquets. Military medics rotating at our training program are instructed on limb tourniquets including indications and practical application. We sought to evaluate the effectiveness of traditional tourniquet teaching compared with a novel, pressurized-cadaver, simulation model for training in limb tourniquet placement by military medics.

Methods: Military medics at our training program who volunteered to participate in the study were randomized to one of two limb tourniquet training arms. Traditional training (TT) consisted of slide-based lecture on tourniquet indications and placement as well as practice sessions. Pressurized-cadaver training (PCT) included initial TT plus hands-on instruction utilizing a pressurized-cadaver, bleeding-limb simulation model. Medics were evaluated in their ability to achieve hemorrhage control with a tourniquet in a cadaver simulation model with a standardized bleeding extremity wound. Outcomes were compared between the two study groups: (1) time to control hemorrhage with tourniquet(s), (2) correct placement of tourniquet(s) including distance from the wound (range: 5.0 to 7.6 cm), and (3) volume of simulated blood loss. Study participants received surveys to assess their confidence (five point Likert scale) in understanding the indications for tourniquet placement and in their ability to place a tourniquet to stop bleeding on an injured limb.

Results: 53 medics were enrolled; 26 randomized to TT and 27 to PCT arms. Groups were equally matched based on prior tourniquet training. Medics in the PCT group controlled bleeding with the first tourniquet more frequently compared with the TT group (96% v 83%, $p<0.03$) and were significantly quicker in achieving hemorrhage control (39 sec. v 45 sec., $p<0.01$). Both groups placed the tourniquets in the correct location and within the described target range above the wound (PCT: 5.5cm v TT: 7.6cm). Medics trained in the PCT model achieved hemorrhage control with significantly less simulated blood loss when compared with the TT group (256 mL v 355 mL, $p<0.01$). There was a trend towards increased confidence in tourniquet application among medics as 57% of the PCT group and 29% of the TT group reported increased confidence in their ability to place a tourniquet on a bleeding extremity.

Conclusion: Utilizing a novel, pressurized-cadaver simulation model for extremity tourniquet training, military medics performed better in placing limb tourniquets more rapidly and with less simulated blood loss than their traditional training counterparts. Moreover, they were more likely to achieve hemorrhage control with the first tourniquet placed and even gain self-confidence in this life-saving procedure. Further studies are indicated to identify the optimal components of effective simulation training for limb tourniquets and other emergent interventions.

Poster # 26

EDUCATIONAL IMPACT OF HAND MOTION ANALYSIS IN THE EVALUATION OF CLINICAL ULTRASOUND SKILLS FOR FAST EXAM

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Introduction: Hand motion analysis (HMA) was introduced as an objective measure of surgical and ultrasound (US) skills. Previous HMA investigations were affected by data processing limitations, cohort and human models selection biases. Thus, the aims of the present work are: (i) to find quantitative parameters to assess US skills; (ii) to determine experience-dependent FAST tasks to design improved educational pathways.

Methods: Ten experts (EG) and 13 beginners (BG) surgeons performed a FAST exam on a male and a female healthy volunteers (equipment: Esaote MyLab Alfa, IT). BG were residents with no previous US experience; they were tested immediately after a blended FAST course (MUSEC® EFAST). EG were MUSEC Instructors with >5 years of experience. Hand kinematics was recorded with a 3D motion analyzer (BTS Spa, IT). An independent experienced operator approved the obtained target for each view. Participants were also rated according to the QUICk score. Custom software yielded the following hand kinematic variables: total/single-scan duration, working volume, distance travelled, distance travelled normalized by scan duration. A 3-way ANOVA (factors group, model, view) was performed on each variable. A 2-way ANOVA (factors group, model) was conducted on QUICk scores and total duration.

Results: QUICk scores differed between groups (group factor, $p=0.004$): 19.2 (SD 1.1) for the male and 18.7 (1.6) for the female model in EG, and 16.7 (1.8) and 15.4 (4.1) in BG. As expected, total duration was significantly lower in EG: 60.2 (27.1) s and 68.2 (19.3) s compared to 206.8 (49.7) s and 274.5 (106.0) s in BG, for the male and female models, respectively. Group factor was highly significant ($p<0.001$), unlike model factor ($p=0.062$). Selected single-view results are shown in Fig. 1. Working volume was reduced in EG (group factor, $p=0.003$); absolute hand distance travelled was higher in BG (group factor, $p<0.001$), while normalized distance was significantly higher in EG (group factor, $p<0.001$; view factor, $p=0.008$).

Conclusion: Considered variables allowed to distinguish between EG and BG. The LUQ/3 scan was the most difficult for the BG. These finding could be useful for a focused HMA assessment. In EG absolute distance was lower, but normalized distance was significantly higher: i.e., experts' hand moved less, but quickly performed more probe heading adjustments in a reduced volume. Trainees could be stressed to limit arm movements, focusing on wrist and fingers, speeding up the acquisition of tilting and fanning control. There is room to include HMA for objectively assessing US skills.

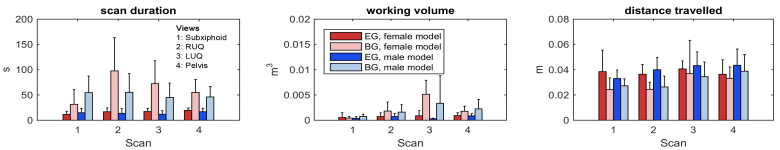

Fig. 1: Scan duration*#, working volume* and normalized distance travelled*# by operators' hand. 3-w ANOVA: significant difference on group (*) or view (#) factor.

Poster # 27

HIGH-FIDELITY SIMULATION IDENTIFIES GAPS IN BASIC TRAUMA RESUSCITATION SKILLS

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Introduction: Simulation based medical education (SBME) has become mainstream required by most residency programs. SBME is often used for complex skill sets with the basics assumed as prerequisite. Our experience developing trauma resuscitation simulation curricula rely on basic skills being mastered prior to the training. This assumption may be false and may lead to worsened patient outcomes. This study investigates the gap between assumed and actual basic life support skills employed in the assessment and resuscitation of the complex trauma patient.

Methods: SimMan 3G (Laerdal Medical) was used for simulation. Our previously reported curriculum using scenarios similar to Advanced Trauma Life Support (ATLS) was applied to learners in multiple settings and disciplines including surgery, anesthesia, emergency medicine, and nursing. Training was done in two sessions on one training day with the known goal of refreshing advanced trauma resuscitation skills. Current Basic Life Support and Advanced Cardiac Life Support certification was a prerequisite. Surgical residents were current in ATLS. Data capture included: airway control, shock physiology identification, resuscitation products and volume delivered, massive transfusion triggers, and endpoints of resuscitation

Results: 71 trainees were included in initial training: 43 general surgery, 11 anesthesia, 9 emergency medicine, and 8 critical care or trauma nurses. 97% of learners asked the patient to speak as evaluation of a patent airway. 27% did no further evaluation for an obviously compromised airway. 15% applied mechanical airway assistance (jaw thrust) to conscious patients. 4% used a nasal/oral airway adjunct. 50% of trainees were unable to articulate clinical findings of pneumothorax (ptx), tension pneumothorax (tptx), massive hemothorax (htx), or esophageal intubation. 33 learners repeated the scenarios >6 months after the initial training: 27 surgical, 4 anesthesia, 2 emergency medicine. 58% now pursued airway control after initially determining it was inadequate. 76% applied mechanical assistance to open the airway. 20% appropriately used an adjunct. 79% appropriately identified abnormal respiratory mechanics (ptx, tptx, htx).

Conclusion: The assumption that our trauma teams have mastery of basic life support skills may be in error. Traditional modes designed to teach these skills may be minimally effective if taught well before the skills are utilized in practice. High-fidelity simulation quickly identifies and rectifies these skill gaps and should be considered the method of choice for remedial and refresher training. These results mimic our original data set during curriculum development and further solidifies SMBE as the training modality of choice for basic initial trauma assessment and resuscitation skills.

Poster # 28

REGIONALIZATION OF CARE FOR PATIENTS WITH NECROTIZING SOFT TISSUE INFECTIONS: OPTIMAL TIMING FOR DEBRIDEMENT

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Introduction: Optimal outcomes from necrotizing soft tissue infections (NSTI) depend on timely diagnosis and surgical source control. Regionalization of treatment for time-sensitive conditions has been shown to improve care. We hypothesize that prompt transfer and regionalization of surgical NSTI treatment can decrease disease morbidity.

Methods: Transfer patterns were evaluated in our institutional NSTI database (retrospective 2002-2014, prospective 2015-2016). Adequate transfer data was available for the prospective cohort, which was analyzed to assess the impact of transfer on time to initial debridement and clinical outcomes. Secondary analysis evaluated the impact of pre-transfer debridement, late debridement (>12 hours), and delayed transfer (>24 hours), on mortality, hospital length of stay, ventilator-free days, ICU-free days, complications, and total number of debridements. Using multivariable regression we adjusted the analyses for severity of acute illness, including shock (lactate>10 or base deficit >6) and initial sodium, WBC, hemoglobin, creatinine, glucose and CRP, as well comorbidities (age, diabetes, smoking, and renal failure).

Results: The database includes 701 patients with confirmed NSTI, with 231 in the prospective cohort. Inpatient mortality was 9.7%. Patient arrival via transfer increased significantly over time, with yearly increase from 56% pre-2012 to 89% post-2014, $p<0.001$. Debridement pre-transfer occurred in 32.5%. Patients who were not debrided prior to transfer had significantly longer median time from presentation to debridement [10.5 hrs, IQR: 8 – 26hrs] than those debrided prior to transfer [8 hrs, IQR: 5 - 23, p 0.03] and patients who did not transfer [6.9hrs, IQR: 5 – 9, $p<0.001$]. Pre-transfer debridement was associated with delayed transfer (>24hrs) (56% vs 21%, $p <0.001$), but 78% of patients were transferred within 48 hours. The median time to the OR on arrival to our center was 3.7 hrs (IQR: 2.6 – 6.95 hrs). In multivariable analysis, mortality, ventilator-free days, ICU-free days, complications and total number of debridements were not affected by late debridement (>12hrs). Pre-transfer debridement was associated with the need for more total debridements. (+1.1, $p <0.001$). However, delayed transfer was associated with longer hospital stay (+11.1 days, $p =0.004$).

Conclusions: The number of patients treated at our center, and the high percentage of transferred patients suggest that NSTI care is regionalizing. Overall, late debridement, delayed transfer, and pre-transfer debridement had little effect on clinical outcomes, in part because overall mortality was low and debridement occurred rapidly after arrival at our center. Pre-transfer debridement significantly decreased the time to initial debridement, but was associated with more debridements and delay to transfer. Delayed transfer was associated with a significant increase in length of stay. These data support the regionalization of time-sensitive NSTI care with expeditious transfer prior to debridement demonstrating the best outcome if the receiving center can provide rapid surgical intervention.

Poster # 29

AGING IS A CRUCIAL FACTOR FOR GLYCOCALYX DISRUPTION LEADINF TO INCREASE RESUSCITATION FLUID REQUIREMENT IN BURN PATIENTS

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Introduction: Following severe burn injury, it is known that massive fluid shift occurs which leads to edema formation and intravascular fluid loss. To correct the intravascular fluid loss, aggressive fluid resuscitation may lead burn induced compartment syndromes. The factors causing the fluid shift have not completely revealed. The aim of this study was to identify the relationships between disruption of glycocalyx and fluid shift following burn injury.

Methods: Patients aged > 18 years old who suffered burn injury over > 20% total body surface area (TBSA) were enrolled in this prospective cohort study. Patients with cardiac arrest on admission or who were transferred > 24 hours after injury were excluded. Patients backgrounds including age, gender, burn size, inhalation injury was recorded at the time of patient enrollment. Serum syndecan-1 was serially measured on admission, at 1 day, 3-5 day, around 1 week, around 2 weeks, and around 1 month following injury to see the kinetics of the syndecan-1 following burn injury. Additionally endothelial damage biomarkers such as thrombomodulin, antithrombin III, and plasminogen activator inhibitor-1 were measured. The fluid requirement for the first 24 hours were counted. And we determined that the relationships between the syndecan-1 level and fluid requirement. Finally, we analyzed the relationships between the syndecan-1 level and morbidity or mortality.

Results: 39 patients were enrolled. Median age was 55 years old, and median burn size was 35%. 16 patients developed burn induced compartment syndrome, and 10 patients died. The syndecan-1 on admission was significantly higher than healthy volunteers and prolonged. The syndecan-1 was associated with patients' age ($r = 0.50$, $p = 0.001$) but not with burn size ($r = 0.08$, $p = 0.63$). The antithrombin III was negatively associated with burn size ($r = -0.48$, $p = 0.002$). The association between the syndecan-1 on admission and the fluid requirements (mL/kg) were significant ($r = 0.38$, $p = 0.017$). After adjusted by age, gender, %TBSA, inhalation injury, the syndecan-1 was still independent parameter for the fluid requirement (Estimate = 48.47, $p = 0.04$), and for the development of burn induced compartment syndrome (Odds ratio = 5.88, $p = 0.03$).

Conclusion: Glycocalyx disruption occurs soon after burn injury in an age dependent manner. The syndecan-1 level was associated with increase of fluid requirement and with development of burn induced compartment syndrome. We may need to develop new strategies to protect glycocalyx for burn patients.

Poster # 30

TRAUMA SIMULATION PRACTICE AFTER ATLS INSTRUCTION IMPROVES SKILLS, UNDERSTANDING, AND CONFIDENCE FOR SURGICAL TRAINEES

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Introduction: Trauma resuscitation is complex and nuanced. After Advanced Trauma Life Support (ATLS) certification, there is little opportunity for practical review of trauma resuscitation scenarios. Patient simulation training has gained increasing popularity and allows for a controlled environment for hands-on training. In 2014 our institution implemented a trauma simulation training course. We sought to investigate how our simulation training impacted providers' understanding and confidence of trauma resuscitation.

Methods: Hi-fidelity manikin-based workshops were conducted to simulate trauma scenarios. Participants were asked to participate in a pre- and post-course survey. Survey data was collected either as categorical (yes/no) or on a Likert scale (1 = strongly disagree, 5 = strongly agree). Pre- and post-course means were compared with paired-sample T test.

Results: A total of 43 trainees participated in the course with 22 (51.2%) of the participants that were already ATLS certified. 26 (60.5%) of providers were post graduate year 1 trainees. The view that trauma simulation participation would be beneficial to confidence and comfort with trauma resuscitations remained high post-course. There was an overall increase in confidence and skills understanding across all other outcomes surveyed.

Survey Question	Pre-Course Mean (SD)	Post-Course Mean (SD)	p-value
Confidence Managing High Acuity (Level 1) Trauma Patient	3.0 (1.2)	4.5 (0.6)	<.0001*
Understand How to Prepare to Receive a Trauma Patient	3.7 (1.0)	4.4 (0.5)	<.0001*
Understand My Role/Responsibilities in the Trauma Bay	3.7 (0.9)	4.4 (0.6)	<.0001*
Understand Other's Role/Responsibilities in the Trauma Bay	3.7 (0.9)	4.5 (0.5)	<.0001*
Understand the Flow/Steps of a Trauma Resuscitation	3.7 (0.9)	4.4 (0.5)	<.0001*
Simulation Training Will/Has Been Useful to Enhance My Confidence and Comfort with Trauma Resuscitation	4.5 (0.7)	4.6 (0.5)	.375*

* = paired-sample T test

Conclusion: Trauma simulation training significantly improved providers' confidence and understanding of responsibilities and management of trauma patients.

Poster # 31

PREDICTORS OF UNPLANNED ADMISSION/READMISSION TO THE INTENSIVE CARE UNIT IN A MATURE TRAUMA NETWORK

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Introduction: Unplanned admission/readmission (UA/R) to the Intensive Care Unit (ICU) has become a major quality measure in national outcome databases (TQIP). We sought to identify predictors of the ICU UA/R population in order to characterize these patients. We hypothesized that UA/R patients could be identified by their specific patterns of complications.

Methods: The Pennsylvania Trauma Outcome Study database was retrospectively queried from 2011-2015 for all patients with ICU admission. The specific population of interest included all patients with ICU UA/R. Demographics, complications, and comorbid conditions were compared between UA/R and non-UA/R counterparts to determine potential predictor variables. A multilevel mixed-effects logistic regression model controlling for injury severity in the form of Trauma Mortality Prediction Model (TMPM), systolic blood pressure, and injury year assessed the adjusted predictive impact of 19 variables on UA/R.

Results: A total of 72,331 patients met inclusion criteria (UA/R: 2,070 [2.86%]; non-UA/R: 70,261 [97.1%]). Compared to non-UA/R counterparts, patients in the UA/R population were significantly older and more severely injured. In addition, the UA/R population was significantly more likely to suffer from respiratory complications and infection. In adjusted analysis, acute respiratory failure, pulmonary embolism, and sepsis were the three strongest predictors of UA/R. Increased ventilator days and head injury were associated with reduced odds ratios for UA/R (Table 1).

Conclusion: ICU UA/R patients are disproportionately burdened by respiratory complications. Head injury appears to be protective against UA/R. Isolating predictors of ICU UA/R is the first step in developing a potential scoring system to identify these patients.

Table 1. Demographic, complication, and comorbid condition variables significantly associated with bounceback

		UA/R
Variable	AOR (95% CI)	*p*
Age	1.02 (1.01-1.02)	<0.001
Gender (Male)	1.20 (1.08-1.33)	0.001
Acute Respiratory Failure	4.25 (3.66-4.94)	<0.001
Pulmonary Embolism	3.12 (2.42-4.03)	<0.001
Sepsis	2.46 (1.98-3.06)	<0.001
Myocardial Infarction	1.96 (1.45-2.66)	<0.001
Pneumonia	1.67 (1.43-1.95)	<0.001
Central Line	1.66 (1.47-1.87)	<0.001
Deep Vein Thrombosis	1.53 (1.23-1.90)	<0.001
Lower Extremity Fracture	1.38 (1.22-1.55)	<0.001
Chronic Obstructive Pulmonary Disease	1.28 (1.13-1.45)	<0.001
Obesity	1.17 (1.00-1.36)	0.045
ICU Length of Stay	1.13 (1.11-1.14)	<0.001
Ventilator Days	0.88 (0.86-0.89)	<0.001
Head Injury (AIS Head ≥3)	0.76 (0.68-0.86)	<0.001
		AUROC: 0.83

* Controlling for TMPM, Systolic Blood Pressure, Injury Year

*Non-significant variables not displayed

Poster # 32

DOES THE ADDITION OF DEXMEDETOMIDINE TO PROPOFOL SEDATION REDUCE THE DURATION OF MECHANICAL VENTILATION IN SURGICAL ICU PATIENTS?

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Introduction: Sedative medications are standard treatment for mechanically ventilated ICU patients. The Society of Critical Care Medicine guidelines state that the preferred agents are non-benzodiazepines, either propofol (PROP) or dexmedetomidine (DEX). Despite the efficacy of DEX as an exclusive agent, there is uncertainty as to the practice of adding DEX to PROP sedation in routine clinical ICU practice for both discrete and non-discrete indications. The primary objective was to compare duration of mechanical ventilation (MV) between those sedated with continuous infusions of PROP alone or combination use of DEX+PROP.

Methods: Data was retrospectively obtained from a university-based, Level-1 trauma center, mixed trauma and surgical intensive care unit (SICU) and included adult admissions from 2010 to 2014. Exclusions included clinical reasons for prolonged MV irrespective of sedative (e.g. spinal and/or major head injury, alcohol withdrawal treatment with benzodiazepine, continuous infusions of other sedation agents). A propensity matched (1:1) cohort study, using 8 variables for matching (e.g. age, gender, APACHE II score, hemodynamic instability, admitting service) was constructed. The timing of exposure to DEX was incorporated in the matching algorithm. Primary outcomes were MV duration, SICU length of stay (LOS), and all-cause SICU mortality. Exploratory outcomes included delirium and sedation score comparisons.

Results: Of 943 cases with MV > 24 hours, 149 received DEX+PROP, with 143 matched to those treated with PROP alone. The median duration of MV in the PROP alone cohort was 142.8 hours and 137.0 hours in the DEX+PROP cohort (P=0.31). The median absolute difference of PROP infusion was 22.6 hours less in the DEX+PROP group (P=0.07). Median hours from propofol initiation to start of DXM were 58 hours. There was no statistical difference in SICU LOS; median absolute difference of 5.3 hours for PROP alone group (P=0.43). The SICU mortality was not statistically different (RR=1.002, P=0.88). Examining a 14-day period post treatment with DEX, on any given day (excluding day 1 & 14), DXM-PROP treated patients had a 0.5% to 22.5% greater likelihood of being delirious (CAM-ICU positive). In addition, DXM+ Prop treated patients had a 4.5% to 18.8% higher likelihood of being above target sedation score (more agitated) compared to PROP-alone patients.

Conclusion: In this propensity matched cohort study, adjunct use of DEX to PROP did not show a statistically significant reduction with respect to MV duration, SICU LOS, or SICU mortality despite a trend toward receiving fewer hours of PROP. There was no evidence that DEX+PROP improved sedation scores or reduced delirium.

Poster # 33

ACHIEVEING LACTATE NORMALIZATION, NOT LACTATE CLEARANCE LEVELS, PREDICTS SURVIVAL AFTER SEVERE BLUNT TRAUMA

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Introduction: Serum lactate is useful biomarker to guide resuscitation after severe injury. Lactate studies often consider "initial lactate," "lactate clearance," or time to "lactate normalization" but there is little comparison between these. Further, resuscitation goals often differ between studies. We sought to compare various lactate analysis techniques using a large validated multicenter database.

Methods: The Glue Grant Trauma Related Database (TRDB) was used; all patients with multiple lactate levels were included. Demographics, injury and physiologic data, lactate levels, and outcomes were collected and analyzed. Survivors and non-survivors were compared using chi-square and Student's t test where appropriate. Patients were grouped by degree of lactate clearance (LC) at 12, 24, and 48 hours (<0%, 0-25%, 25-50%, 50-75%, >75%), and time to lactate normalization (<12 hours, 12-24 hours, 24-48 hours, > 48hours). Normal lactate ≤ 2.5mmol/L. A logistic regression model, controlling for demographics, APACHE II, and ISS, was created to predict mortality for each separate group. Bonferroni correction was used with p<0.0026 considered significant.

Results: Of 2008 patients in the TRDB, 1817 had multiple lactates. Demographics are in Table 1.

TABLE 1	Survivors	Nonsurvivor	p value	OR	95% CI	p-value	AUC
Age	41 ± 18	50 ± 21	<0.00001	1.02	1.01 - 1.02	**<0.0001**	0.6181
Sex (%Male)	67%	67%	p=0.86	0.93	0.69 - 1.27	0.66	
Race			p=0.31			0.39	
Mechanism			p=0.23			0.47	
APACHE II	27.9 ± 6.7	35.4 ± 6.2	<0.00001	1.2	1.16 - 1.23	**<0.00001**	0.8030
ISS	37.7 ± 13.5	45.1 ± 15.1	<0.00001	1.3	1.02 - 1.04	**<0.00001**	0.6369
Initial lactate	4.2 ± 2.5	6.5 ± 3.8	<0.00001	1.18	1.12 - 1.24	**<0.00001**	0.7066

Age, APACHE II, ISS, and initial lactate were associate with mortality (p<0.00001). After multivariable regression (Table 2) for LC only a negative clearance (increasing lactate) at 24 hours (OR 2.06 (142-2.98); p<0.0002) and >75% LC (OR 0.21 (0.06-0.68); p<0.001) – essentially normalization - predicted mortality. No other clearance levels at 12, 24 or 48 hours were associated with outcome. For lactate normalization time, only achieving normalization within 12-24 (OR 0.42 (0.26-0.69);p<0.001) and failure to normalize by 48 hours (OR 2.56 (1.79-3.67); p<0.00001) were predictive. Early (<12 hours) and 24-48 hour normalization were not.

Conclusions: Lactate clearance percentages are not useful is predicting mortality after severe blunt trauma - except negative clearance (worsening lactate) at 24 hours. Achieving a normal lactate by 24 hours appears to be a useful goal while failure to normalize lactate by 48 hours should alert surgeons to higher risk of mortality.

TABLE 2	Category	OR	95% CI	p-value	AUC
Lactate Normalization	< 12 hrs	0.52	0.30 - 0.89	<0.02	0.7000
N=1534	12 - 24 Hrs	0.42	0.26 - 0.69	**<0.001**	
	24 - 48 hrs	0.92	0.58 - 1.44	0.71	
	> 48 Hrs	2.56	1.79 - 3.67	**<0.00001**	
12HR Lactate Clearance	Negative	0.97	0.69 - 1.37	0.88	0.5506
N=1401	0-25%	1.49	1.02 - 2.19	<0.05	
	25-50%	0.81	0.50 - 1.30	0.38	
	50-75%	0.77	0.40 - 1.47	0.77	
	>75%	0.2	0.03 - 1.55	0.12	
24HR Lactate Clearance	Negative	2.06	1.42 - 2.98	**<0.0002**	0.6249
N=1278	0-25%	0.82	0.51 - 1.31	0.41	
	25-50%	0.98	0.65 - 1.48	0.92	
	50-75%	0.70	0.46 - 1.09	0.11	
	>75%	0.21	0.06 - 0.68	**<0.001**	
48HR Lactate Clearance	Negative	1.79	1.15 - 2.77	<0.01	0.6007
N=1072	0-25%	0.86	0.48 - 1.56	0.63	
	25-50%	1.00	0.64 - 1.54	0.99	
	50-75%	0.83	0.54 - 1.26	0.38	
	>75%	0.54	0.26 - 1.14	0.11	

Poster # 34

IN A NATIONAL SAMPLE OF 2-MILLION INJURED PATIENTS, TRAUMATIC INJURY IS ASSOCIATED WITH A 2.5 FOLD INCREASED INCIDENCE OF VAP AS COMPARED TO UNINJURED CONTROLS

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Introduction:Up to 40% of intubated trauma patients will develop pneumonia. This is significantly higher than the rates of pneumonia observed in non-trauma populations, and suggests that trauma is associated with an increased risk of pulmonary infection. To measure the effect of trauma on the diagnosis of ventilator associated pneumonia (VAP) we compared the incidence of VAP diagnoses and the frequency and outcomes diagnostic procedures such as broncheoalveolar lavage (BAL) in injured vs. uninjured patients using both the National Inpatient Sample (NIS) and data from our institutional database.

Methods:The National Inpatient Sample from 2010-2014 was queried for trauma cases over age 18 based on the presence of ICD-9 800.00-959.9. These cases where then matched with uninjured controls for age, length of stay (LOS), Elixhauser Comorbidity Index, race, gender and operating room procedures; the incidence of VAP was measured based on ICD-9 997.31. We then identified patients admitted to our institution from January 1999 to October 2016 with a diagnosis of VAP (ICD9 997.31); trauma was defined based on ICD-9 as above and frequency and outcome of BAL was extracted from the medical record. Frequencies were compared by χ^2, and continuous variables by Student's T-test using SPSS software package.

Results: In the NIS from 2010-2014; 96.4% were successfully matched on an uninjured control. In the matched cohort 49.7% were female; the average age was 63.0. We found that injury was associated with a 2.5-fold increased incidence in the diagnosis of VAP as compared to uninjured controls (0.17% vs. 0.07%, $p<0.001$); however, VAP in injured patients was associated with a significantly decreased risk of death (15.0% vs 20.3%, $p<.001$). To determine differences in how VAP is diagnosed in injured vs. uninjured patients, we identified 200 injured patients and 434 uninjured patients with diagnosis of VAP at our institution from 1998-2014. Within this cohort, injured patients with a diagnosis of VAP were more likely to have undergone a BAL than uninjured patients with a diagnoses of VAP (55.5% vs 40.3% $p<.001$) and less likely to be diagnosed with VAP without undergoing any diagnostic procedure (2.5% vs 8.1% $P = .007$).

Conclusion: In a large national sample of inpatients, traumatic injury is associated with a 2.5-fold increase in the diagnosis of VAP. However, the mortality of VAP in injured patients is significantly less than that of matched controls. Within our institution, injured patients with a diagnoses of VAP are more likely to have undergone BAL as compared to uninjured patients. Taken together, these data suggest that VAP may be overdiagnosed in trauma patients despite an increased rate of diagnostic procedures. Given that nosocomial infections are subject to increasing regulatory and compliance scrutiny, the potential overdiagnoses of VAP is concerning.

Poster # 35

TRAUMA IS ASSOCIATED WITH 1.5-FOLD INCREASED RATE OF UNREIMBURSED CATHETER ASSOCIATED URINARY TRACT INFECTION IN A NATIONAL SAMPLE OF 2-MILLION INJURED PATIENTS

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Introduction:Traumatic injury is associated with immune dysfunction resulting in 45% of injured patients developing an infectious complication. In 2008, the Center for Medicare and Medicaid Services identified Catheter-Associated Urinary Tract Infection (CAUTI) as an unreimbursed preventable iatrogenic complication. To determine if injury was associated with an increased risk of CAUTI, we measured rates of CAUTI in injured vs. uninjured patients in the National Inpatient Sample. We hypothesized that after controlling for clinical metrics, patients with injuries would have an increased susceptibility to UTI.

Methods:Injured patients from the 2010-2014 National Inpatient Sample were identified. Patients under the age of 18 and elective admissions were excluded. Eligible patients were then case matched by age, gender, race, length of stay, Elixhauser comorbidity index, and presence of major operating room procedures. We then measured the effect of injury on the rate of CAUTI and related outcomes. Injury was defined by ICD-9 codes 800-959 and non-elective admission; CAUTI was defined as ICD-9 code 996.64. Frequencies were compared by χ^2; normally distributed continuous variables were compared with Student's T test using the SPSS software package.

Results:We identified 1.98 (10^6) injured patients in the NIS; 96.4% were successfully matched to an uninjured control. 49.7% were female; the average age was 63.0. The average Elixhauser index was 2.64. 35.8% of patients underwent major operating room procedures. Traumatically injured patients were 1.5-fold more likely to be diagnosed with CAUTI than non-injured patients (0.52% vs. 0.35% $p<.001$); however, CAUTI was associated with significantly lower mortality in the injured patients (2.6% vs. 3.8% $p<.001$). Total hospital visit charges were not significantly different between cohorts.

Conclusion:After controlling for age, length of stay and comorbidities, traumatic injury is associated with a significant increase in the frequency of diagnosis of CAUTI, but with significantly decreased associated mortality. Together, the increased incidence and decreased mortality in trauma patients suggests that CAUTI may be overdiagnosed in trauma patients. Given that nosocomial infections have been put forth as benchmarks for patient safety, the over-diagnosis of CAUTI in injured patients may significantly impact quality metrics and remuneration for organizations caring for trauma patients.

Poster # 36

SPLENIC HYPOPLASIA CAUSES REACTIVE THROMBOCYTOSIS AFTER SEVERE TRAUMA

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Introduction: Reactive thrombocytosis is defined as a platelet count greater than $450\times10^3/mm^3$ due to various causes such as inflammation, infection, neoplasm, surgery, trauma, or asplenia. The etiology and influence factors for reactive thrombocytosis after severe trauma have not been elucidated so far. The aim of this study was to clarify the risk factors for reactive thrombocytosis in patients with severe trauma.

Materials and Methods: Severe trauma patients with an injury severity score (ISS) of more than 16 and admitted to our trauma intensive care unit (ICU) between January 2015 and December 2015 were retrospectively studied. We excluded patients who died or discharged within 9 days after ICU admission and patients with splenic injury. Baseline characteristics including age, sex, types of trauma, ISS, and initial volume of spleen were recorded. To measure the initial spleen volume, CT images were analyzed by a radiologist without knowledge of any patient's medical history. We also recorded the serial changes in platelet counts, mean platelet volume (MPV), and C-reactive protein (CRP). Associations between risk factors and peak platelet counts were explored using stepwise multivariate linear regression analysis.

Results: A total of 77 consecutive trauma patients were included during the study period. Reactive thrombocytosis developed in 34 patients (41%) at a mean of 15 days after admission. The average initial spleen volume was $107.5mm^3$. Patient with reactive thrombocytosis had a lower initial spleen volume and a shorter MPV maximum day compared to the patients without thrombocytosis. The stepwise linear regression analysis revealed that reactive thrombocytosis was significantly associated with a smaller spleen volume and early MPV elevation independently.

	β	95% confidence interval		p value
Age	-2.690	-4.313	-1.068	.002
Peak CRP level	7.306	3.374	11.237	.000
Day of peak MPV	-14.859	-26.307	-3.411	.012
Shaft bone fracture	86.483	8.114	164.852	.031
Initial spleen volume	-.500	-.993	-.008	.047

Conclusion: In summary, reactive thrombocytosis after severe trauma is a common finding and associated with the smaller spleen volume. Our results suggested that splenic hypoplasia may be risk for reactive thrombocytosis.

Poster # 37

Infections and the low yield of fever evaluations in severe traumatic brain injury patients

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Introduction: Infections are common complications among TBI patients and are associated with increased length of stay and mortality. Although necessary to identify infection, workups may be invasive, expensive, and low yield. Infection workups usually follow a fever however noninfectious fevers among TBI patients occur often due to autonomic dysfunction. There is scant evidence to guide a more directed fever work up(FWU) or to address which component of the FWU is most likely associated with an infection.

Methods: Retrospective review of patients ≥18 years old with severe TBI (GCS </= 8) over 18 months. Patient and injury characteristics, daily maximum temperature(TMax), white cell, neutrophil and lymphocyte counts were reviewed for 14 days. Fever was defined as TMax≥101.4 F. Persistent fevers were≥2 days of TMax≥101.4 F prior to FWU. Bronchoalveolar lavage(BAL) was deemed positive if cultures grew ≥10,000 cfu/mL. Blood cultures(BCx) were drawn via peripheral venipuncture and urine workups(Uw) consisted of a urinalysis and if this was positive a urine culture was done.

Results: 106 patients presented with severe TBI, mean age was 47 yrs, 74% were male, mean ISS was 26.2. The most common injury was SDH (56.6%) and 22.6% required craniotomy. Infection work up included 67 BAL(62.7% positive), 135 BCx(5.9% positive) and 141 Uw(2.8% positive). Among the 106 pts, 48 pts (45.3%) had at least one infection. We therefore assessed frequency of fevers and correlation between fever and infection. Among patients with fevers, there were 292 fever days out of 820 hospital days. Of the 292 days of fever, 176 (60.3%) triggered a FWU. Of these 176 FWUs, 29% were positive, with pneumonia being the most common infection. Comparing positive infection versus no infection FWUs there was no difference in rates of persistent fever prior to FWU (55% vs 51%; p=0.8) or rates of 3+ days of fever prior to FWU (26.3% vs 25.9%;p=1.0). Among fever workups, those returning positive for infection had a lower WBC the day of the workup compared to noninfected work-ups (10.9+/-0.6 vs 12.9+/-0.4; p=0.048) However, there were no other differences between infected versus noninfected workups with respect to rates of leukocytosis (42.9% vs 52.7%; p=0.3), rates of lymphopenia (48.4% vs 36.7%; p=0.24), or absolute neutrophil or lymphocyte counts.

Conclusion: Infections, especially pneumonia, occur frequently in patients with severe TBI. Fevers are also extremely common in severe TBI patients. No feature of the fever profile was predictive of an infectious etiology in our series. Other than clinically directly BAL for pneumonia the yield of other components of an infection work up were extremely low. Intensivists should focus on reducing the tendency to reflexively send blood or urine specimens following a fever, thereby reducing costs, invasive testing and phlebotomy in patients with severe TBI.

Poster # 38

Is Airway Pressure Release Ventilation Safe in Patients with Traumatic Brain Injury?

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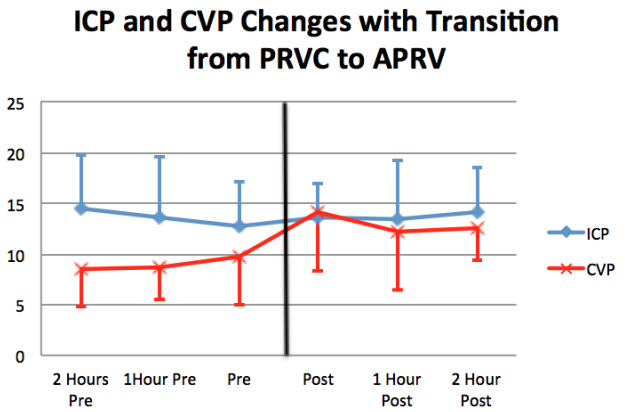
Introduction: Airway Pressure Release Ventilation (APRV) use as a mode of mechanical ventilation in patients with traumatic brain injury (TBI) remains controversial. While some feel the elevated thoracic pressures may cause clinically significant increases in intracranial pressure (ICP), this effect has not been well established.

Methods: A retrospective review, from 2009 – 2015, of traumatically injured patients were identified who were transitioned from traditional ventilator modes to APRV and also had an ICP monitor in place. The trauma registry as well as chart review was used to determine injury characteristics as well as laboratory data and hemodynamic parameters surrounding the transition. Data are presented as mean +/- standard deviation or median (IQR).

Results: Fifteen patients undergoing 19 transitions to APRV were identified. The average age of the cohort was 40 +/- 17 years old and 87% were male. The average ISS was 33 +/-13 with an AIS-Head of 4.1 +/- 0.9 and 60% survived. Prior to transitioning to APRV the average static and dynamic compliance was 22.9 +/- 5.6 and 16.5 +/- 4.12 mL/cm H2O. Vital sign parameters were largely unchanged after the transition to APRV (ICP 12.7 +/- 4.3 vs. 13.5 +/- 3.4, p = 0.356, MAP 87.2 +/- 12.8 vs. 86.79 +/- 14.5, p = 0.884, CPP 74.5 +/- 11.6 vs. 73.3 +/- 14.0, p = 0.672) but there was a significant change in CVP (9.7 +/- 4.8 vs. 14.2 +/- 5.9, p = 0.041) and P:F ratio (162+/-92 vs. 221+/- 116, p = 0.035). The patients' pH and arterial CO2 values were also not significantly different. Individually, only 4 patients had ICP values > 20 in the first hour after transitioning to APRV and the rate of ICP elevations (# of ICP readings > 20/hours on mode of ventilation) was similar between the two modes of ventilation (0.067 #ICP>20/hour (0.018 – 0.217) vs. 0.025 #ICP>20/hour (0.000 – 0.128), p = 0.332).

Conclusion: APRV is a viable mode of ventilation in patients with TBI who also have poor lung compliance. The increased mean airway pressures and central venous pressure of this mode of ventilation do not appear to adversely affect ICP or hemodynamic parameters. A further evaluation of other effects of APRV ventilation on TBI patients is warranted.



Poster # 39

A COMPARISON OF OUTCOMES BETWEEN PATIENTS NEEDING NEUROCRITICAL CARE BY PHYSICIANS CERTIFIED BY UNITED COUNCIL FOR NEUROLOGIC SUBSPECIALTIES VS. AMERICAN BOARD OF MEDICAL SPECIALTIES

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Introduction: There have been increasing pressures to create specialized neurocritical care (NCC) units that are staffed solely by United Council for Neurologic Subspecialties (UCNS) certified physicians. Our hospital traditionally provided care for NCC patients by attendings who were either surgical or medical critical care boarded by the American Board of Medical Specialties (ABMS-CC). A new NCC service staffed by UCNS certified intensivists was created at our level one trauma center and this study compared outcomes and costs between patients cared for by the UCNS service versus the traditional ABMS-CC teams.

