



## Trauma Center Practice Management Guideline

**DISCLAIMER:** These guidelines were prepared by Trauma Services at Mission Hospital. They are intended to serve as a general statement regarding appropriate patient care practices based upon available medical literature and clinical expertise at the time of development. They should not be considered to be policy, nor are they intended to replace clinical judgment or dictate care of individual patients.

<b><u>Title:</u> Pediatric – Management of Abdominal Solid Organ Injuries</b>	
<b><u>Guideline Number:</u> 2PC.TSG.0020</b> <b><u>Page Number:</u> Page 1 of 8</b>	Effective: August 28, 2020 Last Reviewed: N/A
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### **Guideline Applicability:**

Trauma Center Practice Management Guideline for the care of the pediatric patient sustaining injuries to solid organs is applicable to MH Mission Hospital, LLLP, and other locations where services of the hospital are being provided.

### **Purpose:**

The majority of pediatric abdominal injuries are due to blunt trauma. The spleen and liver are the two most commonly injured organs in pediatric patients sustaining blunt abdominal trauma, and a majority can be managed non-operatively. Early recognition and standardized management are associated with improved outcomes. The following guideline has been established to facilitate standardized, evidence-based management of the pediatric trauma patient with an isolated abdominal solid organ injury.

### **Definitions:**

1. **Spleen injury:** The spleen is the most commonly injured abdominal organ in children. Injured patients may demonstrate left upper quadrant pain, left shoulder pain (“Kehr’s sign”), abdominal distention, and ecchymosis/abrasions to the left upper quadrant. Criteria for staging splenic injury should be based on the American Association for the Surgery of Trauma (AAST) splenic injury scale (Appendix A).
2. **Liver Injury:** The liver is the second most commonly injured intra-abdominal organ. Patients who sustain an injury to the liver frequently complain of abdominal pain and right shoulder pain. Criteria for staging liver injuries should be based on AAST liver injury scale (Appendix B).

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3. **Pancreas Injury:** Major pancreatic injuries less common than liver or spleen injuries. Clinical features include a history of direct blow to the epigastrium with local pain and tenderness on examination. Grading per Appendix C.

**Guideline Statements:**

1. Primary and secondary survey (see appendix D):
  - a. Initial evaluation of pediatric trauma patients should follow the standard Advanced Trauma Life Support protocol. Life-threatening injuries that compromise airway, breathing, and circulation should be addressed first. Assessment for abdominal injury should take place as part of the secondary survey.
  - b. The diagnosis of injuries to the liver, spleen, and pancreas should be made on the basis of clinical assessment by history and physical examination and confirmed by diagnostic imaging rather than injury grade.
  - c. The clinical features of solid organ injury may include findings of hypovolemic shock (eg, tachycardia, prolonged capillary refill time, pallor, altered mental status, decreased urine output, hypotension), abdominal contusions, or tenderness over the upper abdomen.
  - d. Hematologic studies, serum chemistries, and urinalysis are adjuncts to diagnosis and are not substitutes for clinical assessment and further imaging of children with suspected trauma to the liver, spleen, or pancreas.
  - e. Abdominal and pelvic CT with intravenous contrast is the preferred diagnostic imaging modality to detect intra-abdominal injury in hemodynamically stable children who have sustained blunt abdominal trauma. CT is sensitive and specific in diagnosing liver and spleen injuries, which may be managed nonoperatively. CT with intravenous contrast alone is less sensitive for detecting pancreas injuries.
    - 1) When a major pancreatic injury is suspected based upon CT findings, endoscopic retrograde cholangiopancreatography (ERCP) or magnetic resonance cholangiopancreatography (MRCP) may be used to confirm whether one of the major pancreatic ducts has been disrupted because the duct is generally not visualized on CT.
  - f. FAST (Focused Assessment and Sonography for Trauma) exam may be used as an adjunct/alternative in unstable patients to identify intraperitoneal fluid and may warrant immediate operative intervention in lieu of CT of the abdomen.
2. Hospital Course (see appendix D):
  - a. Length of stay and level of care for children with isolated solid organ injury should be based upon clinical presentation.
  - b. Hemodynamically stable patients can be admitted to general pediatric floor for monitoring of vital signs, hematocrit, and urinary output. Patients who are initially hemodynamically unstable or anemic should be admitted to intensive care unit.
  - c. In most instances, children with liver or spleen injuries are management non-operatively, but some patients may require operative intervention. Multiple studies find that the first 12 to 24 hours after injury is the most likely time for non-operative trial failure.
  - d. Hemodynamically unstable children with blunt abdominal injury who remain unstable following adequate resuscitation may warrant emergency exploratory laparotomy or in some patients, angioembolization.
    - 1) Arterial embolization is a useful tool in the non-operative management of solid organ injuries in patients with an arterial blush on imaging and hemodynamic compromise from ongoing bleeding. Prophylactic embolization in hemodynamically stable patients, even if an arterial blush is noted on imaging is not indicated.
  - e. Stable patients should have a shortened period of bed rest of 1 day or less with unchanged hemoglobin levels.
  - f. Transfusion threshold of 7/9 g/dl is reasonable for children undergoing non-operative management.
  - g. Other admission and monitoring criteria should be followed as outlined below:

