Poster # 60

CIVILIAN PREHOSPITAL TOURNIQUETS FOR EXTREMITY TRAUMA: MORE COMMON AND GETTING BETTER ALL THE TIME

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Introduction: From lessons learned in recent U.S. military conflicts, extremity tourniquets (TQ) have become standard practice in civilian prehospital care. We hypothesized that civilian EMS TQ use has increased and TQ are more often applied correctly to patients with extremity vascular injury. The specific aim of this study was to investigate the rate of civilian TQ placement and compare TQ placement in patients with and without vascular injury.
Methods: This was a retrospective study (2014-2022) of all adult trauma patients who had a prehospital extremity TQ placed and were transported to our trauma center at the highest level of activation. Data collected includes demographics, mechanism, physiology, injury severity, presence of extremity vascular injury (ICD-9 and 10 codes), and TQ year, number, and location. The primary outcome was the rate of TQ placement over time, while secondary outcome was the presence of an extremity vascular injury.
Results: There were 353 patients who had a total of 482 prehospital extremity TQ placed. The TQ patients were on average 37 years old, 82% male, 61% sustained penetrating trauma with an ISS=15, and 26% had an extremity vascular injury. There was an average of 1.4 TQ placed per patient, with 44% placed on an arm and 59% placed on a leg. TQ placement increased during the study period for both TQ placement per EMS transport (4% → 15%, $p<0.0001$) and TQ placement per vascular injury (11% → 39%, $p<0.0001$). When comparing TQ patients with and without vascular injury, there was no difference in age, gender, race/ethnicity, or ISS, but the vascular injury patients more often sustained penetrating trauma (82% vs. 54%, $p<0.0001$) and had a lower prehospital systolic blood pressure (106 vs. 116, $p=0.03$). On logistic regression, while controlling for age, gender, as well as number and location of tourniquets, only penetrating injury (AOR: 3.4 [1.7-6.8], $p=0.0004$) and prehospital hypotension (AOR: 2.9 [1.6-5.4], $p=0.0005$) were independently associated with the patient having an underlying extremity vascular injury.
Conclusions: Civilian EMS TQ use has increased over the past decade, and one in four patients with a TQ had an extremity vascular injury. There may be room to further refine indications for civilian prehospital TQ application, considering mechanism and hemodynamic condition in the decision making.

Poster #61

COMPUTED TOMOGRAPHY AFTER PENETRATING CARDIAC BOX INJURY IS SAFE IN STABLE PATIENTS: A REVIEW OF THE NTDB AND A TRAUMA CENTER REGISTRY

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Introduction: Surgeons may be reluctant to bring stable patients with penetrating cardiac box injuries to the CT scanner due to a perceived risk of sudden cardiopulmonary deterioration. The primary purpose of this study is to address this concern by evaluating the risk of complications during CT in these patients. A secondary purpose is to explore how CT guides management.
Methods: Penetrating cardiac box injuries were selected from one Level I Trauma Center's registry, and penetrating thoracic injuries were selected from the National Trauma Data Bank (NTDB) for years 2017-2021. Patients were included if they were stable (shock index <1) and received a CT chest as part of their trauma workup. Patients were excluded if they had critical or worse head injuries (AIS>4). Variables extracted included mechanism, vitals, abbreviated injury scale, procedures performed, and mortality.
Results: Out of 290 penetrating thoracic injuries in stable registry patients, 74 were to the box, and 42,987 NTDB patients met criteria. FAST was negative in all registry patients. There were no complications associated with going to CT in the registry. There were 93 deaths (0.2%) within 6 hours of presentation in the NTDB. After CT, in the registry and the NTDB respectively, 27.0% and 25.7% received a chest tube, 95.9% and 89.8% avoided open chest exploration, and 18.9% and 18.5% underwent abdominal exploration. Among the registry cohort, 85.0% of post-CT chest tubes were placed for findings absent on trauma bay chest X-ray.
Conclusion: In stable patients with penetrating box injuries, CT is rarely associated with complications and often seems to guide management.

Cohort and post-CT management	N	Died in under 6 hrs	Chest tube, no thoracotomy	Abdominal exploration	Thoracic exploration
Registry "cardiac box" injuries	74	0	20, 27.0%	14, 18.9%	3, 4.1%
NTDB penetrating thoracic injuries	42987	93, 0.2%	10224, 23.8%	7964, 18.5%	4386, 10.2%
NTDB firearm thoracic injuries	19490	82, 0.4%	4949, 25.4%	4574, 23.5%	2291, 11.8%

