PROSPECTIVE VALIDATION AND APPLICATION OF THE TRAUMA SPECIFIC FRAILTY INDEX: RESULTS OF AN AAST MULTI-INSTITUTIONAL OBSERVATIONAL TRIAL

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Invited Discussant: Richard Miller, MD

Background: The TSFI was created & validated at a single center to accurately identify frailty while remaining a practical risk-prediction tool. The aim of this study is to prospectively validate the TSFI in a multi-institutional cohort of geriatric trauma patients. We hypothesized that frailty predicts worse outcomes in geriatric trauma patients. **Methods:** This is a prospective, observational, multi-institutional trial across 17 ACS Level I & II trauma centers. All geriatric patients (≥65 yrs) presenting during a three-year period were included. Frailty status was measured within 24 hrs of admission using the 15-variable TSFI, & patients were stratified: non-frail (TSFI ≤0.12); pre-frail (0.13-0.25); frail (>0.25). Outcomes include--ed index admission mortality, complications, & unfavorable discharge (skilled nursing facility/rehabilitation center), & 3-month post-discharge readmissions, falls, complications, & mortality. **Results:** A total of 1,321 patients were identified (Non-frail: 33%; Pre-frail: 30%; Frail: 37%). Mean age 77±8 yrs, 49% were male, median ISS was 9 [5-13], most common mechanism of injury was fall (69%). Overall, 14% had a major complication, 42% had unfavorable discharge, & 5% died during index admission. Frail patients had higher rates of complications (21 vs 14 vs 10%, $p<0.001$) & mortality (7 vs 3 vs 4%, $p=0.048$) compared to pre-frail & non-frail patients. Of 1,116 patients discharged who had follow-up information, 16% were readmitted within 3 months, 7% had a second fall, 7% had a complication, & 2% died within 3 months. On both univariate & multivariate analyses, frailty was associated with worse outcomes both during the index admission & 3 months post-discharge (**Table**).
Conclusion: TSFI was able to be applied at 17 ACS Level I & II trauma centers. TSFI is an independent predictor of worse outcomes, both in the short-term as well as long-term. TSFI is a practical & effective risk-stratification tool that clinicians should use in the management of geriatric trauma patients.

Table	Univariate Analysis				Multivariate Analysis- Independent Effect of Frailty		
Outcome Measures	Non-frail (N=435)	Pre-frail (N=392)	Frail (N=494)	p-value	aOR	95% CI	p-value
Index Admission							
Mortality	18 (4%)	13 (3%)	33 (7%)	0.048	1.93	1.12 – 3.32	0.018
Major Complications	35 (8%)	42 (11%)	102 (21%)	<0.001	3.55	2.26 – 5.57	<0.001
Unfavorable Disch. Disp.	131 (30%)	164 (42%)	259 (52%)	<0.001	1.98	1.44 – 2.72	<0.001
3-months Post-discharge							
Readmissions	39 (10%)	46 (14%)	96 (24%)	<0.001	2.70	1.69 – 4.31	<0.001
Fall Recurrence	10 (4%)	10 (4%)	40 (12%)	<0.001	5.77	1.94 – 17.15	0.002
Major Complications	17 (4%)	17 (4%)	42 (10%)	0.002	2.44	1.20 – 4.95	0.013
Mortality	1 (0.3%)	5 (2%)	16 (4%)	<0.001	6.89	2.17 – 21.85	0.001

aOR=adjusted odds ratio; CI=confidence interval; Disch. Disp.=discharge disposition

NOT SO FAST WITH ABC FOR NONCOMPRESSIBLE TORSO HEMORRHAGE: AN AD-HOC REVIEW OF AAST MIT

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Invited Discussant: Ryan Dumas, MD

Background: The tenet of Airway, Breathing, Circulation (ABC) after traumatic injury is standard of care but has recently begun to be called into question in patients with hemorrhagic shock. We sought to determine the impact of Emergency Department (ED) intubation in hypotensive noncompressible torso hemorrhage (NCTH) patients on mortality.

Methods: This was an AAST-sponsored multicenter, prospective analysis of hypotensive [systolic blood pressure (SBP) ≤ 90 mmHg] patients aged 15+ years who presented with NCTH from to May 2018-December 2020. Primary outcome of interest was in-hospital mortality after ED intubation.

Results: There were 237 patients included of which 92 (38.8%) were intubated in the ED prior to operating room (OR) disposition. Intubated patients were older (p=0.01), had higher median New Injury Severity Score (34 vs 27, p<0.001), higher median ED shock index (1.5 vs 1.3, p<0.001), lower median initial SBP (78 vs 82, p=0.001), and lower median initial Glasgow Coma Scale (8 vs 15, p<0.001).

Those intubated were more likely to be blunt injured (63% vs 39%, p< 0.001), have pelvic injury (31.5% vs 18%, p=0.02), and had higher mortality than those non-intubated (64.6% vs 32.3%, p<0.001). There was no difference between groups in regards of intra-operative cardiac arrest, damage control laparotomy or thoracotomy nor median time from ED to OR start. ED intubation in hypotensive NCTH patients was shown to be associated with significantly higher odds of mortality even after controlling for potential confounders. (**Table**) Analysis of the predictive ability of the model revealed an area under the curve of 0.814 (p<0.001).

Conclusion: ED intubation in hypotensive NCTH patients was associated with increased mortality even after controlling for injury type and severity and physiological derangement. This suggests a need to reorder the ABCs to address circulation first in this patient population. Future randomized trials are necessary.

Table. Multivariable logistic regression of factors associated with mortality

Parameter	Odds ratio	95 % CI	P
Age in years	1.06	1.03 – 1.09	**< 0.001**
Penetrating injury	3.71	1.19 – 11.64	0.02
Pre-hospital crystalloids given	1.11	0.45 – 2.79	0.82
New Injury Severity Score (NISS)	1.05	1.02 – 1.08	**< 0.01**

WHEN IS ENOUGH ENOUGH? ODDS OF SURVIVAL BY UNIT TRANSFUSED

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Invited Discussant: Michael Goodman, MD

Introduction: Balanced transfusion is lifesaving for hemorrhagic shock. Massive transfusion protocols (MTP) expedite delivery of blood in balanced ratios. The American Red Cross critical blood shortage in January 2022 threatened the immediate availability of blood products. To eliminate waste, we reviewed the utility of transfusions per unit (U) at an urban level 1 trauma center. The goal was to define expected mortality at various levels of balanced blood product resuscitation.

Methods: A retrospective study of 296 patients receiving MTP on presentation was performed from January 2018 to December 2021. U of packed red blood cells (PRBC), fresh frozen plasma (FFP), and platelets (PLT) received in the first 4 hours were recorded. Patients were excluded if they died in the Emergency Department (DIE), died on arrival (DOA), received <2U PRBC or FFP, or received PRBC: FFP >2:1. Primary outcomes were mortality and odds of survival to discharge. Subgroups were defined as transfused (T) if receiving 2-9U PRBC, massive transfusion (MT) for 10-19U PRBC, and ultramassive transfusion (UMT) for ≥20U PRBC.

Results: 207 patients were included: median age 31 years, median Injury Severity Score 25, 67% with penetrating mechanism. Mortality was 18% (38/207) at 24 hours, 29% (61/207) at discharge. Odds of survival = odds of mortality at 11U PRBC (OR 1.02, 95% CI 0.70, 1.35). Beyond 17U PRBC, odds of mortality exceed survival (OR 0.59, 95% CI 0.24, 0.94). Odds of survival are negligible at 37U PRBC (OR -0.86, 95% CI -0.03,-1.70). No patient survived after 67U PRBC. Subgroup mortality rates increased with U transfused (16% T vs 36% MT, z=-3.00, p=.0027; 36% MT vs 67% UMT, z=-2.76, p=.0058).

Conclusion: Mortality increases with each U balanced transfusion. Surgeons should view efforts heroic beyond 17U PRBC/4 hours, near futile beyond 37U PRBC/4 hours, and ineffective beyond 67U PRBC/4 hours. With limited blood supplies, surgeons should assess futility at 17U PRBC.

Odds of Survival by Unit PRBC (Balanced Transfusion)
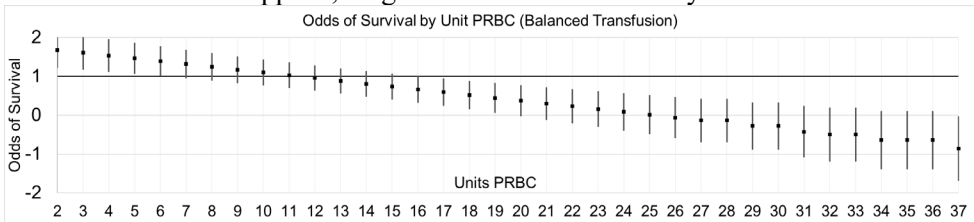
INTO THE FUTURE: PRECISION AUTOMATED CRITICAL CARE MANAGEMENT (PACC-MAN) FOR CLOSED-LOOP CRITICAL CARE

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Invited Discussant: Michael Vella, MD

BACKGROUND: Goal-directed blood pressure management can improve trauma outcomes but is labor-intensive. Automated critical care (ACC) systems can deliver scaled interventions and avoid excessive fluid or vasopressor administration. We compared a custom automated drug and fluid delivery platform to a novel algorithm, incorporating more physiologic inputs and therapeutics. We hypothesized that our improved algorithm would provide a more balanced resuscitation.

METHODS: Twelve swine underwent 30% hemorrhage, then 30min of zone-1 REBOA. Next, animals underwent shed blood transfusion, REBOA removal, and randomization into a standardized critical care (SCC) algorithm or enhanced version (SCC+) for 4.25hrs. SCC+ measured response to fluid bolus. Vasopressin was added as an adjunct to norepinephrine. Lactate and urine output were incorporated into the algorithm. Primary and secondary outcomes were decreased crystalloid administration and maintaining goal normotension, respectively.

RESULTS: Weight-based fluid bolus volume was lowered in SCC+ compared to SCC (26.9 ml/kg vs. 67.5 ml/kg p=0.02). There was no difference in cumulative norepinephrine dose required (SCC: 13.76 mcg/kg vs. SCC+: 26.9 mcg/kg, p=0.24). Three out of 6 animals (50%) in SCC+ triggered vasopressin. Mean arterial blood pressure proportional time spent between 60-70 mmHg and terminal creatinine / lactate were not different (SCC: 79%, 2.2 mg/dL, 3.8 mmol/dL and SCC+: 80%, 2.4 mg/dL, 4.6 mmol/dL, p=0.09, p=0.26, p=0.30, respectively).

CONCLUSION: Refinement of the SCC algorithm showed significant decrease in crystalloid administration without sacrificing time in normotension, significant increase in vasopressor support, or increase in terminal lactate and creatinine levels. This approach demonstrates feasibility of ACC to achieve target hemodynamics in a distributive-shock model.

ESTRADIOL PROVOKES HYPERCOAGULABILITY AND AFFECTS FIBRIN BIOLOGY: A MECHANISTIC EXPLORATION OF SEX DIMOR-PHISMS IN COAGULATION

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Invited Discussant: Matthew Kutcher, MD, MS

Background: Sex dimorphisms in coagulation are well-established and persist after injury, with female-specific hypercoagulability conferring a survival benefit in the setting of trauma-induced coagulopathy (TIC). While circulating sex hormones versus intrinsic differences in cellular biology have been proposed as the mediating forces, the molecular mechanism for this hypercoagulability and survival benefit is unknown. The objective of this study was to examine the effect of estradiol on clot viscoelastic, thrombin formation, and fibrin biology. We hypothesize that estradiol provokes a hypercoagulable profile in vitro and alters FXIII cross-linking of the fibrin matrix.

Methods: To examine the effect of estradiol on clot viscoelastics and thrombin formation, whole blood was collected from healthy adult volunteers, specifically 15 premenopausal females and 15 age-matched males. Citrated native thrombelastography (TEG), functional fibrinogen TEG, platelet mapping TEG, and whole blood thrombin generation (TG) were performed after pre-treatment of the blood with physiologic concentrations of beta-estradiol. To examine the effect of estradiol on clot formation, we performed analysis in both plasma and whole blood clots. First, clots were formed from pooled platelet poor donor plasma stock with a titration of beta-estradiol and then imaged with confocal microscopy with fluorescently labelled fibrinogen to examine clot architecture. We then formed whole blood clots in vitro from healthy volunteers, washed to isolate the insoluble fibrin matrix, chemically and enzymatically digested, and then fractionated with high pH reversed phase (HPRP) chromatography and analyzed via LC-MS/MS to identify cross-linked peptides.

Results: Estradiol provoked a hypercoagulable phenotype in TEG in males and females, specifically a shorter time to clot formation (8.6 min vs 10.7 min, $p=0.01$), greater rate of clot propagation (61.8o vs 55.0o, $p=0.04$), higher clot strength (66.5 mm vs 59.5 mm, $p=0.004$), and diminished clot lysis (LY30 0.7% vs 2.3%, $p=0.0004$). This hypercoagulability was also characterized by increased functional fibrinogen (FLEV 529.2 vs 392.3, $p=0.007$) and platelet hyperactivity (ADP inhibition of 99.6% vs 54.9% and AA inhibition of 99.6% vs 67.0%, $p < 0.0001$). TG was significantly more robust after addition of estradiol, with a greater peak thrombin of 94.6 nM versus 84.2 nM ($p=0.03$) in females. On plasma clot formation analysis, the fiber resolvability (a metric of the density of clot architecture) significantly increased with estradiol concentration, signifying more highly structured and distinct fibrin fibers (Figure). On proteomic analysis of whole blood clot composition, estradiol was associated with robust increases in several procoagulant and antifibrinolytic proteins, specifically alpha-1 antitrypsin, fibrinogen alpha chain, myosin-0, complement components, apolipoprotein A-1, coagulation factor IX, and multiple platelet glycoproteins. Additionally, cross-linking mass spectrometry analysis showed addition of estradiol increased the abundance of several FXIII cross-links within the FIBA alpha chain.

Conclusion: Estradiol provokes a hypercoagulable phenotype, affecting time to clot formation, clot propagation, clot strength, and clot fibrinolysis. The induced fibrinolytic shutdown is likely due to its transformation of normal fibrin biology to increase FXIII cross-linking and alter clot proteomics. In sum, these data highlight the role of estradiol in driving female-specific hypercoagulability and pose the question of its role as a therapeutic adjunct in resuscitation of TIC.
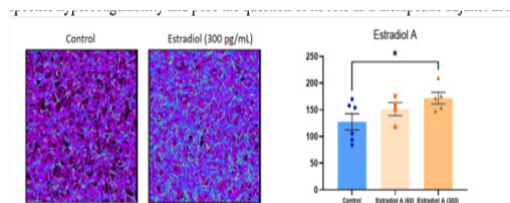

Figure. Representative images of the fiber resolvability index as a function of the average STDEV of every pixel through the depth of the optical section from clots formed in control conditions and with the addition of estradiol . Summary data shows that clots formed with estradiol have higher signal distinction (i.e., high contrast against the background), relative to control.

TRENDS IN TRAUMA CARE ACCESS AND SOCIO-DEMOGRAPHIC PREDICTORS OF INJURY MORTALITY IN THE UNITED STATES, 2005 - 2020

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Invited Discussant: Stefan Leichtle, MD, MBA

Background: Timely access to high level (I/II) trauma centers (HLTC) is essential to minimize mortality after injury. Over the last 15-years there has been a proliferation of HLTC nationally. The current study evaluates the impact of these additional HLTC on population access and injury mortality. We hypothesize that additional HLTC have not improved population level access or injury mortality.

Methods: A geocoded list of HLTC, with year designated, was obtained from American Trauma Society and 60-minute travel time polygons were created around HLTC using OpenStreetMap data. Census tract population centroids, summarized at county level, and American Communities Survey demography were integrated. Age-adjusted injury mortality was obtained from CDC, Wide-ranging Online Data for Epidemiologic Research (WONDER). Geographically weighted Poisson regression models were created to predict access to HLTC, and injury mortality, adjusting for demography, income, health status, racial composition, and rurality.

Results: Over the 15-year (2005–2020) study period HLTC coverage increased by 30.11% (445 to 579). Population access to HLTC increased by 4.21% (79.05% to 83.26%) – Figs I&II. Increased coverage was higher for white populations (4.7% vs 3.4%). Population level age-adjusted injury mortality decreased by 3.6/100,000 (45.9 vs 42.3) – Fig III. Counties with limited access (< 50% population) were primarily rural (78.2% vs 40.9%), whiter (78.2% vs 74.8%), with lower median household income ($48,000 vs $59,600) and suffered higher age-adjusted injury mortality (47.2 vs 36.6/100,000) – $p < 0.001$ for all. Despite greater access to HLTC, after controlling for other factors, counties with higher proportion of non-whites had higher injury mortality (IRR 1.29, 95%CI 1.28-1.31).

Conclusions: Over the past 15-years, HLTC have increased 30% while population access to HLTC has increased only 4%. HLTC designation is likely driven by factors other than population need.

TACKLING THE BEDSIDE ARTIFICIAL INTELLIGENCE BARRIER: NATURAL LANGUAGE PROCESSING TO EXTRACT INJURY ICD10 DIAGNOSIS CODES REAL-TIME FROM ELECTRONIC MEDICAL RECORDS

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Invited Discussant: Rachael Callcut, MD

Introduction: Despite surging interest, artificial intelligence (AI) prediction tools are rarely used at the bedside. Many prediction tools require ICD10 diagnosis codes as inputs, yet these are time-consuming to extract manually. To tackle this prevalent bedside AI adoption barrier, we aimed to build a natural language processing (NLP) algorithm that outputs injury ICD10 diagnosis codes real-time using unstructured free text from the electronic medical record.

Methods: Our dataset comprised deidentified trauma tertiary survey notes from 3,400 consecutive patients admitted to our level I trauma center between 2016 and 2020. The dataset was split into train, validation, and test sets. We trained and fine-tuned a deep learning Bidirectional Encoder Representations from Transformers algorithm to automatically extract injury ICD10 diagnosis codes from unstructured free text. We compared algorithm-extracted ICD10 diagnosis codes with manual, trauma registrar-extracted codes (ground truths). We measured validation set performance using micro-area under the curve (AUC) and compared our algorithm's performance against that of an industry benchmark (Amazon Comprehend Medical).

Results: Our NLP algorithm was trained using 1986 tertiary survey notes with 7914 injury ICD10 diagnosis codes (3957 ground truths, 3957 randomly generated negative samples). The model automatically produced injury ICD10 diagnosis codes after users input free text describing injuries (e.g. injury list, radiology report). Compared with Amazon Comprehend Medical's micro-AUC of 0.76, our algorithm achieved validation set micro-AUC of 0.84.

Conclusion: We built a NLP algorithm that automatically extracts injury ICD10 diagnosis codes real-time from unstructured free text. Interim performance exceeded that of a leading industry benchmark. Reliable, automated ICD10 diagnosis code extraction could connect the critical missing link for many AI prediction tools to reach the patient bedside.

EARLY PNEUMONIA DIAGNOSIS DECREASES VENTILATOR-ASSOCIATED PNEUMONIA RATES IN TRAUMA POPULATION

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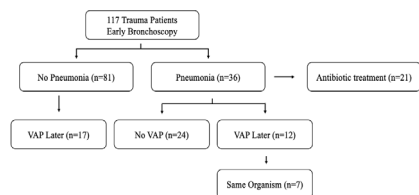Invited Discussant: Samuel Carmichael, MD

Introduction: Ventilator-associated pneumonia (VAP) is a source of morbidity and mortality for trauma patients. Aspiration events are also common in trauma patients due to traumatic brain injury, altered mental status, or facial trauma. In patients requiring mechanical ventilation, early pneumonias, often due to aspiration, may be erroneously classified as ventilator-associated leading to the reporting of artificially inflated VAP rates.

Methods: A prospective early bronchoscopy protocol was implemented from January 2020 through January 2022 at a single ACS-verified level 1 trauma center. Trauma patients intubated prior to arrival or within 48 hours of admission underwent bronchoalveolar lavage (BAL) within 24 hours of intubation. Patients with more than 100,000 colony forming units (CFU) on BAL were considered to have early pneumonia. Patients with clinical signs of infection were treated with antibiotics. Patients with early pneumonia were compared to patients without early pneumonia.