Methods: Between Jan 2014 and May 2016, there were intermittent periods (several weeks – months) without UCNS intensivist coverage. This created two comparator groups that cared for the same patient populations. Two separate cohort analysis between patients cared for by either UCNS or ABMS-CC were done to evaluate outcomes and costs. The first analysis specifically looked at neurosurgery patients that were either cared for by ABMS surgical CC or the UCNS team. The second analysis evaluated patients who had a primary diagnosis of an acute critical non-traumatic neurological illness (i.e. CVA, SAH, status epilepticus, etc).

Results: The first cohort analysis compared 80 UCNS to 150 ABMS surgical CC patients. Mean age and race were similar. The UCNS group had higher 90-day mortality and daily ICU cost. Comparison of outcomes and costs are summarized in Table 1a. In the second cohort analysis, we matched patients with acute critical neurological illness in a 1:2 ratio yielding 138 UCNS and 276 ABMS-CC patients. Both groups had similar demographics. UCNS patients had significantly more studies performed (6.8 vs 5.3, $p<0.001$), higher mortality, increased costs, and longer length of stay. Table 1b

Conclusion: While there are certain advantages to specialized critical care teams, the creation of a dedicated UCNS staffed service at our institution did not demonstrate improvement in outcomes and cost increased. This data suggests that not all centers may benefit equally from a dedicated UCNS staffed NCC service and ABMS-CC intensivists provide efficient quality care. This data provides key information that supports caring for these patients by American Medical Board approved physicians.

Table 1. Comparison of NCC Patients by Physician Certification

A.) Analysis of neurosurgical cohort n=230

	UCNS n=80	ABMS surgical CC n=150	p
Mean age, years	57.9 ± 14.7	55.4 ± 15.8	0.268
Mean LOS, days	11.9 ± 8.4	10.5 ± 10.6	0.296
Mean ICU days	8.7 ± 7.2	7.1 ± 8.9	0.148
Mean ventilator days	5.2 ± 7.7	4.8 ± 9.8	0.753
In-hospital mortality	15 (18.8%)	19 (12.7%)	0.216
90-day mortality	20 (25.0%)	21 (14.0%)	0.038
Total cost	$52,755 ± 42,901	$47,348 ± 42,974	0.364
ICU cost/ day	$1,559 ± 365	$1,458 ± 297	0.023

B.) Matched cohort analysis (1:2) by primary NCC diagnosis n= 414

	UCNS n=138	ABMS-CC n=276	p
Mean age, years	59.95 ± 15.74	61.25 ± 17.56	0.462
Mean LOS, days	10.69 ± 8.44	8.95 ± 8.72	0.054
Mean ICU days	7.58 ± 6.60	5.75 ± 7.11	0.012
Mean ventilator days	4.63 ± 6.75	3.39 ± 7.17	0.093
In-hospital mortality	35 (25.4%)	45 (16.3%)	0.028
90-day mortality	41 (29.7%)	53 (19.2%)	0.016
Total cost	$39325 ± 33809	$31180 ± 32670	0.019
ICU cost/ day	$1568 ± 405	$1435 ± 297	<0.001

Poster # 40

UNDERSTANDING THE BROKEN HEART: RISK FACTORS AND OUTCOMES FOR TAKOTSUBO'S CARDIOMYOPATHY IN CRITICALLY INJURED TRAUMA PATIENTS

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Introduction: Takotsubo's cardiomyopathy (TTC) is a transient and reversible dysfunction of the left ventricle with a characteristic balloon shape and wall motion abnormalities on echocardiogram. Symptoms, biochemical, and electrocardiographic profiles are indistinguishable from an acute myocardial infarction (MI), but angiography reveals clean coronary arteries. Risk factors, pathogenesis, treatment and outcomes of TTC remain largely unknown. Previous studies on TTC have been in medical intensive care unit (ICU) patients despite increased recognition in trauma patients; there are no large studies in trauma or surgical patient population. We aim to investigate the clinical characteristics leading to Takotsubo's cardiomyopathy and resulting outcomes in critically injured patients.

Methods: A retrospective chart review of injured patients diagnosed with TTC on echocardiogram in a surgical ICU over a 5 year period was performed. Controls with 1:1 ratio were randomly selected from remainder of the injured patients admitted to the surgical ICU. Factors including Injury Severity Score (ISS), acute physiology and chronic health evaluation (APACHE) II score, abbreviated injury scale (AIS), and mechanism of injury were collected. Mortality, length of stay (LOS), ICU LOS, ventilator days, and need for blood transfusion were primary outcomes. Bivariate analysis were conducted with two-sided chi-square tests, t-test or Wilcoxon two-sample test.

Results: Of the 2283 injured patients admitted to the SICU in 5 years, 416 (18.2%) received echocardiograms during their hospital course and 63 patients (2.8%) were diagnosed with TTC. Sixty three controls were randomly selected from the remaining 2220 patients. Forty nine (78%) patients with TTC were male. Most patients (60%) with TTC were >=60 compared to 35% of controls($p = 0.0043$). The majority of TTC patients (57%) suffered a fall which was associated with TTC ($p=0.037$). Median APACHE II score for TTC patients was higher compared to controls (10 Vs 7; $p= 0.0001$). ISS was not predictive or significantly different (median 17; $p=0.321$). Patients with AIS Head >= 3 (59% Vs 41%; OR: 6.654) and AIS chest >=3 were more likely to develop TTC (62% Vs 38%; OR: 6.32) respectively, however the association did not reach statistical significance due to low frequencies. Prior history of Afib (18%), prior MI (16%), or need for hemodialysis (1.6%) were not associated with TTC ($p= 0.192, 0.256, 0.094$). Patients with TTC had longer length of stay (14 days Vs. 7 days, $p=0.0182$), longer ICU LOS (6 days Vs. 3 days; $p=0.031$), and more ventilator dependent days (median 2 days Vs 0 days; $p=0.024$). Patients with TTC required more blood transfusions compared to controls (median 0 Vs 1, $p=0.012$). Mortality was not significantly different between TTC and controls (9.5% Vs 4.8%; $p=0.299$). Most patients with TTC (60%) needed to be discharged to a facility and required additional care compared to only 43% of controls ($p=0.05$).

Conclusion: Incidence of TTC in our study is 2.8% which is comparable to the incidence described in the medical patients. Age >= 60, mechanism of injury, and higher APACHE II scores were significant risk factors. TTC patients had a similar mortality rate, but hospital LOS, ICU LOS, ventilator dependent days and blood transfusions were significantly higher for TTC patients compared to controls. Larger studies are needed to address some of the complex risk factors identified by our study in further details

Poster # 41

Abdomen Surveillance Culture after Open Abdominal Management for Trauma Patients: A Single-center Prospective Cohort Study

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Background: Open abdominal management (OAM) has been widely used as a damage control strategy for patients with physical trauma. However, infectious complications are serious problems in intensive care management after OAM. At our center, for OAM, operations are conducted every 24 to 72 hours until abdominal closure. During operation, we conduct abdominal surveillance culture (ASC) to identify the source of the infectious bacteria. The aim of this study is to examine the impact of ASC results on OAM.

Methods: The subjects were the consecutive 76 trauma patients who underwent OAM at our center between April 2002 and May 2014. We excluded cases where the patients had died within the first 48 hours and those who did not wish to be actively resuscitated. To conduct the ASC, we collected culture samples from the gauze used during the OAM operation and from the ascites. The samples with bacteria were considered ASC positive. The ASC-positive and ASC-negative groups were compared, and we examined the risk factors that might cause in-hospital death or ASC positivity.

Results: Of the 76 patients, 32 (42%) were ASC positive. No significant differences in age, sex, injury severity score (ISS), and wound location were found between the ASC-positive and ASC-negative groups. The mortality of the ASC-positive patients was 31% (10/32), whereas that of the ASC-negative patients was 7% (3/44; $p < 0.01$). The odds ratio for in-hospital death between the two patient groups was 6.2 (95% confidence interval,1.7–29.9), and the corrected odds ratio using trauma and injury severity score (TRISS) was 8.0 (95% CI, 2.0–45.1). Furthermore, the causes of death of those who tested ASC positive and ASC negative were sepsis in most cases (8/10) and head injury in all the cases, respectively. As to the predictors of those patients becoming ASC positive, the study found a strong correlation between becoming ASC positive and the conditions during intervention (i.e., how much bleeding took place in the first operation, and how much blood transfusion took place in that 24-hour period, and the number of times OAM was conducted) rather than anything relating to the patients' backgrounds.

Conclusion: ASC positivity strongly correlated with in-hospital death. Once identified as ASC positive, a quarter of patients die of sepsis. While we found no correlation between ASC positive and the patients' backgrounds, a strong correlation was observed between the amount of blood loss during the initial surgery and the number of times OAM was conducted for those who were ASC positive. Thus, this study indicated the importance of finding a strategy to reduce these factors.

Poster # 42

THE EFFECT OF LMWF5A ON DIFFERENTIATED THP-1 MONOCYTES: POTENTIAL ACTIVATION OF ANTI-INFLAMMATORY MACROPHAGES

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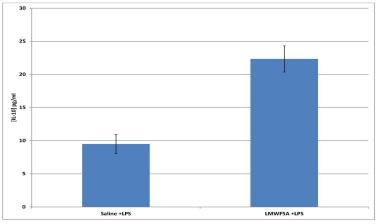
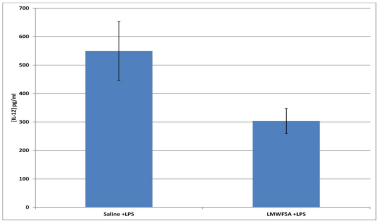
Introduction: After development, macrophages encounter various stimuli leading to an activated state. Depending on the type of stimuli, activated macrophages either become M1 (pro-inflammatory) or M2 (anti-inflammatory) macrophages. This study aims to determine whether the low molecular weight fraction of 5% human serum albumin (LMWF5A) favors the activation of the anti-inflammatory M2 lineage.

Methods: A human peripheral blood monocyte cell line (THP-1) was differentiated into macrophages using phorbol 12-myristate 13-acetate (PMA). After a 7 day differentiation period, macrophages were pre-treated with LMWF5A for 1 hour prior to overnight stimulation with lipopolysaccharide (LPS). Supernatants were assayed by ELISA for cytokines of M1 or M2 activation such as IL-12 or IL-10, respectively.

Results: THP-1 cells were differentiated for 7 days into macrophages as evidenced by adherence to tissue culture plates and other morphological changes such as increases in size and development of vesicles associated with phagocytosis. More importantly, treatment of LPS-stimulated, differentiated THP-1 cells with LMWF5A caused a 3-fold increase in the release of the anti-inflammatory cytokine IL-10 with a concomitant 50% decrease in IL-12 release.

Conclusion: These findings suggest that LMWF5A promotes the activation of M2 macrophages which favors suppression of the immune response and promotion of wound healing/tissue remodeling. Therefore, LMWF5A is potentially a useful therapeutic in medical conditions where inflammation is prevalent such as trauma, sepsis, osteoarthritis, and various chronic conditions.





Poster # 43

Management of Acute Surgical Conditions in Patients with Dementia: Should We Operate?

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Introduction: Patients with dementia pose a challenge to the system when acute care decisions are required. Non-operative management is often appropriate for high-risk patients. We
examined outcomes in operative and non-operative patients with Alzheimer's disease and related dementias (ADRD) and acute abdominal general surgical conditions.

Methods: Patients ≥55y with ADRD admitted emergently or urgently with an acute abdominal surgical condition were identified using Florida inpatient claims (2008-2013). Patients were classified by operative status. Operative cases (O) were exact matched to non-operative controls (NO) with the same surgical condition within each hospital. Patient comorbidities, socioeconomic and demographic factors, functional disability, sepsis severity and admission location were also matched using an optimal sparse network with refined balance. Matched cases and controls were compared on inpatient mortality, condition-specific prolonged length of stay (pLOS), and discharge destination using the McNemar test.

Results: Of 60,449 patients, 12.7%(n=7703) had an operation. We matched 6514 case-control pairs. Before matching, more operative patients had severe sepsis (O:27% vs. NO:14%, p<0.001) and more non-operative patients had baseline functional disability (O:20% v. NO:13% p<0.001). (Table) Outcomes differed significantly before matching. After optimal matching, the operative group had higher mortality (O:5.9% v. NO:3.6% p<0.001), pLOS (O:70.0% v. NO:36.9% p<0.001) and lower rates of discharge to home if admitted from home (O:37.9% v. NO:43.2% p<0.001).

Conclusion: For patients with ADRD and an acute abdominal surgical condition, operative management is associated with increased mortality, prolonged hospitalization, and a lower rate of returning home compared to non-operative management.

Table. Representative Match Results for Operative and Non-Operative Alzheimer's Disease and Related Dementia (ADRD) Patients with Acute Surgical Conditions.

	Before Match		After Match			
N = Number of Patients Variables (% except age)	*Operative N=7,703*	*Non-Operative N=52,746*	*Operative N=6,514*	*Non-Operative N =6,514*	**Std. Diff Before Match**	**Std. Diff After Match**
Patient Demographics						
Age (years)	80.1	82.5	81	81.5	-0.23	-0.07
Sex (% female)	56	61	58	59	-0.11	-0.03
African American	12	15	12	12	-0.09	0.00
Admit from home	95	92	95	96	0.12	-0.03
Clinical Characteristics						
Severe Sepsis	27	14	22	22	0.32	0.00
Functional Disability	13	20	13	12	-0.19	0.03
Weight Loss	14	9	12	12	0.15	0.00
Acute Surgical Condition						
HPB	45	10	44	44	0.86	0.00
Colorectal	16	27	16	16	-0.28	0.00
General Abdominal/Hernia	9	30	10	10	-0.56	0.00
Upper GI	12	17	12	12	-0.13	0.00
Intestinal Obstruction	18	16	18	18	0.05	0.00

Note. 12 of 56 covariates used in match are displayed. All after-match Std.Diff <0.10.

Poster # 44

EFFECT OF NORADRENALINE DOSAGE ON MORTALITY IN PATIENT WITH SEPTIC SHOCK

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Introduction: Using high dose noradrenaline was thought immunosuppressive action, brought to bad mortality. This study aimed to evaluate correlation whether noradrenaline dosage and prognosis for patient with septic shock.

Methods: This study was nested cohort of RCT (DExmedetomidine for Sepsis in ICU Randomized Evaluation: DESIRE trial). We evaluated 112 patients who had septic shock with initial SOFA circulation category above 2 and initial lactate level above 2 mmol/L. We divided the patients into two groups according to the noradrenaline dosage in initial seven days: high dose (≧416 microgram/kg) (H group, n=56) and low dose (< 416 microgram/kg) (L group, n=56). We assessed the CRP, PCT, other vasopressor dosage, ventilator free days (VFD) and 28 days mortality in both group. The paired Student's *t*-test or Wilcoxon rank was used to calculate statistical significance. The cumulative incidence was estimated by the Kaplan-Meier method. Data are shown as the mean (SD) and median [IQR].

Results: Age was 71 (13) year in L group vs 71 (14) year in H group. Causes of sepsis were lung (n=29), abdomen (n=52), and other cause (n=31). APACH II score (25 [19, 44] in L group vs 25 [20, 30] in H group), initial SOFA score (10 [8, 12] vs 10 [8, 12]), initial lactate level (4.5 [3.0, 7.8] vs 4.4 [3.6, 6,6] mmol/L), initial CRP (12 [5, 24] vs 16 [5, 27] mg/dL) and initial PCT (29 [3, 82] vs 40 [13, 100] ng/mL) were did not significant difference in both group. The cumulative incidence of death at 28 days were 29.9 % (15 patients) in the L group and 29.4% (16 patients) in the H group ($P = 0.91$). The median 28-day VFD in the L group was 21 [0, 25] compared to 17 [0, 22] in the H group ($P < 0.05$).

Conclusion: Patient with septic shock treated with high dosage noradrenaline compared with low dosage noradrenaline did not result in statistically significant 28 days mortality. However VFD, in low dosage group was longer than in high dosage group.

Poster # 45

CHARACTERISTICS OF EMERGENCY GENERAL SURGERY PATIENTS TRANSFERRED BETWEEN ACUTE CARE FACILITIES

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Introduction: Despite outcomes being worse and costs higher for transferred emergency general surgical (EGS) patients, our understanding of interhospital transfers is limited because prior research has relied upon single facility and cross-sectional administrative data. We characterized interhospital transfers of EGS patients using representative state-based longitudinal data that tracks patients between facilities.

Methods: We utilized 2013 Healthcare Cost and Utilization Project State Inpatient Databases and State Emergency Department Databases for New York, Florida, and Wisconsin. We included patients 18 years or older with an AAST ICD-9 EGS diagnosis code for their initial ED encounter or initial urgent or emergent inpatient admission who were transferred to another acute care facility. Descriptive statistics (means, proportions) characterized interhospital transfers.

Results: 9,130 interhospital transfers occurred in 2013 in the states of interest, representing 7,541 unique patients. In total, patients were transferred between 502 unique facilities. Characteristics of the patients **(Table 1)** and transfers **(Table 2)** are presented.

Conclusion: Transferred EGS patients are a highly vulnerable, resource intensive population. This research provides a comprehensive assessment of transfers across the continuum of care. This information is critical to inform quality improvement efforts, resource utilization decisions, and policy initiatives.

Table 1. Characteristics of 7541 Emergency General Surgery Patients Transferred between Acute Care Hospitals in Florida, New York, and Wisconsin in 2013 at Initial Presentation

Demographics		**EGS Diagnoses**, n (%)	
Age (mean, SD)	59.2±19.2	Abdominal pain	1284 (17.0%)
Female, n (%)	3787 (50.2%)	Gastrointestinal Hemorrhage	1050 (13.9%)
White, n (%)	6159 (81.7%)	Disorders of the gallbladder or bile duct	853 (11.3%)
Primary payer, n (%)		Intestinal obstruction without hernia	737 (9.8%)
Medicare	3833 (50.8%)	Cellulitis or abscess	678 (9.0%)
Private Insurance	1853 (24.6%)	Acute pancreatitis or pseudocyst	569 (7.6%)
Medicaid	1044 (13.8%)	Diverticulitis	201 (2.7%)
Uninsured	554 (7.4%)	Hernias	153 (2.0%)
Other	256 (3.4%)	Other	2016 (26.7%)
Patient income, n (%)			
0-25th percentile	1575 (20.9%)		
26th to 50th percentile	3234 (42.9%)		
51st to 75th percentile	1649 (21.9%)		
76th to 100th percentile	900 (11.9%)		
Rural location, n (%)	3444 (45.7%)		

Table 2. Characteristics of 9130 Transfers Among 7541 Emergency General Surgery Patients in Florida, New York, and Wisconsin in 2013

Length of stay, mean (SD) days	
Referring facilities	1.8±4.4
Final destination	6.5±9.8
Final disposition, n (%)	
Discharged home	7067 (77.4%)
Discharged to postacute care setting	1364 (15.0%)
Died	359 (3.9%)
Other	335 (3.7%)

Poster # 46

A Prospective Study of Family Satisfaction after Tracheostomy in Trauma Patients

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Introduction: Patients requiring prolonged endotracheal intubation for ventilatory support commonly receive a tracheostomy in order to decrease time on the ventilator, avoid ventilator associated pneumonia, and prevent the rare occurrence of subglottic tracheal stenosis. When approached to consent for this invasive procedure, families of critically ill patients may have concerns about the nature of the intervention, the implications for their often unconscious loved one, and may face this decision with anxiety and fear. The issue of family satisfaction after tracheostomy has not been examined. We hypothesized that families would be more satisfied after tracheostomy. Our specific aim was to study family satisfaction before and after tracheostomy in trauma patients.

Methods: A prospective study was performed on a convenience sample of families of intubated trauma patients admitted to the ICU at an academic level 1 trauma center who subsequently underwent an elective tracheostomy. After informed consent was obtained, the next of kin family member was asked to complete an eight-point questionnaire using a forced Likert scale of graded responses (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree). The same questionnaire was administered the day before the tracheostomy as well as 24 and 72 hours after tracheostomy. The responses before and after tracheostomy were compared using univariate analysis.

Results: A total of 26 family members completed the survey:

	Before	24 Hours	72 Hours
1. My family member appears generally comfortable:	3.0 ± 1.2	**4.0 ± 0.9 p=0.004**	**4.0 ± 1.0 p=0.02**
2. My family member does not appear to be in any distress:	2.8 ± 1.2	3.0 ± 1.0 p=0.09	3.8 ± 1.2 p=0.07
3. My family member appears to be progressing based on my understanding of the updates I have received from the medical team:	3.7 ± 1.1	**4.3 ± 0.7 p=0.02**	**4.4 ± 0.7 p=0.002**
4. My family member is able to see and interact with me:	2.8 ± 1.4	**3.8 ± 1.2 p=0.01**	**4.4 ± 0.8 p=0.0001**
5. I worry that my family member may have permanent scars or disfigurement based on need for medical devices:	3.0 ± 1.3	2.8 ± 1.5 p=0.68	2.6 ± 1.2 p=0.67
6. I feel that I am able to provide the support and comfort that my family member needs:	4.0 ± 1.1	4.2 ± 0.8 p=0.31	4.4 ± 0.7 p=0.45
7. I feel a high level of stress and anxiety with regard to my family member:	3.6 ± 1.3	3.1 ± 1.3 p=0.15	**2.3 ± 1.0 p=0.01**
8. I feel comfortable visiting my family member:	4.5 ± 0.8	4.5 ± 0.9 p=0.99	4.6 ± 0.66 p=0.66

Conclusion: After 24 hours, family members of trauma patients who receive a tracheostomy believe their loved one appeared more comfortable, was making progress, and was better able to see and interact with them. By 72 hours, the level and stress and anxiety of the family members decreased compared to before the tracheostomy. Family satisfaction may be an additional benefit in support of early tracheostomy.

Poster # 47

PREDICTORS OF THIRTY-DAY READMISSION IN EMERGENCY GENERAL SURGERY PATIENTS.

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Introduction: Thirty-day readmissions are responsible for a significant cost burden to the United States health care system. The Centers for Medicare and Medicaid Services began penalizing hospitals for excess 30-day readmission in 2017. This has led many to investigate potential causes of 30-day readmission in an effort to reduce readmission rates in specific patient populations. We hypothesized that we would be able to identify modifiable risk factors for readmission in an emergency general surgery (EGS) population.

Methods: A single institution retrospective review of patients who underwent an emergency general surgical procedure performed by an acute care surgeon from January 1, 2010 through December 31, 2015 was performed using the institutional National Surgical Quality Improvement Program database. Patients who died during the index hospitalization were excluded. We examined multiple parameters including demographics, type of procedure, pre-existing conditions, in-hospital complications, need for additional procedures, discharge destination, and weekend versus weekday discharge. Statistical analysis was performed using chi-square, t test and logistic regression to determine factors associated with increased rate of 30-day readmission. Significant associations on bivariate analysis were subjected to stepwise multivariate analysis.

Results: Over the six-year period, there were 781 patients who met criteria for inclusion. Our overall readmission rate was 7.21%. On multivariate analysis, patients with a higher likelihood of readmission were patients of male gender, current smokers, with dyspnea on exertion, patients with hypertension requiring treatment with medication, and those patients whose index hospitalization was complicated by organ space surgical site infection (Table).

Conclusion: Only organ space surgical site infection was a targetable post-operative event to reduce readmissions. The other principal factors driving readmission were patient demographics and pre-existing conditions which are not modifiable in the emergency setting but should alert clinicians to risk for readmission. Aggressive efforts to reduce organ space infection after emergency general surgery should reduce readmission rates after emergency general surgery.

Risk Factor	n	Odds Ratio	95% CI	p Value
Gender (Male)	363	2.542	1.105 - 5.847	0.0282
Current Smoker	132	2.137	0.842 - 5.434	0.110
Dyspnea on Exertion	26	25	3.425 - 166.667	0.0015
Hypertension requiring medication	260	2.801	1.164 – 6.757	0.0216
Chronic steroid use/Immunosuppression	47	1.812	0.397 – 8.264	0.4431
Organ Space SSI	45	35.714	12.195 - 100	<0.0001

Poster # 48

THE MILITARY INJURY SEVERITY SCORE (mISS: A BETTER ABILITY TO PREDICT MORTALITY IN COMBAT THAN INJURY SEVERTIY SCORE(ISS AND NEW INJURY SEVERITY SCORE (NISS

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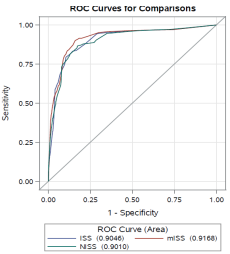
Introduction: The Injury Severity Score (ISS) was introduced in 1974 and became the 'gold standard' to describe anatomical injury severity in civilian trauma. The ISS is limited because it does not account for more than one injury to a body region. To account for this and other limitations of the ISS, the New ISS (NISS) was introduced in 1997. The complexities of combat trauma are not accounted for in either of these scoring systems, thus the Military ISS (mISS) was developed in 2005 to adjudicate their discrepancies in this complex trauma population. The aim of this analysis is to compare the mISS to the ISS and NISS in terms of the capability and accuracy to predict mortality.

Methods: Data were obtained from the Department of Defense Data Registry. Inclusion criteria were U.S. troops injured in Afghanistan and Iraq from 1/2002 to 12/ 2014 and complete data availability for the variables tested. ISS is defined as a sum of the squares of the 3 most severe abbreviated injury scale (AIS) scores from 6 body regions. NISS was calculated as a sum of 3 most severe AIS scores regardless of body regions. mISS is a variant of ISS but uses the AIS 2005-Military scale. Area under the ROC curve (AUROC) was used to discriminate among mISS, ISS and NISS. Sensitivity and specificity were compared. Logistic regression was used to calculate the likelihood of mortality by levels of mISS, ISS and NISS overall and by battle (BI) vs. non-battle (NBI), type and mechanism of injury. The Hosmer-Lemshow goodness-of-fit test was used for calibration of the models. The AIC was also used to compare the model of best fit. Mann-Whitney or t-test & chi-square test were used. P <0.05 is significant. The primary outcome was mortality.



Results: A total of 27,213 patients were analyzed. Median (IQR) age was 24 (21-29). BI was 66%. Penetrating (40%) and blunt (56%) injury types and explosion (53%) and gunshot (15%) mechanisms predominated. Median (IQR) ISS, mISS and NISS were: 4 (1-9), 4 (1-10) and 5 (2-12) overall; 4 (1-9), 4 (1-9) and 5 (2-12) in survivors; 25 (16-30), 37 (25-75) and 30 (22-48) in non-survivors, respectively. mISS was discordant with ISS about 14.4% and NISS about 49.5%. NISS was discordant with ISS about 45.9%. AUROC (Figure) was significant higher in mISS (0.92) followed by ISS (0.90) and NISS (0.90) overall, and no significant difference was found between ISS and NISS in ability of predicting mortality. Similar patterns were found in BI (0.92 vs. 0.90 vs. 0.90), NBI (0.89 vs. 0.88 vs. 0.87), blunt injury (0.89 vs. 0.87 vs. 0.88), penetrating injury (0.92 vs. 0.90 vs. 0.89), explosion (0.91 vs., 0.9 0 vs. 0.91) and gunshot wounds (0.92 vs. 0.89 vs. 0.87), all p-values < 0.001, except ISS vs. NISS was only statistically significant in patients with penetrating injuries (P=0.005). Mortality rate at Role 3 was 2.2% overall and 6.7% in those with ISS≥9 or mISS≥9. A higher score was associated with a higher likelihood of mortality.

Conclusion: The mISS is a better predictor of combat mortality than ISS and NISS.The importance of an optimized and reliable scoring system that accurately predicts mortality is paramount for real-time performance improvement across the continuum of care.

Poster # 49

TARGETED TEMPERATURE MANAGEMENT FOR TRAUMATIC ARREST

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Introduction: Therapeutic Hypothermia (TH) and Targeted Temperature Management (TTM) have been shown to improve outcomes in survivors of ventricular fibrillation cardiac arrest. Trauma patients have been excluded from most published reports due to presumed risks of bleeding and infection. We hypothesize that TH/TTM is safe in trauma patients.

Methods: A retrospective cohort study was conducted to review all trauma patients treated with TH/TTM following cardiac arrest at a single level I trauma center from 2008 to 2016. Demographics, medical history, trauma mechanism and recent surgeries were collected, along with outcomes such as hospital LOS, mortality, discharge GCS and disposition. Rates of in-hospital complications are reported.

Results: Of the 21 traumatic arrest patients, 52% were treated with TH and 48% with TTM protocols with goal temperatures of 33C and 36C respectively. Mean age was 57 ± 15, with 17 (81%) males. Survival was 38% (n=8) of which 88% (7) were following commands at discharge. Of the 13 deaths, none were attributable to complications of TH/TTM, and none of the deaths had significant bleeding. Complications included pneumonia (19%), sepsis (5%), major bleeding (5%), arrhythmias (5%), and seizures (19%), with rates similar to literature values of complications for traditional TH/TTM patients.

Conclusion: Traumatic arrest patients appear to have similar complication rates to standard TH/TTM patients, suggesting that this therapy should be considered in trauma patients following cardiac arrest.

Poster # 50

Impact of Multi-Professional Rounds on Critical Care Outcomes in the Surgical Trauma Intensive Care Unit

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Introduction: Multi-professional rounds (MPR) represent a mechanism for the coordination of care in critical ill patients. Previous studies have shown that MPR foster communication among care providers and streamline workload management in medical intensive care units (ICU), and thus can improve outcomes. Herein, we examined the impact of MPR implementation in the surgical trauma ICU (STICU) on ventilator days (Vent-day) and ICU length of stay (LOS).

Methods: A multi-professional team at a Level-I trauma center developed guidelines, including an organ system-based daily goal checklist, and MPR began in February 2016 in the STICU. Patients admitted from November 2015 to November 2016 with ICU LOS greater than 5 hours were included. Outcome data consisted of Vent-day and ICU LOS were captured automatically via electronic medical record. Severity of illness, consisting of injury severity score (ISS) and APACHE-IV for trauma and surgical patients respectively, were collected. Linear regression models are constructed to observe the impact of MPR, by month after implementation, on ICU outcomes.

Results: There were a total of 2,633 patients, 1,702 of whom received mechanical ventilation. The mean ISS was 17.7 and mean APACHE IV was 58.5. Overall, the mean Vent-day was 3.5 and mean ICU LOS was 3.3 days.

Among surgical patients with Vent-day > 5 hours (n=1,165), the months after MPR was a significant predictor of V-day reduction when controlled for APACHE IV score (p=0.008; coefficient -0.09 days/month; 95% CI [-0.16, -0.02]). For trauma patients (n=537), the months after MPR was also a significant predictor of Vent-day when controlled for ISS (p=0.05; coefficient: -0.1 days/month; 95% CI [-0.2, 0.0]).

Among patients with ICU LOS > 5 hours (n=2,497), the months after MPR was a significant predictor of ICU LOS when controlled for severity of illness (p=0.04; coefficient -0.04 days/month; 95% CI [-0.08, -0.003]). Likewise, combining surgical and trauma patients with ICU LOS > 2 days, the months after MPR was a significant predictor of LOS reduction. For a subgroup of trauma patients with ICU LOS > 2 days (n=468), the months after MPR was a significant predictor of ICU LOS (p=0.05; coefficient -0.12 days/month; 95% CI [-0.23, -0.004]).

Conclusion: Implementation of multi-professional rounds in the surgical trauma ICU, with an organ system-based daily goal checklist, was associated with a reduction in ventilator days and ICU length of stay.

Poster # 51

VALIDATION OF AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA ANATOMIC SEVERITY SCORE IN ACUTE PANCREATITIS

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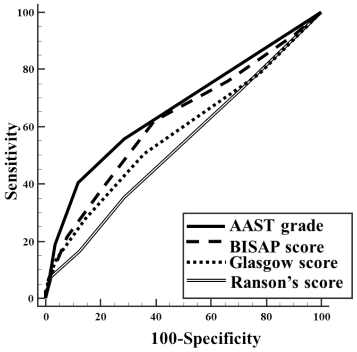
Introduction: The AAST recently developed a standardized grading system to determine anatomic severity for a variety of emergency general surgery (EGS) diseases. We aimed to internally validate this grading system for acute pancreatitis hypothesizing that increased AAST grade is associated with important physiologic, management and clinical outcomes.

Methods: Single institution retrospective analysis of adult patients admitted with a primary diagnosis of acute pancreatitis from 10/2014 to 1/2016. Patients not assessed with CT imaging were excluded. Imaging, operative, and pathological AAST grades were assigned by two reviewers. Summary and univariate analyses were performed. AUROC analysis was performed comparing AAST grade with other severity scoring systems (Ranson's, BISAP and modified Glasgow) as a predictor for the number of readmissions.

Results: There were 297 patients with a mean (±SD) age of 55±17 years; 60% were male. Gallstone pancreatitis was the most common etiology (28%). The overall complication rate was 51%; the mortality rate was 1.3 % with an ICU admission rate of 25%. Readmission up to 90 days occurred in 32% of patients. Procedures performed included: ERCP (n=61, 21%), endoscopic necrosectomy (n=84, 28%), surgical necrosectomy (n=7, 2%), cholecystectomy (n=42, 14%), and CT guided percutaneous drainage (n=11, 4%). Multiple procedures were performed in 14% of patients. Only one patient failed endoscopic management and required operative necrosectomy. Increasing AAST grades was associated with worst outcomes (Table). AUROC analysis (Figure) demonstrated that the AAST grade outperforms other severity scores to predict the number of readmissions.

Figure 1. ROC curve analysis for number of readmissions



Outcomes	AAST I; 176 (60%)	AAST II; 46 (15%)	AAST III; 44 (15%)	AAST IV; 24 (8%)	AAST V; 8 (3%)	P value
LOS*	4 (3-6)	6 (4-9)	14 (8-22)	29 (10-35)	37 (17-78)	p<0.0001
ICU stay*	0 (0-0)	0 (0-0)	2 (0-12)	2 (0-10)	13 (8-32)	p<0.0001
Pressor use†	1.7	2.2	19.5	33.3	62.5	p<0.0001
TPN use†	2.8	6.5	19.1	26.1	37.5	p<0.0001
DTPF*	1 (0-2)	1 (1-3)	4 (2-7)	4 (1-6)	5 (1-10)	p<0.0001
BISAP score*	1 (0-1)	1 (0-2)	2 (1-3)	2.5 (1-3)	4 (2-4)	p<0.0001
Modified Glasgow score*	1 (0-2)	1 (0-2)	2 (2-3)	2 (1-5)	3 (3-5)	p<0.0001
CD score*	0 (0-2)	1 (0-3)	4 (4-4)	4 (4-4)	4 (4-5)	p<0.0001
Ranson's score*	2 (1-3)	2 (1-3)	4 (4-6)	3 (3-6)	5 (4-6)	p<0.0001
Values are reported as *median [IQR] or † percentage						

Table 1.Outcomes according to AAST score

LOS: Length of hospital stay, TPN: Total parenteral nutrition, DTPF: Days till prepyloric feeding, CD: Clavien- Dindo.

Conclusion: The AAST grading system for acute pancreatitis was valid in our population; patients with increasing AAST grades had longer hospital and ICU stays, and an increased rate of readmission. AAST grades assigned using CT findings were comparable to other severity scoring systems utilizing complex physiology and laboratory values. Further studies should determine the generalizability of the AAST system.

Poster # 52

A PROTOCOL FOR NON-OPERATIVE MANAGEMENT OF UNCOMPLICATED APPENDICITIS

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Introduction: We developed a protocol to identify candidates for non-operative management (NOM) of uncomplicated appendicitis. Our objective was to evaluate protocol efficacy with the null hypothesis that clinical outcomes, hospital readmission rates, and hospital charges would be unchanged following protocol implementation.

Methods: We performed a propensity score matched retrospective cohort analysis of 406 patients with acute uncomplicated appendicitis. The protocol recommends NOM for patients with modified Alvarado score ≤6 and no appendicolith. Patients admitted before (n=203) and after (n=203) protocol implementation were matched by Charlson comorbidity index, duration of symptoms, and modified Alvarado score. Outcomes included operative management, days on antibiotic therapy, length of stay, and hospital charges, as well as readmissions, complications, mortality within 180 days. Continuous variables are presented as median [interquartile range].

Results: Baseline characteristics were similar between groups (age 31 years, ASA class 2.0, Charlson comorbidity index 0.0). Protocol compliance was higher when the protocol recommended appendectomy (97%) rather than NOM (73%, p <0.001). The incidence of operative management decreased after protocol implementation (Table). In the protocol group, there was a lower incidence of open surgery (4% vs. 10%, p =0.044) despite a longer interval between admission and surgery (8.6 vs. 7.1 hours, p <0.001). Fifty-five patients had NOM: eighteen failed NOM during admission, seven failed NOM after discharge. The protocol group had similar length of stay, antibiotic days, and complication rates, but significantly more readmissions (Table). Charges for the first admission and all admissions within 180 days were lower after the protocol (Table).

	Before protocol (n=203)	After protocol (n=203)	p
Appendectomy	202 (99%)	167 (82%)	<0.001
Complications	23 (11%)	21 (10%)	0.873
Readmissions	3 (1%)	13 (6%)	0.019
First admission $	6,878 [5,669-9,599]	5,630 [4,824-6,301]	<0.001
All admissions $	6,916 [5,690-9,668]	5,689 [4,952-6,457]	<0.001

Conclusion: Implementation of a protocol to identify candidates for NOM of uncomplicated appendicitis was associated with fewer appendectomies, lower rates of open surgery, decreased hospital charges, and no difference in complications despite high rates of readmission and failed NOM.

Poster # 53

DOES THE ACS-NSQIP SURGICAL RISK CALCULATOR WORK IN THE ACUTE CARE SETTING? AN ANALYSIS FROM A SINGLE LEVEL-1 TRAUMA CENTER.

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Introduction: The ACS-NSQIP Surgical Risk Calculator (SRC) is an evidence-based clinical tool commonly used for evaluating postoperative risk. The goal of this study was to validate SRC-predicted complications by comparing them to observed outcomes in the acute care surgical setting.

Methods: As a pilot toward a more representative study of 3000+ cases, we retrospectively reviewed 552 acute care surgeries (appendectomies, cholecystectomies, breast and retroperitoneal abscess I&D, colectomies, hernia repair, resection of intestines, lysis of adhesions, and ulcer repair) performed at a Level-1 Trauma Center. Outcomes compared included Serious Complications, Any Complications and Length of Stay (LOS). An SRC-identified "above average" risk of complication was considered a positive prediction. Sensitivity, specificity, Brier Score (mean squared difference between predicted probabilities and actual outcomes) and paired T-test were used to assess the validity and accuracy of the SRC predictions.

Results: Overall 15.8% of our patients had Any and 15% had Serious Complications. Based on the above average risk criteria, the sensitivity of the SRC for Serious Complication was 75.9% (ranging from 33.3% to 100% for various acute care surgeries) and for Any Complication was 89.7% (ranging from 66.7% to 100% for various acute care surgeries). The predicted probabilities for Serious and Any Complication overall had very low inaccuracy (Brier Score=0.095). Brier score was <0.1 for emergency appendectomies and cholecystectomies and was 0.2 or greater for each of the other surgeries (smaller sample sizes). On average, the predicted LOS was shorter by 2.7 days, as compared to the actual length of stay ($p<0.001$).

Conclusion: For a single hospital, the SRC performed well in discriminating between patients who developed postoperative complications and those who did not by assigning relatively higher probabilities to those who developed complications. However, using the national data-based designation of above average risk does not seem to be a valid criterion for identifying patient outcomes. We suggest future research focus on identifying risk categories that incorporate more hospital- and surgical procedure-specific variability.

