Session XIII: Quickshot Session I 1-13
Quickshot 1: 8:00 AM - 8:06 AM

REDUCING DONOR SKIN IN SOFT TISSUE RECONSTRUCTION USING AN AUTOLOGOUS CELL HARVESTING DEVICE COMBINED WITH MESHED AUTOGRAFT

Sharon Henry, MD; Steven Mapula, MD; Mark Grevious, MD;
Neil Mashruwala, MD; Herbert Phelan, MD; Jeffrey Shupp, MD;
Joseph Molnar, MD; Kevin Foster, MD
R.A. Cowley Trauma Center
Invited Discussant: Amy Liepert, MD

Introduction: The Autologous Cell Harvesting Device is a regenerative medicine platform that enables clinicians to prepare autologous skin cell suspension (ASCS) from a small sample of the patient's skin at point-of-care. The system was FDA-approved in September 2018 for treating acute thermal burn wounds. This study was designed to evaluate safety and effectiveness of ASCS in conjunction with widely meshed autografts in patients undergoing reconstruction of full-thickness, non-thermal skin defects such as those resulting from trauma and surgery.

Methods: This was a prospective, randomized, within-subject, blinded evaluator, multicenter, controlled study conducted under FDA IDE 13053. Patients ≥ 5 years of age with an acute non-thermal skin defect were eligible for enrollment. An autografting plan for closure was developed in accordance with the investigators' standard of care. Two comparable study treatment areas each ≥80 cm2 in size were randomized to receive autografting treatment consistent with the investigator's pre-identified plan (Control) or ASCS treatment in combination with an autograft meshed more widely than identified in the plan (e.g. 2:1 autograft vs. 3:1 autograft + ASCS). Co-primary effectiveness endpoints included 100% healing at (or prior to) 8 weeks post-treatment confirmed at two consecutive study visits at least two weeks apart and the ratio of donor site to treatment area expansion ratios.

Results: Sixty-five patients with surgical (63%) and traumatic (37%) skin defects were treated. Both the healing and donor-sparing co-primary endpoints were met; healing of the ASCS treatment area was non-inferior to Control ($p=0.005$), and donor skin sparing associated with ASCS treatment was superior to Control ($p<0.025$), with an average 30% reduction in donor skin required. There was a similar safety profile between ASCS and Control.

Conclusion: Compared to the standard of care, the application of ASCS with a widely meshed autograft resulted in comparable healing outcomes and an average of 30% less donor skin required for closure. The Autologous Cell Harvesting Device offers a simplified approach to soft tissue reconstruction by reducing skin needed without compromising healing outcomes.

Session XIII: Quickshot Session I 1-13
Quickshot 2: 8:06 AM - 8:12 AM

GEOSPATIAL ACCESS TO ACS/AAST VERIFIED EGS CENTERS IN THE US: STRATEGIC OPPORTUNITIES FOR THE EGS VERIFICATION PROGRAM

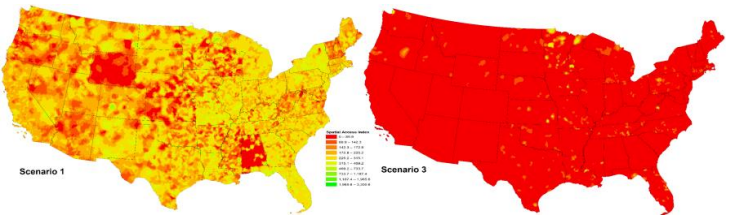
David S. Silver, MD, MPH; Jamison Beiriger, BS;
Liling Lu, MS; Matthew D. Neal, MD;
Andrew B. Peitzman, MD; Joshua B. Brown, MD, MS
University of Pittsburgh
Invited Discussant: Lara Senekjian, MD

Introduction: The ACS and the AAST have released a framework for verification of EGS centers. Geospatial access to care has been associated with mortality for EGS patients. Given the novelty of this program, it is unclear which centers may pursue verification and how this translates to access. Our objective was to assess geospatial access to EGS verified centers and potential disparities under different scenarios.

Methods: We used AHA hospital characteristics data and the known 5 pilot EGS verified centers to devise 3 scenarios of centers pursing EGS verification: (1) all EGS advanced capable hospitals; (2) 75%ile of pilot center capabilities/volume; (3) quaternary referral centers indicated by liver or lung transplant programs. We used enhanced 2-step floating catchment area methods to calculate a spatial access index (SPAI) for each census block group in the US based on 60min drive time to the nearest EGS verified center under each scenario. To evaluate potential disparities in geospatial access based on social determinates of health, we compared the SPAI across quartiles of the Area Deprivation Index (ADI) within each scenario. We also compared the difference in SPAI from the lowest (least disadvantaged) to highest (most disadvantaged) ADI quartile across the three scenarios.

Results: EGS verification was assigned to 1932 centers under Scenario 1 (EGS capable), 307 centers under Scenario 2 (75%ile of pilot centers), and 146 centers under Scenario 3 (quaternary centers). SPAI declined over the scenarios (226.6 [111.7, 330.7]; 51.8 [0,126.1]; 6.2 [0, 62.2], $p<0.001$; Figure). Within each scenario, SPAI also declined as the ADI quartile increased ($p<0.001$). Scenario 2 had the largest disparity in SPAI between the 1st and 4th ADI quartiles (-49.0), followed by Scenario 3 (-32.4) and Scenario 1 (-14.7).

Conclusion: Geospatial access to EGS verified centers may vary significantly depending on how the program is implemented across the US. More disadvantaged communities may bear the burden of lower access. Further work to study regional needs can allow a strategic implementation of the EGS verification program to optimize outcomes while minimizing disparities for EGS patients.

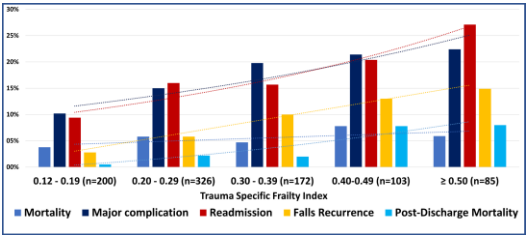


Session XIII: Quickshot Session I 1-13
Quickshot 3: 8:12 AM - 8:18 AM

THE FRAILTY SPECTRUM: CHANGING THE BINARY CLASSIFICATION OF FRAILTY

Qaidar Alizai, MD; Audrey L. Spencer, MD; Hamidreza Hosseinpour, MD; Christina Colosimo, DO, MS; Sai Krishna Bhogadi, MD; Adam Nelson, MD; Collin Stewart, MD; Khaled El-Qawaqzeh, MD; Louis J. Magnotti, MD, MS, FACS; Bellal Joseph, MD, FACS
The University of Arizona
Invited Discussant: Esther Tseng, MD

Introduction: Frailty is shown to predict poor outcomes. However, the spectrum of accumulated physiologic deficits, once a patient is identified as frail, is unknown. We aimed to assess the dynamic association between increasing frailty and outcomes among frail geriatric trauma patients.
Methods: This is a secondary analysis of the AAST Frailty Multi-institutional Trial. All patients (≥65 yrs) presenting to one of seventeen Level I/II trauma centers (2019-2021) were included. Frailty status was measured using the trauma-specific frailty index (TSFI), ranging from 0 to 1. After excluding non-frail patients, frail patients were then stratified based on TSFI scores: 0.12-0.19, 0.20-0.29, 0.30-0.39, 0.40-0.49, and ≥0.50. Multivariable analysis was performed to identify the effect of increasing TSFI on in-hospital and 3-month post-discharge outcomes of frail patients.
Results: We identified 886 frail patients. The mean age was 78±8 years and 47% were males. Median ISS was 9 [4-12], 75% following a low-level fall. Overall, 16% had a complication, and 5% died during the index admission. Of all survivors with a complete follow-up, 19% were readmitted within 3 months of discharge, 7% had a fall recurrence, 8% had a post-discharge complication, and 3% died within 3 months of discharge. In-hospital and post-discharge outcomes worsened as the frailty score increased (**Figure**). On multivariable analysis, every 0.1 increase in TSFI score among frail patients was associated with higher odds of in-hospital mortality (OR 1.196; p=0.023), major complications (OR 1.329; p<0.001), as well as 3-month readmission (OR 1.264; p<0.001), fall recurrence (OR 1.490; p<0.001), major complications (OR 1.329; p<0.001) and mortality (OR 1.65; p<0.001).
Conclusions: Increasing TSFI score, independent of age, is significantly associated with worse outcomes in frail geriatric trauma patients. These findings suggest that the frailty syndrome goes beyond a binary stratification of patients into Non-Frail and Frail and should be considered as a spectrum of increasing vulnerability to poor outcomes.