Results: A total of 117 patients met inclusion criteria and underwent early BAL. Ninety-three (79.5%) had any growth on BAL with 36 (30.8%) of these patients having greater than 100,000 CFU, meeting criteria for early pneumonia. For the total study population, 29 (24.8%) patients later developed a VAP on secondary BAL, 12 of which had previously been diagnosed with early pneumonia. Out of patients who were diagnosed with early pneumonia (n=36), 21 (58.3%) were treated with antibiotics based on clinical signs of infection. In patients with early pneumonia who had a subsequent VAP (n=12), seven (58.3%) grew the same organism from their initial BAL. Patients with early pneumonia had a higher rate of smoking history (41.7% vs. 19.8%, p<0.001) compared to patients without early pneumonia. There was no difference in median hospital length of stay (LOS), ICU LOS, ventilator days, or mortality between the two groups. Without the investigation of early pneumonia, the total patient population would have had a reported VAP rate of 45.3% (n=53), but this was reduced to 24.8% (n=29) by excluding the early pneumonias.

Conclusion: Early pneumonia appears to be common in trauma patients intubated within the first 48 hours of admission. Identification of this process allows for prompt treatment of early respiratory infection, possibly due to aspiration events. Accounting for these patients that have a nidus of infection at admission significantly reduces reported VAP rates.

Figure: Diagnosis of Early Pneumonia in a Trauma Population

117 Trauma Patients Early Bronchoscopy

No Pneumonia (n=81) — Pneumonia (n=36) → Antibiotic treatment (n=21)

VAP Later (n=17) — No VAP (n=24) — VAP Later (n=12)

Same Organism (n=7)

EXTERNAL VALIDATION OF CRASH PROGNOSTIC MODEL IN AN URBAN TERTIARY CARE PUBLIC HOSPITAL

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Invited Discussant: Barclay Stewart, MD

Introduction: Road traffic injury is the 7th most common cause of mortality in low income countries. Amongst road traffic injuries traumatic brain injuries (TBI) are the major cause of mortality and morbidity. The multicentre randomized control trial CRASH published a prediction model for traumatic brain injury patients to estimate prognosis. This prediction model was derived based on data from High Income and Low and Middle-Income Countries. The external validity of this prediction model was not assessed in Low and Middle-Income Countries. To fill this gap we aim to external validate the CRASH prediction model in TBI patients in India, a lower-middle income country.

Methods: It is a prospective observation study was done at General Surgery Department of an urban tertiary care public university hospital. Calibration and discrimination of CRASH model were evaluated in traumatic brain injuries (TBI) patients referred to the emergency department. Variables required for calculating CRASH predicted outcomes and observed 14 day mortality and 6 month unfavourable outcomes were gathered. The correlation of CRASH predicted and the observed outcome of the patients was evaluated. The data were analyzed using STATA version 14.0.

Results: In this study, 417 patients with the median age of 40 and range of 18-95 years were evaluated (83.7% male). Calibration of the basic and CT models in prediction of 14 day mortality and 6 month unfavourable outcome were in the desirable range ($P < 0.05$ The area under the ROC curve in basic and CT models in prediction of 14 day mortality were 0.885 (95% CI: 0.849-0.921) and 0.885 (95% CI: 0.849-0.921), respectively. In addition, Area under the ROC curve in basic and CT models in prediction of 6 month unfavourable outcome were 0.901 (95% CI: 0.871-0.938) and 0.896 (95% CI: 0.860-0.931), respectively. There was no significant difference between the discriminations of the models in prediction of 14 day mortality (basic $p = 0.082$, CT $p = 0.067$) and 6 month unfavourable outcome (basic $p = 0.688$, CT $p = 0.204$)

Conclusion: The results of this study showed that the CRASH basic and CT model both accurately predict 14 day mortality and 6 month unfavourable outcomes of TBI patients in an urban tertiary care public university hospitals of India.

ASSESSING TRAUMA READINESS COSTS IN LEVEL III AND LEVEL IV TRAUMA CENTERS

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Invited Discussant: R. Shayn Martin, MD, MBA

Background: Readiness costs are real expenses incurred by trauma centers to maintain essential infrastructure providing emergent services on a 24/7 basis. Although the components for readiness are well described in the American College of Surgeon's *Resources for Optimal Care of the Injured Patient*, the cost associated with each component is not well defined. Previous studies have described readiness costs for level I and level II trauma centers based on these criteria. The purpose of this study was to quantify the cost of level III and level IV trauma center readiness.
Methods: The state trauma commission in conjunction with trauma medical directors, program managers, and financial staff of each trauma center standardized definitions for each component of trauma center readiness cost and developed a survey tool for reporting. Readiness costs were grouped into four categories: Administrative/Program Support Staff, Clinical Medical Staff, In-House Operating Room, and Education/Outreach. To verify consistent cost reporting, a financial auditor analyzed all data. Trauma center outliers were further evaluated to validate variances. All Level III/Level IV trauma centers (n=14) completed the survey on 2019 data.
Results: Average annual readiness cost is $1,715,025 for a Level III trauma center and $81,620 for Level IV centers. Among the costliest components were clinical medical staff for level III's and administrative costs for level IV's representing 54% and 97% of costs respectively. Although education/outreach is mandated, levels III and IV trauma centers only spend approximately $8,000 annually on this category (0.8%–3%), demonstrating a lack of resources.
Conclusion: This study defines the cost associated with each component of readiness as defined in the Resources for Optimal Care of the Injured Patient manual. Average readiness cost for a level III trauma center is $1,715,025 and $81,620 for a level IV. The significant cost of trauma center readiness highlights the need for additional trauma center funding to meet the requirements set forth by the American College of Surgeons.

ROUTINE POST-OPERATIVE LABS AND HEALTHCARE SYSTEM BURDEN IN ACUTE APPENDICITIS

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Invited Discussant: Angela Ingraham, MD

Introduction: Data from the National Health Expenditure Accounts have shown a steady increase in healthcare cost paralleled by availability of laboratory tests and by the adoption of electronic medical records (EMR). Multiple societies have made attention to resource utilization, including reducing laboratory testing, a top priority for reducing health care costs and improving value. We hypothesized that there would be significant variation in perioperative resource utilization resulting in significant costs and healthcare system burden, in acute appendicitis (AA) management.

Methods: Patients presenting with uncomplicated AA from the years 2016-2020 admitted through the emergency department were identified by operative codes and ICD-10 codes across a large health system consisting of large academic and small community hospitals. Clinical variables, patient demographics, medication usage, and admission data were abstracted from the EMR. Electrolyte repletions and post-operative lab usage was determined. Abnormal and critical lab results were pre-defined by the hospital system. Correlations were determined with ANOVA with Bonferroni adjustment and negative binomial regression.

Results: 3724 patients with uncomplicated AA were identified. The average LOS for acute appendicitis was 41.9 hours with an average post-operative LOS of 9.6 hours. Half of patients (1840, 49.4%) had post-operative labs and 173 (9.4%) received non-critical electrolyte repletion. Total costs of labs (99.7%) and repletions (0.3%) were $369,000. Post-operative time was associated with comorbidity, age, blood pressure, OR time, gender, blood pressure but not post-operative labs (Table 1). Patients with critically abnormal labs had on average four comorbidities compared to one in the remainder of the cohort.

Conclusions: In our patient population, post-operative labs resulted in significant costs but no significant change in outcomes as obtaining labs did not lead to findings that increased length of stay. Routine post-operative laboratory testing should be avoided in patients with minimal or no comorbidity as this likely increases cost without adding value.

RACIAL AND ETHNIC DISPARITIES IN INTERHOSPITAL TRANSFER FOR COMPLEX EMERGENCY GENERAL SURGERY

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Invited Discussant: Adel Elkbuli, MD

Introduction: Interhospital transfer (IHT) for Emergency General Surgery (EGS) conditions is often required for patients with complex disease to access specialized resources. We evaluated if racial and ethnic disparities exist in the decision to transfer patients with complex EGS conditions.

Methods: A cross-sectional analysis of the 2019 Nationwide Emergency Department Sample was performed, identifying adults with 13 EGS conditions and complex disease using previously published ICD-10 codes for AAST severity scales. Multivariable logistic regressions were used to determine the association between race/ethnicity and IHT. We controlled for age, sex, Charlson Comorbidity Index, region, rurality, hospital ownership, and hospital teaching status (Model 1). As we hypothesized that income and primary insurance might mediate the relationship between race/ethnicity and IHT, we then added these variables (Model 2).

Results: Of 387,610 weighted ED visits to 989 hospitals, 59,395 (15.3%) patients were transferred. In Model 1, when compared to White patients, the adjusted odds of IHT was lower for Hispanic/Latino (aOR 0.79, 95% CI: 0.71-0.87) and Asian/Pacific Islander (aOR 0.74, 95% CI: 0.62-0.88) patients, with no differences noted for Non-Hispanic Black and Other race patients. In Model 2, these trends were preserved for all groups (Table). These findings were preserved in sub-analysis of rural/community hospitals most likely to transfer patients for higher level care.

Conclusion: In a nationally representative sample, patients of minority race/ethnicity presenting with complex EGS disease were less likely to be transferred than White patients, an association not explained by income or insurance status. Further work is needed to understand mechanisms of transfer disparities and how such inequities contribute to patient outcomes.

Table: Interhospital Transfer for Complex EGS by Race/Ethnicity

Race/Ethnicity	Rates of IHT	Model 1 aOR (95% CI), p-value	Model 2 aOR (95% CI), p-value
White	17.0%	Ref	Ref
Non-Hispanic Black	14.7%	1.03 (0.95-1.11), p=0.5	0.76 (0.88-1.04), p=0.30
Hispanic/Latino	9.0%	0.79 (0.71-0.87), p<0.001	0.75 (0.68-0.83), p<.001

THE DICHOTOMY OF DEFINING VALUE IN HEALTHCARE: COST ELIMINATION OF A MULTIPROFESSIONAL (mPATH) TEAM LED TO INCREASED LOS

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Carolinas medical center
Invited Discussant: Weidun Alan Guo, MD, PhD

Intro: A multi-professional, acute trauma health care team (mPATH) was developed as a quality initiative to address resource intensive patients with severe traumatic brain injury (TBI) and spinal cord injuries (SCI) requiring tracheostomy. Despite demonstrating decreased length of stay (LOS) and perceived healthcare costs, the hospital administration withdrew support after 31 months and the dedicated team was dissolved. We sought to determine the impact of this decision on the outcomes of the TBI/SCI population since the dissolution of the mPATH team.

Methods: A retrospective cohort study was performed comparing patients pre mPATH team (2014), during mPATH team (2016), and for a two-year period following the dissolution of the mPATH team (2018-2019). Demographics were collected for all groups and specifically looking at patients with TBI/SCI requiring tracheostomy. The primary endpoint was hospital LOS; secondary endpoints included ICU LOS, step-down LOS, and inpatient mortality.

Results: There were 70 pre, 80 during, and 65 post mPATH patients. There were 14 (6.5%) deaths: 5.7 vs 3.8 vs 10.8%, p=0.118. Hospital LOS decreased with mPATH and then increased after funding was cut [Median (IQR): 27(21-31) vs 19 (15-26) vs 30 (23-51) days; p<0.001)]. ICU LOS also increased [14 (10-18) vs 11 (8-16) vs 14 (11-20); p<0.001)], Step-down LOS was increased [8(5-12) vs 7 (4-11) vs 13 (8-30) days p=0.008)] and time to tracheostomy was increased (9 vs 7 vs 8 days).

Conclusion: The administrative withdraw of financial support for a multi-professional health care team dedicated to the resource intensive patients with severe TBI and SCI requiring tracheostomy led to significant increases in ICU-LOS, hospital LOS, and increased time to tracheostomy. Administrative and clinical alignment of value for our patients is vital to their improved outcomes.

EVALUATION OF AN EVIDENCE-BASED, COMPREHENSIVE CLINICAL DECISION SUPPORT SYSTEM IMPLEMENTED AT 9 U.S. TRAUMA CENTERS FOR PATIENTS WITH TRAUMATIC RIB FRACTURES

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University of Minnesota
Invited Discussant: TBD

Introduction: Traumatic rib fractures are associated with high morbidity and mortality. Clinical decision support systems (CDSS) have been shown to improve adherence to evidence based (EB) practice, reduce health disparities, and improve clinical outcomes. The objective of this study was to investigate if a rib fracture CDSS care map implemented across 9 U.S. trauma centers reduced hospital length of stay (LOS). A secondary objective was to investigate the independent association of EB practices on clinical outcomes.

Method: The CDSS was scaled across 9 U.S. trauma centers. The CDSS included the following modules: risk stratification, NEXUS Chest CT tool, surgical rib stabilization tool, admission order bundle, RibScore documentation support, PIC early warning system (EWS), nursing Brain, and a post-discharge monitoring application. Implementation began 11/2020 and the CDSS was scaled across all trauma centers by 7/2021. All emergency department (ED) and transfer patients ≥ 18 years old with rib fractures from 7/2015-1/2022 were included. Multivariable logistic and negative binomial regression models were risk-adjusted for the trauma mortality prediction model (TMPM), age, sex, admitting hospital, elixhauser comorbidity index, and the following ED results: pain level, incentive spirometry (IS) level, respiratory rate, heart rate, oxygen saturation, systolic blood pressure, temperature, respiratory support, carbon dioxide level, creatinine, hemoglobin, and sodium.

Results: 1640 patients met inclusion criteria (1453 PRE, 187 POST). On risk-adjusted analysis, LOS significantly decreased following the intervention (IRR 0.79, 95% CI 0.66-0.93, p=0.01) representing a 1 day reduction in the predicted probability of median hospital LOS (PRE: 4.1 days, POST: 3.2 days). There was not a significant reduction in mortality (PRE: 2.6%, POST: 1.2%, OR 0.45, 95% CI 0.02-11.5, p=0.6) or ICU admission (PRE: 12.7% POST: 5.8%, OR 0.32, 95% CI 0.09-1.17, p=0.08). Provider utilization of the admission order bundle was 52% (peak 75%). Rates of the following EB practices increased following implementation: rib fixation for patients with flail chest (13.0% to 25.0%), neuraxial blockade for patients stratified as severe risk (4.5% to 7.0%), IS utilization and documentation (41.4% to 63.6%), and adherence with the NEXUS Chest CT criteria (64.0% to 84.0%). The EWS fired on 58.9% of patients, proper adherence to the recommendation made by the EWS (provider notified) was 48.2%. The integration of the EWS was associated with a significant reduction in median hospital LOS (2.88 to 3.17 days, p=0.03). EWS triggers in response to tachycardia (IRR 3.44, p=0.02), cough (IRR 5.15, p=0.04), and IS volume (IRR 1.63, p = 0.05) were most associated with increased hospital LOS.

A novel, user-centered, comprehensive CDSS improves adherence to the following EB practices: rib fixation for flail chest, neuraxial blockade, IS use, and NEXUS Chest CT and is associated with a significant reduction in hospital LOS.

CASE VOLUME AND RATE ARE ASSOCIATED WITH OUTCOMES IN GERIATRIC TRAUMA: A CASE FOR GERIATRIC TRAUMA CENTERS?

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Tokyo Women's Medical University Adachi Medical Center
Invited Discussant: Jody DiGiacomo, MD

Introduction: Increased morbidity and mortality in geriatric trauma patients are usually due to decreased physiologic reserve and increased comorbidities. It is unclear whether geriatric trauma case volume and rates, compared to non-geriatric patients, are correlated to a survival benefit. We hypothesized that geriatric patients would have increased survival when treated in high case volume and rate trauma centers.

Methods: A retrospective cohort study using the TQIP database (2015 – 2019) was conducted. Geriatric trauma patients (65 years and older) with severe injury (ISS ≥ 16) were included. Geriatric case volume (GCV) was defined as the mean annual number of treated geriatric trauma patients, whereas geriatric case rate (GCR) was the number of elderly trauma patients divided by all trauma patients in each center. Trauma centers were classified into low-, medium-, and high volume and rate facilities based on GCV and GCR. The association of GCV and GCR with in-hospital mortality was assessed using Generalized Additive Model (GAM) and Multivariate Generalized Linear Mixed Model (GLMM) adjusted for patient characteristics (age, sex, ISS, Revised Trauma Score, and modified Frailty Index) and hospital-level factors (random effect variable).

Results: A total of 170,429 geriatric trauma patients from 810 trauma centers were included. The GAM plots showed that the adjusted odds of in-hospital mortality decreased according to the increase in GCV and the GCR (Figures). The GLMM model revealed that both high-GCV and high-GCR centers had lower observed mortality rates compared to low GCV and GCR centers (AOR [95% CI] of high-GCV and high-GCR centers = 0.82 [0.72–0.92] and 0.81 [0.73-0.90], respectively).

Conclusion: High geriatric trauma center volume and rates were associated with decreased mortality of geriatric trauma patients. Consolidation of care for elderly patients with severe injury in specialized high-volume centers may be considered.
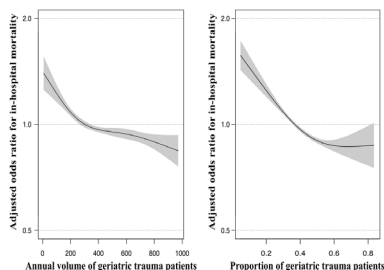
WHEN MINUTES MATTER: PREHOSPITAL TRANSFUSION REDUCES MORTALITY IN PEDIATRIC TRAUMA

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Invited Discussant: Jeffrey Upperman, MD

Background: Optimal hemostatic resuscitation in pediatric trauma is not well-defined. The study objective was to assess the impact of prehospital (PH) transfusion in injured children.

Methods: The Pennsylvania Trauma Outcomes Study database was queried for children 0-18 years who received a PH blood transfusion from 2009-2019. Interfacility transfers were excluded. The primary outcome was 24-hour mortality. Propensity Score Matching was performed accounting for age, sex, race, insurance status, injury mechanism and severity score, shock index, and Glasgow Coma Score. Secondary outcomes included in-hospital mortality and complications.

Results: Of 31,343 children who were transported to a Pennsylvania trauma center directly from the scene, n=3,140 (10%) were in shock and n=100 (0.3%) received PH blood transfusions. At baseline, the PH transfusion group had higher ISS (17(6-29) vs 6(4-11)), older age (15(10-17) vs 11(4-16) years), more commonly sustained penetrating trauma (21% vs 11%) and were in shock (41% vs 10%). Unadjusted 24-hour mortality was greater in the transfusion group (16% vs 2%), however, after propensity-matching to adjust for the confounders listed above, PH transfusion was associated with a statistically and clinically significantly reduction in 24-hour mortality (12.8% vs 16.3%; p=0.044). The number needed to treat to save one child's life is 28. On adjusted analysis, the PH transfusion group had significantly decreased in-hospital mortality (18.6% vs 19.8%; p=0.05).

Conclusion: Prehospital transfusion is rare in injured children but is independently associated with increased survival, suggesting that bleeding pediatric patients benefit from early hemostatic resuscitation. Though the logistics of PH blood product programs are complex, strategies to shift hemostatic resuscitation toward the immediate post-injury period should be pursued.

ARE WE WAITING FOR THE SKY TO FALL? PREDICTORS OF WITHDRAWAL OF LIFE-SUSTAINING SUPPORT IN GERIATRIC TRAUMA PATIENTS

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Invited Discussant: Miriam Bullard, MD

Introduction: Scarce data exist regarding the impact of advanced care planning on trauma management for injured geriatric patients. We hypothesized that patients with advance directives limiting care (ADLC) compared to those without ADLC are more likely to undergo withdrawal of life-sustaining support (WLSS).

Methods: This is a retrospective study of ACS TQIP patients $\geq$ 65 years entered from 2017-2018, excluding those who died within 24 hours. Patients with ADLC on admission were compared to those without ADLC. The primary outcome was WLSS and days prior to WLSS. Additional factors examined included hospital LOS, unplanned operations, unplanned ICU admissions, and in-hospital cardiac arrests. Patients with and without ADLC were compared, using Student's t-test for continuous and x^2 for binary variables. A logistic regression model assessed factors associated with WLSS.

Results: 597,840 patients were included: 44,001 patients with an ADLC (7.4%) compared to 553,839 with no ADLC (92.6%). Clinical characteristics were comparable between groups, with median GCS of 15 and median ISS 9 (p>0.05). Patients with an ADLC underwent WLSS more often than those with no ADLC (8.6% vs 2.9%, p< 0.001) and were hospitalized fewer days until WLSS (5.3 vs. 6.6, p < 0.001). Patients with ADLC were more likely to undergo WLSS (OR 3.14, 95% CI 3.02-3.26), although stronger predictors of WLSS included unplanned operations (OR 5.69, 95% CI 4.93-6.56), unplanned ICU admissions (OR 5.27, 95% CI 4.99-5.57), and in-hospital cardiac arrests (OR 12.60, 95% CI 11.71-13.53).

Conclusion: A small proportion of the geriatric trauma population had ADLC on admission. While ADLC was predictive of WLSS, adverse events were more strongly associated with WLSS. To ensure patient-centered care, surgeons should delineate goals of care early regardless of ADLC. Consequently, this may lead to a decrease in interventions that are of no benefit to the patient.