Poster # 54

DIABETES MELLITUS DOES NOT INCREASE MORTALITY IN EMERGENCY GENERAL SURGERY PATIENTS

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Introduction: Patients with diabetes mellitus (DM) are considered high risk for poor outcomes after admission for emergency general surgery (EGS) conditions. While recent research suggests that peri-operative glycemic control, rather than the presence of DM itself, is more impactful, to date no population analyses exist describing outcomes for diabetic patients admitted to US hospitals for EGS conditions. We hypothesized that among EGS patients, diabetics would have higher mortality than non-diabetics.

Methods: The study population was garnered from the Nationwide Inpatient Sample (2002–2012) using AAST-defined ICD-9-CM codes to identify EGS patients and surgical procedures. Adult diabetic and non-diabetic patients were compared for demographics, operative rates, and outcomes (mortality, complications, length of stay) using chi-square, t-test, and Cochran-Armitage trend test. Multivariable logistic regression utilized demographics, comorbidities, diabetic and surgical status, and APR-DRG (severity of illness) categorization; models were run for the whole population and for each year separately; $p<0.05$ was significant.

Table 1	Non-DM	DM	p-value
Total	23,741,197	6,829,271	
Age, mean ± SD	57 ± 21	64 ± 16	<0.0001
Sex, % Male	45.3%	47.8%	<0.0001
Race, % Caucasian	73.0%	65.8%	<0.0001
Operative Rate (%)	30.5%	23.5%	<0.0001
Mortality (%)	2.0%	1.7%	<0.0001
Post surgical	2.3%	2.2%	<0.0001
Non-operative	1.8%	1.6%	<0.0001
Length of Stay, d, mean ± SD	5.0 ± 6.1	5.5 ± 5.8	<0.0001

Results: During the study period >30,500,000 patients were admitted nationwide for EGS conditions. Diabetes prevalence was 21%, which had increased over time from 18% to 26%, $p<0.0001$). Diabetics were more like older, male, and non-white and experienced a 23% lower operative rate (Table 1). The 11-year mortality rate was lower for DM patients. Multivariable regression demonstrated, in all models, that DM is not an independent risk factor for mortality while age, certain other comorbidities, surgery, and illness severity were predictive. (Table 2)

Table 2 Parameter		OR	95% CI	p-value
Age		1.05	1.04 - 1.05	<0.0001
Sex - Male		1.06	1.04 - 1.07	<0.0001
Race (vs White)	**Black**	0.96	0.94 - 0.99	<0.003
	Hispanic	0.88	0.85 - 0.90	<0.0001
	Other	0.96	0.94 - 0.97	<0.0001
Surgery		1.03	1.01 - 1.04	<0.0001
Diabetes Mellitus (+)		0.79	0.78 - 0.80	<0.0001
Essential Hypertension		0.69	0.68 - 0.70	<0.0001
Congenstive Heart Failure		0.80	0.78 - 0.81	<0.0001
Chronic Renal Failure		1.14	1.12 - 1.16	<0.0001
Coagulopathy		1.33	1.31 - 1.36	<0.0001
Peripheral Vascular Disease		1.20	1.18 - 1.23	<0.0001
APR-DRG 2 vs 1		3.69	3.48 - 3.90	<0.0001
APR-DRG 3 vs 1		17.51	16.58 - 18.49	<0.0001
APR-DRG 4 vs 1		159.42	151.0 - 168.3	<0.0001

Conclusion:Among EGS patients, DM is common and increasing. Patients with DM experience lower operative rates than non-diabetics. EGS mortality is lower for DM patients whether managed with or without surgery. Regression analysis confirms that diabetes mellitus is not an independent risk factor for mortality from EGS conditions. Further investigation is required to explore the role of glycemic control in surgical outcomes in EGS but surgeons should not consider the presence of diabetes itself to be higher risk during surgical decision-making.

Poster # 55

SIMULTANEOUS LAPAROSCOPIC CHOLECYSTECTOMY AND INTRA-OPERATIVE ERCP FOR COMMON BILE DUCT STONES: EXPERIENCE OF THE ONE-STEP APPROACH AT TWO REFERRAL HOSPITALS.

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Introduction: The timing and optimal method for common bile duct (CBD) clearance and laparoscopic cholecystectomy remains controversial. Several different approaches are available in clinical practice. The current study presents the experience of two referral hospitals in simultaneous laparoscopic cholecystectomy (LC) and intra-operative endoscopic retrograde cholangiopacreatography (IO-ERCP) in patients with cholelithiasis and CBD stones.

Methods: Retrospective analysis of all consecutive patients subjected to LC + IO-ERCP during their index admission between 4/2014 and 9/2016. Data accrued included patient demographics, laboratory markers, operation time (minutes) reported as mean (± SD), and hospital length of stay (LOS) reported as median (25th and 75th percentiles).

Results: During the 29-months study, a total of 201 consecutive LC+IO-ERCPs were performed. The mean age of patients was 55±19 years and 67% were female. Laboratory, radiological findings, as well as pre-operative diagnosis are depicted in Table 1. The mean intervention time was 105±44 min. The total LOS was 4 (3,7) days and the post-operative LOS was 1.5 (1,3) days. A total of 6 (3%) patients experienced iatrogenic pancreatitis and two patients had Strasberg A type bile leak. All patients were successfully discharged.

Conclusion: Simultaneous LC+IO-ERCP is associated with few complications. Further studies investigating cost-benefit and patient satisfaction are warranted.

Table 1. Laboratory test, pre-operative diagnosis, and the mode of pre-operative radiological diagnosis of CBD calculi in the 201 studied patients.

Laboratory Tests		Normal Range
WBC (SD)	9. 0 (4.1)	3.5-8.8 10*9L
CRP (SD)	41 (71)	<5 mg/L
AST (SD)	4.3 (3.8)	0.2-0.6 µkat/L
ALP (SD)	3.5 (2.3)	0.6-1.8 µkat/L
Bilirubin (SD)	54 (39)	<25 µmol/L
Lipase (SD)	14 (24)	0.4-5.0 µkat/L
Preoperative Diagnosis		
Cholecystitis	61 (30%)	
Choledocholithiasis	175 (87%)	
Pancreatitis	40 (20%)	
Cholangitis	9 (5%)	
Preoperative CBD stone verified by		
US	92 (46%)	
MRCP	46 (23%)	
CT	36 (18%)	

Poster # 56

A PROSPECTIVELY VALIDATED COMBINED SONOGRAPHIC AND CLINICAL SCORE FOR DIAGNOSING APPENDICITIS

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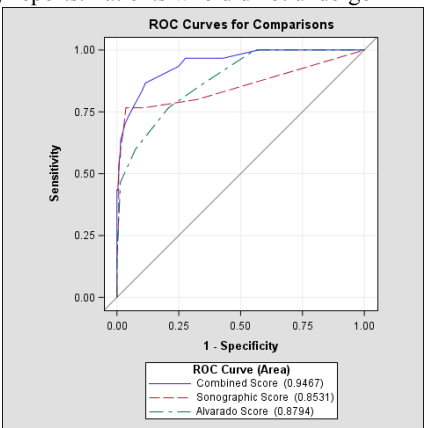
Introduction: We previously developed and reported an ultrasound (US) based scoring system with high sensitivity and specificity designed to be used in conjunction with the Alvarado score for the diagnosis of appendicitis. We hypothesized that our retrospectively-derived scoring system that combined weighted US findings and a clinical score would perform well in a prospective validation study.

Methods: We conducted a prospective observational study of all patients who presented through the ER with suspected appendicitis and underwent US as the initial imaging modality. Patients who were known to be pregnant or underwent CT initially were excluded. Staff radiologists and technicians identified the score's parameters: appendiceal diameter, compressibility, hyperemia, and secondary signs of inflammation: free fluid and focal and diffuse tenderness, allowing the derivation of the US score. This score was combined with the Alvarado Score to calculate a Combined Score. Final diagnosis was assigned by reviewing operative and pathology reports. Patients who did not undergo operation were followed prospectively for symptom resolution.



Results: We identified 308 patients for inclusion. Forty-three patients had evidence of non-appendiceal pathology on US. In 125 (40%) the appendix was not visualized and partially visualized in 62 (23%). Thirty-three patients underwent appendectomy, of which 6 (18.2%) had a non-visualized appendix on US and 3 (9.1%) were negative.

At a US Score of 1.5, the sensitivity and specificity were 77% and 96%. This improves with the Combined Score at a cutoff of 5.5 to 97% and 72% respectively. At a cutoff of 6.5, the sensitivity and specificity were 87% and 89% (TABLE). Area under receiver operating characteristic (ROC) curves were not significantly different between our US score and the Alvarado score (P=0.65). The combined score produced an AUC of 0.947 which was significantly better than either the US or Alvarado score alone (P=0.03 and P=0.003 respectively). This persisted regardless of inclusion of patients with non-appendiceal pathology on US.

Score Sensitivities and Specificities

Score	Cutoff	Sensitivity (%)	Specificity (%)
Alvarado	5.0	86.7	64.7
	6.0	76.7	79.1
	7.0	60.0	92.4
Sonographic	0.5	80.0	67.6
	1.0	76.7	91.4
	1.5	76.7	96.4
	2.0	66.7	97.5
Combined	5.0	96.7	62.6
	5.5	96.7	72.3
	6.0	93.3	75.2
	6.5	86.7	88.4

Conclusion: The combined scoring system based on sonographic findings in combination with clinical data is highly sensitive and specific for appendicitis. It creates a standardized and reproducible way to diagnose appendicitis without other imaging.

Poster # 57

ADMISSION HYPONATREMIA IS ASSOCIATED WITH AN INCREASED RISK FOR COMPLICATIONS FOLLOWING CHOLECYSTECTOMY FOR ACUTE CHOLECYSTITIS

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Introduction: Acute calculous cholecystitis remains a common indication for urgent operative intervention. Recent single institutional studies have identified an association between hyponatremia and the presence of infectious disease processes including perforated appendicitis and gangrenous cholecystitis. We hypothesized that admission hyponatremia would be predictive of adverse outcomes in patients undergoing same admission cholecystectomy for acute cholecystitis.

Methods: Patients from the 2005-2014 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database undergoing cholecystectomy for acute cholecystitis were analyzed. Patients with admission hyponatremia (defined as a serum sodium < 135 mEq/L) were compared to patients without hyponatremia. Variables analyzed included demographics, comorbidities, and operative procedures. Coarsened Exact Matching was used to match hyponatremic patients in a 1:1 fashion to patients without hyponatremia.Thirty-day outcomes were compared in both the aggregate and matched cohorts. Multiple logistic regression analysis was performed to identify independent predictors of complications, including surgical site infections (SSIs).

Results: A total of 17,908 patients were identified, of which 17,184 (95.6%) had a documented preoperative sodium level. Males comprised 44% of the study population and the overall mean age was 54 ± 18. The median time to surgery was 0 days (IQR 0-1). On both aggregate and matched cohort analyses, patients with admission hyponatremia had a higher incidence of complications (both infectious and non-infectious), SSIs, readmission, and mortality ($p < 0.01$). On multivariate analysis, after adjusting for variables with a $p < 0.1$ on bivariate analysis, hyponatremia was identified as an independent predictor of 30-day aggregate complications (OR=1.2; 95% CI=1.05-1.45, p=0.009), as well as the development of SSIs (OR=1.8; 95% CI=1.64-2.08, $p<0.001$).

Conclusion: Admission hyponatremia in patients presenting with acute cholecystitis is associated with adverse outcomes including the development of infectious and non-infectious postoperative complications. Further studies are required to determine if sodium is a reliable sign of systemic inflammation and to elucidate the pathophysiology of this metabolic response.

Poster # 58

Nonoperative management of uncomplicated acute appendicitis and the untreated malignancy: Review of the American College of Surgeons National Surgical Quality Improvement Program Database

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Introduction: Cancer of the appendix is a rare occurrence commonly found incidentally on appendectomy and account for 0.5% of all gastrointestinal malignancies. The role of routine antibiotics with nonoperative management of uncomplicated acute appendicitis (UA) in adults is an ongoing debate. The aim of our study was to identify the rate of appendiceal malignancy (AM) and highlight the importance of traditional surgical management of appendicitis using the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) data.

Methods: ACS-NSQIP database was queried (2005-2015) for all cases of UA who underwent surgery. Complicated appendicitis including perforation, empyema or abscess formation, and fecal peritonitis were excluded. For this study, AM was defined as invasion of appendiceal wall by neoplastic epithelium and all reported carcinoid tumors. ICD-9 codes were used to identify NSQIP data reporting AM pathology recorded as neoplasm of appendix vermiformis and carcinoid of appendix. Analysis included age, sex, race, type of AM and surgical procedures.

Results: We identified 203,190 patients at > 600 participating ACS-NSQIP hospitals who received surgical intervention for UA. Of those, 2,382 (1.2%) patients were identified with AM. Population was predominantly caucasian (79.8%) with a mean age of 52.1 ± 4.16 years (range, 18 to 90+ years) and 46% males. Majority of patients were classified as non-emergent (86.8%). Most commonly (2005 - 2015) ACS-NISQIP reporting was unspecified malignant neoplasm of appendix vermiformis (70.6%). Additionally, sub-analysis of ACS-NSQIP data (2009 to 2015) identified benign (10.3%) and malignant (18.9%) carcinoid tumors.

Conclusion: Our study emphasizes surgical intervention with adult UA as the 1% incidence of AM if treated with antibiotics alone will presumably lead to a delay in surgical treatment and progression of disease.

Poster # 59

ACUTE CARE SURGERY MODEL OF CARE DELIVERY: ANALYSIS OF OPERATING ROOM CASE VOLUME, UTILIZATION AND MISSED OPPORTUNITY COST

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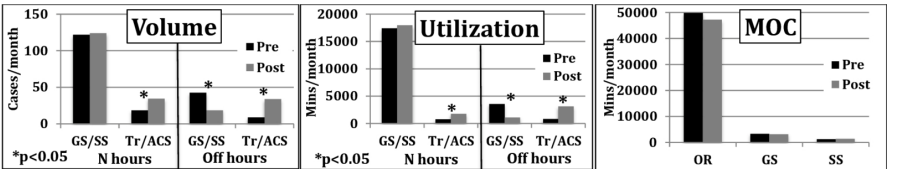
Introduction: OR efficiency demands maximizing 'Normal' hours (fixed cost) and minimizing on call 'Off' hours (variable cost) utilization. We hypothesize: ACS model with ready availability of OR and surgeon will improve efficiency – increase Normal hours utilization and reduce missed opportunity cost (MOC).

Methods: OR utilization metrics – case volumes, utilization (Normal and Off hours) and MOC – were obtained from OR management database [WiseOR® (Palo Alto, CA)] 12 months before (Pre: Oct 2014-Sept 2015), and 11 months after (Post: Oct 2015-Aug 2016) ACS model implementation and compared. Significance set at $p<0.05$.

Results: Pre implementation Trauma (Tr), General (GS) and Specialty (SS) surgery provided emergency general surgery. Post implementation, ACS service was the sole provider. OR volume increased (999 to 1043 cases/month – $p<0.05$). Almost all of this increase was attributable to ACS (27 to 68 cases/month – $p<0.05$). ACS case volume increase was during Normal (18 to 34 cases/month) ***and*** Off (9 to 34 cases/month) hours ($p<0.05$ both). Off hours increase was equivalent to Off hours decrease in GS and SS volumes ($p<0.05$). ACS Normal hours increase consisted of additional cases and not from shifting since GS and SS Normal hours volumes were unchanged (pre: 122; post: 124 cases/month). OR time utilization in minutes/month paralleled case volume changes. Proportion of cases during Normal hours for GS and SS increased 74% to 87% ($p<0.05$) and Normal hours proportion of total operative time increased 83% to 94% ($p<0.05$). MCO for the entire OR, GS and SS remained unchanged ($p>0.05$).



Conclusions: ACS service model with ready availability of staffed OR and qualified surgeon results in improved case volumes and OR efficiency but not in MOC.

Poster # 60

EMERGENCY GENERAL SURGERY IS NOT ASSOCIATED WITH REDUCED LIFE EXPECTANCY IN PATIENTS WITH END-STAGE CANCER

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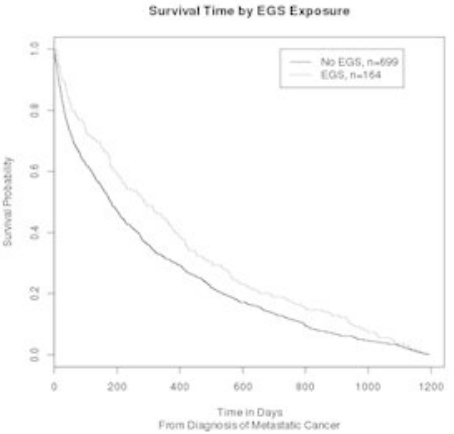
Introduction: For elderly patients with end-stage cancer, an acute surgical condition (such as bowel perforation, acute cholecystitis, or necrotizing soft tissue infection) can be a terminal event. Despite uncertain outcomes, patients often choose to undergo surgery for these conditions, with hope for prolonged survival or improved short-term quality of life. It is unknown if emergency general surgery (EGS) for this patient population is beneficial.

Methods: A retrospective cohort study was performed using the 1992-2009 Health and Retirement Study, which includes longitudinal recurring biennial health surveys linked to Medicare claims. Patients with metastatic cancer who died within three years of diagnosis were identified. Within this cohort, patients were categorized as having undergone EGS or not having undergone EGS (non-EGS), as defined by previously published procedure codes. Mortality was compared between groups. Secondary outcome of interest was quality of life as measured by instrumental activities of daily living (IADLs).

Results: 863 patients were identified, with the most common cancer sites being lymph, connective tissue, and respiratory. 164 (19%) patients underwent 223 EGS procedures. The most common procedures included tube thoracostomy (15%), right colectomy (14%), and small bowel resection (5%). EGS patients had significantly better baseline IADL performance. Overall median survival for the cohort was 196 days; EGS patients had significantly longer median survival (290 days vs. 180 days, $p<0.05$, Figure). 434 patients survived for a repeat health survey. EGS and non-EGS patients had similar IADL limitations at followup.

Conclusion: Among patients with end-stage cancer, those who had EGS had a longer median survival compared with those who did not. There is an important limitation in this study that cohort groups are dissimilar at baseline. However, this study suggests that emergency general surgery in end-stage metastatic cancer patients is not always a terminal event and may allow an important extension of life, without a major decline in quality of life.



Poster # 61

NOT ALL DEEP VENOUS THROMBOSES ARE EQUAL: ASSESSING THE INCIDENCE OF CHRONIC DEEP VENOUS THROMBOSIS IN TRAUMA

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Introduction: Deep venous thrombosis (DVT) is considered a preventable complication in hospitalized trauma patients. Hospitals are required to report rates of DVT under Patient Safety Indicator 12 and may face financial penalties unless it is pre-existing or chronic rather than hospital-acquired or acute. Lower extremity duplex ultrasound (LEDUS) can detect specific characteristics differentiating acute (ADVT) from chronic DVT (CDVT). The objective of this study was to determine the incidence of CDVT in hospitalized trauma patients.

Methods: We performed a retrospective registry review of trauma patients admitted to our Level I trauma center between 7/1/2006 and 8/1/2016 who had a DVT on their initial screening LEDUS. Our center utilizes screening and surveillance LEDUS on all patients admitted for >48 hours. Definitions for CDVT and ADVT were extracted from existing literature. Patients with DVT on their initial LEDUS underwent review of that LEDUS to assess for characteristics associated with CDVT. Patients were classified as having acute, chronic, or indeterminate DVT. Demographics, medical history, and injury characteristics were extracted from the trauma registry. Patients with ADVT and CDVT were compared.

Results: The incidence of CDVT among trauma patients with a DVT on their initial LEDUS was 29.9%. CDVT occurred in older and less-severely injured patients. An above-the-knee component was significantly more common in CVDT (65%). Only 34 (41%) of those with CDVT reported a history of DVT. Among those with CDVT, 43 (52%) had a subsequent LEDUS, of whom 4 (9%) showed progression of the thrombus and 6 (14%) formed a new DVT.

Conclusion: CDVT represents nearly 30% of all DVT found on initial screening LEDUS in trauma patients. Those with CDVT should receive pharmacologic and mechanical prophylaxis because of the incidence of progression and new ADVT. They should also be counseled regarding the possibilities of recurrence and chronic venous insufficiency. LEDUS screening can detect CDVT, reducing the negative implications associated with the reporting of patient safety indicators.

DVT on Initial LEDUS	Chronic DVT	Acute DVT	p-value
N (%)	83 (29.9)	144 (51.8)	
Age	68	51	<0.001
ISS	9	14	<0.001
Above-knee DVT (%)	54 (65)	42 (30)	<0.001
Progression on follow-up LEDUS (%)	4 (9)	20 (22)	0.09

Poster # 62

PROSPECTIVE OBSERVATIONAL VASCULAR INJURY TREATMENT (PROOVIT) REGISTRY: EVALUATION OF TEMPORARY INTRAVASCULAR SHUNT USE IN CIVILIAN VASCULAR TRAUMA

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Introduction: The management of vascular injury remains time-sensitive to reduce ischemia time. In the military, temporary intravascular shunts (TIVS) help stabilize patients for transport. In the civilian setting, the primary role of TIVS has been for damage control. The use of TIVS remains limited in the civilian population. This AAST study evaluates the use of shunts in a civilian trauma setting.

Methods: Data on the use of TIVS from the American Association for the Surgery of Trauma PROspective Vascular Injury Treatment (PROOVIT) registry was prospectively collected from 2012 to 2016 from fourteen institutions. The propensity scoring method was used to match selected variables in order to compare the experimental TIVS group to the control group. The variables that were matched included: injury severity score (ISS), abbreviated injury scale (AIS), glasgow coma scale (GCS), systolic blood pressure (SBP), age, and lactate.

Results: Brachial, femoral, and popliteal artery injuries were entered into the PROOVIT registry, where 51 (9.6%) patients were managed with placement of TIVS. There were 21 brachial shunts, 23 femoral shunts, and 7 popliteal shunts placed. The control group of 481 patients consisted of patients managed without a shunt. The ISS was 19.5 in patients who received shunts and 14.9 in the control group. Propensity score matching showed that the TIVS group had lower ICU length of stay (LOS) at 5.6 days vs 9.0 days (p=.22), fewer ventilator days 2.3 vs 4.3 (p=.167), and decreased rate of amputation 8% vs 11% (p=.80). In patients with only brachial artery injuries, amputation rate was less in TIVS patients 0% vs 10% (p=.99), but had a longer ICU LOS at 5.8 days vs 1.4 days (p=.05). Patients with femoral artery injury managed with TIVS had a lower rate of amputation at 5.9% vs 12.5% (p=.58), lower hospital length of stay at 10.1 vs 19.5 (p=.018), but an increased in-hospital death rate of 23% vs 15% (p=.58).

Conclusion: TIVS is a technique for the management of vascular trauma that may reduce the rate of amputation. The use of TIVS is biased towards more severely injured patients, although still showing improved limb salvage. The data also suggests that location of the injury may be a predictive factor. The benefits of shunt use for early reperfusion suggest that it should not be reserved for only those patients requiring damage control procedures, and should be utilized more liberally.

Poster # 63

DOES OBESITY INCREASE RISK OF AMPUTATION FOLLOWING POPLITEAL ARTERY INJURY? AN ANALYSIS OF TWO YEARS OF DATA FROM THE NATIONAL TRAUMA DATA BANK

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Introduction: Popliteal artery injury can often be difficult to diagnose and has a high rate of limb loss. The effect of obesity on peripheral vascular injury has not been studied. We hypothesized a higher amputation rate in the obese population with popliteal artery injury.

Methods: The National Trauma Data Bank was queried for the years 2013-2014 for popliteal artery injury. Demographics, height, weight, time in emergency department (ED), mechanism of injury, comorbidities, and amputation as a surgical procedure for patients with diagnosed popliteal injury were abstracted from the database. Obesity was defined as BMI $\geq$ 30.0 kg/m ^{2} with subclasses of 30.0-34.9, 35-39.9, and $\leq$40. Patients with amputations performed within the first 24 hours were excluded. Logistic regression was used to calculate unadjusted and adjusted odds ratios (OR) for the association between obesity and amputation.

Results: A total of 1,191 patients sustained popliteal artery injury, 745 non obese and 446 obese. The association between amputation and obesity was not statistically significant (OR 0.957, p=0.730), nor was it significant when using obesity subcategories (BMI 30-34.9: OR 1.099, p=0.547; BMI 35-39.9, OR 0.874, p=0.517; BMI $\geq$40, OR 0.809, p=0.336). BMI 35-39.9 and $\geq$40 trended toward longer time spent in ED, but was not statistically significant (44 min and 53 min with p=0.109 and 0.062, respectively). When controlling for time in ED and other risk factors, there remained no difference in amputation rate between non-obese and obese, including BMI subcategories. There was no difference in amputation rate between blunt and penetrating injury (39.69% vs 38.48%, OR 1.079, p=0.549).

Conclusion: The amputation rate in patients with popliteal artery injury does not differ between obese and non-obese patients. Further, there is no difference in amputation rates among obesity subclasses. There is a trend toward longer ED time, perhaps reflecting time to diagnosis, for certain obese populations with popliteal artery injury.

Poster # 64

IMMEDIATE OPEN REDUCTION INTERNAL FIXATION OF ISOLATED TIBIAL PLATEAU FRACTURES IMPROVES SHORT-TERM OUTCOMES IN SKIERS AND SNOWBOARDERS

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Introduction: Tibial plateau fractures (TPF) are frequently associated with motor vehicle accidents, auto-pedestrian crashes, and falls, while only 3-9% occur from sports-related injuries. Hospitals serving regions with ski resorts commonly treat TPF ensuing from snow sports. Skiing can be a high velocity sport which creates sudden forces to the knee through the ski, boot, and binding systems. To fracture the tibial plateau in a healthy, active person, the forces in the knee may be as high as those seen in motor vehicle accidents. But, we suspect the mechanism causing a TPF during snow sports is different than when external collision forces cause TPF, which immediately compromises the soft tissue envelope and precludes immediate surgery. Our objective was to determine if immediate (≤24 hours) versus delayed (>24 hours) open reduction internal fixation (ORIF), stratified by high (Schatzker IV-VI) and low (Schatzker I-III) energy fractures, effected in-hospital outcomes.

Methods: Isolated TPF patients injured while skiing or snowboarding were identified from a Level III Trauma Center that serves four major ski resorts between 2010-2013. Demographics, clinical characteristics, time between injury and ORIF, and in-hospital outcomes (compartment syndrome, need for fasciotomy, infection, mortality, length of stay [LOS], and admission to the intensive care unit [ICU]) were obtained from an existing trauma database. Imaging was reviewed by three providers to evaluate the fracture patterns using the Schatzker classification system. Chi-square and Wilcoxon two-sample tests were utilized to examine differences between immediate and delayed ORIF. These analyses were also performed in the subsets of patients with high and low energy fractures.

Results: ORIF was performed on 119 snow sport patients, 93 (78%) immediately. Overall, patients had a median age of 49 years (range 19-70), were predominantly male (66%), had no preexisting comorbidities (82%), and 40% sustained a high energy TPF. There were no differences in the Schatzker scores for patients treated with immediate versus delayed fixation. There were no in-hospital infections, deaths, or ICU admissions. Compared with delayed fixation, patients treated immediately had less compartment syndrome (3% vs 27%), needed fewer fasciotomies (6% vs 31%), and had a shorter LOS (3 vs 6.5 days), $p<0.05$ for all. These results persisted among the patients with high energy fractures; no differences in compartment syndrome or fasciotomy were observed among patients with low-energy fractures (Table).

Conclusion: Treating patients immediately led to more favorable in-hospital outcomes compared to delayed treatment, even among the patients with a Schatzker score between IV-VI.

Table. Characteristics and short-term outcomes of skiers and snowboarders with high or low energy isolated tibial plateau fractures by immediate or delayed open reduction internal fixation (n=119)

	High Energy Fracture Patients			Low Energy Fracture Patients		
	Immediate (n=36)	Delayed (n=12)	*P*	Immediate (n=57)	Delayed (n=14)	*P*
Age, median (range), years	45 (19-61)	52 (22-63)	0.23	51 (23-67)	49 (25-70)	0.24
Male	25 (69.4%)	11 (91.7%)	0.25	34 (59.7%)	9 (64.3%)	>0.99
No Comorbidities	30 (83.3%)	8 (66.7%)	0.24	47 (82.5%)	12 (85.7%)	>0.99
Hospital arrival ≤ 180 minutes after injury	9 (25.0%)	6 (50.0%)	0.15	33 (61.1%)	9 (69.2%)	0.75
Compartment Syndrome	1 (2.8%)	6 (50.0%)	**<.001**	2 (3.5%)	1 (7.1%)	0.49
Fasciotomy[a]	3 (8.3%)	7 (58.3%)	**<.001**	3 (5.3%)	1 (7.1%)	>0.99
Discharged Home	36 (100%)	11 (91.7%)	0.25	57 (100%)	13 (92.9%)	0.20
LOS, median (range)	3 (1-10)	8 (4-20)	**<.001**	2 (1-7)	3.5 (1-34)	**0.006**

[a]One patient had more than one fasciotomy

Poster # 65

CONTEMPORARY OUTCOMES AND MANAGEMENT OF BLUNT CERBROVASCULAR INJURIES: RESULTS FROM THE AAST PROOVIT MULTICENTER REGISTRY

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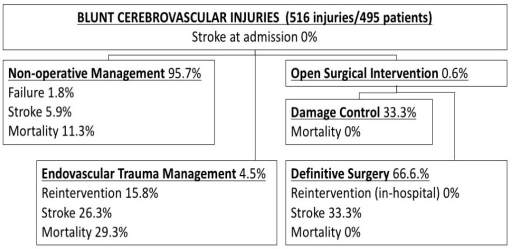
Introduction: In 2010 the Eastern Association for the Surgery of Trauma (EAST) published guidelines for the treatment of blunt cerebrovascular injuries. Analysis of prospectively collected data following the implementation of these guidelines can help inform future practices.

Methods: The American Association for the Surgery of Trauma PROspective Vascular Injury Treatment (PROOVIT) registry was used to collect demographic, diagnostic, treatment, and outcome data on cerebrovascular injuries.



Results: A total of 516 blunt cerebrovascular artery injuries (bCVIs) in 495 patients from 19 centers (18 ACS Level I and 1 ACS Level II) have been captured since February 2013. Most injuries occurred in males (63.4%, 327/516) with a median age of 38.0 years (IQR 28) and a documented Injury Severity Score greater than 15 in 63.2% (326/516), primarily from motor vehicle collision (67.2%, 347/516). Injuries to the common carotid (4.3%, 22/516), internal carotid (45.5%, 235/516), and vertebral (50.2%, 259/516) arteries were identified, with multiple injuries identified in 21 patients (4.2%). bCVI severity was distributed as follows: Grade I and II (intimal tear or flow limiting defects): 34.9%, III (pseudoaneurysm): 12.1%, IV and V (occlusion or transection): 24.1%. Treatment was as follows: Grades I and II: non-operative management (NOM) 96.9%, endovascular trauma management (EVTM) 2.5%, open surgical intervention (OSI) 0.3%; Grade III: NOM 96.0%, EVTM 4.0%, OSI 0%; Grade IV and V: NOM 92.8%, EVTM 5.6%, OSI 1.6%. Anti-thrombotic agents were used in 57.2% of injuries, (NOM 58.1%, EVTM 77.8%, OSI 0%; p=0.49). Failure of NOM occurred in 1.8% of injuries. EVTM required re-intervention in 15.8% with none requiring open revision. In-hospital re-intervention was not required after OSI in any patient. Stroke after initiation of management occurred in 6.8% of bCVIs (NOM 5.9%, EVTM 26.3%, OSI 33.3%; $p < 0.001$). Overall hospital mortality was 12.3% (NOM 11.3%, EVTM 29.3%, OSI 0%; p=0.11). Follow-up is available for 80 injuries (15.5%) for a median of 2.0 months (IQR 2.0 mo). During the available follow up period, out of hospital stroke rate was 0% and reintervention was necessary for only 1 injury (0.2%) after open repair due to flow-limiting stenosis.

Conclusions: Initial data suggests that management of bCVI largely follows the EAST guidelines. However, NOM predominated even in higher grade injuries. The number of bCVIs requiring intervention was small, but data suggests OSI and EVTM may be associated with a higher rate of stroke than NOM.

Poster # 66

LOWER EXTREMITY COOLING REDUCES ISCHEMIA-REPERFUSION INJURY FOLLOWING ZONE III REBOA IN A PORCINE HEMORRHAGE MODEL.

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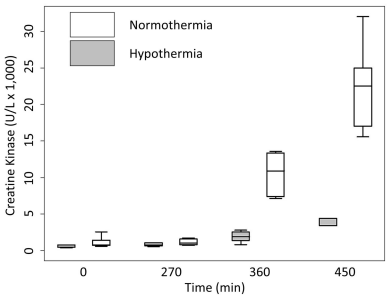
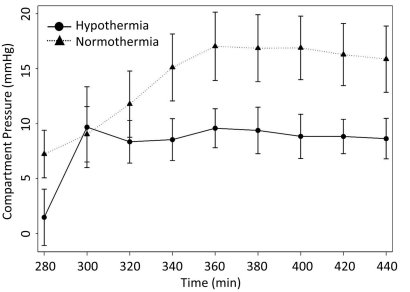
Introduction: New strategies to mitigate ischemia during REBOA and to prolong its maximal duration are needed. We hypothesized that simple external cooling of the hind limbs would decrease ischemia-reperfusion injury following prolonged zone III REBOA.

Methods: Twelve swine were anesthetized, instrumented, splenectomized then underwent 15% total blood volume hemorrhage. Animals were randomized to hypothermia or normothermia followed by 4 hours of zone III REBOA, resuscitation with the shed blood, and 3 hours of critical care. Physiologic parameters were continuously recorded and laboratory specimens were obtained at regular intervals. Baseline and end-of-study muscle biopsies were obtained for histologic analysis.

Results: There were no significant differences between groups at baseline or after hemorrhage. No histologic differences were observed in hind limb skeletal muscle. Maximum creatine kinase (Figure 1) was significantly lower in the hypothermia group compared to the normothermia group (median [IQR] = 3,445 U/mL [3,380-4,402] vs 22,544 U/mL [17,030-24,981]); $p < 0.01$). Maximum serum myoglobin was also significantly lower in the hypothermia group (1,792 ng/mL [1,250-3,668] vs 21,186 ng/mL [14,181-24,779]; $p < 0.01$). Fascial compartment pressures (Figure 2) were significantly lower during critical care in the hypothermia group ($p = 0.03$).

Conclusion: External cooling during prolonged zone III REBOA decreased ischemic muscle injury and resulted in lower compartment pressures following reperfusion. Hypothermia may be a viable option to extend the tolerable duration of zone III occlusion, beyond what is currently achievable. Future survival studies are required to assess functional outcomes.





Poster # 67

THE ADVERSE EFFECTS OF OBESITY ON OUTCOMES ARE POTENTIALLY PREVENTALBE.

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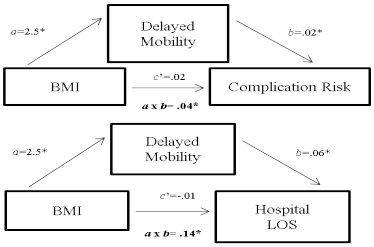
Introduction: Obese patients requiring surgery for orthopedic trauma have increased risk of adverse outcomes, although the mechanisms accounting for the relationship remain unknown. This study examined the effect of body mass index (BMI) on clinical outcomes in patients who underwent femur fracture fixation, and explored the mediating effects of pathophysiologic factors and clinical management.

Methods: A retrospective chart review evaluated outcomes in adult patients who received surgical fixation for femur fractures at our Level 1 center (2010-2016). Demographic data, Injury Severity Score (ISS), Glasgow Coma Scale (GCS) and mechanism of injury (MOI) were taken from the registry. Operative data included time to definitive fixation, operative time and estimated blood loss (EBL). Specific complications were pneumonia, sepsis, pulmonary embolism, deep vein thrombosis and respiratory failure. Primary outcomes were hospital length of stay (HLOS), ICU length of stay (ICU-LOS), mortality, complications, and time to mobility (first out of bed, FOB). Bivariate correlations were used to examine the relationship between BMI and baseline characteristics and unadjusted outcomes. Unique effects of BMI were further explored via multiple logistic and linear regression models. Path analysis tested whether the relationship between BMI and clinical outcomes was mediated by differences in 1) clinical management, or 2) physiologic variables. Multiple mediation models were compared for fit.

Results: The patient demographics were as follows: 57.4% male, mean age 43.4 ± 22.7 years and ISS of 12.5 ± 6.8. Predominant MOIs were motor vehicle crashes (43.8%) and falls (34.5%). There were no association between BMI and age, ISS, or GCS. Higher BMI corresponded with higher rates of diabetes, cardiovascular and pulmonary diseases, and more severe abdominal injuries, *p*s<.05. Overall complication and mortality rates were 9% and 0.6%, respectively. In univariate analysis, higher BMI was linked to longer HLOS (*r*=.12), longer ICU-LOS (*r*=.15), and higher number of total complications (*r*=.12), specifically respiratory failure (OR=1.1), *p*s<.05. BMI also correlated with a longer time to FOB, *r*=.18, *p*<.001. Controlling for severity and comorbidities, a 10-point increase in BMI corresponded to 2.2 times higher odds of respiratory failure, 1.1 days longer ICU-LOS, 1.2 days longer HLOS, and a 23 hour delay in FOB. BMI was also associated with longer operative times (*r*=.11) and greater EBL (*r*=.11), *p*<.05. The effect BMI on poor outcomes was accounted for by delayed mobility (FOB), as shown by the significant indirect effects (*a* x *b* paths) in Figure 1. The nonsignificant direct effect (c' path) indicates no effect of BMI after controlling for delayed mobility (i.e., full mediation). Indirect effects were not significant when models included number of comorbidities as the mediating variable.



Conclusions: Higher BMI puts patients at risk for longer hospital stays and increased rate of systemic complication. Mediation models indicate that the adverse clinical outcomes associated with obesity are caused by delays in mobility, a preventable non-patient physiologic factor. Clinical strategies should be directed at early mobilization to minimize morbidity.

Poster # 68

TRANSCRIPTION FACTOR NUCLEAR FACTOR-KAPPAB IS ACTIVATED IN FILTER-IMPLANTED VENA CAVA

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Introduction: Implantation of a retrievable vena cava filter (VCF) is an effective therapy for preventing fatal pulmonary embolism. Retrieval of filters, however, may be difficult due to intimal hyperplasia and inflammation in the caval wall. The nuclear factor-kappaB (NF-kappaB) transcription factor plays an important role in the inducible regulation of a vari-ety of genes involved in the inflammatory and proliferative responses of cells. The present study was designed to determine if VCF implantation resulted in activation of NF-kappaB in the neointima.

Methods: Filters were placed in the infrarenal vena cava **(**VC) in 4 swine for 30 days and then removed. Tissues of normal VC segments and neointimal tissues adherent to the filter struts were collected. NF-kappaB DNA binding activity was measured with an enzyme-linked immunosorbent assay (ELISA) kit. Immunohistochemical analyses were used to assess the NF-kappaB subunits p65 and p50, the phosphorylated Inhibitor of kappaB-alpha (phosphor-IkappB) and smooth muscle alpha-actin in the neointimal tissues.

