

# 6. Abdominal Trauma

Educational materials and pathways regarding the evaluation and management of abdominal injuries.

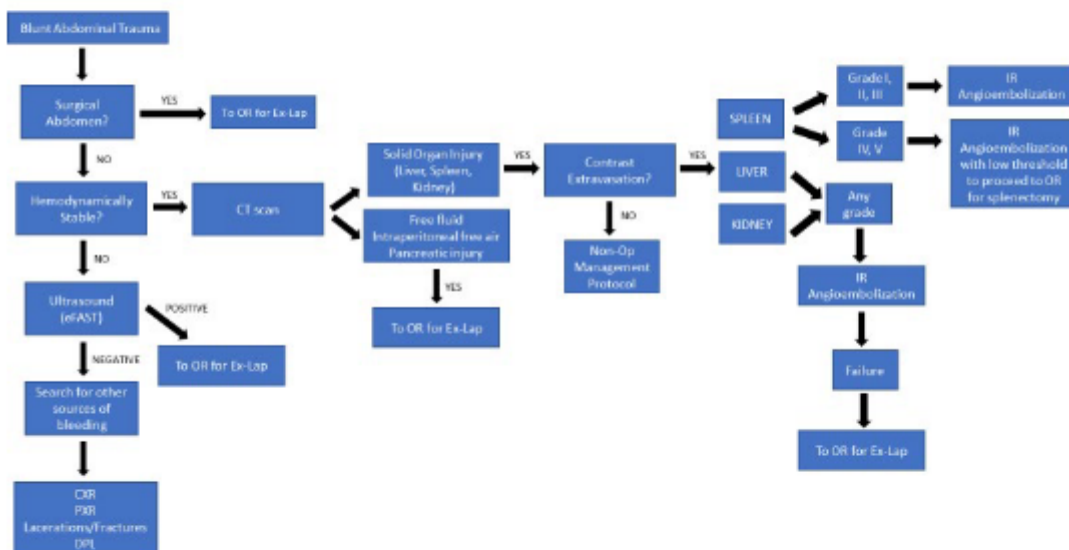
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# Blunt Abdominal Trauma

## BLUNT ABDOMINAL TRAUMA

This document provides an overview of considerations and guidelines that are important in the evaluation and management of patients with blunt abdominal trauma. It is not intended to be used as a rigid set of treatment instructions but rather provide recommendations and guidelines based on current literature. The management of blunt abdominal trauma must be individualized based on each patient's clinical situation and the clinical judgement of the providers responsible for directing this aspect of patient care.

### Blunt abdominal trauma algorithm



### REFERENCES:

1. Hoff WS, Holevar M, Nagy KK et. al. Practice management guidelines for the evaluation of blunt abdominal trauma: The EAST practice management guidelines work group. *J Trauma*. 2002;53: 602-614.

# Evaluation and Management of Blunt Splenic Injury

## Purpose

Splenic injury is one of the most common injuries following blunt abdominal trauma and can result in significant bleeding given the vascular nature of this organ. Unrecognized injury can be a cause of preventable death following trauma. The following guidelines outline the approach that should be taken when evaluating and managing a trauma patient with splenic injury and the decision-making process between operative and non-operative management.

## Background/Definitions

During the last century, management of blunt splenic injury has shifted from observation/expectant management in the early 1900s to operative intervention for all injuries, to the current practice of selective operative and non-operative management of splenic injury. The current non-operative paradigm in adults was stimulated by the success of non-operative management of solid-organ injuries in hemodynamically stable children. The potential advantages of non-operative management include lower hospital cost, earlier discharge, avoiding nontherapeutic laparotomies (as well as associated cost and morbidity), fewer intra-abdominal complications, and reduced transfusion rates associated with an overall mortality of these injuries. While the non-operative approach to blunt splenic injury has been proven to work well in hemodynamically stable patients with lower grade injuries, there is still a role for operative and/or endovascular intervention in those patients who are hemodynamically unstable or those with higher grade injuries.

Splenic injuries are classified by a grading system established by the AAST (American Association for the Surgery of Trauma). In general, the higher the grade equals more severe injury and potential for associated morbidity and mortality.

