PRACTICE GUIDELINE

Effective Date: **6-18-04** Manual Reference: **Deaconess Trauma Services**

TITLE: OPERATIVE MANAGEMENT OF LIVER / SPLENIC INJURIES

PURPOSE

- To define when operative management of liver and/or splenic injuries are safe and desirable.
- To define a clinical pathway for the operative management of liver and/or splenic injuries.

DEFINITIONS

LIVER

- Grade I Hematoma: Subcapsular: <10% surface area
- Grade I Laceration: Capsular tear: <1 cm parenchymal depth
- Grade II Hematoma: Subcapsular: 10-50% surface area; intraparenchymal: <10cm in diameter
- Grade II Laceration: Capsular tear: 1-3cm; parenchymal depth: <10 cm length
- Grade III Hematoma: Subcapsular: >50% surface area or expanding or ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma >10 cm or expanding
- Grade III Laceration: >3 cm parenchymal depth
- Grade IV Laceration: Parenchymal disruption involving 25-75% of hepatic lobe or 1-3 Couinaud segments
- Grade V Laceration: Parenchymal disruption of >75 percent of a hepatic lobe, >3 segments within a single lobe. Vascular: juxtahepatic venous injuries (retrohepatic vena cava, central major hepatic veins)
- Grade VI – Hepatic avulsion

SPLEEN

- Grade I Hematoma: Subcapsular: <10% surface area
- Grade I Laceration: Capsular tear: <1 cm parenchymal depth
- Grade II Hematoma: Subcapsular: 10-50% surface area
- Grade II Laceration: Intraparenchymal: <5 cm in diameter; capsular tear, 1-3 cm parenchymal depth which does not involve a trabecular vessel
- Grade III Hematoma: Subcapsular: >50% surface area or expanding
- Grade III Laceration: Ruptured subcapsular or parenchymal hematoma: intraparenchymal hematoma >5 cm or expanding >3 cm parenchymal depth or involving trabecular vessels
- Grade IV Laceration: Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen)
- Grade V Laceration: Vascular: completely shattered spleen or hilar vascular injury which devascularizes spleen

GUIDELINES

1. Indications for operative management of liver and/or splenic injuries:
    a. Operative management should be considered when there is ongoing bleeding from the injury resulting in unstable vital signs or there is the possibility of other injuries.
        i. Markedly unstable patient with rapidly expanding abdomen or increasing rigidity.
        ii. Grossly positive peritoneal lavage.
        iii. Grade V injury on CT scan.
        iv. A "swirl" pattern on CT scan suggestive of ongoing bleeding.
        v. Gunshot wound to the abdomen in the RUQ or LUQ.
        vi. Use Massive Transfusion Protocol
        vii. Tranexamic acid (TXA) if onset blood loss < 3 hours

2. Operative management liver injury
    a. Transfer patient immediately to the operating room, have self-retaining retractors available.
    b. Prep from chin to mid-thigh; table to table.
    c. Generous midline incision from xiphoid to below the umbilicus.
    d. Pack the RUQ with multiple lap pads.
    e. Pack the other quadrants and check the mesentery for bleeding.
    f. Assess the bleeding from the liver.
        i. If the bleeding is brisk, clamp the porta hepatis with your finger or a non-crushing clamp (Pringle maneuver).
            a) If bleeding persists, consider hepatic vein injury or retrohepatic caval injury.
                i) Consider atrial-caval shunting.
                ii) Consider veno-veno bypass.
                iii) Consider resectional debridement to get to the vena cava and the branches of the hepatic veins.
                iv) Consider packing.
            b) If bleeding subsides:
                i) Control bleeding with suture ligaments.
                ii) Release Pringle maneuver and control major bleeding with suture ligatures.
                iii) Consider omental pack.
        ii. If bleeding subsides but worsens because of coagulopathy, consider packing.
            a) If bleeding is moderate but controllable with packs:
                i) Mobilize the liver:
                    1) Divide falciform ligaments.
                    2) Divide lateral triangular ligaments.
                    3) Rotate liver medially into wound.
                ii) Explore injury (but do not worsen it).

iii) Control bleeding with suture ligatures.
iv) Consider liver edge approximation with large absorbable sutures.
v) Consider omental pack.

iii. If bleeding is controllable but then worsens because of coagulopathy, then consider packing.

g. When hepatic hemorrhage is controlled, explore the rest of the abdomen with particular attention to porta hepatis, duodenum, pancreas and right colon.
h. Drain liver if lacerations are deep and there is possibility of bile leak and fluid collection.
i. If packs are placed, they should be removed in 24-48 hours. Prepare for this procedure with the availability of autotransfusion, the argon beam coagulator and blood products.
j. If packs are placed, consider empiric antibiotic therapy while packs are in place.

3. Operative management splenic injuries - Failures (requires laparotomy)
   a. Children: requires >40 ml/kg of blood transfusion to maintain hematocrit >26%.
   b. Adults: requires 2 units of blood to maintain hematocrit >26% in the absence of other injuries.
   c. Any patient: new onset of diffuse peritoneal irritation suggestive of perforated viscus.
   d. If splenectomy is required, administer vaccines on post op Day 1
      i. Pneumococcus vaccine (Pneumovax)
      ii. Meningococcus vaccine
      iii. *Hemophilus influenzae* vaccine

4. Pitfalls
   a. Fever and/or jaundice – consider biloma.
      i. CT scan to confirm.
      ii. Percutaneous drainage.
      iii. Consider ERCP with stent placement and/or sphincterotomy.
   b. UGI bleed two to four weeks after injury – consider hemobilia.
      i. CT scan to confirm large intrahepatic injury or clot.
      ii. Angiography to confirm etiology.
      iii. Angiographic embolization of vessel.
      iv. Do not explore for hemobilia.
   c. Hypotension, drop in hematocrit seven to ten days after non-operative management of severe liver injury
      i. Repeat bleed, usually arterial.
      ii. Admit to ICU, stabilize.
      iii. Angiography to confirm etiology.
      iv. Angiographic embolization of the vessel.
      v. Attempt to avoid exploration at this time.

REFERENCES:

- Deaconess Trauma Guideline Manual, PENETRATING INJURIES TO THE ABDOMEN.
- Deaconess Trauma Guideline Manual, BLUNT ABDOMINAL TRAUMA.
- Deaconess Trauma Guideline Manual, DIAGNOSTIC PERITONEAL LAVAGE.
- Christmas AB, Jacobs DG. Management of hepatic trauma in adults. *UpToDate*. Nov 24, 2015
- Maung AA, Kaplan LJ. Management of splenic injury in the adult trauma patient. *UpToDate*. Apr 27, 2016

REVIEWED DATE	**REVISED DATE**
JAN 2005	JAN 2008
JAN 2006	SEP 2012
JAN 2007	AUG 2016
OCT 2011	
AUG 2014	
JUL 2016	
JAN 2017	
JAN 2018	
JAN 2019	
AUG 2020	
JUNE 2021	