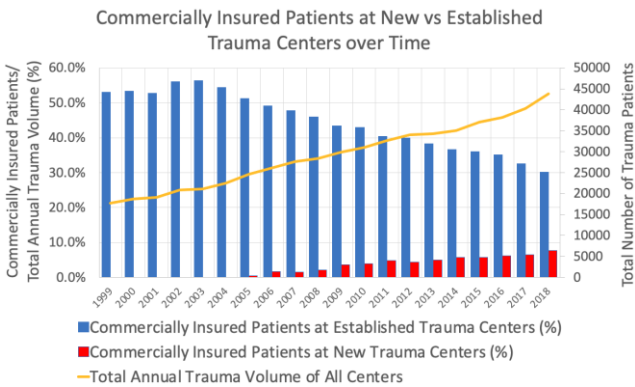


Session XIII: Quickshot Session I 1-13
Quickshot 4: 8:18 AM - 8:24 AM

CHANGES IN PAYER MIX OF NEW AND ESTABLISHED TRAUMA CENTERS: THE NEW TRAUMA CENTER MONEY GRAB?

Diane N. Haddad, MD, MPH; Justin Hatchimonji, MD;
Satvika Kumar, BA; Jeremy W. Cannon, MD; Patrick M. Reilly, MD;
Patrick K. Kim, MD; Elinore J. Kaufman, MD, MSHP
University of Pennsylvania
Invited Discussant: Patricia Ayoung-Chee, MD, MPH

Introduction: Rising numbers of trauma centers (TC) across the country have not been shown to improve trauma outcomes. Establishment of new TCs may not reflect community or geographic need and can impact case mix and volume at existing TCs. We hypothesized that newly designated TCs would see a disproportionate share of commercially insured patients, possibly imposing financial stress on existing centers.
Methods: We collected data from all accredited adult TCs in Pennsylvania using the state trauma registry including patients aged ≥16, 1999-2018. We compared patient characteristics and payer mix between TCs established before and after 2004 when state payment policy changed. We used multivariable logistic regression to assess the relationship between payer and odds of presentation to a new vs. established TC after 2010.
Results: 26 established and 15 new TCs were evaluated. Of 326,204 patients, 2010-2018, 282,579 (85%) were treated at established TCs. New TCs treated more blunt trauma (95.6% vs 91.8%, $p<0.001$) and more elderly patients (49.7% vs 40.7%, $p<0.001$). In multivariable analysis, patients presenting to new TCs were more likely to have Medicare (OR 2.1, 95% CI 1.9-2.2) and commercial insurance (OR 1.8, 95% CI 1.7-1.9) compared to Medicaid. Over time, fewer patients at established TCs and more patients at new TCs had private insurance (Figure).
Conclusions: With the opening of new centers, payer mix changed unfavorably at established TCs. New TCs can improve access to care, but trauma system development should consider community and regional needs, as well as impact on existing centers. System sustainment may require innovative payment approaches to address these disparities.



Session XIII: Quickshot Session I 1-13
Quickshot 5: 8:24 AM - 8:30 AM

CHEMOKINE RESPONSE CHANGES WITH RATE OF TRANSFUSION: MIXED MESSAGES FOLLOWING INJURY

Stephanie Savage, MD; Ben L. Zarzaur, MD, MPH; Patrick Carney, MD; Erin Fox, PhD; Charles Wade, PhD; John Holcomb, MD
University of Wisconsin School of Medicine and Public Health
Invited Discussant: Prerna Ladha, MD, MBBS

Introduction: Chemokines are a key component of the inflammatory response and activate and mobilize neutrophils, macrophages, and Natural Killer (NK) cells to manage injury. The purpose of this study is to understand how the rate of packed red blood cell (PRBC) transfusion may impact the chemokine response. We hypothesize that rate of transfusion, rather than total PRBCs, has a fundamental effect on this response.
Methods: The PROPPR dataset was used in this retrospective analysis. All patients received a 1:1:1 or 1:1:2 transfusion for their resuscitation. Rate of transfusion was defined as the Critical Administration Threshold (CAT) status, in which 3 units of PRBC are given in any 60-minute period. Total number of CAT+ episodes in the first two hours after injury were used to define rate of transfusion and were compared to total PRBC volume at 24 hours. Longitudinal response of key chemokines IL-8, IP-10, Eotaxin, MIP-1a, MIP-1b, MCP-1 and RANTES, were measured serially over 72 hours and compared to rates of transfusion.
Results: Of 680 enrolled patients, 267 were included in this analysis. ISS was not significantly different regardless of rate of PRBC transfusion (Table). Increasing rates of transfusion were associated with decreases in IL-8 ($p<0.0001$), Eotaxin ($p=0.0008$), IP-10 ($p=0.0008$), MIP-1b ($p=0.0265$), and MCP-1 ($p=0.0002$). MIP-1a was not significant. RANTES was significantly increased ($p=0.0005$). Conversely, there were no associations between chemokine expression and 24 hour PRBC volume.

	No CAT[1] (0)	Low CAT[1] (1-2)	Mid CAT[1] (3-4)	High CAT[1] (>5)
ISS	28 (SD 14.7)	28.3 (SD 14.6)	33.9 (SD 17.6)	35.1 (SD 15.3)
p-value	-ref-	0.9408	0.1268	0.0552

Conclusion: The rate of blood product transfusion, rather than the total PRBC volume or severity of injury, has a fundamental impact on the expression of chemokines following injury. However, the immunologic message is mixed. Increased transfusion rates are associated with elevations in RANTES, crucial to leukocyte migration. However, related chemokines with similar function are notably suppressed. These data may reflect early discoordination in the inflammatory response in a subset of massively resuscitated patients.

Session XIII: Quickshot Session I 1-13
Quickshot 6: 8:30 AM - 8:36 AM

MESENCHYMAL STEM CELLS DO NOT PRODUCE MEASURABLE HYPERCOAGUABILITY ON VISCOELASTIC TESTING

Lydia Buzzard, BS; Sawyer Smith, MD, MBA; Alix Dixon, MD; S. James El Haddi, MD; Maria Appleman, PhD; Sarayu Subramanian, MD; Brandon Behrens, MD; B Madtson; A Goodman; James Murphy, MD; Belinda McCully, PhD; Amonpon Kanlerd, MD; Alpa Trivedi, PhD; Shibani Pat, MD, PhD; Martin Schreiber, MD
Oregon Health & Science University
Invited Discussant: Sharven Taghavi, MD, MPH, MS

Introduction: Mesenchymal Stem Cells (MSCs) have been studied as a treatment in trauma and in lung injury to modulate inflammation. However, due to their ability to express tissue factor (TF), they have been considered a thrombogenic risk. This study used swine injury models to demonstrate the safety of MSCs with respect to hypercoagulability.
Methods: 83 juvenile female Yorkshire crossbred swine were randomized to injury groups including pulmonary contusion (PC) alone, PC plus liver injury, a control group, and treatment groups including LR, FFP, KCentra, and MSCs. Blood samples for TEG were collected at baseline as well as at 1 hour, 3 hours, 6 hours, and every subsequent 6 hours until 48 hours post-injury. Effects were analyzed in R with generalized mixed linear models and ANOVA.
Results: 2 subjects were excluded due to early deaths unrelated to the models. At 6 hours post-injury, KCentra produced significantly lower R times compared to MSCs ($p = 0.005$), Control ($p = 0.007$), LR ($p = 0.04$), and FFP ($p = 0.02$) while R times in the MSC group were not significantly different from control, LR, or FFP. R times were not significantly different by treatment at any other time points.
Conclusion: This study found that R time is not significantly impacted by administration of MSCs when compared to controls. This suggests that while MSCs may express TF, they do not produce pathologic hypercoagulability in relevant animal models of uncontrolled hemorrhagic shock and trauma.

Session XIII: Quickshot Session I 1-13
Quickshot 7: 8:36 AM - 8:42 AM

HOSPITAL EXPERIENCE WITH GERIATRIC TRAUMA IMPACTS LONG-TERM SURVIVAL

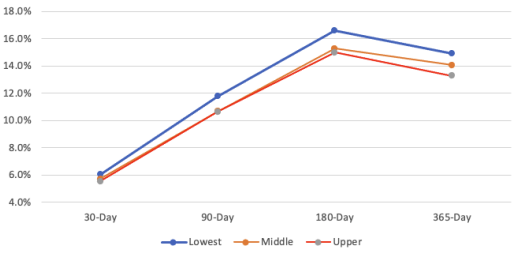
Manuel Castillo-Angeles, MD, MPH; Cheryl K. Zogg, PhD, MSPH, MHS; Molly Jarman, PhD; Reza Askari, MD; Stephanie Nitzschke, MD; Ali Salim, MD; Zara Cooper, MD, MSc; Joaquim M. Havens, MD
Brigham & Women's Hospital
Invited Discussant: Joseph Posluszny, MD

Introduction: It has been established that hospital experience measured by geriatric trauma proportion (GTP) is associated with in-hospital mortality among geriatric patients. However, these studies are limited to short-term outcomes. Our goal was to determine the impact of GTP on long-term survival among older trauma patients.