PREDICTORS OF CARE DISCONTINUITY IN GERIATRIC TRAUMA

Cheryl K. Zogg, PhD, MSPH, MHS; Molly P. Jarman, PhD, MPH; Reza Askari, MD; Stephanie Nitzschke, MD; Zara Cooper, MD; Ali Salim, MD; Joaquim Havens, MD; Manuel Castillo Angeles, MD, MPH
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Invited Discussant: Jay Yelon, DO

Objectives: Readmission to a non-index hospital, or care discontinuity, has been shown to have worse outcomes among surgical patients. Little is known about its effect on geriatric trauma patients. Our goal was to determine predictors of care discontinuity and to evaluate its effect on mortality in this geriatric population.

Methods: This was a retrospective analysis of Medicare inpatient claims (2014-2015) of geriatric trauma patients. Care discontinuity was defined as readmission within 30 days to a non-index hospital. Demographic and clinical characteristics (including readmission diagnosis category) were collected. Multivariate logistic regression analysis was performed to identify predictors of care discontinuity and to assess its association with mortality.

Results: We included 754,313 geriatric trauma patients. Mean age was 82.13 (SD 0.50), 68% were male and 91% were white. 21,615 (2.87%) were readmitted within 30 days of discharge. Of these, 34% were readmitted to a non-index hospital. Overall, 30 day-mortality after readmission was 25%. In unadjusted analysis, readmission to index hospitals was more likely to be due to surgical infection, GI complaints, or cardiac/vascular complaints. After adjusted analysis, predictors of care discontinuity are shown in the table. Care discontinuity was not associated with mortality (OR 0.93, 95% Confidence Interval 0.86–1.01).

Odds of Care Discontinuity		
Variables	**Adjusted OR**	**95% CI**
Age	0.98	0.97 – 0.99
Injury Severity Score	1.02	1.01 – 1.03
Charlson Comorbidity Index	0.95	0.94 – 0.98
Hospital size (>=200 beds)	0.75	0.69 – 0.82
Region (ref. Northeast)		
Midwest	1.16	1.05 – 1.28
South	1.51	1.38 – 1.64
West	1.21	1.08 – 1.36
Travel time (mins)	0.99	0.98 – 0.99
Readmission Diagnosis (ref. Others)		
Surgical Infection	0.38	0.33 – 0.43
GI Complication	0.59	0.53 – 0.67
Cardiac Complication	0.75	0.68 – 0.82
Admitting Hospital (Ref. Level I)		
Level 2 Trauma Center	0.65	0.59 – 0.73
Level 3 Trauma Center	0.59	0.52 – 0.67
Non-Trauma Center	0.59	0.53 – 0.66

Conclusions: More than a third of geriatric trauma patients are readmitted to a non-index hospital, which is driven by readmission diagnosis, travel time and hospital characteristics. However, unlike other surgical settings, this care discontinuity is not associated with increased mortality. Further work is needed to understand the reasons for this and to determine which standardized processes of care can benefit this population.

EARLY SURGICAL STABILIZATION OF RIB FRACTURES FOR FLAIL CHEST IS ASSOCIATED WITH IMPROVED PATIENT OUTCOMES

Alexander Simmonds, MD; Kyle Alexander, MS; Alex Simmonds, MD; Julia Smolen, MS; Mathew Ciurash, MS; Yahya Alwatari, MD; James Whelan, MD; Jonathan Bennett, MD; Stefan Leichtle, MD, FACS; Michel Aboutanos, MD, MPH, FACS; Edgar Rodas, MD, FACS
Virginia Commonwealth University Medical Center
Invited Discussant: Babak Sarani, MD

Introduction: Rib fractures are a common injury associated with thoracic trauma. Increasingly, patients with flail segments are being treated with surgical stabilization of rib fractures (SSRF). We sought to review the Trauma Quality Improvement Program (TQIP) database to determine if a difference in outcomes exists in patients undergoing early SSRF (< 3 days) vs late SSRF (> 3 days).

Method: TQIP data from 2017-2019 was examined. Patients with flail chest were identified by CPT code, assessing those who underwent SSRF. We excluded those under age 18 and AIS head severity scores greater than 3. Patients were grouped based on SSRF before and after hospital day 3. These patients were case matched based on initial GCS, ISS score, and AIS chest score. All data was examined using χ^2, Student t-test* and Fisher's Exact Test within SPSS version 28.0.

Results: Over 3 years, 20,324 patients were noted to have flail chest, and 3,345 (16.46%) of these patients underwent SSRF. After case matching, 319 patients were found in each group. No significant difference existed between any major comorbidities reported. Patients with early SSRF had less unplanned intubations (8.2% Vs. 14.1%, p=0.017), less total ventilator days (9.16 days ± 8.70 Vs. 11.75 ± 9.12 p=0.006), ICU length of stay (9.59 days ± 8.58 Vs. 13.28 days ± 9.58 p<0.001) and hospital length of stay (14.55 ± 9.28 vs 20.64 ± 11.87, p<0.001). Cases with early plating had statistically significant lower rate of DVT, Ventilator Acquired Pneumonia, and sepsis. No difference existed in mortality (3.4% vs 1.6%, p=0.129).

Conclusion: In trauma accredited centers patients with flail chest who undergo early SSRF (< 3 days) had improved outcomes including less unplanned intubation, decreased ventilator days, decreased ICU LOS and HLOS, decreased PNA, DVT, and sepsis.

TRIAL OF ANTIBIOTIC RESTRAINT IN PRESUMED PNEUMONIA

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University of Kansas Medical Center
Invited Discussant: John Agapian, MD

Background: Pneumonia is the most common hospital-acquired infection in the trauma and emergency general surgery population. Despite guidelines urging aggressive antibiotic use, data supporting aggressive antibiotic initiation in cases of suspected infection is limited. Our hypothesis was that a protocol of 'conservative' antibiotic initiation would have similar compliance and outcomes to an 'aggressive' strategy.

Methods: To test our hypothesis, we devised a pragmatic cluster-randomized crossover trial. Four Surgical Intensive Care Units were randomized to either an 'aggressive' or 'conservative' antibiotic initiation protocol for intubated patients in whom a bronchial culture was obtained. In the 'aggressive' arm antibiotics were started immediately after the culture regardless of patient status. In the 'conservative' arm antibiotics were delayed until objective gram stain or culture results suggested infection. If the patient was in septic shock antibiotics were started immediately. Each arm of the study ran for 4 months followed by a washout period and 4-month cross-over to the opposite arm. Outcomes were protocol compliance, all-cause 30-day mortality, and ventilator-free alive days at 30 days. Standard statistical techniques were applied.

Results: 186 patients had 244 total cultures of which only the first was analyzed. 93 patients (50%) were enrolled in each arm. 97.8% were Trauma or EGS patients. There were no differences in demographics, comorbidities, SOFA, APACHE II or Injury Severity Scores. Antibiotics were started significantly later in the 'conservative' arm (0 vs 9.3 hours; p<0.0001) with 19 (20.4%) patients avoiding antibiotics completely for that episode. There was no difference in the rate of protocol adherence (74.2% vs 82.8%; p=0.15). There were no differences in 30-day mortality (18.3% vs 18.3%) or ventilator-free alive days at 30-days (7 vs 8 days; p=0.6).

Conclusion: In this cluster-randomized crossover trial, we found similar compliance rates between 'aggressive' and 'conservative' antibiotic initiation strategies. Delayed or 'conservative' antibiotic initiation in patients with a suspected hospital-acquired pneumonia did not result in worse clinical outcomes compared to 'aggressive' initiation.

ELEVATED PLASMA SERPINB1 IS A MARKER OF IMMUNE DYSREGULATION PREDICTIVE OF POST-INJURY OUTCOMES

Terry Schaid, MD; Margot DeBot, MD; Ernest E. Moore, MD, FACS; Angela Sauaia, MD, PhD; Alexis Cralley, MD; Christopher Erickson, PhD; Ian Lacroix, MD; Christopher Silliman, MD, PhD; Angelo D'Alessandro, PhD; Kirk Hansen, PhD; Mitchell J. Cohen, MD, FACS
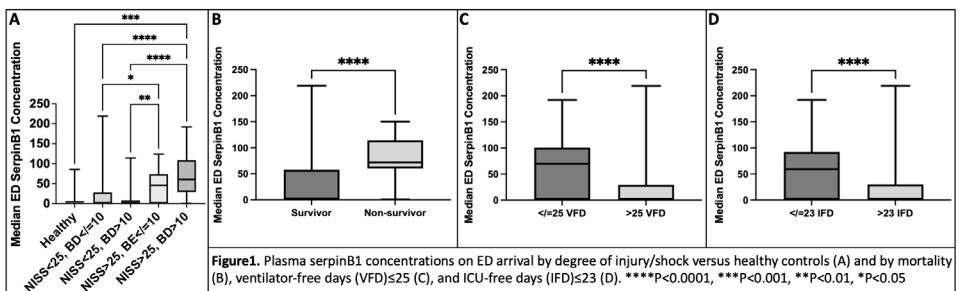University of Colorado at Denver
Invited Discussant: Lawrence Diebel, MD

Introduction: Serine protease inhibitors (serpins) regulate multiple proteolytic cascades. SerpinB1, an intracellular serpin, is vital to neutrophil function. We hypothesized that aberrations in plasma serpinB1 levels, reflective of disrupted neutrophil homeostasis, are associated with injury severity and clinical outcomes.

Methods: Blood was collected from injured patients at a Level I Trauma Center as part of the COMBAT study. Plasma proteomics were performed using liquid chromatography coupled with mass spectrometry. Mann-Whitney tests, Kruskal-Wallis tests, and multiple linear regression were used to analyze association between injury, serpinB1 levels, and clinical outcomes.

Results: Patients with NISS>25 and base deficit (BD) >10mEq/L had elevated serpinB1 levels on emergency department (ED) arrival (Figure1A). ED SerpinB1 was elevated in non-survivors, patients with ≤25 ventilator-free days (VFD), and patients with ≤23 ICU-free days (IFD; $P<0.0001$, Figure1B-D). Independently of NISS and BD in multiple regression, elevated ED serpinB1 was associated with fewer VFD and IFD ($P<0.05$). SerpinB1 levels at 24 hours returned to those of healthy controls ($P<0.01$).

Conclusions: SerpinB1 plasma levels are elevated early after severe injury and are independently associated with adverse outcomes. SerpinB1 is an early marker of immune dysregulation that may stratify trauma patients at risk for inflammatory complications. Mechanisms of elevated serpinB1 are unclear but may involve neutrophil lysis and extracellular trap release, which occurs following severe injury. Comprehensive proteomics with animal models will clarify the role of serpinB1 in the global immunological signature related to adverse outcomes post-injury.

Figure1. Plasma serpinB1 concentrations on ED arrival by degree of injury/shock versus healthy controls (A) and by mortality (B), ventilator-free days (VFD)≤25 (C), and ICU-free days (IFD)≤23 (D). ****$P<0.0001$, ***$P<0.001$, **$P<0.01$, *$P<0.05$

EARLY TRACHEOSTOMY IN POLYTRAUMA PATIENTS IS ASSOCIATED WITH IMPROVED OUTCOMES

Alexander Simmonds, MD; Christopher Liu, MS; Yahya Alwatari, MD;
Luke Wolfe, MS; Hiba Ezzeddine, MD; Stefan Leichtle, MD, FACS;
Michel Aboutanos, MD, MPH, FACS; Edgar Rodas, MD, FACS
Virginia Commonwealth University Medical Center
Invited Discussant: Bryce Robinson, MD, MSc

Introduction: Early tracheostomy is beneficial in certain patient populations, but insufficient evidence exists to inform the timing of tracheostomy for the general trauma population. We sought to use the Trauma Quality Improvement Program (TQIP) database to examine if patients undergoing early tracheostomy had improved outcomes. **Methods:** TQIP data from 2017-2019 was examined. Patients undergoing tracheostomy were identified using ICD procedure codes. Those with AIS head severity scores more than 3 or that died within 48 hours of admission were excluded. Cases were identified as undergoing early tracheostomy (3-7 days) or late tracheostomy (8-21 days). Propensity score matching was then used to control for NSQIP frailty index comorbidities as well as AIS head injury scores, ISS scores, and anticoagulation usage. Data was examined using χ^2, Student t-test[*] and Fisher's Exact Test within SAS version 9.4. **Results:** 15,807 patients were identified undergoing tracheostomy in the 3 years examined. After matching, 4,295 patients remained in each group. Age (46.0 years vs 47.0 p=0.0041), BMI (27.2 vs 27.4, p=0.03), and ISS (18.0 vs 17.0, p=0.0005) were similar between groups. No significant difference existed in major comorbidities or injury mechanism. Early tracheostomy was associated with significantly shorter ICU length of stay (14.1 days $\pm$ 12 vs 24.2 $\pm$ 12, p<0.001), total length of stay (20.5 days $\pm$ 16 vs 31.4 $\pm$ 18, p<0.001), and ventilator days (11.4 days $\pm$ 10 vs 19.9 $\pm$ 12, p<0.001) Early tracheostomy was also associated with significantly lower rates of unplanned intubation (7.7% vs 20%, p<0.0001) and higher rates of discharge to home (34.2% vs 18.4%, p<0.001). There was no significant difference in mortality (4.8% vs 4.6%, p=0.68).
Conclusion: Early tracheostomy in severely injured patients without head trauma is associated with shorter length of ICU and total hospital stay, reduced ventilator days, and increased rates of home discharge.

# VENOUS THROMBOEMBOLISM RISK AFTER SPINAL CORD INJURY: A SECONDARY ANALYSIS OF THE CLOTT STUDY

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UCSD

Invited Discussant: Jeremy Cannon, MD

Introduction: Patients with spinal cord injury (SCI) are at high risk of venous thromboembolism (VTE). Pharmacologic VTE prophylaxis (VTE ppx) is frequently delayed in patients with SCI due to concerns for bleeding risk. Here, we hypothesized that delaying VTE prophylaxis until ≥ 48 hours would be associated with increased risk of thrombotic events.

Methods: This is a secondary analysis of the prospective, observational, cohort CLOTT study of patients age 18-40 from 2018-2020 at 17 US Level 1 trauma centers. Patients admitted for > 48 hours with a diagnosis of SCI were evaluated. Timing of initiation of VTE ppx, rates of thrombotic events (Deep vein thrombosis (DVT), pulmonary embolism (PE) or de novo pulmonary thrombosis (PT)) and missed VTE ppx doses were analyzed. The primary outcome was VTE (DVT and PE). Secondary outcomes included de novo PT and bleeding complications.

Results: There were 343 patients identified with SCI. The mean age was 29.0 ± 6.6 years, 77.3% were male and 78.7% blunt mechanism. There were 44 patients (12.8%) with thrombotic events: 30 (8.7%) DVT's, 3 (0.9%) PE's and 11 (3.2%) PT's. Only 21.3% of patients

Rates of Thrombotic Events
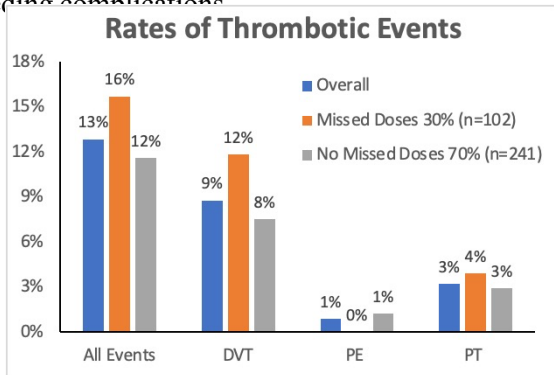
started VTE ppx at ≤ 24hours, this increased to 48.7% at ≤ 48hours. The VTE rate was high overall at 9.6%; however, the VTE rate was lower in patients starting VTE ppx within 48 hours (6.6% vs 12.5%, p=0.063). There was no difference in the number of patients with an abdominal AIS>3 that started VTE ppx +/- 48 hours suggesting that associated solid organ injury did not limit timely initiation of VTE ppx. Missed doses of VTE ppx were common (30%) and associated with higher rates of thrombotic events (graph).

Conclusion: Rates of thrombotic events in patients with SCI are high. Prompt initiation of VTE ppx and avoiding missed doses is critical to limit thrombotic events in high-risk patients with SCI.

IMPACT OF WHOLE BLOOD LEUKOREDUCTION ON OUTCOMES IN TRAUMA PATIENTS, A MULTICENTER RETROSPECTIVE REVIEW

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Invited Discussant: Jon Simmons, MD

Background: Whole blood transfusion has been widely adopted for the management of traumatic hemorrhage in both military and civilian settings. In prehospital or resource limited settings, the logistical ease of transfusion makes cold-stored low titer Group O whole blood (LTOWB) a pragmatic option for balanced resuscitation. However, LTOWB is frequently leukoreduced for use in civilian hospitals, which is known to decrease both platelet number and function. In this study, we compared outcomes in non-leukoreduced LTWOB use at a military Level I trauma center in the US (MIL) to leukoreduced LTWOB use at a civilian Level I trauma center (CIV.)

Methods: All trauma patients who received an emergent transfusion of LTOWB between 7/1/2016 and 10/15/2019 at MIL and CIV were retrospectively analyzed for outcomes and blood product utilization. Patients who expired or received CPR within 30 minutes of arrival were excluded. A logistic regression model was used to compare 30-day mortality between institutions. Hospital and ICU free days, and number of transfusions were compared using Wilcoxon rank sum tests. Mortality and complication rates were compared using chi-square tests or Fisher's exact tests as appropriate.

Results: 447 patients were included in the analysis. There was no significant difference seen in mortality by institution (19.0% CIV, 22.9% MIL, p = 0.703), when controlling for age, sex, mechanism, and prehospital transfusion. There was also no difference observed between institutions in ICU FD (p = 0.42), or HFD (p = 0.28). Significantly fewer MIL patients (3.2%) developed AKI compared to CIV patients (11.7%), p <0.001. Whole blood, platelet, RBC, plasma, and cryo transfusions were all significantly less in MIL patients (all p-values < 0.001.)

Conclusion: Our model demonstrated a higher rate of AKI at CIV and increased blood transfusion requirements, but otherwise did not reveal statistically significant associations in outcomes for patients receiving non-leukoreduced vs leukoreduced LTWOB.

COMPUTED TOMOGRAPHY FIRST RESUSCITATION WITH HYBRID EMERGENCY ROOM FOR SEVERELY INJURED PATIENTS

Satomi Senoo, MD; Shokei Matsumoto, MD; Masayuki Shimizu, MD;
Tomohiro Funabiki, PhD
Saiseikai Yokohamashi Tobu Hospital
Invited Discussant: Christine Gaarder, MD, PhD

Introduction: The introduction of hybrid emergency room with high-speed computed tomography (CT) scan has dramatically changed the management for severely injured patients in some centers in Japan. We developed CT first resuscitation (CTFR) strategy in hybrid ER with the goal of minimizing the time to identification of critical injuries and the definitive treatment (Fig 1). The purpose of this study was to provide a current descriptive outline of our experience with CTFR over two years.

Methods: All patients who met CTFR criteria during the first two years of starting the strategy (2019 to 2021) at a Japanese trauma center were compared with those during the previous two years (2017 to 2018). CTFR criteria included presumptive hemorrhage shock on pre-hospital vital signs. Demographics, injury patterns, interventions, time from arrival to CT and intervention, adverse event related to CTFR, and outcome were analyzed.

Results: Ninety-five patients who met the inclusion criteria were identified: 49 in the CTFR group and 46 in the non-CTFR group. There were no differences in the patient's characteristics between the two groups. Median door to CT initiation time was significantly shorter in the CTFR group than those in the non-CTFR group (1.5 [0.6-4.0] minutes vs 15.0 [8.8-23.0] minutes; P < 0.001). Median scan time using the setting for CTFR (Fast CT) was 56 [15.0-284] seconds. During CT scans, no patient was aggravated in hemodynamic status in both groups. However, there was no statistical difference in the mortality (14.0% vs 4.3%: P=0.098), the time of hemostatic intervention initiation (55.5[24.8-92.5] minutes vs 69.0 [48.0-94.0] minutes; P = 0.487), the amount of red blood transfusion (0 [0-4] units vs 0 [0-8] units; P = 0.562) between the two groups.

