Differential diagnosis of focal liver lesions

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Overview

• Imaging techniques

• «classic» benign and malignant focal liver lesions

• You can do it yourself! (80-90%)
Imaging techniques

CT: availability (+), radiation (-)

MRI: availability (-), radiation (+)

(Ultrasound): low costs (+), time consuming (-), strongly operator dependent
Dynamic contrast phases

**CT**

- Non-contrast enhanced
- Arterial (early, late), portal venous, venous, late phases (wash-out in HCC)

**MRI**

- Pre-contrast: T2w, T1w fs, in- und opposed phase, DIXON
- Dynamic contrast phases: arterial (up to 5 Phasen), portalvenous, venous
- Late phases after 5, 10, 20 minutes, 120 min (Multihance) (intracellular uptake)
Dynamic contrast phases in CT

- Early arterial phase
  CT-angiography

- Late arterial phase
  hypervascularized tumors

- Venous phase
Dynamic contrast phases in MRI

arterial phase

portalvenous phase

venous phase
Late phase with liver specific contrast media:
Primovist (5-20 minutes)
Multihance (approx. 120 min)
Gadolinium based contrast agents (GBCA)

Normal renal and liver functions

Vascular and Extra-cellular Spaces

Gadoxetate 50%
Gadobenate 5%
Other GBCAs 0%

Liver

via the bile ducts and bowel into the feces

Gadoxetate 50%
Gadobenate 95%
Other GBCAs 100%

Kidneys

via the renal collecting system into the urine

intra-venous injection

Gadoxetate
Gadobenate
Other GBCAs
Imaging protocol MRI of the liver

Multi-parametric (predominantly non-liver-specific MRI contrast media) approach

- Heavily T2-w SSTSE/SSFSE/HASTE
- Moderate T2-w TSE/FSE/DWI low b
- DWI DWI w/ two b-values
  DWI w/ multiple b-values (IVIM)

Fat detection/quantification IPOP/IDEAL/DIXON

Pre-contrast T1 THRIVE/LAVA/VIBE/DIXON

Liver-specific MRI contrast medium approach

- Fat detection THRIVE/LAVA/VIBE/DIXON
- Pre THRIVE/LAVA/VIBE/DIXON
- ART THRIVE/LAVA/VIBE/DIXON
- POR THRIVE/LAVA/VIBE/DIXON
- DEL THRIVE/LAVA/VIBE/DIXON

HBP 5 minutes

- T2-w TSE/TSE

HBP 10 minutes

- T2-w TSE/TSE

HBP 15 minutes

- T2-w TSE/TSE

HBP 20 minutes

- DWI DWI w/ two b-values

HBP (1-5 hour window)
Hepatocyte in a normal liver

Hepatocyte in HCC lacking Transporter I activity

Hepatocyte in FNH with reduced Transporter II activity

HBP (Gadobenate) normal liver

HBP (Gadobenate) - HCC in cirrhotic liver most common uptake pattern

HBP (Gadobenate) normal liver with FNH
Focal liver lesions

Lesions that are clearly good or bad
Diagnostic certainty >99%
You can do it yourself!

Some are ugly
Diagnostic certainty 50-90%
Get help (Radiologist etc.)
Literature

The best book so far!

coming soon, July 2016
General aspects about characterizing a liver lesion

• Position
• Size (variation over time)
• Boundary
• Density in CT
• Signal in MRI (T2w, T1w pre and post contrast medium)
• Late hepatobiliary phase uptake decrease
• Vessel infiltration
The good:
Lesions everyone should be able to differentiate

- Cysts
- Hemangioma
- Focal nodular hyperplasia (FNH)
- Biliary Hamartoma
Simple cysts

Derived from biliary endothelium
Content: fluid
Sharp margins
Single – multiple
Imaging:
US: low central echogenity, increase behind lesion
CT: low density
MRI: bright in T2w, low signal in T1w, no contrast enhancement
Simple liver cyst

Variantion in size
Single vs. multiple

Patient with adult polycystic kidney disease (APKD)
Hemangioma

Most common benign liver lesion, incidence up to 20%

Composed of dilated vascular channels filled with blood lined by single layer of endothelial cells and supported by thin fibrous stroma

Types:

- Capillary or high-flow-hemangioma (type 1), 1-2 cm
- Cavernous (type 2), most common, < 5 cm
- Giant (type 3) >5 cm
- Atypical
Hemangioma: small (1-2 cm)

US: lobulated contour
Homogeneous hyperechoic mass

MRI: low signal in T1w, bright in T2w
**Hemangioma: cavernous**

Nodular hyperenhancement
Centripetal fill-in on later images
Enhancement follows blood pool
= Iris diaphragm phenomenon

MRI: T1w pre contrast, 20, 55, 120 sec post contrast
Hemangioma: Giant >5cm

T2w

T1w+contrast (15 sec)

T1w+contrast (60 Sek)

T1w+contrast (120 sec)
FNH: Focal Nodular Hyperplasia

Lesion with hyperplastic response to localized vascular abnormality

homogeneous, vascular, nonencapsulated mass with a central scar and thin radiating septa dividing the mass into hyperplastic nodules.

liver wedge resection shows a well-circumscribed nodular lesion with a central stellate scar, typical of FNH.
FNH: CT

• Unenhanced: isodense, might not be seen at all

• Arterial phase: strong enhancement

• Portalvenous phase: isodense again, delayed enhancement of central scar

• Central scar in about 50%
FNH: MRI

- In T2w and T1w nearly isointense
- After contrast medium
  - Bright homogeneously enhancing mass on arterial phase CT or MR with delayed enhancement of central scar
  - Hyperintense enhancement on hepatobiliary phase after liver specific cm
  - Uptake > surrounding liver tissue
Biliary hamartoma

