Poster #89

CHARACTERIZING HIGH-GRADE SPLENIC INJURIES TO GUIDE PROCEDURE CHOICE FOR INITIAL ANGIOGRAPHY

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Introduction: The Western Trauma Association and The Eastern Association for the Surgery of Trauma Guidelines for the management of adult blunt splenic trauma recommends angiography for patients with contrast blush on initial CT scan. The American Association for the Surgery of Trauma (AAST) Spleen Injury Score was updated in 2018 and reclassified all splenic injuries with a blush as Grade 4+. This study compared outcomes of patients requiring repeat splenic intervention after initial angiography (defined as repeat angiography or splenectomy) based on the new scoring system. We hypothesized that findings on initial CT imaging could indicate likelihood of requirement for repeat intervention.
Methods: A retrospective review was conducted of all patients presenting to a single Level I Trauma Center who underwent splenic angiography for splenic trauma between January 1, 2002, and December 31, 2021. Each patient's injury was graded using the revised 2018 AAST Spleen Injury Scale, and all Grade 4 and 5 splenic injuries were included in the study. High-risk features on CT imaging were defined as active extravasation, evidence of pseudoaneurysm, hilar injuries, multiple lacerations, or Grade 5 injuries. Data was analyzed using chi-square, one-way ANOVA and Mann-Whitney-U analysis.
Results: There were 153 patients with Grade 4 and Grade 5 injuries who underwent initial angiography. Of these, 44 (28.8%) underwent angiography alone (AO), 17 (11.1%) underwent proximal embolization (PE), and 92 (60.1%) underwent selective embolization (SE). There was no evidence of active extravasation at angiography in 36% (n=9) of patients who underwent initial angiography and required a repeat splenic intervention; each of these patients had Grade 5 splenic injuries, multiple splenic lacerations, or hilar lacerations on initial CT imaging. After initial angiography, 25 (16.3%) patients required repeat splenic intervention. Repeat intervention was required in 18.2% (n=8) AO patients, 16.3% (n=15) SE patients, and 11.8% (n=2) PE patients. All patients who required a second procedure after initial embolization had active extravasation and 96% (n=24) had a perisplenic hematoma on initial CT imaging. Furthermore, 60% (n=15) of the patients who required repeat intervention were classified as Grade 5 on initial CT scan. Of the patients who required repeat intervention, 28% (n=7) had a pseudoaneurysm or vascular irregularity identified during initial angiography. A greater percentage of patients in the repeat procedure group died versus those that did not require a repeat intervention (12.0 vs 3.9%). The repeat procedure group had more ventilator days (4.0 vs 2.5, $p < 0.001$), longer LOS (14.2 vs 10.7, $p < 0.001$), and a higher complication rate (63.6% vs 36.9%, $p = 0.016$) compared to patients who did not require a second procedure. There was no difference in the average procedural time of initial procedure for those that required repeat intervention and those that did not (38.9 vs 35.6 minutes $p = 0.901$).
Conclusion: The results demonstrate that all patients requiring repeat splenic intervention after initial angiography had evidence of high-risk features on initial CT imaging. Furthermore, Proximal Embolization patients were shown to require less repeat intervention. Overall, the requirement for repeat intervention is associated with worse outcome measures. Studies prioritizing PE in patients with high-risk features on CT imaging even without evidence of active extravasation on initial angiography should be considered.