Risk of injury progression or hemodynamic status	Low risk and/or hemodynamically stable	High risk and/or hemodynamically unstable
<b>Anticipated ED Disposition</b>	<ul style="list-style-type: none"> <li>▪ Pediatric Floor</li> </ul>	<ul style="list-style-type: none"> <li>▪ Pediatric ICU</li> </ul>
<b>Potential hospital LOS</b> <b>Potential ICU LOS</b>	<ul style="list-style-type: none"> <li>▪ 0-3 days</li> <li>▪ 0-1 days</li> </ul>	<ul style="list-style-type: none"> <li>▪ 2-6 or more days if additional injuries or risk factors</li> <li>▪ 1-3 or more days if additional injuries or risk factors</li> </ul>
<b>Labs</b>	<ul style="list-style-type: none"> <li>▪ Arrival, 12h, +/- 36h post injury, more frequently if drop noted</li> </ul>	<ul style="list-style-type: none"> <li>▪ Arrival, H&amp;H q4-6h until stable, then q12 for 24h then q24h until discharge</li> <li>▪ ROTEM if requiring blood products</li> </ul>
<b>Meds</b>	<ul style="list-style-type: none"> <li>▪ Tylenol 15mg/kg PO or PR q4h prn minor</li> <li>▪ Oxycodone 0.05-0.2 mg/kg PO q4h prn moderate</li> <li>▪ Call for severe pain</li> </ul>	<ul style="list-style-type: none"> <li>▪ Tylenol 15mg/kg PO or PR q4h prn</li> <li>▪ Oxycodone 0.05- 0.2 mg/kg PO q4h prn moderate</li> <li>▪ Morphine 0.1mg/kg q4h PRN</li> </ul>
<b>Assessment/Notify</b>	<ul style="list-style-type: none"> <li>▪ Qshift abdominal exam, vitals per unit protocol</li> <li>▪ Call for: hg drop 2 or more, HR &gt;100 or age range normal, systolic BP &lt;100 or age range normal, temperature &gt;100.4, RR &gt;24 or age range normal, hematuria, abdominal exam change, with increased pain, tenderness, rigidity or development of ecchymosis</li> </ul>	<ul style="list-style-type: none"> <li>▪ Q2h abdominal exam, cardiac monitor, vitals per unit protocol</li> <li>▪ Call for: hg drop 2 or more, HR &gt;100 or age range normal, systolic BP &lt;100 or age range normal, temperature &gt;100.4, RR &gt;24 or age range normal, hematuria, abdominal exam change, with increased pain, tenderness, rigidity or development of ecchymosis</li> </ul>
<b>Treatments</b>	<ul style="list-style-type: none"> <li>▪ Incentive Spirometer</li> <li>▪ Consider transfusion for hg &lt;7.0</li> </ul>	<ul style="list-style-type: none"> <li>▪ Incentive Spirometer</li> <li>▪ NGT/OGT, foley, CVC prn</li> <li>▪ Consider transfusion for hg &lt;7.0</li> </ul>
<b>Intervention</b>	<ul style="list-style-type: none"> <li>▪ Observation, non-op trial, serial exams</li> </ul>	<ul style="list-style-type: none"> <li>▪ Observation, non-op trial, serial exams, interventional radiology or surgery</li> </ul>
<b>Nutrition</b>	<ul style="list-style-type: none"> <li>▪ Clear liquids only, advance as tolerated</li> </ul>	<ul style="list-style-type: none"> <li>▪ NPO 1<sup>st</sup> 24h, advanced to clear liquids as tolerated</li> </ul>
<b>Discharge criteria</b>	<ul style="list-style-type: none"> <li>▪ Hemodynamic stability – stable H&amp;H on draws 12 hours apart</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hemodynamic stability – stable H&amp;H on draws 12 hours apart</li> <li>▪ Any other injuries or care issues addressed and stabilized</li> </ul>
<b>Discharge info</b>	<ul style="list-style-type: none"> <li>▪ D/C when hemodynamically stable</li> <li>▪ Restricted activity to grade of injury plus 2 weeks</li> </ul>	<ul style="list-style-type: none"> <li>▪ D/C when hemodynamically stable</li> <li>▪ Restricted activity to grade of injury plus 2 weeks</li> </ul>

