

An Imaging Primer of Pancreatic Trauma: A Rare but Important Injury Spectrum

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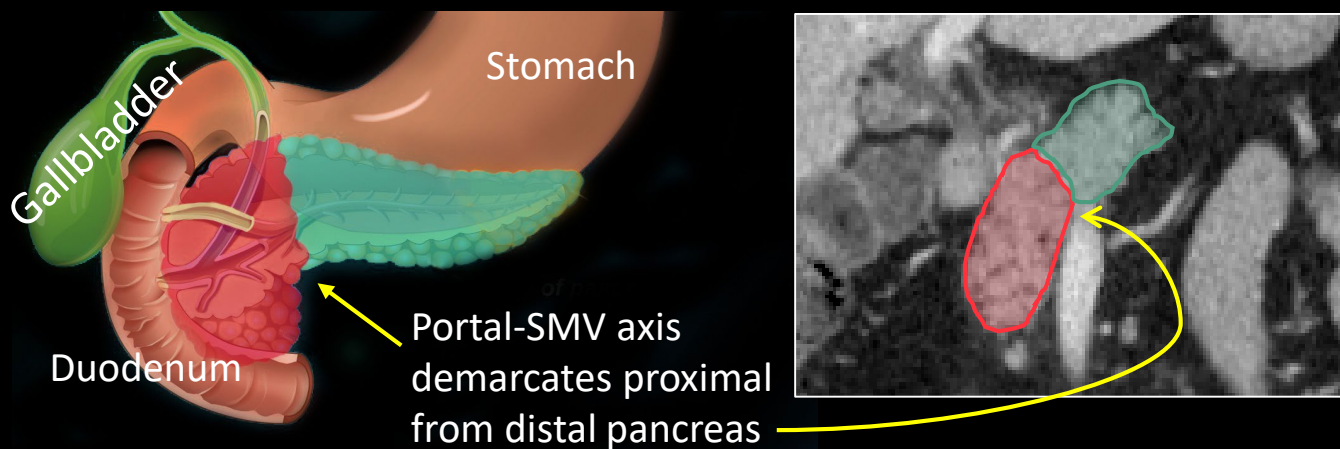
Learning Objectives:

- 1 Know the fundamental principles of pancreatic trauma imaging
- 2 Recall the AAST Injury Scoring Scale for pancreatic trauma, including best practices for classification and reporting
- 3 Understand imaging factors that guide operative versus non-operative management of pancreatic trauma



* Some case examples from CIREN (Crash Injury Research Engineering Network) Database to which Emory contributes.

Basic Pancreatic Anatomy



About the pancreas:

- Retroperitoneal gland with exocrine and endocrine functions
- Very closely associated with other organs and vessels; 50-100% of pancreatic injuries involve injuries to other organs or vascular structures
- Light tan/pinkish color, covered with very thin connective tissue capsule, which extends inward as septa, partitioning gland into lobules

Important Terminology

Definitions to Learn for Pancreatic Trauma

1. Contusion – indistinct area of parenchymal edema and hemorrhage
2. Laceration – discrete linear or branching area of parenchymal tear/injury
3. Proximal Pancreas – tissue to the right of the SMV
4. Distal Pancreas – tissue to the left of the SMV
5. Tissue Loss – non-salvageable geographic region of injured pancreatic tissue with loss of identifiable architecture by imaging

AAST Injury Scoring Scale for Pancreas

Advance one grade for multiple injuries up to Grade 3

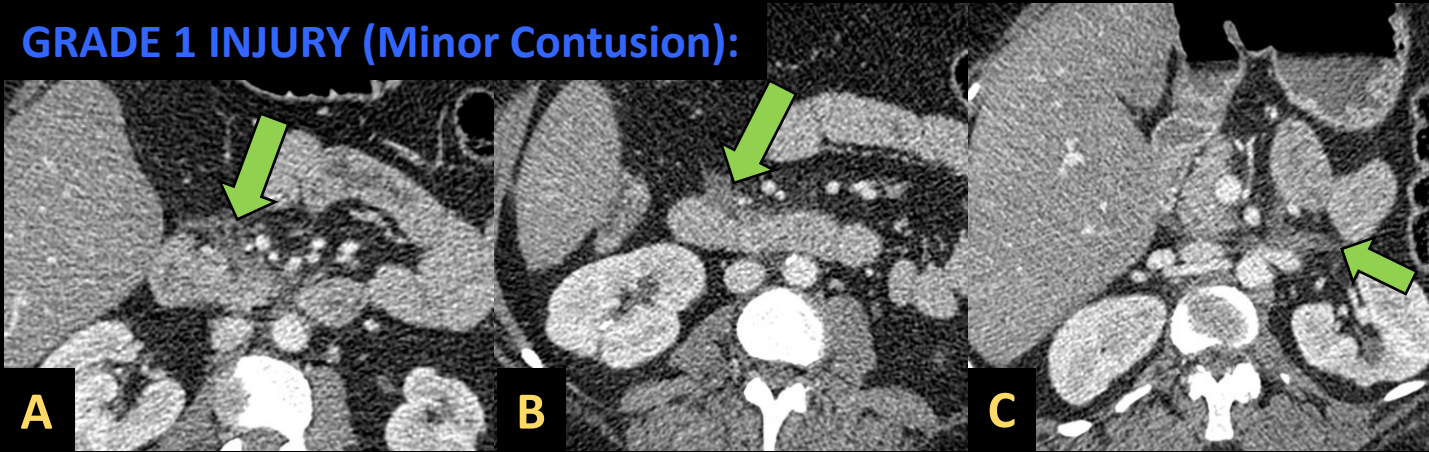
1. A. Minor contusion without duct injury
B. Superficial laceration without duct injury
2. A. Major contusion without duct injury or tissue loss
B. Major laceration without duct injury or tissue loss
3. A. Distal pancreatic transection (through & through laceration)
B. Deep parenchymal injury without duct injury (can have tissue loss)
4. A. Proximal pancreatic transection (through & through laceration)
B. Deep parenchymal injury involving the ampulla (can have tissue loss)
5. A. Massive disruption of the pancreatic head (combination of lacerations and contusions)

PEARL: Vascular injury and active contrast extravasation are *not* included in these AAST criteria and must be reported as important caveats (e.g. AAST Grade 4 pancreatic injury with active contrast extravasation arising from...)

AAST Grade 1 & 2 Pancreatic Injuries (Low-Grade Injuries)

Contusion Morphology: Pancreatic contusions are essentially pancreatic bruises (regions of edema & hemorrhage) with **2 key imaging findings:** 1) Areas of pancreatic hypoenhancement & swelling and/or 2) Peripancreatic edema/fluid. The latter is almost always present and may suggest parenchymal contusion even if the parenchymal abnormality is not visible (due to phase of contrast).

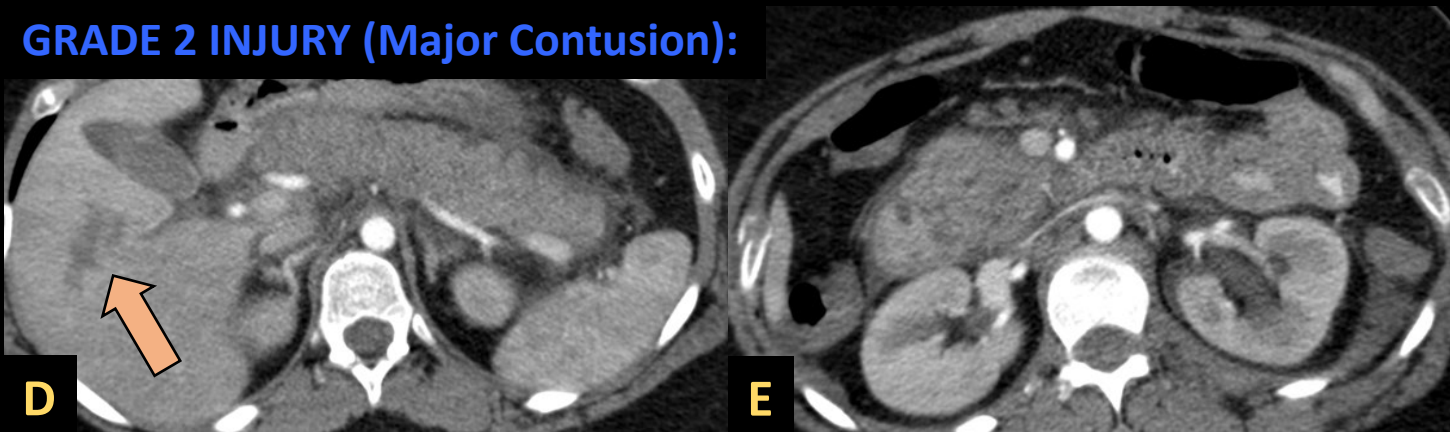
GRADE 1 INJURY (Minor Contusion):



A-C. Status-post MVC. Axial CECT images show mild stranding adjacent to pancreatic uncinus process and in the left anterior pararenal space (**arrows**) suggesting *minor pancreatic contusion* without visible focal parenchymal abnormality. Peri-pancreatic fluid is a combination of hemorrhage and edema. Pt had elevated pancreatic enzymes.

