Imaging Acute Pancreatitis

- Chris Allmon, Harvard Medical School Year III
- Gillian Lieberman, MD
Acute Pancreatitis Pathophysiology

- Blockage of the pancreatic duct leads to increased pressure in pancreatic duct and rupture.
- Pancreatic fluid (proteolytic and lipolytic enzymes) ruptures into pancreas parenchyma and anterior pararenal space
Anatomy of the Pancreas
Anterior Pararenal Space

- Kidney is retroperitoneal
- Shares Anterior pararenal space with duodenum, ascending and descending colon
- Anterior to Aorta, IVC, and kidneys

Robbins and Cotran, *Pathologic Basis of Disease*
Avenues of Spread of Inflammation and Fluid in Acute Pancreatitis

- 1 = spread into the lesser sac
- 2 = spread into the transverse mesocolon
- 3 = spread into the root of the bowel mesentery
- 4 = extension into the duodenum
- 5 = inferior spread into the remainder anterior pararenal space

D = duodenum; L = lung; P = Pancreas; S = Spleen; SBM = Small bowel Mesentery; TC = transverse colon

Gore and Levine, Textbook of Gastrointestinal Radiology
Our Patient

• **CC:**
  – 37 yo male, HIV+, alcoholic with chronic pancreatitis complaining of 3 days of epigastric pain

• **Hospital Course:**
  – 18 days in the ICU
  – Intubated HD 2-15
  – Discharged HD 20

*Note: All subsequent radiographs, except “Normal Pancreas” are from our patient.*
Imaging Goals in Pancreatitis

1. Exclude other abdominal disorders that can mimic acute pancreatitis
   - DDx: acute cholecystitis, bowel obstruction or infarction, perforated viscus, renal colic, duodenal diverticulitis, aortic dissection, appendicitis, and ruptured abdominal aortic aneurysm

2. Confirm clinical diagnosis of acute pancreatitis

3. Staging the disease, by evaluation of the extent and nature of pancreatic injury and peripancreatic inflammation
   - Menu of Tests: Plain Film, Ultrasound, CT, MR

Gore and Levine, *Textbook of Gastrointestinal Radiology*
Abdominal Plain Film

- **Use:** Quick and easy study useful in ruling out items in the differential requiring urgent surgery like appendicitis
- **Findings of Acute Pancreatitis on Abdominal Plain Film**
  - Duodenal ileus in 42% of patients
  - Colon cutoff (paucity of gas distal to splenic flexure due to spasm of colon affected by spread of pancreatic inflammation)
  - Pancreatic abscess (gas bubbles)
  - Abdominal fat necrosis and saponification (effects of activated lipase on fatty tissues)

Gore and Levine, *Textbook of Gastrointestinal Radiology*
Our Patient: Duodenal Ileus

Gore and Levine, *Textbook of Gastrointestinal Radiology*

Radiograph courtesy of Dr. Anne Kim
Plain Chest Film

• 1/3 of acute pancreatitis patients have pulmonary changes secondary to superior spread of pancreatic inflammation to diaphragm and lung bases

• Findings of Acute Pancreatitis on Plain Chest Film:
  – pleural effusions (seen on 10% of chest films)
  – basal atelectasis
  – pulmonary infiltrates
  – elevated diaphragm
  – Acute Respiratory Distress Syndrome

Gore and Levine, *Textbook of Gastrointestinal Radiology*
Our Patient: Pleural Effusion and Lower Lobe Atelectasis

Rapid appearance of air bronchograms suggest Atelectasis

Diaphragms are Silhouetted out by Effusion

Image courtesy Dr. Anne Kim
Ultrasound

• **Indications**
  – Good screening test in mild disease, suspected biliary pancreatitis, and thin patients lacking fat planes for good CT evaluation

• **Uses**
  – Exclude a diagnosis of gallstones
  – Followup of pseudocysts
  – Doppler of cystic masses to rule out pseudoaneurysm

• **Major Limitations**
  – Bowel gas hinders visualization of pancreas and extrapancreatic spread of inflammation visualization in 1/3 to 1/2 of patients.
  – US cannot specifically reveal areas of necrosis – an extremely important prognostic indicator
  – Liver is internal reference for echogenicity and is often abnormal in pancreatitis patients