Methods: This was a retrospective analysis of Medicare inpatient claims (2014-2015) of geriatric trauma patients admitted in Florida. GTP was calculated by dividing the number of geriatric trauma patients by the overall adult trauma volume in each hospital. Hospitals were then categorized into tertiles of GTP. Our main outcome was mortality at 30, 90, 180, and 365 days. Controlling for demographic, injury severity, comorbidities, and hospital-level characteristics, multivariate logistic regression analysis was performed to identify the association between GTP and long-term survival.

Results: We included 64,125 geriatric trauma patients from 161 hospitals. Mean age was 82.53 (SD 8.40), 68.5% were female, 92.3% were white, and mean ISS was 8.93 (SD 5.49). The tertiles of GTP had medians of 48%, 66%, and 78% respectively. No level 1 trauma centers were categorized within the highest GTP tertile. As compared with hospitals in the lowest tertile, patients treated at the highest tertile were associated with lower mortality at 90 days (OR 0.88, 95% Confidence Interval [CI] 0.81–0.97), 180 days (OR 0.88, 95% CI 0.81–0.95), and 365 days (OR 0.90, 95% CI 0.84–0.96).

Figure: Risk-adjusted mortality based on GTP tertiles.



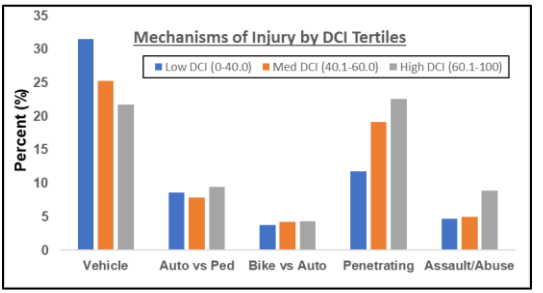
Conclusion: Higher GTP is associated with improved long-term outcomes. However, mortality following trauma among geriatric patients continues to increase for six months, and this effect is especially pronounced at low GTP centers.

Session XIII: Quickshot Session I 1-13
Quickshot 8: 8:42 AM - 8:48 AM

ANALYSIS OF NEIGHBORHOOD SOCIOECONOMIC DISADVANTAGE INDICES AND INJURY MECHANISM PATTERNS: DOES THE INDEX MATTER?

Miharu Arase, MD, PhD; Monica Wong, MS;
Kenji Inaba, MD; Kazuhide Matsushima, MD;
Morgan Schellenberg, MD, MPH; Matthew Martin, MD
LAC & USC Medical Center
Invited Discussant: Alaina Lasinski, MD

Introduction: Social determinants of health, including measures of community or neighborhood distress, has an increasingly appreciated role in trauma care. We sought to examine differences in injury patterns and mechanisms by neighborhood socioeconomics, and to compare two of the most commonly used neighborhood distress indices.
Methods: Patients with traumatic injuries at a Level 1 safety net center over 1-year were identified. Area Deprivation Index (ADI) and Distressed Communities Index (DCI) were used to determine the neighborhood socioeconomic status. Injury mechanisms and patterns were analyzed and stratified by ADI and DCI categories. The correlation between ADI and DCI tertiles was also analyzed.
Results: A total of 4950 patients were included in this study. Among them, 3933 patients were analyzed with ADI, and 4497 patients were analyzed with DCI. Greater disadvantage areas determined by ADI or DCI (higher ADI or higher DCI) were strongly associated with increased penetrating injuries (both $p<0.01$). Higher DCI was also associated with increased rates of assault/abuse mechanisms ($p<0.01$) but there was no association with ADI. In contrast, less disadvantaged areas defined by DCI had increased vehicular injuries ($p<0.001$), but no differences were seen with ADI. Direct comparison of ADI versus DCI categorizations showed a weak correlation ($R=0.35$, $p<0.001$) between the two measures.



Conclusion: Increasing neighborhood disadvantage scores identified populations at higher risk for penetrating and assault/abuse injury mechanisms. There was only a weak correlation between DCI and ADI, with DCI demonstrating greater ability to differentiate injury mechanism patterns and incidence.

Session XIII: Quickshot Session I 1-13
Quickshot 9: 8:48 AM - 8:54 AM

PROPOSED EVIDENCE-BASED REVISION OF THE AAST RENAL TRAUMA ORGAN INJURY SCALE

Rano Matta, MD; Sorena Keihani, MD; Kevin Hebert, MD;
Raminder Nirula, MD; Marta McCrum, MD, MPH;
Joshua J. Horns, PHD; Jeremy B Myers, MD;
Multi-institutional Genito-Urinary Trauma Study Group (MiGUTS)
University of Utah
Invited Discussant: Alexander Schwed, MD

Introduction: To update and improve the American Association for Surgery of Trauma (AAST) renal trauma grading using important thresholds for bleeding control intervention from the Multi-Institutional Genitourinary Trauma Study (MiGUTS).

Methods: We conducted a secondary analysis of MiGUTS phase-2. This was a multi-center retrospective study including patients with high grade renal trauma from 7 Level-1 trauma centers from 2013-2018. All eligible patients were assigned new renal trauma grades based on revised criteria. The primary outcome used to measure injury severity was intervention for renal bleeding. Secondary outcomes included intervention for urinary extravasation, units of packed red blood cells (PRBCs) transfused within 24 hours, and mortality. To test the revised grading system, we performed mixed effect logistic regression adjusted for multiple baseline demographic and trauma covariates. We determined the area under the receiver-operator curve (AUC) to assess accuracy of predicting bleeding interventions from the revised grading system and compared this to 2018 AAST organ injury scale.

Results: We included 549 patients with AAST Grade III-V injuries and CT scans based on the 2018 system (III: 52% (n=284), IV: 45% (n=249), and V: 3% (n=16)). Among these patients, 89% experienced blunt injury (n=491) and 12% (n=64) underwent intervention for bleeding. After applying the revised grading criteria, 55% (n=306) were downgraded and 4% (n=23) were upgraded; specifically, 44% (n=7) were downgraded from V to IV, and 60% (n=150) were downgraded from IV to III. The revised renal trauma grading system demonstrated improved predictive ability for bleeding interventions (2018 AUC = 0.805, revised AUC = 0.882; p=0.002) and number of units of PRBCs transfused. When accounting for urinary injury in the revised system, there was no difference in its predictive ability.

Conclusion: Using a revised renal trauma grading system, which does not include urinary collecting system injury a significant number of injuries are downgraded. This revised renal trauma grading system better delineates the need for hemostatic interventions than the current AAST grading system.

Session XIII: Quickshot Session I 1-13
Quickshot 10: 8:54 AM - 9:00 AM

CHARACTERIZING USE OF SPLENIC ARTERY EMBOLIZATION TO TREAT BLUNT SPLENIC INJURY: WHO BENEFITS?

Jamie Benson, BA, AEMT; Stas Amato, MD, MSc;
Solomon Feuerwerker, MD; Turner Osler, MD, MSc; David Hosmer, PhD;
Amanda Galenkamp, BS, MS; Gary An, MD; Ajai Malhotra, MD
University of Vermont Medical Center
Invited Discussant: Jay Collins, MD

Introduction: Splenic artery embolization (SAE) is an adjunct to non-operative management (NOM) to reduce failure rates and increase splenic salvage following blunt splenic injury (BSI). The published literature is mixed as to whether increasing SAE rates are associated with increased splenic salvage rates. The current study aims at determining whether higher SAE rates correlate with increased splenic salvage. We hypothesize that facilities with higher SAE rates will have higher splenic salvage rates.
Methods: The National Trauma Data Bank (2016-19) was queried for all patients presenting with BSI. Patients undergoing splenectomy <6-hours of presentation were considered operatively (OP) managed with spleens not-salvaged. Remaining patients were considered NOM. Facility keys were obtained for each patient, and SAE rates for each facility were calculated. Among the NOM patients (with or without SAE) those who underwent a delayed splenectomy were considered NOM failures with spleens non-salvaged. NOM patients, with or without SAE who did not undergo a delayed splenectomy were considered as spleens salvaged. Facility level SAE rates were correlated with splenic salvage rates.
Results: 76,354 adult patients met inclusion. 14.87% were OP. Of the 85.13% NOM, 4.67% underwent SAE. Median SAE utilization was 3.79% of BSI (IQR: 1.27-6.76%) but varied from 0-100% across centers. Median facility salvage rate was 83.18% (IQR: 77.97-88.57%). Centers in the bottom (Q1) quartile of SAE use had significantly lower overall salvage rates than the top (Q4) quartile (82.99% vs 84.25% - $p < 0.001$). On subgroup analysis based on splenic grade, there was a divergent dose response relationship with higher SAE centers having higher salvage rates for high grade (III-V) injuries, and the opposite for low grade (I-II) injuries (Fig.)
Conclusions: Centers with high rates of SAE utilization for BSI have a higher rate of overall splenic salvage, BUT *only* for high grade spleen injuries. For low grade spleen injuries, increased utilization of SAE is associated with lower overall salvage. These results suggest that SAE should be utilized *more* for high grade spleen injuries while there should be a *pause* in utilization for low grade injuries.