3. Discharge:
  - a. Restricting activity to grade of injury plus 2 weeks is safe. Radiographic healing may not correlate with organ integrity.
  - b. Routine follow-up imaging for asymptomatic, uncomplicated, low grade injuries in children with solid organ injuries is not indicated. Imaging should be reserved for symptomatic patients at follow up.

#### **Quality Metrics:**

1. Patient Level Data: Overall volume and grade of injury
2. Operative Data: Failed non-operative management
3. Embolization Data: Failed embolization rate
4. Re-admissions: Patient who returned to hospital within 30 days and required admission

#### **References:**

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**Appendix A**

American Association for the Surgery of Trauma (AAST) splenic injury scale

AAST grade	Imaging criteria (CT findings)	Operative criteria	Pathologic criteria
I	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm depth</li> <li>▪ Capsular tear</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm depth</li> <li>▪ Capsular tear</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm depth</li> <li>▪ Capsular tear</li> </ul>
II	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;5 cm</li> <li>▪ Parenchymal laceration 1 to 3 cm</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;5 cm</li> <li>▪ Parenchymal laceration 1 to 3 cm</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;5 cm</li> <li>▪ Parenchymal laceration 1 to 3 cm, &lt;10 cm in length which does not involve a trabecular vessel</li> </ul>
III	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm</li> <li>▪ Parenchymal laceration &gt;3 cm depth</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area or expanding; ruptured subcapsular or intraparenchymal hematoma ≥5 cm</li> <li>▪ Parenchymal laceration &gt;3 cm depth</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area; ruptured subcapsular or intraparenchymal hematoma ≥5 cm or expanding</li> <li>▪ Parenchymal laceration &gt;3 cm depth or involving trabecular vessels</li> </ul>
IV	<ul style="list-style-type: none"> <li>▪ Any injury in the presence of a splenic vascular injury or active bleeding confined within splenic capsule</li> <li>▪ Parenchymal laceration involving segmental or hilar vessels producing &gt;25% devascularization</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal laceration involving segmental or hilar vessels producing &gt;25% devascularization</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal laceration involving segmental or hilar vessels producing &gt;25% devascularization</li> </ul>
V	<ul style="list-style-type: none"> <li>▪ Any injury in the presence of splenic vascular injury with active bleeding extending beyond the spleen into the peritoneum</li> <li>▪ Shattered spleen</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hilar vascular injury that devascularizes the spleen</li> <li>▪ Shattered spleen</li> </ul>	<ul style="list-style-type: none"> <li>▪ Hilar vascular injury that devascularizes the spleen</li> <li>▪ Shattered spleen</li> </ul>
<p>*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 a grade III.</p>			