AAST Splenic Injury Grading Scale

Table 7

## Spleen Injury Scale (2018 revision)

Grade*	AIS Severity	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria
I	2	Subcapsular hematoma <10% surface area	Subcapsular hematoma <10% surface area	Subcapsular hematoma <10% surface area
		Parenchymal laceration <1 cm depth	Parenchymal laceration <1 cm depth	Parenchymal laceration <1 cm depth
		Capsular tear	Capsular tear	Capsular tear
II	2	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <5 cm	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <5 cm	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <5 cm
		Parenchymal laceration 1-3 cm	Parenchymal laceration 1-3 cm	Parenchymal laceration 1-3 cm
III	3	Subcapsular hematoma >50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm	Subcapsular hematoma >50% surface area or expanding; ruptured subcapsular or intraparenchymal hematoma ≥5 cm	Subcapsular hematoma >50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm
		Parenchymal laceration >3 cm depth	Parenchymal laceration >3 cm depth	Parenchymal laceration >3 cm depth
IV	4	Any injury in the presence of a splenic vascular injury or active bleeding confined within splenic capsule	Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization	Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization
		Parenchymal laceration involving segmental or hilar vessels producing >25% devascularization		
V	5	Any injury in the presence of a splenic vascular injury with active bleeding extended beyond the spleen into the peritoneum	Hilar vascular injury with devascularizes the spleen	Hilar vascular injury with devascularizes the spleen
		Shattered spleen	Shattered spleen	Shattered spleen

Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen. More than one grade of splenic injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to grade III.

From Kozar et al.; with permission

<https://www.aast.org/resources-detail/injury-scoring-scale#spleen>

## Guideline Inclusion Criteria

- All trauma patients sustaining blunt abdominal trauma should be evaluated for potential splenic injury.

## Guideline Exclusion Criteria

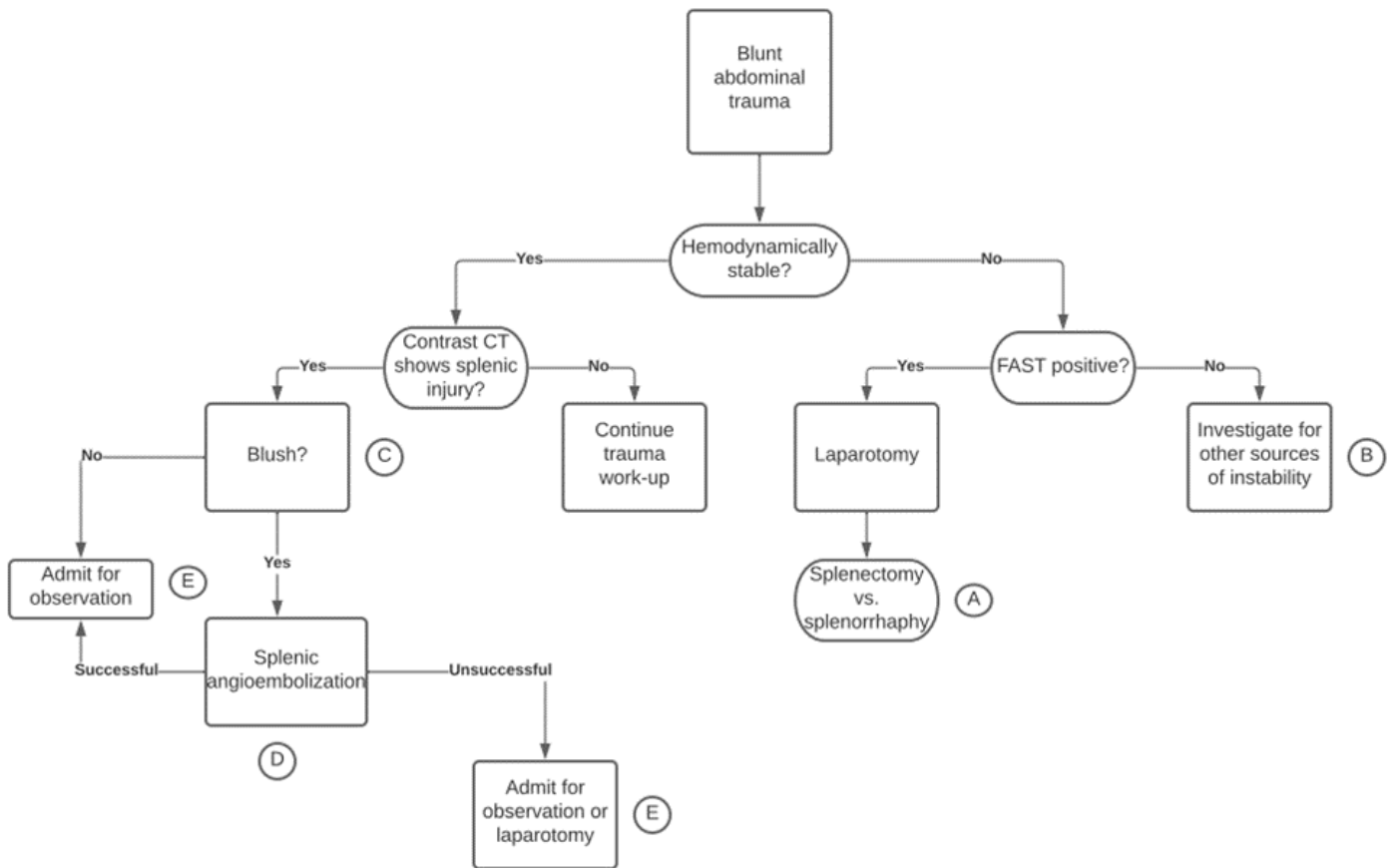
- Patients who no longer have a spleen.
- Pediatric patients <15 yrs age.