Poster #90

DEAD SHOT: THE ROLE OF WHOLE-BODY COMPUTED TOMOGRAPHY IN THE MANAGEMENT OF PATIENTS WITH GUNSHOT WOUNDS TO THE TORSO

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Introduction: This study aims xto evaluate the safety and outcomes (number of surgical interventions and overall mortality) of whole-body computed tomography (WBCT) in the management of patients with gunshot wounds (GSW).
Methods: We conducted a cross-sectional, retrospective analysis of all patients with GSW's to the torso admitted at a Level 1 Trauma Center from January-2018 to December-2021. Patients with head AIS-scores >= 3 and ISS-scores<9 were excluded. Institutional WBCT protocol for penetrating trauma consists of a single-pass arterial and portal venous contrast scan that includes the neck, thorax, abdomen, and pelvis. All hemodynamically unstable (HU) patients [Systolic blood pressure (SBP) <100 mmHg and/or heart rate (HR) >120 bpm] taken to the scanner were transient responders (TR) to initial resuscitation.
Results: A total of 582 patients were included: 258 (44%) HU and 324 (56%) hemodynamically stable (HS). WBCT was performed in 135 (52%) and 175 (54%) patients of each group, respectively. In HS patients who did not have major surgery, the rate of minimally invasive procedures (MIP) increased by 150% in the WBCT group compared to the non-WBCT group. Among HU patients, the rate of major surgery decreased by 40% and the rate of MIP increased by 58% in the WBCT group vs. the non-WBCT group. In addition, overall mortality was lower in the WBCT group vs. the non-WBCT group, which was also true for TR [WBCT 4% vs. non-WBCT 15%, p=0.06]. None of the patients (HU or HS) died in the CT scanner. A sub-analysis including patients with injuries to multiple anatomical regions [N=204] showed that the MIP rate was 5 times higher in HS patients that had WBCT. On the other hand, the rates of major surgery [37% vs. 65%,p<0.01], overall mortality [6% vs. 28%, p<0.01], and TR mortality [6% vs. 19%, p=0.07] were all lower in HU patients that had a WBCT.

	Hemodynamic Stability (N = 582)					
	Unstable (n=258) 44%			Stable (n=324) 56%		
	WBCT (n=135) 52%	No WBCT (n=123) 48%	P value	WBCT (n= 175) 54%	No WBCT (n=149) 46%	P value
ISS, median (IQR)	17(13-26)	17(13-25)	0.8	16(10-20)	10(9-16)	<0.001
ISS > 15, n (%)	90(67%)	83(67%)	0.9	89(51%)	41(28%)	<0.001
SBP, mm Hg, median (IQR)	92(81-100)	80(64-95)	<0.001	123(112-133)	125(115-137)	0.2
SBP < 100 mm Hg, n (%)	110(81%)	111(90%)	0.04	NA	NA	-
No Major Surgery[1], n (%)	95(70%)	62(50%)	<0.001	123(70%)	113(76%)	0.2
Minimal Invasive Procedures[2], n/N (%)	47/95(49%)	19/62(31%)	0.02	49/123(40%)	18/113(16%)	<0.001
Overall Mortality, n (%)	5(4%)	19(15%)	0.001	0	1(1%)	0.45
Mortality TR, n/N (%)	5/130(4%)	10/102(10%)	0.06	0	1(1%)	0.45

1) No Major Surgery: No major incision was performed (Laparotomy, Thoracotomy, Sternotomy, or Cervicotomy)
2) Minimal Invasive Procedures: Laparoscopy, Thoracoscopy, and/or Thoracostomy
Abbreviations: ISS: Injury Severity Score, NA: Not Applicable, SBP: Systolic Blood Pressure, WBCT: Whole Blood Computed Tomography, TR: Transient Responders.

Conclusion: WBCT in hemodynamically unstable GSW patients who are transient responders is a safe and effective tool that can avoid unnecessary major surgeries and increase the use of minimally invasive procedures without impacting mortality.

