

Chapter 15

Benign Entities

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Benign Entities

Introduction

Many benign entities may occur in patients with cirrhosis.

- These may be related to the underlying cirrhosis (e.g. regenerative nodules, vascular shunts, confluent fibrosis) or be incidental non-hepatocellular lesions (e.g., cysts, hemangiomas) that predate cirrhosis.

LI-RADS v2018 does not provide strict imaging criteria for diagnosis of benign entities. Rather, it relies on radiologists' prior knowledge of the typical imaging appearances of various benign lesions.

The presence of underlying cirrhosis may alter the typical imaging appearance of benign lesions due to compressive effects of adjacent fibrosis/regeneration and perfusional changes related to portal hypertension, intrahepatic portosystemic shunts, diminished portal flow, and compensatory increase in arterial flow.

If, in the radiologist's judgment, the imaging features of an observation are:

- Diagnostic with 100% certainty of a benign entity : LR-1 category is assigned
- Suggestive but not diagnostic with 100% certainty of a benign entity: LR-2 category is assigned

Otherwise, a category of LR-1 or LR-2 cannot be assigned; the LI-RADS diagnostic algorithm should be applied to assign the appropriate category (see [CT/MRI Diagnostic Table](#))

This Chapter discusses the following benign entities that may be identified in the livers of patients at high risk for HCC and that usually should be categorized LR-1 or LR-2:

- Cyst ([page 15-2](#))
- Hemangioma ([page 15-4](#))
- Perfusion alteration ([page 15-11](#))
- Hepatic fat deposition ([page 15-14](#))
- Focal fat sparing ([page 15-16](#))
- Confluent fibrosis ([page 15-18](#))
- Hypertrophic pseudomass ([page 15-21](#))
- Focal scar ([page 15-23](#))
- Vascular anomaly ([page 15-25](#))
- Distinctive nodule without malignant imaging features (LR-2) ([page 15-26](#))

Cyst

RADLEX ID: RID3890

Definition

Fluid-filled closed cavity lined by benign epithelium.

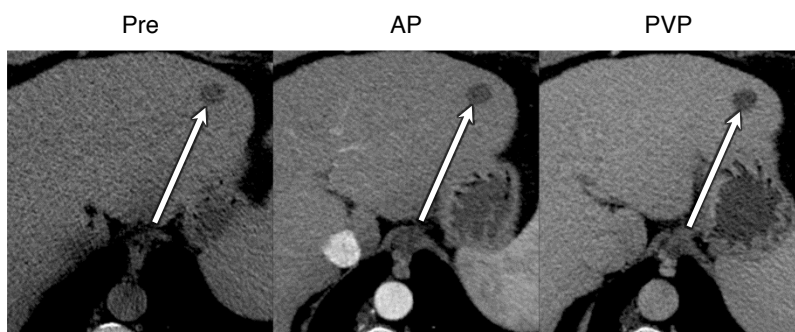
Categorization

- Observations thought to definitely represent cysts should be categorized LR-1, e.g., cysts with typical imaging features and large enough to characterize.
- Observations thought to probably represent cysts should be categorized LR-2, e.g., cysts with mildly atypical features or low density lesions too small to characterize at CT.
- Observations that are indeterminate for cysts versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

- Well-defined, round/oval, sometimes with smooth lobulations
- Single or multiple
- On CT:
 - Fluid attenuation (< 20 HU)
 - No enhancement ($\Delta < 20$ HU)
- On MRI:
 - Markedly hyperintense on T2w
 - Hypointense on T1w
 - No enhancement

Example: CT



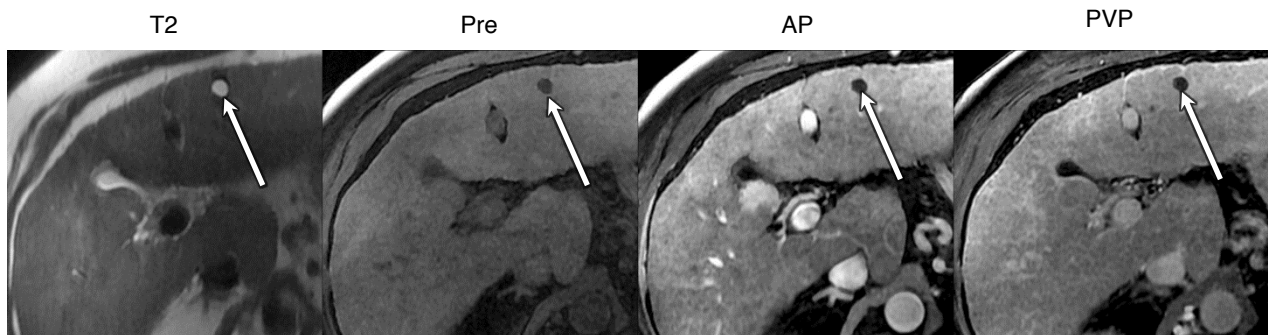
Well-defined observation demonstrating fluid attenuation and no enhancement

Cyst

RADLEX ID: RID3890

Typical imaging features (Cont'd)

Example: MRI



Well-defined observation demonstrating markedly high signal on T2w and no enhancement

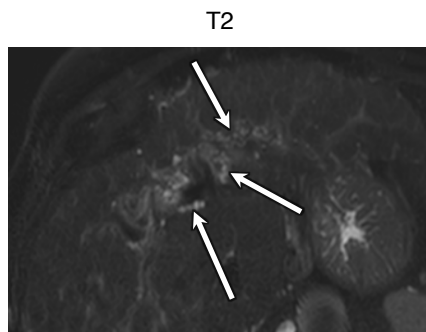
Comments

Most cysts are easily recognized, cause no diagnostic confusion, and do not require reporting. Radiologists may choose at their discretion to report cyst(s).

The two most common cysts in the liver are

- hepatic cysts
- cystic biliary hamartomas.

Peribiliary cysts are rare cysts associated with advanced cirrhosis and caused by cystic dilatation of the extramural glands in the periductal connective tissue. They parallel the bile ducts, and they may be misinterpreted as dilated bile ducts.



Peribiliary cysts: Clusters of tiny cysts distributed along the intrahepatic bile ducts

Hepatic cysts, cystic biliary hamartomas, and peribiliary cysts do not communicate with the bile ducts.



Hemangioma

RADLEX ID: RID3969

Definition

Benign tumor consisting of vascular channels lined by endothelial cells.

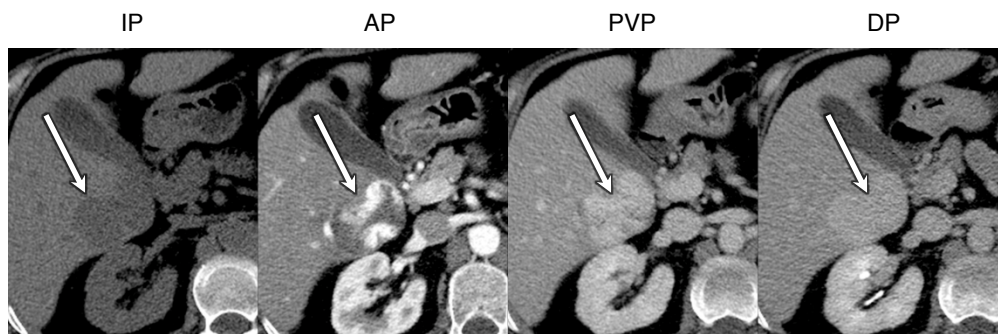
Categorization

- Observations thought to definitely represent hemangiomas should be categorized LR-1.
- Observations thought to probably represent hemangiomas should be categorized LR-2.
- Observations that are indeterminate for hemangiomas versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

- Peripheral discontinuous puddles of enhancement in arterial phase with progressive central expansion and coalescence of puddles in PVP and DP without “washout”. Intensity of enhancement approximately parallels blood pool (e.g. adjacent vessels). Hence, enhancement:
 - persists on CT (although may be difficult to ascertain, see pitfalls below)
 - persists on ECA-MRI
 - declines over time compared to the liver on gadoxetate-MRI (see pitfalls below)
- Sharply demarcated, markedly hyperintense on T2w images
- ADC lower than cysts but higher than liver: ADC overlaps with malignant lesions
- No fat, no blood products, no capsule
- In cirrhotic liver: no growth; instead, may involute over time