Peripancreatic fluid without parenchymal injury is a presumed contusion or shallow nonvisible laceration, AAST Grade 1 Injury

GRADE 2 INJURY (Major Contusion):



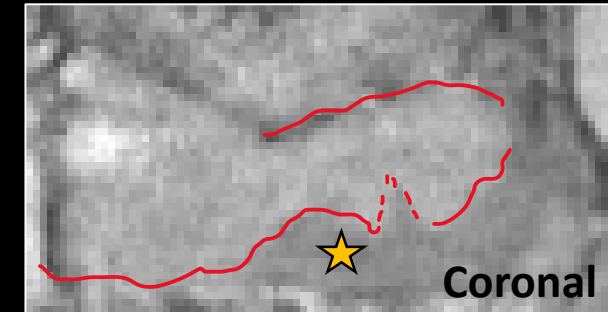
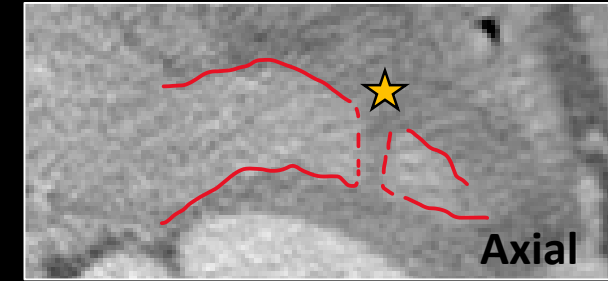
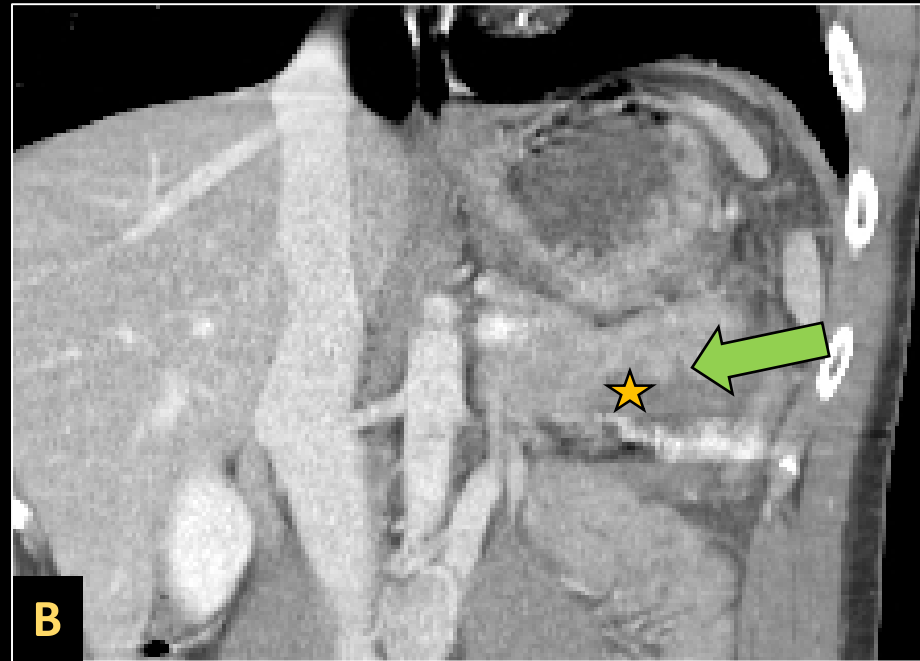
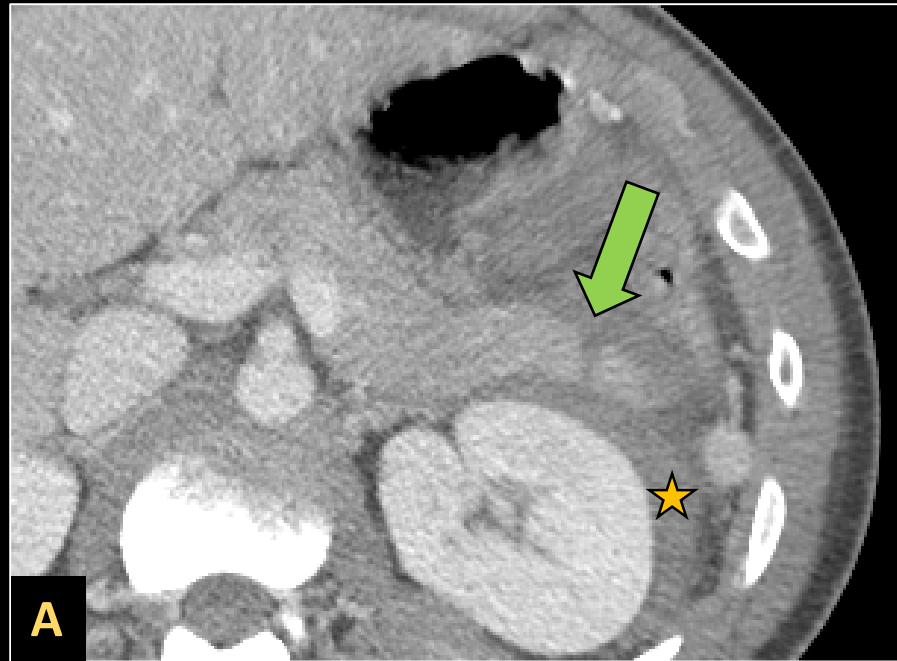
D,E. Status-post blunt trauma. Axial CECT images show fat stranding surrounding the diffusely swollen pancreas. The pancreatic parenchyma is slightly heterogeneous without visible laceration. This is a *major pancreatic contusion* without focal laceration or imaging findings of main duct injury. There is also a liver laceration (**arrow**).

