SONOGRAPHY OF THE PANCREAS AND SPLEEN

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Ultrasound of the Pancreas

- Anatomy
  - Details
  - Vascular markers
- Pathologic manifestations
- Role of ultrasound

Why US of the Pancreas?

- US is the screening modality for jaundice
- Although CT is much more accurate in pancreatic diagnosis and provides more information,
- not all patients can have CT
  - Pregnant women
  - Children
  - Contrast allergies
- CT is not always available

Pancreatic Anatomy

- Retroperitoneal
- Pancreas lies posterior to the stomach
- Water is useful
- Head lies in duodenal C-loop
- Vascular anatomy is important

Normal Pancreas

- Head, neck, uncinate process, body, tail
- Classical scan

Vascular Landmarks

- Veins
  - SV
  - SMV
  - MPV
  - IVC
- Arteries
  - Aorta
  - SMA
  - Celiac
  - Splenic
  - GDA

Netter Atlas

Normal Pancreas

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Vascular Landmarks

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  • SMA
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  • Splenic
  • GDA
**Splenic Vein**
- Posterior to body & tail
- Ends at portal confluence
- US: “Cobra head” or “scallion” appearance
- Marker for body & tail

**Superior Mesenteric Vein**
- Courses parallel and to the right of the partner SMA
- Ends at portal confluence
- Landmark for pancreas:
  1) Head is lateral
  2) Neck is anterior
  3) Uncinate process is posterior

**SMV versus Splenic Vein**
- Do not mistake the SMV for the splenic vein
- Longitudinal of SMV is on a sagittal scan
- Longitudinal of SV is on a transverse scan
- SMA, aorta & spine are posterior to splenic vein

**Superior Mesenteric Vein: SAG**
- On a sagittal scan, the pancreatic neck is anterior to the SMV and the uncinate process is posterior

**Splenic Vein**
- Masses originating from the pancreas are located anterior, not posterior, to the splenic vein
Main Portal Vein and IVC
- MPV crosses obliquely & anteriorly to the IVC
- Pancreatic head extends inferiorly
- MPV-on-IVC is a marker for the head
- Head: Up to 4 cm in length

Superior Mesenteric Artery: TRV
- Anterior to aorta
- Surrounded by characteristic echogenic mesenteric fat
- Marker for the pancreas anteriorly

Superior Mesenteric Artery: SAG
- Anterior & parallel to aorta
- Surrounded by characteristic echogenic mesenteric fat
- Marker for the body of pancreas anteriorly
- Creates a shallow angle with the aorta

Celiac Artery: Sagittal
- Travels along the cranial border of the pancreatic body & tail
- Superior to the splenic vein
- Marker for cranial aspect of pancreatic body and tail
- Tortuous course, weaves in & out of gland

Splenic Artery
- Travels along the cranial border of the pancreatic body & tail
- Superior to the splenic vein
- Marker for cranial aspect of pancreatic body and tail
- Tortuous course, weaves in & out of gland
Tortuous Splenic Artery: Pitfall

Any cystic structure in or around the pancreas should be interrogated with Doppler

Calcified Splenic Artery: Pitfall

Sonographic Vascular Markers for the Pancreas

- Splenic vein
- SMV, confluence
- Splenic artery
- Main portal vein

Body & tail
Head, neck, uncinate
Cranial margin body & tail
Cranial margin head

Where are the Vascular Markers for the Pancreas?