Typical hemangioma: CT



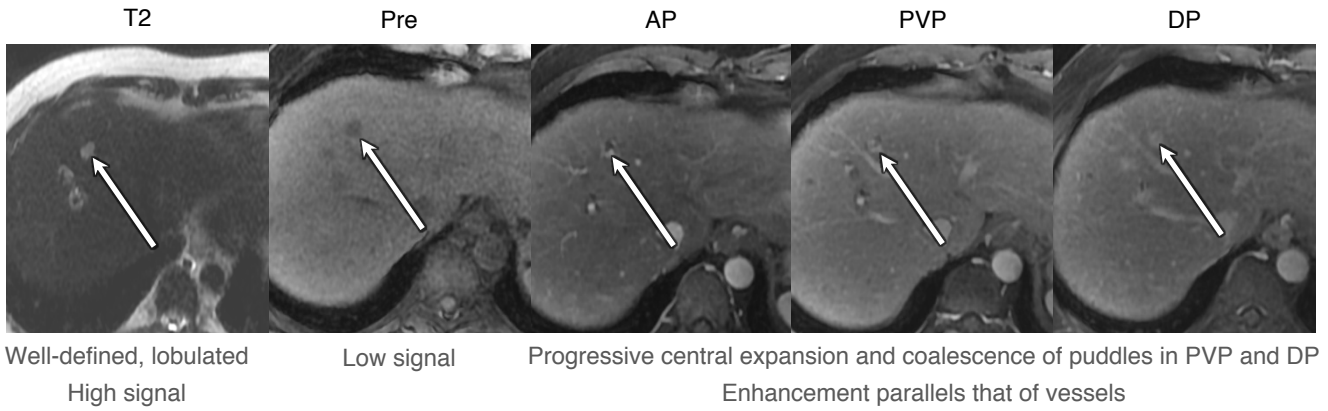
Early peripheral nodular enhancement

Progressive central expansion and coalescence of puddles in PVP and DP
Enhancement parallels that of vessels

Hemangioma

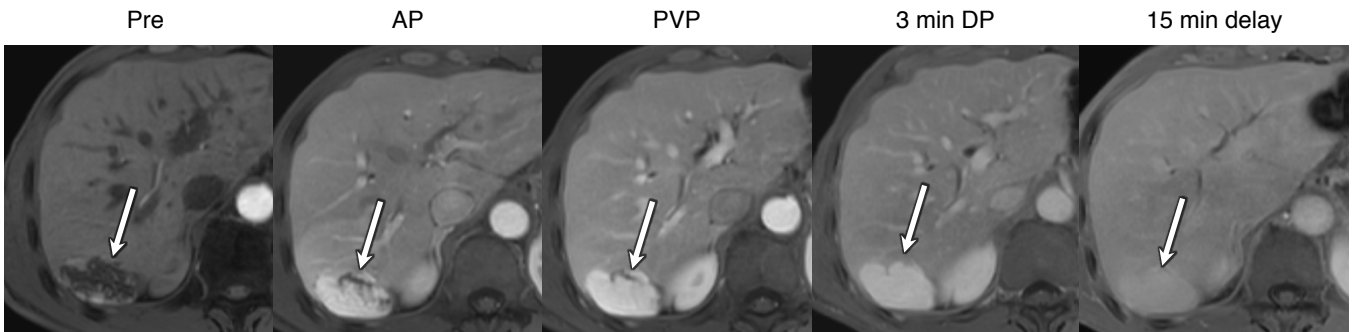
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Typical hemangioma: MRI-ECA

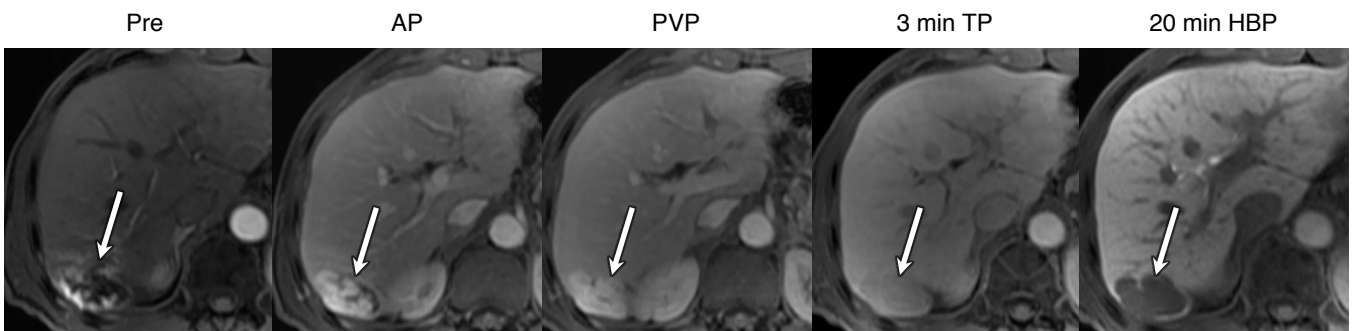


Typical hemangioma: MRI-ECA vs MRI-Gx

MRI-ECA



MRI-Gx





Hemangioma

RADLEX ID: RID3969

Pitfalls and practical considerations

Hemangiomas are seen less frequently in cirrhotic than in non-cirrhotic livers.

In patients with advanced cirrhosis, hemangiomas may be difficult to diagnose confidently at CT and MRI. Comparison to prior studies when cirrhosis was less advanced may be helpful, as the hemangioma may have had more characteristic features previously.

Sclerosing hemangioma

Cirrhosis tends to alter the appearance of hemangiomas so that hemangiomas in cirrhosis may lack the typical features described on [page 15-4](#). Instead, hemangiomas in cirrhosis may become fibrotic and involute over time (“sclerosing hemangioma”) manifesting the following unusual features:

- Rim APHE (attributed to coalescence of once peripheral, discontinuous puddles)
- Slow incomplete progressive central expansion and coalescence of puddles
- Mild rather than marked T2 hyperintensity (attributed to fibrosis)
- Poorly demarcated rather than sharply demarcated on T2w images (attributed to fibrosis inside and out the lesion)
- Liver surface retraction if peripherally located (attributed to “desmoplastic” effect from intralesional fibrosis)
- Enhancement less than that of blood pool

Owing to rim APHE and other features, sclerosing hemangiomas may resemble iCCA or other non-HCC malignancies and be categorized LR-M.