Conclusion: CTFR facilitated timely trauma management without adverse events. This novel strategy was not associated with increased mortality. A further prospective study including optimal patient selection is warranted.
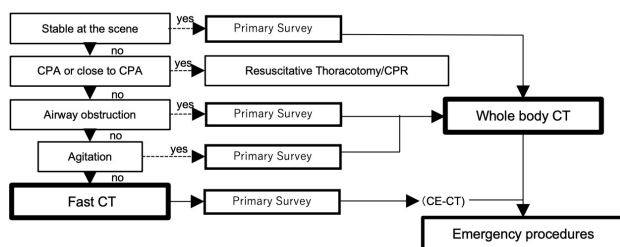
MULTICOMPARTMENTAL TRAUMA ALTERS BONE MARROW ERYTHROBLASTIC ISLANDS

Lauren S. Kelly, MD; Jennifer A. Munley, MD; Kolenkode B. Kannan, PhD; Erick E. Pons, BS; Philip A. Efron, MD, FACS, FCCM; Alicia M. Mohr, MD, FACS, FCCM
University of Florida College of Medicine
Invited Discussant: Timothy Pritts, MD

Introduction: Trauma is associated with widespread inflammation, neuroendocrine activation, and an inadequate bone marrow response to anemia. During late-stage erythropoiesis, erythroid progenitors/erythroblasts form clusters on the surface of specialized bone marrow (BM) macrophages where they are supported through terminal differentiation and enucleation. We hypothesized that these erythroblastic islands (EBIs) are adversely impacted by multicompartmental polytrauma (PT).

Methods: Groups (n=3-7/group) included male Sprague-Dawley rats subjected to either polytrauma (PT) (lung contusion, hemorrhagic shock, cecectomy, bifemoral pseudofracture, and 50% shed blood resuscitation), PT plus 2 hours daily chronic stress in a restraint cylinder (PT+CS), or naïve controls. Rats were sacrificed on either day 2 or 7. Nuclear-stained, enriched BM EBIs were fixed and stained for CD71, VCAM-1, and CD163, and confocal images were obtained at 20x magnification. Numbers of erythroid cells/EBI and ratio of reticulocytes/EBI were counted by a blinded observer. Differences were compared using ANOVA, with significance defined as $*p < 0.05$. Data presented as mean±SD.

Results: PT and PT+CS had significantly reduced numbers of erythroid cells per EBI on day 2 when compared to naïve (PT: 5.9±1.0*, PT+CS: 6.8±0.8* vs. naïve: 8.5±0.8 cells). On day 7, the number of erythroid cells/EBI increased following PT (8.3±0.4 cells), but remained reduced following PT+CS (5.9±0.5* cells). This corresponded to an increased proportion of reticulocytes/EBI on day 7 following PT alone, which was not present following PT+CS (PT: 54%* vs. PT+CS: 28%).

Conclusion: Late-stage erythropoiesis was altered following multicompartmental polytrauma early after injury and these alterations persist with the addition of daily chronic stress. Alterations in EBI structure and function after severe trauma and critical illness may serve as a promising new area of study to improve mechanistic understanding of persistent anemia after trauma.

PROSPECTIVE VALIDATION OF K/ICA RATIO AS A PREDICTOR FOR MORTALITY IN SEVERE HEMORRHAGE

Brennan Gagen, BS; Michael Ghio, MD; Abby Duplechain, BS; Danielle Krakosky, BS; John T. Simpson, MD; Danielle Tatum, PhD; Juan Duchesne, MD, MPH
Tulane School of Medicine
Invited Discussant: Abhijit Pathak, MD

Background: Patients receiving massive transfusion protocol (MTP) are at risk for post-transfusion hypocalcemia and hyperkalemia due to citrate-containing blood. This prospective study sought to validate previous retrospective analysis indicating the value of the potassium/ionized calcium (K/iCa) ratio as a predictor for mortality in patients receiving MTP.
Methods: This is a prospective analysis of adult trauma patients from 2019-2021 who received MTP at a Level 1 trauma center. K and iCa lab values were collected after the start of MTP. A receiver operating characteristic (ROC) curve was used to establish a K/iCa ratio cut-off. Kaplan-Meier (KM) survival analysis and Cox regression model determined the prognostic capability of the K/iCa ratio on survival.
Results: A total of 110 MTP patients were included in the study. Deceased patients had a significantly higher median K/iCa ratio compared to those who survived ($p<0.01$). As seen in Figure 1, The KM survival curve demonstrated a strong prognostic indicator of mortality for the K/iCa ratio ($p<0.01$). Cox regression showed a significant association between K/iCa and mortality (HR 2.15, 95% CI 1.28-3.61, p=0.004). Median emergency department (ED) Glasgow Coma Score (GCS) was significantly lower in deceased patients ($p<0.01$), but there was no significant difference in ED systolic blood pressure (SBP), heart rate (HR), or shock index.
Conclusion: This evidence further highlights the importance of the K/iCa ratio in predicting mortality for patients receiving MTP and post-transfusion K levels along with iCa should be carefully monitored in the MTP setting.

Figure 1: KM Survival Analysis of the K/iCa ratio
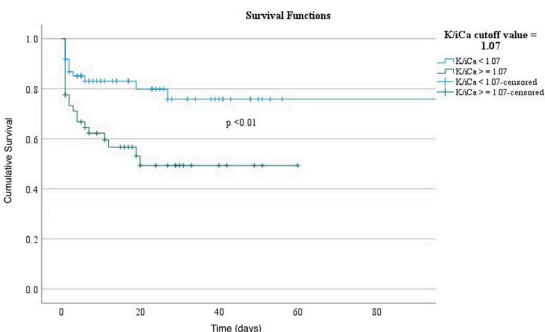
PLATELET AND CRYOPRECIPETATE TRANSFUSIONS FROM FEMALE DONORS HAVE IMPROVED HEMOSTATIC POTENTIAL

Margot DeBot, MD; Marguerite Kelher, MD; Terry Schaid, MD; Ernest E. Moore, MD, FACS; Alexis Cralley, MD; Ian Lacroix, MD; Christopher Erickson, PhD; Angelo D'Alessandro, PhD; Kirk Hansen, PhD; Mitchell J. Cohen, MD, FACS; Christopher Silliman, MD, PhD; Julia Coleman, MD
University of Colorado
Invited Discussant: Carrie Sims, MD

Introduction: Females are relatively hypercoagulable compared to males, but the impact of transfusing female blood products remains unclear. We hypothesize that transfusion of female (F) blood products optimizes hemostatic capacity compared to male (M) blood products.

Methods: Sex dimorphisms in coagulation assays and total fibrinogen (Fbg) measured via mass spectroscopy were compared in healthy volunteers. The effect of transfusions from F verses M donors was evaluated using an *in vitro* coagulopathy model. F or M platelets (plt) or single-donor cryoprecipitate (cryo) was added to "recipient" whole blood after dilution of recipient blood with citrated saline to provoke a coagulopathic profile. Citrated native thrombelastography was then performed.

Results: Healthy F had relatively increased plt count, functional Fbg (FLEV), active Fbg (Von Clauss), angle, maximum amplitude (MA), and shorter R time (Table 1). When we compared functional and total Fbg in F verses M, F active Fbg ($r^2=0.63$, $p<0.0001$ vs. $r^2=0.21$, $p=0.008$) and FLEV Fbg ($r^2=0.33$, $p<0.0001$ vs $r^2=0.04$, $p=0.15$) had stronger correlations with total Fbg indicating an increased proportion of functional Fbg in F donors. F plt induced greater decrease in R time (-8% vs 0%, $p=0.02$) than M plt in M recipients. F cryo induced greater decrease in R time (-9% vs -5%, $p<0.05$) than M cryo in M recipients and greater increase in angle in M (23% vs. 14%, $p=0.04$) and F recipients (28% vs 20%, $p=0.04$).

Conclusions: Healthy females have increased plt and functional Fbg, and transfusion of F blood products improves clot formation more than M blood products. This highlights the potential role for sex-specific transfusion strategies to improve hemostasis in the critically injured patient.

Table 1. Sex Dimorphisms in Coagulation

	Platelets (10^9/L)	Active Fbg (mg/dL)	FLEV (mg/dL)	Total Fbg (LSM)	R time (min)	Angle (degrees)	MA (mm)
Female (n=47)	283 (247-335)	293 (254-330)	402 (374-447)	61000 (53000-6800)	13.7 (12.7-15.2)	47.3 (42.2-54.3)	59.0 (54.4-62.1)
Male (n=52)	250 (213-278)	249 (235-277)	329 (299-438)	59000 (56000-64000)	15.6 (13.4-17.8)	39.0 (35.5-62.8)	53.3 (50.0-62.5)
p value	0.0007	0.0002	<0.0001	0.68	0.0013	<0.0001	<0.0001

Data expressed as median (IQR). P value calculated using Mann-Whitney test.

MYOCARDIAL ALTERATIONS FOLLOWING TRAUMATIC HAEMORRHAGIC INJURY

Rebecca Simpson, MBBS, BSc; Banjerd Praditsuktavorn, MD; Johanna Wall, MD, PhD; Christoph Thiemermann, MD, PhD; Jordi Lopez-Tremoleda, DVM, PhD, MRCVS; Karim Brohi, MD
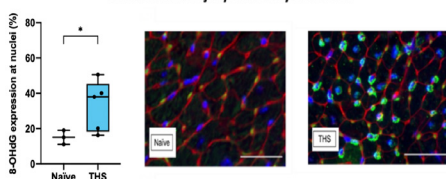Centre for Trauma Sciences, Blizard Institute, Queen Mary University of London
Invited Discussant: Scott Brakenridge, MD

Introduction: Cardiac Dysfunction (CD) has emerged as a key contributor to delayed organ failure and late mortality in patients surviving the initial traumatic haemorrhagic response. Inflammatory processes are implicated in the initial stages of this CD, however downstream pathways leading to a characteristic rapid fall in SV and CO are not yet fully defined. Currently, no cardioprotective treatments are available. We investigated the role of myocardial oxidative stress in the pathogenesis of CD associated to traumatic haemorrhagic injury, and its related metabolomic profile.
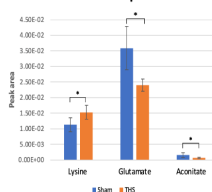
Methods: Ex vivo tissue from a 3-hour murine model of pressure-controlled trauma haemorrhagic shock (THS) was analyzed. Animals were randomized to echocardiography-guided crystalloid fluid resuscitation or a control group (sham: cannulation and anaesthesia only, or naïve: no intervention). THS and naïve samples were assessed by immunohistochemistry for nuclear 8-OHdG expression as a marker of oxidative stress. Metabolomic analysis of THS and sham group tissue was performed by LC-MS.

Results: 8-OHdG expression across the myocardium was significantly higher following THS injury compared to naïve group ($33.01 \pm 14.40\%$ vs. $15.08 \pm 3.96\%$, $p<0.05$). THS injury significantly increased lysine ($p=0.022$), and decreased aconitate ($p=0.016$) and glutamate ($p=0.047$) in the myocardium, indicating activation of a catabolic metabolism and oxidative stress response.

Effect of THS injury in the myocardium

Effect of THS injury on myocardial metabolite profile

Conclusion: We confirm the acute development of oxidative stress lesions and altered cardiac energy metabolism following traumatic haemorrhage injury, providing insight into the relationship between inflammatory damage and impaired cardiac contractility. These findings may provide targets for development of novel cardioprotective therapeutics aiming to decrease late mortality from trauma.

OUTCOMES OF FIVE YEARS OF PATIENTS WITH MILD TRAUMATIC SUBARACHNOID HEMORRHAGE

Mark Broadwin, MD; Puja Patel, DO; Tara Stansbury, MD; Jeffrey Brown, BS; Anh Hoang, DO; Kamalesh Shah, MD, FACS; Mark Cipolle, MD, PhD
Lehigh Valley Health Network
Invited Discussant: Bellal Joseph, MD

Introduction: It is standard practice for patients with isolated mild traumatic subarachnoid hemorrhages (tSAH), defined as GCS of > 13, to be transferred to trauma centers with neurosurgical services for evaluation. There is low morbidity and mortality associated with tSAH, however, it has become common practice to perform repeat imaging, consult neurosurgical services, or transfer patients to a center with neurosurgery despite the fact that it is uncommon for these patients to require neurosurgical intervention. Current literature suggests that it may be safe to observe patients with tSAH without neurosurgical consultation, but the need for transfer to tertiary center has not been fully explored. The purpose of this study was to investigate if patients suffering from mild tSAH require transfer for neurosurgical evaluation or if they can be safely managed at their presenting institution.

Methods: A retrospective chart review of a trauma database of patients admitted or transferred to a level one trauma center between October 1st, 2015, to September 30th, 2019, with GCS 13-15 and evidence of isolated SAH initial head CT was performed. Descriptive statistics were used to summarize the findings. Bivariate analyses, including the Mann-Whitney U Test and chi-square test of independence/Fisher's exact test, were conducted to determine if certain factors were associated with a worsening repeat CT.

Results: 350 patients presented with isolated tSAH. The majority were blunt injuries (99.1%). There were more females (57.4%) than males (42.6%) and the median age was 73 (IQR: 58-84). The median ISS was 5 (IQR: 5-6). Slightly more than half (56.6%) of the patients were transfers from another facility. While 342 (97.7%) had a neurosurgical consult, only 1 (0.3%) of them required neurosurgical intervention. In-hospital mortality occurred in 4 patients (1.1%). Out of the remaining 346 who did not die in-hospital, 14 (4.1%) were readmitted within 60 days, and 10 (2.9%) died within 60 days (6 patients were missing data for 60-day mortality). 311 (88.9%) patients had at least one repeat CT scan and of those only 16 (5.1%) had the second scan come back worse. The only factor found to be significantly associated with a worse scan change was AIS head ($p=0.0180$).

Conclusion: Neurosurgical intervention was only required in 0.3% of patients presenting with mild tSAH. While 88.9% of them had a repeat CT scan, only 5.1% of them showed worsening results. Our data suggest that it is safe to manage mild tSAH without transfer to a tertiary care center or neurosurgical consultation and that repeat imaging may be of little clinical utility.

DETECTION OF PNEUMOTHORAX ON ULTRASOUND USING ARTIFICIAL INTELLIGENCE

Sean Montgomery, MD; Forrest Li, BS; Christopher Funk, PhD; Erica Peethumangsin, MD; Michael Morris, MD; Jess T. Anderson, MD; Andrew M. Hersh, MD; Stephen Aylward, PhD
Duke University Medical Center
Invited Discussant: Jaswin Sawhney, MD

Background: Ultrasound (US) for the detection of pneumothorax shows excellent sensitivity in the hands of skilled providers. Artificial intelligence (AI) may facilitate the movement of US for pneumothorax into the prehospital setting. The large amount of training data required for conventional neural network methodologies has limited their use in US so far.

Methods: A limited training database was supplied by DARPA of 30 three-second video US, showing 15 cases with sliding lung and 15 cases without. Images were annotated for ribs and pleural interface. The software performed anatomic reconstruction to identify the region of interest bounding the pleura. Three neural networks were created to analyze images on a pixel by pixel fashion with direct voting determining the outcome. Independent verification and validation was performed on a dataset gathered by the DOD. The test images were categorized as sliding and not sliding by subject matter experts (SMEs) from the DOD and our institution.

Results: Anatomic reconstruction with the identification of ribs and pleura was accomplished on all images. On independent verification and validation against the DOD testing data, ARGUS concurred with the SME 80% of the time and achieved a 90% sensitivity (18/20) for pneumothorax and a 71% specificity for the absence of pneumothorax (15/21). Of the 8 mistakes by our AI; 1 was unexplained, 1 had movement of the chest wall, 1 had lung hepatization, and 5 were equivocal cases in which the SMEs did not agree on sliding.

Discussion: Using learning with limited labeling techniques, we were able to identify pneumothorax on US with an accuracy of 80%. Several points of failure were noted that can be improved, to include controlling for chest wall motion, establishing Hierarchical Mixture of Experts ensemble, and the addition of M-mode data to allow accurate classification of equivocal images.

DOES COVID-19 REALLY WORSEN SURGICAL OUTCOMES? A LARGE COVIDSURG PROPENSITY-MATCHED ANALYSIS

Dias Argandykov, MD; Mohamad El Moheb, MD;
Ander Dorken Gallastegi, MD; Mary Bokenkamp, MD; Anthony Gebran, MD; Dmitri Nepogodiev, MBChB; Aneel Bhangu, MBChB, PhD; Haytham Kaafarani, MD, MPH
Massachusetts General Hospital
Invited Discussant: Jeffrey Shupp, MD

Introduction: Patients undergoing surgery with perioperative COVID-19 are suggested to have worse outcome, but whether this is COVID-related or due to selection bias remains unclear. We aimed to compare the postoperative outcomes of patients with and without COVID-19.

Methods: Patients with perioperative COVID-19 from 68 US hospitals in COVIDSURG, an international multicenter database, were 1:1 propensity score-matched to patients without COVID-19 undergoing similar procedures in the ACS-NSQIP database. The matching criteria included demographics, comorbidities, and operation characteristics (e.g., type, urgency, complexity). The primary outcome was 30-day hospital mortality. Secondary outcomes included hospital length of stay (LOS) and 13 postoperative complications.

Results: A total of 97,936 patients were included, 1,054 with and 96,882 without COVID-19. Pre-matching, COVID-19 patients more often underwent emergency surgery (76.1% vs 10.3%, p < 0.001). A total of 843 COVID-19 and 843 non-COVID-19 patients were successfully matched. Figure 1 compares the outcomes of patients with and without COVID-19. Specifically, COVID-19 patients had a higher mortality (12.0% vs 8.1%, p = 0.007), longer LOS (6 [2-15] vs 5 [1-12]) days, and higher rates of acute renal failure (19.3% vs 3.0%, p < 0.001), sepsis (13.5% vs 9.0%, p = 0.003), and septic shock (11.8% vs 6.0%, p < 0. 001). They also had higher rates of thromboembolic complications such as deep vein thrombosis (4.4% vs 1.5%, p < 0.001), pulmonary embolism (2.5% vs 0.4%, p < 0.001), but lower rates of bleeding (11.6% vs 26.1%, p < 0.001).

Conclusion: Patients undergoing surgery with perioperative COVID-19 have higher rates of 30-day mortality and postoperative complications, especially thromboembolic, compared to similar patients without COVID-19 undergoing similar surgeries. Such information is crucial for the complex surgical decision-making and counseling of these patients.
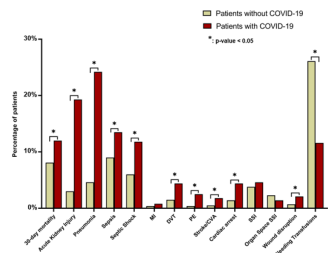
Figure 1. 30-day mortality and postoperative complications of propensity

THE EVOLUTION OF NEUTROPHIL HETEROGENEITY AND EMERGENCE OF A DISTINCT POPULATION OF LOW-DENSITY NEUTROPHILS AFTER TRAUMA

Ingred Goretti-Rica, PhD; Brian A. Joughin, PhD; Alec Griffith, BS; Laura A. Cahill, BS; Simon C. Robson, MD, PhD; Leo E. Otterbein, PhD; Carl J. Hauser, MD; James A. Lederer, PhD; Michael B. Yaffe, MD, PhD
Beth Israel Deaconess Medical Center
Invited Discussant: Mark Hoofnagle, MD

Introduction: Multiple large clinical trauma trials document an increased susceptibility to infection after injury. Although neutrophils (PMN) were historically considered a homogeneous cell type, we hypothesized that injury could alter neutrophil heterogeneity and predispose to dysfunction. To explore whether trauma generates PMN heterogeneity, we performed mass-spectrometry based cytometry (CyTOF) on total leukocytes (TL) as well as low density PMN found in the monocyte fraction (MF) of leukocytes from healthy controls and trauma patients.

Methods: A total of 74 matched samples from 12 trauma patients, each sampled at 1 or more time points, and controls were fractionated and profiled by CyTOF using a panel of 49 distinct markers. After deconvolution and conservative gating on neutrophils, data were analyzed using Seurat, followed by clustering of principal components.

Results: 11 distinct neutrophil populations were resolved in control and trauma neutrophils based on differential protein surface marker expression. Trauma markedly altered the basal heterogeneity of neutrophil subgroups seen in the control samples, with loss of a dominant population of resting neutrophils marked by high expression of C3AR and low levels of CD63, CD64 and CD177 (Cluster 1), and causing expansion of 2 alternative neutrophil populations distinguished respectively by high expression of CD63, CD54, CD95-Fas with suppression of CD16 and CD64 (Cluster 2), or by high expression of CD177 with suppression of CD10, CD16, C3AR, CD63, CD64, and of the active forms of CD11b and CD18 (Cluster 6). Remarkably, following trauma a substantially larger percentage of neutrophils sediment in the monocyte fraction. These low-density neutrophils (LDNs) bear markers of functional exhaustion and form a unique trauma-induced population (Cluster 9) with markedly upregulated expression of active surface adhesion molecules (activated CD11b, CD18, and CD66b), with suppression of nearly all other surface markers, including receptors for formyl peptides, leukotrienes, chemokines, and complement.