Results: Significant NF-kappaB DNA binding activity was found in the neointimal tissues but not in the normal VC tissues ($p<.05$). The intima was composed predominantly of smooth muscle cells (SMCs). Immunoreactivities of P65, p50 and phosphor-IkappB were present in the intima. Co-localization analyses showed that p65 and p50 were in SMCs and in both cytoplasm and nuclei (an index of activation).

Conclusion: The present study demonstrates for the first time that VCF implantation causes activation of NF-kappaB, and the activity is associated with SMC accumulation in neointima. We further demonstrate the activation is at least partly due to phosphorylation of its inhibitor IkappB-alpha. Our data suggest that activation of NF-kappaB would significantly contribute to development of intimal hyperplasia and inflammation in filter-inserted vena caval walls. NF-kappaB might be a therapeutic target for inhibiting filter-caused intimal overgrowth and improving filter retrieval.

Poster # 69

THE CHANGING ROLE OF ENDOVASCULAR STENTING FOR BLUNT CEREBROVASCULAR INJURIES

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Introduction: Few injuries have produced as much debate with respect to management as have blunt cerebrovascular injuries (BCVIs). Without question, early anticoagulation is the mainstay of therapy for these injuries. However, the role of endovascular stenting for BCVI remains controversial. The purpose of this study was to examine the use of endovascular stents for BCVI and determine which injuries would benefit from their use.

Methods: Patients with BCVI from 2011-2016 were identified and stratified by age, gender, and injury severity. Patients were then divided into two groups (PS=2011-2012 and CS=2013-2016) based on a paradigm shift in BCVI diagnosis and treatment at our institution. Beginning in 2013, we adopted a multidisciplinary team approach to BCVI utilizing both vascular surgeons and dedicated neuro-interventionalists rather than interventional radiologists. Digital subtraction angiography was used for confirmatory diagnosis in both groups and heparin for initial therapy in all patients. The use of endovascular stents and BCVI-related stroke and mortality rates were then calculated and compared by group.

Results: In the CS, 277 patients were diagnosed with BCVI: 69% were male with mean age and Injury Severity Score of 44 years and 21 respectively, compared to 128 patients in the PS. Both groups were clinically similar with no difference in distribution of vessels injured (63% carotid artery injuries in CS vs 61% in PS, $p=0.6$). Beginning in 2013, there was a significant decrease in the use of stents for these injuries. In fact, in the CS, only 21 patients (7.6%) were treated with endovascular stenting compared to 44 patients (34%) in the PS ($p<0.001$). Of the 21 patients in the CS undergoing endovascular stenting, 14 had Grade 3 pseudoaneurysms and 7 had Grade 2 dissections. Despite this reduction in stenting, there was no change in the BCVI-related stroke rate between the CS and the PS (3.6% vs 3.9%, $p=0.89$). In fact, of the 10 strokes in the CS, none were stent-related compared to 2 (40%) stent-related strokes in the PS ($p=0.003$). BCVI-related mortality remained unchanged (0% in both the CS and PS).

Conclusion: Anticoagulation alone is adequate therapy for the majority of BCVI. Nevertheless, there is still a role for endovascular stents in the treatment of BCVI. In fact, their use should be reserved for enlarging carotid pseudoaneurysms and dissections with significant narrowing. The prospect of determining which injuries are best managed by stent placement warrants prospective investigation.

Poster # 70

IMPACT OF VENORRHAPHY AND VEIN LIGATION ON VENOUS THROMBOEMBOLISM AND LOWER EXTREMITY EDEMA

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Introduction: Venous injuries pose a significant challenge for the trauma surgeon. Vein repair can restore outflow, although it risks thrombosis at the suture line and subsequent venous thromboembolism (VTE). Vein ligation is a faster option, although it potentially risks extremity edema. Based on this concern, the purpose of this study was to evaluate the impact of management of venous injury on VTE and symptomatic extremity edema in patients with isolated venous injuries in the lower extremities.

Methods: Patients with common iliac, external iliac, femoral, and popliteal venous injuries over a 10-year period were identified. Deaths within 48 hours of arrival and patients with associated arterial injury were excluded. Patients were stratified by age, gender, severity of shock, management of venous injury, injury severity, and timing and type of anticoagulation. Outcomes included development of symptomatic lower extremity edema and VTE (pulmonary embolism (PE), deep venous thrombosis (DVT)). Outcomes were then evaluated to determine risk factors for symptomatic lower extremity edema and VTE by the management of venous injuries.

Results: 84 patients were identified: 20 common iliac, 27 external iliac, 37 femoral, 0 popliteal. 49 underwent vein repair and 35 underwent vein ligation. 93% were male with a mean ISS and GCS of 17 and 14, respectively. VTE occurred in 18 (21%); 15 (18%) DVT and 4 (5%) PE. 32 patients (38%) developed symptomatic lower extremity edema. VTE developed most commonly after injuries to the external iliac vein (44%, p=0.03). Those who underwent vein ligation had a greater degree of shock on presentation (RBC transfusions, 14 vs 8 units, p=0.03) and were more likely to receive prophylactic fasciotomies (60% vs 33%, p=0.01). There was no difference in time to or type of chemoprophylaxis between patients who underwent vein repair and those who received vein ligation. However, patients with vein ligation had fewer episodes of VTE (9% vs 31%, p=0.02) with no difference in symptomatic lower extremity edema (37% vs 39%, p=0.88) or amputation rates (0% vs 2%, p=0.99). The table demonstrates the percentage of VTE by injured vein and its management.

Conclusion: Vein repair had a higher incidence of VTE while providing no additional benefit in reducing symptomatic extremity edema compared to ligation in patients suffering venous injury. Ligation of most extremity venous injuries can be performed quickly without increasing patient morbidity.

VTE	Common Iliac (n=7)	External Iliac (n=8)	Femoral (n=3)
Repair	86%	87%	67%
Ligation	14%	13%	33%

Poster # 71

PERSISTENT INJURY-ASSOCIATED ANEMIA AND AGING: NOVEL INSIGHTS

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Introduction: Hypercatecholaminemia and bone marrow dysfunction have been implicated in the pathophysiology of persistent-injury associated anemia. The elderly may be more vulnerable due to high basal and peak catecholamine levels and impaired erythroid progenitor growth. We hypothesized that aging would adversely affect persistent injury-associated anemia following severe trauma and chronic stress.

Methods: Sprague Dawley rats age 8-9 weeks and F344-BN rats age 25 months were randomized to: naïve, lung contusion plus hemorrhagic shock (LCHS), and LCHS plus daily chronic restraint stress (LCHS/CS), n=8-11/group. Urine norepinephrine (NE, ng/mL) was measured on days 1 and 7. Bone marrow cellularity (cells x10 ^{6}/mL), colony forming units-erythroid (CFU-E) growth (cells/plate), and peripheral blood hemoglobin (Hb, g/dL), mean corpuscular volume (MCV, fL/cell), and red cell distribution width (RDW, %) were assessed on day 7 (mean±SD, $^a p<0.05$ vs. young counterpart, $^b p<0.05$ vs. naïve).

Results: Aged rats had elevated basal NE levels, increased NE following LCHS, and persistent elevation of NE following LCHS/CS (Table). HPC mobilization correlated with anemia in young rats more than old rats (Table). Although baseline Hb was higher in aged rats, they also had lower MCV and higher RDW, an iron-restricted phenotype (Table).

	Young naïve	Old naïve	Young LCHS	Old LCHS	Young LCHS/CS	Old LCHS/CS
NE day 1	27±32	97±71^a	17±8	420±239^{a,b}	66±22^b	375±185^{a,b}
NE day 7	27±32	97±71^a	61±9^b	212±130	127±103	359±99^{a,b}
Cellularity	218±46	231±55	202±40	181±37	189±41^b	168±38^b
CFU-E	65±5	47±4^a	50±5^b	40±1^{a,b}	44±5^b	38±3^{a,b}
%HPC	1.2±0.7	1.2±0.3	2.7±1.9^b	2.2±1.2	5.4±1.8^b	2.5±2.4^a
Hb	14.3±0.4	15.2±0.9^a	13.4±1.2^b	14.3±1.0	12.3±1.2^b	13.3±1.3^b
MCV	59±5	48±3^a	59±3	47±1^a	60±4	46±1^a
RDW	16.6±1.3	17.0±0.6	16.2±0.8	16.9±0.3^a	16.3±1.1	17.4±0.2^a

Conclusion: Compared to young rats, aged rats had less HPC mobilization and elevated basal and peak NE. Aged animals were disproportionately affected by impaired erythroid progenitor growth and an iron-restricted red blood cell phenotype at baseline which persisted seven days after injury. Further research is needed to assess how the clinical approach to persistent-injury-associated anemia differs for elderly trauma patients.

Poster # 72

ANTITHROMBOTIC USE AND THE PRESENCE OF CEREBRAL ATROPHY: THE INHERENT RISK OF TRAUMATIC INTRACRANIAL HEMORRHAGE

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Introduction: Preinjury antithrombotic therapy (ATT) use and traumatic intracranial hemorrhage (ICH) can lead to increased risk and unfavorable outcomes, however there is little emphasis on the effect of these antithrombotic agents with underlying diffuse cerebral atrophy with aging. The aim of our study was to correlate the presence of cerebral cortical atrophy (CCA) on initial computed tomography (CT) imaging as a predictor of associated increased risk of ICH following blunt head injury and ATT use.

Age	Cortex mean (± SD)	Ventricle mean (± SD)	ICH (n)
50-59 years	47.86 ± 3.28	5.84 ± 1.87	21
60-69 years	47.24 ± 3.36	6.36 ± 1.75	41
70-79 years	45.96 ± 3.38	7.55 ± 2.17	29
80-89 years	44.46 ± 3.47	8.28 ± 2.12	24
90-99 years	42.55 ± 3.53	9.28 ± 1.76	12

Methods: A 6-month retrospective analysis of all patients (>50 years) with blunt head trauma were reviewed. Data was collected on patient age, sex, mechanism of injury, the presence of loss of consciousness (LOC), ATT use, and CT findings. Further subgroup analysis of patients on ATT at admission was performed. Axial views of the brain on CT were used to quantify CCA by identifying the maximal transverse width of the lateral ventricle body (VB) with the cortical parenchymal width (CD) measured by the cortical surface and the ipsilateral lateral ventricle margin.

Results: 1229 patients were reviewed and included in the study. Mean age was 73.82 ±14.98 years, 51% male. Overall mean VB was 6.75 ± 2.25mm and CD 46.67 ± 3.68 mm. As ventricle size increased, cerebral cortex decreased ($p < 0.001$) with increasing age. 127 patients (10%) were identified with ICH. Subgroup analysis of ATT use, 569 patients (46%) identified with a VB 7.63±2.14 mm and CD 45.51 ± 3.67 mm and 58 ICH (10%). Correlating CCA with ATT, age (p= < 0.001), mechanism of injury [MVC (p=0.003), assault (p=0.014), other transport vehicles (p=0.013)], LOC (p=0.004), and ICH (p=0.003) were statistically significant. In total, 12 patients required neurosurgical intervention (10 craniotomies, 2 craniectomies) with VB 9.29± 5.15 mm and CD 44.16±6.60 mm (p=0.005), of which 42% on ATT. Four deaths resulted, a VB 7.53 ± 3.23mm and CCA 42.53± 3.31mm (p= < 0.001).

Patient Demographics	ATT	No ATT	P-value
Age	75.21 ± 10.7	67.15 ± 11.9	< 0.001
% Males	297 (52.3%)	290 (44.9 %)	0.010
% Intracranial hemorrhage	58 (10.2%)	69 (10.7%)	0.787
LOC	187 (32.9%)	220 (34.1%)	0.674
Cerebral Cortex Atrophy			
Intracranial hemorrhage	44.31 ± 5.01	46.14 ± 4.00	0.003
LOC	44.49 ± 3.82	46.35 ± 3.70	0.004
Craniotomy/Craniectomy	42.58 ± 6.72	45.23 ± 6.25	0.020
Assault	45.6 ± 4.83	47.91 ± 3.49	0.014
Motor Vehicle Collision	46.72 ± 3.76	47.37 ± 3.36	0.032
Other Transport Vehicles	46.54 ± 4.84	48.21 ± 2.82	0.047
Cerebral Ventricle Size			
Intracranial hemorrhage	7.73 ± 2.43	7.57 ± 2.58	0.299
LOC	7.48 ± 2.13	6.93 ± 2.39	0.008
Craniotomy/Craniectomy	7.71 ± 3.23	10.03 ± 5.98	0.244
Assault	6.95 ± 1.66	6.32 ± 2.09	0.088
Motor Vehicle Collision	7.00 ± 2.29	5.85 ± 1.92	0.003
Other Transport Vehicles	7.13 ± 1.01	6.24 ± 1.54	0.013

Conclusion: CCA is a normal aging process, however a heightened awareness is warranted with preinjury ATT. Worsening CCA is predictive of ICH development with ATT use. Development of a CCA scoring system may further predict the risk of ICH development in the aging trauma population.

Poster # 73

STATEWIDE PROTOCOL RAPIDLY REVERSES ORAL ANTICOAGULANT INDUCED COAGULOPATHY IN PATIENTS WITH ISOLATED TRAUMATIC BRAIN INJURY

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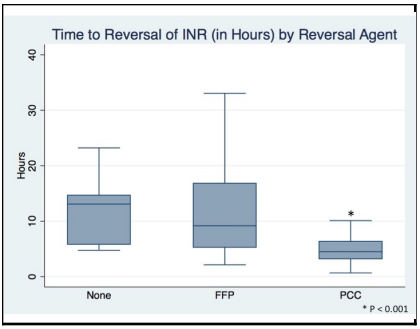
Introduction: Approximately 20% of older trauma patents use oral anticoagulants, most commonly warfarin, and their usage is associated with higher mortality and worse neurologic outcome following injury. Due to demonstrated improved survival rates with rapid reversal of coagulopathy in those with TBI, a 2011 state-wide policy was implemented for reversal with the use of prothrombin complex concentrate (PCC) ± fresh frozen plasma (FFP), rather than FFP alone. We hypothesize this policy would increase PCC use, and that reversal of warfarin-induced coagulopathy would occur more quickly.

Methods: Patients admitted to our Level I trauma center between January 2011 and May 2016 who had isolated TBI (head AIS $\geq$3, other body regions $\leq$2) and an INR >1.5 with warfarin use were evaluated. Data from the trauma registry were linked to laboratory records, the blood bank registry, and pharmacy records. The primary outcomes were frequency of PCC use, and the success and speed of INR reversal ± PCC. Secondary outcomes included the amount of FFP used, time to neurosurgical intervention, thrombotic complications, and death.

Results: We analyzed 197 patients by reversal group, 22 received no reversal (NO), 98 received FFP only (FFP), and 77 received PCC ± FFP (PCC). During the initiation of the policy, 2.7% received PCC versus 63.2% and 50% during years 3 and 4. PCC patients reversed their INR to <1.5 in a median of 4.5 hours (IQR, 3.2-6.3), significantly faster than both NO and FFP patients (13.7 [IQR: 5.8 – 19.8], 9 hours [IQR: 5.2 -16.3]; p <0.001, respectively). PCC patients were more severely coagulopathic on admission (median INR [IQR]: PCC: 2.5 [2-3.3]; FFP: 1.9 [1.7-2.4]; NO: 1.8 [1.6 -2.3], p <0.001), and had a higher median ISS (PCC: 26 [IQR: 17-26]; FFP: 17.5 [16-26]; NO: 17.5 [16-26]; p= 0.038). In the subgroup of patients admitted from the scene, PCC use increased to use over 80% by year 4. In this subgroup, PCC patients used significantly less FFP in the first 24-hours of admission (PCC: 0.5 units [IQR 0-2 units]) vs. FFP: 2 units [IQR: 1.5-3], p = 0.001). After adjusting for propensity to receive PCC, there was no difference in mortality or thrombotic complication rates between the reversal groups.



Conclusion: Since implementation of a statewide protocol for rapid warfarin reversal in TBI: (1) the use of PCC has increased, (2) PCC use more rapidly reversed INR, and (3) PCC use led to less FFP transfusion during reversal, all without increasing thrombotic complications. We plan to add the recently developed reversal agents for the new oral anticoagulants to the statewide protocol, and prospectively evaluate adherence, reversal time and outcomes.

Poster # 74

POPULATION OF PATIENTS WITH TRAUMATIC BRAIN INJURY IN SKILLED NURSING FACILITIES

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Background: The incidence of TBI has steadily risen. Following discharge, TBI patients often require long term care in skilled nursing facilities (SNFs). Despite advances in trauma care, a significant knowledge gap remains about the long term outcomes of TBI patients admitted to SNFs. As previously demonstrated patients with significant impairments in cognitive and functional status show little long-term improvement, are less likely to be discharged to home and are more likely to die while in SNF. Therefore we aim to describe the natural history of TBI patients in SNFs.

Methods: This is a 10 year retrospective (2005-2015), descriptive epidemiologic study of TBI patients. We reviewed Minimum Data Set (MDS), a national and federally mandated dataset for patients aged ≥ 18 years old who had first time admissions to a nursing home with a diagnosis of TBI. We reviewed the dataset for age, sex, cognitive and physical function, length of stay, presence of feeding tube, a terminal condition (death within 6 months), and dementia. Cognitive function was assessed using the Cognitive Performance Scale (CPS) and the Cognitive Function Scale (CFS). Physical and functional abilities were assessed using Activities of Daily Living (ADL) with ≥ 23 being severe physical impairment.

Results: Over the 10 year period, the number of first time admissions to SNFs of patients with TBI increased annually from 17,247 patients in 2005 to 20,787 in 2014. The percentage of patients with TBI under the age of 65 decreased from 29% to 21% *($p<0.05$)* and the percentage of patients over the age of 85 increased from 28% to 33% *($p<0.05$)*. Average ADL score increased from 16.9 to 17.7 *($p<0.05$)*, however the percentage of patients with ADL score ≥ 23 decreased from 25% to 14% *($p<0.05$)*. The overall percentage of patients with severe cognitive impairment decreased from 18% to 10% *($p<0.05$)*. More patients had Dementia in 2014 compared to previous years *($p<0.05$)* and the presence of a terminal condition increased from 1% to 1.5% over the 10 year period *($p<0.05$)*. In 2005, 18% of patients had a feeding tube but only 11% in 2014 *($p<0.05$)*. The percentage of patients that stayed less than 30 days was noted to increase steadily over the 10 years, starting with 48% in 2005 and ending with 53% in 2013 *($p<0.05$)*.

Conclusion: In this national study of TBI patients, it is evident that long term SNF care remains a significant burden and the number of patients with TBI requiring SNFs continually increases. As acute trauma care has improved, the focus should now turn towards optimizing post-hospital care in this population. Furthermore, this care should be centered in facilities specializing in TBI.

Poster # 75

THE IMPACT OF PALLIATIVE CARE IN OLDER PATIENTS WITH SEVERE TRAUMATIC BRAIN INJURY

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Introduction: Older patients with traumatic brain injury (TBI) have increased morbidity and mortality compared to their younger counterparts for equivalent injury. Palliative care (PC) is recommended for all seriously ill patients with high symptom burden or at risk for adverse outcomes. Little is known about the national practice of PC for patients with TBI. The goal of this study was to assess PC utilization in the elderly, severe TBI patient population. We hypothesized that PC was underutilized despite its positive effects on patient care.

Methods: The National Inpatient Sample database was queried from 2009 to 2013 for patients aged ≥55 with all ICD-9 code defined TBI diagnoses with loss of consciousness ≥24 hours. Outcome measures included PC rate, in-hospital mortality, discharge disposition, length-of-stay (LOS), and intensity of care represented by craniotomy or craniectomy procedures, ventilator use, tracheostomy, and PEG. LOS for survivors was censored to 30 days to eliminate outliers.

Results: 5733 patients met the inclusion criteria. 78% (4479) died in hospital with a median length of stay of 1 day. 85% of the survivors (1060) were discharged to facilities. The overall PC rate in the cohort was 35% (2007). 39% (1728) of deaths received PC, with nearly half (801) within 48 hours of admission. 78% of all patients required ventilator support; 25% (1439) for >4 days. 26% (66) of those who had neurosurgical procedures had PC, compared to 35% of those who were non-operatively treated (p=0.003). Palliative care was associated with less intensity of care in the entire population. For survivors, those with PC had significantly decreased intensity of care and shorter hospital stay, compared to those without PC (**Table**).

Table: Intensity of Care among Survivors

	Palliative Care (n=279)	**No Palliative Care** (n=973)	**P-value**
Tracheostomy	33 (12%)	402 (41%)	<0.001
PEG	30 (11%)	364 (37%)	<0.001
Vent >4 days	81 (29%)	536 (55%)	<0.001
Median LOS	3 days	12 days	<0.001

Conclusion: Despite high mortality, only 1/3 of older patients with severe TBI received PC. PC was associated with decreased use of life support and lower intensity of care. The lower PC rate among those who had neurosurgical procedures suggests a dichotomous approach to care: palliative care versus invasive surgery. As nearly half of deaths who received PC had it within 48 hours, timing is not a barrier to deliver PC. Significant efforts need to be made to bridge this quality gap and improve PC in this high-risk population.

Poster # 76

Sarcopenia Defined By Masseter Area Predicts Early Mortality Following Severe Traumatic Brain Injury

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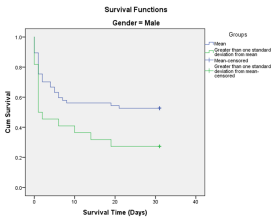
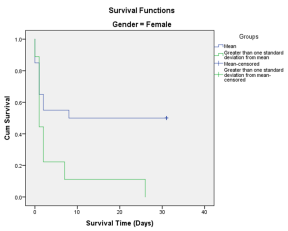
Introduction: Sarcopenia is strongly associated with frailty and long term mortality following injury among the geriatric trauma population. Cross sectional muscle area, most commonly of the psoas, is used as an objective measure to rapidly identify sarcopenia. Masseter area (M-area) has recently been identified as a more available and able to predict two year mortality following traumatic brain injury (TBI). We sought to validate this measure and correlate its use in prediction of short term mortality following severe TBI (sTBI).

Methods: A retrospective analysis of all trauma patients with TBI admitted to an ACS verified level one trauma center from 2011-2016 was performed. Admission Glasgow Coma Score (GCS) ≤8 was used to identify sTBI. The medical record was then utilized to identify demographic and clinical data, including length of mechanical ventilation, hospital length of stay (LOS), ICU LOS, and 30 day mortality. Bilateral masseter area was measured 2 cm below the zygomatic arch and mean M-area calculated for each patient. Sarcopenia was defined as mean M-area one standard deviation or less from the mean. Analysis included Student *t* test followed by logistic regression evaluate M-area. Patients were then compared grouped as with or without sarcopenia and analyzed with Kaplan-Meier survival and Cox proportional hazards models.

Results: 424 patients were identified with sTBI during the study period. 18 were excluded due to incomplete data(16) or death secondary to hemorrhage immediately after arrival(2). 108 patients were age 55 or older, 79 male and 29 female. 77 patients had average M-area and 31 with sarcopenia. Males had significantly larger mean M-area compared to females overall (5.26 vs. 4.11 cm ^{2}, p=<0.001) and ≥55 years old (4.55 vs 3.43 cm^2, p=<0.001). Controlling for gender, decreasing M-area was significantly associated with 30 day mortality (OR 0.58, p=0.002). Sarcopenia resulted in increased risk of 30 day mortality following sTBI (HR 1.75; 95% CI, 1.02-3.00).

Conclusion: M-area is a rapid and more commonly available method to assess for sarcopenia among elderly trauma patients with sTBI who may not undergo full body CT scan. Sarcopenia as defined by M-area may be used to predict early mortality following sTBI.





Poster # 77

DEVELOPMENT OF A NOVEL SCORING SYSTEM PREDICTING THE RISK OF NEUROSURGICAL INTERVENTION IN AN ISOLATED MILD SUBDURAL HEMORRHAGE POPULATION

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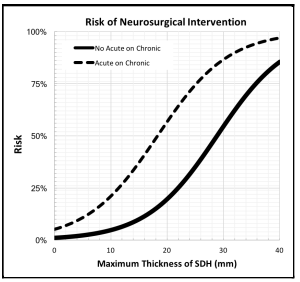
Background: A paucity of studies have examined neurosurgical interventions in the mild traumatic brain injury (mTBI) population with intracranial hemorrhage (ICH). Furthermore, we do not understand how the dimensions of an ICH relate to the risk of a neurosurgical intervention. These limitations contribute to a lack of treatment guidelines. Isolated subdural hematomas (SDHs) are the most prevalent ICH in mTBI, carry the highest neurosurgical intervention rate, and account for an overwhelming majority of all neurosurgical interventions. Decision criteria in this population could benefit from understanding the risk of neurosurgical intervention. The aim of this study was to quantify the risk of neurosurgical intervention based on the dimensions of a SDH in patients with mTBI.

Methods: This was a 3.5 year, retrospective observational cohort study at a Level I Trauma Center. All adult (≥18 years) trauma patients with mTBI and SDH were included in the study. Maximum length and thickness (mm) of acute SDHs, the presence of acute on chronic (AOC) SDH, mass effect and other hemorrhage related variables were double data entered; discrepant results were adjudicated after a maximum of four reviews. Patients with coagulopathy, skull fractures, no acute hemorrhage, a non-SDH ICH, or who did not have imaging on admission were excluded. Tentorial SDHs were not measured. The primary outcome was neurosurgical intervention (craniotomy, burr holes, ICP monitor placement, shunt, ventriculostomy, SDH evacuation). Multivariate stepwise logistic regression was used to identify significant covariates, assessed interactions, and created the scoring system.

Results: There were a total of 176 patients included in our study: 22 patients did, and 154 patients did not, receive a neurosurgical intervention. There were no significant differences between neurosurgical intervention groups in 11 demographic and 22 comorbid variables. There was a strong correlation between the first three reviews on maximum hemorrhage length (R^2=0.82) and maximum hemorrhage thickness (R^2=0.80). The neurosurgical intervention group had an average maximum SDH length and thickness that were nearly 63 mm longer, and 11 mm thicker than the non-neurosurgical intervention group (p<0.001 both). Logistic regression identified thickness as being the most important variable in predicting neurosurgical intervention. SDH length was not determined to be a significant covariate, nor did it interact with SDH thickness. Risk of neurosurgical intervention was calculated using a logistic regression model based on the SDH thickness and presence of an AOC (**Figure 1**, AUROC=0.93, 95%CI: 0.88, 0.96, p<0.001). With a decision point of 9 mm SDH thickness, we predicted neurosurgical intervention with 100% sensitivity, 100% negative predictive value, and 69% specificity.



Conclusions: This is the first study to quantify the risk of neurosurgical intervention based on hemorrhage characteristics in patients with mild TBI and SDHs. Once validated in a second population, these data can be used to better inform patients and families of the risk of future neurosurgical intervention, and evaluate the necessity of inter-hospital transfers.

Poster # 78

GERIATRIC UNDERTRIAGE: TIME FOR A NEW APPROACH

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Introduction: Undertriage (UT) has been reported to adversely affect outcome, particularly in geriatric populations. The American College of Surgeons Committee on Trauma defines undertriage (UT) as a patient with an Injury Severity Score (ISS) >15 not triaged to Trauma Team Activation (TTA). Our center has reported on a protocol of expedited clinical screening and CT imaging for older patients at risk for brain injury who do not meet conventional TTA criteria. We hypothesize that UT occurs frequently in geriatric patients and that UT based on ISS criteria alone is a poor predictor of mortality or need for emergent treatment interventions.

Methods: A retrospective review over a four year period (Jan 2013-Dec 2016) was performed of all moderate to severely injured patients (ISS >15) presenting to our busy Emergency Department (ED) (>130,000 visits annually) and Level II Trauma Center. UT was defined a patient with an ISS >15 not triaged to a TTA. Patients were stratified into 3 age groups for prognostication; group 1 (18-40 years); group 2 (41-64 years); and group 3 (≥65 years). Timeliness of care was measured by time to initial physician evaluation (TPE), time to computed tomographic imaging (TCT), and ED length of stay (EDLOS). Need for ED intubation, blood transfusion, direct transport from the ED to the Operating Room (OR)/Angiography Suite for emergent treatment, as well as in-house mortality were compiled for the TTA and UT cohorts. Logistic regression analysis determined variables independently associated with mortality.

Results: Over the period of study, 947 patients met inclusion criteria. Overall UT rate was 341/947 (36%) with rates within the groups 1-3 being 11%, 24% and 53% respectively. The UT group was more likely to present following falls (77% vs 34%, $p<0.0001$) and had a greater proportion of patients with AIS Head ≥3 injuries (79% vs 64%, $p<0.0001$). The TTA group had more expeditious care (TPE 0 min vs. 24 min, $p<0.0001$; TCT 22 min vs. 97 min, $p<0.0001$; and median EDLOS 106 min vs. 291 min, $p<0.0001$). For the younger two cohorts mortality was statistically similar among TTA and UT patients. However, in the geriatric group, mortality was lower for UT patients (9% vs 23%, $p<0.0001$). Stratified by ISS (16-25, and >25), geriatric UT patients had a lower risk of death (odds ratio [OR] 0.42, $p=0.003$) while groups 1 and 2 had similar risks of death to TTA patients. UT patients were equally likely to require Intensive Care Unit admission (64% vs 60%, $p=0.2$), and angiographic intervention (1.5% vs 3%, $p=0.2$), and less likely to require ED blood transfusion (1% vs 13%, $p<0.0001$), intubation (4% vs 29%, $p<0.0001$), or emergent operative intervention (6% vs 20%, $p<0.0001$). Logistic regression analysis revealed that UT was independently associated with lower mortality (OR 0.48, 95% confidence interval 0.24-0.94, $p=0.03$) when controlled for age, Glasgow Coma Scale, ISS, systolic blood pressure, anticoagulant use, gender, and mechanism of injury.

Conclusions: UT is common in the geriatric population and frequently presents following low-energy mechanisms with occult blunt head injury. UT based on ISS criteria alone is not predictive of outcome and not helpful to trauma quality initiatives in the elderly. Development of non-traditional methods to expeditiously evaluate and treat this rapidly growing population is needed.

Poster # 79

CORRELATION OF THROMBOELASTOGRAPHY WITH CONVENTIONAL COAGULATION TESTING IN ELDERLY TRAUMA PATIENTS ON PRE-EXISTING BLOOD THINNING MEDICATIONS

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Introduction: As the elderly population increases, the incidence of pre-injury anti-platelet (AP) and anti-coagulant (AC) medications is expanding. Thromoboelastography (TEG) has gained popularity in management of injured patients. The utility of TEG in identifying trauma patients on pre-existing AC/AP that are at risk of hemorrhage has not been well studied. We sought to determine the correlation of TEG parameters with conventional coagulation testing in elderly patients on AC/AP medications, and calculate the sensitivity/specificity in determining risk of delayed hemorrhage.

Methods: This was a prospective observational study involving elderly patients sustaining falls with injury that were on pre-existing AC/AP medications presenting to a Level I trauma center in 2016. Patients were included if they had conventional coagulation tests done as well as a TEG drawn at the same point in time. All patients also had to have sequential radiographic imaging to examine for delayed hemorrhagic complications which were defined as any evidence of new bleeding or expansion of a previously noted bleed. Pearson and Spearman correlation was used to determine the relationship between conventional coagulation tests and TEG values were appropriate. The sensitivity and specificity of conventional coagulation parameters (INR/PTT), Platelet Function Assay (PFA), and TEG parameters in determining delayed hemorrhage were calculated.

Results: 112 patients met inclusion criteria. Mean age was 83.7±8.8 years and 54.4% were male. AP medications (66%) were more common than AC (34%), with Aspirin (51.8%) and Coumadin (26.8%) being encountered most frequently. Head injuries (55.8%) were predominant in AC/AP patients, though ISS (Median 10 vs. 9.5, p=0.97) and need for craniotomy (54.3% vs. 50%, p=0.831) was similar. Incidence of delayed bleeding (23% vs. 18.4%, p=0.635) was similar across AC/AP groups. TEG R time had a moderate positive correlation with a rising INR/PTT (**Table**) that was significant, while PFA testing had a weak negative correlation with Maximal Amplitude and Alpha Angle. TEG had superior sensitivity in ruling out delayed hemorrhage compared with INR/PTT or PFA. Specificity for delayed bleeding was the greatest in patients with abnormal PFA.

Conclusions: TEG R Time has a moderate positive correlation with INR/PTT. Though it has superior sensitivity in ruling out delayed hemorrhage than conventional tests, larger prospective studies are warranted to further assess the utility of TEG in patients on AC/AP.

Parameter 1	INR Correlation	PTT Correlation	Parameter 2	PFA Correlation
R time	0.377; $p < 0.001$	0.552; $p < 0.001$	Alpha Angle	- 0.299; $p = 0.107$
K time	0.168; $p = 0.077$	0.192; $p = 0.048$	Max Amplitude	- 0.223; $p = 0.071$
Delayed Hemorrhage		Conventional Coagulation	PFA	TEG
Sensitivity		73.8%	59.6%	86.0%
Specificity		26.1%	50.0%	29.0%

Poster # 80

IMPACT OF AN ASPIRIN BASED STROKE PROPHYLAXIS PROTOCOL IN ADULTS WITH BLUNT CEREBROVASCULAR INJURY

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Introduction: Anticoagulation and antiplatelet therapy have both been used to reduce the risk of stroke in patients who sustain blunt cerebrovascular injury (BCVI). Systemic therapeutic heparinization has been the anticoagulation of choice. Initiation of ASA therapy has been shown to be safe in patients with concomitant solid organ injury as well as traumatic brain injury, allowing for earlier implementation of therapy in these patients. The objective of this study is to report the outcomes of an aspirin-based stroke prophylaxis protocol in patients with BCVI.

Methods: The prospectively collected institutional trauma databank was retrospectively queried for all trauma patients who underwent CTA of the neck to rule out BCVI (utilizing Modified Denver Criteria) from 9/13-10/16. Analysis included injury grade on admission and on follow up studies. Type of anticoagulation or antiplatelet therapy administered on admission and discharge was also reported. Data collected included: age, gender, injury severity score (ISS), abbreviated injury score head (AIS Head), and number of BCVI per patient.. The primary outcome was stroke. Stroke was defined as evidence of an ischemic or embolic event of appropriate chronicity on either head CT or MRI. Chi-squared test was performed on categorical variables. Continuous variables were compared with Kruskal Wallis and reported as median and interquartile range.

Results: During the study period, 11,685 patients were admitted to the trauma service and 1164 CTAs of the neck were obtained. BCVI was diagnosed in 174 patients with a total of 228 vessels injured. Of these injuries, 79 were Grade I (34.6%), 74 were Grade II (32.5%), 29 were Grade III (12.7%) and 46 were Grade IV (20.2%). There were no Grade V injuries. On admission, 155 patients (89%) were started on aspirin (ASA) therapy, 5 (2.9%) were started on a heparin drip, 4 (2.3%) were placed on dual antiplatelet therapy (DAPT) and 3 (1.7%) were placed on clopidogrel. Seven patients (4%) received no anticoagulant or antiplatelet therapy due to death, withdrawal of care, or facility transfer. Median time between admission and initiation of treatment was 28 (IQR 12-58) hours. Seven patients demonstrated stroke symptoms or imaging findings consistent with stroke on presentation. After consideration of these patients, the overall stroke rate was 6.3% (n=9). At the time of stroke, 2 patients (22.2%) were on full anticoagulation, 4 patients (44.4%) were on aspirin therapy, and 3 patients (33.3%) were not anticoagulated. Stroke rates were 3.6% (2/53), 5.7% (3/53), 13.6% (3/22) and 2.6% (1/39) for Grade I through IV injuries, respectively. Aspirin was the most common therapy on discharge (78.2%, (136/174)) followed by a novel anticoagulant at 5.2% (9/174), 3.5% (6/174) of patients were discharged on warfarin, 2.9% (5/174) on clopidogrel, 2.3% (4/174) were discharged on therapeutic low molecular weight heparin (LMWH), and 2.3% (4/174) were discharged on DAPT. The remaining 10 patients (5.8%) were discharged without anticoagulant therapy due to resolution of injury on imaging.

Conclusion: Aspirin should be considered a first line agent for stroke prophylaxis in patients with Biffl grade I-IV injuries. Initiation of early aspirin therapy in patients with BCVI produces outcomes equivalent to those reported in the literature for stroke. A multi-institutional trial should be performed to further validate this treatment approach.

	Grade I	Grade II	Grade III	Grade IV	p-value
Median age (IQR)	49 (27-68)	55 (29-77)	54 (27-78)	62 (31-78)	0.758
Male Gender (%)	67.2	50.1	31.8	61.4	0.028
Median ISS (IQR)	14 (9-22)	14 (10-27)	15 (10-19)	14 (10-22)	0.952
Median AIS Head (%)	1 (0-3)	2 (0-3)	1 (0-3)	1 (0-3)	0.822
% ASA as initial therapy	87.3%	88.7%	86.4%	93.2%	0.772
CVA	2 (3.6%)	3 (5.7%)	3 (13.6%)	1 (2.6%)	NS

Poster # 81

THE GRASS IS NOT ALWAYS GREENER: A PILOT STUDY OF MARIJUANA USE AND PAIN CONTROL FOLLOWING TRAUMA

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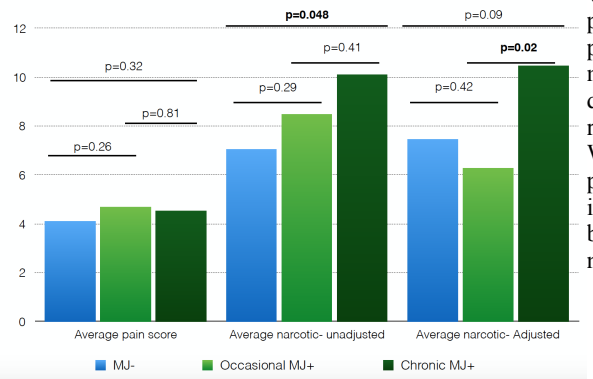
Introduction: Widespread legislative efforts to legalize marijuana have resulted in increased prevalence of marijuana use and abuse. Marijuana has been shown to have antinociceptive effects and is used for treating chronic and neuropathic pain. However, the effects of previous marijuana exposure on pain tolerance and pain management, particularly in the setting of acute pain, remain poorly understood. The objective was to determine the association between pre-injury marijuana use and pain control and narcotics administration following trauma.

Methods: This retrospective pilot study included all consecutively admitted patients to three Level I trauma centers with vehicular trauma from January through April 2016; patients with length of stay > 14 days were excluded. Marijuana (MJ) status was categorized as non-user (MJ-) vs. user (MJ+); MJ+ was further defined as chronic (daily or almost daily use) vs. occasional use. All narcotics were converted to be equianalgesic to 1mg IV hydromorphone. We performed a repeated measures analysis to examine the association between marijuana status and daily narcotics administration, unadjusted and after adjustment for injury severity score, age, other toxicology findings, and average daily pain score (0-10 scale).

Results: Marijuana use was reported in 22% (51/230), of which 29% reported chronic use (15/51). MJ+ patients were more likely to be younger with positive toxicology screen than MJ- users, but were less likely to be intoxicated ($p<0.05$ for all). Overall, 77% of patients were admitted to the ICU. The average daily pain score was 4.2; there were no differences in average pain scores by marijuana status (figure 1). Approximately 7.5mg IV hydromorphone was administered daily. Before adjustment, chronic MJ+ users received significantly more narcotics than MJ- users (10.1 vs. 7.0, $p=0.048$). After adjustment, narcotics administration over the hospital stay was significantly greater for chronic MJ+ users vs. occasional MJ+ users ($p=0.02$) and borderline significantly greater than MJ- patients ($p=0.09$), figure 1.