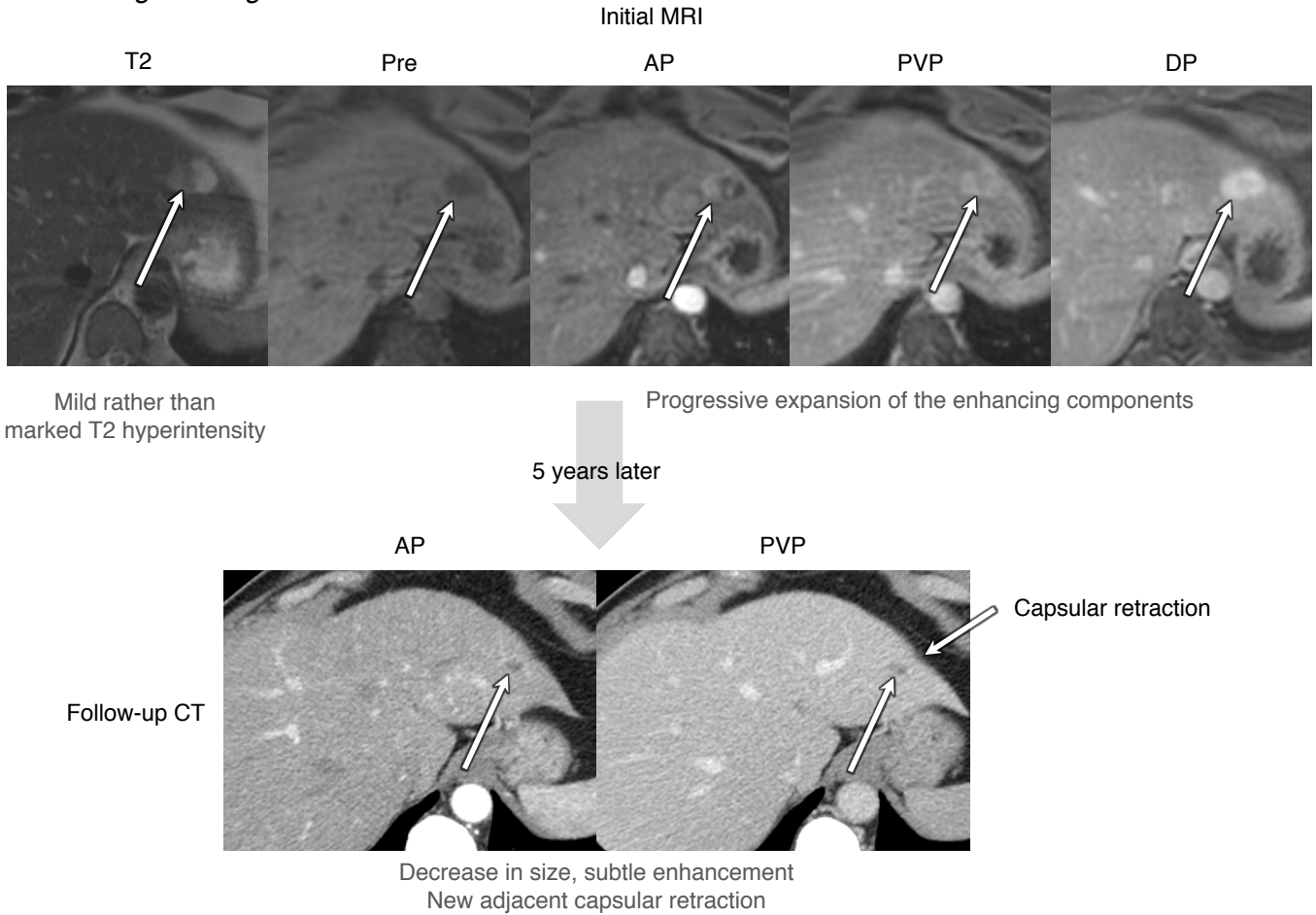
- Key differentiating feature:
 - Sclerosis hemangiomas may involute over months to years. Hence, size reduction over time strongly favors sclerosing hemangioma and may permit LR-2 categorization.
 - As a corollary, growth strongly favors iCCA or other non-HCC malignancy and should prompt LR-M categorization. Growth of small iCCA may take many months to observe.
- Other clues:
 - Sclerosing hemangiomas tend not to have markedly restricted diffusion and do not show peripheral washout.
 - Hence, marked diffusion restriction (especially if targetoid) and peripheral washout strongly favors iCCA or other non-HCC malignancy and should prompt LR-M categorization.

Hemangioma

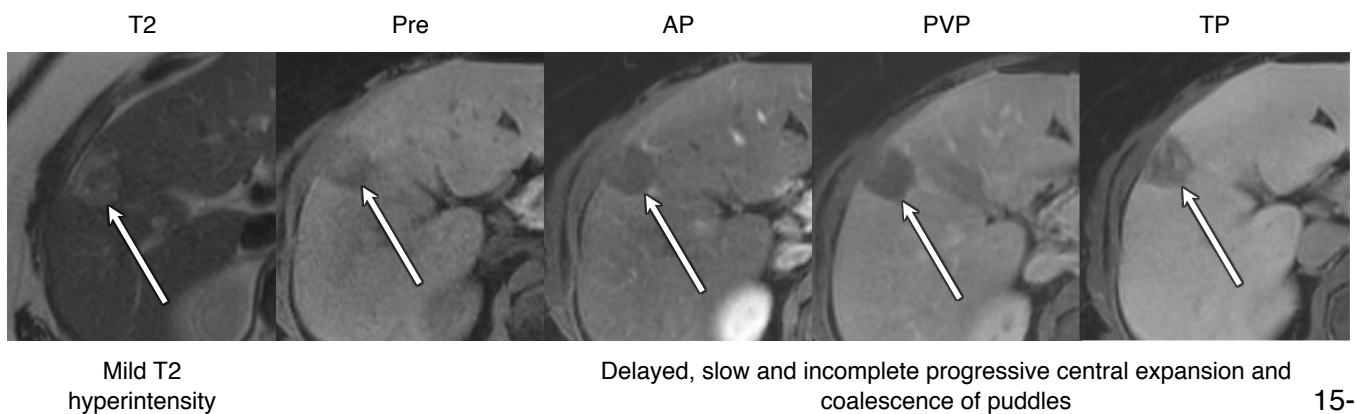
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Pitfalls and practical considerations (Cont'd)

Sclerosing hemangioma: MRI and CT



Sclerosing hemangioma: MRI (path-proven)



Hemangioma

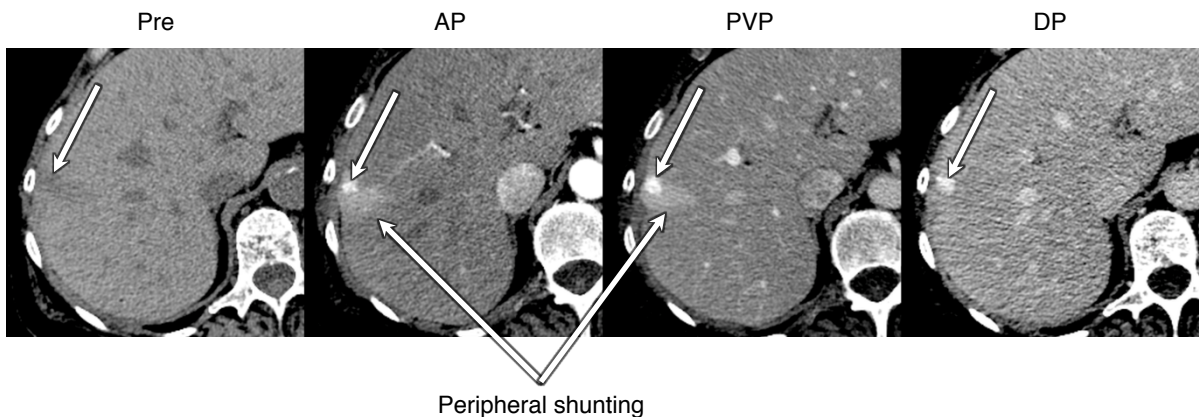
RADLEX ID: RID3969

Pitfalls and practical considerations (cont'd)

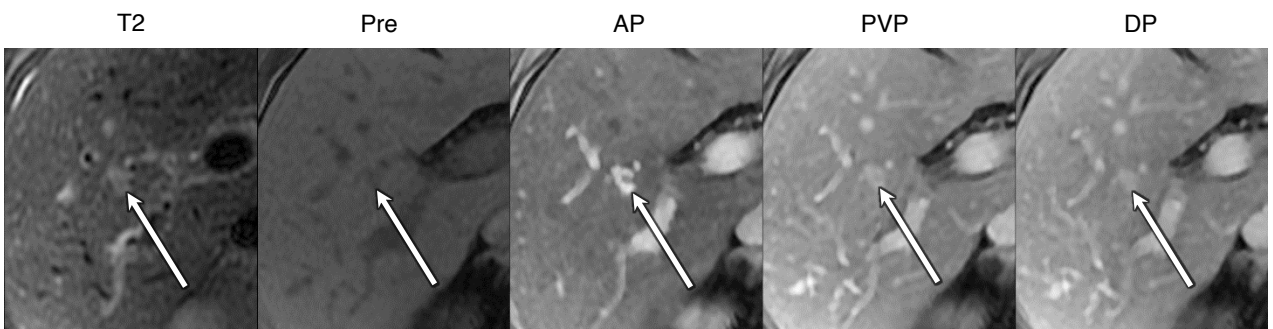
Rapidly enhancing (“flash-filling”) hemangioma

- Usually small
- Enhance uniformly and strongly on AP
- Degree of enhancement follows that of the intrahepatic vessels
- Associated with arteriportal shunting – manifests as wedge shaped area or rounded halo of enhancement in surrounding parenchyma. The area of AP shunting fades to isoenhancement in the postarterial phases.