## Diagnostic Evaluation

- All trauma patients should be initially evaluated per ATLS guidelines with work-up as mechanism and clinical presentation dictate.
- Resuscitative measures should be initiated as clinical status/presentation dictates.
- Labs, imaging and additional tests should be obtained as clinical status/presentation dictates.
- If a patient is hemodynamically UNSTABLE, minimal testing/imaging should occur prior to interventions for hemorrhage control.

## Practice Recommendations for Management

- Once splenic injury is suspected and/or confirmed, management of that injury is dictated largely by the clinical status of the patient.
  - If a patient is hemodynamically **UNSTABLE**:
    - Initiate/continue resuscitative measures.
    - Obtain an eFAST exam.
    - If eFAST is positive, proceed to OR for surgical exploration.
  - If a patient is hemodynamically **STABLE**:
    - May continue with evaluation and work-up as mechanism and presentation dictate.
    - Obtain imaging as indicated, including a multi-phase CT abd/pelvis with IV contrast
    - Determine appropriate management strategy based on grade of injury, presence of blush/extravasation on imaging, and clinical status and injury burden of patient.



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- Operative Management

- Should be used in all patients who are hemodynamically unstable or those with peritonitis on exam.
- Should be considered in patients who are transient responders to resuscitation or in those with injury burden (head injury) in which hypotension secondary to hemorrhagic shock would be detrimental.
- Operative plan should be exploratory laparotomy for trauma with splenectomy vs splenorrhaphy.
  - Splenic salvage/splenorrhaphy may be considered in Grade I-II injuries depending on the clinical status of the patient.
  - Splenectomy should be performed in Grade III-V injuries or in patients with ongoing bleeding.

- IR Angioembolization

- Should be considered in patients who are transient responders to resuscitation, those with evidence of active extravasation/blush on CT abd/pelvis, those with high grade injuries (Grade III-V) or those with injury burden (e.g. head injury) in which hypotension secondary to hemorrhagic shock would be detrimental.

- Non-operative Management

- Non-operative management of splenic injuries should ONLY be considered in hemodynamically stable patients.

- Patients undergoing non-operative management should be monitored closely for deterioration in clinical status suggestive of ongoing hemorrhage (i.e. failure of non-operative management) with vitals per unit protocol, serial labs, abdominal exams and repeat imaging as indicated.
- Bedrest is not routinely indicated for blunt splenic injuries that are managed non-operatively. In general, patients may be activity as tolerated unless bedrest is required for a concurrent injury or at trauma attending discretion.
- Admission level of care will be at the trauma attending's discretion. In general, higher grade injuries (III, IV, V) should be initially monitored in the ICU or Step Down Unit and lower grade injuries (I, II) be initially monitored on the floor or Step Down Unit depending on clinical status and injury burden.
- Suggested non-operative management strategy is as follows:

## **Blunt Splenic Injury Management Guideline Nonoperative and Post-Splenic Angioembolization**

	<b>LOW GRADE</b>	<b>HIGH GRADE</b>
<b>AAST GRADE</b>	<b>I &amp; II</b>	<b>III, IV, V</b>
ICU	No	Yes
Labs (CBC)	q12h until stable x2	q6h until stable x2
Monitoring	Vital signs q4h	Continuous HR with q1h BP
Diet	Clear liquid diet x12h	NPO x12h
DVT prophylaxis	Start within 24h in the absence of a major hemorrhagic component	Start within 24-48h of stable hemoglobin
Follow-up CT scan	Clinical change or decrease in Hgb only	72 hours after injury
Discharge criteria (minimum admission time)	Stable Hgb, 24h from injury and tolerating po	Stable CT, stable Hgb, and tolerating po
Return to normal activity	2 weeks (6 weeks for all sports) and strenuous activity	4 weeks (minimum 6 weeks for all sports based on clinical judgement) and strenuous activity

