MRI OF FOCAL LESIONS IN THE NON-CIRRHOTIC LIVER

Ivan Pedrosa, M.D. Ph.D.
Associate Professor of Radiology and Advanced Imaging Research Center
University of Texas Southwestern. Dallas, TX

Introduction

- Incidental liver lesions are found in >50% of patients at autopsy and in up to 17-33% of patients on imaging
- CT and MRI are both utilized for characterization of liver lesions
  - Higher rate of confident diagnoses with contrast enhanced MR (94.5%-97.6%) than CT (74.0%-92.9%)
- Lower rate for lesion characterization in setting of diffuse background liver disease (steatosis/siderosis)

Approach to Image Interpretation

Step 1: Assess background liver signal on T1w IP/OP for presence of steatosis or siderosis.

Step 2: Compare lesion signal (T1w) to background liver or spleen

Step 3: Categorize as lesion of primary hepatocellular vs. non-hepatocellular origin

Step 4: Differentiate between common non-hepatocellular lesions based on T2W (CHICMAB)

Pattern Recognition
- Faster
- Expertise

Structured Thinking
- Helpful for trainees
- Useful in difficult cases
Step 1: Assess background Liver SI (T1w IP/OP)

Normal - Step 2: compare lesion SI (T1w) to Background Liver

Lesion SI ≥ liver

Step 3: Category - Primary Hepatocellular Origin:

- FNH

Focal Nodular Hyperplasia (FNH)

- Women (oral contraceptives)
- Hyperplastic response to ↑ blood flow in central AVM

Hepatic Adenoma

- Benign proliferation of well-differentiated hepatocytes (high glycogen/fat)
  - Lack normal architecture, no bile ducts
- Solitary (80%), multiple (20%)
  - adenomatosis>10
- Almost exclusively young/middle-age women on oral contraceptives (OCPs)
- Bleed, malignant degeneration (HCC)

Hepatic Adenoma: Classification

- HNF1 (Hepatocyte nuclear factor 1α-inactivated) - 35-40%
  - Lack expression of liver-fatty acid binding protein (L-FABP)
  - Tumor has high fat content
- β-Catenin - 10-15%
  - Higher risk of malignant transformation (>4-5 cm)
- Inflammatory - 50%
  - Serum amyloid A (SAA) and C-reactive protein (CRP) expression
- Unclassified - <10%

HNF1 Hepatic Adenoma: MRI

- 35-40%
- Lack expression of liver-fatty acid binding protein (L-FABP)
- High tumor fat content (78%)
- No steatosis in liver

Inflammatory Hepatic Adenoma: MRI

- Is/SLightly hyperintense on T1 and slightly hyper on T2 (80%)
- Focal tumor fat content (17%)
- Steatosis in liver parenchyma (38%)
- Atoll sign (43%)

Inflammatory Hepatic Adenoma: MRI

- Hx of OCP
- Mild fatty liver
- Mild steatosis in mass.
- Path: Neg β-catenin

β-catenin Hepatic Adenoma: MRI

- Scar (75%)
- Pseudo capsule (75%)
- Poorly delimited high-SI areas
- Hemorrhage

Hepatic Adenoma: Malignant Degeneration

- Overall frequency of malignant transformation of 4.2% (68/1635 adenomas)
- Excluding adenomatosis & glycogen storage disease - higher risk of malignancy
- Only 3 (4.4%) in adenomas < 5 cm in diameter
- Mean age at Dx of malignant transformation is 41 years
- 32% complicated with hemorrhage
Hepatic Adenoma vs FNH: Eovist-MRI

- Hyperintensity or isointensity relative to the liver, which may be diffuse or peripheral, favours FNH
- A hypointense central scar strongly favours FNH (77% vs 21% HA)
- Diffuse hypointensity relative to the liver strongly favours HCA
- Sensitivity and positive predictive value (PPV) for HA of 96%
Hepatic Cysts

- Very common (14%), >40 yo
- Developmental: remnants of blind ending biliary ducts
- Cuboidal epithelium
- Homogeneous ↑↑ SI T2WI, ↓ SI T1WI
- Septations
- No enhancement