Session XIII: Quickshot Session I 1-13
Quickshot 11: 9:00 AM - 9:06 AM

IMPACT OF PREHOSPITAL TOURNIQUETS ON PENETRATING EXTREMITY INJURIES: BLOOD SAVING OR TIME DELAY?

Leah Tatebe, MD; Andrew Dennis, DO; Stephen Wisniewski, PhD; Bryan A. Cotton, MD; Brian Harbrecht, MD; Bellal Joseph, MD, FACS; Ernest Moore, MD; Mayur B. Patel, MD, MPH; Martin Schreiber, MD; Jason Sperry, MD MPH; Frank Guyette, MD, MS, MPH
Northwestern University
Invited Discussant: Caitlin Fitzgerald, MD

Introduction: Prehospital interventions, such as tourniquet (TQ) placement, can be life-saving but also can potentially prolong time on scene. We sought to assess if prehospital TQ usage was associated with reduced blood transfusion or more time on scene.
Methods: Using an eight-center cohort of adult Level 1 trauma admissions from 2017 to 2021, we isolated a nested case-control cohort included penetrating extremity injury with an abbreviated injury score (AIS)>1 and excluded non-extremity AIS>4 to reduce confounding by blood transfusion. TQ patients were matched 1:1 with non-TQ patients by AIS extremity score. Sensitivity analysis was conducted for ballistic, non-ballistic, and arterial injuries. Primary outcome was difference in units transfused in the first 24h with power analysis of n=28 needed to find a 1-unit increase in transfusion. Secondary outcomes included scene time, hospital vitals, and 24h mortality.
Results: Of 77,854 patients, 8986 patients met inclusion and 227 (2.5%) had TQ usage. After matching, 214 were analyzed, where 107 TQ patients were paired with 107 without TQ, with median cohort age=30 (IQR 24, 40), 86% male, AIS upper extremity=3 (0, 3), AIS lower extremity=1 (0, 3), field shock index=0.9 (0.73, 1.2). By mechanism, 122 were ballistic (57%), 92 were non-ballistic (43%), and 198 (93%) had arterial injuries. There was no increase in blood usage at 24hrs in those without a TQ (matched cohort: 0.17 additional units [95%CI: -0.098, 0.44; p=0.21], ballistic: 0.04 [-0.3, 0.39; p=0.81], non-ballistic: 0.34 [-0.09, 0.78; p=0.12], arterial: 0.17 [-0.12, 0.46, p=0.24]). Similarly, no increase in blood usage was seen at 3hr or 6hrs. Among secondary outcomes, patients with a TQ had no difference in scene time, hospital vitals, or 24-hour mortality.
Conclusion: In this multicenter case-control cohort, prehospital TQs for extremity penetrating injuries were not associated with decreased blood usage or prolonged scene time. Limitations include lack of data on if the TQ was arterio-occlusive, missing extremity outcome data, and retrospective study design. Given the widespread use and reported TQ effectiveness, future investigations to evaluate the quality of TQ application and identify which patients would benefit from TQ application.

Session XIII: Quickshot Session I 1-13
Quickshot 12: 9:06 AM - 9:12 AM

IMPLEMENTATION OF A PERCENTAGE OF PREDICTED FORCED VITAL CAPACITY RIB FRACTURE PROTOCOL RESULTS IN IMPROVED ICU UTILIZATION

Jennifer E. Baker, MD; Kevin N. Harrell, MD; Joshua D. Billings, MD;
Stephanie Vega, MBA; Shane Urban, BS;
Michael W. Cripps, MD; Catherine G. Velopulos, MD
University of Colorado
Invited Discussant: Jennifer Hubbard, MD

Introduction: Current protocols to determine disposition of traumatic rib fractures rely on age and number of rib fractures. These protocols ignore the real issue of pulmonary mechanics and physiology resulting in unnecessarily high ICU admissions. We hypothesize that using a protocol based on percentage of predicted forced vital capacity (%FVC) will have better predictive value for disposition and save valuable resources.
Methods: A retrospective review from a single level I trauma center was performed from 1/2019 to 9/2022. The rib fracture protocol was changed on 1/20/2021from utilizing number of fractured ribs/age to utilizing %FVC creating old and new cohorts for comparison. We also compared patients who had a recorded %FVC in the new protocol cohort to non-intubated patients in the old protocol cohort.
Results: A total of 1150 patients were evaluated, 581 in the old protocol and 569 in the new protocol cohorts, and there were no significant demographic or injury characteristic differences. There was a significant decrease in number of ICU admissions after implementation of the new protocol (61.9% vs. 37.6%, $p \leq 0.05$); the drop in ICU admissions due to chest injury (admitted due to rib fracture protocol criteria alone) was more profound (45.6% vs. 12.1%, $p \leq 0.05$). While there was no difference between hospital length of stay (LOS), the ICU LOS was significantly shorter (1 [0,4] vs. 0 [0,3] days, $p \leq 0.05$). When looking at the patients with recorded %FVC (n=349) vs. non-intubated patients in the old protocol cohort (n=501), these significant decreases remain the same (ICU admissions (55.9% vs. 18.1%, $p \leq 0.05$); ICU admissions due to chest injury (163 [58.2%] vs. 22 [34.9%], $p \leq 0.05$); ICU LOS (1 [0,3] vs. 0 [0,0] days, $p \leq 0.05$)). There was a trend towards decreased hospital LOS in the %FVC, however this was not significant (4 [2,9] vs. 3 [1,7] days, $p=0.055$). On linear multivariable analysis, the initiation of the %FVC protocol resulted 0.77 fewer days in the ICU when compared to the old protocol non-intubated cohort ($p<0.001$).
Conclusion: Using a rib fracture protocol based on %FVC decreased the number of ICU admissions and ICU LOS, even in patients with no recorded %FVC. Our protocol may provide better resource utilization and prevent unnecessary ICU admissions.

Session XIII: Quickshot Session I 1-13
Quickshot 13: 9:12 AM - 9:18 AM

SURGICAL APGAR SCORES PREDICT COMPLICATIONS AFTER EMERGENCY GENERAL SURGERY LAPAROTOMY

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Ohio State University
Invited Discussant: Nancy Parks, MD

Introduction: The Surgical Apgar Score (SAS) is a 10-point validated score comprised of 3 intraoperative variables (blood loss, lowest heart rate, and lowest mean arterial pressure). Lower scores are worse and predict major postoperative complications. The SAS has not been applied in emergency general surgery (EGS) but may help guide postoperative disposition. We hypothesize that SAS can predict complications in EGS patients undergoing a laparotomy.
Methods: We performed a retrospective review of adult patients at a single, quaternary care center who underwent an exploratory laparotomy for EGS conditions within 6 hours of surgical consultation from 2015 to 2019. Patients were grouped by whether they experienced a postoperative complication (systemic, surgical, and/or death). Multivariable regression was performed to predict complications, accounting for SAS and other statistically significant variables between groups. Using this model, predicted probabilities of a complication were generated for each SAS.
Results: The cohort comprised 482 patients: 32.8% (n=158) experienced a complication while 67.2% (n=324) did not. Patients with complications were older, frailer, more often male, had worse SAS (6 vs 7, $p<.0001$) and ASA scores, and higher rates of pneumoperitoneum ($p=0.0003$) and open abdomens ($p<.0001$). On multivariable regression, a decreasing SAS independently predicted complications (aOR 0.85, 95% CI 0.75-0.96, $p=0.009$). An SAS ≤ 4 was associated with a 49.2% predicted chance of complications, greater rates of septic shock (9.7% vs 12.3%, $p=0.01$), respiratory failure (20.5% vs 10.8%, $p=0.02$), and death (24.1% vs 7.5%, $p<.0001$). An SAS ≤ 4 did not correlate with surgical complications ($p=0.1$).
Conclusion: The SAS accurately predicts postoperative complications in EGS patients undergoing urgent laparotomy, with an SAS ≤ 4 identifying patients at risk for septic shock, respiratory failure, and mortality. This tool can aid in rapidly determining postoperative disposition and resource allocation.