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- Repeat imaging for splenic injuries managed non-operatively
  - A repeat multi-phase CT abd/pelvis with IV contrast should be obtained for all Grade III or higher splenic injuries between 3-5 days post injury or prior to discharge to evaluate for development of post-

traumatic pseudoaneurysms.

- If pseudoaneurysms are present, then IR should be consulted for consideration of splenic angioembolization.

- Follow-up Care:

- Post splenectomy vaccines
  - Patients undergoing splenectomy as management of their splenic injury should obtain the following vaccines prior to discharge or at 14 days post-op (whichever date comes first)
    - Quadravalent meningococcus (Menactra or Menomune)
    - Pneumococcus (Pneumovax 23)
    - H.influenzae B (HIB, ActHIB)
    - Viral influenza vaccine (depending on time of year)
  - Patients undergoing splenic angioembolization do not routinely require vaccinations.
- All patients with splenic injury should follow-up in trauma clinic 1-2 weeks following discharge pending clinical status at time of discharge and hospital length of stay following injury.

## Outcome Measures and Guideline Adherence

- Time to OR/IR and interventions for all hemodynamically unstable patients will be tracked through our performance improvement process/initiatives.
- Patients failing non-operative management (i.e. those requiring IR angioembolization or exploratory laparotomy in a delayed fashion) will be tracked through our performance improvement process/initiatives.
- Adherence to obtaining repeat imaging for Grade III or higher splenic injuries at post-injury day 3-5 and need for subsequent interventions will be assessed every 6 months.

## Key Contributors

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## Last Updated

July, 2023

## References

1. Stassen NA, Bhullar I, Cheng JD, et. al. Selective nonoperative management of blunt splenic injury: An Eastern Association for the Surgery of Trauma practice management guidelines. *J Trauma Acute Care Surg.* 2012;73(5): S294-300.
2. Rowell SE, Biffi WL, Brasel K, et. al. Western Trauma Association critical decisions in trauma: Management of adult blunt splenic trauma—2016 updates. *J Trauma Acute Care Surg.* 2016; 82(4): 787-93.

3. Wallen TE, Clark K, Baucom MR, et al. Delayed splenic pseudoaneurysm identification with surveillance imaging. *J Trauma Acute Care Surg.* 2022;93(1):113-117.
4. Freeman JJ, Yorkgitis BK, Haines K, et al. Vaccination after spleen embolization: A practice management guideline from the Eastern Association for the Surgery of Trauma. *Injury.* 2022;53(11):3569-3574.

# Evaluation and Management of Hepatic Injury

## Purpose

The liver is the most frequently injured abdominal organ. Most injuries are minor and can heal spontaneously without operative management. Unrecognized injury can be a cause of preventable death following trauma. The following guidelines outline the approach that should be taken when evaluating and managing a trauma patient with hepatic injury and the decision-making process between operative and non-operative management.

## Background/Definitions

During the last century, the management of blunt force trauma to the liver has changed dramatically. A shift away from operative management has resulted in a decline in mortality. The current nonoperative paradigm in adults was encouraged by the success of nonoperative management of solid organ injuries in hemodynamically stable children. As early as 1960, Shaftan advocated “observant and expectant treatment” rather than mandatory laparotomy in the management of penetrating abdominal injury. This was reinforced in 1969 by Nance and Cohn for the management of abdominal stab wounds. The advantages of nonoperative management include lower hospital cost, earlier discharge, avoiding nontherapeutic laparotomies, fewer intra-abdominal complications, and reduced transfusion rates. Gunshot wounds to the abdomen, however, are still commonly treated with mandatory exploration because of multiple reports emphasizing a high incidence of intra-abdominal injuries and the complications of a missed injury or an injury delayed in recognition and treatment. Multiple studies and review of National Trauma database have demonstrated that only 13.7% of hepatic injuries are now managed operatively. Complications develop in 2.5 to 41% of all trauma patients undergoing unnecessary laparotomy, and small bowel obstruction, pneumothorax, ileus, wound infection, myocardial infarction, visceral injury, and even death have been reported secondary to unnecessary laparotomy. It is important to recognize the importance of different mechanisms of penetrating injury (stab versus gunshot versus shotgun wounds), the velocity of the agent (low versus high) as well as the different regions of the abdomen (intraperitoneal, retroperitoneal, and thoracoabdominal areas).

