Multi-modality Imaging in Acute Pancreatitis

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Our Patient R: Introduction

- 52M with 10d history of nausea, vomiting and abdominal pain.
Patient R: Initial Presentation

PRESENTATION
- WBC: 19.1
- ARF: Cr: 3.2 (baseline: 1.2)
- BG: 235
- Lipase: 2211 (0-60)
- Amylase: 804 (0-100)
- ALT: 10  AST: 9  AP: 79
- Ca: 7.9 (8.4-10.2)
- TGs: 511 (0-149)

PMH
- HTN
- Hyperlipidemia
- Congenital deafness
- Gout
- Obesity
Patient R demonstrates a typical presentation of acute pancreatitis
Acute Pancreatitis: Pathophysiology

INFLAMMATION OF THE PANCREAS

• Inappropriate activation of pancreatic enzymes
• Intraparenchymal and extraparenchymal extravasation of enzymes cause autodigestion of pancreatic parenchyma and damage to peripancreatic tissues and vascular network
• Inflammatory response to this injury out of proportion to that of other organs to a similar insult
• Inflammatory response causes further damage
  – Fluid sequestration, fat necrosis, vasculitis leading to occlusions and thrombosis, hemorrhage

# Acute Pancreatitis: Etiologies

<table>
<thead>
<tr>
<th>Etiologies of Acute Pancreatitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mechanical</strong></td>
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<tr>
<td>Gallstones (&gt;45%), sludge, pancreatic mass, ampullary stenosis or mass, duodenal stricture or obstruction</td>
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<tr>
<td><strong>Toxic</strong></td>
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<tr>
<td>Alcohol (&gt;35%), methanol, steroids/drugs, scorpion venom</td>
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<td><strong>Metabolic</strong></td>
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<tr>
<td>Hyperlipidemia, hypertriglyceridemia, hypercalcemia</td>
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<td><strong>Trauma</strong></td>
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<tr>
<td>Blunt or penetrating, ERCP, s/p abdominal surgery</td>
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<tr>
<td><strong>Infection</strong></td>
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<tr>
<td>Viral (mumps), parasitic, bacterial</td>
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<tr>
<td><strong>Vascular</strong></td>
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<tr>
<td>Ischemia, embolism, vasculitis</td>
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<tr>
<td><strong>Congenital</strong></td>
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<tr>
<td>Pancreas divisum</td>
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<td><strong>Genetic</strong></td>
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<tr>
<td>CFTR mutation</td>
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<tr>
<td><strong>Miscellaneous</strong></td>
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<tr>
<td>Autoimmune, renal transplant, alpha-1-anti-trypsin deficiency</td>
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*Adapted from “etiology of acute pancreatitis”; Up-To-Date*
Acute Pancreatitis: Epidemiology

- >200,000 US hospital admission yearly
- 20% have a severe course
  - Associated with systemic and local complications and increased mortality (10-30%)

Severe Course

- **SYSTEMIC COMPLICATIONS**
  - Shock
  - DIC
  - Pulm. Insufficiency/ARDS

- **LOCAL COMPLICATIONS**
  - Necrosis
  - Abscess
  - Pseudocyst
  - Pseudoaneurysm
  - Splenic vein thrombosis
Acute Pancreatitis: Severity Assessment

Severity of acute pancreatitis is commonly assessed using:

1. Ranson’s Criteria
   - 5 clinical signs at presentation and 6 at 48hrs
   - ≥3 associated with severe course (systemic complications and/or pancreatic necrosis)

2. APACHE II
   - 12 routine physiologic measurement, age and previous health status
   - ≥8 associated with severe course

3. CT Severity Index (CTSI)
   - Based on extent of inflammation and presence of complications on CT scan.
Let’s briefly review the anatomy of the pancreas.
Pancreas Anatomy

Retroperitoneal organ stretching from the curvature of the duodenum to the spleen. Rich arterial supply from vessels off the celiac artery superiorly and the SMA inferiorly. Glandular tissue with both endocrine and exocrine function.
Pancreas Anatomy: Axial CT View

Companion Patient 1: Delayed Phase Axial CT

Image from: PACS, BIDMC
Acute Pancreatitis

CLINICAL DIAGNOSIS
- Abdominal pain
- Nausea/Vomiting
- Elevated Pancreatic Enzymes

MANAGEMENT
- Bowel Rest/NPO
- IVF
- Analgesics

http://www.fairview.org/healthlibrary/content/pancreas.gif
The diagnosis of pancreatitis is largely a clinical one based on physical signs and symptoms as well as serum levels of pancreatic enzymes.

What then is the role of Radiology in its management?
Role of Radiology in Acute Pancreatitis

• Rule out other intra-abdominal conditions as cause of abdominal pain or other symptoms
  – Bowel obstruction, infarction or perforation; acute cholecystitis; appendicitis
• Confirm diagnosis and Identify causes (e.g. gallstones)
• Evaluate and stage local pancreatic morphology
• Identify and manage complications
• Menu of Tests: US, Plain Film, CT, MR
Back to Our Patient R
Patient R: Ranson’s Criteria

- **Ranson’s Score ≥ 3 (Threshold)**
  - **At Presentation**
    - Age > 55
    - BG > 200
    - WBC > 16,000
    - LDH > 350
    - ALT > 250
  - **Within 48 Hours**
    - Hct > 10% decrease
    - Serum Ca < 8
    - Base Def > 4
    - BUN > 5 increase
    - Fluid Sequestration > 6L
    - PaO₂ < 60

- **PATIENT X PRESENTATION**
  - WBC 19.1
  - BG 235
  - Age 52
  - ALT 10
  - LDH 15
We are less concerned about our patient progressing down an more severe path based on him having only 2/5 Ranson’s criteria at presentation.
However, we can use radiology to assess whether his acute pancreatitis is due to one of the commonest etiologies: gallstones.

We therefore proceed to abdominal Ultrasound...
Use of Abdominal Ultrasound in Acute Pancreatitis

Indicated early in acute pancreatitis

➢ Pros
  – Inexpensive
  – Excellent for identifying gallbladder pathology, sludge and gallstones (Most common cause of pancreatitis!)
  – Evaluate bile-duct dilation
  – May visualize masses and follow up of pseudocyst

➢ Cons
  – Not optimal for pancreas; retroperitoneal location easily obscured by bowel gas distension
  – Less sensitive for stones in distal CBD
  – Limited in early assessment of pancreatitis

Patient R Abdominal US: Liver, GB

Liver parenchyma: no gross intra-hepatic ductal dilatation

Gallbladder: anechoic cystic region with increased through-transmission

Abdominal Ultrasound: RUQ

Image from: PACS, BIDMC
Abdominal Ultrasound: RUQ

- Non-distended GB with normal wall thickness
- Absence of hyperechoic foci

No signs of acute cholecystitis: lack of gallbladder wall thickening, pericholecystic fluid or cholelithiasis

Image from: PACS, BIDMC
Happily, our suspicion of gallbladder pathology as the cause of our patient R’s acute pancreatitis is now greatly lowered.

So we continue supportive management with bowel rest, IVF and analgesics.
On Hospital Day 5...

...our Patient R develops bowel distension and abdominal pain.

We proceed immediately to Abdominal Plain Film
Use of Abdominal Plain Film in Acute Pancreatitis

- **Pros**
  - Screen for/exclude separate or accompanying abdominal process
    - Signs of peritonitis or bowel ischemia
      - Free air
    - Bowel Obstruction
    - Ascites
  - Inexpensive, readily available and fast
- **Cons**
  - Poor visualization of the pancreas and retroperitoneum
    - May see calcifications due to chronic process
Patient R: Abdominal Plain Film HD 5

- Transverse colon shows no marked distention but with no contrast
- Spasm of the desc. colon just distal to splenic flexure
- Residual contrast in asc. and desc. colon
- Isolated segments of dilated sm. bowel, up to 3cm luminal diameter

Abdominal Plain Film: Supine Image from: PACS, BIDMC
Abdominal Plain Film: L Lat Decubitus

Image from: PACS, BIDMC

Air fluid levels
The presence of distension in the along with air-fluid levels concern us for small bowel obstruction. We decide to closely follow our patient.
On Hospital Day 6...

Our patient has worsening abdominal pain and distension. We quickly perform a repeat abdominal plain film.
Patient X
Abdominal Plain Film
HD 6

- Distended stomach
- Increased focal distension of small bowel
- Marked distension of transverse colon, still with no contrast in lumen.

🌟 arrest of contrast (2 days)

Abdominal Plain Film: Supine

Image from: PACS, BIDMC
We are certainly more concerned about obstruction now. Before we continue, let’s review some possible causes of obstruction in this patient.
Possible Causes of Bowel Obstruction in Our Patient R

• Functional
  – Focal ileus/Sentinel loops (Transverse colon and segments of small bowel) due to adjacent pancreatic inflammatory process

• Mechanical
  – Pancreatic mass
    • Developing fluid collections or pseudocyst
    • GB unseen on U/S
We are more concerned about yet unseen causes of any mechanical obstruction. We now proceed to Abdominal CT to further evaluate the cause of the increasing abdominal distension and to have a better look at the inflamed pancreas.
Use of Abdominal CT in Acute Pancreatitis