Figure 1. Effect of pre-injury marijuana use on average daily narcotic administration (hydromorphone mg IV) and pain scores



Conclusions: Marijuana use and abuse is common in vehicular trauma. These pilot data suggest that pre-injury chronic use of marijuana may have a detrimental effect on pain response following trauma. We are planning a larger prospective study to further investigate the relationship between marijuana use, narcotics, and pain response.

Poster # 82

VENO-VENOUS EXTRACORPOREAL MEMBRANE OXYGENATION SUPPORT FOR RESPIRATORY FAILURE - HOW LONG IS TOO LONG?

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Introduction: The use of extracorporeal membrane oxygenation (ECMO) in adults with respiratory failure has steadily increased over the past decade. Recent literature has demonstrated variable outcomes with the use of extended ECMO. Anecdotally, some centers consider stopping care based solely on an arbitrary duration of time on ECMO. The purpose of this study is to evaluate survival to hospital discharge in patients with extended ECMO runs compared to patients with short ECMO runs at a tertiary care ECMO referral center.

Methods: We retrospectively reviewed all patients on VV ECMO for respiratory failure between August 2014 and February 2017. Bridge to lung transplant, post lung transplant and post cardiac surgery patients were excluded for the purposes of this study. Patients were stratified by duration of ECMO: extended ECMO, defined as > 504 hours (21 days); short ECMO as ≤ 504 hours (21 days). Demographics, pre-ECMO data, ECMO specific data, and outcomes were analyzed. Wilcoxon's rank-sum test and Pearson's chi-square were used when applicable.

Results: 139 patients with respiratory failure were treated with VV ECMO. Overall survival to discharge was 76%. 32 (23%) patients had extended ECMO runs with an 88% survival to discharge. When compared to patients with short ECMO runs, there was no difference in median age, BMI, BSA, P/F and survival to discharge. However, time from intubation to cannulation for ECMO was significantly longer in patients with extended ECMO runs. (p=0.04)

	Total (n=139)	Short ECMO Run (n=107)	Extended ECMO Run (n=32)	P – value
Age (years)	44 [31-54]	44 [31-55]	46 [32-53]	ns
Male	87 (63%)	67 (63%)	20 963%)	ns
BMI (kg/m^2)	33 [27-38]	33 [27-39]	32 [26-26]	ns
BSA (m^2)	2.1 [1.9-2]	2.1 [1.9-2.3]	2 [1.9-2.2]	ns
P/F	71 [55-98]	71 [53-98]	73 [60-96]	ns
Ventilator days*	1 [0-4]	1 [0-2]	2 [0.5]	0.04
ECMO duration (hours)	309 [179-452]	243 [152-338]	811 [657-1199]	< 0.001
Survived to discharge	105 (76%)	77 (72%)	28 (88%)	ns
BMI – Body Mass Index; BSA – Body Surface Area; * days prior to ECMO cannulation				

Conclusions: Recent literature has demonstrated variable outcomes with the use of extended ECMO for patients with respiratory failure. Our data demonstrate that patients with extended ECMO runs have equivalent outcomes to those with short ECMO runs. Although the decision to continue ECMO support in this patient population is multifactorial, we suggest that time on ECMO should not be the sole factor in this challenging decision.

Poster # 83

EXCEPTION FROM INFORMED CONSENT TRIALS IN TRAUMA SURGERY: A PROPOSED COMMUNITY CONSULTATION MODEL

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Introduction: Exception from informed consent (EFIC) research in trauma surgery requires community consultation. Despite its critical role in emergency research, community consultation remains poorly defined. This paper aims to define a concise set of survey questions to accurately assess attitudes toward an EFIC trial, it is designed to be reproduced for future EFIC community consultations.

Methods: A 54-item community consultation survey assessed attitudes towards two EFIC trials. 36 items assessed demographics and participant risk factors, and 18 items directly assessed support for EFIC research using a five-point Likert scale. Items were grouped by several cohorts: support for medical research, support for EFIC research, support for EFIC with self-interest, and support for EFIC with altruism. These items were analyzed using correlation matrices, cronbach alpha scores, factor analysis, and multiple linear regression to produce a concise model ($p<0.05$, power = 0.8) equally predictive of community support for an EFIC trial as the original 54-item survey.

Results: Of the 54 items in the original community consultation survey (N=415), a multiple linear regression found six items that were reliable predictors of support for that EFIC trial and explained 92% of the variance from the original survey (Table 1). The six-item template has acceptable internal consistency (cronbach alpha = 0.82), is statistically significant ($p< 0.05$), and represents all item cohorts (Table 2).

Conclusion: Six questions from EFIC community consultations were identified as statistically significant predictors of support for upcoming EFIC trials. These six questions should be included in all community consultation surveys. This template for community consultation will enable physicians to begin to standardize a historically vague process and leave more time for valuable patient education.

Table 1 – Concise EFIC Community Consultation Survey

1. I, or my family, would benefit from medical research on trauma.
2. Involving patients in a medical research study without asking their permission first is acceptable in emergency circumstances.
3. It is okay for medical researchers to include me in a study that might help me if I am unconscious or too sick to give permission myself.
4. It is okay for emergency research that does not ask for patient's consent to be done in my community if the study might help the patient.
5. It is okay for medical researchers to include me in a study that might NOT help me but might help future patients if I am unconscious or too sick to give permission myself.
6. I think it is acceptable for me to be enrolled into this study without my written consent if I had been shot or stabbed and my legal representative (spouse, children, guardian) could not be contacted.

Table 2 – ANOVA Multiple Linear Regression

Variable	Coefficient	Adjusted R Square	P-Value
Dependent Variable			
Support for EFIC Trial		0.92	< 0.001
Independent Variables			
Question 1	2.918		< 0.001
Question 2	1.887		< 0.001
Question 3	2.173		< 0.001
Question 4	1.993		< 0.001
Question 5	2.005		< 0.001
Question 6	2.887		< 0.001

Poster # 84

Use of Patient-Centered Long-Term Outcomes to Compare Trauma Centers: Better than in-hospital mortality?

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Objective: Quality benchmarking of trauma care is currently based on in-hospital mortality and does not reflect the experience of the >95% patients who survive. To address this, the National Academies of Medicine recent report on military-civilian trauma care recommends collection of longer-term outcomes to assess trauma care quality. Our objective is to determine if patient-centered, long-term outcomes (PCLTOs) could be used to compare trauma center performance.

Methods: An international interdisciplinary panel identified appropriate PCLTOs including: Trauma Quality of Life (TQoL) survey, SF-12 (Mental and Physical components), Post-Traumatic Stress Disorder (PTSD) screening, healthcare utilization, and return to work (RTW). These were routinely collected via telephone interviews at 6 or 12 months after injury at three US Level I Trauma Centers (TCs) for all patients with Injury Severity Score (ISS) ≥9. Mortality and PCLTOs were compared between TCs using multivariable regression models controlled for differences in ISS, age, sex, mechanism of injury, and length of stay.

Results: 665 trauma survivors were interviewed (67% of patients contacted): 352 at TC1, 124 at TC2, and 189 at TC3. During the study period, we found no significant difference in crude (TC1:6.6%, TC2: 5.9%, TC3: 6.7%) or risk-adjusted in-hospital mortality across TCs (p=0.84). However, we found major differences in PCLTOs between TCs (table).

	TC1	TC2		TC3	
Patient-Centered Long-Term Trauma Outcomes	*%*	*%*	*OR (95% CI)*	*%*	*OR (95% CI)*
Trauma Related Return to ED	9%	11%	1.41 (0.70-2.86)	11%	1.11 (0.58-2.14)
Screened Positive for PTSD	20%	18%	0.82 (0.43-1.58)	38%	**1.69 (1.01-2.84)**
At Least one Physical Limitation for Daily-Activities	37%	44%	1.42 (0.91-2.20)	38%	**1.75 (1.14-2.69)**
Did not Return to Previous Work/School	45%	36%	0.63 (0.31-1.29)	45%	1.26 (0.70-2.26)
"My Physicial Healing has Not Improved as I Expected"*	25%	29%	1.19 (0.70-2.05)	42%	**2.12 (1.31-3.45)**
"I Have Pain on a Daily Basis"*	52%	53%	0.99 (0.62-1.60)	50%	0.86 (0.54-1.35)
	mean	*mean*	*Coefficient (CI)*	*mean*	*Coefficient (CI)*
SF-12 Physicial Composite Score	41.7 (12)	41.3 (11.2)	0.36 (-2.65-2.72)	41.4 (11.7)	-2.43 (-4.95-0.81)
SF-12 Mental Composite Score	50.4 (12.1)	51.2 (11.3)	0.78 (-2.11-3.66)	46.8 (13.8)	-1.87 (-4.57-0.83)

TC1: Ref; *TQoL instrument

Conclusions: Comparing trauma centers on mortality alone did not demonstrate any difference in outcomes. However, there were demonstrable differences in PCLTOs between the centers. Use of PCLTOs provides a more in-depth assessment of trauma center quality and should be used to compare trauma center performance.

Poster # 85

EARLIER TIME TO HEMOSTASIS IS ASSOCIATED WITH REDUCED MORTALITY AND ACUTE KIDNEY INJURY: RESULTS FROM THE PRAGMATIC RANDOMIZED OPTIMAL PLATELET AND PLASMA RATIO (PROPPR) TRIAL

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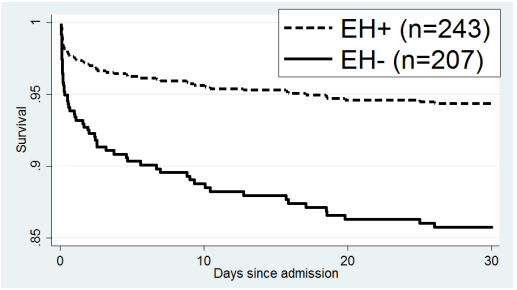
Introduction: Surgeons intuitively recognize that faster time to hemostasis is important in bleeding trauma patients, but these times are rarely reported.

Methods: Prospectively collected data from the PROPPR trial were analyzed. Hemostasis was predefined as no bleeding requiring intervention in the surgical field or resolution of contrast blush on interventional radiology. Patients who underwent an emergent (within 90 minutes) OR or IR procedure were dichotomized by early (EH+, within 2 hours) or no early hemostasis (EH-). Cox proportional hazards regression (controlling for age, ISS, number of blood products transfused, treatment arm [1:1:1 vs 1:1:2], site, and time to OR/IR) tested the hypothesis that EH+ was associated with reduced mortality in patients surviving ≥2 hours. Mixed-effects logistic regression with the above covariates and Bonferroni corrections was used to explore relationships between EH+ versus AKI, ARDS, MOF, sepsis, and VTE in patients surviving ≥24 hours.

Results: Of 680 enrolled patients, 450 (66%) underwent an emergent procedure, and 382 patients (85%) achieved hemostasis with a median time of 92 min (IQR 54-152 min). Incidence and time to hemostasis were not different between sites. EH+ (n=243, 54%) patients were less severely injured (median ISS 22 vs 29) than EH- (n=207, 46%) and had fewer transfusions at 2 hours (median 10 vs 19 units) and 24 hours (median 17 vs 42 units), but there were no differences in age, mechanism, treatment arm, or time to OR/IR. EH+ was independently associated with reduced risk of 30-day mortality (HR 0.4, 95% CI 0.2-0.7) in patients surviving ≥2 hours and reduced risk of AKI (OR 0.4, 95% CI 0.2-0.7) in patients surviving ≥24 hours.

Conclusion: Earlier time to hemostasis was associated with reduced 30-day mortality and AKI in bleeding trauma patients after adjustment for injury severity. Time to hemostasis should be considered as a potential endpoint in trauma studies and used as a quality indicator.



Poster # 86

OPEN-SOURCE MASS SHOOTING DATABASES ARE INCONSISTENT AND SHOULD BE REPLACED WITH A NATIONAL FIREARM INJURY PREVENTION DATABASE

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Introduction: Since 1996, the Dickey Amendment has prohibited federally-funded research that might advocate for "gun control." Several open-source public databases, widely used by the news media, have been created to record the incidence of mass shootings in the United States.

Methods: An Internet search identified five public open-source databases that track mass shootings. As the databases vary in the variables collected and time period covered, a uniform dataset of mass shootings occurring from January 2013 through June 2015 was abstracted from each database. Inclusion criteria, number of shooting incidents, fatalities, and victims (fatalities + injured) were collected. Data were compared using contingency table analysis.

Results: Most databases are maintained by public volunteers rather than experienced researchers. The definition of mass shooting incidents varies by whether fatalities and injuries or only fatalities are counted. Several databases cautioned that inconsistent staffing limits data collection and accuracy. The number of incidents, fatalities, and injuries differs significantly among the available databases ($p<0.0001$).

Database	Criteria	Incidents	Fatalities	Injured
Mother Jones	3+ fatalities	11	65	43
Stanford Mass Shootings	3+ victims	73	204	194
Everytown for Gun Safety	4+ fatalities	133	673	192
Gun Violence Archive	4+ victims	679	732	2640
Mass Shooting Tracker	4+ victims	833	1052	3002

Conclusion: Public open-source databases are highly variable and provide an inconsistent assessment of the problem of mass shootings. These databases cannot be used to guide firearm injury prevention efforts. A comprehensive federally-funded national database is necessary to address the public health crisis of gun violence.

Poster # 87

Admission Rehabilitation Complexity Assessment Predicts Rehabilitation Needs, Disability and Health Outcomes in Trauma Patients

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Background: Injuries affect approximately 700 million people worldwide each year. Survivors are faced with long term complex rehabilitation requirements which ultimately affects long term outcome with huge economic costs. The ability to predict rehabilitation needs and outcomes early in the clinical course is valuable in terms of resource allocation and discharge planning. While injury severity scoring (ISS) is known to be a reasonably accurate predictor of mortality, it is unknown whether this translates to rehabilitation needs in survivors. The objective of this study was to evaluate the effectiveness of the an admission rehabilitation complexity assessment on later requirements, disability levels and health outcomes, as compared to standard injury scoring in major trauma patients.

Methods: We performed a prospective cohort study of patients admitted to a major trauma centre for more than 72 hours over a 12-month period. Demographic data, in-hospital outcomes, rehabilitation needs, disability and health outcomes were collected. Rehabilitation complexity was measured using the Rehabilitation Complexity Scale Extended (RCS-E) and disability with the 20-point Barthel Index (BI) on admission and discharge. Health outcome was measured using the European Quality of Life Scale (EQ5D-3L) prior to transfer or discharge. For statistical analysis patients were grouped into four rehabilitation need categories depending on their rehabilitation complexity core. These were: 'Low' (1-6), 'Moderate' (7-9), 'Heavy' (10-13) and 'Very Heavy' (14-20) rehabilitation requirements as measured with the 20 point RCS-E.

Results: 457 patients were included from a possible 755 (61%). The majority were male (n=354; 78%) with a median age of 35 (IQR 24-50) years and median ISS of 16 (9-25). Two thirds of all patients had Heavy or Very Heavy rehabilitation needs (RCS-E: 10-20; n=288; 63%) and were very disabled (median BI: 6 (IQR 0- 11) on admission. Rehabilitation needs as measured by the RCS-E on admission were strongly associated with hospital length of stay ($p<0.001$) and the need for rehabilitation post-discharge ($p<0.001$). Although there was a reasonable correlation of ISS with rehabilitation needs, 40% of patients with mild to moderate injuries (ISS $\leq$15) had 'Heavy' or 'Very Heavy' rehabilitation needs, while 24% of severely injured (ISS >15) patients had 'Low' or 'Moderate' rehabilitation needs. Quality of life scores reduced on discharge as rehabilitation complexity increased ($p<0.02$). From the five components included in the EQ5D-3L only one component, 'pain and discomfort' did not have a statistically significant correlation with an increase in rehabilitation needs.

Conclusions: The ability to easily measure and predict rehabilitation needs and outcomes could potentially lead to improved allocation of rehabilitation resources. It is useful for discharge planning and able to identify patients at risk of poor health outcomes. Early assessment of rehabilitation needs using the RCS-E better predicts the level of rehabilitation required and provides more relevant information than injury severity scoring alone.

Poster # 88

OPPORTUNITIES FOR IMPROVEMENT IN TRAUMA CARE: ERROR PATTERN ANALYSIS AND COMPARISON BETWEEN A RECENTLY VERIFIED AND A MATURE TRAUMA CENTERS.

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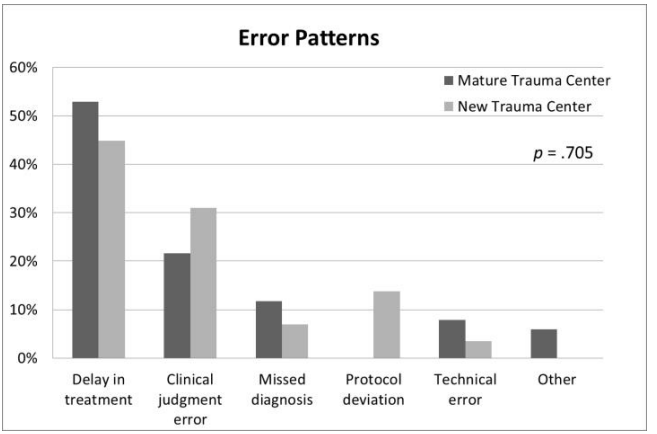
Introduction: Demonstration of an established death review process with identification of opportunities for improvement is required by the American College of Surgeons for trauma center verification. The objective of this study was to review all deaths with opportunities for improvement occurring at a recently verified academic Level I trauma center and compare patterns of error to those previously described for a mature Level I trauma center.

Methods: All trauma deaths were reviewed at a peer-review committee comprised of trauma surgeons, trauma liaisons (Emergency Medicine, Orthopedics, Neurosurgery and Radiology), nurses and trauma program staff. All determination regarding appropriateness of care and identification of opportunities for improvement were made at the committee. Death reports were used to abstract demographics, vital signs, injury type, ISS, autopsy findings, preventability and areas of improvement opportunities. Patterns of error were then compared between the two trauma centers.

Results: Since its verification in July 2009 until October 2015, the newly verified Level I trauma center admitted 19,651 patients. Mechanism was blunt in 89%, 67% were male, 22% had an ISS>16 and 18% required ICU admission. The overall mortality was 3.7% (730) and opportunities for improvement were identified in 4.5% (33) of those deaths. Opportunities for improvement included treatment delay (45%), clinical judgment error (34%), protocol deviation (14%), missed diagnosis (7%) and technical error (3%). This error pattern was not significantly different from what had been demonstrated for the mature trauma center (Figure). Those errors resulted or contributed to death through bleeding (28%), progression of brain injury (24%), multiple organ dysfunction syndrome (21%), cardiorespiratory arrest (10%), ARDS (7%), tension pneumothorax (7%) and metabolic imbalances (3%). The deaths peaked at two time periods: 29% during the first 6 hours and 38% after 7 days.

Conclusion:Trauma care provided at a newly verified Level I trauma center resulted in low rate of preventable deaths and an error pattern comparable to a mature trauma center, with treatment delay and error in judgment being the leading causes of death with opportunity for improvement.



Poster # 89

THE DENVER ED TRAUMA ORGAN FAILURE SCORE (D-TOF) IS A USEFUL TOOL FOR PREDICTING CLINICAL NEEDS OF LEVEL THREE TRAUMA PATIENTS

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Introduction: Trauma patients who do not appear severely injured or whose mechanism of injury (MOI) does not meet higher level criteria are often alerted at the lowest level (Level 3) and may subsequently be seen by the trauma team only as a consult with less concern for severe injury. This perception of injury severity without objective measures may be misleading and result in significant under-triage. Existing measures of injury severity such as the Injury Severity Score (ISS) are complex, and therefore not generated until later in a patient's hospital course, limiting their utility in anticipating needs of the patient early in their admission.
The Denver Emergency Department Trauma Organ Failure (D-TOF) Score is a six-item instrument that has been validated as an accurate tool to predict multi-organ failure (MOF) in trauma patients. Given its ability to predict MOF, the score could also potentially identify signs of more severe injury that may not be appreciated by providers during initial evaluation. As an objective and quickly generated score, the D-TOF may be useful in predicting the need for trauma team involvement, hospital admission, and post-discharge facility placement. We aimed to compare the utility of the D-TOF across the spectrum of injury severity and hypothesized that D-TOF scores would correlate with the need for higher levels of care in both those patients who were alerted at the lowest (Level 3) and highest (Level 1) trauma activations.

Methods: Following IRB approval, the institutional trauma registry of a rural Level One trauma center was queried for all adult Level 1 and Level 3 trauma activations, from 01/01/10 to 12/31/15. Level 3 patients were matched to Level 1 patients by age, gender, and mechanism of injury. Information collected included demographics, ISS, length of stay, post-ED and post-discharge destination, and in-hospital mortality. Additional chart review was performed to collect D-TOF criteria (age, intubation status, systolic blood pressure, hematocrit, blood urea nitrogen, and white blood cell count on arrival to the ED), and scores were calculated for all patients based upon these criteria. Patients who did not have a match, with incomplete data sets, or who were dead upon arrival to the trauma bay and therefore missing labs, were excluded.

Results: A total of 400 (200 Level 1 and 200 Level 3) patients were included. Patients in the two groups were matched by age (median 46.5), gender (70% male) and mechanism of injury (88% blunt), with p=1.000 for all three match criteria. Median D-TOF score for Level 1 patients was 3 (IQR 1-4), while for Level 3 patients median score was 0 (IQR: 0-1). Higher D-TOF scores correlated with a higher ISS. For every 1-unit increase in the D-TOF score in both Level 1 and Level 3 patients, there was a significantly higher need for post-discharge facility admission (rehab, skilled nursing facility) and longer ICU and hospital lengths of stay (Table 1).

Conclusion: The D-TOF is quick and easy to calculate, and is based upon information that is readily available during the initial evaluation of a trauma patient in the ED. The D-TOF score correlates with increasing injury severity and may be beneficial to predicting medical needs in those patients whose injuries are not readily apparent. Subtle yet objective information as laid out by the D-TOF may help guide one's decision to consult the trauma team and determine the need for hospital admission and subsequent medical care.

Table 1. Summary of results

	Level 1	P	Level 3	P
Post-D/C facility admission	OR: 1.16, 95% CI 1.00-1.35	0.044	OR: 2.13, 95% CI 1.29-3.53	0.003
Prolonged ICU LOS (days)	1.3 (95% CI 0.8 to 1.8)	<0.001	0.9 (95% CI 0.6 to 1.3)	<0.001
Prolonged Hospital LOS (days)	1.3 (95% CI 0.4 to 2.1)	0.002	2.0 (CI 0.9 to 3.1)	0.001
***results described are per 1-unit increase in D-TOF score**				

Poster # 90

DO IT AT YOUR OWN RISK: CANNABIS AND ALCOHOL ARE ASSOCIATED WITH INCREASED INJURY SEVERITY

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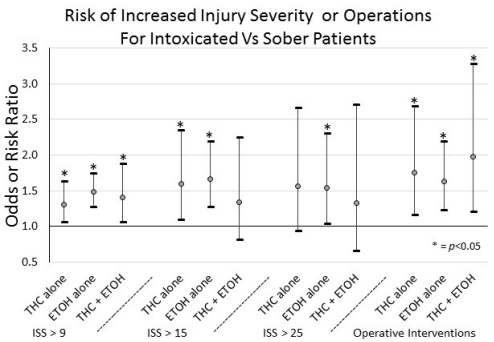
Introduction: Driving under the influence of alcohol is known to increase the risk of crashes, with a four-time crash risk at the legal limit of .08%. Cannabis (THC) on the other hand does not have a clear, indisputable, connection with crashes or a correlation with injury severity. There is an urgent need to define the relationship between THC and injury in order to promote safety, and guide legislation. This study aims to investigate the impact of cannabis and alcohol use on injury severity following motor vehicle (MVC) and motorcycle crashes (MCC). We hypothesize that cannabis and alcohol use are predictors of higher injury severity when compared to sober patients.

Methods: A retrospective review of our Level 1 trauma center registry from January 2008 to December 2016 was performed. Study population included patients over 15 years of age involved in MVC or MCC who underwent alcohol and toxicology screening, and were either sober, THC+ or alcohol+ (ETOH). Patients positive for other drugs were excluded. Demographics, ISS, need for operative interventions, hospital and ICU length of stay (LOS) and mortality were studied. Patients were grouped as follows: sober, THC alone, ETOH alone and THC + ETOH. Univariate, bivariate and multivariate logistic regressions were performed to determine the association of THC and ETOH with injury severity.

Results: 2,276 patients met study criteria. The mean age was 37.7 years, 70.0% of the population were between 15 and 45 years, 64.8% were male, 20.0% were MCC and 80.0% MVC. ISS distribution among the population was 72.1% ISS 1 to 9, 10.5% ISS 10 to 15, 10.13% ISS 16 to 25 and only 7.3% had an ISS >25. Within the population 59.1% were sober (n=1,345), 9.3% THC alone (n=212), 25.7% ETOH alone (n=585), and 5.9% were in the THC + ETOH group (n=134).

The mean hospital LOS was 3.9 days (SD±8.5), and mean ICU LOS 5.2 days (SD±8.6). Overall in hospital mortality was 1.1%, with no significant difference between groups. On multivariate regression analysis, positivity for THC or ETOH was an associated risk factor for higher ISS and for the need of an operative intervention when compared to sober patients (Figure).

Conclusion: Cannabis and alcohol use are associated with significantly increased injury severity for patients involved in motor vehicle and motorcycle crashes. These findings support the need for enhanced injury prevention and education on the risk of operating a vehicle under the influence of cannabis or alcohol.



Poster # 91

NON-POWDER FIREARM INJURIES IN THE PEDIATRIC POPULATION

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Background: Non-powder firearms (e.g. BB and pellet) have significant tissue penetrating capabilities given their comparable velocities to many powder firearms. Children are at particular risk due to the relative ease of access as well as an under appreciation of the injury potential associated with these "toys". Our objectives were to develop a descriptive analysis of non-powder firearm injuries and define their need for operative intervention.

Methods: Retrospective review of pediatric patients (0-17) sustaining non-powder firearm injuries evaluated at a pediatric trauma center between January 2006 and March 2016. Data elements included patient demographics, injury characteristics, hospital associated outcomes and operative interventions.

Results: 140 children were injured by non-powder firearms, of which 118 were male (84%) with a mean age of 10 years (1-16). The majority were Hispanic (64%), followed by non-Hispanic white (35%), and African American (1%). 125 (89%) were determined to be unintentional and 121 (86%) were transferred from a referring hospital. The average injury severity score (ISS) was 3 (1-35) with 11 (8%) having an ISS greater than 16. There were no deaths. Average hospital length of stay (LOS) was 2.4 days, and the average ICU LOS was 0.8 days. Injuries by body region included eye (63%), neck/chest (15%), head/face (12%), abdomen (5%), and extremities/others (5%) with 36% requiring operative intervention. Thoraco-abdominal injuries had a mean ISS of 7 with 50%requiring operation including 4 therapeutic laparotomies and 2 thoracotomies. 20% of children with eye injuries had decreased visual acuity and 11% suffered complete blindness.

Conclusion: The vast majority of non-powder firearm injuries are unintentional and occur in all body regions with a significant minority requiring operative intervention. To prevent non-powder firearm injuries, educational programs targeting firearm safety, parental supervision and responsible use are needed to guide parents and children. Additionally, we believe marketing of non-powder firearms should come with warnings regarding the risk of severe injury.

Poster # 92

PEDIATRIC MAJOR VASCULAR INJURIES: A 16-YEAR INSTITUTIONAL EXPERIENCE FROM A COMBINED ADULT AND PEDIATRIC TRAUMA CENTER

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Introduction: Vascular injury in the pediatric trauma patient is an uncommon phenomenon, comprising less than 2% of injuries, but is associated with a reported mortality of greater than 19% in some series. The purpose of this study was to characterize pediatric vascular injuries and analyze mortality of major vascular injuries (MVI) at a high-volume combined adult and pediatric trauma center.

Methods: A retrospective review (January 2000 – May 2016) was conducted of all pediatric (<18y) trauma patients who presented with a vascular injury. A total of 177 patients were identified in the 16- year study period, with 60 (34%) having a major vascular injury (defined as injury in the neck, torso, or proximal extremity). Patients were excluded if they died prior to admission or had injuries distal to the elbow or knee. Patients were then further categorized based on location of injury, mechanism, and age. A $p \leq 0.05$ was deemed significant.

Results: Of the 60 patients with MVI, the mean age was 14.3 years (range 4-17y). Mean ICU length of stay (LOS) was 5.4 days and mean hospital LOS 12.5 days. Blunt mechanism was more common in patients less than 13 years old while penetrating trauma was more common amongst patients greater than 15 years. Overall, blunt injuries had a longer ICU LOS compared with penetrating trauma (7.8d vs 3.1d; p=0.016).

A total of 33% (n=20) of MVI occurred in the torso with 50% (n=10) of these due to blunt trauma. The location of injury did correlate with mortality, with 45% (n=9) of torso MVI resulting in death (penetrating n=7; blunt n=2). The overall mortality from a MVI was 15.3% (n=9) with all of these being torso MVI. Higher Injury Severity Score (ISS) and Glasgow Coma Score (GCS) were also found to be independently associated with mortality.

Conclusion: Our experience demonstrates that major vascular injuries are associated with a significant mortality (15.3%), more than nine- fold greater than the overall mortality (1.6%) of pediatric trauma patients at our institution. Our overall major vascular injury mortality is consistent with previously published series, as is our demonstrated mortality of torso MVI. Further research should be aimed at improving management strategies specific for major vascular injury in the torso in the pediatric population.

Poster # 93

RETROSPECTIVE EVALUATION OF A PROTOCOL FOR THE DIAGNOSIS AND MANAGEMENT OF PEDIATRIC BLUNT RENAL TRAUMA

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Introduction: Injuries to the kidney are commonly seen following blunt abdominal trauma. Renal injuries may result in significant hemorrhage and extravasation of urine in the acute setting. Long term consequences may include renal insufficiency secondary to ureteral stenosis and arterial thrombosis. Children are more vulnerable to traumatic renal injuries due to a relative absence of perirenal fat and a soft thoracic cage. There are currently no standardized guidelines for the management of blunt renal injuries in pediatric trauma patients. We developed guidelines based on available literature and sought to validate them using retrospective data from two trauma centers.

Methods: After a literature review was performed, we developed guidelines for the management of pediatric blunt renal trauma based on available evidence. All cases of blunt traumatic pediatric renal injury from 2008-2015 at two local trauma centers were reviewed. Data collected included demographic information, grade of kidney injury, total hospital and ICU length of stay, need for blood transfusion, diagnostic imaging, and operative procedures. The proposed guidelines were then applied retrospectively to these cases.

Results: Evidence-based management guidelines were developed that specify initial imaging and level of care, criteria for hospital discharge, and activity restriction recommendations. In our retrospective review, a total of 50 cases were identified. 76% of patients were male and 24% were female. The median age was 13 years (range, 4-17). Motor vehicle collision (24%) and sports injuries (22%) were the most common causes of injury. Grade III renal lacerations were most common (34%) followed by grade IV (24%), grade II (22%), grade I (14%), and grade V (6%). 58% of patients had coexisting abdominal solid organ injuries and 12% had coexisting neurological injury. In 34% of patients, the kidney was the only site of injury. Among patients in whom the kidney injury was their sole injury, application of our protocol would have allowed earlier discharge in most cases. By grade, the average number of hospital days exceeding our guideline recommendations were 0 extra days for grade I, 1.3 extra days for grade II, 1.8 extra days for grade III, and 4.5 extra days for grade IV. This information could not be assessed for grade V injuries since all of these patients had other, severe injuries. Based on retrospective assessment, no major adverse events would have been missed under our guidelines. Interestingly, use of the guidelines would have required an ICU stay in 4 patients with grade III injury (66% of grade III patients, 8% of total) who were managed successfully on a med-surg unit.

Conclusion: Due to a lack of standardized care protocols for the workup and management of traumatic pediatric blunt renal injuries, we developed management guidelines. Retrospective review of how our guidelines would have fared in the management of 50 pediatric blunt trauma patients from two trauma centers suggests that our guidelines would not have resulted in adverse events or missed interventions. Furthermore, the protocol would have reduced hospital length of stay, but may have increased the total number of ICU days. In conclusion, a standardized guideline for the management of traumatic renal injuries in pediatric patients may expedite time to discharge without compromising care. The next step is to validate our guidelines in a prospective manner.

Poster # 94

ESTIMATES OF COMPUTED TOMOGRAPHY RADIATION RISKS IN PEDIATRIC BLUNT TRAUMA: LIBERAL SCANNING IS TO BE AVOIDED

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Introduction: Computed tomography (CT) imaging for blunt pediatric trauma balances potential radiation risk exposure with the probability of a missed injury. The aims of this study were to assess the diagnostic yield and radiation risk of computed tomography (CT) stratified by injury severity.

Methods: A 6-year (2010-2015) retrospective review of all blunt pediatric trauma patients (age<18) admitted to our Level I trauma center was performed. Pediatric patients stable enough to undergo CT imaging were included for analysis. Patients suffering traumatic arrest, prisoners, and pregnant patients were excluded. Data abstracted from the registry included age, sex, injury severity score (ISS), CT findings, radiation data (mSv), surgical interventions, outcomes and follow-up. Radiation exposure was tabulated from the dose-length-product adjusted for patient age, gender and body region. Cancer risks (CA) were estimated via the National Cancer Institute *RadRat* radiation risk calculator.

Results: A total of 1,161 patients were included for study. A total of 944 patients underwent screening CT (81%, mean=1.6 studies), 23 patients underwent delayed CT after triage (1.9%) and 323 patients received additional scans (28%). Overall mortality of the cohort was 1.03%. Follow-up was obtainable in 1,094/1,161 patients (94.2%). Injuries stratified by CT body region, injury severity and radiation risk are shown in **Table 1**.

Table 1: Assessment of CT Radiation Risk by Body Region and Injury Severity

Screening CT	# Injuries	# Additional Studies	# Additional Findings	Surgical Interventions	Number Needed to Treat	Excess XRT (mSv)	Excess CA Risk (%)
CT Head							
Mild TBI (GCS 13+) N=579	162	252	122	29	34	2.65	0.04
Mod TBI (GCS 9-12) N=49	21	37	18	5	17	3.32	0.05
Severe TBI (GCS ≤ 8) N=67	49	114	69	30	6	6.15	0.09
CT Cervical Spine							
ISS < 15 N=579	71	31	10	1	610	4.55	0.07
ISS ≥ 15 N=147	10	7	3	3	7	4.59	0.07
CT Abdomen/Pelvis							
ISS < 15 N=117	64	4	3	4	30	3.66	0.06
ISS ≥ 15 N=15	10	7	3	3	7	4.59	0.07
CT Thorax, Abdomen, Pelvis							
ISS < 15 N=376	182	24	14	12	33	8.19	0.12
ISS ≥ 15 N=140	121	23	14	28	6	3.24	0.05

Additional XRT Dose = # CT scans without significant findings x average XRT dose
NNT = Number Needed to Treat = Number of CT Scans Needed to Produce a Surgical Intervention
Extra XRT for patient = Total Patients/Additional XRT Dose

A total of 83 patients (7%) with a total of 89 injuries were missed by screening CT. The injuries were in the chest (45%-contusions/pneumohemothorax), abdominopelvic (24%-low grade solid organ injury), maxillofacial (21%-nasal fractures and dentition injury), intracranial (9%-expansion of original intracranial hemorrhage) and neck (1%-ligamentous injury) regions. No interventions were necessary in the chest or maxillofacial region, and all surgical interventions in the abdominopelvic region (7 total interventions) were successfully triaged by clinical examination, not requiring CT. Two mortalities in the missed injury group occurred, both due to devastating TBI and had repeat CT examinations showing bleed progression. Mean follow-up among survivors was 412 days (no mortalities reported).

Conclusion: Although the additional risk of cancer is low, the likelihood of a single CT scan leading to a surgical intervention is far lower. Moreover, missed injuries by screening CT are largely non-surgical, suggesting that a selective approach to CT imaging may be appropriate for pediatric blunt trauma.

Poster # 95

HOME IS NOT A SAFE HAVEN: CHILD FATALITIES FROM DOMESTIC MASS SHOOTINGS ARE INCREASING

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Introduction: Mass shooting events in public places are commonly sensationalized in the media. The incidence of domestic mass shootings, where children are most at risk, is underappreciated. We sought to identify the rate of children affected by domestic mass shootings.

Methods: Domestic (in the home) mass shooting data were compiled from the Everytown Research and Mother Jones open-source online databases. Mass shooting was defined as four or more firearm-related deaths not including the shooter. School, public, and drug-related shootings were excluded. Data on children (≤ 18 years) killed in mass shootings were stratified into two groups: EARLY (2009-2011) and LATE (2012-2014). Data are reported as mean ± standard deviation or percentage. EARLY and LATE groups were compared using Mann-Whitney U-test and Chi-square analysis.

Results: From 2009 through 2014, 119 child fatalities occurred in 48 domestic mass shootings in the United States. The child fatality rate per shooting was 2 ± 1 in the EARLY group and 3 ± 1 in the LATE group ($p=0.31$). The number of domestic mass shootings involving children decreased from 29 in the EARLY group to 19 in the LATE group. Compared to total fatalities for each incident, however, the number of children killed significantly increased between the two time periods (EARLY 38% vs. LATE 53%; $p=0.016$).

Conclusion: The child fatality rate from domestic mass shootings is significantly increasing. Greater attention to risk factors leading to gun violence in the home is warranted. A comprehensive federally-funded firearm injury prevention database is needed to guide injury prevention measures in the home.

Poster # 96

ROAD MAPPING THE USE OF CT SCAN IN PEDIATRIC LIVER INJURY: PHYSICAL EXAM AND SERUM TRANSAMINASES CAN SERVE AS A GUIDE

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Introduction: CT scan is considered imaging modality of choice for diagnosing hepatic injuries after blunt abdominal trauma. However, in pediatric patients risk of radiation associated damage precludes its widespread usage. There is a paucity of recommendations in the current pediatric guidelines regarding the use of CT scan for the diagnosis of hepatic injury following blunt abdominal trauma. The aim of our study was to determine if physical examination and serum transaminases would allow ruling out major liver injury following blunt abdominal trauma.

Methods: A 4-year (2008-11) retrospective analysis of all pediatric patients (<18 years of age) with blunt abdominal injury presenting at our level 1 trauma center was performed. Data on liver enzymes including aspartate aminotransferase (AST) and alanine aminotransferase (ALT), and physical exam (PE) findings were collected. PE was considered suggestive of hepatic injury if there was tenderness in right upper quadrant or lower chest wall, contusion or hematoma in the right upper quadrant, or instability in the right lower chest due to rib fracture was detected. Definitive diagnosis and staging of liver injury was based on abdominal CT findings. Sensitivity and specificity of ALT, AST, and PE to detect minor HI (Grade I and II) major HI (grade III, IV & V) were calculated alone and in combination with each other.

Results: A total of 188 pediatric patients with blunt abdominal injury were enrolled with mean (SD) age of 13.4 (4.8) and median [IQR] ISS of 17 [9-27]. 78 patients had hepatic injuries of which 41 patients had minor HI and 37 had major HI. Using receiver operating characteristic (ROC) curve assessment, optimum ALT and AST thresholds were deter-mined as >90 U/L and 120 U/L respectively. PE alone was 40% sensitive and 77% specific. Combining PE with AST or ALT had 95% sensitivity, 63% specificity, 48% PPV and 97% NPV (**Table 1).**

Conclusion: In hemodynamically stable pediatric blunt abdominal trauma patients, CT scan can be reserved for a select group of patients. Pediatric patients with positive physical examination and elevated serum AST or ALT may require CT scan to further evaluate liver injury, while in the absence of these findings, CT scan and thus unnecessary radiation can be avoided.