Rapidly enhancing hemangioma: CT



Rapidly enhancing hemangioma: MRI





Hemangioma

RADLEX ID: RID3969

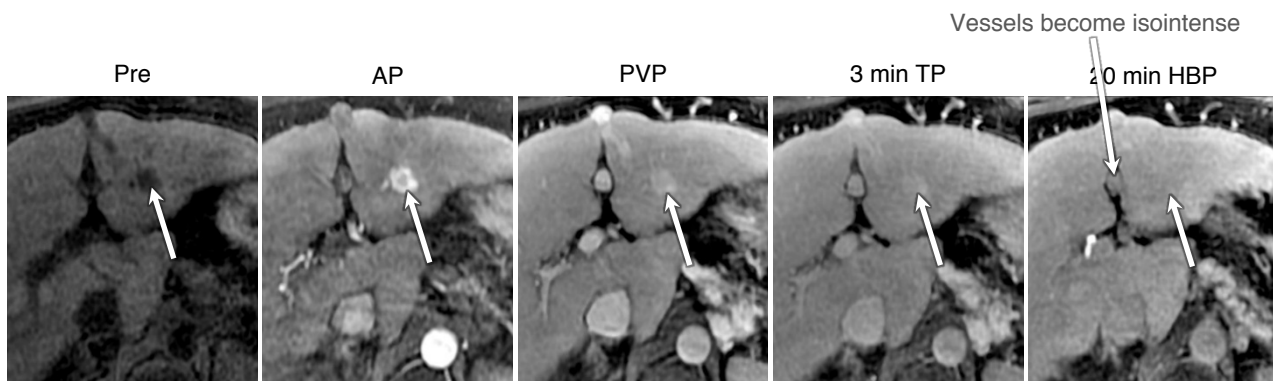
Pitfalls and practical considerations (Cont'd)

Enhancement parallels blood pool – May be difficult to ascertain on CT:

- Blood vessels fade to isoattenuation in the delayed phases.
- Hence hemangiomas also fade to isoattenuation, which may cause diagnostic confusion.
- However, hemangiomas never wash out to become hypoattenuating on CT.

Enhancement parallels blood pool – May be difficult to ascertain on gadoxetate-MRI:

- Assessment depends on degree of liver function/dysfunction and uptake of gadoxetate.
- In a normal liver and cirrhotic liver with preserved hepatocellular function, blood vessels gradually darken and become increasingly hypointense relative to liver from the TP to the HBP. Hemangiomas follow the same intensity and may appear to washout relative to the liver (“pseudowashout”).
- In markedly cirrhotic liver with reduced hepatocellular function, blood vessels may fade to isointensity rather than becoming hypointense. In this setting, hemangiomas also fade to isointensity, potentially causing diagnostic confusion.



On AP, PVP and TP, the enhancement is typical of hemangioma. On HBP, the hemangioma is isointense to liver, as are the intrahepatic vessels.



Hemangioma

RADLEX ID: RID3969

Pitfalls and practical considerations (Cont'd)

Diffusion-weighted imaging

- Appearance on DWI and ADC values do not reliably differentiate hemangiomas from malignant lesions.
 - Hemangiomas may have variable signal on DWI depending on b-value, T2-shine through, and intrinsic ADCs of the hemangioma and background liver.
 - In general, hemangiomas tend to be bright on moderately and even heavily diffusion-weighted sequences, mainly due to T2 shine through, but this can be misinterpreted as restricted diffusion.
-

Perfusion Alteration

RADLEX ID: RID39473

Definition

Change from the usual blood supply in the liver parenchyma.

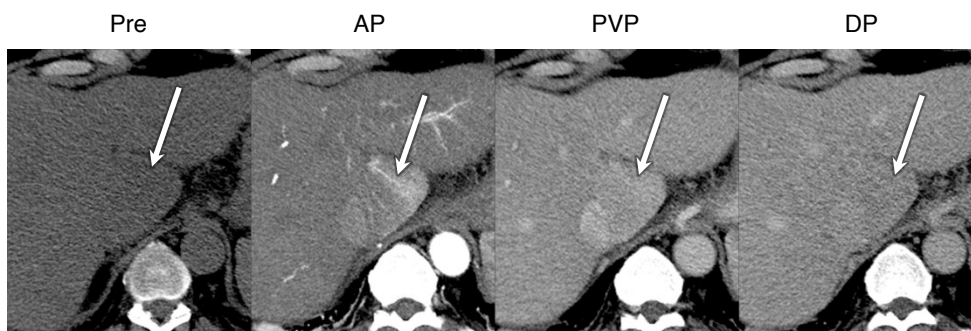
Categorization

- Observations thought to definitely represent perfusion alteration should be categorized LR-1.
- Observations thought to probably represent perfusion alteration should be categorized LR-2.
- Observations that are indeterminate for perfusion alteration versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

- Perfusion alterations, also known as areas of transient hepatic enhancement difference (THED) typically show, relative to liver:
 - Hyperenhancement in the arterial phase
 - Isoenhancement in the portal venous phase and delayed phase
 - Isoattenuation at unenhanced CT and isointensity at T2w, DW, and unenhanced T1w MRI
- Perfusion alterations/THEDs may have variable morphologies (wedge-shaped, rounded) and distributions (diffuse, lobar, segmental, peri-tumoral, subcapsular, patchy).
- Perfusion alterations/THEDs are not masses. Hence they exert no mass effect and they preserve the underlying hepatic parenchyma. When visible, traversing vessels are undistorted.
- Multiplanar images may help correctly characterize observations as perfusion alterations by showing undistorted vessels, preserved hepatic architecture, and wedge shape.

Example: CT



Isodensity on Pre Wedge-shaped area of enhancement on AP Fading to isoattenuation on PVP and DP

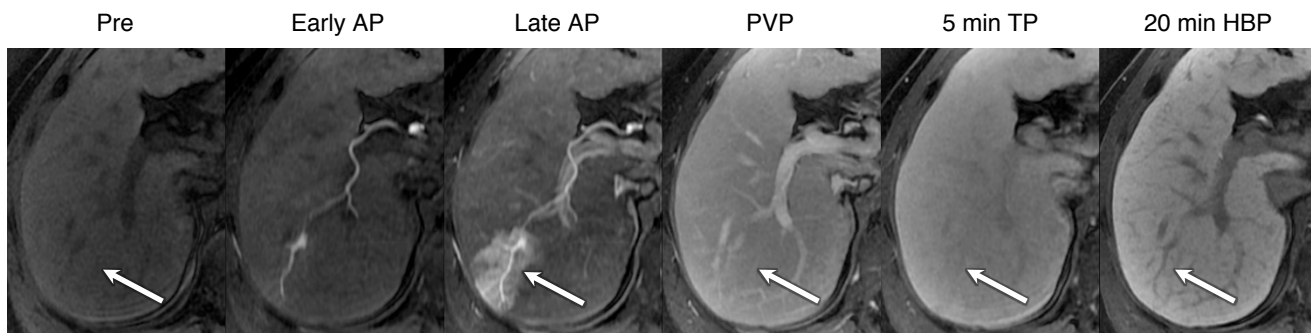


Perfusion Alteration

RADLEX ID: RID39473

Typical imaging features (Cont'd)

Example: Gadoxetate-MRI



Isointensity on Pre

Wedge-shaped area of enhancement on AP, with central undistorted vessels

Isoenhancement on PV, TP and HBP

Pitfalls and practical considerations

While perfusion alterations/THEDs characteristically are isoattenuating at unenhanced CT and isointense at T1w and T2w MRI, they occasionally show abnormalities on unenhanced imaging and delayed imaging and may not be truly “transient.” These abnormalities include:

- Mild hypoattenuation at CT or mild T1 hypointensity and T2 hyperintensity at MRI (attributed to parenchymal edema)
- Focal changes in hepatic fat content (attributed to altered oxygen and nutrient supply)

Imaging features that, if present, favor perfusion alterations/THEDs over HCCs include:

- Isoenhancement to liver in PVP and DP
- Undistorted vessels traversing the observation
- Preserved hepatic architecture
- Absence of mass effect
- Elongated shape (e.g., along orientation of shunt vessel)
- Isoattenuation at unenhanced CT and isointensity at T2w, DW, and unenhanced T1w MRI

< 20mm nodule-like areas of hyperenhancement visible only in the AP are known as nodular arterial phase hyperenhancement (NAPHs).