These issues were first addressed by the Eastern Association for the Surgery of Trauma (EAST) in the Practice Management Guidelines for Non-operative Management of Blunt Injury to the Liver and Spleen published online in 2003. The practice management guideline update was split into separate recommendations for the nonoperative management of blunt hepatic and splenic injuries in adult trauma patients, with the last set of guidelines being published in 2012 for blunt hepatic injuries and in 2010 for penetrating injuries.

Hepatic injuries are classified by a grading system established by the AAST (American Association for the Surgery of Trauma). In general, the higher the grade equals more severe injury and potential for associated morbidity and mortality.

Table 8

## Liver Injury Scale (2018 revision)

AAST Grade	AIS Severity	Imaging Criteria (CT Findings)	Operative Criteria	Pathologic Criteria
I	2	Subcapsular hematoma <10% surface area Parenchymal laceration <1 cm depth	Subcapsular hematoma <10% surface area Parenchymal laceration <1 cm depth Capsular tear	Subcapsular hematoma <10% surface area Parenchymal laceration <1 cm depth Capsular tear
II	2	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <10 cm in diameter  Laceration 1-3 cm in depth and ≤10 cm length	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <10 cm in diameter  Laceration 1-3 cm in depth and ≤10 cm length	Subcapsular hematoma 10-50% surface area; intraparenchymal hematoma <10 cm in diameter  Laceration 1-3 cm in depth and ≤10 cm length
III	3	Subcapsular hematoma >50% surface area; ruptured subcapsular or parenchymal hematoma Intraparenchymal laceration >10 cm Laceration >3 cm depth Any injury in the presence of a liver vascular injury or active bleeding contained within liver parenchyma	Subcapsular hematoma >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma Intraparenchymal hematoma >10 cm Laceration >3 cm depth	Subcapsular hematoma >50% surface area; ruptured subcapsular or intraparenchymal hematoma Intraparenchymal hematoma >10 cm Laceration >3 cm depth
IV	4	Parenchymal disruption involving 25-75% of a hepatic lobe  Active bleeding extending beyond the liver parenchyma into the peritoneum	Parenchymal disruption involving 25-75% of a hepatic lobe	Parenchymal disruption involving 25-75% of a hepatic lobe
V	5	Parenchymal disruption >75% of hepatic lobe Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins	Parenchymal disruption >75% of hepatic lobe Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins	Parenchymal disruption >75% of hepatic lobe Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins

Vascular injury is defined as a pseudoaneurysm or arteriovenous fistula and appears as a focal collection of vascular contrast that decreases in attenuation with delayed imaging. Active bleeding from a vascular injury presents as vascular contrast, focal or diffuse, that increases in size or attenuation in delayed phase. Vascular thrombosis can lead to organ infarction.

Grade based on highest grade assessment made on imaging, at operation or on pathologic specimen.

More than one grade of liver injury may be present and should be classified by the higher grade of injury.

Advance one grade for multiple injuries up to grade III.

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<https://www.aast.org/resources-detail/injury-scoring-scale#liver>

## Guideline Inclusion Criteria

- All trauma patients sustaining abdominal trauma should be evaluated for potential hepatic injury.

## Guideline Exclusion Criteria

- Pediatric patients <15 yrs of age.

## Diagnostic Evaluation

- All trauma patients should be initially evaluated per ATLS guidelines with work-up as mechanism and clinical presentation dictate.
- Resuscitative measures should be initiated as clinical status/presentation dictates.
- Labs, imaging and additional tests should be obtained as clinical status/presentation dictates.
- If a patient is hemodynamically UNSTABLE, minimal testing/imaging should occur prior to interventions for hemorrhage control.