Session XIV: Quickshot Session II 14-26
Quickshot 14: 9:40 AM - 9:46 AM

TRANEXAMIC ACID IS NOT ASSOCIATED WITH A HIGHER RATE OF THROMBOTIC-RELATED REINTERVENTION AFTER MAJOR VASCULAR INJURY REPAIR

Sina Asaadi, MD; Kaushik Mukherjee, MD, MSCI, FACS; Liang Ji, PhD; Xian Luo-Owen, MD, PhD; Maryam B. Tabrizi, MD; Richard D. Catalano, MD; Joseph DuBose, MD; Martin G. Rosenthal, MD
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Invited Discussant: Joseph DuBose, MD

Introduction: Tranexamic acid (TXA) is associated with lower mortality and transfusion in trauma patients, but its role in thrombotic complications is unclear. We investigated whether TXA increases the risk of thrombosis-related failure (TRF) in major vascular injuries (MVI).

Methods: The PROspective Observational Vascular Injury Treatment (PROOVIT) registry was queried from 2013 to 2022 for MVIs repaired with an open or endovascular intervention. The relationship between the TXA administration and TRF was examined.

Results: The TXA group (n=297) had higher rates of hypotension at admission (33.6% vs 11.5%, p<0.001), need for continuous vasopressors (41.4% vs 18.4%, p<0.001), and pRBC transfusion (3.2 vs 2.0 units, p<0.001) during the first 24 hours compared to the non-TXA group (n=1941), although demographics, injury pattern, and interventions were similar. Cryoprecipitate (9.1% vs 2%, p<0.001), and anti-coagulant administration during the intervention (32.7% vs 43.8%, p<0.001) were higher in the TXA group; there was no difference in the rate of factor VII use between groups (1% vs 0.7%, p=0.485). TRF was not different between the groups (6.3% vs 3.8 p=0.141) while the rate of immediate need for re-operation (10.1% vs 5.7%, p=0.006) and overall re-operation (11.4% vs 7%, p=0.009) was significantly higher in the TXA group. Patients in TXA had 7%, 19%, and 33% higher unadjusted odds of thrombosis-related failure, need for immediate re-intervention, and overall re-operation, respectively. However multivariate logistic regression analysis showed no significant association between TXA and a higher rate of immediate need for re-intervention (OR=1.19; 95% CI=0.75-1.88; p=0.465), overall re-operation rate (OR=1.33; 95% CI=0.82-2.17; p=0.249) and thrombotic events in a repaired vessel (OR=1.07; 95% CI=0.60-1.92; p=0.806) after adjusting for type of injury, vasopressor infusions, blood product and anticoagulant administration, and hemodynamics.

Conclusion: Tranexamic acid is not associated with a higher risk of thrombosis-related failure in major vascular injury repairs. Further prospective studies to examine dose-dependent or time-dependent associations between Tranexamic acid and thrombotic events in major vascular injuries are needed.

Session XIV: Quickshot Session II 14-26
Quickshot 15: 9:46 AM - 9:52 AM

PROSTAGLANDIN E - MAJOR URINARY METABOLITE IS A NOVEL BIOMARKER FOR ACUTE MESENTERIC ISCHEMIA

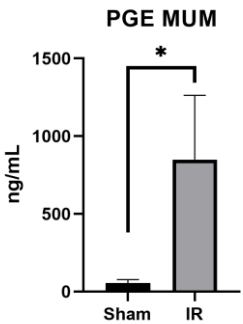
Keisuke Suzuki, MD; Koji Morishita, MD, PhD;
Tomohiro Adachi, MD; Akira Suekane, MD, PhD;
Kouhei Yamamoto, MD, PhD; Keita Nakatsutsumi, MD, PhD;
Panu Teeratakulpisarn, MD; Mitsuaki Kojima, MD, PhD;
Yasuhiro Otomo, MD, PhD; Raul Coimbra MD, PhD
Tokyo Medical and Dental University Hospital
Invited Discussant: Ida Molavi, MD

Introduction: Acute mesenteric ischemia (AMI) is a vascular emergency caused by a disruption in the small intestine's blood supply. Despite advances in diagnostic, interventional, and surgical procedures, AMI remains a life-threatening condition. Prostaglandin E-Major Urinary Metabolite (PGE-MUM) is stable in urine and has been described as a useful biomarker of inflammation of the intestinal mucosa. We investigated whether the level of PGE-MUM in a murine intestinal ischemia-reperfusion (IR) model correlated with the degree of ischemia.

Methods: We performed superior mesenteric artery occlusion (60 min) followed by reperfusion and resuscitation with normal saline for 6 hours (IR group) in rats. Sham animals underwent an identical procedure without ischemia (Sham group). Serum Lactate levels were measured at the end of resuscitation. Small intestine specimens from animals in each group were obtained for histologic examination using an injury scoring system (0–5) after the resuscitation phase. Urine samples were taken at the end of resuscitation, and changes in PEG-MUM levels after intestinal IR and in Sham animals were analyzed.

Results: Lactate levels in the IR and sham groups did not differ to a statistically significant extent (2.1±0.6 vs.1.5±0.2 mmol/L). The histologic injury score of the IR group was significantly greater than that of the sham group (4.3±0.6 vs 0.6±0.9; $p<0.05$). PGE-MUM levels in the IR group were significantly increased in comparison to those in the sham group (849.3±370.7 vs. 55.5±22.5 ng/mL; $p<0.05$).

Conclusions: We found that intestinal IR induced a marked increase in urinary PGE-MUM levels. To our knowledge, this is the first report to evaluate the role of the urinary PGE-MUM level after intestinal ischemia.



Session XIV: Quickshot Session II 14-26
Quickshot 16: 9:52 AM - 9:58 AM

SURGEON PRACTICES AND BARRIERS TO FIREARM SAFETY COUNSELING IN CLINICAL PRACTICE: A CROSS-SECTIONAL STUDY

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Kathryn Jackson, MS; Brendan Campbell, MD, MPH
American College of Surgeons
Invited Discussant: Thomas Duncan, DO

Introduction: Surgeons have previously struggled to incorporate firearm safety guidance into clinical practice, and their current rates of counseling are relatively unknown. Additionally, barriers and potential facilitators of counseling practices by surgeons have not been well studied.
Methods: We created an anonymous cross-sectional survey utilizing previously published instruments and performed pilot testing (n=13) at the annual meeting of the American Association for Surgery of Trauma (2022). The finalized survey was distributed the survey via quick response (QR) code during two sessions at American College of Surgeons (ACS) Clinical Congress (2022): The ACS Committee on Trauma's Injury Prevention Pillar meeting and a special session entitled *"Surgeons on the Front Lines of Gun Violence"*. Eligible participants included surgeons and surgical trainees that attended at least one of these two sessions.
Results: A total of 116 individuals completed the survey, of which the majority were male (n=72, 62%), attending surgeons (n=110, 94.8%), and treated trauma patients (n=72, 63%). Few participants (n=44, 38%) reported counseling patients on firearm safety as part of their clinical practice, and practices did not vary significantly by age, gender, surgical specialty, or census region. The majority of respondents (n=103, 89%) believed that surgeons should provide firearm safety counseling, however, most of these respondents (n=60, 58%) did not counsel their own patients on firearm safety. The most commonly cited barriers to counseling were lack of time (n=47, 40.5%), appropriate training (n=43, 37.1%), and firearm knowledge/experience (n=36, 31.0%). Patient education resources (n=76, 65.5%) and additional personnel (n=70, 60.3%) were identified as potential resources to alleviate barriers.
Conclusion: While the majority of surgeon respondents believed that surgeons should provide firearm safety counseling to their patients, a majority did not provide it themselves. These findings suggest that interventions that do not rely on surgeons for implementation would be a more effective way to incorporate firearm safety counseling into clinical practice.