- NAPHs usually represent either perfusion alterations or small non-malignant masses (e.g., FNH-like lesion, dysplastic nodule), and rarely small HCC. See [page 15-30](#).



Perfusion Alteration

RADLEX ID: RID39473

Comments

Perfusion alterations may be caused by several mechanisms:

- Hypervascular tumor may induce regional arterial hyperemia.
- Arterioportal shunting may be present (due to cirrhosis, benign or malignant tumor, or arterioportal fistula). The shunting causes increased arterial flow to the territory supplied by the portal vein/venule.
- A macroscopic fistula usually causes a wedge-shaped perfusion alteration due to shunting.
- Many arterioportal shunts in cirrhosis are due to tiny arterioportal communications in the microcirculation. These microcirculatory shunts may cause small perfusion alterations, often nodule-like in configuration.
- Portal hypoperfusion may be present due to portal vein obstruction, portal vein invasion, or regional elevation in sinusoidal pressure. Portal hypoperfusion causes compensatory increase in arterial flow (hepatic arterial buffer response).
- Anomalous (non-portal) venous inflow may be present. Compared to portal veins, these anomalous veins have a shorter circulatory path from aorta to liver and are fully enhanced in the hepatic arterial phase.

While the area of the perfusion alteration/THED is benign, perfusion alterations may be caused by HCC or other malignant neoplasms via various mechanisms (regional hyperemia, trans-tumoral arterioportal shunting, portal vein obstruction/invasion). Hence, perfusion alterations/THEDs should be scrutinized for presence of underlying malignancy.

- In the setting of a geographic or triangular perfusion alteration, look carefully at the apex of the perfusion alteration for evidence of a small mass or portal vein obstruction.



Hepatic Fat Deposition

RADLEX ID: RID39455

Definition

Presence of excess lipid within hepatic parenchyma. May be diffuse or focal.

Categorization

- Observations thought to definitely represent hepatic fat deposition should be categorized LR-1.
 - Observations thought to probably represent hepatic fat deposition should be categorized LR-2.
 - Observations that are indeterminate for hepatic fat deposition versus intra-lesional fat should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).
-

Typical imaging features

MRI is more sensitive and specific for detection of hepatic fat deposition than CT.

At MRI, hepatic fat deposition may be diagnosed if the liver, in whole or in part, shows signal loss on out-of-phase (OP) compared to in-phase (IP) gradient-echo.

At CT, hepatic fat deposition may be diagnosed if the attenuation of the liver, in whole or in part, measures:

- ≤ 40 Hounsfield units (HU) on unenhanced or enhanced images OR
- ≥ 10 HU lower than that of spleen on enhanced images

On contrast-enhanced images, focal hepatic fat deposition may appear as an area of darker signal/attenuation than surrounding liver.

Hepatic fat deposition may be diffuse, focal, or multi-focal.

Diffuse hepatic fat deposition affects a large area of the liver (entire liver, lobe, or segment) and may have a homogeneous distribution or a heterogeneous distribution (patchy, perivascular, subcapsular, multi-segmental).

Focal hepatic fat deposition affects a small area of the liver (subsegmental) and usually has a geographic shape. Less commonly it has a rounded shape. It usually occurs in specific areas (e.g., adjacent to the porta hepatis, gallbladder fossa, falciform ligament, and ligamentum venosum).

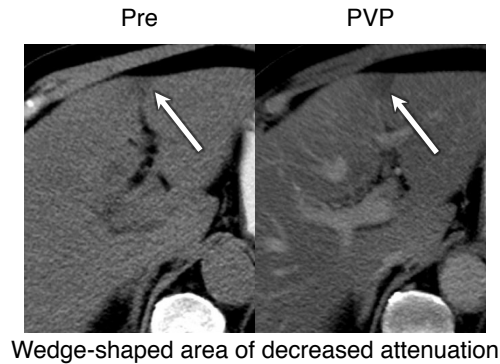
If there are multiple areas of focal hepatic fat deposition, the term multifocal fat deposition applies.

Hepatic Fat Deposition

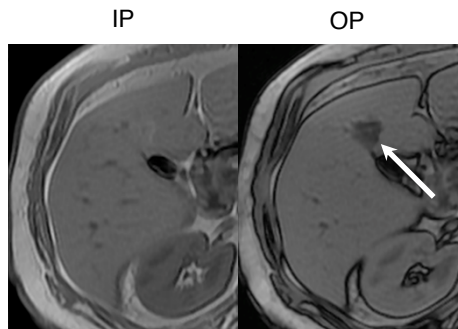
RADLEX ID: RID39455

Typical imaging features (Cont'd)

Example: CT



MRI Example:



Pitfalls and practical considerations

Hepatic fat deposition may overlap in imaging appearance with solitary or multiple fat-containing masses or with diffuse HCC.

Imaging features that favor hepatic fat deposition over fat in mass include:

- Observation is not a mass (see [Chapter 7, page 5](#))
- Presence of undistorted vessels traversing observation
- Geographic rather than round shape
- Presence of attenuation or signal abnormality that does not change relative to background liver over all phases of contrast enhancement (i.e., isoenhancement to liver in all phases)

Multiplanar images may help differentiate hepatic fat deposition from fat in mass by showing undistorted vessels traversing the affected areas, geographic shape, and absence of mass effect.



Focal Fat Sparing

RADLEX ID: RID39456

Definition

Lack of lipid or relative lack of lipid within portion of otherwise fatty hepatic parenchyma.

Categorization

- Observations thought to definitely represent hepatic fat sparing should be categorized LR-1.
- Observations thought to probably represent hepatic fat sparing should be categorized LR-2.
- Observations that are indeterminate for hepatic fat sparing versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

MRI is more sensitive and specific for detection of hepatic fat sparing than CT.

At MRI, hepatic fat sparing may be diagnosed if:

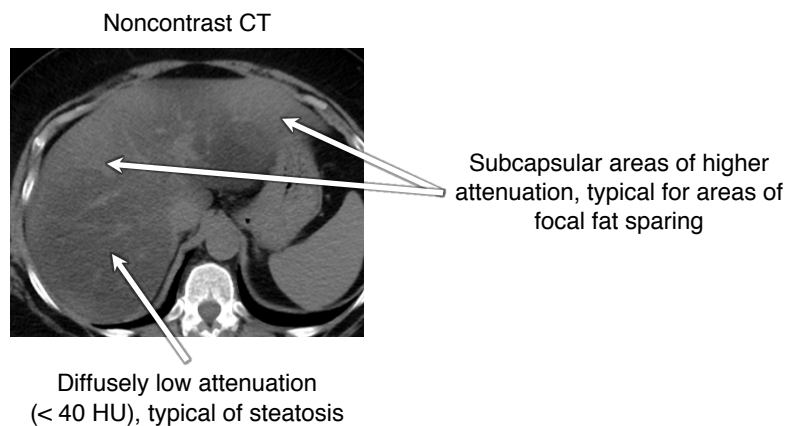
- The liver shows signal loss on out-of-phase (OP) compared to in-phase (IP) gradient echo images (i.e., liver is fatty) AND
- One or more portions of the liver show less signal loss than the rest of the liver on OP compared to IP images (i.e., portions of liver are less fatty).