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**Appendix B****AAST Liver Injury Scale**

AAST grade	Imaging criteria (CT findings)	Operative criteria	Pathologic criteria
I	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm in depth</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm in depth</li> <li>▪ Capsular tear</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &lt;10% surface area</li> <li>▪ Parenchymal laceration &lt;1 cm</li> <li>▪ Capsular tear</li> </ul>
II	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;10 cm in diameter</li> <li>▪ Laceration 1 to 3 cm in depth and ≤10 cm length</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;10 cm in diameter</li> <li>▪ Laceration 1 to 3 cm in depth and ≤10 cm length</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma 10 to 50% surface area; intraparenchymal hematoma &lt;10 cm in diameter</li> <li>▪ Laceration 1 to 3 cm depth and ≤10 cm length</li> </ul>
III	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area; ruptured subcapsular or parenchymal hematoma</li> <li>▪ Intraparenchymal hematoma &gt;10 cm</li> <li>▪ Laceration &gt;3 cm depth</li> <li>▪ Any injury in the presence of a liver vascular injury or active bleeding contained within liver parenchyma</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area or expanding; ruptured subcapsular or parenchymal hematoma</li> <li>▪ Intraparenchymal hematoma &gt;10 cm</li> <li>▪ Laceration &gt;3 cm in depth</li> </ul>	<ul style="list-style-type: none"> <li>▪ Subcapsular hematoma &gt;50% surface area; ruptured subcapsular or intraparenchymal hematoma</li> <li>▪ Intraparenchymal hematoma &gt;10 cm or expanding</li> <li>▪ Laceration &gt;3 cm in depth</li> </ul>
IV	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption involving 25 to 75% of a hepatic lobe</li> <li>▪ Active bleeding extending beyond the liver parenchyma into the peritoneum</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption involving 25 to 75% of a hepatic lobe</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption involving 25 to 75% of a hepatic lobe or 1-3 Couinaud's segments within a single lobe</li> </ul>
V	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption &gt;75% of hepatic lobe</li> <li>▪ Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption &gt;75% of hepatic lobe</li> <li>▪ Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins</li> </ul>	<ul style="list-style-type: none"> <li>▪ Parenchymal disruption &gt;75% of hepatic lobe or &gt;3 Couinaud's segments within a single lobe</li> <li>▪ Juxtahepatic venous injury to include retrohepatic vena cava and central major hepatic veins</li> </ul>

\*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 a grade III.

Kozar, R., Crandall, M., Shanmuganathan, K., et al. (2018). Organ injury scaling 2018 update: Spleen, liver, and kidney. *Journal of Trauma and Acute Care Surgery*, 85(1119).

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Moore EE, Cogbill TH, Malangoni MA, et al. (1990). Organ injury scale, II: Pancreas, duodenum, small bowel, colon, and rectum. *Journal of Trauma*, 30(1427).

**Appendix C****Pancreas Organ Injury Scale**

<b>Grade*</b>	<b>Injury type</b>	<b>Description of injury<sup>¶</sup></b>
I	Hematoma	Minor contusion without duct injury
	Laceration	Superficial laceration without duct injury
II	Hematoma	Major contusion without duct injury or tissue loss
	Laceration	Major laceration without duct injury or tissue loss
III	Laceration	Distal transection or parenchymal injury with duct injury
IV	Laceration	Proximal <sup>Δ</sup> transection or parenchymal injury involving ampulla
V	Laceration	Massive disruption of pancreatic head
<p>* Advance one grade for multiple injuries to the same organ.  <sup>¶</sup> Based on most accurate assessment at autopsy, laparotomy, or radiologic study.  <sup>Δ</sup> Proximal pancreas is to the patients' right of the superior mesenteric vein.</p>		

Moore EE, Cogbill TH, Malangoni MA, et al. (1990). Organ injury scale, II: Pancreas, duodenum, small bowel, colon, and rectum. *Journal of Trauma*, 30(1427).

