Traumatic Pancreatic Injuries: A Case-Based Review

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Goals and Objectives

• Review common mechanisms of pancreatic trauma

• Illustrate primary and secondary findings of pancreatic injuries, focusing on computed tomography (CT)

• Review pancreatic trauma classification systems

• Provide indications for further evaluation or intervention
Target Audience

- Practicing radiologists
- Radiology trainees, particularly those performing on-call duties
Mechanisms of Injury

• Blunt Trauma:
  – Seen in <2% of blunt trauma due to protected retroperitoneal location
  – More common in children given thinner body habitus
  – Typically results from compression against the spine and involves the pancreatic body
  – Common scenarios:
    • Impact on bicycle handlebars
    • Non-accidental trauma (must be considered in young children)
    • Motor vehicle collisions
    • Focal abdominal impact from any object, including a fist, surfboard, rail, etc...

• Penetrating Trauma:
  – Gun shot wounds
  – Stab wounds less common given distance from skin surface
Imaging Evaluation

• CT is the mainstay of initial trauma imaging, particularly in the setting of blunt trauma and hemodynamic instability.

• CT findings of traumatic pancreatic injury are often subtle, particularly when imaging is performed shortly after the trauma.

• Further evaluation with endoscopic retrograde cholangiopancreatography (ERCP) or magnetic resonance cholangiopancreatography (MRCP) should be considered if there is suspicion for a ductal injury in a stable patient.

• Patients with clear ductal injuries on CT typically require surgery, obviating the need for additional imaging.
Primary CT Findings

- Pancreatic fracture
- Linear defect or hypoenhancement through the parenchyma related to a laceration
- Heterogeneous enhancement related to contusion
- Focal pancreatic enlargement due to edema
- Active contrast extravasation from the pancreas
- Hemorrhage interposed between the pancreas and splenic vein
20-year-old man with abdominal pain following a bicycle crash

- partial avulsion of the pancreatic head in the setting of a pancreatic fracture
- active extravasation from a pancreaticoduodenal artery branch

Images also show peri-pancreatic fluid and hemorrhage
35-year-old woman s/p an anterior abdominal stab wound

↑: linear defect extending through nearly the entire width of the pancreatic tail

Images also show peri-pancreatic fluid and hemorrhage

Subsequent MRI (SSFSE)

↔: transection of the pancreatic duct with interval enlargement of the laceration

★: acute peri-pancreatic fluid collection
18-year-old man who crashed on his bicycle and impaled himself on his handle bars. Of note is a thin body habitus and peri-pancreatic fluid and hemorrhage, which are important clues, as pancreatic contusions are often subtle.

Pancreatic Contusion: heterogeneity of the pancreatic body. This is in plane with the spine and is compatible with a typical compression injury.
CT Findings:
- Acute peri-pancreatic fluid collections
- Peri-pancreatic fat stranding
- Fluid in the anterior para-renal spaces or thickening of the left anterior renal fascia
- Injuries to adjacent structures such as the duodenum, liver, spleen, and stomach

Clinical Findings:
- Elevated serum lipase and amylase are often delayed findings
- Classic triad of fever, leukocytosis, and elevated amylase is rarely encountered in practice

↑: hemorrhage layering in the right para-renal space in a 39-year-old man with a pancreatic injury following a surfing accident in which his surfboard hit his abdomen
7-year-old boy who fell onto his handlebars while riding his BMX bike and had persistent abdominal pain

↑: peri-pancreatic fluid and hemorrhage that extends into the anterior para-renal spaces (no discrete pancreatic injury was seen on CT)

★: duodenal hematoma
Pancreatic Trauma Classification

• Several classification systems have been devised, including systems specific to modalities such as CT and ERCP

• Most commonly used system is the American Association for the Surgery of Trauma (AAST), which is originally based on surgical findings, but has been informally adapted to CT:
  – I: minor contusion or superficial laceration without ductal injury
  – II: major contusion or superficial laceration without ductal injury
  – III: distal transection or pancreatic injury with ductal injury
  – IV: proximal transection or pancreatic injury involving the ampulla
  – V: massive disruption of the pancreatic head

• Pancreatic injuries with associated ductal injuries require surgical intervention, although minor ductal injuries can sometimes be treated endoscopically

• If there is question of a ductal injury in a stable patient, an MRCP or ERCP should be performed
Heterogeneity of the pancreatic parenchyma is compatible with minor contusion without ductal injury

Heterogeneity of the pancreatic parenchyma with suggestion of fine linear hypoattenuating components is compatible with contusion and superficial laceration, but without ductal injury
Trauma Classification Examples

**AAST III**

Ductal injury resulting from near-complete distal transection

**AAST V**

Massive disruption of the pancreatic head with lack of continuity and significant separation of pancreatic head parenchyma
Implications of Trauma Classification

• While all traumatic pancreatic injuries are associated with significant morbidity with an overall rate of morbidity nearing 40%, higher grade pancreatic injuries are associated with higher rates of morbidity and mortality
  – Mortality rate for low grade injuries (AAST I and II) is estimated to be less than 10%
  – Mortality rate for higher grade injuries (AAST III and higher) increases to nearly 30%

• Higher grade injuries typically require surgical management given ductal involvement
Complications of Pancreatic Trauma

• Early complications of pancreatic trauma:
  – Active hemorrhage
  – Association with multi-organ injuries

• Late complications of pancreatic trauma:
  – Pancreatitis
  – Pseudocyst formation
  – Pancreatic fistula formation
  – Intra-abdominal abscesses/sepsis
Complications of Pancreatic Trauma

29-year-old man s/p blunt abdominal trauma following assault

- Significant heterogeneity and fracture involving the pancreatic head
- Extravasation in the setting of active hemorrhage
- Redistribution of extravasated contrast on delayed images
Complications of Pancreatic Trauma

Pseudocyst formation

35-year-old woman, three months after pancreatic laceration from a stab wound

•: pseudocysts arising near site of prior laceration
Complications of Pancreatic Trauma

Pseudocyst formation

32-year-old man with persistent abdominal pain three weeks after assault

**: defect in the pancreatic head/body region related to prior laceration

**: large pseudocyst arising from the pancreatic defect

**: anteriorly displaced stomach

**: persistent fluid and hemorrhage in the right anterior para-renal space
Complications of Pancreatic Trauma

CBD Disruption (surgically proven)

20-year-old man with a AAST grade V pancreatic injury with disruption of the pancreatic head:

- discontinuity of the common bile duct
- pooling of radiotracer in the retroperitoneum on a cholecintigraphy without opacification of/passage through bowel
Conclusions and Clinical Implications

• Traumatic pancreatic injuries are rare, owing to the relatively protected retroperitoneal location of the pancreas, and occur in less than 2% of blunt traumas

• Pancreatic injuries are associated with significant morbidity and mortality and are often subtle on initial CT scans

• Understanding mechanisms of pancreatic injuries as well as primary and secondary imaging findings of pancreatic injuries on CT promotes early and accurate imaging diagnoses and, in turn, improves patient care

• Classifying pancreatic injuries facilitates surgical management and provides guidance for when dedicated pancreatic duct imaging with MRCP or ERCP may be beneficial
References and Contact Information

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- References: