Radiologic and Anatomic Characterization of Pancreatic Cancer and Implications for Treatment

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Agenda

• Epidemiology
• Classification
• Relevant anatomy
• Clinical presentation
• Imaging studies
• Management strategies
• Salient points
Epidemiology of Pancreatic CA

• Fifth leading cause of cancer-related death in U.S.
• 29,000 new cases per year
• Significant morbidity and mortality:
  – 5 year survival rate: 2-5%
  – Median survival 15-20 months
  – Most patients have advanced disease at initial presentation
  – Only 15-20% are surgical candidates
Classification of Pancreatic Neoplasms

I. Epithelial nonendocrine tumors
   A. Duct cell origin
      1. Cystic
         a. Microcystic (serous) adenoma
         b. Mucinous cystic neoplasm (cystadenocarcinoma)
         c. Ductectatic neoplasms
      2. Solid
         a. Duct cell adenocarcinoma
         b. Variant carcinomas
            (1) Pleomorphic giant cell carcinoma
            (2) Adenosquamous carcinoma
            (3) Mucinous (colloid) carcinoma
            (4) Anaplastic carcinoma
            (5) Small cell carcinoma
            (6) Ciliated cell adenocarcinoma
            (7) Oncocytic carcinoma
            (8) Clear cell carcinoma
   B. Acinar cell origin
      1. Acinar cell carcinoma
      2. Acinar cell cystadenocarcinoma
      3. Pancreaticoblastoma
   C. Indeterminate origin
      1. Osteoclast-type giant cell carcinoma
      2. Solid and papillary epithelial neoplasm
      3. Mixed endocrine-exocrine tumors
      4. Microadenocarcinoma

II. Endocrine (islet cell) tumors
   A. Insulinoma
   B. Gastrinoma
   C. Glucagonoma
   D. VIPoma
   E. Somatostatinoma
   F. Pancreatic polypeptidoma
   G. Carcinoid
   H. Miscellaneous

III. Other pancreatic neoplasms
   A. Nonepithelial (mesenchymal) tumors
   B. Metastases
   C. Lymphoma

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Pancreatic Duct

Establishing the Diagnosis

• Initial presentation varies with the location of tumor:
  – Head of pancreas → Symptoms of obstruction of the intrapancreatic portion of common bile duct (steatorrhea, weight loss, jaundice)
  – Body, tail → Symptoms from invasion of celiac ganglia (pain, weight loss). Obstruction less common
  – Courvoisier’s law

• Imaging studies play two primary roles:
  – Diagnosis
  – Selecting optimal treatment strategies (i.e. surgical vs. nonsurgical)
## Menu of tests for Imaging Pancreatic CA

<table>
<thead>
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<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Useful in Staging</th>
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<tbody>
<tr>
<td>US</td>
<td>80%</td>
<td>90%</td>
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</tr>
<tr>
<td>EUS</td>
<td>90%</td>
<td>90%</td>
<td>Yes</td>
</tr>
<tr>
<td>CT</td>
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<td>95%</td>
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<tr>
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<td>90%</td>
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<tr>
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<td>90%</td>
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</tr>
<tr>
<td>FNA</td>
<td>90%</td>
<td>98%</td>
<td>No</td>
</tr>
</tbody>
</table>

Steer ML: Clinical manifestations and diagnosis of exocrine pancreatic cancer. From UpToDate literature search, http://www.uptodate.com
Radiologic Studies in the Evaluation and Treatment of Suspected Pancreatic CA

Suspected pancreatic CA

Contrast-enhanced helical CT scan (or MRI)

Dilated biliary tree → ERCP (MRCP) +/- stent placement

Nondilated biliary tree → Questionable resectability based on CT criteria

Resectable based on CT criteria → Resectable

Visceral angiography or EUS → Surgical exploration

Unresectable on CT criteria → Unresectable

Resectable → FNA

Let’s Discuss 2 Patients

J.C.
- 74 yo female
- 2 weeks intermittent upper abdominal pain
  - “Achy” in nature
  - Radiating to back
  - Worse with eating
  - 5-10 lb weight loss
- PE no focal findings
- Lab findings: wnl

E.G.
- 70 yo male
- Steatorrhea, weight loss
- PE: Jaundice, nontender palpable gallbladder ↑ ↑
- Lab findings: Bili, Alk Phos
Radiologic Diagnosis - CT

- Patient J.C.
- Diffuse enlargement
- Focal low density mass, noncalcified, at neck-body junction
- Dilated pancreatic duct

Image courtesy of BIDMC Department of Radiology
DDX: Mass in the Region of the Pancreas on CT or MRI

**COMMON:**
- Pancreatic CA
- Abscess (pancreas, lesser sac)
- Aortic aneurysm
- CA of duodenum, ampulla, bile duct, gallbladder, liver
- Gastric neoplasm
- Lymphadenopathy
- Metastasis
- Pancreatic pseudocyst, cyst, or benign neoplasm
- Pancreatitits
- Renal cyst or neoplasm
- Splenic mass