Conclusions: Circulating neutrophils demonstrate considerable evidence of functional heterogeneity that is markedly altered by trauma. Trauma induces evolution of a novel, exhausted low-density neutrophil population with immunosuppressive features

PSEUDOANEURYSMS AFTER HIGH GRADE BLUNT SOLID ORGAN INJURY AND THE UTILITY OF DELAYED CT ANGIOGRAPHY

Morgan Schellenberg, MD; Natthida Owattanapanich, MD; Brent Emigh, Chance Nichols, MD; Joshua Dilday, DO; Chaiss Ugarte, Atsushi Onogawa, Kazuhide Matsushima, Matthew J. Martin, Kenji Inaba

LAC + USC Medical Center

Invited Discussant: Susan McLean, MD, MPH

Introduction: Pseudoaneurysms (PSA) can occur following high grade blunt solid organ injury. The natural history of PSAs is unclear but risk for spontaneous rupture and exsanguination exist. The yield of delayed CT Angiography (dCTA) for PSA diagnosis is not well delineated and optimal timing is undefined. Study objective was definition of dCTA utility in diagnosing and triggering intervention for PSA after high grade blunt solid organ injury.

Methods: All blunt trauma patients arriving to our ACS-verified Level 1 trauma center with AAST grade ≥3 abdominal solid organ injury (liver, spleen, and/or kidney) were included in this retrospective study (01/2017-10/2021). Exclusions were age <18y, transfers in, death <48h, and immediate nephrectomy/splenectomy. dCTA performance was not protocolized and was pursued at attending surgeon discretion. Demographics, clinical/injury data, and outcomes were collected. Primary outcome was intervention triggered by dCTA. Statistical testing with ANOVA and Chi squared compared outcomes by type of solid organ injured.

Results: 349 blunt trauma patients with 395 high grade solid organ injuries were identified (Figure 1). Median age was 34 [26-50] years and 70% were male. Median ISS was 24 [18-33]. Median AAST grade of solid organ injury for each was 3 [3-4]. Initial management strategy was typically nonoperative (Liver 59%; Spleen 45%; Kidney 65%) or angioembolization (AE) (Liver 24%; Spleen 50%; Kidney 24%), with fewer patients undergoing operative management (OM) (Liver 12%; Spleen 4%; Kidney 9%) or combined OM/AE (Liver 5%; Spleen <1%; Kidney 2%). dCTA to screen for PSA was typically done on hospital day 4 [3-7]. dCTA identified vascular lesions in 16 Splenic, 10 Liver, and 6 Kidney injuries. The proportion of patients undergoing dCTA and the frequency with which this investigation triggered intervention are given in Figure 1. dCTA triggered intervention in 24% of Splenic, 13% of Kidney, and 9% of Liver injuries, for an overall yield of 14%. Intervention was typically AE (n=23, 92%), although two splenic injuries required splenectomy for PSA treatment.

Figure 1.

Conclusion: Delayed CTA screening for PSA after high grade blunt solid organ injury was performed in approximately half of eligible patients at our center. Delayed CT imaging identified a significant number of vascular lesions requiring endovascular or surgical intervention, with highest yield for splenic injuries. We recommend further examination of this subject and consideration of universal screening of high grade blunt solid organ injuries with delayed abdominal CTA to avoid missing PSAs.
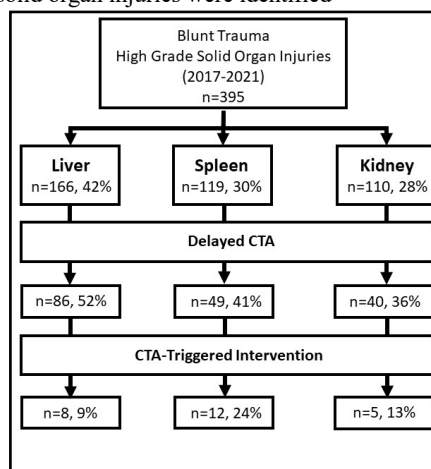
PREHOSPITAL SHOCK INDEX PREDICTS OUTCOMES AFTER PROLONGED RURUAL TRANSPORT

James Bardes, MD, FACS; Bradley Price, PhD; Hannah Bailey, MS;
Alexander Quinn, BS; Zachary Warriner, MD; Andrew Bernard, MD;
Aimee LaRiccia, DO, Chance Spalding, MD; Scott Armen, MD; Melissa
Linskey Dougherty, MD; Alison Wilson, MD
West Virginia University
Invited Discussant: Angela Earley, MD

Introduction: Shock index (SI) predicts outcomes after trauma. Prior single center work demonstrated that emergency medical services (EMS) initial SI was the most accurate predictor of hospital outcomes in a rural environment. This study aimed to evaluate the predictive ability of SI in multiple rural trauma systems with prolonged transport times to a definitive care facility.

Methods: This retrospective review was performed at four ACS-verified level 1 trauma centers with rural catchment basins. Adult trauma patients who were transferred and arrived >60 minutes from scene during 2018 were included. Patients who sustained blunt chest or abdominal trauma were analyzed. Subjects with missing data or severe head trauma (AIS>2) were excluded. A zero inflated Poisson model and binomial logistic regression were utilized to study the effect of SI and delta SI (ΔSI) on outcomes.

Results: After applying criteria 935 patients were considered for analysis, 575 scene patients and 360 transfers. Mean ISS was 8 (IQR 6) for scene and 8.9 (IQR 5) for transfers.

Initial EMS SI was the most significant predictor of the need for blood transfusion and ICU care in both scene and transferred patients (Table 1, p<0.0001), outperforming ΔSI between scene and transferring facility and ΔSI between definitive care and scene. However, any increase in ΔSI was also associated with the need for transfusion and the number of units transfused (p<0.05). Mortality was predicted by initial EMS SI for scene patients (p<0.005). SI was not predictive for operative intervention until measured at the definitive care facility.

Table 1	Scene		Transfer	
Variable/ Response	Use of Blood (Binomial Logistic)	Number of Units of Blood (Poisson)	Use of Blood (Binomial Logistic)	Number of Units of Blood (Poisson)
EMS SI	4.016 ***	1.157 ***	1.994	1.626 **
ΔSI EMS to Definitive	2.443 ***	1.294 ***	0.301	1.411 **
ΔSI EMS to Transfer Fac			0.0151 *	0.895 *
p-values: <0.10 (.), <0.05 (*), <0.01 (**), <0.001 (***)				

Conclusion: Providers must maintain a high level of clinical suspicion for patients who had an initially elevated SI. EMS SI was the greatest predictor for use of blood and ICU care, as well as mortality for scene patients. This highlights the importance of SI and ΔSI in rural trauma care.

RECONCEPTUALIZING HIGH-QUALITY EGS CARE: TOP-TIER HOSPITALS REMAIN CONSISTENT ACROSS VARIABLE OUTCOMES, CONDITIONS, SEVERITIES, AND AGES

Cheryl K. Zogg, PhD, MSPH, MHS; Kristan L. Staudenmayer, MD, MS;
Lisa M. Kodadek, MD; Kimberly A. Davis, MD, MBA
Yale School of Medicine
Invited Discussant: Amy Kwok, MD

Introduction: For years, trauma centers have improved care through the establishment of formal quality-improvement programs. There is now a push to develop comparable programs for emergency general surgery (EGS). Successful implementation will require clear definitions for what constitutes high-quality EGS care. However, given the heterogenous nature of EGS conditions, variability in disease severity, and frequent low in-hospital mortality risk for common conditions like acute appendicitis/cholecystitis, the best approach remains unclear. We developed a novel set of six non-mortality-based quality-metrics that could be used to expand assessment of EGS performance. In this study, we sought to apply them with the goal of determining whether (1) a group of best-performing EGS hospitals can be defined and (2) good performance for one EGS condition in one patient group is associated with similar outcomes for other conditions/patients at an institution.

Methods: Patients hospitalized with 1-of-16 AAST-defined EGS conditions were identified in the 2019 Nationwide Readmissions Database. They were stratified by age and AAST severity (simple-vs-complex) into four cohorts: simple older adults, complex older adults, simple adults, and complex adults. Within each cohort, Bayesian mixed-effects regression models were used to calculate condition-specific risk-standardized quality-metrics. The six quality-metrics included: major morbidity, index hospital length of stay, ability to be discharged home, need for readmission within 30 days, need for reoperation within 90 days, and a patient's average number of hospitalized days within 6 months of index admission. K-means cluster analysis identified hospitals with similar performance. Multinomial regression identified predictors of resultant 'best' EGS care.

Results: N=1,130,496 patients from 2,355 hospitals were included (39.5% simple older adult, 6.4% complex older adult, 40.6% simple adult, and 13.5% complex adult). Within each cohort, K-means cluster analysis identified three distinct clusters (best, average, and worst). Best-performing hospitals demonstrated consistently better outcomes for each included EGS condition and quality-metric. They remained concordant across cohorts. When examined for associations with hospital-level factors, best-performing hospitals were those with larger EGS volumes, urban teaching status, and a larger proportion of EGS patients with higher average Hospital Frailty Risk Scores and more pre-existing medical conditions (two-sided p-value <0.05 for each).

Conclusions: Top-tier EGS hospitals remained consistent across variations in outcomes, EGS conditions, disease severity, and ages of patients. They tended to be larger teaching hospitals located in urban areas managing the most sick and frail patients. Such findings suggest that EGS centers-of-excellence could exist and that use of non-mortality-based quality-metrics could offer a needed, promising means of evaluating high-quality EGS care.

WHO'S INFORMED OF TRAUMA INFORMED CARE? PATIENTS' PRIMARY LANGUAGE AND COMPREHENSIVENESS OF INITIAL TRAUMA ASSESSMENT

Souma Kundu, MPH; Todd W. Costantini, MD; Jay J. Doucet, MD;
Allison E. Berndtson, MD
UC San Diego Health System
Invited Discussant: Nicole Goulet, MD

Introduction: Trauma informed care may improve outcomes by addressing disparities in at-risk patients. For patients with limited English proficiency (LEP), language poses a unique challenge in patient-provider communication. Using certified medical interpretation (CMI) can be difficult in time and resource limited settings including trauma. We hypothesized that there would be limited use of CMI during major trauma resuscitations, less comprehensive assessments, and less empathetic communication for Spanish-speaking patients with LEP (SSP) compared to English-speaking patients (ESP).

Methods: We analyzed video-recorded encounters of trauma initial assessments at a Level 1 trauma center. Each encounter was evaluated from patient arrival until completion of the secondary survey per Advanced Trauma Life Support protocol. A standard checklist of provider actions was utilized to assess comprehensiveness of the primary and secondary surveys and communication events such as provider introduction, reassurances, and communicating next steps to patients. We compared the SSP and ESP cohorts for significant differences in completion of checklist items.

Results: Fifty patients with Glasgow Coma Scale score 14-15 were included (25 ESP, 25 SSP). Mean age was 45 years; 72% SSP were male vs. 60% ESP. SSP received less comprehensive exams and communication (table). No patients were asked their primary language. Two (8%) SSP encounters used CMI; most (80%) utilized ad-hoc interpretation, 12% used English.

Checklist Component	SSP (n=25)	ESP (n=25)	p-value
Complete Motor Exam	48%	96%	<0.001
Complete Sensory Exam	4%	68%	<0.001
History of Present Illness	24%	68%	0.002
Provider explains next steps	32%	96%	<0.001
Provider reassures patient at least once	44%	88%	0.001

Conclusion: We found significant differences in the initial care provided to trauma patients based on primary language. Inclusion of an interpreter as part of the trauma team may improve the quality of care provided to trauma patients with limited English proficiency.

THE IMPACT OF STATE TRAUMA FUNDING
ON TRIAGE AND MORTALITY OF TRAUMA PATIENTS

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Hsia, MD, MSc; Robert C. Mackersie, MD; Anne M. Stey, MD, MSc
Northwestern University
Invited Discussant: Rajan Gupta, MD, MS

Objective: Less than half of states dedicate funding specifically towards
trauma care and systems. This study examines the association between state
trauma funding and mortality among critically injured patients.

Methods: Patient encounters with an injury diagnosis and Injury Severity
Score (ISS) >15 were extracted from 2016 and 2017 Healthcare Cost and
Utilization Project (HCUP) State Emergency Department Databases
(SEDD) and State Inpatient Databases (SID) from five states (FL, MA, MD,
NY, WI). These states capture a broad range of geographic and demographic
variability and allow for patient linkage across encounters. These data were
merged with the American Hospital Association (AHA) Survey and publicly
available state trauma funding data obtained from each state's Department
of Public Health. Patients were linked across emergency and inpatient
encounters to determine triage status, defined as appropriate triage (admitted
to a Level I or II trauma center (TC)), under-triage (admitted to a Level III,
IV, or non-TC), or re-triage (emergently transferred from an emergency
department to a Level I or II TC). We tested the association between state
trauma funding and mortality using a hierarchical logistic regression,
controlling for triage status with a trauma funding by triage status
interaction term and adjusting for age, sex, race, primary payer, Elixhauser
comorbidity score, and ISS.

Results: A total of 242,299 patients with ISS >15 met inclusion criteria.
Median age was 52 years (IQR=28-73). Median ISS was 17 (IQR=16-25).
Two states (MA, NY) allocated $0.00 per capita trauma funding, and three
states (WI, FL, MD) allocated between $0.09-$1.80 per capita trauma
funding. Compared to patients in states with no trauma funding, patients in
states with trauma funding experienced decreased adjusted odds of mortality
(OR=0.75 [0.60-0.93]). Funding was associated with decreased adjusted
odds of mortality among all triage statuses, with the lowest adjusted odds of
mortality among re-triaged patients (OR=0.63 [0.46-0.87]).

Conclusion: State trauma funding is associated with lower adjusted
mortality among severely injured patients. Increasing state trauma funding
may lower adjusted mortality in states without trauma funding.

DEALING WITH THE GROWING EPIDEMIC OF ELDER ABUSE: NATIONWIDE DISPARITIES IN INTERVENTIONS FOR ABUSE AMONG THE VULNERABLE ELDERLY

Khaled El-Qawaqzeh, MD; Lourdes Castanon, MD, FACS; Raul Reina, MD; Colin Stewart, MD; Hamidreza Hosseinpour, MD; Tanya Anand, MD, MPH; Michael Ditillo, DO, FACS; Omar Obaid, MD; Adam Nelson, MD; Bellal Joseph, MD, FACS
The University of Arizona
Invited Discussant: Julie Goswami, MD

Background: Elder abuse is a growing epidemic associated with high morbidity & mortality. Healthcare professionals represent a key component in the management of elder abuse, as they may be the only point of contact for these vulnerable patients capable of recognizing, reporting, & intervening against abuse. The aim of our study was to identify the factors associated with initiation of abuse investigations & change of caregiver at discharge following reported elder abuse on a nationwide scale.

Methods: Analysis of the 2017-2018 ACS-TQIP. All geriatric trauma patients (≥60 yrs) presenting with suspected or confirmed elder abuse & an abuse report filed were included. Patients with missing information regarding abuse interventions were excluded. Outcomes were rates of abuse investigations initiated among those with an abuse report filed, & change of caregiver at discharge among survivors with an abuse investigation initiated.

Results: 1,405 patients with suspected or confirmed elder abuse & an abuse report filed were identified. Mean age was 72 ± 9 years, 43% were male, 72% were White, 15% were Black, 10% were Hispanic, & 76% had government insurance. Mechanisms of injury were: blunt (76%); penetrating (12%); burns (1%) & median ISS was 9 [4-16]. Forms of abuse were: physical (82%); neglect (13%); sexual (5%); psychological (1%). Most common perpetrator of abuse was a member of the extended or stepfamily (53%), followed by a member of the immediate family (38%), or care provider (9%). 1,060 (75%) abuse investigations were initiated following an abuse report. Of those, 23% resulted in a change of caregiver at discharge among the survivors. On multivariate analysis, male gender (aOR 0.69; $p<0.01$), Hispanic ethnicity (aOR 0.59; $p=0.04$), private insurance status (aOR 0.69; $p=0.03$), positive drug screen at admission (aOR 1.90; $p=0.02$), & management at non-level I trauma centers (aOR 0.52; $p=0.01$) were independently associated with initiation of abuse investigation following an abuse report filed. Among those who had an abuse investigation initiated, male gender (aOR 0.72; $p=0.03$), functional disability (aOR 1.50; $p=0.03$), & dementia (aOR 1.74; $p<0.01$) were independently associated with change of caregiver at discharge.

Conclusion: Significant gender, ethnic, & socioeconomic disparities in the nationwide management of elder abuse victims exist. Further studies are strongly warranted to expand on the contributing factors underlying these disparities & possible strategies to address them.

DOES ACQUISITION OF EMERGENCY MEDICAID AT THE TIME OF INJURY LEAD TO SUSTAINED INSURANCE? A STATEWIDE ANALYSIS

Lisa Knowlton, MD, MPH; Linda Tran, PhD; Katherine Arnow, MS; Amber Trickey, PhD; David Spain, MD; Todd Wagner, PhD; Arden Morris, MD, MPH

Stanford School of Medicine
Invited Discussant: Erica Lester, MD

Introduction: Hospital Presumptive Eligibility (HPE) is a temporary Medicaid insurance available to patients at hospitalization. HPE insurance can offset costs of care, increase access to post-discharge resources, and provide patients with a path to sustain long-term coverage by applying for Medicaid. As HPE only lasts up to sixty days, it is unclear whether HPE-approved trauma patients are sustaining insurance. We aimed to determine Medicaid insurance status six months after injury and identify factors associated with successful sustainment.

Methods: With the California Department of Health Care Services (DHCS), we developed a customized longitudinal claims dataset for HPE-approved patients. We analyzed adults admitted with a primary trauma diagnosis (ICD-10) who were HPE approved in 2016 and 2017. Our primary outcome was Medicaid sustainment at six months following HPE approval. Univariate and multivariate analyses were performed.

Results: A total of 9,749 trauma patients with HPE were analyzed; 6,795 (69.7%) sustained Medicaid at six months. Compared to patients who did not sustain, those who sustained had higher injury severity score (ISS>15: 73.5% vs. 68.7%, p<0.001), more often underwent surgical

% Sustained Medicaid by Injury Severity

intervention (74.8% vs. 64.5%, p<0.001) and were more likely to be discharged to post-acute services (23.9% vs. 10.4%, p<0.001). Medicaid sustainment stratified by ISS is described in Figure 1. Medicaid sustainment was high among patients who identified as White (86.7%), Hispanic (86.7%), Black (84.3%) and Asian (83.7%), particularly if their preferred language was English (73.9%). Medicaid sustainment was low among the 2,505 patients (25.7%) who declined to report their race, ethnicity, or preferred language (14.8% sustainment). In adjusted analyses, major injuries (ISS>16) (vs. ISS<=15: aOR 1.51, p=0.02) and surgery (aOR 1.85, p<0.001) were associated with increased likelihood of Medicaid sustainment. Declining to disclose race, ethnicity, or language (aOR 0.05, p<0.001) decreased the likelihood of Medicaid sustainment.

Conclusion: HPE programs are a promising pathway for securing long-term insurance coverage for trauma patients, particularly among the severely injured who likely require ongoing access to healthcare services. Opportunities include educational interventions for patients with less severe injuries, as well as patient and provider interviews to better understand barriers in trust and policy for patients who do not disclose race or ethnicity.
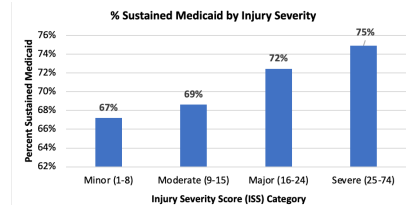
# FINANCIAL VULNERABILITY OF TRAUMA CENTERS: A NATIONAL ANALYSIS

Alexander Marrotte, MD; Richard Calvo, PhD; Derek Benham, MD; Benedict Capacio, MD; Christopher Goljan, MD; Alexandra Rooney, MPH; Alyssa Carroll, BS; Andrea Krzyzaniak, MA; Vishal Bansal, MD; Michael Sise, MD; Matthew Martin, MD
Scripps Mercy Hospital
Invited Discussant: Jason Smith, MD

Objective: Trauma centers function as an essential safeguard in the United States healthcare system. However, there has been minimal study of their financial health or vulnerability. We sought to perform a nationwide analysis of trauma centers using detailed financial data and a recently developed Financial Vulnerability Score (FVS) metric.

Methods: The RAND Hospital Financial Database was used to evaluate all ACS-verified trauma centers nationwide. The composite FVS was calculated for each center using six metrics. FVS tertiles were used to classify centers as High, Medium, or Low vulnerability and hospital characteristics were analyzed and compared. Hospitals were also compared by US Census region and teaching versus non-teaching hospitals.