Table 1. Sensitivity, Specificity and Predictive Values of Physical Exam and Hepatic Enzymes

Variables	Sensitivity	Specificity	PPV	NPV
ALT	83%	79%	60%	93%
AST	73%	74%	50%	89%
PE	40%	77%	32%	82%
PE+ALT/AST	95%	63%	48%	97%

ALT=Alanine Aminotransferase, AST= Aspartate Aminotransferase, PE= Physical Examination

Poster # 97

PEDIATRIC VASCULAR TRAUMA: CURRENT MANAGEMENT AND EARLY OUTCOMES

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Introduction: The hospital course and early outcome of vascular injuries in the pediatric population is not well known due to a paucity of literature, and infrequent occurrence. We sought to describe pediatric vascular injuries including hospital treatment strategies and discharge outcomes using a multicenter, prospectively collected database.

Methods: We included patients 16 years or younger from patient data collected from the American Association for the Surgery of Trauma PROspective Vascular Injury Treatment (PROOVIT) registry. This registry contains demographic, diagnostic, treatment, and in-hospital outcome data for patients with vascular injuries.

Results: Between February 2013 and December 2016, 2,673 patients were enrolled into the PROOVIT registry. 83 of these patients were aged 16 years or younger (3% incidence). The majority were male (80%) with a mean age of 13.5 years (range 3-19). 60% (50/84) were injured by penetrating mechanism including 25 gunshot wounds and 7 stabbings. 36% were injured by a blunt mechanism. Hard signs of vascular injury were present in 41 patients. 61% (51/83) of patients were taken to the operating room immediately. CT scans were performed for diagnosis in 24% (20/83) of patients, most frequently for lower extremity injuries (7/20). The median ISS was 10 (25th percentile 5 – 75th percentile 18). 72% (60/83) of the injuries were to an extremity, 11% to the neck (9/83), and 17% to the abdomen or chest (14/83). Of the extremity injuries, 20% patients (12/60) had a pre-hospital tourniquet placed. 65% of extremity injuries were treated with open repair (39/60). Neck trauma was most commonly treated with observation in 5/9 patients. Abdomen or chest trauma was treated most frequently with open operations (6/14), followed by endovascular intervention (4/14). Overall mortality was 6.4% (5/83).

Conclusions: Pediatric vascular injuries are most frequently penetrating injuries to the extremities, commonly treated with open interventions. The use of endovascular techniques is rare for vascular trauma in this population. Mortality from vascular injuries in the modern era is rare.

Poster # 98

Influence of Concealed Carry Legislation and Socioeconomic Status on Pediatric Firearm Injuries

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Introduction: Pediatric firearm injury remains an important concern for morbidity and mortality in U.S. children. It was unclear to what degree local firearm legislation and socioeconomic status affected regional pediatric firearm injury patterns.

Methods: All children <15 years old treated for a firearm injury from 2001-2015 were identified from the trauma registry of a Level 1 pediatric trauma center that serves a population of more than 770,000 children. The hospital is part of statewide and regional trauma systems and has nearly 100% capture of this age group. The annual number of new and renewed concealed carry firearm licenses granted in the local county served by the children's hospital was extracted from public records provided by the Ohio Attorney General's Office. Median per capita income data were extracted from the 2010 United States Census Database and merged with the trauma registry based on home zip code. Multivariable logistic regression analysis was performed to investigate injury severity score (ISS) and demographic factors associated with surgical intervention.

Results: Overall, 177 children were evaluated after firearm injury. The cohort was mostly male (79.7%), Black (58.8%), ages 10-14 years (73%) and injured at home (44.1%). The annual frequency of firearm injuries varied, ranging from three in 2001 to 21 in 2005. Concurrently, the total number of concealed carry permits in Franklin County increased over 10-fold from 725 in 2004 to 7824 in 2015. There was no correlation between increasing number of concealed carry permits and annual pediatric firearm injury ($r = -0.27$, $p=0.39$). Overall mortality was low (n=9, 5%), but 89% (n=8, $p=0.092$) of the children who died were from areas with a median income of < $40,000. The rate of pediatric firearm injuries per 10,000 was 7.1 times higher for children from the lowest income group (<$30,000) compared to children living in the highest income group (>$70,000), (4.45/10,000 vs. 0.86/10,000, $p < 0.001$). While the cohort included 62 total zip codes, 51% of the cohort was from only 9 zip codes. Injured children less than 5 years old exhibited a significantly higher rate of severe injuries compared to older children ages 10-14 years (34% vs. 14%, $p=0.01$). The need for operative intervention was not affected by demographic factors but was associated with severe injury (ISS >15, AOR 3.35, 95% CI: 1.07-10.47).

Conclusion: The incidence of pediatric firearm injury did not correlate with the local prevalence of concealed carry permits. Instead, pediatric firearm injury appears to be a disease of poverty, isolated to specific geographic regions, disproportionally affecting young black boys. In order to prevent pediatric firearm injury, children living in geographic and socioeconomic areas at the highest risk should be identified and targeted for meaningful interventions and policy level provisions.

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Poster # 99

PEDIATRIC MORTALITY AND PREVENTABLE DEATH AT A MATURE TRAUMA CENTER

Nicole Fox MD,MPH, Anna Goldenberg-Sandau DO, Stacey Staman RN, John Porter* MD, Cooper University Hospital

Introduction: Overall mortality rates for children treated at trauma centers are low and may not be the best outcome measure to judge trauma center quality. For performance improvement purposes, however, it is critical to review pediatric mortalities and identify preventable/potentially preventable death (PD). We sought to characterize mortality in pediatric trauma patients at our center and identify causes of PD.

Methods: A retrospective review of pediatric ($\leq$14) trauma deaths (2006-2016) at our American College of Surgeons verified level 1 adult/level 2 pediatric trauma center was conducted. Patients that died from burns, drowning or hanging were excluded. Demographics, clinical characteristics, and autopsy data were collected. Injury severity (ISS) and trauma & injury severity (TRISS) scores were calculated for each patient. A multi-disciplinary panel reviewed all mortalities and rendered decisions regarding preventability and causes of PD.

Results: 3,065 patients were admitted over the study period and 48 died (mortality rate =1.6%). Overall, patients that died were primarily male (73%) with severe injuries (ISS 32 $\pm$ 19) caused by a blunt (85%) mechanism. Sixteen deaths (33%) were the result of non-accidental trauma (NAT). After calculating TRISS, 10 patients had a $\geq$50% probability of survival. 30% of patients with a TRISS $\geq$ 50% were determined to be PD's for an overall preventable death rate (PDR) of 6%. Failure to control hemorrhage (67%) and failure to secure an airway (33%) were the causes of PD. 38 patients had a <50% probability of survival and there were no PD's identified in this group (Table 1).

Conclusion: We identified a PDR of 6% at our institution and found that a TRISS $\geq$50% correlates significantly with PD. The causes of PD in the pediatric population were failure to control hemorrhage and failure to secure an airway.

Table 1. Characteristics of Pediatric Mortality by TRISS

	TRISS <50% (n=38)	TRISS ≥ 50% (n=10)	*p* value
Age	5±5	6±2	0.576
Gender (male)	76%	60%	0.425
Mechanism (blunt)	82%	70%	0.414
Injury severity score	35±20	21±6	0.035
Non-accidental trauma (yes)	29%	50%	0.266
Potentially Preventable death	0	3	0.006

Poster # 100

IS ROUTINE REPEAT HEAD IMAGING NECESSARY IN PEDIATRIC TRAUMATIC BRAIN INJURIES?

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Introduction: Unintentional injuries are the leading cause of death in all pediatric age groups, with a majority of trauma deaths coming from traumatic brain injuries (TBIs). TBIs are graded as mild, moderate, or severe, yet all are managed similarly in regards to diagnostic imaging. Standard imaging protocol is an initial head image followed by routine repeat head imaging within 24-48 hours. Imaging does come with risks in the pediatric population, such as ionizing radiation, cost, and effects of anesthesia. For these reasons, the use of imaging must be proven to be of greater benefit than risk in any given situation, even TBIs. Studies have indicated that both adult and pediatric populations with either mild or moderate TBIs do not receive a change in medical management with routine repeat head imaging. This study is aimed to evaluate the need for routine repeat head imaging for TBIs in the pediatric population.

Methods: Two separate comparison groups were evaluated to determine if routine repeat head imaging led to neurosurgical intervention; mild or moderate TBI (initial GCS 9-15) vs. severe TBI (initial GCS 3-8) and patients with a decrease in GCS at 24 hours vs. patients with no change or an increase in GCS at 24 hours.

Results: 441 total patients were involved in the study, 241 patients (54.6%) received routine repeat head imaging. Mild/moderate TBI patients received less change in medical management compared to severe TBI patients based on initial GCS after routine repeat head imaging ($p = 0.013$). A novel approach using serial GCS was utilized to compare a decrease vs. no change or increase in GCS during the initial 24 hours in patients receiving routine repeat head imaging in regards to changes in medical management and found no difference ($p = 0.130$).

Conclusion: This study concluded that patients with severe TBIs on presentation should be followed with routine repeat head imaging as it does lead to changes in medical management, while patients with mild or moderate TBIs could be followed clinically since routine repeat head imaging does not lead to a change in treatment. Changes in GCS during the initial 24 hours should not impact the use of routine repeat head imaging in all TBI patients.

Poster # 101

OBESITY FACILITATES DISTINCT GENOMIC CHANGES AND IMMUNE DYSREGULATION IN SEVERE TRAUMATIC INJURY

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Introduction: Obesity is associated with increased infectious and noninfectious complications following traumatic injury. Ongoing innate and adaptive immune suppression and immune cell dysregulation are postulated to drive hospital-acquired complications. We hypothesize that increasing body mass index (BMI) alters immune cell genomic expression profiles, promotes ongoing immune dysregulation, and escalates complication rates following severe traumatic injury.

Methods: We reviewed data from the Inflammation and the Host Response to Injury™ trauma database. Inclusion criteria included blunt trauma patients >18 years of age. Patients were classified according to World Health Organization BMI categories. Blood samples were obtained at 12 hours of admission and 6 additional standardized time points over 28 days. Affymetrix Glue Grant Human Transcriptome (GG-H) Arrays™ were used to complete the genomic analysis. Microarray expression was normalized using Robust Multi-array Average™ software. A paired t-test was used to compare probe set changes and time points. BRB Array Tools™ was used to perform pseudo-time ANOVA to compare genomic expression across BMI groups with time using a False Discovery Rate (FDR) of 0.001%.

Results: 222 patients were included in the analysis. Unsupervised analysis revealed over 14,000 probe sets significantly expressed for each leukocyte class (neutrophils, T-cells, and monocytes) compared with controls. Supervised analysis of neutrophil, T-cell, and monocyte genomic expression data 12 hours after injury revealed no significant differences between BMI classes. However, overweight and obese patients showed significantly greater genomic distance from the mean compared with normal weight patients at 24 hours after traumatic injury. Significant gene expression differences in overweight and obese groups persisted through 28 days compared with the normal weight group. Time series analysis identified 454 neutrophil, 266 T-cell, and 237 monocyte probe sets significant at FDR <0.001 over 28 days. An evaluation of genes associated with immune dysregulation revealed that the most overexpressed monocyte genes included *IL1R2* and *FCGR1A*, the most under expressed neutrophil genes included *IL8* and *CCL4L1/CCL4L2*, and the most overexpressed T-cell genes included *S100A12* and *PPBP*.

Conclusion: Specific genomic alterations in blood lymphocytes, monocytes, and neutrophils are predictive of BMI class and immune dysregulation following severe traumatic injury. These expression differences will be helpful to determine the risk for developing complications and infections following traumatic injury. There are several adaptive and innate immune genes identified that can serve as potential targets for therapeutic intervention to reduce complications following blunt trauma.

Poster # 102

COMPARISON BETWEEN AORTIC BALLOON OCCLUSION (REBOA AND ABDOMINAL AORTIC AND JUNCTIONAL TOURNIQUET (AAJT APPLICATION IN A SWINE UNCONTROLLED HEMORRHAGE MODEL

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Introduction: Uncontrolled truncal hemorrhage remains a major challenge for military medical personnel. Recent success with REBOA has generated interest in endovascular approaches to hemorrhage control, but it may not be feasible in far-forward military scenarios. The AAJT is FDA cleared as a junctional hemorrhage control device that may be placed mid abdomen. The present study investigated hemodynamics and survival of swine subjected to uncontrolled arterial hemorrhage and treated by REBOA or AAJT application.

Methods: Anesthetized female swine (50.5 kg) were subjected to a 20 ml/kg controlled hemorrhage, a femur fracture and then to an iliac artery injury (uncontrolled hemorrhage) to achieve a total 40% blood loss. Arterial hemorrhage was controlled by application of REBOA at zone III or AAJT application at the umbilicus for 60 min (n=10/gp). The iliac artery was repaired and pigs were resuscitated at 15 ml/kg with autologous blood (WB) beginning 5 min before release of the clamp/balloon. A femur fracture only group (n=5) was included as a control. All animals were monitored for 6 hr after arterial injury or until death.

Results: Mean survival time was similar among groups (360 min in controls, 352.7 min in the REBOA group and 334.0 min in the AAJT group). Only two deaths occurred at 287 min and 100 min in the REBOA and AAJT groups, respectively. Both treatments resulted in a rapid rise in MAP from 48 mmHg to 70 mmHg that began to fall during the course of treatments. Low volume resuscitation with WB improved MAP to about 65 mmHg. Heart rate rose in response to both treatments, and was higher than controls at 360 min. Cardiac output was reduced equally (~56 %) in both treatment groups, but was still lower than controls after resuscitation. No significant differences were found in hemodynamics or survival time between swine treated by REBOA or AAJT for 1 hr.

Conclusion: These data suggest that if an appropriate junctional or pelvic injury is identified, the medic operating in prehospital environments may be able to control hemorrhage with AAJT as effectively as using REBOA. Further work is underway to evaluate limitations and safety of these techniques and their inflammatory responses.

Poster # 103

ADIPONECTIN ISOFORMS ARE DIFFERENTIALLY ALTERED IN TRAUMA PATIENTS

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Introduction: Adiponectin is a hormone secreted predominantly by adipose tissue that regulates inflammation and insulin sensitivity. In blood, adiponectin circulates in three oligomeric isoforms; namely, high-, middle-, and low-molecular weight (HMW, MMW, and LMW, respectively). Oligomerization of adiponectin is critical for binding to specific receptors, and hence determine biological activity in target cells. The impact of trauma on adiponectin oligomerization is still unknown.

Methods: All blunt trauma patients admitted to the intensive care or step-down unit were prospectively screened for enrollment starting in 2015. Twenty-two patients were consented for blood draws within 48 hours of admission. Total adiponectin along with HMW, MMW and LMW isoforms were measured in plasma by enzyme-linked immunosorbent (Elisa) assay. Simultaneously, measurements of glucose, insulin and inflammation marker Interleukin-6 (IL-6) were performed. The control group was comprised of 16 "healthy" subjects with similar body mass index and gender distribution.

Results: Among trauma patients (injury severity score, ISS=17 ± 2), only two had a prior diagnosis of diabetes, but all patients exhibited insulin resistance with an elevated insulin resistance index (HOMA-IR = 5.2 $\pm$ 0.7 *vs* 1.3 $\pm$ 0.3 in trauma patients and controls, respectively). In addition, plasma concentrations of IL-6 were significantly ($p< 0.01$) higher than controls. Plasma total adiponectin level was markedly reduced in trauma patients compared to controls (3.8 ± 0.9 *vs*. 8.2 ± 2.0 μg/ml; $p < 0.01$). Among the three isoforms, reduction of HMW and MMW isoforms was the most important (-73 and -52%, respectively), whereas reduction of LMW was less severe (-21%). Neither total adiponectin nor adiponectin isoforms were associated with ISS, but both HMW and MMW isoforms were inversely associated with plasma IL-6 and HOMA-IR. By contrast, changes of blood LMW were neither associated with IL-6 nor with HOMA-IR.

Conclusions: Trauma is associated with strong reduction of plasma concentrations of total and HMW adiponectin, and marked alterations of adiponectin isoform distribution. These alterations are linked to inflammatory response and insulin resistance of the early phase of trauma. Further studies are warranted to establish whether adiponectin could be a potential therapeutic target in blunt trauma.

Poster # 104

THE PHYSIOLOGICALLY ACTIVATED PLATELET: A HINDERANCE TO PLATELET IMPEDENCE AGGREGOMETRY?

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Introduction:Historically, platelets were underappreciated in post-injury coagulopathy, but are now implicated as crucial mediators. Post-injury platelet dysfunction is common (even with normal counts) and associated with worse outcomes. Mechanisms of this dysfunction remain uncertain. Evaluating platelet function in real time remains technically complex and relies on agonist impedance aggregometry focused on the principle that platelets are non-thrombogenic in their resting state and aggregrate when stimulated. Concern exists that post-injury platelets undergo endogenous activation making them thrombogenic before agonist addition, diminishing responses to agonist aggregometry and underrepresenting platelet function. We sought to determine differences in the baseline impedance of post-injury and healthy platelets and hypothesized that post-injury platelets are endogenously activated and have higher baseline impedance.

Methods:Blood collected from 239 trauma patients with normal platelet counts (150-450x10^9/L) and 12 healthy donors at a single Level 1 Trauma Center was assessed using multiple electrode aggregometery. Agonist responses of the tissue injury pathway of platelet activation including collagen (COL) receptor and thrombin receptor-activating peptide 6 [TRAP] were measured as area under the aggregation curve in units (U), aggregation (AU), velocity (AU/min), and baseline/end impedance (Ω).

Results:The 239 patients had a median ISS score of 9 and an 8% in-hospital mortality. Median platelet count was 263x10^9/L (IQR 222-308), but 36% demonstrated dysfunction (U below manufacturer cutoff). Agonist activated median platelet function was lower compared to the controls (COL 49U vs. 70U, p=0.07, TRAP 97U vs. 114U, p=0.06). However, the median *pre-agonist* baseline electrical impedances were higher in the injured compared to controls (COL 1375 vs. 1354 Ω, p=0.07; TRAP 1393 vs. 1353 Ω, p=0.06). Despite this, there was no difference in end impedances to compensate for the difference in baseline. In fact, the median delta between end and baseline impedances for COL/TRAP was higher in the controls (150 vs. 119, p=0.05; 239 vs. 189, p=0.01). Injured patients had lower aggregation (curve height) compared to the controls for COL/TRAP (119 vs. 150AU, p=0.05; 146 vs. 179AU, p=0.02*)* and no difference in velocity (max slope of curve).

Baseline Multiplate Values Injured vs. Healthy Controls

	Injured (N=239)	Healthy (N=12)	*p*-value
Collagen Baseline Impedence Average (Ω)	1375 (1334-1407)	1354 (1308-1376)	0.07
Collagen End Impedence Average (Ω)	1527 (1477-1589)	1563 (1432-1655)	0.63
Collagen Delta Baseline-End (Ω)	159 (133-188)	200 (157-274)	**0.05**
Collagen Aggregation (AU)	119 (99-141)	150 (118-206)	**0.05**
Collagen Velocity (AU/min)	15 (12-18)	16 (14-19)	0.46
Collagen AUC (U)	49 (39-62)	70 (38-94)	0.07
TRAP Baseline Impedence Average (Ω)	1393 (1356-1421)	1353 (1332-1399)	0.06
TRAP End Impedence Average (Ω)	1579 (1526-1628)	1576 (1552-1625)	0.74
TRAP Delta Baseline-End (Ω)	189 (150-226)	239 (197-267)	**0.01**
TRAP Aggregation (AU)	146 (118-173)	179 (152-200)	**0.02**
TRAP Velocity (AU/min)	27 (22-31)	27 (24-30)	0.87
TRAP AUC (U)	97 (82-112)	114 (98-123)	0.06

*Data for skewed variables reported as median with inter-quartile ranges. *p* bolded for alpha <0.05, rounded to closest 0.00

Conclusion: Given the central importance of platelets following injury, elucidation of platelet deficits is critical for prognosis and therapeutic targets. Endogenous activation of platelets following injury increases baseline impedance by agonist aggregometry and may partially account for lower overall measures of platelet function post-injury. Curve characteristics not reliant on baseline impedance, including aggregation/velocity, may be better measures of dysfunction. Given the fundamental importance of platelet function for guiding resuscitation and affecting outcomes, a more comprehensive assessment of biologic platelet function post-injury is an essential focus of investigation.

Poster # 105

INSERTIONAL SAFETY AND STABILITY OF ALTERNATIVE DEVICES FOR NEEDLE DECOMPRESSION OF TENSION PNEUMOTHORAX DURING SIMULATED CASUALTY MOVEMENT

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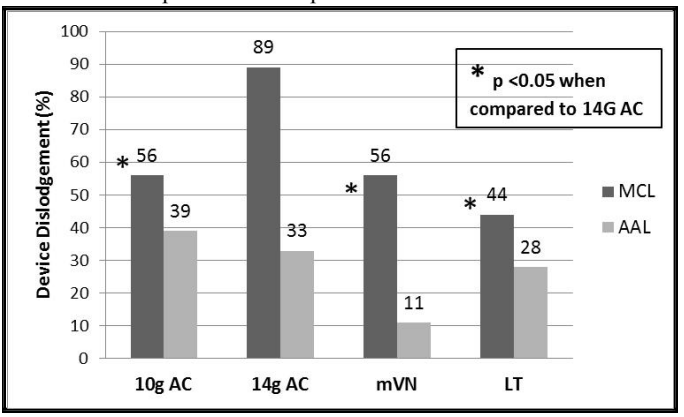
Introduction: Despite a high failure rate, immediate decompression with a 14 gauge angiocatheter (14G AC) in the 2nd intercostal space midclavicular line (2MCL) remains the current standard for treatment of tension pneumothorax (tPTX). Alternative devices, including 10G angiocatheter (10G AC), modified Veress needle (mVN) and laparoscopic trocar (LT), have shown promise in animal studies, but human data is limited. Previously, we have reported interim results of increased dislodgment at the 2MCL compared to the alternative 5th intercostal anterior axillary line (5AAL) during simulated casualty movement.

Methods:Twelve soft-embalmed cadavers were intubated and mechanically ventilated. Chest wall thickness (CWT) was measured. CO2 insufflation was used to simulate a tPTX and needle decompression was then performed with a randomized device (14G AC, 10G AC, mVN, 3mm LT). Insertional depth was measured between hub and skin before and after a simulated casualty litter transport with log-rolling. Thoracoscopy was used to evaluate for intrapleural placement and/or injury during insertion and after movement. Cadaver demographics, device movement and dislodgment (out of pleural space) and injuries were recorded. Three decompressions were performed at each site (2MCL/5AAL), totaling 12 events per cadaver.



Results:144 decompressions were performed. Average cadaver age was 55 years and BMI was 25 kg/m2. The 2MCL had a higher overall rate of dislodgement than the 5AAL (61% vs 28%, $p<0.001$). The 14G AC had a significantly higher rate of dislodgement than the any of the other three devices at the 2MCL, while dislodgement at the 5AAL was similar amongst all devices (Fig. 1). 7 total minor lung punctures of unlikely clinical importance were noted (6 at 5AAL; 1 at 2MCL). 2 diaphragmatic injuries were noted at the 5AAL in a cadaver with an elevated right hemidiaphragm.

Conclusion:The 5AAL is safe and significantly more stable than the 2MCL during simulated casualty movement and should be considered as the primary decompression site for tPTX. Additionally, device rigidity appears to play an important role in device stability, particularly in the less stable anterior location. The highly flexible 14G AC has an exceedingly high dislodgement rate at the 2MCL which further supports existing data regarding the need for a new alternative device.

Poster # 106

ELETRICAL VAGUS NERVE STIMULATION IMPROVES THE INTESTINAL BLOOD FLOW AFTER TRAUMA/HEMORRHAGIC SHOCK.

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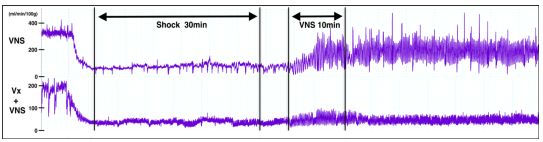
Introduction: Electrical stimulation of the vagus nerve (VNS) prevents gut damage in animal models of trauma/hemorrhagic shock (T/HS) by altering the gut inflammatory response to acute injury, independent of the spleen. However, its direct effect to the intestinal blood flow (IBF) is unknown. The aims of this study were: 1) to determine whether VNS causes a significant systemic hemodynamic effect; and 2) to determine whether VNS increases the IBF after T/HS.

Methods: Male Sprague Dawley rats were randomly assigned to undergo T/HS, T/HS+VNS, or T/HS+Vagotomy (Vx)+VNS. The rats underwent cannulation of the femoral artery and jugular vein to the T/HS (mean arterial pressure 25 mmHg for 30min). Following T/HS, cervical VNS was performed (5V, 2Hz, 10min) without fluid resuscitation. A chort of animals was subjected to abdominal Vx to disrupt the neuroenteric axis. The blood pressure (BP) and heart rate (HR) were recorded, and the IBF was simultaneously measured by laser Doppler flowmetry.

Results: The BP and HR were decreased for several seconds immediately after VNS. The BP then rapidly increased from 25.2 mmHg to 52.1 (34.2-62.8 mmHg) and the HR showed a slight increase . VNS caused an approximately 3.2-fold increase in the IBF in comparison to the shock phase ($p<0.05$). However, abdominal Vx elminated these effects of VNS ($p<0.05$) (See Fig).



Conclusion: We found that VNS promptly improved the T/HS-induced IBF impairment, suggesting that VNS may have an impact on acute gut injury after T/HS.

Poster # 107

VARIATION IN PATIENT PHENOTYPES PORTEND DIFFERENTIAL RISK OF POOR OUTCOME: A PRINCIPAL COMPONENT ANALYSIS OF THE NATIONAL TRAUMA DATA BANK

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Introduction:Characterizing trauma outcomes using standard multiple regression modeling risk overfitting and are limited by the statistical need to exclude potentially relevant covariates to minimize multicollinearity. Fortunately, advanced data mining techniques, including principal component analysis (PCA), provide powerful alternatives to define these relationships within large, complicated datasets. We sought to explore if PCA could be utilized to identify clinically significant patient phenotypes within the NTDB that would predict poor outcomes.

Methods:Using the NTDB-RDS (2008-2012), PCA was performed including all patients ≥16 years. Scores of significant principal components (eigenvalues >1.0, loading values >0.30) were included in multiple logistic regression to predict outcomes.

Results:Complete data were available for 539,141 patients, of which PCA identified 17 significant phenotypes that collectively explain 54.4% of the total outcome variance. As an example, phenotype 1 (PC1) is elderly hypertensive diabetic patients and is significantly associated with increased risk of mortality, acute renal failure (ARF), myocardial infarction (MI), pneumonia, stroke, but decreased rates of surgical site infections (SSI). In contrast, ARF, MI, PE, and decubitus ulcers are less common in PC3 (head injury) but PC3 has similar risk of SSI and increased mortality [Table].

	Acute Renal Failure	MI	Pneumonia	PE	Decubitus Ulcer	Withdrawal Syndrome	Mortality
	n=360,810	n=360,810	n=360,810	n=360,810	n=360,810	n=360,810	n=539,141
Principal Component Patient Phenotype	**OR**	**OR**	**OR**	**OR**	**OR**	**OR**	**OR**
1 Advanced Age, HTN, DM	1.40***	1.48***	1.14***	1.09***	1.17***	1.18***	1.23***
2 Blunt Injury	0.98	1.10**	1.05***	1.05**	1.12***	1.10***	0.86***
3 Head Injury	0.77***	0.90***	1.08***	0.80***	0.86***	1.29***	1.16***
4 Alcoholism & Smoker	1.03*	0.89***	1.18***	1.04*	1.05**	2.18***	0.87***
5 CHF, Respiratory Disease, Bleeding Disorder	1.26***	1.28***	1.19***	1.09***	1.20***	0.97	1.18***
6 Trunk & Spine Injury	1.21***	1.08***	1.21***	1.16***	1.22***	1.18***	0.88***
7 No Comorbidities	1.11***	1.05*	1.01	1.02	1.04	1.13***	0.98*
8 Functionally Dependent, DNR	1.07***	0.91***	1.09***	0.97	1.09***	0.95**	1.15***
9 Increased Temp, RR, HR	1.03**	1.01	1.04***	1.10***	0.99	1.19***	0.82***
10 Active CV Disease	1.11***	1.16***	1.04***	1.01	1.05***	0.99	0.96***
11 Active Cancer/Chemotherapy	1.02**	1.02	1.03***	1.04*	1.02	0.92**	1.08***
12 Diabetes with Renal Failure	1.21***	1.01	1.06***	1.03	1.10***	0.90***	1.09***
13 Upper Extremity Injury	0.92***	0.93**	0.95***	0.96	0.90***	0.74***	0.77***
14 Congenital Anomalies	1.04***	1.00	1.01	1.04*	1.01	0.99	0.95***
15 Liver Failure	1.08***	1.02	1.02***	1.01	1.05***	1.07***	1.05***
16 Obesity, Neck Injury	1.01	0.87***	1.06***	1.06***	1.08***	0.89***	0.94***
17 Increased Temp, O_2 Sat	0.83***	0.80***	0.88***	0.89***	0.95**	0.84***	0.88***

*$p<0.05$; **$p<0.01$; ***$p<0.001$

Conclusion:PCA is a data-driven method of dimensionality reduction that provides a unique approach to exploring trends in trauma to identify distinct patient phenotypes associated with poor clinical outcomes.

Poster # 108

SECONDARY RENAL MICROVASCULAR INJURY INDEPENDENT OF HEMMORHAGIC SHOCK IN A MURINE PULMONARY CONTUSION MODEL OF TRAUMA

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Introduction: Of the nearly 200,000 annual trauma-related deaths in the United States, 10-20%, or up to 40,000, occur 1 to 2 weeks after initial injury. These late deaths are possibly initiated by early, subclinical mechanisms. Previously, we hypothesized that injury-mediated systemic tissue factor mobilization in severe trauma drives microvascular thrombosis and resultant parenchymal inflammation in distant uninjured organs as an early event in trauma. We showed glomerular fibrin deposition and increased parenchymal ICAM-1 expression in a murine trauma model of pulmonary contusion and hemorrhage. Both pulmonary contusion and 15% hemorrhage independently and when combined led to increased tissue factor expression by monocytes. However, 15% hemorrhage alone was not sufficient for significant increase in glomerular fibrin deposition relative to uninjured animals. We hypothesized that 15% hemorrhage has a muted inflammatory response in the absence of concomitant tissue injury and this impacts glomerular fibrin deposition and inflammation.

Methods: Anesthetized male C57/Bl6 mice underwent 7.5%, 15%, or 30% hemorrhage by body weight through retro-orbital plexus phlebotomy. Anesthetized sham mice did not undergo hemorrhage. After 6 hours, a terminal bleed was performed.
Plasma was analyzed for creatinine, neutrophil gelatinase-associated lipocalin (NGAL), syndecan-1, and cytokines. Harvested kidneys were fixed, embedded, and sectioned for analysis by immunohistochemistry and immunofluorescence.

Results: A 50% mortality over 6 hours was seen with 30% hemorrhage while all mice survived in sham, 7.5%, and 15% hemorrhage groups. Renal parenchymal vacuolization was present within 6 hours following 7.5%, 15%, and 30% hemorrhage, suggestive of early renal injury, but there was no evidence of fibrin deposition in any of the groups. While plasma creatinine was unchanged in all groups, plasma NGAL was elevated in mice within 6 hours following 15% hemorrhage, also suggestive of early renal injury. Analysis of mice with 15% hemorrhage demonstrated no significant increase in plasma levels of MCP-1, IFN-gamma, IL-6, TNF, IL-12p70, or GCSF. Analysis of blood collected 6 hours after hemorrhage demonstrated no significant difference in plasma syndecan-1 levels.

Conclusion: A 15% hemorrhage alone did not result in glomerular fibrin deposition or systemic elevation of the cytokines and chemokines MCP-1, IFN-gamma, IL-6, TNF, IL-12p70, or GCSF. Hemorrhage of 7.5%, 15% or 30% did not lead to detectable syndecan-1 shedding though a 30% hemorrhage lead to 50% mortality. The results show that in a model of pulmonary contusion and hemorrhage, the hemorrhage alone is not sufficient to promote glomerular thrombosis. The results further provide a critical foundation for investigation of the contribution of tissue injury combined with hemorrhage as opposed to hemorrhage alone on the development of acute renal microvascular thrombosis following heterotopic trauma.

Poster # 109

THE UTILITY OF CARBOHYDRATE DEFICIENT TRANSFERRIN IN IDENTIFYING CHRONIC ALCOHOL USERS IN THE INJURED PATIENT: EXPANDING THE TOOLKIT

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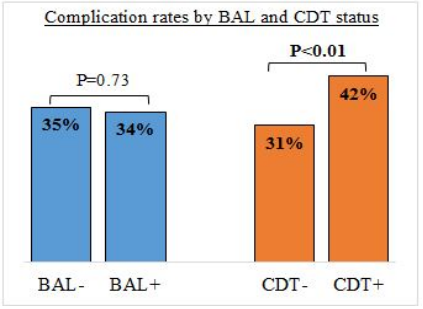
Introduction: Chronic heavy alcohol users have an increased risk of hospital complications, ventilator days, prolonged ICU stay, readmission, and potential mortality. While blood alcohol levels (BAL) provide limited interpretation, previous studies have demonstrated that the Carbohydrate Deficient Transferrin (%dCDT) blood test can better differentiate episodic binge drinkers from sustained heavy consumers. We sought to utilize %dCDT and BAL levels in trauma patients to characterize alcohol use as chronic or acute and to compare outcomes of those testing %dCDT+ and %dCDT-, as well as BAL+ and BAL-.

Methods: This prospective, observational study assessed %dCDT and BAL levels in trauma patients (≥18 years) at an ACS COT level-1 trauma center from 7/2014 to 6/2016. %dCDT levels >1.7% were considered positive for chronic heavy alcohol use. Using a multivariable linear regression adjusting for age, gender, race, ISS, GCS, and mechanism of injury (MOI), we compared outcomes by both %dCDT and BAL status.

Results: We studied 732 patients (77.1% male, 55.1% <40 years, and median ISS of 14 [interquartile range 6 to 22]). Common MOIs were motor-vehicle crash (41.8%), gunshot wounds (17.9%), motorcycle crashes (14.2%), and falls (10.8%). While 31.8% of patients had a positive %dCDT, 48.1% had a positive BAL (1-100: 16.7%, 101-200: 13.8%, 201+: 17.6%). After adjustment, patients with a positive %dCDT level had significantly longer ICU stays (+2.6 days, P<0.01) and days on ventilator (+3.9 days, P<0.01), compared to those with negative %dCDT levels. There was no difference identified between positive and negative BAL in relation to ICU and ventilation days. Furthermore, complication rates were also significantly different by %dCDT status (%dCDT+: 42% vs %dCDT-: 31%, P<0.01), but not by BAL status (Figure).

Conclusion: In this study, one-in-four (26%) trauma patients had a positive BAL but a negative %dCDT, which likely indicated binge drinking but not chronic alcohol use. We found that %dCDT, but not BAL, was a surrogate marker for worsened outcomes. Patients with a positive %dCDT had a longer ICU stays, longer ventilator days, and higher complication rates. Identifying these at-risk patients early on in their hospital course may improve outcomes.



Poster # 110

RAPID IDENTIFICATION OF PATHOGENS IN PATIENTS WITH SEPSIS USING PLASMA DNA SEQUENCING

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Introduction: One of every three to five patients who develop sepsis in the surgical ICU dies during the same admission. Diagnosis of bacteremia in sepsis relies on blood culture followed by antimicrobial sensitivity testing. However, this takes 5-7 days and often yields false negative results. We hypothesized that pathogens shed DNA into plasma and direct next-generation sequencing of plasma DNA in patients with clinical suspicion of sepsis will enable rapid identification of bacteria.

Methods: We conducted a prospective study of 30 consecutive patients suspected of sepsis in the Surgical Trauma ICU. Plasma samples were collected at the time of diagnostic workup for sepsis. Blood samples were collected in Streck Cell-Free DNA tubes and processed within 24 hours. DNA was extracted using QIAamp Circulating Nucleic Acid Kit. For patients with positive blood cultures, we performed whole genome sequencing of plasma DNA. After subtracting human DNA reads, we used an informatics approach developed in-house to identify sources of non-human DNA.

Results: 3/30 patients with sepsis had positive blood cultures growing Escherichia coli, Group B Streptococcus and Staphylococcus haemolyticus respectively. For 3 samples from these patients and 1 sample from a healthy control individual, we performed whole genome sequencing and generated 80-120 million sequencing reads per sample on 3 lanes of Illumina Hiseq. As expected, 95-98% of sequencing reads were of human origin. Number of bacterial species potentially contributing non-human plasma DNA ranged from 55-328 per sample, suggesting the need for further refinement of informatics approaches. When ranked by number of informative reads, the expected bacterial species was ranked 1/97, 7/307 and 4/55 for patients with Group B Streptococcus, Escherichia coli and Staphylococcus haemolyticus respectively. Corresponding ranks for the same species in the control sample were 119, 63 and 14 of 328 candidates.

Conclusion: Direct sequencing of bacterial DNA in plasma is feasible and may allow rapid identification of pathogens in patients with sepsis. Future efforts need to focus on enrichment of non-human DNA in plasma samples to increase assay accuracy and reduce cost of sequencing.

Poster # 111

DO PRE-ARRIVAL PHYSIOLOGY AND RESUSCIATION IMPACT FIBRINOYTIC PHENOTYPE? AN ANALYSIS OF THE PROPPR TRIAL.

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Introduction: Recent research has shown that both hyperfibrinolysis (HF) and fibrinolytic shutdown (SD) are associated with increased mortality in severely injured patients. However, among patients receiving massive transfusion (MT), the HF-phenotype is the most lethal. We sought to examine demographic, baseline and pre-arrival variables that might effect, or reflect, the admission fibrinolytic phenotype.

Methods: Trauma patients predicted to receive a MT at 12 level 1-trauma centers were randomized to one of two blood component transfusion ratios as described in the PROPPR trial. Fibrinolysis phenotypes were determined based on admission TEG clot lysis at 30 minutes (LY30): SD <0.9%; physiologic (PHYS) 0.9-2.9%; and HF ≥ 3%. Univariate and multivariate analyses were performed.

Results: Among the 680 randomized patients, 547 (80%) had admission TEG values available to determine fibrinolytic phenotypes. Among the three phenotypes, there were no differences in age, gender, race, or body mass index, but penetrating mechanism was higher in PHYS (60%) compared to SD (48%) or HF (35%), p<0.001). There were no differences in pre-arrival physiology between the three groups. However, the SD group received more fluids (median 1.7 L, IQR 0.5, 3.0) than either PHYS (1.1 L, IQR 0.3, 2.5) or HF (1.0 L, IQR 0.1, 2.4); p=0.060. The HF group received more pre-arrival blood products (median 2, IQR 2, 3) than either SD (2, IQR 1, 3) or PHYS (2, IQR 1, 3); p=0.001. Logistic regression (controlling for pre-arrival vitals, mechanism, and ISS) demonstrated that each liter of pre-arrival fluids was associated with an increase the likelihood of SD by 15% (OR 1.15, 95% C.I. 1.03-1.28, p=0.010), while each unit of blood was associated with an increase the likelihood of HF by 15% (OR 1.15, 95% C.I. 0.99-1.35, p=0.078).

