BILIARY DISEASES – PROBLEM SOLVING APPROACH

KARTIK S. JHAVERI, MD
ASSOCIATE PROFESSOR
ABDOMINAL IMAGING

OBJECTIVES
- Cardinal Signs
- Diagnostic Algorithm
- Imaging Options
- MR Technique Pointers
- Case Discussions
- Summary

CARDINAL SIGNS
NORMAL = NO “TED”
TED = Thickening, Enhancement, Dilatation

SIGNS – BILE DUCT DISEASE
OUTSIDE • WALL • INSIDE

DIAGNOSTIC APPROACH
BILIARY DISEASE
Liver – Cirrhosis Pancreas – AIP Abd – Malignancy
Thickening Enhancement <-> Diltn
Unifocal Diffuse Multifocal
CCA Mets Pseudo tumor
Cholangitis Pyogenic HIV Stent
PSC RPC Ischemic Mets
Parallel
PostChol Stone Pan ca Node
Ballooning / Ectasia
Caroli Chole. Cyst

IMAGING TESTS
US | CT | MR

BILIARY MR & MRCP

**CORE PRINCIPLES**
- Exploit Inherent Higher Soft tissue Contrast
- Exquisite Display of Bile ducts
- Explore Functional / Biological Properties
- Enable Characterization and Staging

**CORE PULSE SEQUENCES**
- Generic Abdominal Sequences
- High Resolution MRC
- DWI
- Dynamic Gd-Enhanced Series

**MR PROTOCOL**
- Cor & Ax T2 TSE
- AX T1 IN/OPP
- 3D T2 COR
- Radial T2 HASTE
- AX T2 HASTE
- EPI
- B=0,50,400,800
- AX T1 3D GRE
- VIBE / LAVA

**MRCP TECHNIQUES**
- T2 Unenhanced
- T1 –Hepatobiliary Contrast agent*

**Conventional T2 MRCP**
- T2 MRC
- 2D
- 3D
  - Thick slabs
  - Thin sections
  - 1mm Thin Slices

**2D THICK SLAB MRCP**
- 40 mm Slab T2 (HASTE / SSFSE)
- Coronal Oblique FS
- 12-15 Slabs radially @15-30 deg
- BreathHold 1sec Acquisitions
- **Interslab period of >8 sec**
- Comprehensive view
- Diffuse ductal diseases
**2D THIN SECTION MRCP**
- Axial/Coronal
- Breathhold RARE(HASTE/SSFSE)
- 12-20, 3-4mm slices
- Fine details
- Intraluminal Filling defects
- Largely replaced by 3D sequences

**What’s “NEWer” ?**
- 3D T2 MRC Sequences
- T1 Hepatobiliary Contrast En. MRC (Gd-EOB-DTPA / Gd-BOPTA)
- DWI
- Parallel Imaging
- 3T

**Sampling Perfection with Application optimized Contrast using different angle Evolutions**
- 3D T2 FSE/TSE
- SPACE/FRFSE
- Navigator Triggered
- Spatial Resolution
- SNR
- Isotropic / Reformat
- Varying Flip SAR 3T

**3D MRC- Thick Slice MIP**

**T1 Hepatobiliary Contrast MRC**

**MR PROTOCOL-DWI**

- Bile leak following Cholecystectomy
- Vitellas et al. AJR 2002 ; 179 : 400-416

Is there a role ??
In Evolution ?

Intraductal Mass

RF ENERGY ABSORPTION – POOR SNR

SSFP (FISP / FIESTA)

CASE 1

53 year old lady with RUQ pain & jaundice

FISP / FIESTA Pulse Seq.