At CT, hepatic fat sparing may be diagnosed if:

- The attenuation of the liver measures ≤ 40 HU (on unenhanced or enhanced images) or ≥ 10 HU less than spleen (on unenhanced images)(i.e., liver is fatty) AND
- Portion(s) of liver are hyperattenuating relative to rest of liver (i.e., portions of liver are less fatty).

Focal fat sparing usually occurs in similar areas as focal fat deposition (e.g., adjacent to porta hepatis, gallbladder fossa, falciform ligament and ligamentum venosum). In diffusely fatty liver, it may occur around the margin of a mass or in an area affected by a perfusion alteration.

Example: CT



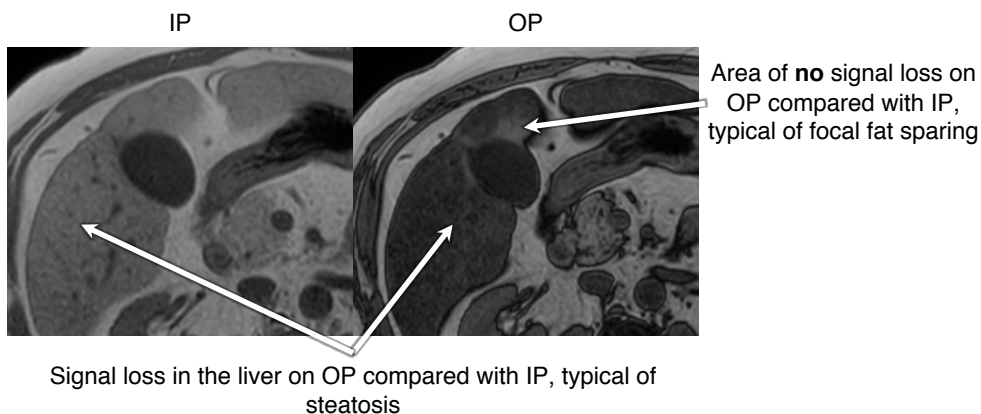


Focal Fat Sparing

RADLEX ID: RID39456

Typical imaging features (Cont'd)

Example: MRI



Pitfalls and practical considerations

Focal hepatic fat sparing may overlap in imaging appearance with expansile masses (solitary or multiple).

Imaging features that favor focal hepatic fat sparing over expansile mass include:

- Observation is not a mass
- Presence of undistorted vessels traversing the observation
- Geographic rather than round shape
- Presence of attenuation or signal abnormality that does not change relative to background liver over all phases of contrast enhancement (i.e., isoenhancement to liver in all phases)

Multiplanar images (source or reformatted) may help correctly characterize observations as hepatic fat sparing by showing undistorted vessels traversing the spared areas, geographic shape, and absence of mass effect.



Confluent Fibrosis

RADLEX ID: RID39441

Definition

Macroscopically evident benign process of scarring in the liver parenchyma.

Categorization

- Observations thought to definitely represent confluent fibrosis should be categorized LR-1.
- Observations thought to probably represent confluent fibrosis should be categorized LR-2.
- Observations that are indeterminate for confluent fibrosis versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

Confluent fibrosis typically has the following features:

- Band-like, wedge-like, or geographic shape
- Straight or concave borders
- Radiates from portal hilum to contact liver surface
- Peripherally located
- Often involves central segments (IV, V, or VIII)
- Associated with parenchymal volume loss and liver surface retraction; the volume loss often progresses on follow-up studies
- Unenhanced CT
 - Hypoattenuating (high water content)
- Unenhanced MRI
 - T1 hypointense (high water content)
 - T2 hyperintense (high water content)
 - DW hyperintense (due at least in part to T2 shine through)
- Hypo- or isoenhancing in the arterial phase
- CT and MRI with extracellular contrast agent (ECA):
 - Increasing enhancement in portal venous and delayed phases (large interstitial spaces)
- MRI with gadoxetate:
 - Some enhancement in portal venous phase
 - Iso- or slightly hypointense to the parenchyma on TP
 - Hypointense to the parenchyma on HBP (not composed of hepatocytes)

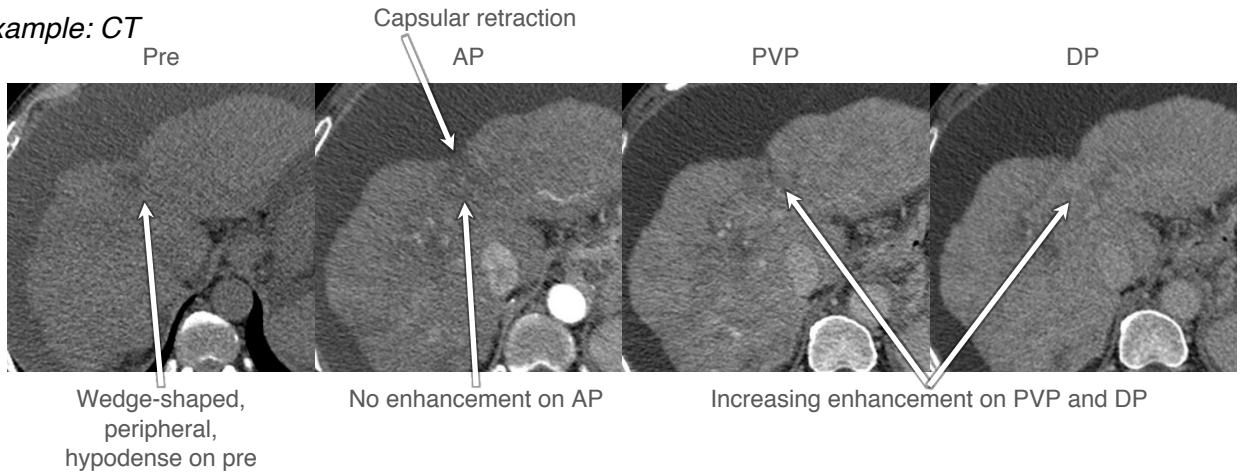
Multiplanar images may help to depict the characteristic morphology: band-like or wedge-like shape; straight or concave borders.

Confluent Fibrosis

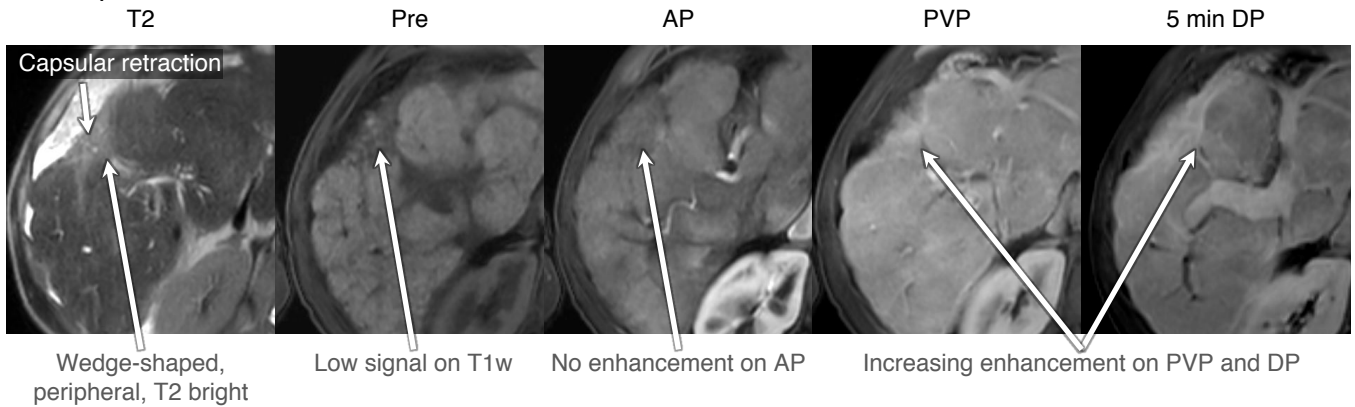
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Typical imaging features (Cont'd)