Hemangioma

- Congenital (??)
- Fibrous tissue/venous lakes
- Low SI on T1-WI
- Moderately high SI on T2-WI, usually less than cysts/fluid
- Nodular, discontinuous, peripheral enhancement with progressive, centripetal filling, and persistent delayed enhancement (= blood pool SI)

Giant Hemangioma

- "Lake-within-a-lake" appearance (pathognomonic?)
  - Better seen on SSFSE than multi-shot T2?
  - Central component rarely "fills in" with contrast

'Atypical' Hemangioma

- Low SI T1, High SI T2
- Capular retraction
- Decrease size over time
- Loss of previously seen regions of enhancement

Sclerosed Hemangioma (In Fatty Liver)

- Giant cavernous hemangioma (>10 cm)
- <1% of hemangiomas
- Rupture is extremely rare (28 cases reported)

Spontaneous Bleed in Giant Hemangioma

- Baseline
- Acute RUQ Pain
**Infection/Abscess**

- Thick walled lesions, low SI T1, high SI T2, progressive enhancement of wall.
- Adjacent parenchyma shows high SI T2 and possibly arterial enhancement.

**Biliary Cystadenoma**

- Benign neoplasm of the bile ducts
- Malignant potential
- Mucin-secreting columnar epithelium (SI on T1)
- 2 types:
  - with ovarian stroma (females) - better prognosis
  - without ovarian stroma

**Biliary Hamartomas**

- Von-Meyenburg complexes
- Size <5mm (<1.5 cm)
- Peripheral rim enhancement (compressed parenchyma)
- Neoplastic transformation?

**Inflammatory Pseudotumor**

- Epigastric pain and gastric ulcer
- Uncommon, benign, lesion that mimics a malignant tumor.
- Most likely inflammatory or infectious in origin

**Cholangiocarcinoma**

- Second hepatic malignancy (10-20%)
  - PSC, hep C, cirrhosis
- Periductal (Central)
  - Soft-tissue mass obstructing duct
  - Klastkin tumor: hepatic bifurcation
- Mass-forming (Peripheral)
  - Soft-tissue mass in parenchyma
  - Intraductal

**Inflammation Pseudotumor**

- Xanthogranulomatous inflammatory response that heals with scarring.

**Text Content**

- *GIST*
- *Hemangioma*
- *Infection-abscess*
- *Cholangiocarcinoma*
- *Metastasis*
- *Atypical hemangio
ea*
- *Biliary Cystadenoma*
- *Biliary Hamartoma*

- *GIST*
- *Hemangioma*
- *Infection-abscess*
- *Cholangiocarcinoma*
- *Metastasis*
- *Atypical hemangioma*
- *Biliary Cystadenoma*
- *Biliary Hamartoma*

- *GIST*
- *Hemangioma*
- *Infection-abscess*
- *Cholangiocarcinoma*
- *Metastasis*
- *Atypical hemangioma*
- *Biliary Cystadenoma*
- *Biliary Hamartoma*

- *GIST*
- *Hemangioma*
- *Infection-abscess*
- *Cholangiocarcinoma*
- *Metastasis*
- *Atypical hemangioma*
- *Biliary Cystadenoma*
- *Biliary Hamartoma*

- *GIST*
- *Hemangioma*
- *Infection-abscess*
- *Cholangiocarcinoma*
- *Metastasis*
- *Atypical hemangioma*
- *Biliary Cystadenoma*
- *Biliary Hamartoma*
**Cholangiocarcinoma: mass-forming**
- Low signal on T1
- Variable SI on T2
  - Hyperintense rim and central hypointensity (fibrosis)
- Hypervascular (arterial enhancing rim) in 30-50%
  - Longer disease-free survival?
  - more in chronic viral hepatitis
- Progressive concentric filling (fibrosis)

**Cystic/necrotic Metastasis**
- Very high SI on T2
- Areas with no enhancement
  - Neuroendocrine, sarcomas, melanoma
- “Penetrating vessels” also in lymphoma