Conclusion: In a large cohort of severely bleeding patients cared for at multiple level 1-trauma centers, pre-arrival resuscitation fluids are associated with arrival fibrinolytic phenotypes. Whether these fluid and blood product choices are causative or simply a reflection of underlying pathophysiology requires further study.

Poster # 112

The A, B, Cs of Trauma Do We Have The Orders Of The Factors Backwards? Circulation First: An American Association for the Surgery of Trauma Multicenter Trial

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Introduction: The traditional sequence of trauma care: Airway, Breathing, Circulation (ABC) has been practiced for many years without much evidence behind it. In patients with hypovolemic shock intubation drugs, and positive pressure ventilation can exacerbate hypotension. We hypothesized that patients in hypovolemic shock would have similar outcomes with initiation of bleeding treatment (transfusion) prior to intubation (CAB), compared to those patients treated with the traditional ABC sequence.

Methods: This study was sponsored by the American Association for the Surgery of Trauma (AAST) multicenter trials committee. We performed a retrospective analysis of all patients that presented to trauma centers with presumptive hypovolemic shock (history of hypotension or currently hypotensive SBP<90 mmHg), and required intubation in the trauma bay between January 1, 2014 to July 1, 2016. Data collected included demographics, timing of intubation, vital signs before and after intubation, timing of blood transfusion initiation related to intubation, and outcomes.

Results: Twelve centers were included in the study, two of these centers are international institutions. There were 440 patients who met inclusion criteria with 245 patients in the circulation first group (CAB). There was no difference in ISS, mechanism of trauma, or comorbidities between the groups (Table1). Both groups had similar amount of crystalloid infused by prehospital personnel (CAB 500 cc Vs. ABC 800 cc, p = 0.13). Both groups had a similar percentage of patients that received blood transfusion overall (CAB 62% Vs. ABC 68% p = 0.11). Patients in the CAB group had an average GCS of 9 compared with 4 in the ABC group, p = 0.0005. The only difference in hemodynamic parameters between the groups was a lower initial diastolic blood pressure in the CAB group (CAB 48 mmHg Vs ABC 51 mmHg, p = 0.03). Since these patients were in extremis mortality was high for both groups (CAB 47% and ABC 50%).There was no statistical difference regarding ICU admission, length of stay or mortality (Table2).

Table1.

	PRBC first	Intubation first	p-value	test
Age	41 (28-56)	37 (25-53)	0.26	Wilcoxon
ISS	25 (16-38)	25 (17-38)	0.99	Wilcoxon
penetrating mechanism	30.8%	35.5%	0.3	Chi-squared
SBP initial	80 (50-95)	82 (62-99)	0.1	Wilcoxon
DBP initial	48 (0-64)	51 (25-68)	0.03	Wilcoxon
IVF volume prehospital	500 (250-1010)	800 (300-1800)	0.13	Wilcoxon
any PRBC	62.1%	69.4%	0.11	Chi-squared
Hypertension	11.8%	10.6%	0.7	Chi-squared
other comorbidity	33.3%	33.5%	0.98	Chi-squared
MTP	34.4%	29.4%	0.27	Chi-squared

Table2.

	PRBC first	Intubation first	p-value	test
Lactate before	0 (0-3)	0 (0-2)	0.5	Wilcoxon
Lactate after	3 (0-6)	2 (0-5)	0.12	Wilcoxon
Initial GCS	9 (3-15)	4 (3-13)	0.0005	Wilcoxon
ICU	72.8%	67.8%	0.25	Chi-squared
LOS	8 (0-22)	4 (1-20)	0.24	Wilcoxon
Mortality	47.7%	50.0%	0.63	Chi-squared

Conclusions: The current study highlights that many centers are already initiating transfusion prior to intubation when treating hypovolemic shock, even in patients with a low GCS. This practice was not associated with an increased mortality.

Poster # 113

Oligoanalgesia in Trauma Patient Resuscitation: Physiologic Risk Association and Implications for Systems Improvement

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Introduction: Numerous studies have demonstrated the benefits of both early administration of analgesia to trauma patients and the system-wide improvement of analgesic delivery through implementation of evidence-based pain management protocols. Despite this evidence, oligoanalgesia—the under-evaluation and under-treatment of pain—is still widely reported in patients suffering traumatic injury. Commonly, trauma surgeons defend oligoanalgesia during the initial trauma resuscitation based upon concern for causing adverse effects with opioid analgesics in at-risk patients. The goal of this study was to determine if specific clinical concerns related to adverse effects of analgesics is the true primary driver of the trauma surgeon's tendency to under-manage pain, or if oligoanalgesia is better explained by under-prioritization or lack of appropriate protocols.

Methods: We performed an IRB-approved, retrospective medical record review of all adult trauma patients admitted to an academic Level I trauma center over a one year period whose initial evaluation was directed by a board-certified trauma surgeon and who were included in the institutional Trauma Registry. Exclusions were inter-hospital transfers, pregnancy, intubation, and cardiac arrest. Variables associated with possible increased risk for opioid adverse effect were compared against primary outcomes of analgesic administration, time to first analgesic dose, and total weight-based dose of analgesic received in the trauma bay using logistic and quantile regression.

Results: Included in the final analysis were 380 patients with the following profile: average age 45.5 ± 19.3 years, 72.1% male, 85.5% blunt injury, 40.5% post-ED destination of ICU, 21.1% post-ED destination of OR, 31.6% receiving prehospital opioid, and average Revised Trauma Score of 7.72 ± 0.41. Average time to analgesia was 14.5 ± 11.7 minutes; average total dose of fentanyl received in the trauma bay was 1.12 ± 0.8 mcg/kg. Patients with age >55 ($p=0.0001$) and with GCS <15 ($p=0.0265$) were at significantly higher risk of not receiving analgesia. Multiple variables correlated with increased delivery of analgesia including tachycardia, prehospital tachypnea, and abnormal breathing pattern on physical exam ($p<0.05$). No risk factors suggestive of hemodynamic instability (hypotension, tachycardia, bradycardia, abnormal breathing pattern, hypoxia, increased need for crystalloid/blood product resuscitation) were identified that correlated with risk of not receiving analgesia, increased time to initial analgesia, or decreased total dose of analgesia (p=ns).

Conclusion: Advanced age and altered mental status are risk factors for oligoanalgesia in trauma patients, as previously reported. There was no evidence that patients with additional signs of hemodynamic instability were less likely to receive analgesia, experience a longer delay to analgesic administration, or receive lower total doses of analgesic. We believe that the evidence provided in this study argues that oligoanalgesia in trauma patients is driven primarily by lack of prioritization and protocols, and less so by the intentional withholding of analgesia to those at higher risk for adverse effects of opioids. Our data suggests that there are numerous patients who could safely receive opioid analgesia—or could receive analgesia earlier—but fail to receive it. Institutional protocols prompting all trauma team providers for early analgesia consideration may improve the quality and safety of trauma patient care.

Poster # 114

IMPACT OF ADMISSION HYPERFIBRINOLYSIS DIAGNOSED BASED ON FIBRIN/FIBRINOGEN DEGRADATION PRODUCT LEVEL ON PATIENTS WITH SEVERE TRAUMA

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Introduction:Patients with severe trauma who develop traumatic coagulopathy are well known to have a poor prognosis. Fibrin/fibrinogen degradation product (FDP) is a highly sensitive and simple screening test that can be used to diagnose the presence of hyperfibrinolysis (HF). In this study, we aimed to clarify the relationship between admission HF diagnosed based on FDP level and hospital mortality in patients with severe trauma.

Methods:A single-institution retrospective observational study was conducted from January 2012 to December 2015. Adult trauma patients who were transported from the scene to a Japanese civilian trauma center with measured FDP at the time of admission and Injury Severity Score (ISS) ≥16 were enrolled in this study. Patients with cardiac arrest on arrival were excluded. Correlation between admission HF and hospital mortality was assessed using Pearson's correlation coefficient. Receiver operating characteristic (ROC) curve analysis was performed to evaluate the effect of admission FDP level with respect to mortality and to detect its cutoff value. Additionally, a comparison was performed between the HF and non-HF groups, which were divided based on the FDP cutoff value. Cox regression analysis was utilized to determine whether admission FDP level could be an independent mortality predictor.

Results:A total of 760 patients were enrolled in this study. Victims of blunt trauma accounted for 97% of the overall number of patients. Sixty-eight percent of patients received prehospital treatment. The median age of the patients was 60 [interquartile range: 42–71] years, the median ISS was 25 [18–34], and the mortality rate was 10.3%. The admission FDP value was associated with the injury severity (ISS; correlation coefficient: 0.50, P<0.01; Revised Trauma Score: −0.45, P<0.01, respectively). The area under the curve of the FDP value's ROC for hospital mortality was 0.86 (95% confidence interval [CI]: 0.82−0.91, P<0.01). The cutoff value of FDP was 80 μg/ml, and its sensitivity and specificity values were 80.8% and 68.7%, respectively. We divided the patients into two groups based on the FDP levels: HF (FDP ≥80 μg/ml, 277 patients) and non-HF (FDP <80 μg/ml, 483 patients) groups. Patients in the HF group were older and had higher injury severity than those in the non-HF group (median age, 65 vs. 56 years; median ISS, 34 vs. 22, respectively). The HF group used tranexamic acid (TXA) more frequently on arrival day than the non-HF group (57.0% vs. 43.9%, P=0.01). Cox regression analysis, which was adjusted for age, severity, and prehospital treatment, revealed that FDP level ≥80 μg/ml was a prognostic factor for HF (hazard ratio, 3.27; 95% CI, 1.64–6.51; P<0.01).

Conclusion:An FDP level ≥80 μg/ml was a prognostic factor for HF. TXA should be administered by at least this value.

Poster # 115

PROLONGED HYPERLACTATEMIA AND EARLY-ONSET MULTIPLE ORGAN FAILURE AS POST AORTIC OCCLUSION SYNDROME

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Introduction:Aortic occlusion (AO) methods, including open aortic clumping (OAC) and resuscitative endovascular balloon occlusion of the aorta (REBOA), are among the temporary hemostasis techniques for life-treating trunk injury. Patient survival rates have increased with the increasing use of REBOA worldwide. However, the probability of a fatal condition occurring after AO remains to be determined. We aimed to describe the clinical process following AO and clarify its prognostic.

Methods:A single-center retrospective study was conducted from January 2012 to December 2015. Among the 3,354 trauma patients admitted to a Japanese civilian trauma center, 75 adult patients who underwent resuscitative AO were included in this study. Patients who had cardiopulmonary arrest on hospital arrival were excluded. After data collection on the patients' characteristics, we selected 45 patients who survived for 24 hours or more after admission and divided them into two groups (survivor [S] group, n=23; nonsurvivor [NS] group, n=22). The Sequential Organ Failure Assessment criteria were used to diagnose multiple organ failure (MOF). Additionally, serum lactate level was adopted as a tissue dysoxia indicator. The criterion of prolonged hyperlactatemia (PH) was lactate level ≥4.0 mmol/L that persists for more than 24 hours after admission. Continuous variable was expressed as median [IQR].

Results:Victims of blunt trauma accounted for 94% of the total number of patients. Prehospital treatment, including OAC, was performed to 78% of the patients. The age of the patients was 61 [43–74] years, the Injury Severity Score (ISS) was 41 [25–54], and the hospital survival rate was 30.7%. The percentage of patients who underwent REBOA as the initial AO approach was 22.7%. The initial treatment of 50 patients (66%) were converted from OAC to REBOA. The proportions of patients with head injury (Abbreviated Injury Scale ≥3), chest injury, abdominal injury, and pelvic fracture were 46%, 88%, 41%, 25%, respectively. Crush laparotomy (45%) and pelvic packing (16%) were performed with thoracotomy during AO in the emergency department, followed by arterial embolization (18%). To compare the 45 survivors, the patients from the S group had higher ISS, Revised Trauma Score, and head injury proportion than those in the NS group. However, no differences in other injury lesion, AO approach, hemostasis, and transfusion amount were observed between the two groups. The NS group had significantly higher lactate levels upon hospital arrival and ICU admission than the S group (S vs. NS: 4.4 vs. 8.9, 5.3 vs. 11.0, respectively). The time from occlusion to initial deflation was significantly shorter in the S group than in the NS group (15 min vs. 34, $P < 0.01$). Meanwhile, the NS group had higher PH and MOF occurrences than the S group (21% vs. 54%, 39% vs. 77%, respectively). MOF occurred on the second day from ICU admission (2 [2–4]) and was associated with PH ($P<0.01$).

Conclusion:The hospital survival rate of patients with resuscitative AO was approximately 30%. MOF and PH frequently occurred after survival for 24 hours and were associated with hospital death. We propose to isolate this severe and specific pathology as Post Aortic Occlusion Syndrome (PAOS).

Poster # 116

A NOVEL METHOD TO DIRECTLY MEASURE FIBRIN STRENGTH IN A CONTRACTING CLOT

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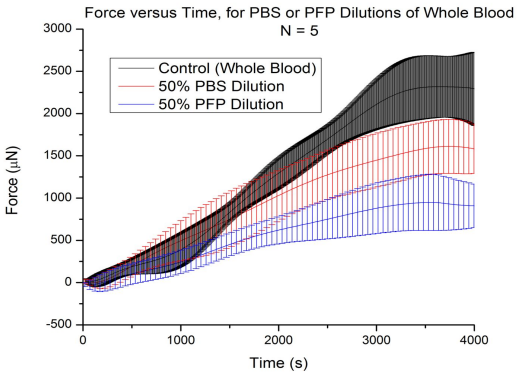
Background: Clot formation depends on stabilization by fibrin to provide structural strength. Fibrinolysis in trauma is associated with high mortality with empiric anti-fibrinolytic treatment having proven benefit. There is no proven method to discern the contribution of fibrin to clot strength. This study proposes a novel method to directly measure the fibrin component of clot strength.

Methods: Whole blood from healthy volunteers (N=5) was diluted by 50% with autologous platelet free plasma (PFP) or phosphate buffered saline (PBS). These two dilutions had similar platelet counts and the PBS dilution had fibrinogen concentration reduced by one-half. A novel device was used to measure platelet contraction forces. Re-calcified citrated blood injected between acrylic plates in a heated chamber formed an adherent clot. Platelet contraction within this clot against a wire cantilever was captured using a camera and microscope objective; force created by the contracting clot was captured over time. Assays were run in duplicate and differences ($p < 0.05$) were determined by ANOVA with Tukey post-hoc analysis.

Results: Platelets exert force on both the fibrin meshwork and the wire cantilever during contraction in this experiment. The maximum force detected for the PFP dilution was significantly decreased from the PBS dilution (1610 ± 320 Newtons (N) versus 950 ± 330 N, respectively). Both were different from control assays with a max force of 2317 ± 360 N. Increased fibrin concentration in the PFP dilution decreases the force transmitted to the wire cantilever and reflects strength of the fibrin component. The increased maximum force of the PBS dilution reflects the increased force transmitted to the wire cantilever due to decreased fibrin concentration. The difference between the PBS and PFP dilution represent fibrin strength.



Conclusions: This study demonstrates a novel method of isolating clot strength derived from fibrin.

Poster # 117

THE PHARMACOKINETICS OF TRANEXAMIC ACID VIA INTRAVENOUS, INTRAOSSEOUS AND INTRAMUSCULAR ROUTES IN A PORCINE (SUS SCROFA) HEMORRHAGIC SHOCK MODEL

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Introduction: Intravenous (IV) tranexamic acid (TXA) is an important adjunct for resuscitation of patients in hemorrhagic shock. However, IV access in these patients may be difficult or impossible. Alternatively, intraosseous (IO) or intramuscular (IM) administration could be quickly performed with minimal training. We investigated TXA pharmacokinetics when administered via IV, IO and IM routes in a swine hemorrhagic shock model.

Methods: Fifteen castrated male Yorkshire-cross swine (*Sus scrofa*) weighing between 58 and 72 kg were anesthetized, had 35% of their estimated blood volume (EBV) removed, and were randomized to IV, IO, or IM routes. Each animal was given 1gm/10mL of TXA (X-Gen Pharmaceuticals, Inc., Horseheads, NY) in a single dose. Physiologic parameters (heart rate, mean arterial pressure, oxygenation, and tissue perfusion) were continuously recorded and blood specimens (blood gases, electrolytes, coagulation profile, and serum for TXA concentrations) were intermittently obtained for five hours, after which the shed blood was returned, the animals recovered from anesthesia, and the injection sites monitored for seven days. The serum was analyzed with high pressure liquid chromatography-mass spectrometry (HPLC-MS) to determine TXA concentrations and pharmacokinetics via each route in a shock state. Gross examination of the injection site tissues and marrow was performed at necropsy.

Results: There were no significant differences in baseline measurements between groups. After hemorrhage, all animals lost a similar amount of blood (38% EBV, 22.8mL/kg, p=0.56) and were in a congruent state of class III shock with increased heart rate, decreased mean arterial pressure, and decreased peripheral tissue perfusion. Serum sample analysis by HPLC-MS showed all three routes achieved an adequate serum concentration of >10μg/mL within 10 minutes of administration which was maintained over 120 minutes. There were no injection site changes noted at necropsy.

Conclusion: TXA administration by alternate routes is effective in hemorrhagic shock patients without IV access. Further study is required to clarify pharmacokinetics in humans when administered via alternative IM and IO routes. This study will support the development of an IM TXA auto injector for battlefield self or buddy administration.

Poster # 118

EXPERIENCE WITH UNCROSSMATCHED BLOOD REFRIGERATOR IN EMERGENCY DEPARTMENT

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Introduction: Hemorrhage is the most common cause of preventable death within 48 hours following trauma. Uncrossmatched red blood cell (RBC) transfusion is fundamental in the initial resuscitation of hemorrhaging patients. Ready availability of uncrossmatched RBCs can be achieved by storing uncrossmatched blood in a blood bank refrigerator in the ED. We sought to describe our clinical experience using an ED blood bank refrigerator.

Methods: This retrospective study was performed at a Level 1 trauma and tertiary referral center from January 2013 to March 2014. Possible inappropriate transfusion was defined as patients who received ≤2 units of uncrossmatched blood from the ED refrigerator and no further transfusions in the first 24 hours. We examined all adult patients who received at least one uncrossmatched transfusion from the ED refrigerator. Deaths within the first 24 hours were excluded. Those who received ≤2 units from the ED refrigerator and no further transfusion were compared with those who received ≥3 units from the ED refrigerator.

Results: 158 adults received at least one unit from the ED refrigerator. 140 patients (88.6%) were trauma patients. 37 (23.4%) received massive transfusion (≥10 units in 24 hours). 42 (26.6%) deaths were excluded. 22 (19%) survivors received massive transfusion. 21 patients received ≤2 units (possibly inappropriately transfused) and 95 received ≥3 units in the first 24 hours (appropriately transfused). Appropriately transfused patients were more likely to have a HR >120 (35.5% vs 4.8%, p=0.004), a higher mean shock index (1.1 vs 0.8, p= 0.003), lower PO2 (95.7 vs 141.6, p=0.033) and hematocrit (24.7 vs 30.4, p=0.014), higher rates of massive transfusion protocol activation (52.6% vs 23.8%, p=0.028), and higher likelihood of receiving FFP (54.8% vs 11.8%, p=0.001). Appropriately transfused patients were more likely trauma patients, GI hemorrhages and ruptured abdominal aortic aneurysms. Potentially inappropriate uses were more likely in anemic patients without source of hemorrhage, trauma patients with extremity arterial injuries, and blunt trauma patients with either unexplained hypotension or abdominal solid organ injury without hypotension.

Conclusion: Storing uncrossmatched blood in an ED blood bank refrigerator is associated with a low rate of unnecessary uncrossmatched transfusion. This at risk group may be prospectively identified and potentially reduced through performance improvement.

Poster # 119

INFLUENCE OF INSTITUTIONAL DIFFERENCES ON EFFECTIVENESS OF RESUSCITATIVE ENDOVASCULAR OCCULUSION OF THE AORTA IN TRAUMA PATIENTS UNDERWENT EMERGENCY TORSO SURGERY

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Introduction: Excess mortality in Japanese trauma patients who underwent emergency torso surgery and resuscitative endovascular occlusion of the aorta (REBOA) in comparison of those without REBOA has been reported. However, the previous reports did not consider institutional differences as confounder of REBOA use. This study aimed to demonstrate mortality associated with REBOA use after adjustment for institutional (cluster) effect.

Methods: We conducted a retrospective analysis of trauma subjects who underwent any kind of emergency torso surgery and were registered in the Japan Trauma Databank. In addition to propensity score (PS) matching analysis, to adjust for institutional differences cluster-exact PS matching and multivariable linear regression mixed effect model (LMM) assessed association of in-hospital mortality and use of REBOA.

Results: Ordinal PS matching analysis (625 for REBOA and 625 for control) demonstrated association of excess in-hospital mortality and use of REBOA (mortality 61.8% versus 45.3%, difference +16.5% [95% confident interval +10.9%, +22.0%], P<0.001). After adjustment for cluster effect, use of REBOA remained hazardous in both cluster-exact PS matching (588 for REBOA and 588 for control, mortality 60.7% versus 40.5% [95% confident interval +14.5%, +25.9%], difference +20.2%, P<0.001) and LMM (634 for REBOA and 11419 for control, difference in adjusted mortality +26.7% [95% confident interval +22.2%, +31.2%], P<0.001).

Conclusion: Excess mortality in association with use of REBOA could not be explained by institutional difference which included hospital systems, resources and equipment, and skills of the trauma team.

Poster # 120

GERIATRIC TRAUMA PATIENTS WITH ISOLATED HIP FRACTURES - NO TRANSFUSION GOES UNPUNISHED

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Introduction: Geriatric trauma (G60) patients with isolated hip fractures (IHF) managed operatively are frequently given packed red blood cell (pRBC) transfusions. Blood transfusions have known deleterious effects such as transfusion reactions, viral transmission and immune suppression. In the G60 population there is an additional risk of fluid overload with CHF exacerbation. The purpose of this study was to determine the incidence of transfusions and to identity the predictors of pRBC transfusion in G60 trauma patients with IHF.

Methods: Consecutive trauma patients ≥60 years of age admitted (June 2014 – May 2016) with isolated hip fractures were retrospectively identified from our ACS Level I and III trauma registries. Patients were stratified based on pRBC transfusion. Outcomes were compared between transfused and non-transfused patients. Variables including demographics, mechanism of injury, injury severity score (ISS), hemoglobin values, clinical measures, fracture pattern, blood loss, and surgery type were compared between the two groups. Multivariate analysis was then performed to identify factors associated with pRBC transfusion.

Results: 447 trauma patients were reviewed for hip fractures and the receipt of packed red cell transfusions. The following hip fracture types were observed: Intracapsular=310 (69.4%), intertrochanteric=121 (27.1%), trochanteric=11 (2.5%) and subtrochanteric=5 (1.1%). One-hundred seventy four (174) out of 447 (38.9%) G60 patients were transfused. A statistically significant difference was noted in admission hemoglobin levels for transfused vs not transfused patients (11.56 vs. 13.18, $p<0.001$). A statistically significant association between fracture type and transfusion (Pearson's Chi-Square (3df) = 11.277, p=0.010. Sixty two (62) (51.2%) patients with intertrochanteric fractures were transfused compared to only 20% of patients with subtrochanteric fractures. A biphasic distribution was observed between total numbers of pRBCs transfused and hip fracture type. The largest pairwise difference in the units transfused was between patients with intertrochanteric vs. intracapsular fractures (0.291 units, (95%CI =0.047-0.535), p=0.047. Transfused patients had longer length of stay (LOS) (days) 6.3±3.6 vs. 4.7±2.3, p=.001 and were discharged home less frequently (23.4 vs. 76.6%) Z-score = 2.7454, p=0.006. Based on multivariate analysis, admission hemoglobin level, intertrochanteric fracture type and age, and LOS were independent predictors of transfusion after controlling for mechanism of injury, comorbidities and ISS.

Conclusion: In our population of G60 IHF patients, nearly 39% received pRBC transfusions. We have identified that patients with intertrochanteric fractures are at highest risk for receiving pRBC transfusion and these patients had longer LOS and were less likely to be discharged to home. Our intention is to use this information to promote a uniform set of transfusion criteria aimed at reducing pRBC transfusions and establish an acceptable benefit-risk ratio.

Poster # 121

EARLY USE OF A CHEST TRAUMA PROTOCOL IN PATIENTS WITH RIB FRACTURES IMPROVES PULMONARY OUTCOME

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Introduction: Rib fractures are among the most common injuries identified in blunt trauma patients. It has been shown that morbidity increases with increasing age as well as increasing number of rib fractures. At our Level 1 Trauma Center we noted a high number of patients requiring unplanned transfer to the intensive care unit (ICU) or unplanned intubation for respiratory distress. The use of noninvasive ventilation (BIPAP) has been shown to be helpful as a rescue technique avoiding intubation in patients who have become hypoxemic but little data with regards to its use to prophylactically prevent worsening respiratory status. We developed a Chest Trauma Respiratory Protocol (CTRP) for our "elderly" (>45yo) trauma patients and sought to determine if this would improve pulmonary outcomes.

Methods: We retrospectively reviewed our elderly chest trauma patients one year before (CTRL) and 9 months after implementation (STU) of CTRP. The protocol consisted of intravenous narcotics, oral non-steroidal anti-inflammatory drugs (NSAIDS), prophylactic BIPAP and measurements of incentive spirometry.

Results: In the control year there were 176 patients meeting study criteria while 140 met criteria in the study group. The CTRL group had 11 unplanned ICU admissions (rate=0.063), 6 unplanned intubations (rate=0.034) and 8 patients diagnosed with pneumonia (rate=0.045). These rates decreased in the STU group to two unplanned ICU admissions (rate=0.014, p=0.044), one unplanned intubation (rate=0.007, p=0.138) and no patients with pneumonia (rate=0.0, p=0.010). There were no adverse events from CTRP in the study group.

Conclusion: Our CTRP has significantly decreased adverse pulmonary events such as ICU transfer and pneumonia in our elderly blunt chest trauma population with multiple rib fractures. There is likely a decrease in unplanned intubations as well. All members of our trauma team embrace the CTRP and we use it frequently.

Poster # 122

Combining Resuscitative Endovascular Balloon Occlusion Of The Aorta (REBOA) And A Median Sternotomy In Hemodynamically Unstable Non-compressible Torso Hemorrhage (NCTH) Patients' With Penetrating Chest Trauma: Is This Feasible?

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Introduction: REBOA has emerged as an alternative for bleeding control in hemodynamically unstable NCTH patients. However, penetrating chest trauma remains an absolute contraindication for the use of REBOA. Distal aortic occlusion with REBOA in cases of proximal penetrating injury to the site of aortic occlusion offers both myocardial and cerebral perfusion support with the associated downside of potentially increasing the rate of bleeding from the injury site. That is why we propose that a median sternotomy be performed in conjunction with REBOA as a feasible and effective means of hemorrhage control in patients suffering from penetrating chest trauma who present hemodynamically unstable. The objective of our study was to present our initial experience with this approach.

Methods: A prospectively collected case series of the use of REBOA (10 French catheters) in conjunction with a median sternotomy from January, 2015 to December, 2016 at a Level I Trauma Center.

Results: A total of 68 trauma related emergent thoracic surgeries were performed at our institution during the study period. Of these, eight underwent REBOA plus median sternotomy **(Table)**. REBOA was placed in zone I of the aorta. The median (range) ISS/NISS was 25/41 (9-59/18-57). The median base deficit was 16 (4.6-21). Seven out of the eight patients suffered intra-thoracic vascular injuries: 2 subclavian arteries (one of them was at the point of origin), 2 internal mammary arteries, 2 aortic arch and 5 mayor central venous injuries. Four patients had an associated lung injury with AIS > 3, of which two suffered a pulmonary hilar vessel disruption. One patient had a right ventricular injury with an associated cardiac tamponade. Median systolic blood pressures significantly increased after REBOA placement (50 vs. 123 mmHg, p=0.01). The median time of aortic occlusion was 40 minutes (20-60). REBOA-related complications included one case of upper gastrointestinal bleeding secondary to gastric ischemia that resolved after standard medical treatment. One patient died in the operating room from coagulopathy and exsanguination. Overall 30-day survival was 87%. No adverse neurologic outcomes or deficits were observed in survivors.

Case	1	2	3	4	5	6	7	8
Age/Gender	19/M	34/M	35/M	46/M	19/M	22/M	34/F	18/F
Mechanism of Injury	GSW	GSW	SW	SW	SW	GSW	SW	GSW
ISS / NISS	25/48	59/50	16/57	25/36	13/34	25/41	9/18	25/50
Physiologic Status	pH=7.2 BD=4.6	pH=6.8 BD=21	pH=7.01 BD=21	pH= 7.23 BD=18	pH=7.3 BD=12	pH=7.1, BD=8	pH=7.26 BD=14	Ph=7.24 BD=19
Injuries	LSA	IV, IJV, RSV Grade IV Lung Grade IV Liver	RSA	MV, MA Grade V Lung	RV with Cardiac Tamponade Grade III Liver	RSV, AA Grade IV Lung	MA Grade II Lung	AA, ICA, Grade V Lung
SBP Before & After REBOA	80/123	33/65	78/131	46/100	70/NA*	50/130	NM/127	60/100
Time of Occlusion	40	40	26	60	NA*	57	53	20
Complications	None	None	None	Gastric Ischemia	NA*	None	None	None
30 Day Outcome	Alive	Dead	Alive	Alive	Alive	Alive	Alive	Alive

M= Male; F= Female; ISS= Injury Severity Score; NISS= New Injury Severity Score; BD= Base Deficit; LSA= Left Subclavian Artery; IV= Innominate Vein; IJV= Internal Jugular Vein; RSA= Right Subclavian Artery; MV= Mammary Vein; MA= Mammary Artery; RV= Right Ventricle; RSV= Right Subclavian Vein; AA= Aortic Arch; MA= Mammary Artery; NM= Non Measurable; NA= Not Applicable; ICA= Intercostal Artery; SBP=Systolic Blood Pressure

* The REBOA was not inflated.

Conclusion: The use of REBOA in conjunction with a median sternotomy can be a feasible approach for hemorrhage control in selected hemodynamically unstable NCTH patients' secondary to penetrating chest trauma. However, further study is required prior to widely adopting this approach.

Poster # 123

DOES HIGHER VOLUME EQUATE TO HIGHER SURVIVAL? A NATIONWIDE ANALYSIS OF EMERGENCY DEPARTMENT THORACOTOMIES.

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Introduction:Emergency Department Thoracotomy (EDT) is an aggressive approach for injured patients arriving in extremis. Current guidelines regarding EDT differ with respect to the indications and timing making this procedure the subject of continuing debate. To provide a modern perspective regarding the effectiveness of this procedure and to determine the effect of EDT volume on survival, we conducted an analysis of all EDTs for traumatic injury conducted in in the United States (US) between 2006 and 2012.
Methods:Data was obtained from the US Nationwide Emergency Department Survey (NEDS) for the years 2006 to 2012. Traumatic injury was identified using ICD-9 codes. EDTs were identified using the procedure code for "Open chest cardiac massage" (3791) and the Current Procedural Terminology (CPT) code for "Thoracotomy with cardiac massage" (32160) occuring in the ED. Injury severity was quantified using the ICD-derived Injury Severity Score (ICISS) and a cut off of 0.94 was used to identify patients with < 6% chance of survival. Trauma center designation, teaching status, and external cause of injury were categorized using NEDS variables. Descriptive statistical analysis consisted of survey-adjusted counts, proportions, means, standard errors (se), and 95% confidence intervals. We assessed univariate associations with unadjusted odds ratios with weighted estimates and robust covariances accounting for survey clustering. We conducted a multivariable logistic regression with fatality as the outcome variable controlling for age, and indicator variables for trauma center status, teaching status, and injury mechanism.
Results: 4,197 (se = 366) patient underwent EDT in the US between 2006 and 2012. The average age of a person undergoing an EDT was 35.5 (se = 1.9) with the large majority performed on men (86.9%, se=2.9). Of all EDTs, 83.5% (se=2.7) were performed in Level 1 or 2 trauma centers; 79.4% (se=3.5) were performed in urban teaching hospitals. Overall survival to hospital discharge for an EDT was 12.0% (se=2.9). All individuals undergoing EDT were classified as having severe injuries (ICISS < 0.94). The proportion surviving to hospital admission was 14.1% (se=3.9) in Level 1 or 2 trauma centers, and 9.1% (se=6.4) in non-Level 1 or 2 trauma centers ($p < 0.0001$). Fully 4.9% (se=0.6) of all severely injured (ICISS < 0.94) victims of firearms in the US underwent EDT, compared to 0.8% (se=0.2) of severely injured persons with stab or piercing wound injuries and 0.2% (se=0.03) of persons with severe motor vehicle crash injuries. Survival to discharge was 13.1% (se=1.7%) for firearm injuries, 7.5% (se = 2.5%) for stab or piercing injuries and 17.2% (se=3.4%) for motor vehicle crash injuries. In a multivariable logistic regression model that adjusted for age, gender, teaching hospital status and penetrating vs. blunt injury mechanism, a survival benefit was seen in EDTs done at Level 1/2 trauma centers (AOR = 0.65, 95% CI 0.51, 0.83). In the adjusted model, penetrating injuries were associated with a 19% higher survival than non-penetrating mechanisms, (AOR = 0.81, 95% CI 0.74, 0.89.)
Conclusion:Our study demonstrates a higher in-hospital survival proportion for EDT than is traditionally reported over a wide range of injury mechanisms, a finding which may add to the evidence for volume-outcome associations in trauma and may contribute to future EDT guidelines in regards to patient selection for this potentially life-saving procedure.

Poster # 124

FIRST RIB FRACTURE: A HARBINGER OF SEVERE TRAUMA?

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Introduction: Prior to computed tomography (CT), a fracture of the first rib was seen as a harbinger of severe trauma, specifically lethal great vessel injuries. The evidence for this assertion was limited. With widespread use of CT, many more first rib fractures (FRFs) are now identified whose impact on outcome is unknown. We hypothesized that FRFs identified on screening chest x-ray (CXR) may be found in conjunction with significant associated injuries, however when such fractures are only recognized on CT scan FRFs would be of minimal consequence.

Methods: Retrospective review of all adult blunt trauma patients presenting to a Level 1 Trauma center between January 2014 and October 2015 with chest abbreviated injury scale (AIS) ≥ 1 was performed. Patients with a FRF were divided into two groups, those diagnosed on initial CXR and those seen only on CT; demographics, characteristics and severity of injury, and outcomes collected from the trauma registry were compared. Additionally, charts of patients with FRFs were reviewed for associated injuries looking specifically for vascular injuries.

Results: Of 429 patients who met inclusion criteria, 56 patients (13%) had a FRF. The mean injury severity score (ISS) was higher in patients with FRFs than without (22 vs 18, p=0.01). These patients had increased need for intubation (36% vs 21%, p=0.016). Interestingly, FRF patients were found to have significant associated injuries, including 60% with ≥4 rib fractures and 82% with pelvic fractures. Of patients with a FRF, 11 (20%) were diagnosed on initial chest x-ray and 45 (80%) only on CT scan. Those diagnosed on CXR were older (61 vs 48 p=0.03), had a trend towards higher ISS (29 vs 21 p=0.068), and had more severe chest trauma (45% vs 13% with chest AIS>3, p=0.029). These patients also had an increased intensive care unit length of stay (10 vs 4 days, p=0.046) and need for intubation (73% vs 27%, p=0.011). There was only one vascular injury in each group of FRF patients, neither of which was clinically significant. There were no cardiac injuries, Horner's syndrome, or brachial plexus injuries identified in either group.

Conclusion: Once considered rare, the widespread use of CT scanning has resulted in the identification of high numbers of FRFs (13% of patients with any chest trauma vs 2.5% when limiting diagnosis to CXR). While not associated with life-threatening vascular injuries, FRFs do correlate with high morbidity and a significant incidence of associated injuries. In contrast to identification on CT scanning, first rib fractures diagnosed on CXR are associated with a significantly increased morbidity from blunt trauma. While not the harbinger of vascular injuries as once described, a first rib fracture, especially when seen on screening CXR, correlates with significant injuries and should still alert the trauma surgeon to evaluate the patient closely since many will require intubation and an ICU stay.

Poster # 125

COMPARISON OF STERNOTOMY VERSUS THORACOTOMY IN ISOLATED PENETRATING CARDIAC INJURY

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Introduction: The utilization and comparative outcomes of sternotomy and left thoracotomy used for the management of penetrating cardiac injuries (CI) is unknown. Our study sought to investigate it by analyzing data from the National Trauma Data Bank (NTDB).

Methods: Review of NTDB 2007-2014 included adult (≥ 16 years old) patients who underwent sternotomy (STER) or thoracotomy (THOR) for isolated penetrating CI and had length of stay >1 day. Patients who were either in shock (systolic blood pressure <80 mmHg) or dead on arrival were excluded. Patients' demographics, clinical characteristics, morbidity, mortality, geographic location and characteristics of treating hospital were compared between the two groups.

Results: 157 patients met inclusion criteria; 90 (57%) of them underwent STER. Mechanism of injury (stab vs. gunshot wounds), age, gender, and race did not differ between the groups. The THOR had lower GCS (median, interquartile range (IQR)); 15 (8-15) vs. 15 (15-15) (p=0.015); higher admission heart rate (113±28 vs. 107±25, p=0.045), and injury severity score (median (IQR): 25 (14-28) vs.17 (9-25); (p=0.005) than STER. The risk of complications in THOR (14.8%) did not differ significantly from STER (8.1%, p=0.2). There were no deaths in the STER group, and 5 (7.5%) in THOR (p=0.01). There were no differences between groups in trauma center designation level, academic vs. non-academic status, number of trauma surgeons, and bed-size of the treating facilities. There was significant regional variation in the use of STER vs THOR (p=0.0013); with STER more frequently performed in the South (75%) while THOR was more likely to be performed Western states (58%) (Figure 1).

Conclusion: In patients with penetrating cardiac injuries, lower GCS, higher heart rate and ISS were more frequently observed in those who underwent thoracotomy. Geographical location, but not other characteristics of the treating institutions, was associated with variation in the prevalence of the two procedures.

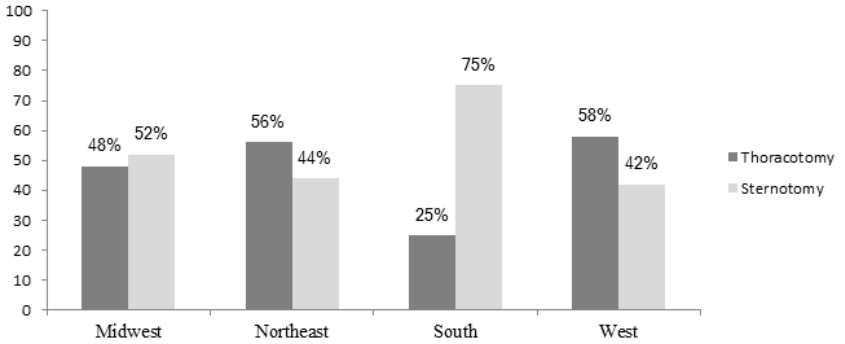

Figure 1. Geographical distribution of trauma centers and frequency of performance of sternotomy and thoracotomy.