Poster #91

DEMOGRAPHIC DIFFERENCES IN TIME-TO-OR FOR BLUNT AND PENETRATING ABDOMINAL TRAUMA PATIENTS

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Introduction: Both time-to-OR and socioeconomic (SES)/demographic factors have been shown to influence outcomes for abdominal trauma. This study characterizes the demographic variability of facilities with better trauma performance. We additionally evaluated patient factors and injury patterns of abdominal trauma victims after stratifying for time-to-OR.
Methods: This is a cohort study of TQIP data (2010-2020) including patients with abdominal trauma treated surgically within 6 hrs. Patients with abdominal AIS=6 and head, neck, or thorax AIS>2 were excluded. Hospitals were classified as slow, medium, or fast using 75th percentile time-to-OR. Patient demographics, clinical characteristics, and outcomes (time-to-OR, mortality, hospital LOS, time on ventilator, OR, and hospital disposition) were summarized by facility speed. Data are mean±SD.
Results: There were 55,950 patients from 2,730 facilities; a higher percentage of patients were male (83%), Black (36%), Hispanic (22%), and self-pay (27%) than the national average of those characteristics. There were 1163(43%) community, 374(14%) nonteaching, and 1166(43.1%) University hospitals, the majority of which were nonprofit (89%). For facilities, 76(3%) were categorized as slow, 2395 (88%) were medium, and 241(9%) were fast. Compared to fast hospitals, slow facilities had more female, white, and privately insured patients ($p<0.0001$). Slow hospitals had more blunt injuries (36.7%vs13%) and less penetrating injuries (63.1%vs87%). The overall Injury Severity Score and abdominal AIS score were similar across all facilities. Facility-level analysis showed an equal number of yearly abdominal trauma cases across all hospitals, with similar teaching and nonteaching hospitals ($p>0.05$). The mean time-to-OR for slow hospitals was 127.0±84 min compared to 52±51 for fast. Mean ICU LOS was longer in fast hospitals (7vs6 days), ventilator time was similar. Total LOS was longer for fast hospitals; these patients were significantly more likely to be discharged to home without services (73%vs67%).
Conclusion: Hospitals with faster door-to-OR time are large university centers with a higher proportion of uninsured minority patients with penetrating injuries. Though these hospitals get patients to the OR faster, they face more extended hospital LOS and difficulty discharging patients to skilled care.

Poster #92

FINDING THE SWEET SPOT: IMPACT OF ADMISSION GLUCOSE ON OUTCOMES IN TRAUMATIC COLON INJURIES

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Introduction: Perioperative hyperglycemia has long been associated with infectious complications in non-trauma patients undergoing colon surgery. Whether it plays a similar role in patients with traumatic colon injuries has yet to be established. The goal of this study was to examine the impact of admission blood glucose on outcomes in patients with traumatic colon injuries.
Methods: Consecutive patients over a 3-year period who underwent operative management of colon injuries were identified. Patient characteristics, mechanism and injury severity, admission glucose, intraoperative packed red blood cell transfusions (PRBC), use of intestinal diversion, and type of repair were recorded. Outcomes including mortality and colon-related morbidity (intraabdominal abscess formation or suture line failure) were collected and compared. Multivariable logistic regression (MLR) analysis was then performed to determine the impact of admission glucose on colon-related morbidity.
Results: 246 patients were identified: 108 with non-destructive injuries and 138 with destructive injuries. Of the destructive colon injuries, 38 underwent proximal diversion and 100 underwent resection and anastomosis. Patients with colon-related morbidity (n=70) were clinically similar to those without (n=68) with respect to age (31 vs 28 years-old, p=0.290), gender (82.9% male vs 91.2%, p=0.147), penetrating mechanism of injury (70% vs 64.7%, p=0.507), ISS (21 vs 19, p=0.303), admission systolic blood pressure (117 vs 122, p=0.174), and admission lactate (4.08 vs 3.16, p=0.151). There were no colon-related mortalities. Admission glucose (170 vs 142, p=0.021) and intraoperative PRBC transfusions (4 vs 0.5 units, p=0.0004) were higher in those patients who developed colon-related morbidity. MLR identified only intraoperative PRBC transfusions as an independent predictor of increased colon-related morbidity (OR=1.076, 95%CI 1.018-1.147, p=0.015).
Conclusion: While higher admission glucoses are associated with increased risk of intraabdominal abscess formation or suture line failure, intraoperative transfusion requirements remain the best independent predictor of colon-related morbidity.