Major pancreatic contusion is an AAST Grade 2 Injury: the distinction between what constitutes a minor vs. major contusion is not established. In the authors' expert opinion, a contusion which involves >25% of the pancreas is considered major.

AAST Grade 2 Pancreatic Injury

Major Laceration without Duct Injury or Tissue Loss

History: 28-year-old male status-post close-range, low-caliber gunshot to the left upper abdomen. Patient is hemodynamically stable with oozing entrance wound to the LUQ.



A. Axial CECT image suggests nearly full-thickness laceration to the pancreatic tail (**arrow**). **B.** Coronal CECT image clarifies that this laceration only traverses the inferior aspect of the pancreas (**arrow**), sparing the main pancreatic duct. Magnified images are presented to the right with the laceration outlined in **dashed red** and the pancreas in **solid red**. There is peripancreatic and perirenal retroperitoneal hemorrhage (**stars**).

AAST Description for Grade 2 Injury:

Major laceration *without* duct injury or tissue loss

FACT: Pancreatic injury occurs in 0.2-2% of trauma patients. Outside of the US, blunt trauma is the primary cause, but in the US, penetrating trauma accounts for 50-80% of such injuries.

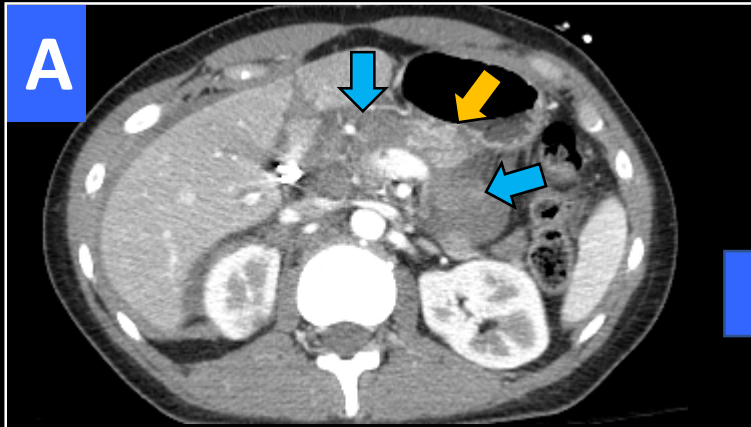
PEARL:

Laceration on both sides of the main pancreatic duct by imaging *implies* ductal injury.