Results: There were 617 centers identified: 194 Level I, 278 Level II, and 145 Level III. The largest share of the high FVS tier was comprised of Level III centers (59%), with the majority of Level I (40%) and Level II (43%) in the middle and low FVS tier, respectively (Figure). The most vulnerable centers had fewer beds, negative operating margins, and significantly less cash on hand. Lower FVS centers had greater asset:liability ratios, lower outpatient shares, and three times less uncompensated care. New England and East North Central regions had the largest proportion of high FVS centers. Non-teaching centers were statistically significantly more likely to have high vulnerability compared to teaching centers (46% vs. 29%).

Conclusion: With approximately 25% of Level I and II trauma centers at high risk for financial vulnerability, disparities in characteristics, including payer mix and outpatient status, should be targeted to reduce vulnerabilities and bolster the healthcare safety net.

Financial Vulnerability by Trauma Center Designation
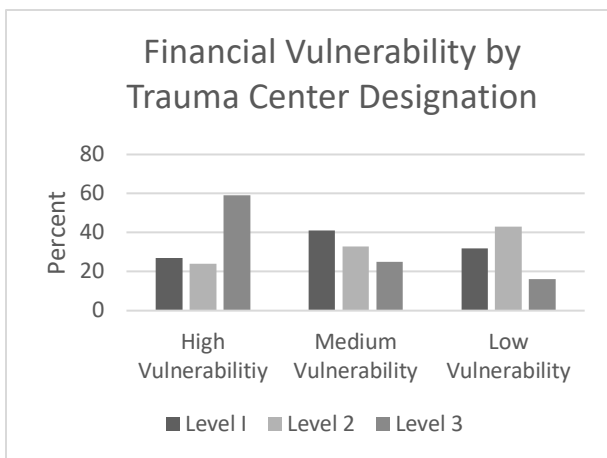
GREATER SPATIAL ACCESS TO CARE IS ASSOCIATED WITH LOWER MORTALITY FOR EGS DISEASE

Marta L. McCrum, MD; Chelsea Allen, PhD; Angela Presson, PhD; Neng Wan, PhD

University of Utah

Invited Discussant: Vanessa Ho, MD, MPH

Introduction: Emergency General Surgery (EGS) diseases are time-sensitive conditions that require urgent surgical evaluation, yet the effect of geospatial access to care on outcomes remains unclear. We examined the association of spatial access with outcomes for common EGS conditions. **Methods:** Retrospective analysis of twelve 2014 State Inpatient Databases, identifying adults admitted with one of eight common EGS conditions. Complex disease was defined by previously published ICD-9 codes for AAST severity scales. We assessed geospatial access to surgical care using the Spatial Access Ratio (SPAR)– an advanced spatial model that accounts for travel distance, hospital capacity, and population demand, normalized against the national mean (i.e. SPAR <1 indicates lower than average access.) Sequential multivariable logistic regression models adjusting for patient and hospital factors were used to evaluate the association between SPAR with a) in-hospital mortality and b) major morbidity. **Results:** Of 1,161,424 admissions, 134,729 (11.6%) patients had low-access (SPAR<0.5) to surgical care and 767,580 (66.1%) high-access (SPAR≥1). Low-access patients were more likely to be white, male and treated in small, non-teaching hospitals. Low-access patients also had higher incidence of complex EGS disease when compared to high-access patients (16% vs 10%, p<0.001) and greater in-hospital mortality (3.3% vs 2.5%, p<0.05). Adjusting for confounding factors, including presence of advanced hospital resources, high-access was protective against in-hospital mortality (aOR 0.96, 95% CI 0.94 -0.97, p<0.001), and remained so when complex disease – a potential mediator of the relationship between geospatial access and mortality - was included in the model. Spatial access had a minor association with major morbidity (aOR 0.99, 0.99-1.00 p<0.001). **Conclusions:** This is the first study to demonstrate that restricted geospatial access to surgical care is associated with higher incidence of complex EGS disease, and that greater spatial access is independently associated with lower in-hospital mortality. These results suggest that organized systems for EGS care are warranted to address the impact of spatial access to surgical care for these high-burden and time-sensitive diseases.

CATASTROPHIC HEALTH EXPENDITURE IN NON-NEUROLOGICAL INJURY DUE TO MOTOR VEHICLE CRASH

Madhuri Nishtala, MD; Madeline Reed, BS; Michael Collins, PhD, MPP; Manasa Venkatesh, BS; Bret Hanlon, PhD; Jessica Schumacher, PhD; Ben Zarzaur, MD
University of Wisconsin School of Medicine and Public Health
Invited Discussant: David Zonies, MD, MPH, MBA

Background: Hospitalization due to injury is costly. Single center studies demonstrate that 80% of injured patients suffer from financial hardship in the year after injury. Financial hardship after injury is associated with worse Health-Related Quality of Life. Motor Vehicle Crashes (MVC) are a leading cause of traumatic injury in the United States. There are little national data describing patients at risk for financial hardship for this common cause of injury. The purpose of this study is to describe financial hardship in terms of Catastrophic Health Expenditure (CHE) in a cohort of MVC patients. **Methods**: The study cohort, derived from the National Inpatient Sample, consisted of adult patients ages 26-64 who suffered non-neurologic injury after MVC between 2014-2017. Post-subsistence spending was calculated using average cost of food for each income quartile (Bureau of Labor Statistics). Average yearly maximum out-of-pocket costs were calculated for all private insurance plans. CHE was defined as hospital costs ≥40% of post-subsistence spending after accounting for insurance status. Patient/hospital characteristics were compared based on insurance status. **Results:** Amongst the 189,080 patients in the cohort, 149,705 were privately insured and 39,375 were uninsured. Most patients were male (65.6%), white (63.7%), treated at a large (65.1%) urban facility (83.2%), and survived to discharge (99%). 91.4% of uninsured patients and 10.1% of privately insured patients were at risk for catastrophic health expenditure. The risk of CHE was similar among most subpopulations, but some subpopulations had significant differences in risk of CHE. Among uninsured patients, patients in the lowest community income quartile (93.3%) had higher CHE risk than those in the highest (81.4%) ($p<0.001$). Patients treated at urban facilities had higher CHE risk (91.6%) than rural (86.5%) ($p<0.001$). **Conclusions:** MVC is one of the most common causes of injury in the United States. Over 90% of uninsured patients who suffer from non-neurologic injury due to MVC are at risk for CHE. While insurance is protective against CHE, 10% of insured patients are still at risk for CHE, suggesting that insurance alone is inadequate in eliminating financial hardship for all patients.

Risk of CHE in MVC patients
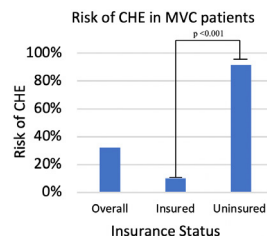
THE IMPACT OF A MULTIMODAL PAIN REGIMEN ON ANALGESIA PRESCRIBING AT AN ACADEMIC HOSPITAL

Krista Stephenson, MD; Allison Wells, MS; Allison Jenkins, Pharm D; Ronald Robertson, MD; Mary Kimbrough, MD; Avinash Bhavaraju, MD; Nolan Bruce, MD; Benjamin Davis, MD; Melissa Kost, MD; Joseph Margolick, MD; Anna Privratsky, MD; Matthew Roberts, MD; Kyle Kalkwarf, MD

University of Arkansas for Medical Sciences
Invited Discussant: Andrew Bernard, MD

Introduction: Opioid-sparing, multimodal pain therapy (MMP) was initiated at our institution in Aug 2016 when a new faculty member joined the Division of Trauma & Acute Care Surgery (TACS). Over the next two years, the practice was codified into a protocol as new members joined the division. This study aims to evaluate the dissemination and impact of MMP.

Methods: We conducted a single-center retrospective cohort study of all patients admitted to a surgical service from May 2015-July 2020 to evaluate opioid and non-opioid prescribing for analgesia. The analysis consisted of three populations: patients admitted to the TACS service, general surgery subspecialty (GSS) services with general surgery resident coverage, and other surgical department (OSD) services. Patients with a length of stay <24 hours, ICU admissions, and those prescribed an epidural/PCA were excluded.

Results: 12,010 patients met inclusion criteria. The mean age was 57.3 years. 1,979 (16.5%) were admitted to the TACS service, 1,106 (9.2%) to GSS services, and 8,925 (74.3%) to OSD services. Opioid morphine milligram equivalents (MME) varied widely, with an overall average of 38.6±33.3 daily, but decreased in all groups over the study period. Non-opioid adjunctive medications were used in 5,932 (49.4%) and increased in all groups after implementation of the protocol (all p<0.001). After MMP introduction, non-opioid analgesic use increased most rapidly in TACS and slowest in OSD. Conversely, after protocol application the average daily MME decreased most rapidly in TACS (24.4%, p<0.001), while GSS and OSD services saw a subsequent decrease in opioid use (p=0.004 and p<0.001, respectively) as MMP increased.

	Start	1-Aug-2015	1-Aug-2016	1-Aug-2017	1-Aug-2018	1-Aug-2019
	End	31-Jul-2016	31-Jul-2017	31-Jul-2018	31-Jul-2019	31-Jul-2020
Trauma & ACS	MME/day	18.0+/-23.6	16.4+/-20.2	13.0+/-17.8	13.5+/-17.9	14.3+/-19.8
	Non-opioid %	34.6%	57.1%	73.9%	76.2%	81.6%
General Surgery Subspecialties	MME/day	44.5+/-35.4	33.7+/-26.0	30.2+/-25.8	22.6+/-18.2	41.4+/-60.6
	Non-opioid %	36.3%	31.0%	34.3%	58.3%	68.6%
Other Surgical Departments	MME/day	50.1+/-33.6	49.7+/-34.2	40.5+/-29.1	40.5+/-28.9	39.3+/-33.9
	Non-opioid %	37.9%	39.3%	45.6%	52.8%	54.6%

Conclusion: Implementation of a multimodal pain protocol by a single division can facilitate the rapid spread of non-opioid adjunctive pain medication use and decrease opioid utilization throughout surgical specialties in a hospital.

MEDICAL MANAGEMENT IS THE TREATMENT OF CHOICE FOR LOW GRADE BLUNT THORACIC AORTIC INJURIES

Joseph Dubose, MD; Simin Roward, MD; Jessica Efird, MD; Pedro Teixeira, MD; Tatiana Cardenas, MD; Marc Trust, MD; Jayson Aydelotte, MD; Carlos Brown, MD
Dell Seton Medical Center at the University of Texas
Invited Discussant: Charles Butts, MD

Objective: Thoracic endovascular aortic repair (TEVAR) has become standard of care for the treatment of blunt thoracic aortic injuries (BTAI) requiring intervention. There is data showing that low grade BTAI (Grade 1 or Grade 2) will resolve spontaneously if treated with medical management (MM) alone. To date there has been no comparison between the use of MM vs. TEVAR for low grade BTAI. We hypothesize that low grade BTAI injuries can be safely managed with MM alone.

Methods: Retrospective analysis of all patients with a low grade BTAI in the Aortic Trauma Foundation Registry from 2016 to 2021 was performed. The study population was divided into two groups according to BTAI management strategy: MM vs. TEVAR. The primary outcome was mortality. Secondary outcomes included complications, hospital and ICU length of stay, and ventilatory days.

Results: 880 patients with BTAI were enrolled, of these, 274 (31%) sustained low grade BTAI. Five patients (2%) progressed to higher grade injuries, underwent uncomplicated TEVAR, and were excluded from further analysis. Of the 269 patients with low grade BTAI, 218 (81%) were treated with MM alone (81% Grade I, 19% Grade II), while 51 (19%) underwent a TEVAR (20% Grade I, 80% Grade II). Comparing low grade BTAI patients who underwent MM vs. TEVAR, there was no difference in demographics or mechanism of injury. Admission systolic blood pressure was lower in patients undergoing TEVAR (Mean (mm Hg): 114 vs 124, p= 0.035). Rates of thoracotomy, craniectomy, and sternotomy were equal between the two groups, however TEVAR patients were more likely to undergo laparotomy (31% vs 15%, p= 0.007). There was a significant difference in mortality between MM alone and TEVAR (8% vs. 18%, p=0.009). Aortic-related mortality was 0.5% in the MM group and 4% in the TEVAR group (p=0.06). TEVAR patients also had an increased incidence of DVT (12% vs. 1%, p= 0.002) and ARDS, (10% vs. 3%, p= 0.038). Hospital and ICU length of stay, and ventilator days were not different between the two groups.

Conclusions: MM alone is safe and appropriate management for low grade BTAIs, with significantly lower mortality and decreased rates of complications when compared to routine initial TEVAR.

DOES THE USE OF REBOA IMPROVE SURVIVAL IN PATIENTS WITH PELVIC FRACTURES REQUIRING HEMORRHAGE CONTROL INTERVENTION?

Herbert Downton-Ramos, MD; Jonathan Gates, MD; Ya-Huei Li, PhD; Stephen Thompson, BS; Matthew Lissauer, MD; Daniel Ricaurte, MD
Hartford Hospital
Invited Discussant: Susan Rowell, MD

Introduction: Resuscitative endovascular balloon occlusion of the aorta (RE-BOA) can be utilized for hemorrhage control for bleeding below the dia-phragm. The aim of this study is to assess whether use of zone 3 REBOA decreases mortality in patients with pelvic fractures requiring control procedures.

Methods: Retrospective study of the ACS TQP Participant Use File from 2016-2019 included hypotensive patients $\geq$18 years, with blunt pelvic fractures requiring a hemorrhage control procedure, comparing those who underwent Zone 3 REBOA deployment (RB) versus those that did not (NR). Primary outcomes included in-hospital and 24hr mortality. Secondary outcomes included blood utilization at 4hrs and 24hrs, hospital and ICU LOS, SSI, lower limb amputation and AKI.

Results: 4,453 records were analyzed, with 139 patients in the RB group and 4,314 in the NR group. Patient demographics were not significant between groups. Median systolic BP and GCS were lower in the RB group, while ISS was higher. Propensity score matching for demographics, ISS, systolic blood pressure, and GCS matched 121 patients to each group. In-hospital (50.5% vs 25%, p<0.001) and 24hr mortality (31% vs 14.3%, p = 0.002) were higher in the RB group. Median PRBC transfusions in the first 4hrs (4,000mL vs 1,750mL, p<0.001) and 24hrs (5,600mL vs 2,800mL, p<0.001) were also higher in the RB group. Of those that survived, there were no differences in ICU and hospital LOS. AKI was higher in the RB group (15.7% vs 6.6%, p = 0.025), while the rate of lower extremity amputations was similar between groups.

Conclusion: Zone 3 REBOA use in patients with pelvic fractures that require a hemorrhage control procedure appear to have worse outcomes. Further prospective studies are warranted.

DISPELLING DOGMA: AAST PROSPECTIVE, MULTICENTER TRIAL OF INITIAL VS. DELAYED FASCIOTOMY AFTER EXTREMITY TRAUMA

University of Connecticut
Jane Keating, MD; Joanelle A. Bailey, MD; Nathan Klingensmith, MD; Alexis Moren, MD; Fabio Saccomanno, BS; David Skarupa, MD; Anthony Loria, MD; Zoe Maher, MD; Sarah A. Moore, MD; Michael C. Smith, MD, FACS; Robert Jean, MD; Amanda Leung, BA; Kevin M. Schuster, MD, MPH; Mark J. Seamon, MD
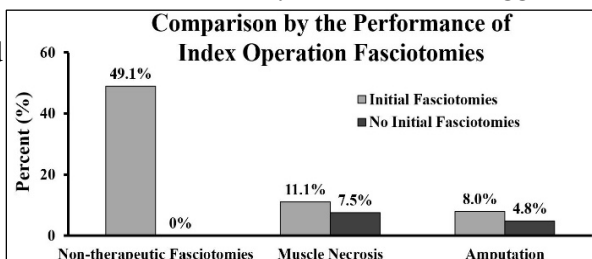Invited Discussant: Leah Tatebe, MD

Background: Surgical dogma suggests "if you think about doing a fasciotomy, then do it," yet the outcome benefit to this approach remains unclear. We hypothesized that early fasciotomy during index operative procedures for extremity vascular injury would improve outcomes. **Methods:** This prospective, observational multicenter (18LI, 2LII) analysis included patients ≥15yrs with extremity vascular injuries requiring operative management. Clinical variables and outcomes were analyzed with respect to fasciotomy timing for correlation with our primary study endpoint, muscle necrosis development or limb amputation. Associated variables ($p<0.05$) were input into multivariable logistic regression (MVLR) models. **Results:** Of 442 study patients, most were males (86%) with penetrating (56%) lower extremity (77%) arterial (72%) vein (40%) and bony (51%) injuries with prolonged hospital LOS (med, 11 days). Patients who had index fasciotomies (66%) were compared to those who did not (34%). No differences were appreciated with respect to "hard" signs of vascular injury, SBP, MTP activation, extremity AIS, ISS, concomitant vein injury, initial OR>6hrs after arrival, shunt use, or exam after repair. Of 289 patients who underwent index fasciotomies (Figure), 49% were non-therapeutic, 11% developed muscle necrosis, 4% required repeat fasciotomies and 8% required amputation while only 28 of 147 (19%) required delayed fasciotomies in those without index fasciotomies. Importantly, no additional muscle necrosis or amputation risk was noted in the delayed fasciotomy group ($p>0.05$). After controlling for confounders, index fasciotomies were not associated with either muscle necrosis or amputation risk in MVLR. **Conclusion:** Routine, index operation fasciotomies failed to demonstrate an outcome benefit in this prospective, multicenter analysis. Our results suggest that a careful observation and fasciotomy when needed approach in select patients with extremity vascular injuries may limit unnecessary surgery and morbidity.

Comparison by the Performance of Index Operation Fasciotomies

Legend: Initial Fasciotomies; No Initial Fasciotomies

- Non-therapeutic Fasciotomies: 49.1% (Initial Fasciotomies), 0% (No Initial Fasciotomies)
- Muscle Necrosis: 11.1% (Initial Fasciotomies), 7.5% (No Initial Fasciotomies)
- Amputation: 8.0% (Initial Fasciotomies), 4.8% (No Initial Fasciotomies)

Y-axis: Percent (%), 0 to 60

ANTIBIOTIC ADMINISTRATION WITHIN ONE-HOUR FOR OPEN LOWER EXTREMITY FRACTURES: INFECTION PREVENTION OR JUST SURGICAL DOGMA?

Areg Grigorian, MD; Morgan Schellenberg, MD; Kenji Inaba, MD;
Matthew Martin, MD; Kazuhide Matsushima, MD; Michael Lekawa, MD;
Jeffry Nahmias, MD, MHPE
University of Southern California
Invited Discussant: Addison May, MD, MBA

Introduction: Open fractures have a high risk of infection with limited data correlating timing of prophylactic antibiotics administration and rate of subsequent infections. The Trauma Quality Improvement Project (TQIP) has established a standard guideline of antibiotic administration within one-hour of arrival, but there is a lack of adequately powered studies validating this metric. We hypothesize that open femur or tibia fracture patients undergoing orthopedic surgery have a decreased risk of deep or superficial surgical site infection if antibiotics are administered within one-hour of presentation compared to delayed administration after one-hour.

Methods: The 2019 TQIP was queried for adults with isolated (AIS<1 head/face/spine/chest/abdomen/upper-extremity) open femur or tibia fractures undergoing orthopedic surgery. Transfer patients were excluded. Patients receiving early antibiotics (EA) within one-hour were compared to patients receiving delayed antibiotics (DA) greater than one-hour from arrival.

Results: A total of 3,367 patients were identified, of which 2,400 (70.4%) received EA. Patients receiving EA had a higher rate of infections compared to DA (0.9% vs. 0.2%, p=0.033). After adjusting for age, comorbidities, injury severity, washout of the femur/tibia $\leq$6-hours, blood transfusion and vitals on admission, patients in the EA group had a similar associated risk of infection compared to the DA cohort (p=0.13). These results remained in subset analyses of patients with only femur fractures, only tibia fractures or combined fractures (all p>0.05).

Conclusion: In this large national analysis, 70% of isolated open femur or tibia fracture patients undergoing surgery received antibiotics within one-hour. After adjusting for known risk factors of infection including abbreviated-injury-scale grade of the lower extremity, there was no association between infection and timing of antibiotic administration. Reconsideration of the surgical dogma that antibiotics must be initiated within one-hour for open fractures appears warranted.

ADMISSION MA-R RATIO: ASSOCIATION BETWEEN THROMBOELASTOGRAPHY (TEG) VALUES PREDICTS POOR OUTCOME IN INJURED CHILDREN

Elissa Abou Khalil, MD; Katrina Morgan, MD; Ward Richardson, MD;
Barbara A. Gaines, MD; Christine M. Leeper, MD, MSc
UPMC
Invited Discussant: Mary Edwards, MD

Background: TEG-MA/R, a derived ratio that accounts for both hypo- and hypercoagulable changes in coagulation, is associated with poor outcomes in adults. The relationship between these TEG values and its association with outcome has not been studied in children.

