Radiologic Staging of Pancreatic Cancer

Michelle A. Lee, Harvard Medical School Year IV
Gillian Lieberman, MD

July 2002
Pancreatic Cancer

- 4th leading cause of cancer deaths in men and women
- peak incidence at 60-80 years of age
- in the US, incidence and mortality are decreasing for men and increasing for women
- in the US, higher incidence and mortality in black persons than white persons
- associated with Northern European or Jewish ancestry and genetic syndromes: NHPCC, BRCA2, hereditary pancreatitis, ataxia-telangiectasia, Peutz-Jeghers, FAMMM
- risk factors: smoking, occupational, pernicious anemia, lower SES, industrialized society, ? chronic pancreatitis
The Pancreas in the Retroperitoneum

- common hepatic duct
- cystic duct
- common bile duct
- portal vein
- splenic artery and vein
- celiac artery
- superior mesenteric artery
- superior mesenteric vein

Anatomy of the Pancreas

- common bile duct (ductus choledochus)
- principal pancreatic duct of Wirsung
- accessory pancreatic duct of Santorini

Embryology of the Pancreas

- **week 6**: 
  - ventral bud
  - duodenum

- **week 7**: 
  - dorsal bud
  - ampulla of Vater

- **week 8**: 
  - main pancreatic duct
  - ventral bud
  - dorsal bud

Physiology of the Pancreas

• Endocrine function: metabolism
  – Islets of Langerhans cells make glucagon, insulin, gastrin
  – also somatostatin, pancreatic polypeptide, VIP

• Exocrine function: digestion
  – acinar cells make amylase, lipase, trypsinogen, procarboxypeptidase
  – ductal cells make Na\(^+\) HCO\(_3\)^-
Differential Diagnosis of the Pancreatic Mass

- pancreatitis
- pancreatic pseudocyst, cyst, or benign neoplasm
- pancreatic carcinoma
- metastasis
Imaging Pancreatic Cancer

• CT with iv contrast to identify tumor or assess resectability
  – with contrast there is increased signal intensity of normal pancreatic parenchyma
  – pancreatic carcinoma, which is hypovascular, is seen as a focal hypodense mass
  – pancreatic cancer is associated with dilation of bile duct (58%) or pancreatic duct (67%) or both (“double duct” sign)
Imaging pancreatic cancer - 2

- CT angiogram for equivocal CT or to examine pre-op vascular anatomy
  - patency and location of celiac access and superior mesenteric artery, as well as portal and systemic veins can be visualized
Imaging pancreatic cancer - 3

- MR when CT cannot be performed or would be limited by streak artifact
  - T1 spin echo sequence with fat suppression shows pancreatic cancer with decreased signal intensity relative to normal pancreatic parenchyma
Imaging pancreatic cancer - 4

- **ERCP for equivocal CT**
  - pancreatic cancer encases or obstructs pancreatic and/or bile ducts, and causes acinar defects and duct necrosis with tumor cavitation

- **Ultrasound for initial evaluation for obstructive jaundice**
  - pancreatic cancer appears as an anechoic focal or diffuse mass at head of the pancreas associated with dilated pancreatic and/or bile ducts
PATIENT 1

- **Hx:** 1 month of fatigue and abdominal distention, now with bright red blood per rectum
- **Labs:** Hct 24%
- **Dx:** ischemic colitis in the splenic flexure of the colon identified by colonoscopy

- **STUDY:** CT with iv contrast to look for pathology at the splenic flexure of the colon
Patient 1: Scout Film

paucity of air in the descending colon
Patient 1: Mass in the tail of the pancreas

- transverse colon
- duodenum
- ivc
- stomach
- pancreatic tail mass
- SMA
- aorta
- spleen
Patient 1: Mass invading the stomach and liver metastasis
Patient 1: Mass invading the spleen and encasing the colon
Patient 1: Mass completely encasing the right splenic artery
Patient 1: Thrombus in the superior mesenteric vein

smv, patent

smv, thrombosed
PATIENT 1: UNRESECTABLE PANCREATIC ADENOCARCINOMA

- 88%
- mass continuous with the surface of adjacent structures
- extracapsular extension
- contiguous organ invasion
- distant metastasis to liver or nodes
- vascular involvement
- ascites (indicating carcinomatosis)

