MANAGEMENT OF PENETRATING LIVER TRAUMA
CASE PRESENTATION

- 17 year old male GSW to right paraspinal back below scapula, GSW left forearm through and through, GSW left hip below ASIS, bullet palpated,

- Primary survey - tachycardic to 120s, peritoneal abdomen

- Secondary survey - no hard signs of vascular injury, distal radial pulse, motor and sensation intact
INTRA-OP

- Rushed to OR as level 1 for crash laparotomy
- Evacuated 1L dark blood clots
- Hole in right diaphragm, repaired primarily
- Placed right chest tube
- Grade 4 liver injury, posterior right lobe blast injury
INTRA-OP CONTINUED

- Eviscerated and ran the bowel
- Mobilized and divided the falciform ligament
- Packed liver with lap pads and Nu-Knit over injured area
- Temporary abdominal closure
- Received: 6 RBC 6 FFP 2 Platelets
POST-OP COURSE

- Transferred to SICU
- Hypertensive - systolic 150s
- Intermittently tachycardic to 130-140s
- Transiently responded to 2 PRBC and 2 FFP
- Continued output from Barker vac approaching 100-200cc/hr
- Concern for ongoing hepatic bleeding
ANGIOGRAM

- Contrast blush in segment 7 or 8 represents extravasation
- Other small focal collections of contrast seen scattered through right lobe
- Angioembolization performed of right hepatic artery with gel-foam
HOSPITAL COURSE

- Planned take back POD3, removal of hepatic packs, Blake drain and JP drain placed, abdomen closed
- POD4 patient extubated, chest tube d/c’ed
- Blake drain approximately 100-200cc/24hr bilious fluid
- POD 9 JP less than 20cc/24hr serosanguinous JP d/c’ed
- POD14 CT scan showed a small necrotic patch of liver. HIDA scan showed active extravasation of bile
HOSPITAL COURSE

- POD 15 underwent ERCP, unable to stent or perform sphincterotomy
- POD 21 drain continued output ~100cc/24hr, afebrile, benign abdomen, wbc and liver enzymes normalized - d/c’ed home with follow up in clinic
Any Questions?
“IF TRAUMA SURGERY IS A CONTACT SPORT, THE BADLY INJURED LIVER IS THE NINJA MASTER: A VICIOUS, CUNNING AND LETHAL ADVERSARY.”
-TOP KNIFE
PENETRATING LIVER TRAUMA

- Liver anatomy
- Grading
- Background
- Decision making
- Management
ANATOMY

Source: Mattox KL, Moore EE, Feliciano DV: Trauma, 7th Edition:
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ANATOMY
<table>
<thead>
<tr>
<th>GRADE</th>
<th>INJURY DESCRIPTION</th>
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<tbody>
<tr>
<td>1</td>
<td>Subcapsular hematoma, &lt;10% surface area; Capsular tear, &lt;1 cm parenchymal depth</td>
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<tr>
<td>2</td>
<td>Subcapsular hematoma, 10%-15% surface area; Intraparenchymal, &lt;10 cm in diameter; Laceration 1-3 cm parenchymal depth, &lt;10 cm in length</td>
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<tr>
<td>3</td>
<td>Subcapsular hematoma, &gt;50% surface area or expanding; Ruptured subcapsular or parenchymal hematoma; Intraparenchymal hematoma &gt;10 cm or expanding; Laceration &gt;3 cm parenchymal depth</td>
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<tr>
<td>4</td>
<td>Parenchymal disruption involving 25% to 75% of hepatic lobe or 1-3 Couinaud’s segments within a single lobe</td>
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<tr>
<td>5</td>
<td>Parenchymal disruption involving &gt;75% of hepatic lobe or &gt;3 Couinaud’s segments within a single lobe; Vascular juxtahepatic venous injuries; i.e., retrohepatic vena cava/central major hepatic veins</td>
</tr>
<tr>
<td>6</td>
<td>Vascular hepatic avulsion</td>
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HISTORICAL PERSPECTIVE

- Change in paradigm over last 30 years
- Decline in operative liver trauma and decline in mortality
- 1960 Shaftan Kings County - Landmark study on penetrating abdominal trauma and unnecessary laparotomies
- 1986 Kings County - utility of CT scan in hemodynamically stable penetrating trauma to flank and back
- 1986 Demetriades et al. documented nonoperative management of liver injuries
BACKGROUND

- Incidence of penetrating trauma decreasing from 75% in 2000 to 20% in 2010
- The liver is most frequently injured intraabdominal organ
- Now only 13.7% of liver injuries are managed operatively

THE SITUATION

- Non op vs. operative management
- Low numbers of operative management and less high grade injuries
- High grade liver injury - how do you manage?
Practice Management Guidelines for Selective Nonoperative Management of Penetrating Abdominal Trauma

John J. Como, MD, Faran Bokhari, MD, William C. Chiu, MD, Therese M. Duane, MD, Michele R. Holevar, MD, Margaret A. Tandoh, MD, Rao R. Ivatury, MD, and Thomas M. Scalea, MD

- Literature review from 1960 to 2007

- Recommendations

  - Hemodynamically unstable or peritonitis should be taken for laparotomy (level 1)

  - Hemodynamically stable with unreliable clinical exam warrants further investigation or laparotomy (level 1)