**Hypervascular Metastasis**
- Arterial enhancement
  - RCC, melanoma, choriocarcinoma, thyroid
- High SI on T1
  - Melanin and/or Hemorrhage in melanoma

**Metastasis**
- Most common hepatic malignancy
  - Met vs primary, 40:1
- Variable appearance (primary)
  - Low SI on T1W
  - High SI T2WI with ill-defined margins (SSFSE)
- Peripheral enhancement
  - Portal phase

**Metastatic colon**
- Capsular retraction
- Desmoplastic tumor
- Segmental ductal dilation
- Eovist
  - Pseudo-washout during hepatobiliary phase (liver uptake)
Metastasis vs Hemangioma

- Hemangioma
- Metastasis

**T2 SSFSE**
- Metastasis

**T1 IP**
- Hemangioma

**Hemangioma**

**T1 IP**
- Metastasis

**T2**
- Hemangioma

**T1 FS**
- Metastasis

**ART**
- Hemangioma

**PORT**
- Metastasis

**DEL**
- Hemangioma

**Eovist**

**HB**
- Hemangioma

**T1 IP**
- Metastasis

**T2**
- Hemangioma

**T1 FS**
- Metastasis

**ART**
- Hemangioma

**PORT**
- Metastasis

**DEL**
- Hemangioma

Improved Detection of Liver Mets (Eovist)

**ART**
- Portal

**Dynamic CE-MRI**
- 16-18 sec Breath-holds

**Hepatobiliary Phase**

**12 sec Breath-holds**

**Liver Top**

**Liver Bottom**

**DWI: Contraindication to Gadolinium**

**Metastases in Polycystic Liver**

Detection & Characterization without I.V. Contrast

**DWI b500**

**DWI b1000**

**DWI b800**

**ADC**

**Fibrolamellar Carcinoma (FLHCC)**

- Rare (1-2% primary tumors)
- FLHCC+HCC worse prognosis
- Young females (25 y) without underlying liver disease
- AFP is normal
- Large size (13 cm), margins well-defined, low SI T1, high SI T2
- Central scar (71%)
- 80% arterial heterogeneous enhancement

**Ichikawa al. Radiology 1999**

- Central scar (71%)
- 80% arterial heterogeneous enhancement

**Lymphoma**

- Hepatomegaly, LN
- 1ry - extremely rare
- 2ry - non-Hodgkin (50%)
- Variable findings, non-specific
- Low SI T1, high SI T2 or low SI + high SI rim, target lesion (high SI rim with very high core on T2)
- Marked restricted DWI (cellular), vessel penetration sign
- Most low level enhancement
Step 1: Assess background Liver SI (T1w IP/OP)

Normal - Step 2: compare lesion SI (T1w) to Background Liver

Step 2: compare lesion SI (T1w) to Background Liver

Hepatic Steatosis

* Hepatocellular:
  - T1 IP similar/ > than normal liver

* Non Hepatocellular:
  - T1 IP lower than normal liver
  - Similar to normal spleen (iron!)

Hepatocellular Adenoma

Hepatic Steatosis

* Hepatocellular:
  - T1 IP similar/ > than normal liver

* Non Hepatocellular:
  - T1 IP lower than normal liver
  - Similar to normal spleen (iron!)

FNH

* Hepatocellular:
  - T1 IP similar/ > than normal liver

* Non Hepatocellular:
  - T1 IP lower than normal liver
  - Similar to normal spleen (iron!)

Metastasis

Any hypervascular (arterial enhancing) lesion

Fat from digestion

Hemangioma in Fatty Liver

Metastasis in Liver with Iron Overload

T1 IP

T1 OP

T2

B=0

T1 FS

ART

PORT
Benign

- Iso/hyper on T1W = Hepatocellular origin (FNH, adenoma)
- Very high SI on T2W SSFSE = cyst, hemangioma

Malignant

- Ill defined margins on T2W SSFSE/HASTE = Malignant (+ infection)
- Capsular retraction suggests IHC

Matos et al. WJH 2015