

Purpose

To provide information and evidence-based literature to guide the evaluation and management of pancreatic injury following blunt abdominal trauma in children.

Incidence

Pancreatic injuries occur in 3-12% of children with blunt abdominal trauma and rarely occur as an isolated injury. Up to 60% of cases are usually associated with liver, spleen, or duodenal injuries¹⁴.

Etiology

- Pancreatic trauma is one of the leading causes of acute pancreatitis in children. Pancreatic injury is associated with a high morbidity and reported complication rates of 19-55%. Pancreatic pseudocyst formation, pancreatitis and pancreatic fistula formation are common complications of pancreatic trauma.
- Pancreatic injury secondary to blunt abdominal trauma is a rare finding compared to other solid organ injuries. Pancreatic injury most often results from a direct epigastric blow that compresses the organ against the vertebral column, thereby causing injury. In children, the pancreas is not as protected as in adults, due to reduced muscle wall and poor quantity of superficial and deep adipose tissue. Diagnosis may be difficult due to non-specific clinical presentation and challenges with imaging and laboratory studies.

Guideline Eligibility Criteria

Injured children from newborn through adolescence with blunt abdominal trauma.

Guideline Exclusion Criteria

This is a guideline only. Individual circumstances need to be considered, as there may be times when it is appropriate or desired to deviate from this guideline. Special considerations may be needed for neonates or children with underlying medical conditions.

Diagnostic Evaluation

History

Assess for history of blunt abdominal trauma to include mechanisms such as bike accidents with handlebar impact, MVC, especially with seat belt sign, penetrating injury, or other direct force to the epigastric area or abdomen.

Physical Examination

- Stabilize per ATLS guidelines and proceed with examination of the abdomen. Aside from the stigmata of a direct epigastric blow, there are no specific signs or symptoms of pancreatic injury and the general principles of examination of a trauma patient should be adhered to.
 - Hemodynamically unstable patients with signs of abdominal trauma or peritonitis should be taken to the OR for exploratory laparotomy.
 - Classify pancreatic injury if identified.

Laboratory Tests

- Serum amylase and lipase may be drawn based on clinical suspicion as part of the initial trauma lab panel.
 - Initial normal values do not exclude pancreatic trauma.

- Conversely, the sensitivity and specificity of elevated early enzymes are low. Elevated amylase is not specific for pancreatic trauma and can be elevated in head or hepatic trauma, and bowel injuries.
- Typically, serum amylase rises 3 to 12 hours after injury and is elevated for several days post-injury.
- Repeat serum levels 3-6 hours post injury or trending values with serial levels every 6 hours has a greater diagnostic significance in regards to identifying pancreatic injury, especially if diagnostic imaging is inconclusive. Elevated or increasing levels of serum amylase and lipase in the absence of imaging to support a definitive diagnosis should warrant further investigation
 - It has not been shown that peak levels predict the course of disease, and higher peak levels do not necessarily correlate with higher grades of injury. However, decreasing serial enzyme levels have been correlated with predicting success of non operative management.
 - Elevation of amylase level beyond 10-30 days post-injury is associated with an increased risk of pseudocyst formation.

Imaging Studies

- CT imaging is the most sensitive and specific diagnostic modality for identification of pancreatic injury. Ideally, a protocol involving limited oral and IV contrast with a series of fine cuts through the pancreas maximized the opportunity to accurately describe relative anatomy.
- CT imaging should not be used as a study of exclusion. Failure of initial CT to identify a pancreatic injury does not reflect inaccuracies of this particular diagnostic method, but rather the evolving nature of injury. The accuracy of CT for pancreatic injury is greater 12-24 hours after injury in hemodynamically stable patients because of the changes seen with injury (fluid accumulation between injured segments).
- Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic Retrograde Cholangiopancreatography (ERCP) are considered valuable diagnostic tools for detecting pancreatic ductal injuries. MRCP can be considered a second-line noninvasive diagnostic modality to definitively identify pancreatic parenchymal and pancreatic ductal lesions. ERCP is invasive and may cause iatrogenic pancreatitis, but offers the possibility of immediate intervention via stenting, however, the therapeutic effects of stenting remain unclear.
- Ultrasound (US) or contrast enhanced ultrasound (CEUS) is of little utility in the initial evaluation and diagnosis of pancreatic injury. However, US or CEUS is the modality of choice for follow up imaging in the event the patient has ongoing symptoms after 1 week of bowel rest, or with recurrent symptoms following discharge.