AAST Grade 3 Pancreatic Injury

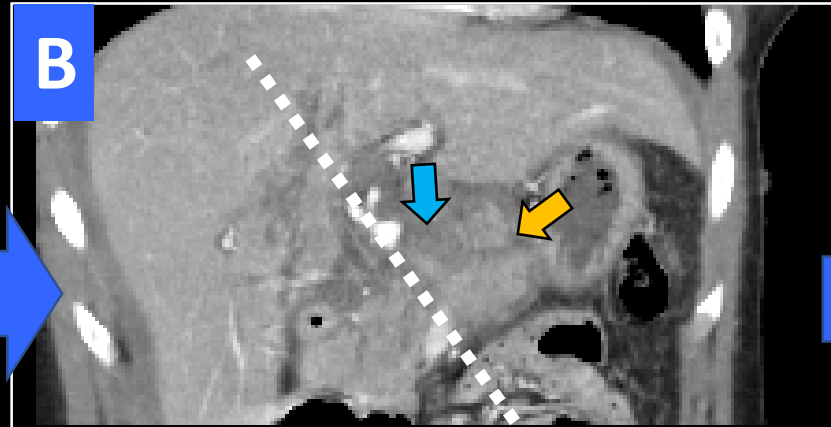
Major Contusions, Multiple Injuries

History: 31-year-old female who fell off horse while riding, with horse landing on patient; positive FAST scan in trauma bay

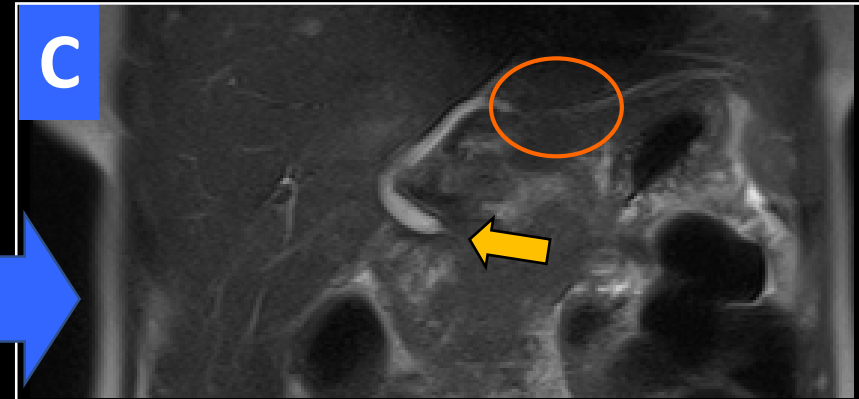


Axial CECT image shows normally enhancing pancreatic parenchyma in the mid-body (**arrow**), with upstream and downstream regions of pancreatic contusion (**arrow**).

PEARL: advance one grade up to AAST grade 3 for multiple injuries!



Portal-SMV axis (**dashed line**) divides “proximal” from “distal” pancreas by AAST terminology. Coronal CECT image shows parenchymal contusion (**arrow**) extending deep to the level of the main duct (**arrow**). Note the effacement of peripancreatic and porta-hepatic fat planes by blood products.



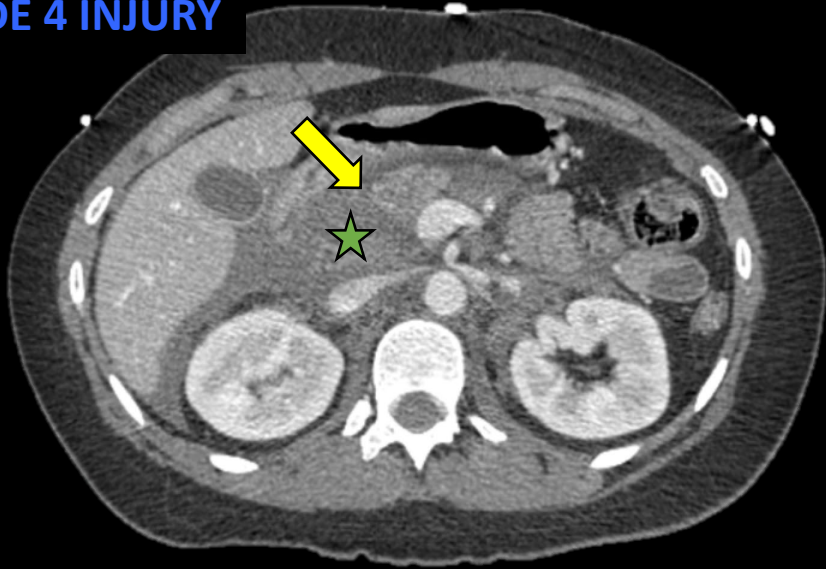
Follow-up MRI: Coronal T2w MR image shows distal CBD narrowing (**arrow**) and a 2.5 cm segment of main pancreatic duct narrowing with possible discontinuity (**circle**) at site of prior injury on initial CT. During surgery, this was found to be due to edema with mass effect on the duct rather than intrinsic ductal injury.