- Tx: supportive care and pain control
Pancreatic Ductal Adenocarcinoma

• 95% of exocrine pancreatic carcinomas
• histology: infiltrating glands surrounded by dense reactive fibrosis
• gross pathology: 60% arise in the head of the pancreas, others from the body/tail or diffuse
• metastasis: to liver, peritoneum, lungs, pleura, adrenals

• Prognosis
  – 5% survival at 5 years s/p resection
  – death in months to 2 years without resection
PATIENT 2

• Hx: jaundice, weight loss, abdominal pain (also anorexia, pruritis, steatorrhea, thrombophlebitis, depression, glucose intolerance could be associated)

• STUDY: CT with iv contrast to identify the cause of biliary obstruction
Patient 2:  
Mass at the head of the pancreas

gall bladder
pancreatic mass
duodenum

stomach
small bowel
sma
aorta
Patient 2: Dilated common bile duct and pancreatic duct

common bile duct

pancreatic duct

splenic artery
Patient 2: Dilated Intrahepatic Bile Ducts

portal veins

intrahepatic ducts
PATIENT 2: RESECTABLE PANCREATIC ADENOCARCINOMA

- 12%
- <2cm mass
- normal surrounding parenchyma
- no local or extracapsular extension, vascular invasion, or nodal or hepatic metastases

- Tx: pylorus-sparing pancreatoduodenectomy-Whipple or total pancreatectomy
Resection of pancreatic cancer

PATIENT 3

• Hx: long history of alcohol abuse, known pancreatic cystic mass, now with abdominal pain

• STUDY: US (transverse shown) indicated increased size of cystic mass with nodules

• STUDY: CT angiogram obtained to assess resectability
Patient 3: Cystic mass with nodules in the head of the pancreas

dilated pancreatic duct
pancreatic cystic mass with nodules
air in bowel

normal pancreas
sma
Patient 3: Normal body and tail of the pancreas

tail of pancreas

body of pancreas
Patient 3: Two cystic masses in the head of the pancreas with dilation of the common bile duct and pancreatic duct.
Patient 3: CTA Reconstructions

- Celiac artery
- SMA
- Portal vein
- Normal pancreas
- SMV

Mass 1 and Mass 2
Calcifications
Biliary Obstruction Secondary to Pancreatic Cancer

gall bladder and biliary ducts

duodenum

mass 2: cancer or dilated accessory duct?
PATIENT 3: Resectable Pancreatic Cancer?

- mass >2cm, not surrounded by normal parenchyma, abutting adjacent tissues
- no local or extracapsular extension, vascular invasion, or nodal or hepatic metastases
- but the mass is cystic
Differential Diagnosis of Pancreatic Cystic Lesions

- fluid collection
- pseudocyst
- less likely
  - serous cystic neoplasm (rarely malignant)
  - mucinous cystic neoplasm (malignant potential or malignant, but with 40-50% 5 year survival)

* Patient 3’s diagnosis: resectable mucinous cystic neoplasm
Early Detection of Pancreatic Cancer

• screening of patients with familial syndromes radiologically (using EUS, then ERCP if the patient is symptomatic or the EUS is abnormal) has been shown to be effective
  – all patients with findings who underwent pancreatectomy had pancreatic dysplasia on pathology

• laboratory screening may ultimately be combined with radiologic screening
  – mutant K-ras oncogene can be detected in pancreatic juice or stool samples
  – tumor marker CA-19-9 can be measured in plasma
Summary

• pancreatic carcinoma appears as a focal or diffuse mass, or possibly a cyst, associated with dilated pancreatic and/or biliary ducts

  – on CT: a hypodense lesion
  – on MR: a hypointense lesion
  – on US: a hypoechoic lesion
Summary - 2

• Identification of candidates for surgical resection is imperative
• CT is the primary imaging modality for assessing resectability of pancreatic carcinoma
• Equivocal CT studies can be followed by CT angiography, MR, or ERCP
• Both CT and MR overpredict resectability (CT: PPV 72%, NPV 100%)
References

*All radiographic images were copied from BIDMC PACS.


References - 2


Acknowledgements

• Damon Soeiro, MD
• Chad Brecher, MD
• Jonathon Kruskal, MD
• Gillian Lieberman, MD
• Pamela Lepkowski
• Webmasters: Larry Barbara and Cara Lyn D’amour