BILIARY STONE DISEASE

Detection

Complications-Cholangitis, Mirizzi Syndrome

Role

Anomalies/Variants

Underlying Disease

CHOLEDOCHOLITHIASIS

- 2mm and up
- T2 dark filling defects
- T1 Iso to Hyperintense
- Dependent (vs flow artifacts, air)
- Non-dilated ducts can create difficulty-20-30%
- Accuracy favorable to ERCP
  - Sens- 91%-100%
  - Spec- 85%-100%
- US and CT 60-85%

CHOLEDOCHOLITHIASIS

Recurrent symptoms after cholecystectomy
Cystic Duct Remnant Stone

ACUTE CHOLANGITIS

Laparoscopic Cholecystectomy almost doubles risk of iatrogenic bile duct injury
- Report Anomalies!!!
- Cystic duct variants (low, medial insertions, long parallel course)
- Aberrant RHD to CHD or cystic duct

UNDERLYING DISEASE

DISTAL CBD STRicture

Anomalies / Variations
Anomalies / Variations

Aberrant RHD to Cystic Duct !!

Long Parallel Cystic Duct with Low Insertion

Filling Defects Mimicking Stones

- Pneumobilia (Air)
- Flow artifact
- Stent
- Clip susceptibility artifact
- Neoplasm
- Blood Clot

FLOW ARTIFACT
STONE
STONE vs. FLOW ARTIFACT

Filling Defects Mimicking Stones

3D T2 FSE COR
AX T2

CASE 2

42 year old man with cholestatic picture on liver panel
PRIMARY SCLEROSING CHOLANGITIS

- Chronic obliterative inflammation of bile ducts
- Ulcerative colitis, M:F 2:1
- Intra and Extra hepatic disease >70%
- *Extrahepatic only <5-10% - Think IgG4*
- Overlap Syndromes-AIH,AIP
- MRI Sensitivity 86% & Specificity 94%*
- Screen by MRCP and ERCP limited to neg MRCP

*Primary Sclerosing Cholangitis: Meta-Analysis of Diagnostic Performance of MRI Cholangiopancreatography. Radiology 2010, 256:2,387-96*

MRI FEATURES

- Ductal Irregularity without Dilatation
- Multifocal Strictures
- Beaded or Pruned tree
- Parenchymal changes
- Cirrhosis
- Small duct PSC(10%) -Normal MRCP!

MULTIFOCAL STRICTURES

Intra and ExtraHepatic Disease

PARENCHYMAL CHANGES

Low power view of liver hilum showing periductal fibrosis.

Arrows indicate strictured segmental bile ducts.
**PSC & CholangioCA**

- 1% Annual Incidence
- Detection of CCA in PSC on single exam remains problematic
- Serial MR + Tumor Markers (CA 19-9) increases yield


- PET prior to transplant in advanced PSC?


**PSC-CCA**

**Warning Signs On MR Imaging**

- Short Interval Appearance/New area of Increased Biliary Dilatation
- Unequal Regional/Segmental Biliary Dilatation
- Subtle/New Parenchymal Lesion adjacent to Bile ducts
- MASS

8 MONTHS LATER

**Recurrent Pyogenic Cholangitis**

- “Oriental Cholangiohepatitis”-Clonorchis
- Recurrent episodes of acute pyogenic cholangitis
- Lateral Segment of left lobe and posterior segments of right lobe
- Irregular Strictures or ectasia
- Intraductal Stones (Pigment type)
- Duct wall thickening/enhancement
- Cholangiocarcinoma

**HIV CHOLANGIOPATHY**

CD4 < 100

MRI and MRCP of HIV Infection
Bilgin et al. AJR 2008; 191:228-232

CASE 3

62 year old man with jaundice

CHOLANGIOCARCINOMA

- Tumors arising from bile duct epithelium anywhere from liver periphery to Ampulla of Vater
- Diverse range of growth pattern, location and imaging appearances
- Diagnostic and Therapeutic Challenges

- MRI
  - Detection
  - Staging
  - Surveillance Hi Risk Groups

CLASSIFICATION

**The Liver Cancer Study Group of Japan**

GROWTH PATTERN**

Mass forming Periductal-Infiltrating Intraductal-growing

Mass Forming CCA

- Variable T2
- Capsular Retraction
- Peripheral Bile duct Dilatation

CLASSIFICATION

**The Liver Cancer Study Group of Japan**

GROWTH PATTERN**

- Periductal-Infiltrating
- Hilar
- Grow along bile duct wall deep to submucosa
- Perineural Invasion
- Unfavourable
**Periductal-Infiltrating**