AAST Grading: There is major contusion (Grade 2) with injury extending inferiorly to the main pancreatic duct without injury on both sides of the duct, indicating no definite duct injury by CT. Since there are two distinct Grade 2 injuries, advance one AAST grade to **AAST Grade 3 pancreatic Injury**.

Take Home Point: The main pancreatic duct is best evaluated by MRI/MRCP. Analysis of peripancreatic fluid was helpful in proving false-positive duct injury on MR.

AAST Grade 4 and 5 Pancreatic Injuries (High-Grade Injuries)

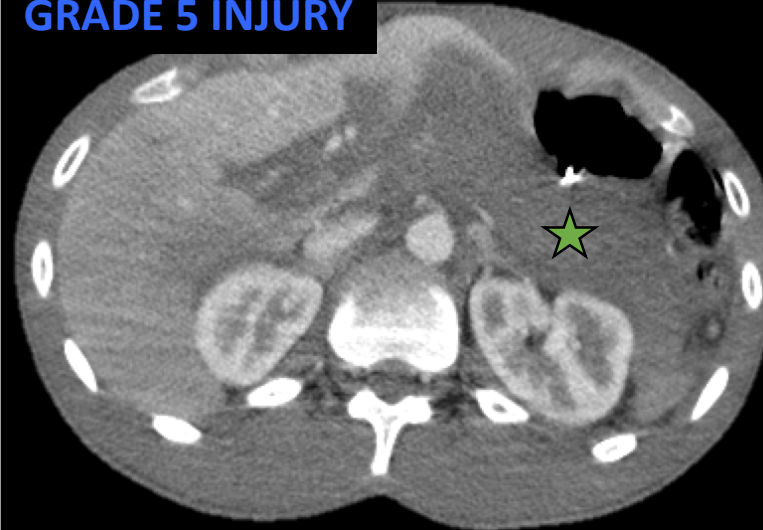
GRADE 4 INJURY



This MVC patient has edema and hypo-enhancement of the pancreatic head (**star**) with peripancreatic hemorrhage in region of ampulla. There is a sharp margination between normal and abnormal pancreas, suggesting a proximal pancreatic laceration (**arrow**). This is consistent with AAST Grade 4 injury.

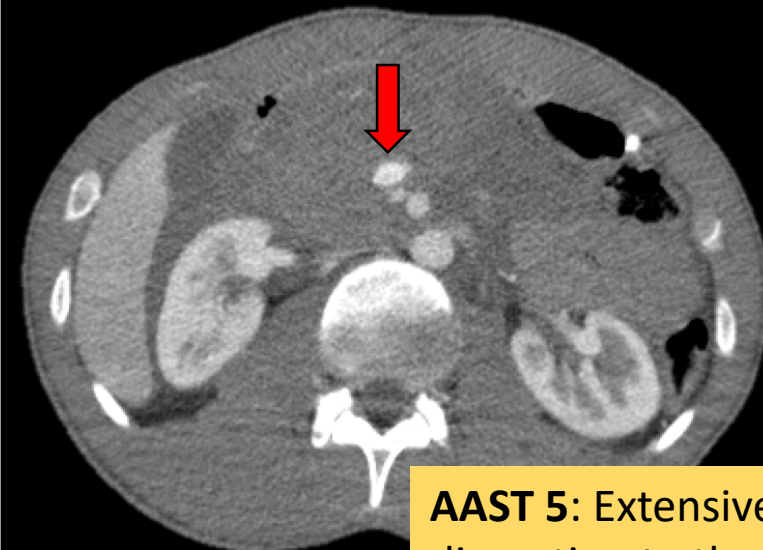
AAST 4: Proximal pancreatic transection or deep parenchymal injury in the region of the ampulla.

GRADE 5 INJURY



Diffuse parenchymal Injury: Note the diffusely swollen, hypodense pancreatic parenchyma (**star**). There is massive disruption of pancreas, including the head.

Peripancreatic hemorrhage: The hypoattenuating pancreas is difficult to distinguish from the peripancreatic blood.



Vascular injury: Pooled focus of contrast extravasation (**arrow**) noted anterior to the take-off of replaced hepatic artery (which arises from the SMA). Note attenuation is greater than that of the aorta on this portal venous phase.

AAST 5: Extensive injury, including “massive disruption to the pancreatic head.”