Methods: A level I pediatric trauma center database was queried for children age<18 who had a TEG assay on admission between 2016-2020. Demographics, injury characteristics, and admission TEG values were recorded. The MA/R ratio was calculated and divided into quartiles. Main outcomes included mortality, transfusion within 24 hours of admission, and thromboembolism. A logistic regression model was generated adjusting for age, injury severity score, injury mechanism, admission shock and Glasgow Coma Score.

Results: In total, 657 children were included. The median(IQR) age = 11(4-14) years, 70% male, median (IQR) ISS =10(5-22), 75% had blunt mechanism. In-hospital mortality = 7% (n=45) and 17% (n=112) required transfusion. Most R and MA values were within normal limits. On unadjusted analysis, the lowest MA-R ratio quartile was associated with increased mortality (15% vs 4%, 5%, and 4%, respectively; p<0.001) and increased transfusion need (26% vs 12%, 16%, 13%, respectively; p=0.002) compared to higher quartiles. In the logistic regression models, low MA/R ratio was independently associated with increased in-hospital mortality (Odds Ratio (95% CI) = 4.4 (1.9-10.2) and increased need for transfusion within 24 hours of admission (OR (95% CI) = 2.0 (1.2-3.4) compared to higher MA/R ratio. There was no association between MA/R ratio and thromboembolism (DVT rate by quartile = 4%, 2%, 1%, 3%).

Conclusion: Although individual admission TEG values are not commonly substantially deranged in injured children, the MA/R ratio is an independent predictor of poor outcome. MA/R ratio may be a useful prognostic tool in pediatric trauma; validation is necessary.

NATIONWIDE TRENDS IN THE MANAGEMENT OF ISOLATED HIGH-GRADE SPLENIC INJURIES: LESS SPLEENS ARE THROWN INTO A BUCKET

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Invited Discussant: Ben Zarzaur Jr., MD, MPH

Introduction: The management of blunt splenic injury (BSI) has significantly changed since the introduction of non-operative management (NOM) in the late 1990s. A recent study reported that overall splenectomy rates for high-grade BSI remained unchanged between 2008 and 2014 despite an increased use of angioembolization. The purpose of this study was to report the recent trends in the management of isolated high-grade BSI, particularly the early splenectomy rate.

Methods: The American College of Surgeons Trauma Quality Improvement Program (ACS TQIP) database was searched to identify patients (aged $\geq$ 16 years) with isolated high-grade BSI (Abbreviated Injury Scale $\geq$ 3) between 2013 and 2019. The patients were divided into two groups based on their hemodynamic status (hemodynamically stable [HS] and hemodynamically unstable [HU] groups). Hemodynamic instability was defined as admission systolic blood pressure (SBP) < 90 mmHg, heart rate > 120 bpm, or lowest SBP < 90 mmHg within an hour after admission. The primary outcome was splenectomy rate each year and the secondary outcome was the use of angioembolization. Early splenectomy was defined as that performed within 6 hours, whereas delayed splenectomy between 6–72 hours after admission. Multiple regression models were constructed to estimate the annual trends in splenectomy rates.

Results: A total of 5,929 patients with isolated high-grade BSI were included in the analysis: 4,525 (76.3%) and 1,404 (23.7%) in the HS and HU groups, respectively. Multiple regression models showed significant decrease in the rate of splenectomy in the HS group (from 24.0% in 2013 to 14.9% in 2019, OR = 0.881, CI = 0.836–0.929, p < 0.001: Figure), while it remained stable in the HU group (from 60.6% in 2013 to 46.5% in 2019, OR = 0.969, CI = 0.897–1.050, p = 0.424). The rate of splenic angioembolization did not significantly change in the HS group (OR = 0.967, CI = 0.864–1.080, p = 0.554), but increased in the HU group (OR = 1.240, CI = 1.110–1.390, p < 0.001). In the HS group, early splenectomy rate decreased significantly (from 16.6% in 2013 to 8.8% in 2019, OR = 0.841, CI = 0.790–0.896, p < 0.001).

Conclusions: For isolated high-grade BSI, the splenic salvage rate showed increasing trends, particularly in HS patients. Because the rate of splenectomy has not significantly changed in HU patients, regardless of increased splenic embolization, further research is needed to identify the optimal group of patients who can benefit from splenic angioembolization to further increase the rate of splenic salvage.
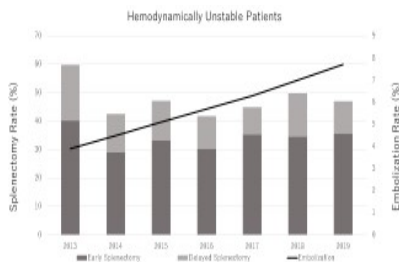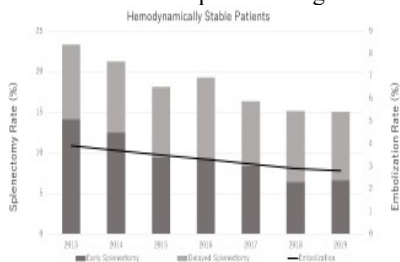
AAST MULTICENTER STUDY: DOES ANGIOEMBOLIZATION IMPROVE SURVIVAL FOR SEVERE HEPATIC INJURIES?

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MSN, TCRN; David V. Feliciano, MD; Grace F. Rozycki, MD, MBA;
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Invited Discussant: Mark Seamon, MD

Introduction: The hypothesis is that angioembolization (angio) improves survival in patients with severe hepatic injuries.

Methods: Data from 29 trauma centers were collected and analyzed on adult (≥18 yrs.) patients with Grades III, IV, and V hepatic injuries. Demographics, mechanism of injury, shock index (SI), transfusions (≥ 6 PRBCs), length of stay (LOS), ISS, use/timing of angio, and outcomes were recorded. Data were analyzed by mechanism and management: nonoperative with/without angio, operative with pre or post angio, and operation alone. Logistic regression was used to identify associations with mortality, $p < 0.05$.

Results: From 2013-2018, 2,430 patients (1,697 blunt, median ISS = 29; 733 penetrating, median ISS = 25) sustained severe hepatic injuries. The strongest associations of mortality for blunt and penetrating patients were ISS ≥25 ($p<0.0001$) and

PREDICTORS OF MORTALITY: LIVER INJURY GRADES III, IV, V				
	BLUNT		PENETRATING	
	OR (CI 95%)	P Value	OR (CI 95%)	P Value
SI>1.0	0.965 (0.0703-1.325)	0.8253	0.722 (0.657-2.974)	0.181
ISS≥25	3.793 (2.411-5.966)	<0.0001	7.576 (3.899-14.718)	<0.0001
≥6U PRBCs in 24h	4.587 (3.168-6.642)	<0.0001	6.828 (3.965-11.760)	<0.0001
Timing of Angio relative to index operation: pre/post	0.39 (0.132-1.155)	0.0892	Grp size too small; no statistical signficance	
Angio alone versus nonoperative management	1.619 (0.987-2.655)	0.0562	9.923 (2.028-48.563)	0.0046

≥6u PRBC in the first 24 hours ($p<0.0001$). SI was found to be associated with a higher mortality but only in a subgroup analysis of blunt Grade V liver injuries.

For patients undergoing operative management, the use of preop or postop angio had no impact on survival, but angio showed a decrease in mortality in penetrating injured patients when compared to nonoperative management alone, ($p=0.0046$)

Conclusion: Angio does not improve survival in most cases of severe hepatic injuries but does offer a survival benefit in nonoperative high grade penetrating hepatic injuries.

HERNIA RECURRENCE RISK FACTORS IN BLUNT TRAUMATIC ABDOMINAL WALL HERNIAS: A SECONDARY ANALYSIS OF A WESTERN TRAUMA ASSOCIATION MULTICENTER STUDY

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Invited Discussant: Benjamin Davis, MD

Introduction: While recent studies have supported the feasibility of early repair of blunt traumatic abdominal wall hernias (TAWH) during emergent laparotomy (EL) or initial hospitalization, concerns remain regarding the potential for increased recurrence. Little data exists, however, on the incidence of recurrence and risk factors that may predispose to hernia recurrence.

Methods: Patients who underwent repair of a TAWH from January 2012 to December 2018 were identified from 20 trauma centers recruited through the Western Trauma Association Multicenter Trials Committee. Patients were stratified into recurrence and non-recurrence groups. Logistic regression models were used to investigate risk factors for hernia recurrence.

Results: TAWH were repaired in 175 patients with 21 (12.0%) known recurrences. The recurrence group had a higher injury severity score (ISS) (26.0 ± 16.5 vs. 15.1 ± 16.0, p=0.011) and were more commonly female (66.7% vs. 37.7%, p=0.022). No difference was found in hernia location, hernia defect size, primary fascial repair, or median time to repair between the recurrence and non-recurrence groups. Patients with hernia recurrence more commonly underwent EL on presentation (90.5% vs. 63.0%, p=0.013) and had a bowel resection (81.0% vs. 38.8%, p<0.001) compared to the non-recurrence group. Recurrence patients also had a higher rate of surgical site infection (42.9% vs. 11.1%, p<0.001). Mesh use was similar between the cohorts (33.3% vs. 38.3%, p=0.840), and not protective of recurrence. Female sex, ISS, EL, and bowel resection were associated with hernia recurrence using logistic regression. Bowel resection remained significant when these variables were placed into a multivariable model.

Conclusion: There is increased incidence of hernia recurrence after repair of TAWH in female patients, patients with higher ISS, and after EL or bowel resection. However, only, bowel resection remained significant in a multivariable logistic regression model as an associated risk factor for recurrence. Mesh use was not associated with lower recurrence rates. Surgeons should be aware of these factors when repairing these complex injuries and consider repair after initial resuscitation if laparotomy is not indicated for some other reason, such as for bowel injury.

Table Logistic regression for risk factors influencing TAWH recurrence

Variable	Univariable			Multivariable		
	OR	95% CI	p-value	OR	95% CI	p-value
Female sex	3.31	1.26-8.68	0.015	2.13	0.75-6.02	0.153
ISS	1.04	1.01-1.08	0.014	1.03	0.99-1.06	0.178
EL	5.58	1.2-24.8	0.024	2.49	0.51-12.07	0.257
Bowel resection	6.71	2.15-20.95	0.001	3.90	1.15-13.23	0.029
Mesh use	0.81	0.31-2.11	0.659	0.78	0.28-2.20	0.636

TIME TO CRTICIAL INTERVENTION: PUSHING ADVANCED RESUSCITATION INTO THE PREHOSPITAL SETTING

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Invited Discussant: Adam Fox, DO

Introduction: Hemorrhage is the leading cause of preventable death after injury. Damage control resuscitation can reduce this but is usually only available at a trauma center. Recent data suggest advanced prehospital resuscitation (aPHR) improves survival in longer prehospital (PH) time. Our objective was to evaluate if time to resuscitation initiation impacts mortality.

Methods: We combined data from two randomized PH trials; the PAMPer trial in which patients received PH plasma or standard care and the STAAMP trial in which patients received PH tranexamic acid (TXA) or placebo. We included scene patients with SBP<70 or SBP 70-89 plus HR>108. PRBC, plasma, or TXA administration were considered aPHR. We calculated the time to critical intervention (TCI) as the minutes from EMS arrival to receiving aPHR or arrival at the trauma center for those not receiving aPHR. Mixed-effects logistic regression assessed the association of 24h and 30d mortality with TCI, controlling for demographics, injury severity, vital signs, resuscitation, and procedures accounting for clustering by EMS agency and site. We tested the interaction of TCI and PH time.

Results: 1,187 patients met inclusion criteria (407 PAMPer; 780 STAAMP). 667 patients received aPHR (351 TXA; 148 plasma; 109 PRBC; 59 multiple). Every 1-min delay in TCI was associated with a 4% increase in odds of 24h mortality (OR 1.04; 95%CI 1.01-1.07, p=0.02) and 2% increase in odds of 30d mortality (OR 1.02; 95%CI 1.01-1.03, p=0.03). The interaction of TCI and PH time was not significant for 24h (p=0.07) or 30d (p=0.14) mortality. PH time was associated with increased 24h (OR 1.07; 95%CI 1.01-1.13, p=0.02) but not 30d morality, while TCI remained associated with 24h (p=0.04) and 30d mortality (p=0.02). A delay in TCI for each aPHR component was associated with higher 30d mortality (p<0.05).

Conclusions: TCI is associated with early and late mortality in patients with hemorrhagic shock after injury. TCI may be more important than simple PH time for long term outcomes. This suggests bleeding patients need advanced resuscitation early, whether at the trauma center in systems with short PH times or in the field when PH time is prolonged. EMS professionals should consider initiating available aPHR interventions when arrival at the trauma center may be delayed in patients with hemorrhagic shock.

MULTICOMPARTMENTAL TRAUMATIC INJURY AND THE MICROBIOME: SHIFT TO A PATHOBIOME

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Invited Discussant: Matthew Kutcher, MD, MS

Introduction: Previous animal models have demonstrated altered gut microbiome after mild traumatic injury; however, the impact of injury severity and critical illness is unknown. We hypothesized that a rodent model of severe multicompartmental injuries and chronic stress would demonstrate microbiome alterations toward a "pathobiome" characterized by an overabundance of pathogenic organisms which would persist one week after injury.

Methods: Male Sprague-Dawley rats (n=8/group) were subjected to either polytrauma (PT) (lung contusion, hemorrhagic shock, cecectomy, and bifemoral pseudofractures), PT plus 2-hours daily chronic restraint stress (PTCS), or naïve controls. Fecal microbiome was measured on days 0, 3, and 7 using high-throughput 16S rRNA sequencing and QIIME2 bioinformatics analysis. Microbial alpha-diversity was assessed using Chao1 (number of different unique species) and Shannon (species richness and evenness) indices. Beta-diversity was assessed using principle coordinate analysis. Pairwise analyses were performed in R software package, with significance defined as $p<0.05$.

Results: There were no differences in diversity or microbiome composition between groups at baseline. PT demonstrated significant alterations in beta-diversity at days 3 ($p=0.01$) and 7 ($p=0.04$) compared to naïve. PTCS demonstrated significant differences in beta-diversity at day 3 ($p=0.01$) which persisted at day 7 ($p=0.01$) versus naïve. PTCS also significantly depleted bacterial diversity (Chao1) at day 3 ($p=0.01$) which persisted up to day 7 ($p=0.03$) versus naïve. Bacteroides dominated both PT and PTCS cohorts while Enterococcus was prevalent in PT.

Conclusion: Polytrauma with and without chronic stress induced significant alterations in microbiome diversity and composition within three days after injury; these changes were more prominent and persisted for one-week post-injury with chronic stress. This rapid and persistent transition to a "pathobiome" phenotype represents a critical phenomenon that may influence outcomes after severe trauma and critical illness.

EVALUATION OF LEAD AND OTHER HEAVY METAL LEVELS FROM RETAINED BULLET FRAGMENTS: A PILOT STUDY

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Invited Discussant: Jessica Weaver, MD

Introduction: Worldwide, lead toxicity is a major public health problem, with serum levels ≥5 µg/dL associated with symptoms. In the US, retained bullet fragments (RBFs), made of lead and other heavy metals, are a common, yet rarely studied etiology of lead toxicity after firearm injury. The objective of this study was to correlate RBFs, lead and other heavy metal levels, and symptoms of toxicity.

Methods: Adult patients who sustained gunshot wounds at an urban Level 1 trauma center between July 2020 and November 2021 were evaluated. Participants were sorted into two groups: exposed (≥1 RBF) and control (0 RBF). Vital signs, blood and urine samples were collected at the time of index hospitalization and at 2 to 4 weeks following injury. The samples were tested for lead and other heavy metals. Demographics, injury patterns, and clinical outcomes were analyzed. Surveys were used to assess prior exposure to lead and cognitive impairment post-injury.

Results: There were 103 patients enrolled and 95 included in the analysis after discarding subjects with missing data. Compared to the control, exposed subjects were younger (IQR [18-65]) with a higher mean blood lead level (BLL) (81.4 ng/mL vs 19.5 ng/mL, respectively, p=0.01). There was no difference in race, gender or injury severity between groups. After controlling for prior lead exposure, the exposed group was also more likely to have an increase in mean BLL at 1 month follow-up from baseline (see figure). There was no difference in vital signs or cognitive impairment between the groups. There was no difference in levels of non-lead heavy metals.

Conclusion: Survivors of gunshot wounds with RBFs are at increased risk of lead toxicity. The duration of this risk is unknown as our data show worsening elevation of BLL with time. This study supports the need for changes to clinical protocols regarding the removal of retained bullets and how patients are informed of the effects of leaving RBF in situ. Partnerships with toxicologists who can monitor and treat lead toxicity are warranted.

TIMING IS EVERYTHING: EARLY VERSUS LATE PALLIATIVE CARE CONSULTS IN TRAUMA

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Invited Discussant: Kathleen O'Connell, MD

Introduction: The incorporation of dedicated palliative care (PC) services in the care of the critically injured trauma patient is not yet universal. Preexisting data demonstrates both economic and clinical value of PC consults, yet patient selection and optimal timing of these consults is poorly defined, possibly leading to underutilization of PC services. Prior studies in geriatric patients have shown benefits of PC when PC clinicians are engaged earlier during hospitalization. We aim to compare hospitalization metrics of early versus late PC consultation in trauma patients.

Methods: All patients age ≥18 admitted to the trauma service between 1/1/19 and 3/31/21 who received a PC consult were included. Patients were assigned to EARLY (PC consult ≤3 days after admission) and LATE (PC consult >3 days after admission) cohorts. Demographics, injury and underlying disease characteristics, outcomes, and financial data were compared. Length of stay (LOS) in the EARLY group is compared to LOS-3 in the LATE group.

Results: 154 patient records met inclusion criteria (60 EARLY and 94 LATE). Injury severity score, head abbreviated injury score, and medical comorbidities (congestive heart failure, dementia, previous stroke, chronic obstructive pulmonary disease, malignancy) were similar between the groups. The LATE group was younger (69.9 ± 19.2 vs 75.3 ± 18.5, p=0.04). Patients in the LATE group had significantly longer LOS (17.5 ± 16.5 vs 7.0 ± 8.4 days, p<0.01) and higher hospital charges ($291,166 vs $107,046, p<0.01) and costs ($79,080 vs $24,904, p<0.01).

Conclusion: Early PC consultation is associated with shorter LOS and lower charges and costs in trauma patients even after correcting for delay to consult in the late group. This association suggests the need for mechanisms leading to early PC consult in critically injured patients.

DETRIMENTAL IMPACT OF FRAILTY ON LONG-TERM PATIENT REPORTED OUTCOMES IN EGS PATIENTS

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Invited Discussant: Amy Gore, MD

Introduction: Frailty presents a clinical challenge and is associated with increased perioperative morbidity and mortality. Few studies examine the effect of frailty on functional outcomes and return to baseline after emergency surgery. We aimed to determine the long-term effect of frailty on patient reported outcomes in an emergency general surgery (EGS) population.

Methods: This was a prospective cohort study of adult patients admitted for emergency surgical evaluation to a tertiary referral center between 03/2020 - 01/2021 and hospitalized >36 hours. Patients enrolled during their index hospitalization and completed baseline, 6-month assessments. Frailty was identified based on the EGS-specific frailty index. Patient-reported outcome measures included SF-36, Katz and Lawton measures of independent activities of daily living (IADL), and the GAD7 and PHQ9 measures of depression and anxiety. Analyses utilized a repeated measures linear mixed effects model for each of the five outcomes of interest.

Results: Seventy-five patients were enrolled; 29 completed 6-month assessment (38%), the majority being female (n=43, 57%), and on average 56 years of age (range 23-88). Fifty-five patients (73.3%) required operative intervention, 14 (25.5%) required a second operative procedure. The average hospital length of stay was 5.9 days (range: 2-43.7). Thirty-two (43.8%) patients scored as frail. Frail patients scored 6 points lower on the SF-36 physical component score (p=0.03) and 19 points lower on the mental component score (p<0.001). Both frail and non-frail patients had a decline in IADLs, but frail patients had a significantly worse decline as compared with the non-frail (p<0.001). Frail patients also had significantly worse anxiety and depression scores on the GAD 7 (5.69; p<0.01) and PHQ 9 (6.35; p<0.01) as compared with the non-frail group.

Conclusion: Admission for an EGS evaluation results in significant functional and mental health declines in frail patients. Frail patients have worse post-discharge anxiety and depression symptoms. To return these patients to their baseline functioning, any intervention to rehabilitate these patients needs to include mental health care, as well as physical rehabilitation.

