How to differentiate benign liver lesions

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Classical behavior of liver metastases (LM)

- Almost always extrahepatic metastases
- Colon CA, carcinoid and HCC may present with metastases limited to the liver
- CT routinely used, MRI as problem solver
- Characteristics similar to the primary tumor: hypo- or hypervascular
- Incomplete and central progression of lesion enhancement
- Early ring enhancement
- Peripheral wash-out on delayed scans
- Margins can vary from well defined to ill defined

Classical behavior of liver metastases (LM)

- Peripheral enhancement with hypodense center: most common
- Homogeneous enhancement in small lesions
- Heterogeneous enhancement in large lesions
- Stays of high signal on b0 → b600-1000 with DWI

TYPICAL MRI APPEARANCE

- Multiple and variable
- Moderately high SI on T2WI, low SI on T1WI
- Relaxation times between liver and cyst
- Hypovascular/thin vascular rim
- Hypervascular: NET, renal cell, breast, melanoma, thyroid
- Patterns: Doughnut, Target, Amorphous, Halo, Lightbulb

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Liver nodules mimicking metastatic disease

A. Primary benign liver lesions
1. Hemangioma
2. Focal Nodular Hyperplasia
3. Hepatocellular Adenoma
4. Nodular Regenerative Hyperplasia
5. Cyst
6. Biliary microhamartoma

B. Secondary benign liver lesions
1. Abscess

C. Hepatic Pseudolesions
1. Focal Steatosis, Focal spared Area in Fatty Liver
2. Inflammatory pseudotumor
3. Solitary Necrotic Nodule
4. Vascular disorders

Primary benign liver lesions
1. Hemangioma

Path.
- Composed of cavernous vascular spaces lined by a single layer of endothelium
- Supported by fibrous septa
- Varying degrees of thrombosis, sclerosis and calcification

MRI APPEARANCE:
- Signal intensity: Homogeneously hyperintense on T2, no halo
  - Mimicking metastases of a NET ("lightbulb" sign)
  - Low SI on T1
- Morphology:
  - Sharply circumscribed
  - Lobulated
  - Subcapsular (normal liver contour)
  - Cystic areas
  - Occasionally pedunculated
  - Calcification in <10% phleboliths
  - Fibrotic areas

Primary benign liver lesions
1. Hemangioma

MRI APPEARANCE:
- Enhancement pattern:
  - Peripheral nodular enhancement (same attenuation as aorta)
  - Progressive centripetal fill-in
  - The clue is the contrast pooling (same SI as the vessels at the equilibrium phase images)
  - Hyalinized hemangioma has internal fibrotic changes, does not fill up totally with contrast
  - Capillary hemangiomas: uniform early enhancement
  - Small hemangioma difficult to differentiate on portal venous phase CT: MRI is problem solver
Primary benign liver lesions
2. Focal Nodular Hyperplasia = FNH

- 2nd most common benign hepatic tumor
- 1-5% of population
- F>>> (5-17 :1)
- 3rd to 5th decade
- Incidental finding
- Rarely symptomatic
- Usually solitary
- Recent data shows that FNH is caused by a portal tract injury
  - Formation and enlargement of arterial to venous shunts
  - Local arterial hyperperfusion
  - Oxidative stress
  - Reaction from stellate cells to form central scar.
- Often other vascular lesions: adenoma, hemangioma, even HCC

Path:
- Hyperplasia of normal appearing hepatocytes
- Fibrous septae, which deviate the lesion into nodules
- Septae often merge centrally or eccentrically to form a scar (localized fibrosis)
- The scar and the septae usually contain 1 or more large arteries with fibromuscular hyperplasia
- The septae contain a variable number of proliferating bile ductules and inflammatory cells
- NO capsule
- Areas of necrosis or hemorrhage are very rare
Primary benign liver lesions
2. Focal Nodular Hyperplasia = FNH

MRI APPEARANCE:
- Signal intensity
  - Iso, hyp or hyper intense
  - High signal of the scar on T2
- Morphology
  - 2-10 cm
  - No capsule, fuzzy margin
  - No Calcification
  - Central stellate scar
  - 65% of big FNH
  - 35% of small FNH (<3 cm)
- Enhancement pattern
  - Homogeneous on all phases
  - Very hypervascular on arterial phase
  - Disappears on venous phase
  - Delayed enhancement of scar
  - Hepatobiliary agents: uptake and prolonged excretion (high SI)