Poster #93

HIGH-GRADE LIVER INJURIES WITH CONTRAST EXTRAVASATION MANAGED INITIALLY WITH ANGIOGRAPHY VERSUS OBSERVATION: A MULTICENTER STUDY

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Introduction: High grade (IV-V) liver injuries with active extravasation (HGLI+Extrav) are associated with significant risk of complications and mortality. For low grade injuries, an observation (OBS) first strategy is beneficial over initial angiography (IR), however, it is unclear if OBS is safe for HGLI+Extrav. Therefore, we evaluated the management of patients with HGLI+Extrav, hypothesizing that patients receiving initial IR will have decreased operative and mortality rates compared to initial OBS.

Methods: This is a secondary analysis of a prospective, observational, multicenter study. Patients with HGLI+Extrav managed with initial OBS or IR were included. Pregnant patients, non-traumatic hemorrhage, transfers, those with cirrhosis, or dead-on arrival patients were excluded. The primary outcome was need for operation. Secondary outcomes included liver-related complications and mortality. Bivariate comparisons of patients managed initially with OBS versus IR were performed.

Results: From 59 patients with HGLI+Extrav, 23 (39.0%) were managed with OBS, and 36 (61.0%) with IR initially. There was no difference in age, sex, mechanism of injury, or injury severity score between cohorts (all $p>0.05$). IR patients had an increased median heart rate (103 vs. 91, $p=0.04$) but statistically similar, albeit clinically different shock index (0.94 vs 0.75, $p=0.06$) compared to OBS patients. 75% of IR patients underwent angioembolization during first IR, whereas only 13% of OBS patients underwent any IR, with all undergoing angioembolization. IR patients had increased rates of operation (13.9% vs. 0%, $p=0.049$), but there was no difference in liver-related complications (44.4% vs 43.5%) or mortality (5.6% vs 8.7%) between cohorts (both $p>0.05$).

Conclusion: Over 60% of all patients with HGLI+Extrav were managed with IR initially. Patients selected for IR initially had an increased rate of operation yet similar rates of liver-related complications and mortality compared to patients selected by surgeons to be initially managed with OBS. This suggests that in appropriately selected HGLI+Extrav initial OBS may be reasonable. Future prospective randomized trials are needed to confirm these findings as there are concerns for selection bias within this observational study.

Poster #94

INTERRATER AGREEMENT OF CT GRADING OF BLUNT SPLENIC INJURIES: DOES THE AAST GRADING NEED TO BE REIMAGINED?

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Introduction: The Revised Organ Injury Scale (OIS) of the American Association for Surgery of Trauma (AAST) is the most widely accepted classification of splenic trauma. Splenic injury grade is a key factor for deciding on non-operative management, splenic embolization, and predicting risk of non-operative management failure. The objective of this study was to evaluate inter-rater agreement for CT grading of blunt splenic injuries.
Methods: CT scans in adult patients with splenic injuries at a level 1 trauma centre were independently graded by 5 fellowship trained abdominal radiologists using the AAST OIS for splenic injuries – 2018 revision. The inter-rater agreement for AAST CT injury score, as well as low-grade (I-III) versus high-grade (IV-V) splenic injury was assessed. Examinations with two rater disagreement in key clinical scenarios (no injury versus injury, and high versus low grade) were reviewed by a staff abdominal radiologist and trauma surgeon to identify possible underlying causes of disagreement.
Results: A total of 610 examinations were included in the study. The inter-rater absolute agreement was low (Fleiss kappa statistic 0.38, $p < 0.001$), but improved when comparing agreement between low and high grade injuries (Fleiss kappa statistic of 0.77, $p < 0.001$). There were 34 cases (5.6%) of minimum two-rater disagreement about no injury vs injury (AAST grade ≥ I). There were 46 cases (7.5%) of minimum two-rater disagreement of low grade (AAST grade I-III) versus high grade (AAST grade IV-V) injuries. Likely causes of disagreement were interpretation of clefts versus lacerations, peri-splenic fluid versus subcapsular hematoma, application of adding multiple low grade injuries to higher grade injuries, and identification of subtle vascular injuries.
Conclusion: There is significant disagreement in grading of splenic injuries using the existing AAST OIS for splenic injuries, including at key clinical cutoffs that can significantly impact patient management decisions.