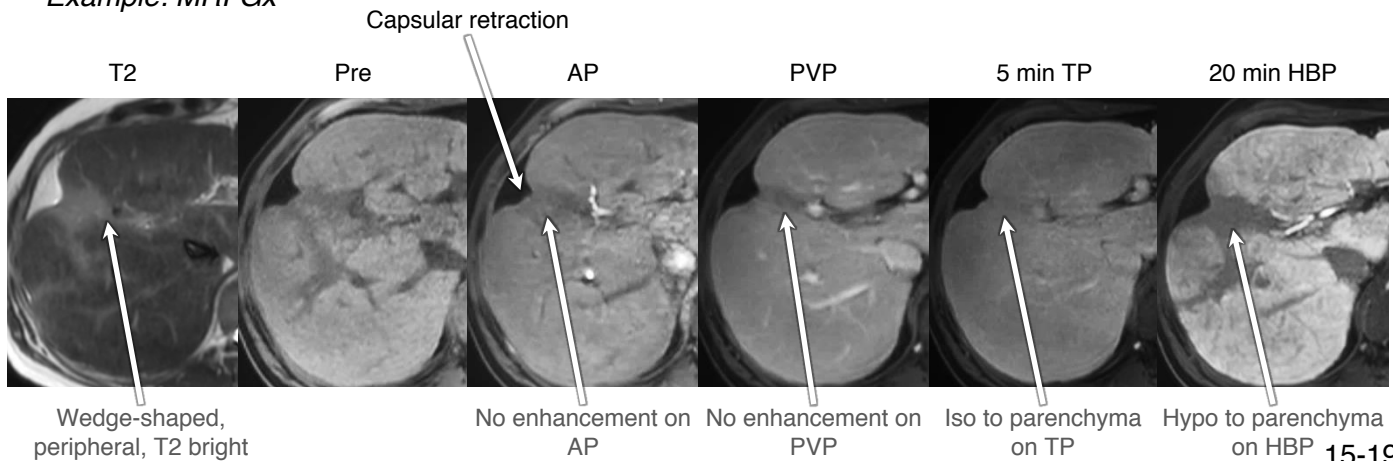
Example: CT



Example: MRI-ECA



Example: MRI-Gx





Confluent Fibrosis

RADLEX ID: RID39441

Pitfalls and practical considerations

While confluent fibrosis typically is arterial phase hypo- or isoenhancing, it may be arterial phase hyperenhancing. Characteristic morphology and location usually permit the interpretation and LI-RADS categorization as LR-1 or LR-2.

Confluent fibrosis may overlap in imaging appearance with HCC.

- Features that favor confluent fibrosis:
 - Band-like or wedge-like shape with straight or concave borders (rather than round shape)
 - Liver surface retraction
 - Increasing enhancement
- Features that favor HCC:
 - Rounded shape
 - Diffuse arterial phase hyperenhancement
 - Nonperipheral washout appearance
 - Enhancing capsule appearance
 - Nonenhancing capsule appearance
 - Fat in mass
 - Presence of intra-lesional or peri-lesional hemorrhage (blood products)

Confluent fibrosis may overlap in imaging appearance with iCCA

- Features that favor confluent fibrosis:
 - Band-like or wedge-like shape with straight or concave borders
 - Extension from portal hilus to contact liver surface
 - Homogeneous delayed enhancement
- Features that favor iCCA:
 - Rounded shape
 - Any LR-M feature

Comment

Confluent fibrosis is more common in PSC, secondary biliary cirrhosis, and alcoholic liver disease than in viral liver disease.



Hypertrophic Pseudomass

RADLEX ID: RID39459

Definition

Hypertrophic area of liver that is surrounded by atrophic, fibrotic liver parenchyma and may at imaging have a bulging appearance.

Categorization

- Observations thought to definitely represent hypertrophic pseudomasses should be categorized LR-1.
- Observations thought to probably represent hypertrophic pseudomasses should be categorized LR-2.
- Observations that are indeterminate for hypertrophic pseudomasses versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

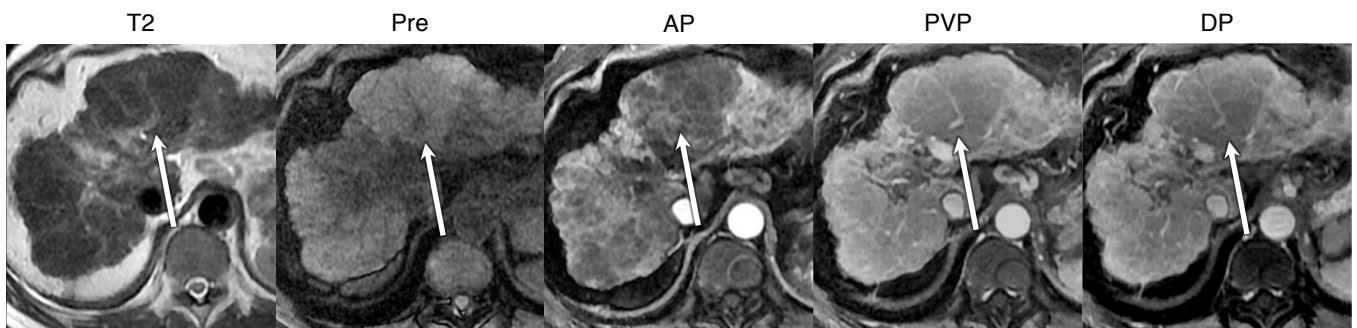
Typical imaging features

In comparison to surrounding more fibrotic liver, hypertrophic pseudomasses usually are:

- Mildly T1 hyperintense
- Mildly T2 hypointense
- Hypoenhanced in the delayed phase

In the setting of underlying fatty liver disease (e.g., alcoholic or non-alcoholic fatty liver disease), hypertrophic pseudomasses may have greater fat deposition than surrounding liver since the hypertrophic pseudomass is less fibrotic and therefore potentially more steatotic.

Example:





Hypertrophic Pseudomass

RADLEX ID: RID39459

Pitfalls and practical considerations

Hypertrophic pseudomasses need to be differentiated from expansile masses.

Imaging features that favor hypertrophic pseudomass over expansile mass:

- Preserved hepatic architecture
- Presence of undistorted vessels

Multiplanar images (source or reformatted) may help correctly characterize observations as hypertrophic pseudomasses by showing preserved hepatic architecture and undistorted vessels.

Comment

Hypertrophic pseudomasses are seen more frequently in certain etiologies of cirrhosis (PSC, Budd-Chiari syndrome, alcoholic liver disease) and cirrhosis complicated by chronic portal vein occlusion.



Focal Scar

RADLEX ID: RID39453

Definition

Macroscopically visible scar limited to a small area or volume of the hepatic parenchyma.

Categorization

- Observations thought to definitely represent focal scars should be categorized LR-1.
- Observations thought to probably represent focal scars should be categorized LR-2.
- Observations that are indeterminate for focal scars versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

Focal scars typically have the following features:

- Small
- Linear, band-like or wedge-like in shape
- Peripherally located
- Associated with focal, mild liver surface retraction
- Unenhanced CT
 - Hypoattenuating
- Unenhanced MRI
 - T1 hypointense
 - T2 hyperintense
 - DW hyperintense (due at least in part to T2 shine-through)
- Enhancement pattern:
 - Hypo- or isoenhancing in the arterial phase
 - Increasing enhancement in portal venous and delayed phases (if extra-cellular contrast agent is administered).

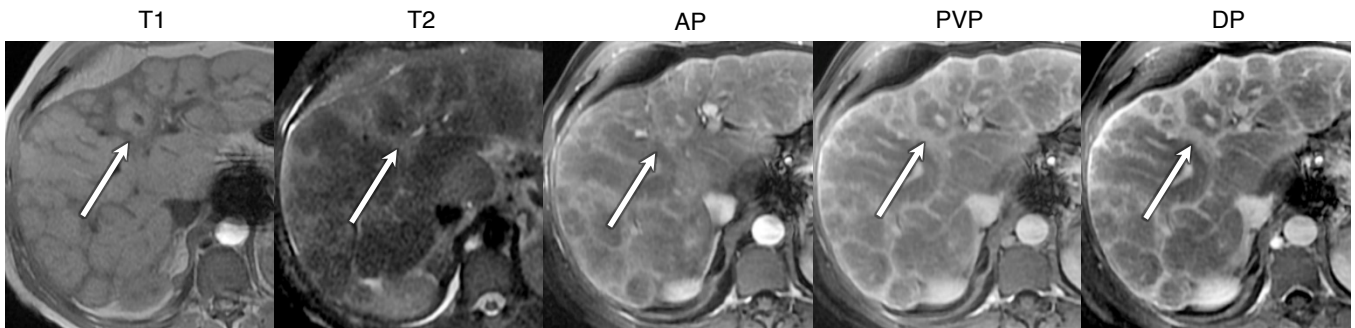
Multiplanar images may help to depict the characteristic linear, band-like, or wedge-like shape.