- benign malformations of biliary tract, a.k.a. von Meyenburg complexes
- Usually asymptomatic
- Multiple, near water density/intensity liver lesions <15 mm in diameter
  - No contrast enhancement
  - No communication with biliary tree
The bad:

Lesions everyone should be able to differentiate

• Hepatocellular carcinoma (HCC)

• Metastases
Hepatocellular Carcinoma (HCC)

- Most frequent primary malignant tumor of the liver
- Massive increase in incidence

Key imaging features
- Heterogeneous hypervascularity on arterial phase (CT or MR) with washout on venous and delayed
- Hypointense lesion on hepatobiliary phase of gadoxetate-enhanced MR
- Presence of a capsule
- Evidence of portal or hepatic vein invasion
Hepatocellular Carcinoma (HCC): CT
HCC: MRI

T2w fs

T1w arterial fs

T1w venous phase
Metastases

Most common malignant liver lesion

• Hypovascular metastases: Low-density center with peripheral rim or target-like enhancement

• Hypervascular metastases: Hyperdense (intense) on arterial phase CECT or CEMR

• Cystic metastases: < 20 HU, fluid levels, debris, mural nodules

• Liver-specific MR contrast agents: Hypointense lesions made more apparent compared with bright enhancement of liver on delayed phase imaging
Liver metastases

- multiple spherical liver lesions with a "target" appearance
- most typical appearance for liver metastases, especially from colon cancer.
- Containing blood vessels may be seen
- focally dilated bile ducts due to compression by the metastases
Liver metastases: MRI

**Fig. 42.1** Metastasis, colorectal, drawings. **T2 fatsat:** Metastasis is predominantly hyperintense to the liver with a brighter center; **T1 in phase:** metastasis is hypointense to the liver; **ART:** metastasis shows a typical irregular ring-shaped enhancement; **DEL:** metastasis shows heterogeneous enhancement.
Liver metastases: DWI and liver specific cm

- Increased detection of small lesions
- “Uptake defect”
- DWI: b image useful especially in NET metastases
The ugly

Lesions that may be difficult to differentiate

Fibrolamellar carcinoma

Adenoma

Cholangiocarcinoma (CCC)

Hepatic angiosarcoma

Some more rare entities...
Fibrolamellar carcinoma (FLC)

- Heterogeneously enhancing, large, lobulated mass with hypointense central scar and radial septa
- Calcification and necrosis are common (> 50%)
- Nodal metastases (> 50%)
- Vary from 5-20 cm (mean: 13 cm)
- Slow-growing tumor that usually arises in normal (noncirrhotic) liver
- Also in young age!

- DD FNH
  - homogeneous contrast uptake
  - no calcification
Hepatic adenoma

Heterogeneous group of benign hepatocellular neoplasms with distinctive genetic, pathologic, and clinical features

Heterogeneous, hypervascular mass with foci of fat or hemorrhage in a young woman

DD: FHN

• Liver specific contrast medium: Adenoma shows no substantial uptake or retention
• Key distinction from FHN

DD: HCC

• Older patients, cirrhotic liver
Quiz cases

www.rippenspreizer.com
Case 1  Cysts, one with increased proteine content

T1w without cm

T2w

20 min after liver specific cm
Case 2

T2w

T1w without cm
Case 2

Diagnosis: FNH

Cyst?  
HCC?  
Hemangioma?  
Metastasis?
Summary

Remember:

There are many lesions that are clearly good or bad.
You can do it yourself in many cases!
Thank you!

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Differenzierung fokale Leberläsionen

**a)**
- **T2**
- hyperintense similar to fluid
- Liver

**b)**
- **T2**
- hyperintense slightly lower than fluid
- Liver

**c)**
- **T2**
- moderately hyperintense
- Liver

**Cyst**
- **T1**
- hypointense
- **ART**
- no enhancement
- Liver

**Hemangioma**
- **T1**
- hypointense
- **ART**
- peripheral nodular enhancement
- Liver

**Metastasis**
- **T1**
- hypointense
- **ART**
- irregular ring enhancement
- **DEL**
- peripheral washout contrast gradient moves centrally
- Liver
Differenzierung fokale Leberläsionen

- **Differenzierung fokale Leberläsionen**
  - **FNH**
    - T1: near-isointense
    - ART: intense homogeneous enhancement
  - **HCA**
    - T1: near-isointense
    - ART: faint homogeneous enhancement
  - **HCC**
    - T2: heterogenous, predominantly hypointense
    - T1: heterogenous, predominantly hypointense
    - ART: heterogeneous enhancement
    - DEL: washout with capsular enhancement

**Images:**
- **d**: FNH with central scar
- **e**: HCA with faint enhancement
- **f**: HCC with heterogeneous appearance

**Legend:**
- **T2**: T2-weighted image
- **T1**: T1-weighted image
- **liver**: Liver
- **ART**: Arterial phase
- **DEL**: Delayed phase

**Additional Terms:**
- **near-isointense**: Similar intensity to surrounding tissue
- **intense**: Bright intensity
- **faint**: Slightly bright intensity
- **heterogeneous**: Varying intensities within the lesion
- **hypointense**: Darker than surrounding tissue
- **hypointense**: Darker than surrounding tissue
- **capsular enhancement**: Enhanced tissue boundary