Letting the Stones Roll: Imaging and Intervention of the Biliary Tract

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Our Patient

- JG, a 73 year-old male presented to outside hospital with RUQ pain, jaundice, fever
- Elevated LFTs, T-bili 8.0
- Medical history is non-contributory
- PSH: CABG, Cholecystectomy
- Clinical impression: Hepatobiliary/pancreatic pathology
Anatomy of the Biliary Tract

• An understanding of biliary tract anatomy is crucial to interpreting radiologic studies of this area.
• Differential diagnoses vary with the anatomical site of obstruction.
Menu of tests for biliary tract imaging

- Ultrasound
- CT
- Endoscopic retrograde cholangiopancreatography (ERCP)
- MRI/MR cholangiopancreatography (MRCP)
- Percutaneous Transhepatic Cholangiography (PTC)
Ultrasound – A good place to start

- Used for jaundiced patient to rule out obstruction
  - 71-80% accuracy for identifying cause of obstruction
  - 75-89% sensitivity for proximal CBD stones
- Techniques for identifying obstruction:
  - Stones visualized by changing patient between supine, LLD, RLD and/or RAO positions
  - In patients believed to have cholangiocarcinoma, it is important to assess biliary dilatation, level of obstruction, presence of mass, focal or diffuse thickening of BD wall, hepatic tumors, local nodes
  - Occasional adjunct is measuring CBD before and after fatty meal; enlargement of 2 mm is positive study
Ultrasound

Film findings:
1. Dilated common bile duct (CBD)
2. Dilated gall bladder (GB)
3. Mass in the head of the pancreas (P. MASS)

Is this the RUQ ultrasound of our patient?

http://www.gemedicalsystems.com/medical/ultrasound/msul7nn.htm
Different patient

• Remember, our patient is s/p cholecystectomy and this ultrasound clearly shows a gallbladder!
• This second patient has the classic ultrasound appearance of a pancreatic cancer obstructing the CBD
• Our first patient, JG, had a CT scan as the first study, instead of a RUQ ultrasound, because he was s/p cholecystectomy
• The films are not available, but we will show you some classic CT examples of biliary duct pathology
CT – The accidental tourist

- Seldom used specifically for bile duct imaging
  - Only 20% of duct stones are of homogeneously high attenuation on CT
  - 50% of stones appear with either soft-tissue attenuation or slightly higher than bile and can be difficult to detect on CT

- Often used to image abdomen, thus it is important to recognize signs of bile duct pathology

- Key to evaluating the bile duct on CT is recognizing pattern of dilatation in cross section
Patterns of dilatation

Benign

Malignant

Baron RL, Seminars in Roentgenology
Dilated intrahepatic ducts on CT

Film findings:
1. Dilatation of intrahepatic ducts; they measure greater than 2 mm.
2. No stones were identified
3. No pancreatic mass was seen
Portal anatomy on CT

Criteria for bile duct dilatation:
Normal CBD = 4-6 mm; >8 mm - dilated; >10 mm - unequivocally dilated

http://www.rad.uab.edu:591/tf/FMPro
Let’s take a closer look

- Hepatic Arteries
- Portal Vein
- Common bile duct
• No stones were identified on CT
• No pancreatic or other masses were seen

In our patient, JG, is a stone ever possible?
(Remember the history)
A stone with no gallbladder?!

- There is a 5-15% incidence of retained stones after cholecystectomy.
- Associated with increased risk of recurrent biliary obstruction, pancreatitis, and cholangitis.
- Obstructing stones are still a consideration in our patient.
- An ERCP is the next step.
ERCP – Imaging with attitude

- The diagnostic procedure of choice for abnormalities of the biliary and pancreatic ducts
- Offers the option of intervention
  - Stone extraction
  - Sphincterotomy
  - Placement of biliary stent
- A side viewing endoscope is advanced into the descending duodenum; the papilla of Vater is identified and cannulated; contrast is injected to visualize the pancreatic duct and biliary duct systems
- Unsuccessful in 3-10% of cases; 1-5% incidence of pancreatitis and other complications
Report of our patient’s ERCP

- The pancreatic duct was visualized and normal
- The bile duct could not be cannulated
- Causes for ERCP failure include:
  - Upper GI stricture/stenosis
  - Complete ductal obstruction limiting retrograde filling
  - Postsurgical biliary-enteric fistula
  - Technical failure
- MRCP is an effective alternative when ERCP is unsuccessful
- Let’s first view a film from a successful ERCP to become familiar with the appearance of the CBD on this study
Classic ERCP

When ERCP is successful you can see the CBD clearly outlined with contrast

Film findings:
(different patient)
1. Dilated proximal CBD
2. Tight stenosis in mid CBD
3. Normal caliber distal CBD

http://home.flash.net/~drrad/tf/081197.htm
Differential for filling defect or segmental lesion of bile duct

**Common**
- Air bubble
- Calculus
- Carcinoma of common duct, ampulla, duodenum, or pancreas; metastasis
- Edema of ampullary segment
- Stricture