  - Laparotomy not indicated in stable patients with stab wounds without signs of peritonitis (level 2)

  - Laparotomy not indicated in stable patients with GSW if wounds are tangential and without signs of peritonitis (level 2)

  - Patients selected for NOM, abdominopelvic CT should be strongly considered as a diagnostic tool (level 2)

  - Patients with penetrating injury isolated to RUQ may be managed without laparotomy in presence of stable vital signs, reliable exam, and minimal to no abdominal tenderness (level 3)
You’ve made the decision to operate on a patient with a liver injury

Staring at a high grade IV injury to right hepatic lobe after a gun shot wound… How do you proceed?
INTRAOP MANAGEMENT
Obtain temporary control of bleeding

- Manual compression, temporary packing, Pringle maneuver
- How do you perform a Pringle Maneuver?
- Lesser omentum is opened, enter the foramen of Winslow and the hepatoduodenal ligament encircled
Continued arterial bleeding despite Pringle

- What is next step?

- Supraceliac aortic clamping

- Dark blood from posterior liver - retrohepatic venous injury

Figure 3-37: Supraceliac aortic compression can buy some time for resuscitation efforts.
TOTAL VASCULAR CONTROL

- FOR CONTROL OF INFRA HEPATIC IVC - EXTENDED KOCHER MANEUVER MAY MOBILIZE KIDNEY FOR POSTERIOR UPPER IVC ADRENAL VEIN
SUPRAHEPATIC IVC
CONTROL

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MOBILIZE THE INJURED LOBE

- Unless dealing with anterior laceration, the injured lobe must be delivered to midline.
- To mobilize left lobe, divide the falciform, divide the left triangular ligament.
- To mobilize the right lobe, incise the right triangular ligament up to the anterior coronary ligament.
- Any suspicion for retrohepatic venous injury, don't mobilize the liver.
MORE EXPOSURE?

- If needed for added exposure, convert midline laparotomy into Chevron, or Kocher
- Thompson retractor or Omni retractor
SMALL PROBLEM OR BIG PROBLEM?

- Small problems - liver injuries may be fixed with a simple maneuver
  - electrocautery, liver stitch, local hemostatic agent
- Big problem
  - Damage control mode
  - Focus is on rapid control of hemorrhage
  - Preservation of the patient’s physiology
OPTIONS FOR HEMOSTASIS

- Liver packing
- Immediate postoperative angiography
- Deep liver sutures
- Total vascular exclusion
- Balloon tamponade
HEPATOTOMY WITH SELECTIVE VASCULAR LIGATION

- Pringle
- Extend laceration with cautery
- Open parenchyma
- Deaver retractors to facilitate exposure
- Finger fracture leaves ductal structures
- Hemoclip, suture ligate bleeders
RESECTIONAL DEBRIDEMENT

- Evaluation of lobe - if destroyed and bleeding profusely - debridement
- Mobilize, and encircle the injured area
- Resect immediately outside the injured area, never resect within injured tissue
- Don’t attempt in a patient rapidly dying on operating table
BILE DUCT INJURY

- Damage control solution - external drainage
  - Cannulate proximal duct to abdominal wall
  - Drain in Morrison’s pouch
- Definitive repair - simple repair and t tube or Roux-en-Y hepaticojejunostomy
ROLE OF ANGIOEMBOLIZATION

- Ability to diagnose vascular lesions deep in parenchyma.
- Can achieve hemostasis without need for laparotomy and blood loss.
- Generally accepted guidelines.
  - Higher grade of hepatic injury.
  - Part of multidisciplinary strategy when using damage control.
  - After perihepatic packing tamponades nonsurgical bleeding, AE can be key for final hemostasis and prevent rebleeding at time of unpacking.

Scalea, T. Angioembolization, Hepatic. Shock Trauma Center, University of Maryland School of Medicine, Baltimore, MD.
3 year retrospective review

37 DC patients

Compared 8 DC laparotomy and angio to 11 DC laparotomy alone

Endpoints - death, intraabominal processes, ARDS, MODS, ARF

All DC/angio survived while 10/11 DC alone survived to second operation

Integration of AE represents a logical extension of modern damage control technique, and can be safely performed in select patients in damage control scenario.
TAKE HOME POINTS

- PENETRATING TRAUMA TO ABDOMEN - HEMODYNAMIC INSTABILITY OR PERITONITIS WARRANTS LAPAROTOMY

- OBTAIN INFLOW CONTROL WITH PRINGLE MANEUVER AND OUTFLOW CONTROL WITH SUPRA AND INFRA HEPATIC IVC CLAMPING

- AWARENESS OF ABERRANT ARTERIAL ANATOMY KEY FOR VASCULAR CONTROL

- HIGH GRADE LIVER TRAUMA THAT REQUIRES OPERATIVE INTERVENTION, LIVER PACKING IS AN EFFECTIVE OPTION

- DO NOT DIVIDE Already INJURED LIVER WHEN PERFORMING SELECTIVE VASCULAR LIGATION

- ANGIOEMBOLIZATION IS A USEFUL ADJUNCT FOR DAMAGE CONTROL
REFERENCES


- AAST Organ Injury Scale Liver/spleen • The American College of Surgeons. Committee on Trauma. • American Association for the Surgery of Trauma