Sagittal Sections of Pancreas

Sagittal: Head of Pancreas
- Sagittal: Neck & Uncinate of Pancreas
- Sagittal: Body of Pancreas
- Sagittal: Body of Pancreas
- Sagittal: Tail of Pancreas
- Pancreatic Duct
  - Should not be mistaken for the posterior wall of the stomach
  - Pancreatic duct is in center of gland
Uncinate Process
- Embryologically, the pancreas originates from dorsal & ventral anlage that fuse. May have different fat content and echogenicity
- Do not mistake for a mass

Pancreatic Pathology
- Acute pancreatitis
- Chronic pancreatitis
- Pancreatic tumors
  - Carcinoma
  - Cystic tumors: cystadenoma
  - Exocrine tumors (islet cell tumors)
  - Lymphoma
  - Metastases

Acute Pancreatitis: Diffuse
- US is normal in 20% cases
- Enlargement: diffuse, focal
- Pancreas is hypoechoic compared to liver

Acute Pancreatitis: Focal
- Mimicks carcinoma: must follow to resolution
- Inflammatory mass is more likely in the head (suspect carcinoma if located in tail)

Acute Pancreatitis: Complications
- Phlegmon
- Necrosis
- Abscess
- Hemorrhage
- Pseudocyst formation
- Biliary obstruction
- Venous thrombosis
- Pseudoaneurysm

Pancreatic Phlegmon
- Inflammatory mass formed by edema and continuous leakage of activated pancreatic enzymes
Pancreatitis & Infection
- Infected peripancreatic fluid, necrotic tissue, pseudocyst and abscess formation
- Life threatening complication

Role of US in Acute Pancreatitis
- Gallstones
- Biliary dilatation
- Complications
- Follow up fluid collections
- Guidance for aspiration and drainage
- Unsuspected cases of pancreatitis

Pseudocyst
- 90% of cystic pancreatic masses
- Encapsulated, mass-like fluid collection of tissue, edema, enzymes, blood and debris surrounded by a fibrous capsule
- Size: 2-20cm
- Multiple
- May be in remote areas (intrasplenic, paracolic gutters, mediastinum, etc.)

Pseudocyst: Complications
- Infection, hemorrhage, rupture
- Calcification

Acute Pancreatitis: Complications
- Thrombosis of adjacent veins: SV, SMV, MPV

Acute Pancreatitis: Complications
- Pseudoaneurysms of adjacent arteries: SA, GDA, SMA, HA
- Any cystic structure around the pancreas should be interrogated with Doppler
**Splenic Artery Pseudoaneurysm**
- Pancreatic enzymes dissect from the tail of the pancreas into the splenic hilum and erode the artery
- Similar method of intrasplenic pseudocyst formation

**Chronic Pancreatitis**
- Decreased size
- Increased echogenicity
- Heterogeneous
- Calcifications – ducts, parenchyma
- Irregular pancreatic outline
- Irregularly dilated duct
- Fluid collections

**Chronic Pancreatitis**
- Approx. 1/3 of patients have focal masses
- Increased echogenicity (rare in carcinoma)
- Scattered calcifications
- Small cysts in the mass

**Pancreatic Carcinoma**
- Adenocarcinoma: solid, focal, irregular, lobulated, hypoechoic mass
- 60% in head, 40% in body and tail

**Pancreatic Carcinoma**
- Invasion, encasement of adjacent vessels
- Biliary obstruction

**Pancreatic Carcinoma**
- Splenic vein
Pancreatic Carcinoma

- Pancreatic duct dilatation

Pancreatic Carcinoma

- Liver metastases
- Lymphadenopathy
- Local invasion

Cystic Pancreatic Neoplasms

- Microcystic adenomas
  - Serous cystadenoma
- Macrocytic adenomas
  - Mucinous* cystadenoma/carcinoma
- IPMTP (intraductal papillary mucinous tumor pancreas)*
- Papillary cystic neoplasms

*All mucinous tumors have malignant potential

Islet Cell Tumors

1. Insulinoma
2. Gastrinoma
3. VIP-oma (vasoactive intestinal polypeptide)
4. Glucagonoma
5. Somatostatinoma

Endoscopic US (EUS)

- Sensitive
- FNA biopsy

Lymphoma

- Rare as a primary, more in NHL
- Diffuse heterogeneous enlargement of pancreas, rarely focal mass

SONOGRAPHY OF THE SPLEEN
Normal Spleen
- Homogeneous, moderately echogenic
- Less visible vessels than the liver (no second set of veins equivalent to portal veins)

Wandering Spleen
- Also called “floating”, “ectopic”, “ptotic”, “aberrant” spleen.
- Susceptible to torsion around vascular pedicle.