Session XIV: Quickshot Session II 14-26
Quickshot 17: 9:58 AM - 10:04 AM

BONE ANCHOR FIXATION IN THE REPAIR OF BLUNT TRAUMATIC ABDOMINAL WALL HERNIAS: A WESTERN TRAUMA ASSOCIATION MULTICENTER STUDY

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Invited Discussant: Allison McNickle, MD

Introduction: Blunt traumatic abdominal wall hernias (TAWH) are relatively rare but require a variety of operative techniques to repair. This includes bone anchor fixation (BF) when tissue tears off bony structures creating a hernia defect. This study aimed to provide a descriptive analysis of BF technique for blunt TAWH repair. In addition, BF and no-BF repairs were compared, hypothesizing increased hernia recurrence with BF repair.
Methods: A post hoc secondary analysis of the WTA blunt TAWH multicenter study was performed including all patients who underwent repair of their TAWH (01/2012-12/2018). Patients with BF were compared to those with no BF with bivariate analyses.
Results: 176 patients underwent repair of their TAWH with 41 (23.3%) undergoing tissue or mesh BF. Patients requiring BF most commonly had flank hernias (56.1%) and were repaired with open surgery (92.7%). 26 (63.4%) patients had tissue fixed to bone, with 7 of those reinforced with mesh. The remaining 15 (36.6%) patients had bridging mesh anchored to bone. The BF group had a similar age, sex, body mass index, and injury severity score compared to the no BF group (all $p>0.05$). The median defect size (8 vs. 8.5 cm, $p=0.206$), time to repair (1 vs. 1 days, $p=0.158$), as well as rate of hernia recurrence (9.8% vs. 12.7%, $p=0.786$) and surgical site infection (SSI) (12.5% vs. 15.6%, $p=0.823$) were all similar between cohorts (Table).
Conclusions: This largest series to date found that nearly one-quarter of TAWH repairs required BF. In contrast to the hypothesis, BF repairs had a similar rate of hernia recurrence and SSI compared to no BF repairs, suggesting this is a reasonable option for repair of TAWH. Future prospective studies are needed to investigate specific BF techniques and evaluate long-term outcomes including patient centered outcomes such as pain and quality of life.

Variable	No bone fix (n=135)	Bone fix (n=41)	p-value
Defect Size (cm)	8 [4.4-14.3]	8.5 [5.3-15.8]	0.206
Time to repair (days)	1 [0-3]	1 [1-3.5]	0.158
Recurrence	17 (12.7%)	4 (9.8%)	0.786
SSI	21 (15.6%)	5 (12.5%)	0.823

Session XIV: Quickshot Session II 14-26
Quickshot 18: 10:04 AM - 10:10 AM

COMPARISON OF MILITARY AND CIVILIAN SURGEON OUTCOMES WITH EMERGENT TRAUMA LAPAROTOMY IN A MATURE MILITARY-CIVILIAN PARTNERSHIP

Danny Lammers, MD; Rindi Uhlich, MD, MSPH; Omar Rokayak, DO; Nathan Manley, MD, MPH; Richard Betzold, MD; Parker Hu, MD
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Invited Discussant: Kenji Inaba, MD

Introduction: Medical readiness is of paramount concern for active-duty providers. Many of the military's single surgeon teams are staffed by non-trauma fellowship trained general surgeons. This coupled with low volumes of complex trauma in military treatment facilities has driven the armed forces to embed surgeons in high-volume civilian centers to enhance their skillset for the deployed environment. It is currently unclear what impact this strategy may have on patient outcomes in these civilian centers. We sought to compare emergent trauma laparotomy (ETL) outcomes between active-duty Air Force surgeons (AF) and civilian faculty at a major ACS verified level 1 trauma center.

Methods: Retrospective review of a prospectively maintained, single center database of ETL from 2019-2022 was performed. ETL was defined as laparotomy from trauma bay within 90 minutes of patient arrival. The primary outcome was to assess for all-cause mortality differences at multiple time points.

Results: 514 ETL were performed during the study period. 22% (113/514) of patients were hypotensive [systolic blood pressure (SBP) $\leq$ 90 mmHg] on arrival. Five AF surgeons performed 43 ETL compared to 471 ETL by civilian faculty. There were no differences in median ED length of stay (27 vs. 22 minutes; p=0.21), but operative duration was significantly longer for AF compared to civilian surgeons (129 vs. 110 minutes; p=0.01). There were no differences in intraoperative (5% vs. 2%; p=0.30), 6-hour (3% vs. 5%; p=0.64), 24-hour (5% vs. 5%; p=1.0), or in-hospital mortality rates (5% vs. 8%; p=0.56) between AF and civilian surgeons. AF surgeons did not significantly impact the odds of 24-hour mortality on multivariate analysis (OR 0.78; 95% CI 0.10, 6.09).

Conclusion: AF surgeons had equivalent rates of mortality following ETL when compared to their civilian counterparts at a single university, ACS verified level 1 trauma center. Military surgeons may benefit from valuable clinical experience, maintenance of technical skills, and mentorship from experienced civilian trauma surgeons without a deficit in quality of care.

Session XIV: Quickshot Session II 14-26
Quickshot 19: 10:10 AM - 10:16 AM

EFFECTS OF LOCAL HYPOTHERMIA ON LIMB VIABILITY IN A TRAUMATIC MODEL OF ACUTE LIMB ISCHEMIA DURING PROLONGED DAMAGE CONTROL RESUSCITATION

Emily Kao, MD; Xu Wang, MD; Kristyn Ringgold, PhD;
Jessica Snyder, DVM; Susan Stern, MD; Eileen Bulger, MD;
Nathan White, MD; Shahram Aarabi, MD
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Invited Discussant: Sigrid Burruss, MD

Introduction: New strategies are needed to mitigate further tissue injury during traumatic limb ischemia in cases requiring prolonged damage control resuscitation (pDCR). We hypothesized that external limb cooling would reduce local limb metabolism and ischemic tissue injury, and we secondarily compared two hypothermic temperatures.
Methods: 13 swine were anesthetized and instrumented, then underwent hemorrhage of 30mL/kg to induce shock. This was followed by induction of bilateral limb ischemia using both distal infrarenal aortic vessel loop and limb tourniquets, then resuscitation via previously published pDCR protocol. Animals were randomized to 5ºC or 15ºC cooling of one hind limb, with the contralateral hind limb serving as an uncooled control. After 5 hours of ischemia, blood flow was restored for 1 hour. Physiologic parameters, limb temperature, and tissue metabolites (glucose, lactate, and pyruvate) were routinely measured. Muscle and nerve biopsies were obtained upon conclusion of the 6-hour protocol.
Results: There were no significant differences in hemorrhage or resuscitation volumes between the 5ºC and 15ºC cooling groups. Average time to target temperature was significantly faster in the 15ºC group compared to the 5ºC group (51.1 minutes vs 134.0 minutes, p=0.01). Lactate and pyruvate levels were significantly lower in the cooled limbs compared to the 32ºC control limbs. There was no significant difference in lactate or pyruvate levels between the 5ºC and 15ºC limbs, or in tissue glucose between the three temperature groups. Mean histologic muscle score was significantly greater in the 5ºC group compared to control (p=0.03). There was no significant difference between the mean nerve scores of the 5ºC cooled limbs and paired control limbs, or between the mean muscle and nerve scores of the 15ºC cooled and paired control limbs.
Conclusion: Cooling to 15ºC could be achieved within 60 minutes and resulted in significantly reduced tissue metabolites compared to ambient room temperature while producing no significant increase in histologic muscle or nerve damage. In contrast, cooling to 5ºC significantly reduced tissue metabolites but also resulted in significantly higher histologic muscle damage. These results warrant further functional testing but suggest an approach to prevent of limb ischemia through local hypothermia.

Session XIV: Quickshot Session II 14-26
Quickshot 20: 10:16 AM - 10:22 AM

FUNCTIONAL OUTCOMES AFTER ECMO IN A TRAUMA POPULATION

Jamie Robinson, MD; Rebecca Maine, MD; Nick Johnson, MD; Barclay Stewart, MD; Alex Malloy, MD; Scott Brakenridge, MD, MSCS; Saman Arbabi, MD, MPH; Eileen Bulger, MD; Erika Bisgaard, MD
Harborview Medical Center
Invited Discussant: Abhijit Pathak, MD

Introduction: The use of extra-corporeal membrane oxygenation (ECMO) in trauma patients who develop ARDS is an effective rescue therapy. Data are limited on functional outcomes for these patients. We sought to evaluate functional outcomes for a cohort of trauma and burn patients who required ECMO for respiratory support.

Methods: We performed a retrospective cohort study of adult patients with traumatic injuries, near drownings, or burns who required veno-venous ECMO therapy at a single level I trauma center between 2016 and 2022. Demographics, ISS, ECMO data, complications, mortality, discharge disposition, and functional outcome as assessed by the modified-Functional Independence Measure (mFIM) at discharge were collected. Data were compared using student's t-test.

Results: Of the 28 ECMO patients that met inclusion criteria, 21 were trauma, 4 near-drownings and 3 were burn patients. A total of 25 were male (89) with an average age of 33 years and ISS of 32. Comparing survivors (n=16) and non-survivors (n=12), neither ISS (32 vs 35 p=0.66) nor days on ECMO pump (14 vs 8, p=0.21) differed. Survivors were cannulated later (6 days vs 2, p=0.02), and had longer hospital LOS (44.6 vs 11.5, p=<0.05), and ICU LOS (36.25 vs 11.33, p<=0.05). Bleeding complicated the course in 16 patients (57%); only 4 requiring interventions. Survival to discharge was 57% (16/28). Of these 44% (7/16) were discharged to inpatient rehab, 31% (5/16) were discharged home, and 13% (2/16) were discharged to skilled nursing facility. The mFIM was recorded for 12 patients; of whom, 100% (12/12) had full independence with expression, 83.3% (10/12) were completely independent with feeding function, and 75% (9/12) with complete or moderate locomotion function.