Poster #95

MULTI-CENTRIC STUDY ON ORGAN DONATION AFTER TRAUMA: A HIERARCHICAL MACHINE-LEARNING CLUSTER ANALYSIS

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Introduction: Organ availability has always been a significant setback, and as the number of patients being added to waiting lists rises, the gap between organ supply and demand continues to increase. The primary aim of this study is to characterize subtypes of organ donors after major trauma and examine the relationship between the application of damage control strategies (DCS) and organ donation outcomes.
Methods: Prospective multicentric observational data were recorded from three major trauma centers in Northern Italy. A hierarchical machine-learning algorithm was used for clustering the patients. The functional response rate is defined as the proportion of organs that did not have primary dysfunction in the first 30 days from all transplanted organs.
Results: A significant difference between the clusters was found in the total number of DCS procedures applied (Cluster 1 4.31 ± 2.54 vs. Cluster 2 1.98 ± 1.54, $p<0.001$). With regards to the donation of solid organs, Cluster 1 has produced significantly more hearts (65% vs. 34%, $p=0.001$). The functional response rate was equal (93% vs. 93%, $p=0.929$).
Conclusion: Aggressive DCS to save trauma patients' lives does not negatively impact the chances of organ donation in suitable donors

Poster #96

PANCREATICODUODENECTOMY IN TRAUMA PATIENTS WITH GRADE IV-V DUODENAL OR PANCREATIC INJURIES: A MULTICENTER TRIAL

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Introduction: The utility of pancreaticoduodenectomy (PD) for high-grade traumatic injuries remains unclear and data regarding its use are limited. We hypothesized PD does not result in improved outcomes when compared to non-PD surgical management of grade IV-V pancreaticoduodenal injuries.
Methods: This is a retrospective, multicenter analysis from 35 Level-1 trauma centers from 1/2010-12/2020. Included patients were ≥ 15 years old with AAST grade IV-V duodenal and/or pancreatic injuries. The study compared operative repair strategy: PD vs non-PD.
Results: The sample (n=95) was young (26 years), male (82%), with penetrating injuries (76%). Non-PD patients (n=63) underwent primary repair alone (PRA, 35%) or complex repair with adjunctive measures (CRAM, 65%) such as pyloric exclusion, duodenectomy, and/or gastrojejunostomy. There was no difference in demographics or severity of illness (SBP, GCS, ISS, MTP) between PD (n=32) vs non-PD patients (all $p>0.05$). Anatomically, PD patients had more concomitant pancreaticoduodenal (91%vs 70%), grade V duodenal, grade V pancreatic, ampulla, pancreatic head, and pancreatic ductal injuries compared to non-PD patients (all $p<0.05$); however, 43% of grade V duodenal and 40% of grade V pancreatic injuries were still managed with non-PD. There was no difference in damage control, number of operations, duodenal leak, other anastomotic leak, mortality, or readmission between PD vs non-PD (all $p>0.05$). PD patients had more GI related complications and longer ICU and hospital length of stay compared to non-PD patients (all $p<0.05$).

Pancreaticoduodenectomy(PD) vs non-PD Outcomes in Grade IV-V Pancreaticoduodenal Injuries

	All Patients (n=95)	PD (n=32)	Non-PD (n=63)	p value
Duodenal Leak	22 (23%)	7 (22%)	15 (24%)	1.000
Anastomotic Leak	9 (10%)	5 (16%)	4 (6%)	0.159
Antibiotic Use for Leak	18 (19%)	3 (9%)	15 (24%)	0.105
Parenteral Nutrition	52 (55%)	21 (66%)	31 (49%)	0.190
GI Related Complication	50 (53%)	22 (69%)	28 (44%)	**0.031**
ICU Length of Stay (days)	10 [4-24]	17 [7-29]	6 [2-23]	**0.012**
Hospital LOS (days)	27 [13-42]	34 [24-45]	25 [9-38]	**0.017**
Mortality	19 (20%)	4 (13%)	15 (24%)	0.279

Conclusion: PD did not offer improved outcomes among patients with grade IV-V pancreaticoduodenal injuries. Without sound scientific support for PD outcome benefit, our results suggest PD may be overutilized.