Primary benign liver lesions
3. Hepatocellular Adenoma: mixed group

- Rare, 7-12/100,000
- Mostly in young women, associated with the use of contraceptive hormones (85%)
- Glycogen storage disease, anabolic steroids, ...
- Decreases in hormone dosage have led to a decrease in incidence
- 70-80% solitary
- Rarely “adenomatosis”, >3 to dozens
- In a non-cirrhotic liver
- Rarely transform to carcinoma
- Large tumors (>5 cm) may rupture and bleed
- Should be resected

Primary benign liver lesions
3. Hepatocellular Adenoma: mixed group

- Path:
  - Composed of hepatocytes in trabecular arrangement
  - Nuclei are regular
  - The cytoplasm may contain fat or glycogen
  - Areas of hemorrhage and scars from previous necrosis may be present
  - Lack of portal tracts
  - May contain sinusoidal dilatation
  - Seldom capsule
  - No bile ducts
Primary benign liver lesions
3. Hepatocellular Adenoma: mixed group

**MRI APPEARANCE:**
- Signal intensity
- Morphology
  - Well defined, smooth, round
  - Usually heterogeneous due to the fat, necrosis, hemorrhage, calcifications
  - If hemorrhagic
    - Large size
    - Heterogeneous
    - Hemosiderin rings
- Enhancement pattern
  - Hypervascular nature, may mimic HCC - hypervascular metastases
- Clue:
  - No clear diffusion restriction

Primary benign liver lesions
3. Hepatocellular Adenoma: RECENTLY DEIVED INTO GROUPS ~ genotype:

3. β-catenin mutated type (10%):
- Men and women
- High risk of HCC

**MRI APPEARANCE:**
- May mimic HCC (wash-out)

4. Unclassified HCA (10%)

Primary benign liver lesions
3. Hepatocellular Adenoma: RECENTLY DEIVED INTO GROUPS ~ genotype:

1. Inflammatory HCA (= previously telangiectatic FNH)(40%):
- Women > men
- Sinusoidal dilatation
- Inflammatory infiltrates and dystrophic arteries
- Risk of HCC

**MRI APPEARANCE:**
- T1: iso - hyper
- T2: hyper
- Gd: intense in art., persists in portal and delayed

2. Hepatocyt Nuclear Factor 1α mutated type (30-35%):
- Only women
- Adenomas frequently
- Intracellular fat = steatosis

**MRI APPEARANCE:**
- T1: iso - hyper
- T2: iso - slightly hyper
- Gd: moderate in art., iso in portal and delayed

Primary benign liver lesions
4. Nodular Regenerative Hyperplasia

= Nodular transformation, Non-cirrhotic nodulation, Adenomatous hyperplasia
- Rare: 0.72% of autopsies
- Male = Female
- Hepatic parenchyma is transformed into small regenerative nodules
- Portal hypertension
- Secondary to altered blood flow
- Obstructive portal or hepatic veins
- Associated with clinical conditions:
  - Malnutrition, prothrombotic, rheumatological, idiopathic
  - Common abnormal LFT (cholestatic), but no cirrhosis
  - Survival is related to underlying disease
  - Path.:
    - Multiple hyperplastic parenchymal nodules
    - Thickened liver-cell plates
    - No or only slightly fibrosis (=cirrhosis)
Primary benign liver lesions

4. Nodular Regenerative Hyperplasia

**MRI APPEARANCE:**
- **Signal intensity**
  - Hypo on T2
  - Hyper- to isointense on T1
- **Morphology**
  - Multiple
  - Small (1-4cm)
- **Enhancement pattern**
  - Hypervascular homogeneous enhancement
  - Unlike HCC, may take up and retain Gd-EOB-DTPA (=benign)
- Imaging studies are usually unable to provide definitive diagnosis as lesions are very small and difficult to differentiate from cirrhosis
- Definitive diagnosis is by biopsy

5. Cyst

- In utero intrahepatic duct formation defects
  - ductules that lack connection from rest of the biliary tree
dilate to form simple cysts
- Solitary in > 50%
- Polycystic disease
- Most < 5cm
- Can be confusing, if small, on CT scan (partial volume effect)
Primary benign liver lesions
6. Biliary microhamartoma (Von Meyenburg Complexes)