## Practice Recommendations for Management

- Once hepatic injury is suspected and/or confirmed, management of that injury is dictated largely by the clinical status of the patient.
  - If a patient is hemodynamically **UNSTABLE**:
    - Initiate/continue resuscitative measures.
    - Obtain an eFAST exam.
    - If eFAST is positive, proceed to OR for surgical exploration.
  - If a patient is hemodynamically **STABLE**:
    - May continue with evaluation and work-up as mechanism and presentation dictate.
    - Obtain imaging as indicated, including a multi-phase CT abd/pelvis with IV contrast.
    - Determine appropriate management strategy based on grade of injury, presence of blush/extravasation on imaging, and clinical status and injury burden of patient.
- Operative Management
  - Should be used in all patients who are hemodynamically unstable or those with peritonitis on exam.
  - Should be considered in patients who are transient responders to resuscitation or in those with injury burden in which hypotension secondary to hemorrhagic shock would be detrimental.
  - Operative plan should be exploratory laparotomy for trauma with consideration of cauterization, topical hemostatic agents, hepatorrhaphy or packing +/- endovascular procedures.
  - Diagnostic laparoscopy may be considered as a tool to evaluate diaphragmatic lacerations as well as peritoneal penetration.
  - In severe/high grade liver injuries, interventional radiology for angioembolization may also be considered for hemorrhage control in conjunction with operative interventions.
- IR Angioembolization

- Should be considered in patients who are transient responders to resuscitation, those with evidence of active extravasation/blush on CT abd/pelvis, those with high grade injuries (Grade III-V) or those with injury burden (e.g. head injury) in which hypotension secondary to hemorrhagic shock would be detrimental.
- Non-operative Management
  - Non-operative management of hepatic injuries should ONLY be considered in hemodynamically stable patients.
  - Patients with penetrating injury isolated to the right upper quadrant of the abdomen may be managed without laparotomy in the presence of stable vital signs, reliable examination and minimal to no abdominal tenderness.
  - The severity of hepatic injury (as suggested by CT grade or degree of hemoperitoneum), neurologic status, age of more than 55 years, and/or the presence of associated injuries are not absolute contraindications to a trial of nonoperative management in a hemodynamically stable patient.
  - Patients undergoing non-operative management should be monitored closely for deterioration in clinical status suggestive of ongoing hemorrhage (i.e. failure of non-operative management) with vitals per unit protocol, serial labs, abdominal exams and repeat imaging as indicated.
  - Interventional modalities including endoscopic retrograde cholangiopancreatography (ERCP), angiography, laparoscopy, or percutaneous drainage may be required to manage complications (bile leak, biloma, bile peritonitis, bilious ascities, and hemobilia)
  - Bedrest is not routinely indicated for blunt hepatic injuries that are managed non-operatively. In general, patients may be activity as tolerated unless bedrest is required for a concurrent injury or at trauma attending's discretion.
  - Admission level of care will be at the trauma attending's discretion. In general, higher grade injuries (III, IV, V) should initially be monitored in the ICU or Step Down Unit and lower grade injuries (I, II) be initially monitored on the floor or Step Down Unit depending on the clinical status and injury burden of the patient.
  - Suggested non-operative management strategy is as follows (Table 1):

Table1. Blunt Hepatic Injury Guidelines for Nonoperative and Postintervention Management

AAST GRADE	LOW GRADE	HIGH GRADE
	I & II	III, IV, & V
ICU	No	Yes—24h minimum (*Select high-grade injuries without evidence of hemorrhage may not require ICU admission*)
Labs (CBC)	Q12h until stable x 2	Q6h until stable x 2
Monitoring	Vital signs q4h	Vital signs q1h
Diet	Clear liquid diet x 12h	NPO x 12h
VTE prophylaxis	Start within 24h of stable hemoglobin (Hgb)	Start within 24-48h of stable Hgb
Follow-up CT scan	Clinical change (sepsis, abdominal pain, jaundice) or laboratory change (elevated transaminases or decrease in Hgb) only	72 hrs after injury or prior to discharge (evaluate for <u>psuedoaneurysms</u> , AV fistula, biliary issues) AND with clinical/laboratory change needed
<u>Biloma</u> /bile leak	ERCP/IR	ERCP/IR Surgical management if recurrent, failure of nonoperative management
Abscess	Drain/IR Surgical management if recurrent, failure of nonoperative management	Drain/IR Surgical management if recurrent, failure of nonoperative management
Discharge criteria (minimum admission time)	24 hrs from injury with stable Hgb and tolerating PO	72 hrs from injury with stable CT, stable Hgb and tolerating PO
Return to normal activity	2 weeks (6 weeks for all sports and strenuous activity)	4 weeks (minimum 6 weeks for all sports and strenuous activity based on clinical judgement)

- Repeat imaging for hepatic injuries managed non-operatively
  - Clinical factors such as a persistent systemic inflammatory response, increasing persistent abdominal pain, jaundice, or an otherwise unexplained drop in hemoglobin should prompt reevaluation by CT scan.
  - A repeat multi-phase CT abd/pelvis with IV contrast should be obtained for all Grade III or higher blunt hepatic injuries between 3-5 days post injury or prior to discharge to evaluate for development of post-traumatic pseudoaneurysms, AV fistulas or biliary issues.

