



AAST Acute Care Surgery Didactic Curriculum

Penetrating Liver Injury

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Blunt liver injury

Highlights:

- Blunt trauma patients with a positive FAST or DPA who remain hemodynamically unstable after resuscitation should go directly to the operating room for exploration
- Most low-grade liver injuries (Grade I and II) can be managed non-operatively with a period of serial clinical observation and hemoglobin monitoring
- High-grade liver injuries (Grade III, IV, V) without hemodynamic instability may also undergo a trial of non-operative management but have a higher rate of morbidity and non-operative management failure. At minimum they require ICU admission for close monitoring and may require further intervention (angioembolization, interventional radiology percutaneous drainage, and operative intervention)

Penetrating liver injury

Highlights:

- Non-operative management of penetrating liver injuries may be attempted if the patient has an isolated liver injury and no evidence to suggest injury to other abdominal structures (e.g. CT showing an injury trajectory only involving the liver and no radiographic or clinical signs concerning for extra-hepatic injury).
- Principles are similar to blunt injury management.

Approach to liver hemorrhage

Highlights:

- Select hemodynamically unstable patients who respond to transfusion and to whom there are no other indications for operative therapy may be managed with an angiography first approach.
- Operative hemorrhage control for liver injury should start with packing. If packing fails to control bleeding, a Pringle maneuver should be performed. If a Pringle maneuver controls bleeding, the source of bleeding is most likely hepatic parenchymal, hepatic arterial, or portal.
 - Manual compression and re-packing may first be attempted.
 - If recurrent bleeding with Pringle removal occurs then on table angiography with embolization, direct exploration and vessel ligation, or rapid transfer to an angiography capable room will be required.

- Bleeding from deep within the liver parenchyma may require tractotomy (hepatotomy) for better visualization and access should surgical ligation be necessary.
- If packing and Pringle maneuver does not control liver bleeding, the bleeding source is most likely retrohepatic or involving the hepatic veins. Early identification and rapid intervention is necessary for a successful outcome as patients with severe physiologic derangement are unlikely to tolerate the steps necessary for successful repair.
 - Strongly consider calling in an additional surgeon(s)
 - Upper extremity vascular access should be obtained by the Anesthesia team.
 - Manual compression of the liver posteriorly toward the spine should first be done. If successful in controlling hemorrhage then repeat packing after a period of hemostasis with compression should be attempted.
 - If unsuccessful then rapid hepatic vascular isolation should be obtained. Suprarenal and supra-hepatic IVC control should be obtained. Supra-hepatic control is most rapidly achieved by median sternotomy and intra-cardiac control.
 - An alternative to operative control may be resuscitative endovascular control of the vena cava with a bridging balloon in the retrohepatic position
 - If bleeding continues despite venous isolation or because only infra-renal IVC control can be obtained then supra-celiac aortic control with a vascular clamp or REBOA should be performed.
 - When available, extracorporeal veno-venous bypass from the femoral vein to the right atrium may allow tolerance of total hepatic isolation.

Role of Angioembolization

Highlights:

- Angioembolization is a well accepted adjunctive management technique for liver hemorrhage control. However, its best use remains controversial. Studies have demonstrated a mortality benefit from liver angioembolization, however it is associated with a high morbidity rate.
- The presence of a contrast blush in the liver on CT imaging does not mandate angioembolization for all patients.
- The strongest indications for angioembolization are (1) the presence of a contrast blush on CT with evidence of ongoing hemorrhage in a clinically stable patient, and (2) as an adjunct for hemorrhage control in patients with high-grade liver injuries undergoing operative intervention (e.g. bleeding from deep liver parenchyma)
- The most common complication of angioembolization is hepatic necrosis, which has been documented to be as high as 40% of patients undergoing the procedure in the setting of hepatic trauma.

NOM complications and management

Highlights:

- Non-operative management has a high success rate for most patients with liver trauma.
- The most common complications of non-operative management involve bleeding (delayed hemorrhage, hemobilia), bile leaks (bile leak, bilious ascites, bile peritonitis), infection (hepatic abscess), and ischemia (hepatic necrosis).
- The main signs of failure of non-operative management are the development of clinical symptoms: fever / sepsis, peritonitis, clinical instability, worsened pain, jaundice, GI bleed.

Follow Up

Highlights:

- The role of routine repeat imaging in high grade liver injuries is controversial. Recent guidelines suggest reserving repeat imaging to investigate clinical changes or symptoms. However, there have been studies that have demonstrated that routine interval imaging in high grade injuries that undergo either operative or nonoperative management leads to the diagnosis of vascular injury (pseudoaneurysm and AV fistula) that undergo intervention in up to 17% of patients.
- The duration of activity limitations to prevent rebleeding is unclear. The American Surgical Association has developed guidelines that recommend grade + 2 weeks. Activity limitation restrictions should be tailored to the grade of injury, patient age comorbidities, the risk of activity / occupation, and need for antithrombotic therapy. Interval imaging demonstrating injury healing may help delineate the appropriate time to return of activities.