Critical Points of Evidence

Evidence Supports

- Use of standardized guidelines for the management of solid organ injury has been shown to be very effective in pediatric trauma. The American Association for the Surgery of Trauma (AAST) has a universally accepted grading scale for pancreatic injury, allowing for the standardization of diagnosis with potential management options. While pancreatic injury is more challenging to identify than other solid organ injuries, once the injury is graded with potential duct disruption identified, operative vs nonoperative management can be explored.
- There is general consensus that mild blunt pancreatic trauma without disruption of the pancreatic duct (grade I & II) should be treated nonoperatively⁹.
- A five year pediatric review of National Trauma Data Bank (NTDB) data of blunt pancreatic injury found that mortality and major morbidity were 5% and 26.5% respectively, indicating the continued difficulty managing these patients. Higher grades of pancreatic injury and overall injury severity were strongly associated with the use of operative pancreatic management, while pancreatic head injuries were associated with nonoperative management⁵.

Evidence Lacking/Inconclusive

- The treatment of more serious pancreatic injuries with capsular, ductal or parenchymal disruption in pediatric patients remains controversial. Based on a literature review by Maeda, although children with pancreatic injuries without ductal disruption do not appear to suffer increased morbidity following conservative management, patients with ductal disruption may benefit from operative intervention¹³.
- Conversely, a review of the literature by Jahromi et al. concluded that both operative and nonoperative approaches for management of major pancreatic duct transection offer similar complication rates. Recommendations were also based on authors' retrospective review of 7 patients (4 pediatric) treated (3 operative, 4 nonoperative) at their own trauma center⁸.
- According to a Cochrane review of 83 relevant references, there are no randomized clinical trials investigating operative treatment compared with non-operative treatment of severe pancreatic lesions in children⁹. Treatment of severe blunt pancreatic trauma with lesion of the pancreatic duct (grade III-V) is controversial, and treatment can be non-operative or operative. Case reports of successful conservative management of high grade injuries are available^{6,4}. Patients who initially are treated non-operatively might require an operation if clinical condition deteriorates. It has been suggested that surgery is technically more difficult in patients who initially were treated conservatively due to intra-abdominal adhesions and leakage of pancreatic enzymes in the surgical field⁹.
- According to a multi-institutional 17 year pediatric review comparing operative with nonoperative management for grades II & III pancreatic injuries, distal pancreatectomy is superior to nonoperative management with more rapid resumption of diet, fewer repeat interventions, and a shorter period to complete resolution¹¹.
- A recent study evaluating NTDB data over a 10 year period concludes that overall, children with pancreatic injury managed nonoperatively have equivalent or better outcomes when compared with operative and delayed operative management in regard to death, overall complications, length of stay and critical care stay. This study stratified data based on abbreviated injury severity score of 3-5 (moderate to severe injury), rather than grade of pancreatic injury. Authors also concluded that patients with delayed operative management were found to have the worst outcomes among the three groups¹⁵.
- The operative approach to pancreatic trauma can consist of laparoscopy or laparotomy with drainage of the peripancreatic area, distal pancreatectomy with or without preservation of the spleen, Roux-en-Y pancreaticojejunostomy, and more seldom, pancreaticoduodenectomy (Whipple's procedure). The type of operation depends on the grade and location of the pancreatic lesion. Spleen-preserving surgery should be attempted in children, to avoid the life-long risk of infection after splenectomy⁹.

Evidence Against

None

Practice Recommendations & Principles of Clinical Management

Principles of Clinical Management

- The determination of grade of injury is made with assessment of the integrity of the main pancreatic duct. This should be accomplished as soon in the patient's course as possible. Options for determining grade of injury include: MRCP, ERCP, CT or operative exploration.
- Pancreatic injuries are graded according to the following AAST scale:
 - Grade I
 - Hematoma – minor contusion without duct injury
 - Laceration – Superficial laceration without duct injury
 - Grade II
 - Hematoma – Major contusion without duct injury or tissue loss

- Laceration – Major laceration without duct injury or tissue loss
- Grade III
 - Laceration – Distal transection or parenchymal injury with duct injury
- Grade IV
 - Laceration – Proximal transection or parenchymal injury involving ampulla
- Grade V
 - Laceration – Massive disruption of pancreatic head

Treatment Recommendations

Management of pancreatic injury is determined by grade of injury and clinical status of the patient.