Splenomegaly
- > 13 cm length
- > 6 cm thickness
- Spleen is much longer than left kidney

Splenule/Accessory Spleen
- Small, smooth, round, isoechoic mass, < 3 cm
- Developmental
- Near splenic hilum or vessels
- Up to 10% of patients
- More common with splenomegaly
- Usually solitary, may be multiple
- Should not confuse with mass from adjacent organ

Splenosis
- Spontaneous transplantation of splenic tissue to unusual sites after splenic trauma/rupture
- Nodules of ectopic splenic tissue develop on peritoneal, omental, mesenteric surfaces
- Similar to endometriosis deposits

Cystic Splenic Masses
- Cyst (primary or secondary)
- Hemorrhagic cyst
- Hematoma
- Abscess
- Pseudocyst
- Splenic artery aneurysm, pseudoaneurysm
- Cystic metastases
**Splenic Cysts**
- Primary
  - True cysts, rare
- Secondary
  - Old trauma
  - Hematoma to seroma
  - "Pseudocyst"
- Complication of hemorrhage, infection

**Splenic Hematoma**
- Intraparenchymal

**Splenic Hematoma**
- Subcapsular

**Perisplenic Hematoma**
- Doppler helps to delineate parenchyma

**Splenic Abscess**
- Usually result of bacterial endocarditis or septicemia
- IV drug abuse, immunocompromised patients

**Echinococcal Cysts**
- Hydatid disease in endemic areas, usually in sheep raising areas
Splenic Microabscesses
- Fungal: Candidiasis
- Target, bull's eye lesions

Splenic Pseudocyst
1. Post traumatic pseudocyst: an organized splenic hematoma after occult splenic rupture
2. Intrasplenic pancreatic pseudocyst: result from dissection by enzymes

Splenic Artery Aneurysm
- Atherosclerosis, septic emboli, infection, trauma
- High morbidity, fatal hemorrhage
- Rare

Thrombosed Aneurysm

Splenic Artery Pseudoaneurysm
- Trauma, pancreatitis
- Doppler cystic masses in the spleen

Cystic Splenic Metastasis
- Primary tumor is cystic
- Secondary changes
  - degeneration
  - hemorrhage
  - necrosis
  - infection

Solid Splenic Masses
- Granulomas
- Infarct
- Hemangioma
- Hamartoma
- Lymphoma
- Metastases
- Angiosarcoma
Splenic Granulomas

- Hyperechoic foci
- Tiny shadows
- Granulomatous disease exposure
  - Histoplasmosis
  - Tuberculosis
  - Sarcoidosis

Splenic Infarct

- Most common focal lesions of spleen
- Septic emboli
  - IV drug use
  - Endocarditis
  - Atrial fibrillation
- Thrombosis of splenic vessels
  - SS disease
  - Pancreatits
  - Leukemia, lymphoma

Splenic Hemangioma

- Rare, unlike in liver
- Typical hyperechoic masses
- May have variable features
- Indistinguishable from other etiologies
- May require splenectomy for diagnosis
- Spleen size is usually normal

Splenic Hamartoma

- Benign primary neoplasm of spleen
- Asymptomatic
- Incidental tumor discovered at autopsy
- Mixed echogenicity

Lymphoma of Spleen

- Diffuse or focal
- Single or multiple
- Hypoechoic or hyperechoic masses
- May have associated splenic hilar lymphadenopathy

Splenic Metastases

- Rarely seen outside of autopsy
- Late manifestation of widespread disease
- Hematogenous spread of tumor
- Melanoma
- Breast, lung, colon
Angiosarcoma of Spleen

- Rare primary malignant tumor from endothelial cells
- Usually solitary
- Heterogeneous, complex masses
- Spontaneous rupture and hemoperitoneum

THE END

Thank you for your attention!