INTERFACILITY TRANSFER IS ASSOCIATED WITH SURVIVAL BENEFIT IN SEVERELY AND PROFOUNDLY INJURED PATIENTS

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Invited Discussant: Jordan Estroff, MD

Background: Interfacility transfer may be necessary to provide appropriate level care for injured patients. We hypothesized that interfacility transfers confer a survival benefit for all patients regardless of age or injury severity.
Methods: This retrospective study utilized the 2019 iteration of ACS TQIP and included all adult patients aged 18 and older who presented to a Level I, II, or III trauma center or who required trauma surgery consultation. Pregnant patients and patients who arrived with no signs of life were excluded. Collected variables included age, sex, vital signs at presentation, GCS score, functional dependence, fall history, anticoagulation, medical comorbidities, max. abbreviated injury scale (AIS) score, injury severity score (ISS), and interfacility transfer status. Primary outcome was mortality. Secondary outcomes were hospital length of stay (LOS), need for ICU, and vent days. Adjusted logistic regression was used to determine significant associations between interfacility transfer, age, ISS, and mortality.
Results: Of 898,807 total patients, 344,985 (38.4%) were geriatric patients aged 65 years or older. Of 217,431 total interfacility transfers, 89,160 (41.0%) were geriatric patients. After adjusting for age, sex, maximum AIS score, and ISS, adult non-geriatric patients with severe (ISS 16-24) and profound (ISS 25+) injuries demonstrated higher odds of mortality if not transferred (OR 9.72, 95% CI 8.64-10.93, p<0.001) compared to their transferred counterparts (OR 8.19, 95% CI 7.22-9.29, p<0.001). Similarly, geriatric patients with severe and profound injuries demonstrated higher odds of mortality when not transferred (OR 4.99, 95% CI 4.43-5.61, p<0.001) compared to their transferred counterparts (OR 3.59, 95% CI 3.19-4.05, p<0.001).
Conclusion: Interfacility transfer confers a survival benefit in severely and profoundly injured patients, most notably in patients aged 65 and older.

SURGICAL RESIDENT OPERATIVE AUTONOMY ON NIGHTS AND WEEKENDS: WHAT HAPPENS TO SURGICAL EDUCATION DURING OFF-HOURS?

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Invited Discussant: Amy Hildreth, MD

Introduction: Surgical resident operative autonomy is critical for trainee maturation to independence. Acute care surgery (ACS) cases commonly occur off-hours and tension between OR availability and on-call staff can affect resident operative autonomy. We examined operative resident autonomy for general, vascular, and thoracic (GVT) surgery during nights and weekends.

Methods: Utilizing the VASQIP database, we examined all GVT cases at VA teaching hospitals from 2004-2019. All cases are coded for the level of supervision at the time of surgery: (AP) attending primary surgeon; (AR) attending and resident operating together; and (RP) resident primary (attending supervising but *not* scrubbed). Cases starting between 6pm to 7am Monday thru Friday were considered nights, cases on Saturday/Sunday were considered weekends, and collectively considered "off-hours." RP case rates were compared by start time and type.

Results: Over the 15-year study period, there were 666,421 GVT cases performed with 38,097 cases (6%) performed "off-hours". During off-hours, 31,396 (83%) were ACS compared to 5% of daytime cases. The proportion of RP cases for case type by start time are shown in Table 1. Overall, off hours cases have higher RP rate than daytime cases (6.8 vs 5.8%, $p<0.001$). The 3 most common (40% of total) ACS cases were appendectomy, amputation, and cholecystectomy. Daytime ACS cases have higher rates of RP than nights/weekends (7.6 vs 6.8%, $p<0.001$). Conversely, daytime elective cases have lower RP than nights (5.7 vs 7.9%, $p<0.001$). During off-hours, there are more RP cases on nights compared to weekends (7.1 vs 6.5%, $p=0.02$).

Conclusions: Overall, residents were afforded more operative autonomy during off-hours, with nights having greater RP than weekends. In contrast, ACS cases have more autonomy during weekdays. These data have potentially significant implications for ACS service staffing, night float rotations and overall resident operative experience on ACS services.

Table 1. Proportion of RP cases by case type and day/time

	Weekdays	Weeknights	Weekends	Off Hours	Overall
Elective	5.7%	7.9%	5.3%	6.8%	5.7%
Emergency	7.6%	6.9%	6.8%	6.8%	7.2%
Overall	5.8%	7.1%	6.5%	6.8%	5.9%

A COMPREHENSIVE ANALYSIS OF 30-D READMISSIONS AFTER EGS PROCEDURES. ARE RISK FACTORS MODIFIABLE?

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Invited Discussant: Kimnberly A. Davis, MD, MBA

Background: Post-operative hospital readmissions are costly, lead to increased resource utilization, and decreased patient satisfaction. Risk factors associated with procedure-related 30-day readmission after emergency general surgery (EGS) have not been comprehensively studied. We set out to determine risk factors for procedure-related 30-d readmission after EGS procedures identifiable in the pre-operative, post-operative (in-hospital), and post-discharge periods.

Methods: Using the NSQIP database (2013-2019), a retrospective cohort study was conducted including 9 surgical procedures encompassing 80% of the burden of EGS diseases, performed on an urgent/emergent basis. The procedures were classified as low risk (open and laparoscopic appendectomy and laparoscopic cholecystectomy) and high risk (open cholecystectomy, laparoscopic and open colectomy, lysis of adhesions, perforated ulcer repair, small bowel resection, and exploratory laparotomy). Data on patient characteristics (Age, Sex, BMI, ASA scores, and pre-op presence of sepsis), Direct Admissions/Transfers, Procedure Risk, Length of Hospital Stay (LOS), and Discharge Destination were analyzed by multivariate logistic regression.

Results: A total of 312,862 patients were included in the study [16,306 procedure-related 30-d readmissions (5.2%), and 296,556 non-readmissions). 30-d readmission patients were on average 8 years older, with higher ASA scores, more often underweighted or markedly obese, and more frequently presented with sepsis then non-readmitted patients. Multivariate Logistic Regression identified risk factors for EGS procedure-related 30-d readmission including sepsis present at the time of surgery (AOR=1.91), BMI < 18 (AOR=1.16), BMI≥40 (AOR=1.16), ASA ≥ 3 (AOR=1.39), high-risk procedures (AOR=1.51), 4 d ≤ LOS ≤ 7d (AOR=1.93), LOS > 8d (AOR=1.83), discharge to rehab (AOR=1.22), and discharge to SNF (AOR=1.36). Interestingly, transfers and low-risk procedures were not associated with 30-d readmissions. Additionally, 30-d readmissions following low-risk procedures occurred at a median of 5 days (IQR: 2-11), whereas 30-d readmissions in high-risk procedures occurred at a median of 6 days (IQR:3-11). Of the high-risk procedures, open colectomy and small bowel resection cases were the most common. Surgical site infections, postop sepsis, wound disruption, and thromboembolic events were more prevalent in the 30-d readmission group. The mortality rate was 6-fold higher in the 30-d readmission group (2.4% vs. 0.6%; p<0.001). Conclusions: We have demonstrated that patient characteristics such as obesity and multiple comorbidities, sepsis on presentation, procedure risk, LOS > 4 days, and discharge destination except for home, are associated with increased risk of EGS procedure-related 30-d readmission. These findings are not modifiable in the short term, indicating the significant burden of EGS diseases. Instituting financial penalties to hospitals and providers will not reduce readmissions

SURGICAL STABILIZATION OF CRITICAL ABDOMINAL INJURIES PRIOR TO TRANSFER HAS IMPROVED SINCE 2010

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Invited Discussant: Alison Wilson, MD

Introduction: Worse outcomes following injuries are more likely in rural compared to urban areas. Iowa established an inclusive trauma system in 2001 to improve mortality. No study has yet examined the impact of the Iowa trauma system on abdominal injuries. We hypothesized that maturation of the Iowa trauma system would be associated with more exploratory laparotomies for time-critical abdominal injuries prior to transfer to a higher level of care and better outcomes.

Methods: Our institution's trauma registry was queried to identify all patients transferred between 01/01/2010 and 12/31/2020 who underwent exploratory laparotomy (ex-lap) either before transfer or within 4 hours of arrival. We compared the first 6-year period (2010-2015) to the last 5-year period (2016-2020). Categorical and continuous variables were compared using Chi-Squared tests and Mann-Whitney tests, respectively. $P < 0.05$ was considered significant.

Results: We included 213 patients; 63 had ex-lap performed before transfer and 150 after. Rates of ex-lap before and after transfer and outcomes (mortality, hospital LOS, ICU LOS, ventilator days) were similar between the first and last periods ($p = 0.314$ for ex-lap, $p = 0.941, 0.291, 0.274, 0.588$ for outcomes). Compared to the first period, the rate of ex-lap performed before transfer for severe injuries (abdominal AIS >3) significantly increased during the last period (57.1% vs. 30.6%, $p = 0.011$). Similarly, incidence of damage control laparotomies (43.9% vs. 23.6%; $p = 0.02$) and transfusion of plasma and platelet products (33.6% vs. 13.2%; $p < 0.001$, 22.4% vs. 8.5%, $p = 0.005$, respectively) significantly increased. Finally, injury to ex-lap time for patients stabilized prior to transfer significantly decreased over time (1h47min ± 1h vs. 2h11min ± 55min, $p = 0.04$).

Conclusion: Our results suggest improvement in the identification and stabilization of critical patients at the non-level I facilities prior to transfer to the level I facility. We also observed a significant increase in usage of blood products at these facilities and increased use of damage control techniques over time. These findings suggest a shift in the approaches to surgical stabilization and resuscitation efforts in our trauma system. Interestingly, this shift did not translate in a decrease in mortality or improved outcomes.

LONGITUDINAL STUDY EVALUATING POST-ICU SYNDROME DIFFERENCES BETWEEN ACUTE CARE SURGERY AND TRAUMA SICU SURVIVORS

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Invited Discussant: Jennifer Gurney, MD

Introduction: Recently, we identified a high occurrence of Post-ICU Syndrome (PICS) in Acute Care Surgery (ACS) and Trauma SICU survivors. Researchers are beginning to understand that critical illness due to ACS or Trauma may represent different pathophysiologic entities. In this longitudinal study, we sought to identify differences in patient characteristics, associated hospital factors, recovery, and the occurrence of PICS in these two groups.

Methods: Patients 18 years or older who required SICU care for at least 72 hours were included in the study. These patients were seen in a dedicated ICU Recovery Center at 2-, 12-, and 24-weeks after discharge. PICS sequelae, which include Physical, Cognitive, and Psychiatric domains, were diagnosed by dedicated specialists using clinical criteria and screening questionnaires. Pre-admission demographics, psychosocial histories (including substance use, psychiatric illness, baseline cognitive and physical impairments), hospital course, and recovery data were collected via retrospective chart review. Results: One-hundred twenty-nine patients were included in the study, with 74 (57.3%) Trauma and 55 (42.6%) ACS patients. The Trauma cohort was slightly younger (ACS 57 y.o vs. Trauma 50 y.o, p=0.02). Pre-hospital psychosocial histories were similar across both groups. The ACS group had significantly longer hospital lengths of stay, and higher rates of acute renal failure, sepsis, open abdomens, and readmissions. At the 2-week visit, ACS patients had higher rates of PICS (ACS 100% vs Trauma 85.9%, p=0.009), particularly in the Psychiatric (ACS 60.5% vs. Trauma 38.1%, p=0.02) and Cognitive (ACS 48.8% vs. Trauma 31.3%, p=0.07) domains. At the 12- and 24-week visits, the rates of PICS symptoms were equivalent between the two groups.

Conclusion: The occurrence of PICS is high in both ACS and Trauma SICU survivors. Despite entering the SICU with similar psychosocial histories, the two cohorts have different inpatient pathophysiological experiences, which are associated with a higher rate of impairment in the ACS cohort during the early recovery period. These differences resolve during the remaining follow-up period. .

EXTERNAL VALIDATION OF THE TEMPT SCORE AS A PREDICTOR OF BLOOD TRANSFUSION

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Invited Discussants: Bryan Cotton, MD

Introduction: Most prediction tools for transfusion rely on total anatomic injury burden as a major component. This limits their utility for prompting early activation of massive transfusion protocols in the setting of occult injury, as the full injury burden is often not known at presentation. TEMPT (Trauma Early Mortality Prediction Tool) was recently created as an abbreviated injury score (AIS) independent prediction tool for emergency department (ED) use. External validation of prediction tools is the gold standard, and this study is the first external validation of TEMPT for prediction of transfusion of red blood cell (RBC) transfusion.

Methods: A prospective cohort of highest-level trauma activations aged>=18 years old were enrolled in the Precision Approaches to Resuscitation in Trauma (PART III) study if a research blood sample was obtained with first intravenous access on presentation. The enrolling center did not participate in the original TEMPT derivation study and represents a validation site. Demographics, injury characteristics, labs, transfusion data, and outcomes were collected. A TEMPT score (0 to 6) was calculated for each patient using the initial ED value for each component (presence of TBI, age>=59.5 years, base excess>=-4.35, partial thromboplastin time (PTT)>=31.5, INR>=1.25, temperature<=36.25 degrees Celsius). Multiple logistic regression was performed using R statistical package for predictors of RBC transfusion.

Results: From March 2021-Feb 2022, 102 patients were enrolled. Median age was 44 (IQR 30-61), 82% were male, 68% suffered blunt trauma, 30% had an ISS>15, and 53% required ICU admission. RBC transfusion occurred in 32% of the cohort with 88% (n=29/33) receiving RBCs in the first 6 hours of care. Patient TEMPT scores ranged from 0 to 5 with no patient having a positive value for all 6 components of the score. TEMPT was a strong predictor of RBC transfusion with increasing probability of RBC transfusion for each additional score point (p=0.009, Figure).

Conclusion: TEMPT is an easy-to-use tool for real-time early identification of patients likely to need PRBC transfusion and is independent of the need for an abbreviated injury score (AIS).

VIDEO-ASSISTED RETROPERITONEAL DEBRIDEMENT (VARD) FOR NECROTIZING PANCREATITIS IS ASSOCIATED WITH SUPERIOR IN-HOSPITAL OUTCOMES

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Invited Discussant: Nancy Parks, MD

Introduction: Open necrosectomy has been the traditional, standard surgical treatment for necrotizing pancreatitis. Recently, video-assisted retroperitoneal debridement (VARD) has been established as a safe and effective alternative. The present national study evaluated clinical and financial outcomes of patients undergoing VARD and open necrosectomy.

Methods: The 2016-'19 National Inpatient Sample was queried for adult hospitalizations for necrotizing pancreatitis requiring operative debridement. Patients receiving any video-assisted procedures without a subsequent open debridement were classified as *VARD* while the remainder were considered *Open*. The Elixhauser Comorbidity Index was used to numerically quantify the burden of comorbidities. Multivariable regression models examined the association of operative approach on mortality, in-hospital complications, discharge disposition, hospitalization duration and adjusted costs.

Results: Of an estimated 15,240 patients with necrotizing pancreatitis, 2,615 (17.2%) required operative intervention. Of these, 990 (37.9%) underwent *VARD* with a steady trend in utilization (2016: 34.7% vs 2019: 32.4%, p=0.07). Compared to *Open, VARD* patients were similar in age and burden of comorbidities, etiology, and use of preoperative closed drainage (*Open*: 12.0% vs *VARD*: 15.2%, p=0.30). However, *VARD* had a lower rate of abdominal compartment syndrome (0.5% vs 6.46%,p=0.001). *VARD* was associated with lower rates of several unadjusted endpoints (Figure). After adjustment, *VARD* was associated with lower odds of in-hospital mortality (AOR: 0.33, 95% CI: 0.15-0.75) and pneumonia (AOR: 0.48, 95% CI: 0.23-0.97) and greater likelihood of home discharge (AOR: 1.91, 95% CI: 1.22-3.01). Furthermore, *VARD* was associated with shorter hospitalization duration (β: -11.7 days, 95% CI: -16.6- -6.7) and adjusted costs (β: -$63.3K, 95% CI: -88.2- -38.4).

Conclusions: Compared to those receiving open pancreatic debridement, patients undergoing VARD for necrotizing pancreatitis appear to have lower mortality and significantly lower resource utilization. Although not increasing in utilization, our findings demonstrate that a minimally-invasive may be preferrable in appropriate patients.
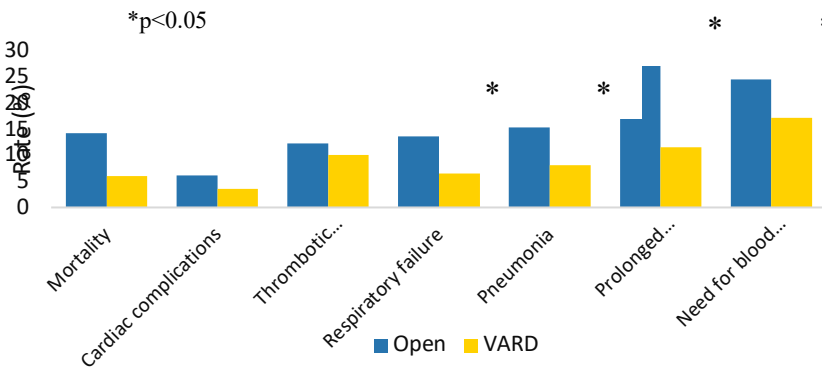
MULTIYEAR EXPERIENCE WITH MOBILE ONLINE PLATFORM FOR DOCUMENTATION OF ACUTE CARE SURGERY FELLOWS SUPERVISION

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Invited Discussant: Jasmeet Paul, MD

Introduction: There is currently no standard for documenting supervision of acute care surgery (ACS) fellows. To accomplish this goal, we developed a web-based survey that is accessible via mobile platform. We hypothesize that our mobile access survey is an effective, reproducible tool for assessing fellow clinical performance.

Methods: A retrospective review from 2016-2022 of all data captured in an encrypted database on all ACS fellows at our institution was performed. Supervision was defined as: type 1 direct face-to-face, type 2a immediately available in-house, type 2b available after notification via phone with remote electronic medical record access, and type 3 retrospective review. Data were collected by supervising faculty using a web-based clinical performance survey created by fellowship program leadership. Survey data collected included clinical summary, trainee, proctoring faculty, clinical service, operative/nonoperative, supervision type, Zwisch autonomy scale, time to input data, and graduate medical education (GME) milestone performance. Data were analyzed using descriptive statistics.

Results: A total of 883 proctoring events were identified, including the majority as type 1 (97.4%). Trauma comprised 64% of evaluations. 52% of the proctoring events were surgical cases. Complexity was graded as average (77%), hardest (16%), basic (7%). Guidance included supervision only, 491/666 (74%), with 26% requiring faculty intervention. Fellow performance was graded as average (66%), above average (31%), and below average/critical deficiency (3%). GME performance was available for 247/883 interactions identifying 31 events with potential for improvement. Average evaluation completion time: 2 minutes (n=134).

Conclusion: A mobile web-based survey is a convenient and reliable tool for documenting ACS fellow clinical activity and was effectively utilized by all ACS faculty to record supervision. A combination of clinical and objective data are useful to determine ACS fellows' performance and to provide targeted education and remediation.

EARLY THROMBOPROPHYLAXIS IN NONOPERATIVE BLUNT ABDOMINAL TRAUMA: A CLOTT RESEARCH STUDY

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Invited Discussant: Eric Ley, MD

Introduction: There is concern that early chemical venous thromboembolism (VTE) prophylaxis in patients undergoing nonoperative management of blunt abdominal injuries may lead to bleeding. We hypothesize that early VTE prophylaxis prevents VTE effectively and does not cause bleeding.

Methods: The CLOTT study was a prospective, multicenter, observational cohort study conducted at 17 trauma centers between 2018-2020 focusing on post-traumatic VTE. For the purposes of this analysis, we identified patients with an abdominal AIS of ≥ 3 who were initially managed nonoperatively. Patients were excluded if they had an associated major neurologic injury (head AIS ≥ 3 or spinal cord injury with deficit). The patients were then divided into two groups based on the timing of the initiation of VTE prophylaxis, with early defined as ≤ 24 hours after admission and late as > 24 hours. The primary outcome was the need for delayed operative or angiographic intervention. The secondary outcome was the development of VTE (DVT, PT, PE). Data points included age, sex, VTE risk factors, VTE prophylaxis type, dose, and frequency, ventilator days, ICU days, and mortality.

Results: Of the 7,880 patients in the CLOTT registry, 389 met our criteria, 153 with early and 236 with late VTE prophylaxis. In the early group, 8 (5%) required subsequent operative or angiographic intervention versus 16 (7%) in the late group (p=0.53). The incidence of VTE in the early group was 3% and in the late group 6% (p=0.17). The VTE prophylaxis agent, dose, and frequency was similar between the groups, with enoxaparin 30mg twice daily being most common.

Conclusions: In this largest-to-date prospective study on the issue, early prophylaxis appears to prevent VTE effectively without increasing the likelihood of bleeding that requires intervention.