Grade I-II Injury

Observation with non-operative management. [See NOM Algorithm](#)

- Obtain baseline serum amylase/lipase levels.
- Admit for bowel rest and pain control.
- Initiate TPN/lipids or NJ feeds if not tolerating PO within 7 days.
- Initiate oral diet when there is some improvement in tenderness and/or pain.
- Discharge when pain control is adequate and tolerating some oral feeds.
- If symptoms progress or persist and/or patient cannot tolerate oral diet one week post-injury:
 - Obtain ultrasound and serum amylase/lipase.
 - If an organized peri-pancreatic fluid collection is identified or enzymes are higher than baseline:
 - Hold diet until symptoms improve and observe fluid collection.
 - Initiate/continue TPN/lipids or NJ feeds.
 - If symptoms progress/persist after another week, consider intervention or continue observation.
 - If there is no fluid collection identified on US and amylase/lipase are decreasing from baseline:
 - Hold diet until symptoms improve.
 - Initiate/continue TPN/lipids or NJ feeds.
 - Initiate oral diet when some improvement in tenderness and/or pain.
 - Discharge when pain control is adequate and tolerating some oral feeds.

Grades III-V Injury

- High grade injuries have been managed successfully in a non-operative fashion.
- Non-operative management may be appropriate in the hemodynamically stable patient without peritonitis.
- Hemodynamically unstable patients and those with peritonitis should undergo immediate operative intervention including damage control, reconstructive or other ancillary procedures at the discretion of the trauma surgeon.
- Distal pancreatectomy can be considered up to 7 days post injury.
- For those patients who are determined to require surgery, selected operative options are listed below:

Grade III Injury

- Distal pancreatectomy with splenic preservation.
- Alternatively and in damage control situations, drains may be placed.
- Endoscopic stent placement may also be considered.

Grade IV Injury

- Alternatively and in damage control situations, drains may be placed.
- Oversee proximal duct and reconstruct drainage of the distal pancreas.
- Endoscopic stent placement may also be considered.

Grade V Injury

- Non-operative management / allow pseudocyst formation
- Alternative and in damage control situations, drains may be placed.
- Trauma Whipple

Complications of Pancreatic injury

Pseudocyst

- Pseudocyst formation is the most frequent complication following nonoperative management of pancreatic injuries.
- Pseudocyst is defined as an acute fluid collection persisting 4-6 weeks and encompassed by a distinct wall.
- An acute fluid collection in the first 4-6 weeks after injury is not considered a pseudocyst.
- Allowing pseudocyst formation is an effective management strategy. Treatment may include the following:
 - Close observation
 - Bowel rest with NG tube placement
 - TPN/lipids
 - Octreotide infusion
 - ERCP evaluation with or without papillotomy and stent placement
 - Serial enzyme levels
 - Serial ultrasound evaluations. Timing of serial ultrasound should be based on ongoing symptoms, clinical response and at the discretion of the trauma surgeon
- If an acute peripancreatic fluid collection resolves with the above interventions:
 - Discharge the patient with outpatient follow-up including labs and ultrasound
- If the acute peripancreatic fluid collection matures into a pseudocyst after 4-6 weeks of the above management interventions:
 - Consider endoscopic or surgical cystogastrostomy OR
 - Percutaneous drainage for symptomatic, enlarging, or infected pseudocyst.

Intra-abdominal abscess

- Formation of intra-abdominal abscess occurs in 7-25% of patients with pancreatic injuries³.
- Abd/pelvis CT scan or MRI is recommended to guide treatment³.

Pancreatic fistula

- Following operative drainage or resection, pancreatic fistula occurs in 10-35% of major pancreatic injuries. The majority of these will resolve with drainage and conservative therapies.
- Pancreatogram during ERCP is the first step in planning treatment for persistent pancreatic fistulas³.

Follow-Up

- After discharge, the necessity for follow up imaging should be based on the recurrence of clinical symptoms including abdominal pain, distention, tenderness, fever, vomiting and jaundice.
 - Ultrasound or contrast enhanced ultrasound is the modality of choice for imaging.
 - MRI is preferred when cross sectional imaging is required.
 - No routine follow up imaging is recommended in the absence of symptoms or known sequelae, however, the management of high grade pancreatic lesions Grade III, IV, V should prompt sensitivity to early or late complications of NOM, and stringent follow up for up to 6 months should be³.

Related Policies

Key Contributors

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Approvals

The signatures below indicate support for the attached guideline, protocol and/or algorithm. The intent is not to be prescriptive but to provide a cohesive, standardized, and evidence-based (when available) approach to patient care. The physician must consider each patient and family’s circumstance to make the ultimate judgment regarding best care.

Approved by Trauma Council: 4Dec2020

By: _____	_____
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Appendix A: NOM Algorithm