Conclusion: In trauma patients treated with VV ECMO, 60% survived to hospital discharge and we observed good functional outcomes in a majority of the survivors. Despite the high-risk population and known bleeding and thrombotic complications, these data suggest that ECMO is a viable rescue strategy in appropriately selected trauma patients.

Session XIV: Quickshot Session II 14-26
Quickshot 21: 10:22 AM - 10:28 AM

LEVERAGING MACHINE LEARNING TO PREDICT MORTALITY: WHEN TO STOP IN ULTRA-TRAUMA-RELATED ULTRA-MASSIVE TRANSFUSION

Courtney H. Meyer, MD, MPH; Andrew ElHabr, PhD; John Lyons, MD; Jason Sciarretta, MD, FACS; Jonathan Nguyen, DO; Randi Smith, MD, MPH
Grady Health System
Invited Discussant: Joshua Hazelton, DO

Introduction: Despite the widespread use of ultra-massive transfusion (UMT), defined as transfusion ≥20 red blood cell products within 24 hours of admission, for patients in hemorrhagic shock after trauma, mortality remains at 40-70%. In the current literature, there are no consensus guidelines directing utilization and/or cessation of this resource-demanding intervention. Furthermore, resuscitation is an inherently dynamic process, and our understanding of how the clinical and physiologic parameters associated with survivability may change with ongoing transfusion is limited. Therefore, this study sought to investigate the utility of time-specific machine learning models to predict mortality in trauma-related UMT and identify parameters associated with improved outcomes.

Methods: A retrospective cohort study was conducted at a large, academic Level I Trauma Center verified by the American College of Surgeons from May 2018 through November 2021. All trauma patients meeting criteria for UMT were included. The primary outcome of interest was in-hospital mortality. Data was obtained from the institutional trauma registry and served as input to develop time-specific decision tree machine learning models. Individual models were generated for 0-4, 4-8, 8-12, 12-16, 16-24 and 24-48 hours after the initiation of transfusion and evaluated for predictive accuracy. A 75% train/25% test split was used.

Results: 193 patients met inclusion criteria and collectively generated 37,509 individual temporal observations. They were predominantly black (81%) males (78%) with a median age of 29 years [IQR 24, 44]. The overall mortality rate was 54% (n=105). The deceased received a median of 80 [IQR 50, 110] total units of blood product compared to 50 [IQR 39, 62] in the survivors ($p < 0.001$). The 16- 24 -hour model had the greatest predictive accuracy with AUC 0.81 (0.72-0.90). Early after the initiation of transfusion, the strongest predictive factors for mortality were GCS and HR while in the later time intervals, serum lactic acid, pRBC:FFP ratios and total blood products transfused became more heavily predictive.

Conclusions: Clinical and physiologic parameters most predictive of survival during UMT change over time. This study's time-specific decision tree models were able to integrate these factors and predict mortality with accuracy as high as 81%. With refinement, these models have the potential to serve as real-time, evidence-based decision making tools to guide providers faced with the clinical and ethical challenges of UMT resuscitation. Further research is needed to define the generalizability of these models and validate their accuracy in a prospective manner. **Table 1**: Performance of time-specific decision tree models predicting mortality in trauma-related ultra-massive transfusion

Model Number and Time Window	Number of Patients		Number of Observations		ROC AUC (95% CI)	Primary Decision Tree Node
	N	% Survival	N	% Survival		
1: 0-4 Hours	160	49%	690	53%	0.78 (0.69-0.87)	GCS
2: 4-8 Hours	74	60%	252	63%	0.63 (0.51-0.76)	GCS
3: 8-12 Hours	117	65%	399	66%	0.71 (0.61-0.81)	Injury Type
4: 12-16 Hours	102	73%	348	68%	0.63 (0.51-0.74)	Total Blood Products
5: 16-24 Hours	116	72%	569	75%	0.81 (0.72-0.90)	Serum Lactic Acid
6: 24-48 Hours	115	75%	1,613	78%	0.61 (0.55-0.67)	Serum Lactic Acid

Session XIV: Quickshot Session II 14-26
Quickshot 22: 10:28 AM - 10:34 AM

LONG-TERM OPIOID USE AFTER TRAUMA: INCIDENCE AND RISK FACTORS

Matthew Benns, MD; Jeremy Gaskins, PhD;
Keith Miller, MD; Nicholas Nash, MD; Matthew Bozeman, MD;
Samuel Pera, MD; Jamie Coleman, MD; Jason Smith, MD, PhD;
Glen Franklin, MD; Brian Harbrecht, MD
University of Louisville School of Medicine
Invited Discussant: Katie Iverson, MD, MPH

Introduction: The opioid epidemic in the United States continues to lead to a substantial number of preventable deaths and disability. The development of opioid dependence has been strongly and proportionally linked to previous opioid exposure. Trauma patients seem to be at particular risk, as opioids are frequently utilized to control pain after injury. The purpose of this study was to examine the prevalence of opioid use before and after injury and to identify risk factors for long-term opioid use after trauma.
Methods: Records for all patients admitted to a Level 1 trauma center over a one-year period were analyzed. Demographics, injury characteristics, and hospital course were recorded. A multi-state Prescription Controlled Drug Monitoring Program database was queried to obtain records of all controlled substances prescribed from 6 months prior to the date of injury to 12 months after hospital discharge. Patients still receiving narcotics at 1 year were defined as long-term users and were compared against those who were not.
Results: 2992 patients were analyzed. 20.4% of patients had filled a narcotic prescription within the 6 months prior to injury. 53.5% of patients received opioids at hospital discharge. 12.5% of patients overall had long-term use after trauma. 5.9% of patients had long-term use and were opioid naïve. Significant univariate risk factors for long term use included male sex, length of stay > 8 days, injury severity score > 16, anxiety, depression, illicit drug use, orthopedic injuries, spine injuries, any surgery, and pre-injury use. On multi-variate analysis, the only significant predictor of long-term prescription opioid use was pre-injury use.
Conclusion: Opioid use has a high prevalence among trauma patients both pre-injury and during recovery. Pre-injury use is the strongest predictor of long-term use, but a concerning number of opioid naïve patients receive narcotics long-term. Caution and awareness of the risks of prescription opioids are important in the care of trauma patients.

Session XIV: Quickshot Session II 14-26
Quickshot 23: 10:34 AM - 10:40 AM

OPERATIVE TRAUMA AND MORTALITY: THE ROLE OF VOLUME

Sarah A. Hatfield, MD, MPH; Elizabeth Gorman, MD;
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Robert J. Winchell, MD; Cassandra V. Villegas, MD, MPH
Weill Cornell Medicine/New York Presbyterian
Invited Discussant: David Shatz, MD

Introduction: Operative volume has been associated with improved outcomes across many surgical fields, but this relationship has not been clearly illustrated in trauma patients. This study sought to further evaluate the effect of operative trauma volume on mortality, hypothesizing that increased volume would be associated with reduced risk of death.
Methods: The National Trauma Data Bank (NTDB) was used to identify patients aged 18 years and older at adult Level I or II centers from 2017-2020 undergoing hemorrhage control surgery in the first 24 hours. Hierarchical logistic regression was performed to evaluate the effect of operative volume on in-hospital mortality, controlling for demographics, injury characteristics and physiology.
Results: There were 55,469 patients included in the analysis, treated at 516 trauma centers. Patients often presented in shock (56.6%), with a median ISS of 22 (IQR 14-34), and an overall mortality of 27%. After adjustment, operative trauma volume was associated with reduced mortality (OR 0.999, CI 0.997 – 1.000, p = 0.021). However, there was considerable variability in the volumes at each facility, with the top 5% of trauma centers seeing 86-294 operative traumas per year, while the remaining 95% of centers saw a median of 16 (IQR 7 – 32). To evaluate whether operative volume exhibited a uniform effect, the top 5% of trauma centers were excluded on subset analysis, with operative volume becoming non-significant in the remaining 489 centers (p=0.322).
Conclusion: Increasing operative trauma volume is protective in patients undergoing hemorrhage control surgery, but this mortality benefit appears to arise solely from very high-volume centers. Unlike elective specialty procedures, the time-sensitive nature of hemorrhage control surgery makes centralization at this level impractical. Efforts to further improve outcomes in this population should focus on modifiable factors that can be widely implemented, such as increased simulation training, as the operative volume threshold needed to improve mortality is much higher than that seen by most trauma centers.