Poster #62

GROWING PAINS: EXPANDING ON BIG CRITERIA TO INCLUDE MINOR FRACTURES

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Introduction: The Brain Injury Guidelines (BIG) were developed to reduce the use of repeat CT, ICU and neurosurgical resources in patients that were unlikely to benefit. Until this time, all trauma patients that have a TBI and an additional injury have been excluded from the BIG, regardless of injury severity. We propose that minor fractures (AIS <4) can be safely included within BIG without an increase in morbidity or mortality in patients who would otherwise meet BIG 1 or 2 stratification.
Methods: Retrospective chart review of polytrauma patients with traumatic brain injury patients from a single level-1 trauma center presenting from January 2017 to November 2022. Patients who died in or were discharged from the emergency department, stratified to BIG 3, admitted to ICU or did not have an additional injury were excluded. The remaining patients were stratified by their assigned BIG category or given one based off their imaging and GCS on presentation if they were initially excluded.
Results: 766 patients underwent chart review. 88 patients met final inclusion criteria. 31 patients were assigned BIG 1, and 57 patients were assigned BIG 2. Neurosurgery was consulted in 20 patients (22.7%, BIG 1 35% vs BIG 2 65%) with 0 interventions performed. 27 patients (30.6%) underwent repeat head CT, but progression of TBI was found only in 1 patient (3.7% overall) who underwent observation only. All patients had minor fracture injuries (AIS <4) with a median AIS of 2. 15 (17%) patients underwent surgery a median of 1 day from admission (range 0 to 22 days) with 4 (26.6%) receiving a preoperative neurosurgery consult, 7 (25.9%) of these repeat head CT. Mean time to OR after neurosurgical consultation was 1 day. We observed no in-hospital mortality, no ICU upgrades and 5.6% morbidity. 82% were discharged home, 6.7% to rehab, 4.5% to SNF and 3.3% to inpatient psychiatry.
Conclusions: Addition of minor fracture injuries to institutional BIG criteria can be safe, as demonstrated by our low morbidity, in-hospital mortality and ICU upgrade rates with high rate of home discharge. We additionally demonstrate the low utility of neurosurgical consultation and routine repeat head CT scanning in patients with minor fractures in the setting of TBI meeting BIG 1 or 2 criteria. We were unable to demonstrate a significant delay to OR for fracture fixation imposed by neurosurgical consultation or repeat head CT scanning.

Poster #63

INITIAL IMPLEMENTATION OF A POST-MORTEM CT PROTOCOL AT A LEVEL 1 TRAUMA CENTER

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Introduction: The national rate of autopsies has declined to <8% due to limited resources. There is accumulating evidence that post-mortem computed axial tomography (PMCT) is a valuable tool in forensic pathology, but its potential role as an alternative to conventional autopsy has not yet been fully defined. We hypothesize that PMCT will improve injury severity reporting accuracy by identifying unknown injuries and increasing ISS.

Methods: This is a retrospective study of PMCTs in trauma patients who were dead on arrival (DOA) or arrived with signs of life (SOL) and died shortly after arrival from 3/2023 to 11/2023. PMCT is a noncontrast CT performed from the skull vertex to the upper thighs with options to image the lower extremities if relevant. Patients were divided into two cohorts: (1) those with SOL who received interventions and (2) those who did not. ISS was calculated with and without PMCT.

Results: The majority of patients (79.3%) were male who presented with blunt mechanism with 27.6% from falls, 13.8% motorcycle crashes, 17.2% motor vehicle crashes, 20.7% pedestrians hit by cars, 3.4% jet ski collision and 3.4% bicyclist hit by van. The remaining 13.8% were gunshot wounds. The time from death to performing PMCT was <7hours for all patients. Of the 29 patients, 13 (44.8%) arrived with SOL and received interventions whereas 15 (55.2%) were DOA and received no hospital intervention. Of those who received interventions, the median ISS without PMCT was 11 [IQR: 3.5-23] compared to 50 [IQR: 44-58] with PMCT ($p=0.001$). For patients who did not receive interventions, the median ISS without PMCT was 2.5 [IQR:0.25-8] compared to 47.5 [IQR:35.8-54] with PMCT ($p<0.001$). PMCT identified a lethal injury in 3 patients (10.3%), updating ISS to 75 (I.e. nonsurvivable injury). Only 6 (20.7%) conventional autopsies were completed by the medical examiner at the time of this writing.

Conclusion: PMCTs can be a valuable adjunct, and even a potential alternative, to conventional autopsy in trauma patients. Postmortem CT scan adds educational value and improves the reporting of accurate information to major quality databases in a timely fashion.

