**A REVIEW OF**

**BLUNT AND PENETRATING AAST GRADE III-V LIVER INJURIES**

Time: 2013-2016

Background:

Complex hepatic injuries have been reported to be associated with high morbidity and mortality rates related to hemorrhage and biliary leaks. With improved resolution of CT scans, retrohepatic vascular abnormalities are readily identified but grade of injury has not shown to predict failure of non-operative management or necessarily suggest a higher morbidity or mortality. (1-2) In Grade 4 or 5, hemodynamically stable patients without another injury necessitating operative intervention and transient responders with limited transfusion requirements can be managed successfully non-operatively over 80% of the time. (3-7) Current grading systems including the AAST does not account for predictors of failure of non-operative management including arterial extravasation on CT scan, “peri-portal tracking” of blood, and evidence of multiple solid organ injuries. (8-13)

Up to 15% of patients with Grade 3-5 hepatic injury suffer delayed complications involving bile leaks and bilomas. (14) HIDA scan is reported to be 100% sensitive and specific for the detection of bile leaks with non-operative interventions including ERCP and/or percutaneous drainage resulting in a success rate of over 90%. (15) Early recognition and treatment of bile leaks leads to decreased morbidity. (16-18) In hemorrhagic and biliary complications of hepatic injury, failure of non-operative interventions has been shown to lead to operative intervention 25% of the time.(19,20) Despite the benefits of non‑operative therapy, the biliary and hemorrhagic complications associated with blunt hepatic injury are unchanged. (10,15,16,21-22)

In patients who do not meet clear criteria for non-operative management and have risk factors for failure of non-operative management or undergo operative intervention with complimentary non-operative management elucidation of an algorithm, respective of hemorrhage or biliary leak, for which each intervention(s) should be performed separately or in compliment to one another remains elusive.

The objectives of this study are:

1) to characterize hepatic injuries based upon CT findings intraperitoneal versus intra-parenchymal hemorrhage, contrast pooling, juxtahepatic injuries, number of couinaud segments injured and association with non-operative versus operative management

2) to examine timing of angiography in relation CT scan for total blood products transfused

3) to define timing of intervention for bile leak or biloma (operative intervention, percutaneous drainage, ERCP) and resolution of bile leak or biloma

Our hypotheses are:

1) Characteristics present on CT including intra-peritoneal hemorrhage, contrast pooling, retrocaval injuries and higher number of couinaid segments injured may be associated with either of  increased risk of complications or failure of non-operative intervention or need for operative management.

2) Earlier angiography will reduce total blood products transfused.

3) Earlier identification, treatment of bile leak or biloma will result in shorter duration to resolution to bile leak or biloma.

References

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This will be a multicenter study open with participation open to all trauma centers. Data will be entered into AAST approved data repository at each respective center. Enrollment will tentatively open May 1, 2018 and close December 1, 2018. General information to be submitted per institution: Resolution of CT scanner and trauma multiphasic CT A/P protocol of respective institution and outside hospital if CT scans used from patients transferred in from outside hospital. A data dictionary will be provided.

Entrance criterion:

All adult (> 18 years) patients who sustained Grade 3-5 hepatic injuries per the American Association for the Surgery of Trauma (AAST) Organ Injury Scale and underwent Non-Operative Intervention (Angiography/ERCP/Percutaneous Drainage) or Operative intervention with or without CT Scan of the Abdomen/Pelvis within 24 hours of admission.

Exclusion criteria:

Patients who are:

< 18 years

Pregnant

Cirrhotic

Diagnosed with hepatocellular carcinoma

Not a candidate for ERCP

Data to be collected:

Name

MRN

Encounter Number

Admission to ED Date/Time

Age

Sex

Mechanism of Injury: Blunt or Penetrating

SBP on admission to ED

Heart rate on admission to ED

Shock index on admission to ED

Base Deficit on admission to ED

Antiplatelet agents

Anticoagulant indication

TEG result on admission (if done) and location Date/Time

Rotem (rotational thromboelastometry) and location Date/Time

PT/INT/PTT/Fibrinogen on admission to ED

ISS (after imaging, operation or autopsy)

Was ED Thoracotomy performed? If so, Date/Time aorta clamped, duration

Was REBOA performed? If so, Date/Time of occlusion of aorta, duration

Hepatic Injury Diagnosed in OR or on CT: Date/time and respective AAST Grade of Injury