Poster # 126

BLUNT AORTIC INJURIES IN THE NEW ERA: POLYTRAUMA RISK ASSESSMENT DICTATES MANAGEMENT STRATEGY

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Introduction: Blunt aortic injuries (BAI) are viewed as an indication for immediate surgery. The rise of endovascular aortic repair (EVAR) has dramatically changed the approach to this condition. Recent experience has suggested that some patients may benefit from delayed aortic repair when BAI is associated with other severe injuries. Treatment of multiple injuries needs to be prioritized based on associated risk of mortality. There are currently no guidelines for the optimal timing for aortic repair. The purpose of our study was to identify the risk factors predicting BAI-related mortality in polytrauma patients in order to implement the safest and most effective treatment strategy.

Methods: We reviewed blunt aortic injuries from 3 Level I Trauma Centers from July 2008 to December 2016. We analyzed overall and BAI-related 30-day mortality in relation to: hemodynamics on presentation, ISS, timing of treatment (immediate or delayed), procedure (EVAR vs open), and aortic injury grade as defined by the Society of Vascular Surgery. AI grade was dichotomized (AI) as stable grade I-II and unstable grade III-IV. We reviewed all the diagnostic radiology reports and CAT scan images classifying aortic injuries as "Severe" (radiographic severe injury, RSI) which included findings of (1) total/partial transection, (2) active contrast extravasation, and (3) the association of 2 of more of the following: contained contrast extravasation >10 mm, periaortic hematoma and/or mediastinal hematoma >10 mm, or significant left pleural effusion.

Table 1. Logistic regression of factors known soon after admission to predict the risk of overall mortality and BAI-related mortality.

	Mortality		BAI-related mortality	
	OR (CI)	P value[1]	OR (CI)	P value[1]
Age	1.01 (0.98,1.04)	0.406	1.01 (0.98,1.04)	0.665
Gender	2.16 (0.65,7.17)	0.210	4.69 (1.17,18.72)	0.029
AI	2.65 (0.67,10.45)	0.164	6.63 (0.79,55.41)	0.081
SBP <100	10.54 (2.61,42.65)	<0.001	24.00 (2.84,203.14)	0.004
HR ≥100	4.88 (1.37,17.44)	0.015	7.48 (1.47,38.17)	0.016
Pressors	7.86 (2.12,29.12)	0.002	6.33 (1.52,26.33)	0.011
RSI	3.02 (0.92,9.90)	0.068	5.37 (1.28,22.90)	0.023

[1]Univariate logistic regression.
Abbreviations: AI, aortic injury grade group; BAI, blunt aortic injury CI, 95% confidence interval; HR, heart rate; OR, odds ratio; RSI, radiographic severe injury; SBP, systolic blood pressure.

Results: Of a total of 76 patients (mean age 46, 71% male, median ISS 34), 50 (66%) underwent immediate repair, 24 (31%) delayed aortic repair, and 2 (3%) died prior to repair. 58 patients (76%) had EVAR, while 16 (24%) had open repair. Overall mortality was 18% and BAI-related mortality was 13%. In BAI-related mortalities, 70% of patients had RSI. Patients with high risk of overall mortality had SBP<100, HR≥100, and pressors. AI grade and RSI were not significant predictors for risk of overall mortality. Factors associated with BAI-related mortality included gender, SBP<100, HR≥100, pressors requirement, and RSI.

Conclusion: This is the largest survey of BAI in the modern era of EVAR. Imaging findings characterized by RSI are predictive of mortality associated with BAI. Radiologic assessment of the severity of BAI and characterization of the presence of RSI should direct management strategy guiding treatment priorities.

Poster # 127

A LARGE-SCALE POPULATION-BASED ANALYSIS OF OUTCOMES AFTER THORACIC AORTIC INJURY REPAIR

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Introduction: Despite the increase in endovascular repair of the thoracic aorta (TEVAR) for injury, there is no large-scale outcome assessment. We report perioperative outcomes among California trauma patients who received TEVAR and open repair of the thoracic aorta.

Methods: We evaluated the California Office of Statewide Planning and Development (OSHPD) patient discharge database for calendar years 2007 through 2014. Trauma patients with thoracic aortic injury were identified using ICD-9-CM diagnosis codes and external cause of injury codes. Procedure codes were evaluated for the use of TEVAR or open repair. Outcomes were mortality during the index admission, complications (cardiac, vascular, pulmonary, renal, and neurological), and readmission within 30 days. Two-level logistic regression was used to evaluate the association between both operative methods and each outcome adjusting for age, length of stay, admission year, trauma-related mortality probability, and comorbidity status while accounting for patient clustering by hospital.

Results: Among over 31 million hospitalizations during the study period, 48,357 cases (0.2%) of thoracic aortic disease were identified. Of these, 2,221 (4.6%) were unique trauma patients of whom 344 (15.4%) received operative management (263 underwent TEVAR [76.4%] and 81 [23.6%] received open aortic repair). There were no significant differences in race, sex, or mechanism of injury by operative method. Patients who underwent open repair were older than TEVAR patients (mean age 52.0 vs. 46.8, p = 0.038). There was no significant difference in mortality or 30-day readmission between TEVAR and open repair. Open repair was associated with greater odds for cardiac and neurological complications during the index admission.

Conclusion: Both the incidence and repair of thoracic aortic injuries were low. Importantly, mortality rates by operative method were similar. TEVAR was associated with fewer complications compared with open repair. This suggests that TEVAR, when appropriate, results in significantly lower morbidity.

TEVAR (Reference) vs. Open Aortic Repair			
Outcome	**OR**	**95% CI**	**p**
In-hospital Mortality	0.72	0.19 – 2.77	0.634
30 Day Readmission	0.68	0.20 – 2.28	0.532
Deep Vein Thrombosis	0.77	0.12 – 4.72	0.775
Pulmonary Complications	1.37	0.47 – 3.99	0.565
Renal Complications	1.84	0.81 – 4.16	0.145
Spine Complications	2.16	0.78 – 5.97	0.139
Cardiac Complications	15.12	1.59 – 143.60	0.018
Neurological Complications	2.59	1.06 – 6.28	0.036

Poster # 128

EARLY PREDICTORS OF DAMAGE CONTROL THORACOTOMY

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Introduction: Improved care and volume replacement strategies have resulted in more severely injured patients surviving emergency thoracotomies. A significant number of these patients may end up requiring a damage control thoracotomy (DCT). We retrospectively reviewed a series of trauma patients who were submitted to RT in order to identify risk factors associated with DCT.

Methods: Retrospective review in a level I trauma center. Demographics, clinical characteristics, surgical findings, physiologic variables and indication for massive transfusion were evaluated. Early predictors of DCT were identified by multiple logistic (MLR) modeling.

Results: A total of 187 thoracotomies were performed. Seventy one patients died in the operating room from exanguination and are excluded from the analysis. Of the 116 remaining 112, (96.6%) were male. Penetrating injuries occurred in 108 (93.1%). Median age was 27, (IQR 19.5 – 34) years. Median-IQR of RTS and ISS were 7.0 (5.9-7.4) and 17.5 (16-25) respectively. The lungs were injured in 73 (62.1%) patients, the heart in 35 (30.2%) and major vessels in 4(3.6%). Resuscitative thoracotomy was performed in 18 patients. Packing of different structures was performed in 41(35.3%), tractotomies in 32 (27.6%) and pulmonary resections in 10 (8.6%), three of them deferred. Temporary closure in DCT was done by skin suture over laparotomy pads in 35 subjects (66.0%). Seventy five patients met criteria for massive transfusion, (64.7%). Extrathoracic DC surgery was performed in 33 subjects (28.5%). Six (9.5%)of the non-DCT and 13(24.5%) of the DCT died.

The table shows the variable included in the MLR.

Table. Multiple logistic regression analysis of predictors of DCT

Variable	Descriptor	OR (95% CI)	p
Clinical			
Age (years)	27 (19.5 – 34)	--	0.45
GCS <8	20 (17.2%)	5.5 (1.2 – 24.8)	0.03
Physiologic Index <3	69 (59.5%)	--	0.98
Early indication of DCR*	75 (64.7%)	--	0.72
Intraoperative			
Amount of blood loss (Lt.)	2.0 (1.4 – 3.4)	2.1 (1.4 – 3.2)	<0.001
Need of aortic occlusion	23 (19.8%)	5.0 (1.3 – 19.7)	0.02
Extrathoracic damage control	33 (28.5%)	--	0.10
Main lesion in high risk organ**	75 (83.3%)	4.9 (1.5 – 16.6)	0.01

* Damage control resuscitation

** Lung AIS ≥3, major vascular, trachea or main bronchus, more than 1 bleeding source

The model had a good discriminative ability (AUROC 0.84, 95% CI 0.77-0.91) and goodness of fit (HL p 0.77).

Conclusion: We identified impaired mentation on admission, amount of blood loss, need for aortic occlusion and main injury in high risk structures as independent predictors of DCT that can be recognized early in the clinical evaluation and during the surgical procedure and may aid in the decision making process.

Poster # 129

ASYMPTOMATIC PENETRATING THORACIC TRAUMA: SHOULD COMPUTED TOMOGRAPHY REPLACE SERIAL CHEST RADIOGRAPHS FOR EVALUATION?

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Introduction: The optimal radiographic evaluation of patients with asymptomatic penetrating thoracic trauma remains unclear. Traditionally, serial chest radiographs (CXR) have been used to evaluate for subtle or delayed presentation of thoracic injury, but this approach requires three to six hours of observation in the emergency room and may not detect certain injury complexes. Thoracic computerized tomography (CT) with IV contrast is an attractive alternative that may allow for shorter observation times, and more expeditious diagnosis and treatment of injuries. We hypothesize that thoracic CT with IV contrast is as accurate as and more expeditious than serial CXRs, with added diagnostic capabilities for vascular injury.

Methods: We conducted a retrospective cohort study of all patients with asymptomatic penetrating thoracic trauma at our urban level I trauma center from January 2011 to December 2016. Data was extracted from the trauma registry and the medical record. All patients with a normal initial CXR and no thoracic symptoms were included. Follow-up diagnostic imaging choices were evaluated for sensitivity, specificity and predictive value, and patient outcomes and Emergency Department lengths of stay were compared.

Results: 190 patients met inclusion criteria. 98 (51.5%) underwent thoracic CT with IV contrast, 33 (17.4%) underwent observational management with three-hour CXR, and 59 (31.1%) underwent both modalities. Thoracic CT with IV contrast showed 100% sensitivity and 100% negative predictive value for thoracic injury, with a 91.2% specificity and 81.8% positive predictive value. Additionally, CT revealed four patients with significant vascular injuries requiring urgent intervention that were not appreciated on clinical examination. Negative thoracic CT with IV contrast was 100% predictive of negative 3-hour CXR. A negative CT (n=109) or negative three-hour CXR (n=92) independently predicted discharge without need for intervention in all patients. Patients who were evaluated with CT spent an average of 184 minutes in the ED in comparison to 327 minutes for those undergoing serial CXR, with an average difference of 143 minutes (95% CI 104 – 182, p= <0.0001.)

Conclusion: Thoracic CT scan with IV contrast is an effective tool for evaluating asymptomatic penetrating thoracic trauma. Its adoption would lead to faster diagnosis of significant injuries, rapid recognition of occult vascular trauma, and shorter emergency department length of stay for patients with non-significant injuries. This will help relieve congested urban emergency departments.

Poster # 130

IMPACT OF TRAUMA SYSTEM STRUCTURE ON INJURY OUTCOMES: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction: Injury leads to over 5 million deaths and 100 million temporarily or permanently disabilities every year worldwide. The effectiveness of trauma systems in decreasing injury mortality and morbidity has been well demonstrated. However, the organisation of trauma care varies significantly across trauma systems and little is known about which components of trauma systems contribute to their effectiveness. We aimed to systematically review evidence of the impact of trauma system components on clinically significant injury outcomes including mortality, function and disability, quality of life and resource utilization.

Methods: We conducted a systematic review of studies evaluating the association between trauma system components and injury outcomes. We searched MEDLINE, EMBASE, Cochrane CENTRAL, BIOSIS/Web of Knowledge databases, thesis holdings, key injury organisation Web sites and conference proceedings. Pairs of independent reviewers evaluated studies for eligibility and extracted data from included articles. We classed trauma system components according to recommended elements of trauma system structure published by the American College of Surgeons and the World Health Organization. We calculated pooled effect estimates using inverse-variance random effects models. We evaluated methodological quality using elements of the ROBINS-I tool and quality of evidence was evaluated using GRADE. This review was planned and conducted by members of *the International Injury Care Improvement Initiative*, a global effort of over 60 injury researchers, harnessing national capabilities in injury control from 30 low, middle and high-income countries.

Results: We screened 14,080 records, retaining 39 studies for qualitative synthesis and 20 for meta-analysis. Twelve of 24 recommended trauma system components were not evaluated on any outcome and 68% of intervention-outcome assessments were based on mortality. The following trauma system components were associated with reduced odds of mortality: pre-hospital triage protocols (OR=0.79; 95%CI=0.68-0.91), helicopter transport (Odds Ratio [OR]=0.70; 95% Confidence Interval [CI]=0.55-0.88), inclusive design (OR=0.72; 95%CI=0.65-0.80), and trauma system maturity (OR=0.76; 95% CI=0.68-0.85). Advanced Trauma Life Support (ATLS) was associated with a significant reduction in hospital length of stay (Mean Difference [MD]=5.7 days; 95% CI=4.4-7.0) but a non-significant decrease in mortality (OR=0.78; 95%CI: 0.44-1.12). Population density of surgeons was associated with a non-significant decrease in mortality rates (MD=0.58, 95%CI=-0.22-1.39). Quality of evidence on mortality was moderate for pre-hospital triage protocols, low for an inclusive design, density of surgeons and maturity and very low for ATLS and helicopter transport. Quality of evidence on health care utilisation was moderate for ATLS.

Conclusion: Results offer moderate evidence of the effectiveness of pre-hospital triage protocols, low evidence for an inclusive design and trauma system maturity and very low evidence for helicopter transport for reducing injury mortality. Further research should evaluate other recommended components of trauma systems and nonfatal outcomes and explore the impact system component interactions on clinically important outcomes.

Poster # 131

Helicopter versus Ground Ambulance Transported Trauma Patients: Does It Still Improve Patient Outcomes?

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Introduction: Shorter time to definitive care has often been considered a feature of mature trauma systems, related to the concept of the "Golden Hour". Helicopter Emergency Medical Services (HEMS) were introduced to civilians in 1947 to provide expedited transport to trauma centers for patients located in isolated communities. Despite the clear time-saving advantage helicopter ambulances held over ground ambulances in the past, improvements in pre-hospital care over the past decade have created uncertainty as to whether HEMS transport is still associated with better outcomes compared to ground transportation. We used a national trauma database to examine impact of transport times on trauma outcomes in a modern population.

Methods: A retrospective review was performed on patients from the National Trauma Data Bank who were transferred via helicopter or ground ambulance in 2014. Demographic information, length of stay (LOS), ventilator days, transport times, emergency department (ED) transport times, and mortality rate were abstracted. Transport times were dichotomized into 2 groups (<60 minutes and ≥ 60 minutes).Chi-Square test was performed to analyze categorical variables, independent t-test was performed to analyze continuous variables. Binary logistic regression model was performed to adjust for confounding variables in analyzing mortality rate between trauma patients transported by helicopter versus ground ambulance. The logistic model was statistically significant, Chi-Square=6444.5, $p<0.00001$. The model explained 27.0% (Nagelkerke R^2) of variance and correctly classified 96.9% of the cases.

Results: A total of 792,824 transferred trauma patients were analyzed. After adjusting for confounders (age, ISS Score, trauma severity, gender, ethnicity), trauma patients who were transferred by helicopter were 45.3% less likely to die than those transferred by ground ambulance (95%, CI 0.527-0.568, P<0.0001). Furthermore, HEMS patients had lower mortality rates with transport times <60 minutes (31.9%) and higher mortality rates with transport times >60 minutes (68.1%) (p=0.0001).

Conclusion: The results of this study demonstrated that despite improvements in trauma care in recent years, patients had improved survival if transported by helicopter ambulance. Helicopters appeared to decrease mortality in trauma patients, particularly those who could be transported within the "Golden Hour", as opposed to ground ambulances. The higher level of care provided by helicopter medical personnel and the inherent rapidity of air transport is still associated with better outcomes compared to ground transportation.

Outcome Variable	HEMS (n=80,669) (%)	Ground Ambulance (n=712,155) (%)	P-Value
Mean Age (SD)	39.3 (26.4)	39.9 (40.0)	<.0001
Gender (Male)	51,743	35,4737	<.0001
	Ethnicity		
White	57,135 (70.8%)	420,525 (59.1%)	
Black	6,581 (8.2%)	81,894 (11.5%)	**<.0001**
Hispanic	6,834 (8.5%)	59,828 (8.4%)	
Other	10,119 (12.5%)	149,908 (21.0%)	
Mean ISS Score (SD)	16.0 (48.3)	10.9 (46.9)	<.0001
Mortality	4,933 (6.1%)	15,879 (2.2%)	<.0001
Mean LOS in Days (SD)	7.8 (10.3)	5.0 (7.2)	<.0001
Mean ICU LOS in Days (SD)	3.0 (7.0)	0.5 (4.3)	<.0001
Mean Ventilator Days (SD)	-0.4 (3.1)	1.16 (5.6)	<.0001

SD: Standard Deviation; LOS: Length of Stay; HEMS: Helicopter Emergency Medical Cervices

Outcome Variable (n)	Less than or equal to 60 mins (n=466,659) (%)	Greater than or equal to 60 mins (n=150,562) (%)	P-Value
Overall Mortality	12,505 (2.3%)	7,241 (4.8%)	.0001
HEMS Mortality (4,359)	1,391 (31.9%)	2,968 (68.1%)	.0001
Ground Ambulance Mortality (1,4262)	10,393 (72.9%)	3,869 (27.1%)	

Mins: Minutes; HEMS: Helicopter Emergency Medical Cervices

Poster # 132

MILITARY SURGEONS IN A CIVILIAN SETTING: A COLLABORATIVE EDUCATIONAL MODEL

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Introduction: Maintaining currency and readiness for military surgeons in peacetime can be challenging. The current trauma experience at some Military Treatment Facilities is insufficient to ensure surgeons maintain the required skillset necessary to deploy to the combat theatre on short notice. To overcome these challenges, the Air Force has explored resource-sharing arrangements with civilian and Veterans Affairs medical centers. This paper will explore the contribution to readiness of a mature relationship between an Air Force Medical Treatment Facility (MTF) and a civilian Level 1 trauma center. Throughout the course of this relationship several staffing models have been tested. Most recently (2014) an active duty trauma surgeon has been embedded at the civilian facility, participating in daily rounds, conferences and call. In this study, we will examine surgical procedures and trauma care performed by active duty surgeons at this institution.

Methods: The Level 1 center's trauma registry was queried to identify the number of trauma patients with an ISS $\geq$ 15 treated by military surgeons working at the facility between 2006 and 2016. The electronic operating room record was queried for all emergency general surgery cases and procedures performed by active duty surgeons 2012-2016.

Results: Sixteen Air Force general surgeons have participated in this relationship at the facility between 2006 and 2016. They resuscitated 520 trauma patients with an ISS $\geq$15. Of the 520, 153 required immediate major operations by the Air Force surgeons. In addition, military surgeons operated upon 793 emergency general surgery (EGS) patients between 2012 and 2016, where they performed a total of 1481 procedures. The embedded trauma surgeon who started in 2014 resuscitated 125 trauma patients with ISS $\geq$ 15, and 63 required emergent surgery. During the same period the embedded surgeon operated on 693 EGS patients, performing 1215 procedures.

Conclusion: The relationship between an Air Force MTF and a civilian trauma center has contributed significantly to meeting deployment readiness requirements of the Air Force. Because of the long-standing relationship, these two facilities have afforded the opportunity to examine different staffing models. The embedded model provides the most extensive benefit to trauma surgical readiness and currency. Continuing and expanding this model to include more military surgeons and facilities has the potential to augment military preparedness. The national impact affects the patients cared for at the civilian institution and improved readiness and currency correlates directly with reduced battlefield mortality for those who put their lives in harm's way for our nation.

Poster # 133

TRAUMA PATIENT FLOW IN NEW YORK STATE PRIOR TO ADOPTION OF AMERICAN COLLEGE OF SURGEONS-COMMITTEE ON TRAUMA SYSTEM FOR TRAUMA CENTER DESIGNATION

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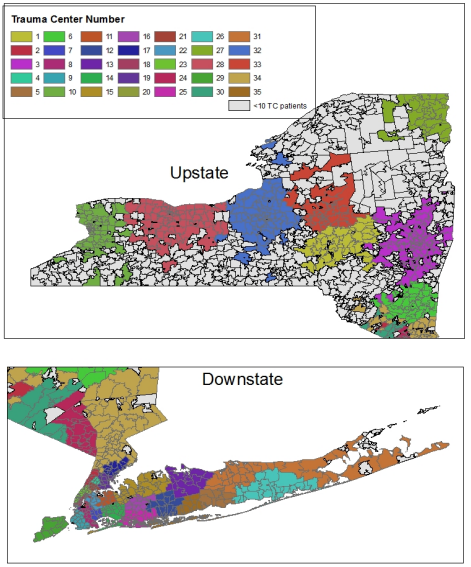
Introduction: In 2012, New York State (NYS) adopted the American College of Surgeons-Committee on Trauma (ACS-COT) standards for trauma center (TC) designation, but did not establish a concurrent process for needs assessment. To facilitate assessment of this system-wide change, we analyzed patterns of patient flow prior to implementation. Substantial heterogeneity in geography, population density and TC density across NYS may result in region-specific patterns of TC access and outcomes that have implications for trauma system policy. We hypothesized that upstate (US) TCs would have wider geographic catchment areas than downstate (DS) TCs but similar mortality rates.

Methods: We defined DS as New York City, Long Island, Westchester and Rockland counties and US as the remainder of the state. We conducted a retrospective cohort study of all injured adult NYS residents in 2011 using the State Emergency Department and Inpatient Databases. We compared patient and hospital characteristics, injury severity, diagnoses and mechanisms at US and DS TCs. We used multivariable logistic regression to calculate adjusted odds of mortality. We derived TC catchment maps from patient home zip codes.

Results: The 8 US and 27 DS TCs were similar in hospital ownership, staffing, and academic status. DS TCs saw 82% of all injured patients, but US TCs had higher proportions of patients with ISS > 15 (2.5 vs. 1.1%, $p < 0.001$). Falls were the most common mechanism and made up 1/3 of injuries in bot h regions. US patients were more often white and more often had private insurance, and were more likely to live in a low-income area ($P<0.001$ for all). Median distance from US patients' home zip code to a TC was 13.5 mi (IQR 4.3-41.6) vs. 2.9 (1.5-8.1) for DS patients ($p < 0.001$). Catchment areas are as shown in the Figure. Adjusted mortality was equivalent for patients with ISS > 15 but US TCs had higher adjusted mortality for ISS ≤ 15 (5.1 vs. 2.9%, $p < 0.001$).

Conclusion: US TCs draw on larger geographic areas. Population and case mix differ US to DS. Optimizing NYS trauma system performance may require attention to TC distribution. We anticipate differential interventions and impact of the ACS-COT system by region.

Figure: New York State Trauma Center Catchment Areas



Poster # 134

THE IMPACT OF AN ACUTE CARE SURGICAL SERVICE ON OPERATING ROOM PRODUCTIVITY

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Introduction: The literature on the financial and operational impact of an Acute Care Surgical service is equivocal. Previously, we examined the impact of a new acute care surgical service on the general surgery services at our institution using several OR management metrics. In this study, we apply productivity benchmarks to the various surgical services impacted by the new program.

Methods: Using WiseOR® (Palo Alto, CA), we extracted elective time-in-block and after-hours minutes for surgical cases with General Surgery (Blue, White) and Trauma/Critical Care Services (ACS) from October 5, 2014 to September 30, 2015. Blue and Trauma services shared coverage of urgent and emergent general surgical cases before implementation of the ACS service. White service (Surgical Oncology) did not take call and therefore served as an internal control. Starting on October 5, 2015, the ACS team covered all urgent and emergent cases. Total monthly workload was calculated for all three services during the study period by summing the elective time-in-block for all three services. Productivity by month was calculated for each service using the following equation:

Productivity = (workload)/(allocated hours + 1.5*over-utilized time)

Pre- and post-intervention means were calculated for productivity and workload for each group. Monthly allocated hours were calculated from the block schedules before and after implementation. All data was entered into Microsoft Excel (Redmond, WA) and analysis performed with Stata 13.1 (StataCorp LP, College Station, TX). Significance was set at $p < 0.05$.

Results: After implementation, group mean monthly workload increased 8.9% ($p < 0.001$). Blue service increased productivity 24.6% ($p = 0.005$) with no statistically significant change in workload. There was no statistically significant change in White service's workload or productivity. Trauma/ACS service increased workload by 136% ($p = 0.048$), yet productivity decreased 41.7% ($p = 0.019$).

Conclusion: Overall workload increased for the three surgical services after implementation of the ACS service, hinting at the plausibility of operational efficiencies from the additional staff members available for urgent and emergent surgical cases. The decrease in ACS productivity is interesting for two reasons. First, the ACS service needed to increase workload as well because it had been allocated additional capacity. Second, productivity is inversely correlated with over-utilized time. OR managers should consider productivity to measure the potential financial impact of an ACS service because there may be a limit to the productivity levels for such a capacity-based service.

Poster # 135

GEOGRAPHICAL LOCATION OF THE TREATING INSTITUTION AND SEVERITY OF INJURY ARE PREDICTORS OF THE NEED FOR REHABILITATION IN INJURED VULNERABLE ROAD USERS.

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Introduction: While injury patterns and clinical outcomes of vulnerable road users (VRU; pedestrians and pedal cyclists) involved in motor vehicle collisions (MVC), have been extensively studied, predictors of their discharge to rehabilitation are unknown.

Methods: Analysis of the National Trauma Data Bank from 2014 was performed and included all adult (≥16 years old) VRUs injured in MVC. Data on demographics, clinical characteristics (injury location and severity, comorbidities), treating hospital characteristics, and outcomes (complications, need for post-discharge rehabilitation, and mortality) were compared between pedestrians and pedal cyclists. A logistic regression model, accounting for clustering of patients within trauma centers, was developed using backward selection ($\alpha \leq 0.10$) to identify predictors of discharge to rehabilitation (or other care) vs home in these patients.

Results: There were a total of 27,784 VRU: 21,554 (77.6%) pedestrians, and 6230 (22.4%) pedal cyclists. Pedestrians had more severe injuries [mean ISS ± standard deviation (SD) 12.7 ± 11.0 vs. 10.9 ± 9.5], higher risks of complications (29.8% vs 25.1%, $p<0.0001$), need for post-discharge rehabilitation (34.4% vs. 20.4%, $p<0.0001$), and greater mortality (6.3%vs. 3.3%, $p<0.0001$) then pedal cyclists. Discharge disposition data were available for 17,958 of VRU subjects, 5197 (29%) of them were discharged to rehab. In the multivariable regression model, predictors of disposition to rehab vs home were as following: increased age, [adjusted odds ratio (AOR), (95% confidence interval (CI)): 1.25 (1.23-1.27) per 5 year increments], female gender [1.29 (1.18-1.40)], private insurance [1.34 (1.20-1.51)], and number of comorbidities [1.17 (1.13-1.21)]. Although increased abbreviated injury severity scores (AIS; range: 0-6)) of almost all anatomical body regions were significant predictors of the need for rehab, the presence of a lower extremity injury had the highest odds of discharge to rehab [AOR 2.11 (1.73-2.58)]. Geographically, when the South region of the United States was used as the reference, all other regions had higher adjusted odds of discharge to rehab: Midwest 1.66 (1.36-2.02), Northeast 2.11(1.73-2.58), and West 1.43 (1.20-1.71). Nonteaching hospitals were more likely to discharge to rehab than academic/community institutions [1.20 (0.98, 1.47)]. The area under the receiver operating curve (ROC) of the final model was 0.85 (95% CI 0.84-0.85). Race, facial injury severity, trauma center level (I/II vs all others) and adult bed size of the hospital were not found to be the predictors in this model.

Conclusion: Pedestrians and pedal cyclists injured in MVC frequently require post-discharge rehabilitation. Increased age, private insurance, female gender, lower admission GCS, and increasing numbers of comorbidities, along with increased severity of injuries, especially lower extremity injuries, predict the discharge to rehabilitation. Even after adjusting for possible imbalances in patient demographics and injuries, teaching/community hospitals and institutions in the South have reduced odds of discharging VRU patients to rehab.

Poster # 136

DISPARITIES IN TRANSFER PATTERNS AND MORTALITY AMONG SEVERELY INJURED PATIENTS TREATED AT NON-TRAUMA CENTERS: A STATEWIDE ANALYSIS

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Introduction: The transfer of severely injured patients from non-trauma centers to trauma centers is a hallmark of regionalized trauma systems. But clinical information regarding the patient selection process and the outcomes of those who are not selected for transfer has been lacking. The purpose of this study was to assess the transfer practices and patient outcomes at non-trauma centers.

Methods: Using data from the State Department of Health (2013-2015), we identified all adult trauma patients with an Injury Severity Score >15 admitted to non-trauma centers. We identified patients who were transferred to trauma centers and calculated the proportion of transfer patients for each hospital. Hospitals were then divided into quartiles according to their proportion of transfer patients. Multivariate logistic regression models were developed, clustering at the hospital level, to test for differences between the transfer and non-transfer cohorts. To examine in-hospital mortality in the non-transfer cohort, we excluded transfer patients and developed a multivariate logistic regression model, again, clustering at the hospital level.

Results: The study included 1,255 patients from 79 hospitals. The mean hospital proportion of patients transferred to trauma centers was 74% (SD 30%), and the median hospital proportion was 81%. Among the notable findings, older patients (>86 years) were less likely to be transferred than younger patients (15-26 years) (OR 0.40, CI 0.25-0.62); Medicare patients were less likely to be transferred than patients with private insurance (OR 0.47, CI 0.32-0.69); black patients were less likely to be transferred than whites (OR 0.50, CI 0.27- 0.94); and patients with burns (OR 9.37, CI 3.64-24.15) and penetrating injuries (OR 2.03, CI 1.03-4.00) were more likely to be transferred than patients who experienced falls. A total of 514 patients were not transferred to trauma centers. Among those patients, mortality was higher among men (OR 2.32, CI 1.25-4.33); mortality was higher in Medicaid patients compared to patients with private insurance (OR 5.26, CI 1.45- 19.11); and mortality was higher in patients with penetrating injuries compared with falls (OR 72.52, CI 10.67-492.99). Of note, hospitals that transferred higher proportions of patients to trauma centers had significantly higher mortality rates among the patients who were not transferred.

Conclusion: Significant disparities in patient selection for inter-hospital transfer and clinical outcomes exist among severely injured patients populations admitted to non-trauma centers. Those disparities are based on patient demographics, injury characteristics, and hospital factors.

Poster # 137

THE PERFORMANCE OF THE NBATS TOOL IN PREDICTING TRAUMA CENTER NEED OF A MATURE TRAUMA SYSTEM.

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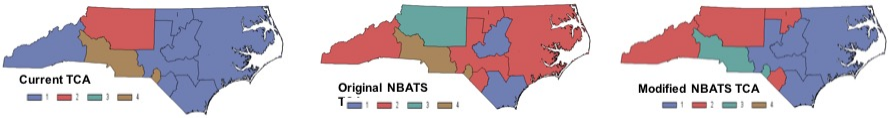
Introduction: Recent proliferation of trauma centers has pushed the debate of trauma center need to the forefront. In an effort to quantify the need, the American College of Surgeons Committee on Trauma Needs Based Assessment of Trauma Systems (NBATS) tool was created. The purpose of this study was to examine the performance of the NBATS tool in North Carolina.

Methods: The NBATS tool calculates the trauma center allocation (TCA) per trauma service area. We utilized the NC trauma registry, the NC EMS database, and the NC hospital discharge dataset to calculate the TCA. We assumed no current trauma centers within the trauma service area at both county and regional levels. We then compared to the results of the NBATS tool to the current allocation of centers. We then modified the tool to ease use and more accurately reflect the current center allocation. The weighted kappa (WK) statistic was used to evaluate inter-rater agreement.

Results: NC has 8 trauma regions with 12 total trauma centers (in 2014) of which 9 are level 1/2. The NBATS predicted a need of 17 level 1/2 centers (WK: 0.05). Modifying the NBATS by decreasing total allocation by 1, allowing allocation to be level 1,2, or 3 centers, and eliminating the ISS calculation improved the model fit significantly on the regional level (WK: 0.56). The NBATS tool did not perform well on a county level but was useful in geographic positioning of the centers within a region.



Conclusion: In NC, the original NBATS tool over-predicted the number of level 1&2 trauma centers required. Small modifications in the tool both improved the reliability and ease of use when compared with the current NC trauma system.

Poster # 138

GERIATRIC PATIENTS ON ANTITHROMBOTIC THERAPY AS A CRITERION FOR TRAUMA TEAM ACTIVATION LEADS TO OVER-TRIAGE

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Introduction: Geriatric patients on antiplatelet or anticoagulant therapy are at a theoretical increased risk of significant injury from low impact trauma. Deciding how best to utilize and mobilize limited trauma resources to meet the needs of these patients is challenging. In July 2015, in response to several delays in diagnosis, we amended our trauma team activation guidelines to include all patients over the age of 65 taking antithrombotic agents presenting with any head trauma; many of these patients would not have met traditional activation criteria based on physiology, anatomy, or mechanism alone. We aim to determine whether this practice was a justified use of resources and hypothesize that it resulted in over-triage of patients.

Methods: A retrospective analysis of our institutional trauma database was performed looking at all trauma contacts over the age of 65 who were reported to have been taking antithrombotic agents. The years before and after a policy change redefining trauma team activation criteria at our institution were analyzed and compared. The Student's T -Test was used for continuous variables and Chi-square or Fisher's Exact Test (where appropriate) were used for categorical data. P value <0.05 was considered significant.

Results: From July 1, 2014 to June 30, 2015, our trauma program saw 611 patients over the age of 65 who were taking antithrombotic agents, of which 182 (29.8%) met our lower tier trauma activation criteria. Of the 182 patients seen prior to the new guideline, 163 (89.6%) met Pennsylvania Trauma Outcomes Study (PTOS) criteria and six (3.3%) patients were discharged home from the emergency department (ED) without injury. One patient went to the OR with neurosurgery from the ED without trauma team activation. In the subsequent year after new guideline implementation, we saw 914 patients, of which 529 (57.9%) met our new activation criteria. Of the 529 patients, only 220 (41.6%) met PTOS criteria and 177 (33.5%) were discharged home from the ED without injury. Zero patients went from the ED to OR without trauma team activation. Patients evaluated after our policy change had a significantly higher GCS and lower total ISS. We saw a similar number of patient transfers from our referring sites in the two study years.

TABLE 1:	2014-15	2015-16	p
Trauma Team Second Tier Activations	182	529	
Age	79.6	79.9	NS
PTOS (% Activation)	163 (89.6)	220 (41.6)	<0.001
Post ED Destination - Home (% Activation)	6 (3.3)	177 (33.5)	<0.001
GCS	13.8	14.4	0.013
AIS Head	2.99	2.79	NS
ISS	12.66	10.87	0.018
Transfers In	139	131	NS

Conclusion: Our change in trauma activation criteria resulted in the trauma team seeing significantly more patients, many of whom had no injuries and were discharged to home from the ED without intervention. There were no significant differences in mortality, length of stay, or discharge disposition for admitted patients between the study years. Further evaluation is needed to determine which of these patients truly benefit from full trauma team activation versus facilitation of rapid head CT alone prior to activation.

Poster # 139

AN EVALUATION OF PRE-TRANSFER CRITERIA FOR INTERFACILITY AEROMEDICAL TRANSPORTS IN PREDICTING OVERTRIAGE IN TRAUMA PATIENTS

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Introduction: Aeromedical ambulances provide high cost advanced medical care for patients for whom ground transport may not be feasible, practical, or safe. There are only a few guidelines as to the necessity for this advanced level medical care. Four pre-transfer criteria for interfacility aeromedical transports were instituted at our facility in an attempt to identify the incidence and factors associated with overutilization of this costly resource. The purpose of this study was to identify pre-transfer clinical and injury related factors associated with overtriage in the use of aeromedical transport.

Methods: An analysis of all patients who underwent interfacility transfer to the regional level 1 trauma center via aeromedical service from January 2013-December 2015 was performed. Overtriage, as defined as discharge from the emergency department following transfer, was the primary outcome. Every transfer was reviewed by a panel consisting of two aeromedical ED physicians and a trauma physician to reach a consensus agreement on the criteria of each case. Information including mechanism of injury, patient demographics, outcomes data and pre-transfer clinical factors was obtained via electronic medical records and a prospectively maintained trauma registry.

Results: A total of 726 patients underwent aeromedical interfacility transport during the study period. Mean population age was 46.0 years (SD±24.3), 491 (67.6%) patients were male and blunt mechanism accounted for 81.0% of injuries. Mean ISS was 10.3±8.6. Overtriage was present in 182 (25.1%) of the transfers. Factors associated with overtraige included younger age, male gender, lower ISS, and penetrating mechanism of injury (Table 1). The presence of several individual pre-existing comorbidities was also highly associated with admission to the trauma center. Patients who were overtraiged met a fewer average number of pre-transfer criteria (1.55 v 1.12, p=0.001). Presence of a time sensitive injury and abnormal vital signs including hypotension, abnormal respiratory rate and decreased Glasgow Coma Score (GCS) were associated with appropriate triage. A multivariate logistic regression analysis of key variables available prior to transfer showed younger age (OR 0.98, CI 0.97-0.99), transfer from a non-trauma center (OR 4.86, CI 2.10-11.3) and penetrating injury (OR 2.54, CI 1.49-4.32) as significant independent risk factors for overtraige. Presence of a time sensitive injury (OR 0.25, CI 0.16-0.38), abnormal respiratory rate (OR 0.27, CI 0.08-0.83) and abnormal GCS (OR 0.03, CI 0.003-0.19) were associated with appropriate triage (C statistic = 0.799).

Table 1. Risk Factors for Overtriage in Interfacility Aeromedical Transfers n=726

	Appropriate Triage (n=544)	Overtriage (n=182)	p
Mean Age (years)	49.1 ± 25.0	36.6 ± 19.5	≤0.001
Male	354 (65.1%)	137 (75.3%)	0.011
African American	130 (23.9%)	78 (42.9%)	≤0.001
Penetrating Mechanism of Injury	81 (14.9%)	41 (22.5%)	0.022
Median ISS (IQR)	10.0 (5.0-17.0)	2.0 (1.0-5.0)	≤0.001
Transfer Criteria			
1. Time Sensitive Injury	390 (71.7%)	84 (46.2%)	≤0.001
2. Ground Transport Contraindicated	82 (15.1%)	29 (15.9%)	0.81
3. Ground Transport > 30 min	213 (39.2%)	74 (40.7%)	0.73
4. Abnormal Vital Signs	156 (28.7%)	16 (8.8%)	≤0.001
Hypotension	46 (8.5%)	6 (3.3%)	0.019
Tachycardia	32 (5.9%)	6 (3.3%)	0.247
Abnormal Respiratory Rate	38 (7.0%)	4 (2.2%)	0.016
Glasgow Coma Scale	82 (15.1%)	1 (0.5%)	≤0.001
Total Number of Criteria Met	1.55 ± 0.84	1.12 ± 0.84	0.001

Conclusion: We identified independent risk factors that led to an overall overtriage rate of 25%. Moving forward to reduce this overutilization, criteria for aeromedical transport needs to focus more on vital signs and less on penetrating mechanism of injury.