Poster #97

PREPERITONEAL PELVIC PACKING INCREASES THE RISK FOR VENOUS THROMBOEMBOLISM IN ISOLATED SEVERE PELVIC FRACTURES

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Introduction: Preperitoneal pelvic packing (PPP) has been advocated as a damage control procedure to reduce bleeding from pelvic fractures and is included in the treatment algorithms of major trauma societies despite weak evidence.to support it. We hypothesized that venous stasis caused by PPP is associated with an increased risk of venous thromboembolism (VTE). In order to minimize other risk factors that complicate the interpretation of the results, the current study included only patients with isolated severe pelvic fractures.

Methods: This is a retrospective cohort analysis using the TQIP database (2016-2019). Adult patients with isolated severe blunt pelvic fractures (pelvis abbreviated injury score [AIS] ≥ 3, AIS ≤ 2 in all other body regions) were included. Patients who underwent PPP in the first 24 hours were matched to patients who did not using a 1:3 nearest propensity score match. Matching was performed based on demographics, vital signs on admission, comorbidities, injury characteristics, type and timing of initiation of VTE prophylaxis, and additional procedures including laparotomy, resuscitative endovascular balloon occlusion of the aorta [REBOA], and angioembolization. The rates of VTE were compared between the two groups.

Results: 11,594 patients with isolated severe pelvic fractures were identified, of which 71 underwent PPP in the first 24 hours. 64 patients in the PPP group were matched with 182 patients in the No-PPP group. There were no significant post-match differences between the groups in any of the baseline variables. PPP patients had significantly higher rates of VTE and deep vein thrombosis (DVT) (VTE: 14.1% vs 4.4% $p=0.018$, DVT: 10.9% vs 2.2% $p=0.008$) as well as higher in-hospital mortality (14.1% vs 2.2% $p<0.001$).

Conclusion: Preperitoneal pelvic packing use in the management of patients with isolated severe pelvic fractures is associated with an increased rate of VTE and DVT complications.

Poster #98

USE OF FUNNEL PLOTS TO IDENTIFY INDIVIDUAL SURGEONS AS SIGNIFICANT OUTLIERS IN MORTALITY AFTER EMERGENT TRAUMA LAPAROTOMY

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Introduction: Comparisons of surgeon-specific procedural outcomes are significantly affected by differences in patient case-mix and volume. Funnel plots are a widely accepted method to account for these differences and identify performance outliers. We applied this technique to further develop our work to compare individual surgeon outcomes following emergent trauma laparotomy (ETL) at a large level 1 trauma center.
Methods: Retrospective review of a single center database of ETL from 2019-2022. ETL was defined as laparotomy within 90 minutes of patient arrival, excluding those with Emergency Department (ED) thoracotomy. Intraoperative (OR), 6-hour, 24-hour, and in-hospital mortality rates were plotted using funnel plots with 95% and 99.7% confidence intervals.
Results: 19 faculty performed 471 ETL [median 25, range=1-62]. 21% (n=100/471) presented with hypotension (SBP≤90). Initial ED vitals/labs, ISS, AIS-Head, and AIS-Abdomen were all similar across individual surgeons. Overall mortality rates for the entire cohort by time period: OR: 2% (11/471); 6-Hour: 3% (15/471); 24-Hour: 5% (22/471); Hospital: 8% (39/471). ED length of stay (p=0.004) and operative duration (p<0.001) were significantly different in the group. Funnel plots showed that mortality was within the 95% confidence interval for most surgeons. There were two "probable outliers" (>99.7%) for 6-hour mortality (**Figure. 1**), one each at OR and 24-hour mortality, and none for hospital mortality.
Conclusion: Probable outliers in early mortality were identified while none were present for hospital mortality. Funnel plots are useful to identify the impact that individual surgeons have on ETL outcomes.