**UNCOMMON:**
- Hydatid cyst
- Portal vein thromboembolism
- Retroperitoneal cyst or neoplasm


Pathologic analysis is ‘gold standard’ for dx.
Patient J.C.: Intact Mesenteric Artery-Resectable

- CT revealed preservation of fat plane around SMA
- No evidence of metastatic disease

Image courtesy of BIDMC Department of Radiology

Hypodense fat plane surrounding SMA, indicating tumor has not invaded this vessel
Surgical Treatment:
Pancreaticoduodenectomy (Whipple)

http://pathology2.jhu.edu/pancreas/surgery.cfm
Radiologic Diagnosis - CT

- Patient E.G.
- Heterogeneous mass in pancreatic head
- Dilated pancreatic and common bile ducts – “double duct” sign

Image courtesy of BIDMC Department of Radiology
Patient E.G.: Involvement of Porto-Mesenteric Vasculature-Non Resectable

- CT-Angiogram (CTA) reconstruction demonstrated encased and compressed main portal vein at the origin of the superior mesenteric vein
- Not amenable to surgical resection

Image courtesy of BIDMC Department of Radiology
Management Strategies

- Neoadjuvant chemotherapy
- Surgical resection
- Palliation
- Depends on extent, location of tumor at diagnosis
- Radiologic studies have a key role in determining optimal treatment (i.e. surgical vs. nonsurgical)
A different patient A showing Obliteration of Splenic Vein with Liver Metastases - Non Resectable

- CT demonstrating:
  - Obliterated splenic vein
  - Hepatic metastases

- MR max. intensity projection image (portal venous phase of contrast enhancement) showing:
  - Obliterated splenic vein (no contrast-asterix)
  - Prominent collateral vessel (gastroepiploic vein)

Image courtesy of BIDMC Department of Radiology

This patient may benefit from Palliation: Celiac Plexus Neurolysis (CPN)

- Chemical splanchnicectomy of celiac plexus (absolute ethanol)
- Ablates afferent nerve fibers that transmit visceral pain
- Approx. 70% will have relief of pain for up to 24 weeks

Image-Guided Palliative Therapy

EUS

Fluoroscopic monitoring

Ethanol distribution following injection into L periaortic space

Let's review the appearance of Pancreatic Cancer on other imaging modalities.
Patient B: Magnetic Resonance

- MR imaging useful when clinical suspicion for disease is high, but CT results are negative or equivocal
- T1-weighted fat-suppressed images usually provide better resolution
  - Desmoplastic reaction of most pancreatic CA lowers signal intensity of tumor on T2-weighted images
  - Better contrast between tumor and normal pancreas

ERCP & MRCP

ERCP: Patient C
Dilated, irregular pancreatic duct with filling defects
Dilated side branches of pancreatic duct

MRCP: Patient D
Dilated pancreatic duct and side branches
Gallbladder

Images courtesy of BIDMC Department of Radiology
Patient E: **Endoscopic Ultrasound (EUS)**

- Improved diagnosis and localization of small (<2-3cm) lesions
  - Early identification is crucial
  - 30% 5-year survival rate
- Useful in detecting lymph node and vascular involvement
- Can determine invasion of duodenal wall and pancreas by ampullary tumors
- More accurately detailed staging information
- Does not reliably detect lesions distant from the pancreas

[Diagram of echoendoscope imaging pancreatic mass through pyloric wall](http://www.mgh.harvard.edu/endoscopy/Endo%20site/EUS.html)

Patient F: The Preoperative Response to Treatment may be evaluated by Nuclear Medicine

- $^{18}$FDG-PET scan performed before (A) and after (B) taxol-based neoadjuvant chemoradiation.

Near total reduction in tumor-specific signal following completion of taxol-based neoadjuvant chemoradiation.

Take Home Points

• Carcinoma of the pancreas is an almost uniformly fatal cancer
• Disturbances in pancreatic structure/function determine initial presentation
• Duct cell adenocarcinoma and its variants account for ~90% of all pancreatic tumors – most occur in the head of the pancreas
• CT is the best pancreatic imaging modality → useful in detection and staging of pancreatic CA
• Helical CT and CTA are useful in determining vascular involvement, resectability of pancreatic tumors (10-15%):
• Radiologic techniques are essential in the performance of nonoperative palliation – CPN
References

- Massachusetts General Hospital Endoscopy, [http://mgh.harvard.edu/endoscopy](http://mgh.harvard.edu/endoscopy).
- Reeder & Felson’s *Gamuts in Radiology: Comprehensive List of Roentgen Differential Diagnoses*.
- Steer ML: Clinical manifestations and diagnosis of exocrine pancreatic cancer. From *UpToDate* literature search, [http://www.uptodate.com](http://www.uptodate.com).
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