Poster #64

PHYSIOLOGY OVER PHARMACOLOGY: EFFECT OF ANTICOAGULATION ON NONOPERATIVE MANAGEMENT OF SOLID ORGAN INJURIES

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Introduction: The risk of anticoagulation (AC) in the management of intraperitoneal solid organ injury (SOI) is not clearly defined. We hypothesize that preinjury anticoagulation will increase the failure of non-operative management (NOM) after blunt liver and/or spleen trauma.
Methods: We performed a retrospective review of adult blunt trauma patients with ≥ 1 liver or spleen injury that underwent initial non-operative management from January 2020 to August 2023. Patients were excluded if there was no initial CT, emergency department (ED) death, or planned operative management. Data collected included age, AC status, AC reversal, initial INR, Injury Severity Score (ISS), ED vitals, embolization status, operative intervention, and transfusion amounts. Using univariate and multivariate logistic regression analyses, we evaluated the relationship between pre-injury anticoagulation, excluding aspirin alone, and NOM failure.
Results: 1492 patients met inclusion criteria. There were 726 isolated splenic, 487 isolated liver, and 279 concomitant liver and spleen injuries. The patients were 64% male with a median age of 37 (IQR 25 - 58) and a median ISS of 22 (IQR 17 – 33). The NOM failure rate was 2.3% overall. 97 patients were on AC prior to injury of whom only two (2.1%) failed non-operative management. In our regression analysis, AC status did not correlate with NOM failure (aOR 0.67; p=0.618), but Grade IV/V injuries (aOR 6.12; p<0.001) and ED transfusion (aOR 1.10; p<0.001) did. AC patients receiving reversal received more blood in the ED (4.6u vs. 1.1u, p<0.001); however, they did not have a significantly different rate of failure of NOM (3.7% vs. 1.4%, p=0.480).
Conclusions: Pre-injury AC was not associated with NOM failure in our cohort. Our NOM success rates are higher than what has been previously reported, even in patients on pre-injury anticoagulation, suggesting that, with modern resuscitation practices, reversal of AC may not be necessary in all patients with intraperitoneal solid organ injury.

Poster #65

PNEUMOTHORAX DETECTION IN THE ED: HOCUS POCUS?

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Introduction: The incidence of pneumothorax (PTX) in polytrauma may be as high as 20%. Prior studies demonstrated have indicated rather variable sensitivity for both POCUS and supine CXR in PTX detection. The efficacy of both modalities in PTX detection at a major ED that serves an overwhelmingly blunt trauma population was assessed.
Methods: All full adult trauma activations admitted from 2019-2021, excluding traumatic arrests or those without POCUS exam, were included. A subset (19%) of POCUS exams were reviewed by the POCUS director.
Results:

Total patients	541
ISS	16 + 13
Pneumothorax (n, %)	76 (14%)
Chest tube for PTX (n)	52
CXR identified PTX (n)	30
CXR Sensitivity	39.4%
POCUS Sensitivity – overall	42%
POCUS Sensitivity – APP/PGY1	44%
POCUS Sensitivity – PGY 2/3	40%
POCUS Sensitivity – Fellow/Attending	45%
POCUS PPV	94%
POCUS FNR	30%

Conclusion: The incidence of PTX was 14%. A chest tube was placed in about 68%. The overall sensitivity of POCUS for PTX was 42%, with limited variation by level of training, with a false negative rate of 30%. Ultrasound image review by POCUS director indicated 97% concordance with the examining provider with regards to PTX presence/absence and location thereof. Further study of imaging process and outcomes is indicated.

Poster #66

SHOULD WE BE SCORING PAIN DIFFERENTLY FOR RIB FRACTURES? A COMPARISON OF TWO SCORING SYSTEMS

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Introduction: Following rib fractures uncontrolled pain leads to hypoventilation, impaired airway clearance, and in some patients, progression to respiratory failure and death. Pain assessment and control is the primary treatment for all patients with rib fractures. Pain is typically assessed at rest. A novel approach is to assess patients' pain with movement, as this may better capture pain that interferes with physical function. We hypothesized that movement pain scores (MPS) would be higher than resting pain scores (RPS) for patients admitted with rib fractures, and would correlate better with opioid administration.
Methods: A retrospective cohort of patients ≥18 years admitted at a Level 1 trauma center with isolated chest injury (non-chest AIS ≤ 2) were eligible. Patients unable to self-report pain scores were excluded. RPS and MPS scales range from 0-10, with 10 being most pain. RPS and MPS were compared during the first 10 days of admission.
Results: During the 3 month study period, 81 patients met inclusion criteria (median age 69 years [47-79]). The median number of rib fractures was 4 [2-6]. 423 hospital days with 1688 pain assessments were analyzed. MPS and RPS agreed only 39% of the time. When RPS and MPS differed, the average MPS was 2.3 points higher than RPS ($p < 0.01$). Days with higher average MPS had higher average opioid usage (42.7 MME vs. 21.5 MME, $p < 0.01$).
Conclusions: Pain scores with movement were higher than resting scores when measured simultaneously for patients admitted with rib fractures. Higher MPS were associated with increased opioid use. Using resting pain scores alone for rib fractures patients may underestimate pain and lead to worse pain control and outcomes for patients.