Damage control laparotomy: Yes/No, Date/time of start based on incision

Exploratory laparotomy: Yes/No, Date/time of start based on incision

Hepatorraphy: Yes/No (during damage control laparotomy or exploratory laparotomy) and nature of intervention

* Peri-hepatic packing
* Topical hemostatic agents
* Extensive hepatorrhaphy with suture ligation
* Hepatotomy with selective vascular ligation
* Resectional debridement with selective vascular ligation
* Lobectomy or segmentectomy
* Selective hepatic artery ligation
* Other, please specify

Drain placement during damage control or exploratory laparotomy: Yes/No Number of drains, date/time of damage control or exploratory laparotomy when they were placed.

Wound vac use: Yes/No, Date/Time

Silo used: Yes/No, Date/Time

If damage control surgery performed, date/time of fascia closure

AAST Injury Score for:

Liver

Extrahepatobiliary

Chest Wall

Lung

Heart

Diaphragm

Adrenal

Spleen

Kidney

Pancreas

Esophagus

Stomach

Duodenum

Small bowel

Colon

Rectum

Cervical Vascular Injury

Thoracic Vascular Injury

Abdominal Vascular Injury

Associated injuries

Major vessel (aorta, vena cava, iliac artery, iliac vein, SMA, SMV)

Pelvic fracture

Long bone fractures (humerus, radius, ulna, femur, tibia, fibula)

TBI (GCS > 8)

Spinal cord injury

Number of units of blood, plasma, platelets, cryoprecipitate transfused during hospitalization.

3 units of blood transfused within 1 hour for the first 24 hours: Y/N

Procedures

HIDA scan, Date/Time performed

Indication for HIDA

ERCP: Yes/No, time of common bile duct cannulation is start time, +/- stent

Serial ERCPs until stent removed: Yes/No, Date/Times

Angioembolization: Yes/No, date/time of puncture, date/time of closure of arteriotomy

Indication for angiography

If angioembolization performed, name/number of branches embolized.

Was hybrid suite used for operative and non-operative interventions? Yes/No, if so which operative and non-operative interventions?

CT scan/US guided drainage of fluid collection: Yes/No

Indication for CT/US guided drainage

* Fluid collection: fluid without evidence of infection or bile
* Biloma/Bile leak: drainage of bile without evidence of infection based upon culture data
* Infected biloma/bile leak: drainage of fluid with evidence of infection based upon culture data
* Abscess: fluid with evidence of infection but no bile

Unplanned reoperation: Yes/No, Date/Time

Indication for unplanned reoperation

Complications:

Ongoing bleeding (need for transfusion of greater than 2 units in 24 hours without hemodynamic improvement)

Sepsis, based upon SOFA score at admission and 72 hours into ICU stay (within 12 hours of each timeframe)

Wound infection: Yes/No, Date/Time

Intraabdominal abscess: Yes/No, Date/Time

Fistula: type, Date/time of diagnosis, intervention Date/Time

Bowel obstruction: Yes/No, Date/time of diagnosis, duration for conservative management (NPO, NGT), and Date/time of operative intervention, if performed

Biloma: Yes/No, Diagnosed in OR/HIDA/Non-Operative intervention(ERCP, Percutaneous drainage) Date/time, intervention Date/time, and resolution Date/time, and criteria for resolution (drains removed without further clinical signs of leak/biloma/fluid collection/abscess or ERCP) Date/time

Clinically significant reaccumulation of bile leak or biloma: Yes/No, Date/time, means of diagnosis (CT, US, ERCP, OR), intervention (non-operative, operative or both), Date/time, resolution based on last drain removal, Date/time.

Hemobilia: Yes/No, Date/time of diagnosis, intervention, resolution, and diagnosis

ICU Length of Stay (LOS)

Number of Ventilator free days in Intensive Care Unit (ICU)

Hospital LOS

Outcome:

Live

Die

Was patient discharged home with drains? If so, number of drains and location.

Duration of days drains in place post-discharge

Criteria used to pull drains

30 day unplanned readmission related to liver injury: Yes/No and Indication

Statistical analyses:

Bivariate analysis will be performed to determine if there are differences between those with the exposure of interest and those without.  Factors found to be associated with the outcomes of interest on bivariate analysis will be included in multivariable models.  The multivariable models will be used to determine if the exposure of interest is associated with the primary and secondary outcomes.