Figure 1. Western Trauma Association algorithm for the diagnosis and management of blunt hepatic injury in adults. Circled letters correspond to lettered section in the articles text. OR, operating room; IR, interventional radiology. (Keric N, Shatz DV, Schellenberg M, et al. Adult blunt hepatic injury: A Western Trauma Association critical decisions algorithm. *J Trauma Acute Care Surg.* 2024 Jan 1;96(1):123-128. Doi:10.1097/TA.0000000000004141. Epub 2023 Sep 25. PMID: 37747241)

### Adult Blunt Hepatic Injury Algorithm

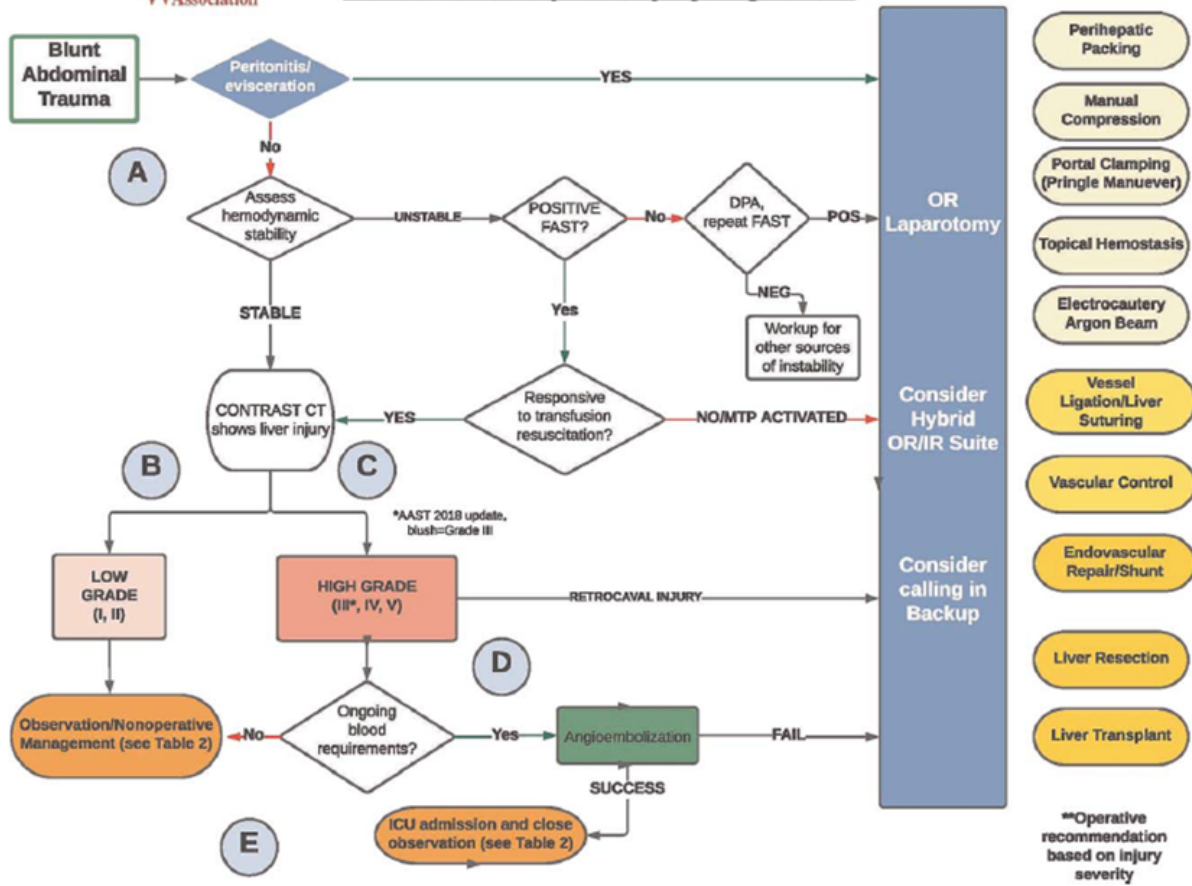
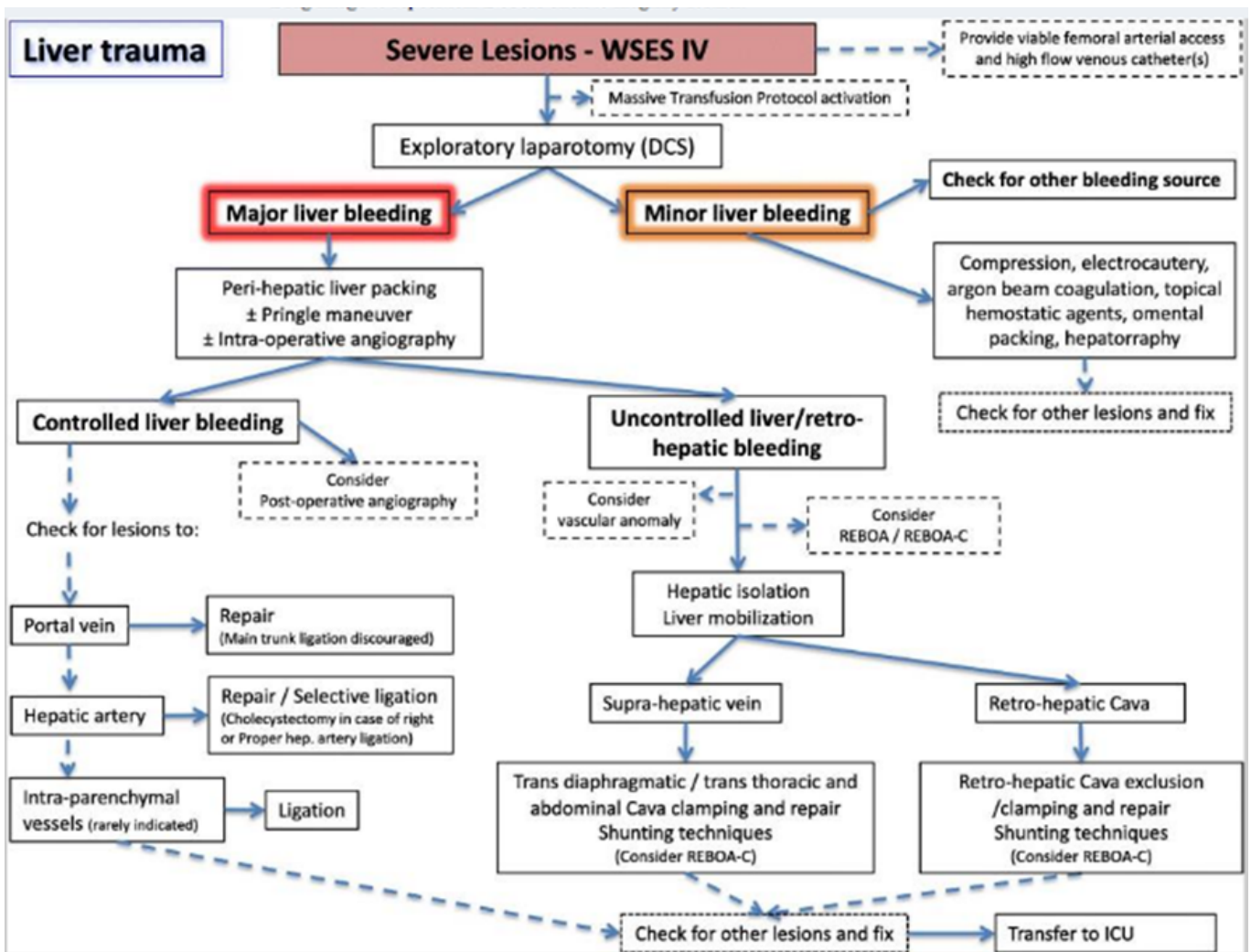


Figure 2. Operative management of blunt hepatic injury in adults.



- Follow-up Care
  - All patients with hepatic injury should follow-up in trauma clinic 1-2 weeks following discharge pending clinical status at time of discharge and hospital length of stay following injury.

## Outcome Measures and Guideline Adherence

- Time to OR/IR and interventions for all hemodynamically unstable patients will be tracked through our performance improvement process/initiatives.
- Patients failing non-operative management (i.e. those requiring IR angioembolization or exploratory laparotomy in a delayed fashion) will be tracked through our performance improvement process/initiatives.

## Key Contributors

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## Last Updated

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