Poster #67

TRAUMA PNEUMONECTOMY: HAS SURVIVAL IMPROVED OVER TWO DECADES?

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Introduction: Trauma pneumonectomy, although infrequently performed, has a mortality exceeding 50% from exsanguination and acute right heart failure. The hypothesis of this study is that recent advances in mechanical cardiopulmonary support and operative management have improved survival over time.
Methods: Retrospective, single center, trauma registry study from January, 2003 to December, 2023 of all adult patients who underwent a pneumonectomy for trauma. Data collected included demographics, mechanism of injury, admission physiology, operative details, the use of veno-venous extracorporeal membrane oxygenation (VV-ECMO) and mortality, defined as early (within 24 hours of surgery) and late (> 24 hours after surgery). Outcomes were compared by decade, the first decade (2003-2010) and second decade (2011-2023), using t-tests, ANOVA, and chi-squared tests.
Results: Twenty patients met inclusion criteria, 9 in the first decade and 11 in the second decade. Fifteen (75%) sustained a penetrating injury (11 gunshot and 4 stab wounds), 2 (10%) sustained a blunt injury and 3 (15%) had incomplete data on mechanism. Comparing the decades, there were no differences in mean age (32.2 vs 25.8, p=0.16) or injury severity score (26.4 vs 34.3, p=0.23). However, those in the second decade had significantly lower mean admission pH (6.89 vs 7.14, p=0.01) and higher admission base deficit (19.3 vs 9.8, p=0.003). The use of thoracic damage control surgery significantly increased from 33% in the first decade to 100% in the second decade (p=0.002). VV-ECMO with lung rest ventilation increased from 22% in the first decade to 64% in the second decade (p=0.06). Mean time to cannulation was 1.6 days (± 2.2) with a mean VV-ECMO duration of 24.8 days (range 5 to 105 days); one patient with persistent hemodynamic instability was converted to veno-arterial ECMO. The overall mortality was 5 (55.6%) in the first decade compared to 5 (45.5%) in the second decade (p=0.65). Early mortality, all secondary to hemorrhagic shock and/or right heart failure, did not significantly change over the respective decades 1 (11%) vs 5 (45.5%), p=0.09. However, late mortality was significantly lower in the second decade compared to the first, 0% vs 50% (p=0.04).
Conclusion: Patients requiring a traumatic pneumonectomy are severely injured, in profound shock and physiologically compromised. Despite improved overall survival, early mortality from intractable hemorrhage and right heart failure, remains high. However, the combination of a thoracic damage control operative strategy and early initiation of VV-ECMO may contribute to the dramatic decrease in late mortality to 0% in the last decade.

Poster #68

SURGICAL STABILIZATION OF RIB FRACTURES – WHO GETS IT?

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Introduction: Clinical benefits of surgical stabilization of rib fractures (SSRF) for patients with severe multiple rib fractures (MRF) or flail chest (FC) have been reported in multiple studies. However, most patients with MRF or FC do not receive SSRF. Our study assessed rates and predictors of SSRF among patients with MRF or FC in the United States.
Methods: Patients with MRF or FC admitted in the inpatient setting were identified within the Premier Healthcare database. All patients had a chest Abbreviated Injury Scale (AIS) score > 1 and > 2 days inpatient stay. Patients were stratified by receiving SSRF anytime during index admission. Variables included patient demographic, comorbid and injury-related characteristics (e.g., injury severity score (ISS), specific lung injury types) and hospital characteristics (size, location, type). Logistic regression analyses were conducted to identify hospital or patient characteristics associated with SSRF. Separate models were built for MRF vs FC patients.
Results: 225,865 patients with MRF and 9,286 with FC were included, of which 2% (4,537) and 31.5% (2,923) received SSRF, respectively. In patients with FC, the two main predictors for SSRF were presence of pneumo- or hemo- or pneumohemo-thorax present on admission and requiring drainage (OR: 5.8 (95% confidence interval (CI): 5.2-6.5), $p < 0.001$) and hospital size > 500 beds (OR: 4.5 (95%CI: 2.3-8.7), $p < 0.001$). The same two predictors were identified for patients with MRF, however in this cohort, White race (vs Black) was also associated with increased odds for SSRF (1.31 (95% CI: 1.17-1.46), $p < 0.001$). Patients with Medicaid and Medicare as payer also had lower odds of SSRF vs patients with commercial insurance (Medicaid: 0.83 (95% CI: 0.75-0.92) – Medicare: 0.85 (95% CI: 0.78-0.92), $p < 0.001$ for both).
Conclusion: SSRF is still underutilized. In patients with FC, hospital size and pneumo- or hemo- or pneumohemo-thorax present on admission predict SSRF utilization. In patients with severe multiple rib fractures, socioeconomic factors such as race and payer are also associated with SSRF utilization.