- 60-70% male
- Prevalence ranges from 0.7 to 2.8% on autopsy series
- Usually asymptomatic
- Pathology:
  - Fibrous stroma
  - Contains irregular duct-like structures
  - Ducts are dilated
- Benign malformations of the intrahepatic bile ducts
- Primitive and aberrant bile ducts
- Cystic dilatation of bile ducts

**MRI APPEARANCE:**
- Signal intensity
  - High SI on T2
- Morphology
  - Wall-defined focal collections of varying degrees, usually less than 5mm
  - Enhancement pattern
    - No enhancement
- Can be confused with liver metastases, microabscesses, liver cysts, Caroli’s disease and biliary adenoma
- Primary tumors causing cystic liver metastases are usually colorectal CA, melanoma, carcinoid, breast CA, renal cell CA and ovarian CA

Secondary benign liver lesions
1. Abscess

- RUQ pain, malaise, weakness, anorexia, fever
- Inflammatory tests
- 80% pyogenic
- Often associated with pelvic abscess or with cholangitis

**MRI APPEARANCE:**
- Signal intensity
  - High SI on T2 (odd cyst)
- Morphology
  - Heterogeneous
  - Multiloculated
  - Clustered satellite lesions
- Enhancement pattern
  - Rim enhancement
- DWI:
  - Differentiate from cystic or necrotic tumors
  - Filled with pus with a high viscosity and cellularity: decreased ADC
  - Decreased ADC-values mimicking necrotic metastases but decreases in the central part (as mets in the peripheral solid part)
  - Segmental perfusion disorders at the late arterial CE imaging phase
**Hepatic Pseudolesions**

1. Focal Steatosis, Focal spared Area in Fatty Liver

**MRI Appearance:**
- **Signal intensity**
  - Combination of in-phase and out-of-phase GRE imaging to detect steatosis with the aid of the chemical shift technique
  - If severe: can be high SI on T1 and T2
- **Morphology**
  - Characteristic location: gallbladder, falciform ligament, periportal
  - Lack of mass effect
  - Branches of the hepatic and portal veins traverse it without change in their course
  - Normal liver contour
  - Well demarcated
- **Enhancement pattern**
  - Same contrast behaviour as normal hepatic tissue
  - No changes on DWI
Hepatic Pseudolesions
2. Inflammatory pseudotumor (IPT)

- A rare benign lesion that shows regression over the course of a month on repeated imaging modalities
- Reason for surgical resection in many cases
- Consist of a fibrous stroma and an inflammatory cell infiltrate
- Etiology in the liver remains doubtful, although infection, biliary obstruction, chronic cholangitis and primary sclerosing cholangitis have been suggested

MRI APPEARANCE:
- Signal intensity
  - Variable
- Morphology
  - Appears as a well-defined mass and has a resemblance to malignancy on imaging
- Enhancement pattern
  - Early arterial enhancement (active inflammation) and increased contrast retention (chronic inflammation due to fibrosis)
  - Clue to DD with metastasis: DWI with high b-values: low SI (+: mets high)

Hepatic Pseudolesions
3. Solitary Necrotic Nodule

- Solitary Necrotic Nodule of the liver is an uncommon lesion, which despite its name, may be multiple
- It may represent the end-stage of a range of benign lesions such as larval infestation, sclerosed hemangioma or (post-surgical, post-radiation) trauma
- Differentiation by means of CT/MRI between these nodules and hepatic metastases remains very difficult or impossible.
- PET scan (DWI?) may aid in the diagnosis
Hepatic Pseudolesions
4. Vascular disorders

- Can mimic hypervascular metastases
- Frequently in cirrhotic liver
- Typically not round
- No diffusion restriction

CONCLUSION
Things to consider:
- Cirrhotic or Non cirrhotic
- Symptomatic or Incidentally detected
- History of Hepatitis, PSC, or malignancy
- Age, gender, OCPs
- Travel history

**Gender**
- Female: HCA (almost always), FNH (variable), Hemangioma
- Male: HCC

**Age**
- 30's: FNH, HCA
- 40's: FNH, Abscess
- 50's: Cyst, Hemangioma, LM, Abscess
- 60's: Cyst, LM, HCC

**Clinical Factors**
- Symptomatic
- Asymptomatic
- HCC, Hemangioma
- Cyst, FNH, Abscess
Biopsy provides definitive diagnosis, but not always required

Follow up imaging for small benign appearing lesions in patient without risk factors for HCC

CONCLUSION

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