Session XIV: Quickshot Session II 14-26
Quickshot 24: 10:40 AM - 10:46 AM

PROPENSITY WEIGHTED ANALYSIS OF CHEMOPROPHYLAXIS AGENTS FOR PREVENTION OF VENOUS THROMBOEMBOLISM IN SEVERE TBI PATIENTS: AN EAST SPONSORED MULTI-CENTER TRIAL

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Invited Discussant: Parker Hu, MD

Introduction: In patients with severe TBI, clinicians must balance preventing venous thromboembolism (VTE) with the risk of intracranial hemorrhagic expansion (ICHE). We conducted a multicenter, retrospective cohort study of severe TBI patients with the hypothesis that low molecular weight heparin (LMWH) would not increase risk of ICHE or VTE as compared to unfractionated heparin (UH).

Methods: We included patients with isolated severe TBI (AIS≥3) at 24 level I and II trauma centers, of patients ≥18 years of age, admitted from January 1, 2014 to December 31 2020. We compared patients who received subcutaneous UH and LMWH injections for chemical venous thromboembolism prophylaxis (VTEP) initiated during admission. Primary outcomes were VTE and ICHE. Secondary outcomes were mortality and neurosurgical interventions after VTEP administration. Covariate balancing propensity score weighting was utilized to balance demographic & clinical characteristics across two groups. Propensity score weighted logistic regression models were estimated for all outcomes with chemical VTEP agent as the predictor of interest.

Results: Of 3,936 patients, 984 patients received chemical VTEP, 482 UH and 502 LMWH. Overall, white patients were more likely to receive VTEP (White 65.9% vs. African American 22.4%, p<0.001). Patients on LMWH more often had pre-existing conditions such as liver disease (UH vs LMWH 1.7% vs. 4.4%, p=0.013), and coagulopathy (4.2% vs. UH 0.4%, p<0.001). Patients on UH had a higher incidence of ICHE (32% vs LMWH 25.9%, p=0.036). There were no differences in neurosurgical interventions performed after VTEP initiation between the two groups. There was a total of 29 VTE events (3%) in the cohort who received VTEP. The 7-day estimated rate without a VTE event was 99% overall, 99% in the LMWH group and 98% in the UH group. A log-rank test demonstrated no statistically significant differences in time to VTE across the two agents (p=0.253). A Kaplan-Meier curve was generated to visualize the probability of no VTE event over the study period (**Figure 1**). Propensity score weighted Cox proportional hazards modeling showed that patients receiving LMWH had a 34% decreased risk of VTE compared to those receiving UH but was not found to be statistically significant (Hazard Ratio=0.66, 95% CI=0.30-1.40, p=0.292).

Conclusion: In this large multi-center analysis, patients who received LMWH had similar risk of developing a VTE compared to those who received UH. There were no safety concerns when using LMWH compared to UH.

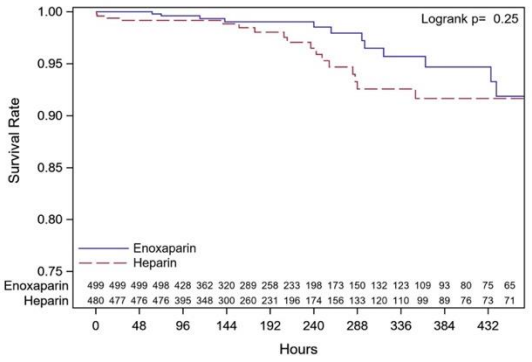

Figure 1: Time to VTE Event by Chemoprophylaxis Agent

Session XIV: Quickshot Session II 14-26
Quickshot 25: 10:46 AM - 10:52 AM

RISK FACTORS FOR EMERGENCY DEPARTMENT UTILIZATION AND READMISSION AFTER TRAUMATIC INJURY: IS FOLLOW-UP REALLY THAT IMPORTANT?

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Invited Discussant: Marissa Boeck, MD, MPH

Introduction: ED visits occur at a rate of 13-14% within 30 days of discharge from traumatic injury. Decreasing ED visits after trauma is a potential target for healthcare systems improvement. This study evaluates the factors associated with ED visits and readmissions after trauma, focusing on the impact of outpatient follow up.
Methods: A retrospective chart review was conducted of all trauma admissions from 12/1/2018 to 12/31/2019. Data from 2020 and 2021 was excluded due COVID-19. Exclusion criteria included age under 18, discharged as deceased, and those transferred to another service during their hospitalization. Categorical variables were compared using Pearson's Chi-square tests. Continuous variables were analyzed using two-tailed t-tests or Mann Whitney Wilcoxon tests for parametric and non-parametric variables, respectively. Logistic regression was used to create an model adjusted for relevant factors identified on univariate analysis. Statistical significance was designated at α=0.05. Analysis was completed using SAS Software Version 9.4 (SAS Institute Inc., Cary, NC, USA).
Results: 1,648 patients met inclusion criteria. The ED visit rate was 20.21% and the readmission rate was 6.98%. On multivariate logistic regression, associations with ED visits were neuropsychiatric conditions (OR 2.248, 95% CI 1.644-3.075), substance use disorder (SUD) (OR 2.467, 95% CI 1.788-3.403), injury location other than home (OR 1.823, 95% CI 1.242-2.674), and violent injury (OR 1.624 95% CI 1.217-2.166). On multivariate logistic regression neuropsychiatric conditions (OR 1.637, 95% CI 1.099-2.437), injury severity score (ISS) (OR 1.023, 95% CI 1.004-1.042), and discharge disposition other than home (OR 3.379, 95% CI 2.152-5.302) were associated with readmission. Attending follow up within 30 days did not have a significant association with ED visits (OR 1.186, 95% CI 0.839-1.675) or readmission (OR 0.910, 95% CI 0.571-1.448).
Conclusion: Outpatient follow up has been thought to reduce ED utilization and readmission after trauma. Our data suggests that emphasizing outpatient follow up is not an effective target in this population. Interventions should focus on supporting at-risk patients with neuropsychiatric conditions, SUD, higher ISS, and victims of violent trauma.

Session XIV: Quickshot Session II 14-26
Quickshot 26: 10:52 AM - 10:58 AM

SURVIVING BUT NOT THRIVING AFTER GUNSHOT WOUND: PROSPECTIVE STUDY OF PTSD, QOL, AND EMPLOYMENT

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Invited Discussant: Bethany Strong, MD, MS

Introduction: Post-traumatic stress disorder (PTSD) is common following gunshot wounds (GSWs), with an incidence of 40-60%. Screening is uncommon in U.S. trauma centers, but undiagnosed PTSD may cause significant morbidity and detrimental effects on recovery. We hypothesized that GSW patients with PTSD experience attenuated quality of life (QoL) and impaired return to work.

Methods: This prospective observational pilot study at an urban Level 1 trauma center examined adult victims of GSW. Participants completed surveys during index hospitalization and at 1 and 3 months. Survey measures included QoL (PROMIS-29, with 7 components measured in standard deviations (SD) from the overall population norm plus a 0-10 pain score), PTSD (PC-PTSD), and employment. Survey data was linked to clinical records regarding injury severity and hospital course. Brain, spinal cord, accidental, and self-inflicted injuries were excluded.

Results: Sixty-three patients presenting between 3/22-9/22 completed the baseline survey, and 43 completed all 3 surveys. Median age was 29 (IQR 21-40), injury severity score 13 (9-17), and hospital length of stay 6 days (4-10). Laparotomy was performed in 28 patients (44%). Forty-nine patients (77.8%) were working prior to injury, 1 (2%) at 1 month, and 34 (54%) at 3 months. Eight (12.7%) patients screened PTSD+ at baseline; 38 (60.3%) screened PTSD+ at 3 months. Three-month PTSD+ patients were similar to PTSD- patients in all clinical and demographic variables. For 3-month PTSD+ patients, all PROMIS component scores were worse than for PTSD- patients: physical function 0.67 SD ($p=0.001$), anxiety 2.32 SD ($p<0.001$), depression 2.12 SD ($p<0.001$), fatigue 1.19 SD ($p<0.001$), sleep disturbance 2.39 SD ($p<0.001$), social roles/activities 1.72 SD ($p<0.001$), pain interference 1.11 SD ($p=0.004$), and pain score 7 vs 3 ($p=0.004$). There was no difference in employment at 3 months according to PTSD status (PTSD+ 33.3% vs PTSD- 40%, $p=0.641$).

Conclusion: Firearm injury causes significant psychosocial morbidity, including a large decline in employment. PTSD affects nearly 2/3rds of patients, consistent with prior reports. Even in this small pilot project, PTSD+ patients suffer from markedly reduced QoL.