**CLASSIFICATIONS**

**GROWTH PATTERN**

- Intraductal-Growing
- Rare
- Polypoidal or Sessile
- Superficial Surface growth
- Papillary
- Favourable

**Intraductal-Growing**

**STAGING - IMPLICATIONS**

- Surgical therapy - Resection or Transplantation is the only effective treatment
- 5-year survival with Surgery - 10-30%
  No Surgery - <1%
- Surgical Morbidity -25% & Mortality rate-5% is HIGH
- Accurate disease staging is critical!

**RESECTABILITY**

- Longitudinal and Radial Tumor Spread
- Vascular Involvement
- Lymph Node
- Distant Metastases
- Liver Volume
- Other Co-Existant Diseases

*Don’t Forget To Look for Biliary, Arterial and Portal Vein Anomalies*

**STAGING - CLASSIFICATIONS**

- Bismuth-Corlette (Perihilar)
- Memorial Sloan-Kettering / Blumgart
- **TNM**
STAGING – BISMUTH-CORLETTE

• Type I
  CHD within 2cm of Confluence

• Type II
  CHD involving both main RHD & LHD

• Type IIIa
  Biliary Confluence and Secondary RHD radicle

• Type IIIb
  Biliary Confluence and secondary RHD radicle

INCOMPLETE SCHEMA AS NO ACCOUNT OF VASCULAR INVASION, NODAL STATUS AND METASTASES

STAGING – BISMUTH-CORLETTE

• Type II
  CHD involving both main RHD & LHD

STAGING – BISMUTH-CORLETTE

• Type III
  Biliary Confluence and Secondary RHD radicle

STAGING – MEMORIAL SLOAN-KETTERING

T1 = Biliary Confluence +/- unilateral extent to 2nd order ducts

T2 = T1 with ipsilateral portal infiltration +/- ipsilateral lobar atrophy

T3 = Biliary confluence + bilateral extent to 2nd order ducts, unilateral extent to 2nd order ducts with contralateral portal vein infiltration or contralateral hepatic atrophy or involvement of main portal trunk or main hepatic artery

UNRESECTABLE TUMOR

• Infiltration beyond second order bile ducts in both liver lobes

• Invasion of secondary bile duct branches in one lobe/Lobar atrophy and vascular invasion in contralateral lobe

• Main portal vein or Main Hepatic Artery

• Both right and left branches of portal vein or hepatic artery

• Portal vein in one lobe and Hepatic artery in contralateral lobe

• Lymph Nodes Metastases beyond N1 station

• Distant Metastases

MEMORIAL SLOAN T3

Lobar atrophy and vascular invasion in contralateral lobe
**Mimics**

- **Colon Metastases**
  
  - *Intrahepatic Bile Duct Dilatation Due to Liver Metastases From Colorectal Carcinoma*
  
  - Jhaveri et al.

- **HCC**

- **AUTOIMMUNE PANCREATITIS (AIP)**

- **LYMPHOMA**

- **CASE 4**
  
  - 35 year old woman with incidentally detected liver cysts on US

**Choledochal Cysts**

- Anomalous junction of ducts (AUPBD) - common channel >1.5cm
- Classic (but uncommon) triad of RUQ pain, mass, jaundice
- Cholangitis and malignancy
- Surgical excision

**Choledochal Cyst and CCA**

Todani Classification  

**Summary**

- Limited no. of ways bile duct reacts to insult
- No specific signs of individual bile duct diseases
- Diagnosis requires good correlation of clinical, imaging and lab features
- MRI cornerstone and plays a key role
- Multi-modality imaging key especially tumor staging

Discretion: I do not endorse Starbucks or its products nor do I or my family have any financial relationship

 Courtesy: Dr. Masoom Haider, Toronto