**Pros**
- Readily available and Fast
- Aid in diagnosis and staging of pancreatitis
- Depict, quantify pancreatic parenchymal injury
  - Ability to assess the presence or absence of:
    - Edema (focal or diffuse)
    - Peripancreatic fluid and inflammation
    - Fluid collections
    - Pseudocysts
    - Necrosis
- Evaluate common bile duct for stones or other obstructions

**Cons**
- Our Patient R is in ARF and this may be exacerbated by IV contrast administration
Patient R Delayed-Phase axial CT: Supra-pancreatic fluid collection

4x7 cm fluid collection just superior to the pancreas

Image from: PACS, BIDMC
Normal vs. Acute Pancreatitis

Acute pancreatitis: swollen, edematous gland with indistinct edges blurred into those of surrounding structures.

Normal pancreas: Fluffy, macronodular gland texture distinct from surrounding organs.

Images from: PACS, BIDMC
Patient R: Abdominal CT - peripancreatic fat stranding and patent splenic vein

Axial Delayed Phase CT: Patient R

Images from: PACS, BIDMC
Patient R Abdominal CT: Focal Transverse Ileus and Arrest of Contrast

Images from: PACS, BIDMC
There is a round hyperdensity measuring 1.4cm with similar attenuation as the adjacent aorta. We can also visualize the IVC posterior and the GDA adjacent and just superior to the lesion.

This could represent:
1. Pseudoaneurysm of GDA
2. Gallstone
3. Reactive lymph node.
What Now???

We need to further explore this lesion as our last study was limited by the lack of both a non-contrast and arterial phase. Luckily, we have another tool in our arsenal.
Use of MR in Acute Pancreatitis

Increasingly used in diagnosis and management of acute pancreatitis

❖ **Pros**
  
  – Non-invasive and no use of IV contrast
  
  – Ability to better characterize fluid collections (acute collection vs. abscess, necrosis, hemorrhage, pseudocyst)
  
  – Ability to delineate pancreatic and bile ducts (detect choledocholithiasis missed on U/S) and other complications comparable to ERCP
  
  – Greater sensitivity vs. CT in detecting mild pancreatitis

❖ **Cons**
  
  – Expensive and in many less severe cases not necessary for diagnosis and management
  
  – Less readily available in non-tertiary medical centers
Our lesion has high signal distinct from the absence of signal (flow-void sequence) in the other three vessels of interest: GDA, IVC and aorta.

In particular, the lesion is distinct from the GDA, significantly reducing our suspicion for pseudoaneurysm.
Patient R: High signal lesion on MR

In this sequence, gallstones would demonstrate no signal and our lesion is consistent with a reactive lymph node.
The suspicious lesion on CT was further evaluated on MR and found to be benign consistent with a reactive lymph node.
A word about Pleural Effusions...
Pleural Effusions: a common complication of Acute Pancreatitis

Approx. 1/3 patients with acute pancreatitis will have abnormal CXRs. The typical findings include elevated hemidiaphragm, pleural effusions, atelectasis and in more severe cases ARDS.
Patient R: Remaining Course

• HD 6
  – Emesis and large BM that largely relieved abdominal pain
• Started on TPN
  – Diet slowly advanced until tolerated regular diet
• Continued on supportive measures as labs normalized and symptoms resolved
• Discharged to Home on HD 16
**Patient R Remaining Course cont’d**

**PRESENTATION**

- WBC 19.1
- ARF: Cr 3.2 (baseline 1.0)
- BG: 235
- Lipase: 2211 (0-60)
- Amylase: 804 (0-100)
- ALT: 10 (0-40)
- AST: 9 (0-40)
- AP: 79 (39-117)
- Ca: 7.9 (8.4-10.2)
- TGs: 511 (0-149)

**DISCHARGE**

- WBC 7.4
- Cr 0.9
- BG: 95
- Lipase: 59*(0-60)
- Amylase: 50* (0-100)
- ALT: 18
- AST: 29
- AP: 79*
- Ca: 8.7 (8.4-10.2)
- TGs: 112 (0-149)

*Last labs drawn before date of discharge*
Summary

• Acute Pancreatitis is a common illness with many potential highly morbid complications.
• Many cases are diagnosed clinically and managed supportively with bowel rest, aggressive fluid administrations and analgesics.
• Radiology plays important role in confirming diagnoses, evaluating severity and identifying and managing complications of acute pancreatitis.
References


• Up-To-Date, ‘Clinical manifestations and diagnosis of acute pancreatitis’, ‘etiologies of acute pancreatitis’
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