Gore and Levine, *Textbook of Gastrointestinal Radiology*
Our Patient: Ultrasound Evaluation

Dirty shadows due to overlying bowel gas

Calipers assessing diameter of common bile duct

Image courtesy Dr. Anne Kim
Other Imaging Studies in Acute Pancreatitis

- **Barium Studies**
  - Inflammation of the posterior stomach with speculation
  - Atony and enlarged duodenal sweep of duodenal ileus

- **Endoscopic Retrograde Cholangiopancreatography**
  - ERCP is rarely used in acute pancreatitis because it can exacerbate inflammation or cause infection

- **Angiography**
  - Usually not performed unless pseudoaneurysm is suspected on CT that can be embolically treated

- **MR**
  - Used in patients with contraindications to iodinated contrast, to better delineate hemorrhagic complications, and to accurately define the morphology of pancreatic and bile ducts
Computed Tomography

“CT is the premier imaging test in the diagnosis and management of patients with acute pancreatitis. It visualizes the gland, the retroperitoneum, the abdominal ligaments, the mesenteries, and the omenta in their entirety.”

- Textbook of Gastrointestinal Radiology,
  Gore and Levine, 2000
Our Patient’s CT: Atelectasis

Patent Airways surrounded by collapsed alveolar air spaces

Image courtesy of Dr. Anne Kim
Our Patient’s CT: Pleural Effusion

Bilateral fluid accumulation in dependent lung regions

Image courtesy of Dr. Anne Kim

ROI: 5 HU (simple fluid)
Pancreas and Anterior Pararenal Space

Normal
• Homogeneous parenchyma
• Distinct fat planes

Our Patient’s Acute Pancreatitis
• Diffuse enlargement with shaggy, irregular borders
• “Boggy,” heterogeneous parenchyma
• Adjacent fat planes are thickened with inflammation in anterior pararenal space

Image courtesy of Dr. Anne Kim
Our Patient’s Pseudocyst in Lesser Sac or Gastric Wall

ROI:
• 12 HU (simple fluid)
• 69mm x 36mm

Gore and Levine, Textbook of Gastrointestinal Radiology

Image courtesy Dr. Anne Kim
Our Patient’s Evaluation for Pancreatic Necrosis

Focal areas of necrosis show enhancement of less than 30 HU in early arterial phase

These Three ROIs:
• 72 HU, 66 HU, and 45 HU

Image courtesy of Dr. Anne Kim
Our Patient’s Inflammation Spreads to the Transverse Colon

Normal Bowel Wall

Edematous, Inflamed Bowel Wall

Inflamed Fat

Normal Fat

Gore and Levine, *Textbook of Gastrointestinal Radiology*

Radiograph courtesy Dr. Anne Kim
Our Patient’s Splenic Vein Occlusion

Image courtesy Dr. Anne Kim
Our Patient’s Volume Rendering Reconstruction: Splenic Vein Occlusion

Image courtesy Dr. Anne Kim
Our Patient’s Fluid Collection

Course:
Superolateral to the region of the lesser sac, becoming contiguous with the greater curvature of the stomach

Structure:
ill-defined, with indistinct margins

ROI: 16 HU (simple fluid)

Image courtesy Dr. Anne Kim
Following the Course of Two Fluid Collections in Our Patient

Image courtesy of Dr. Anne Kim
Our Patient’s Pancreatic Ascites

Dependent fluid collection between liver and diaphragm

ROI: 14 HU

Image courtesy Dr. Anne Kim
Pancreatitis: Still A Major Diagnostic Challenge

• CT has dramatically improved the diagnosis and treatment of acute pancreatitis, but…

1. Only 1 in 3 severe cases of acute pancreatitis is recognized to be severe at initial presentation.

2. 42% of fatal cases of acute pancreatitis do not have the correct diagnosis before autopsy.
Sources


Acknowledgements

• Anne “AC” Kim, MD
• Gillian Lieberman, MD
• Pamela Lepkowski
• Larry Barbaras, Webmaster