**Uncommon**
- Blood clot
- Dilated vessel
- Ectopic cystic duct
- Enlarge lymph node
- Foreign body or food
- Parasites (ascaris, clonorchis
- Pericholedochal adhesions
- Polyp; adenoma
- Postoperative defect
- Pseudocalculus defect in distal common duct
- Spasm of sphincter of Oddi
- [Valves of Heister]
MRI/MRCP – Animal magnetism

- Fast, effective, non-invasive way to image biliary tract
  - Demonstrates ductal dilatation and strictures with 95% sensitivity
  - Sensitivity for stone visualization of 75-95%, better than CT or US

- MRCP uses T2-weighted imaging with parameters designed to afford best view of bile duct
  - Stationary fluid (bile) has a long T2 relaxation time and hence a high signal intensity, so that bile ducts are easily distinguished from vessels on heavily T2-weighted images
  - Fat suppression further contributes to visualization of biliary tract
Coronal MRI of JG

Dilated common bile duct
MRCP of JG

Film findings:
1. Dilated intrahepatic and proximal CBD
2. Collapsed distal CBD
3. Normal caliber pancreatic duct (better seen on other views)

Impression: mid-ductal focal obstructing lesion
NEXT STEP

• A tissue diagnosis is necessary
• Relief of obstruction is necessary
• Because the ERCP was unsuccessful, a percutaneous transhepatic cholangiogram (PTC) was performed
Percutaneous Transhepatic Cholangiography – Old reliable

- Accurate technique for defining the site of obstruction
- Provides option of tissue biopsy and/or intervention with drain or stent
- Has been largely replaced by non-invasive techniques; rarely used unless in conjunction with draining or stenting
- Standard technique:
  - Thin needle puncture in ninth or tenth intercostal space
  - Contrast injected during slow withdrawal of the needle under fluoroscopic guidance
  - When duct placement confirmed, additional injection
  - Films taken in AP, right and left oblique
PTC of JG

Study confirmed focal mid-ductal obstruction; brush biopsies were obtained
Diagnosis for JG

- JG’s age, clinical presentation, and appearance on MRCP and PTC were highly suspicious for malignancy
- The cytology report on the brush biopsy performed transhepatically revealed: “atypical ductal epithelial cells with increased nuclear/cytoplasmic ratio and prominent nucleoli in clusters and sheets”
- He was treated with a presumptive diagnosis of cholangiocarcinoma
Cholangiocarcinoma

- Slow-growing malignancy of the bile duct epithelium
- Second most common primary hepatic malignant tumor
- Peak incidence in sixth and seventh decades; commonly presents with jaundice and weight loss
- Most commonly arises at confluence of right and left hepatic ducts with the CBD – Klatskin’s tumor
- Associated with ulcerative colitis, intrahepatic cholelithiasis, biliary papilloma, cystic diseases of the liver and biliary tree, Caroli’s disease, primary sclerosing cholangitis, infection by *Clonorchis sinensis*, and exposure to Thorotrast
Therapeutic Options

• Surgical resection offers potential for cure but is rarely possible

• Palliation alternatives:
  – Surgical bypass
  – Percutaneous drainage
  – Endoscopic or percutaneous stent placement
Drain placement – A temporary fix

• Three types of drains:
  – External – does not cross obstruction, drains percutaneously
  – Internal-external – bile in obstructed segment enters through the side holes of the catheter and emerges beyond the obstruction; the external segment can be capped
  – Internal – drains only into enteric system
• Internal-external drain provides ready access for later procedures
• External drain requires pain management, bile salt replacement, and maintenance on antibiotics
• Procedure-related major complication rate of 7% and death rate of 3% among patients with malignant disease in series of 152 patients
JG initially had an internal-external drain placed.

Internal-external drain enters through intercostal space.

Drains into the enteric system.
Stenting – A long-term solution

- Over the next week and a half, JG experienced RUQ discomfort and bleeding from the drain insertion site.
- A 10 mm metallic stent was placed in the CBD in the region of the stricture, projecting into the duodenal lumen.
- Stenting eliminates pain and discomfort as well as the need for bile salt replacement.
- Unlike plastic, metallic stents do not require replacement, and are preferred for palliation of malignancy.
Stent placement

JG’s cholangiogram after stent placement

Dilated biliary tree

Decompressed biliary tree

Two overlapping stents
Summary - Imaging

• CT – not a usual first test, but maybe in patients s/p cholecystectomy
• US – cheap, accurate test for evaluating, locating site of obstruction
• ERCP – diagnostic procedure of choice; several interventional options
• MRCP – fast, safe, non-invasive alternative; effective when ERCP fails or cannot be performed
• PTC – highly accurate, but used today mainly for failed ERCP and antegrade intervention
Summary- Intervention

• Drains – temporary measure; require close management of pain, bile salts
• Stents – effective for long-term palliation; metal is preferred material for malignant disease
References

Articles:

Books:

Websites:
Flashnet – Imaging Cases of the Week: [http://home.flash.net/~drrad/ftp/081197.htm](http://home.flash.net/~drrad/ftp/081197.htm)
GE Medical Systems – Clinical Area: [http://www.gemedicaletsystems.com/medical/ultrasound/msul7nn.htm](http://www.gemedicaletsystems.com/medical/ultrasound/msul7nn.htm)
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