Focal Scar

RADLEX ID: RID39453

Typical imaging features (Cont'd)

Example



Multiple focal scars surround nodular areas of less fibrotic parenchyma. Arrow points at one of the scars.

Pitfalls and practical considerations

While focal scars typically are arterial phase hypo- or isoenhancing, they may be arterial phase hyperenhancing. Characteristic morphology and location usually permit correct interpretation and appropriate LI-RADS categorization as, depending on level of confidence, LR-1 or LR-2.

Vascular Anomaly

RADLEX ID: RID39485

Definition

Focal vascular abnormality.

Categorization

- Observations thought to definitely represent vascular anomalies should be categorized LR-1.
- Observations thought to probably represent vascular anomalies should be categorized LR-2.
- Observations that are indeterminate for vascular anomalies versus HCC should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

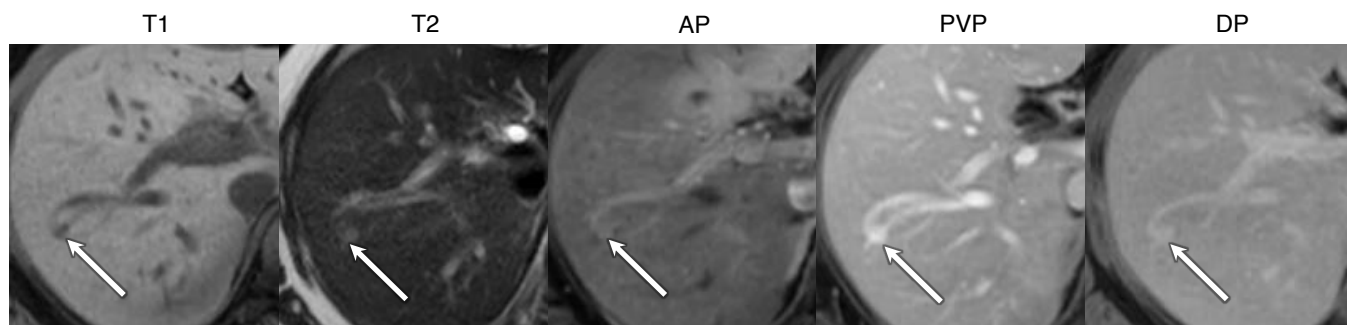
Typical imaging features

Most vascular anomalies are easily recognized, cause no diagnostic confusion, and do not require LI-RADS categorization. Radiologists may choose at their discretion to assign a LI-RADS category to a vascular anomaly.

Examples of vascular anomalies that may be categorized as LR-1 or LR-2 depending on level of certainty:

- Aneurysm (CT, MR)
- Varix
- Prominent vessel along liver surface
- Cavernoma
- Arterioportal or arteriovenous fistula
- Shunt vessel
- Vascular malformation

Example



A rounded observation (arrow) connects a branch of right portal vein to a branch of right hepatic vein, consistent with portovenous shunt.



Distinctive Nodule without Malignant Features

RADLEX ID: N/A

Definition

Solid nodule < 20 mm, distinctive in imaging appearance compared to background nodules AND with no major feature of HCC, no feature of LR-M, and no ancillary feature of malignancy.

Categorization

- Distinctive nodules without malignant features should be categorized LR-2.

Typical imaging features

MRI

- T1 hyperintense
- T2 hypointense
- Siderotic
- HBP hyperintense
- Any combination of above

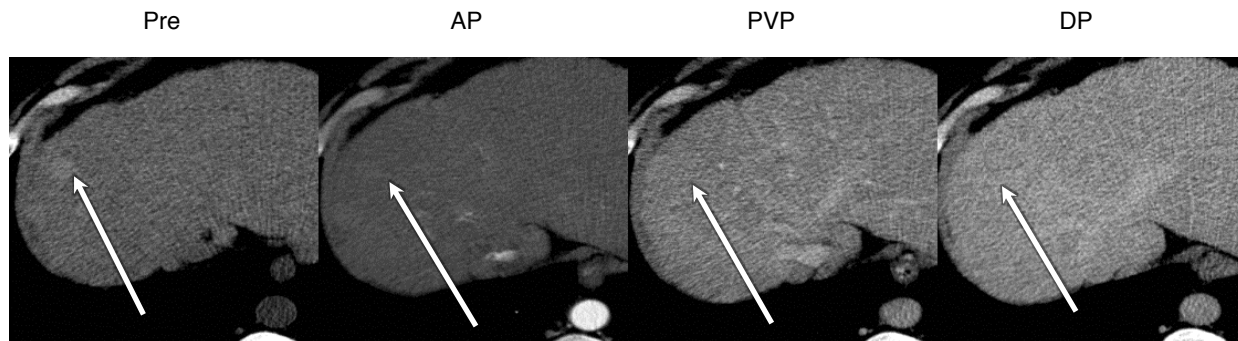
Size < 20 mm

No APHE, WO, capsule, or growth
 No feature of LR-M (see [Chapter 16, page 2](#))
 No ancillary feature of malignancy (see [Chapter 16, page 1](#))

CT

- Intrinsically hypoattenuating
- Intrinsically hyperattenuating

Example: CT



13-mm hyperattenuating nodule

No APHE, WO or “capsule”

Distinctive Nodule without Malignant Features

RADLEX ID: N/A

Typical imaging features (Cont'd)

Example: MRI

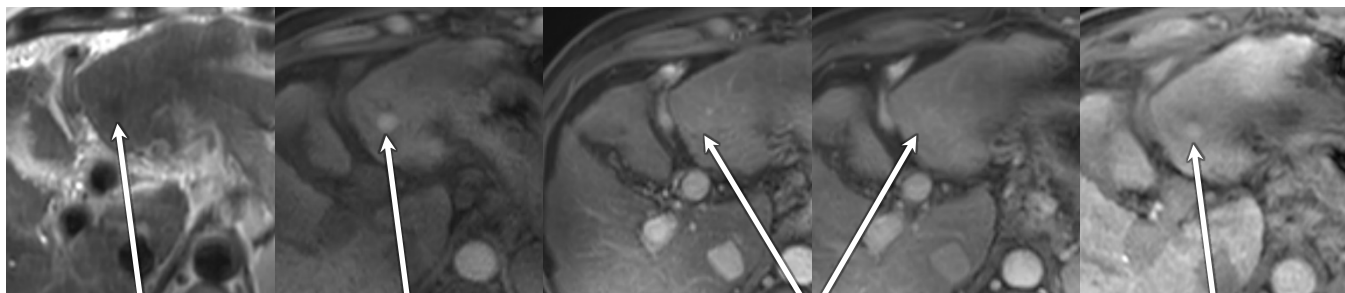
T2

Pre

AP

PVP

HBP



Low signal on T2w
Size: 9mm

High signal on T1w

No APHE, WO or "capsule"

Mildly high signal on
HBP

Distinctive Nodule without Malignant Features

RADLEX ID: N/A

Pitfalls and practical considerations

Distinctive nodules ≥ 20 mm should be categorized LR-3.

- In the absence of ancillary features favoring benignity, they should not be categorized LR-2.

Observations with features suggestive of focal nodular hyperplasia (FNH) or hepatocellular adenoma (HCA) usually should be categorized LR-3. With caution, they may be categorized LR-2. They should not be categorized LR-1.

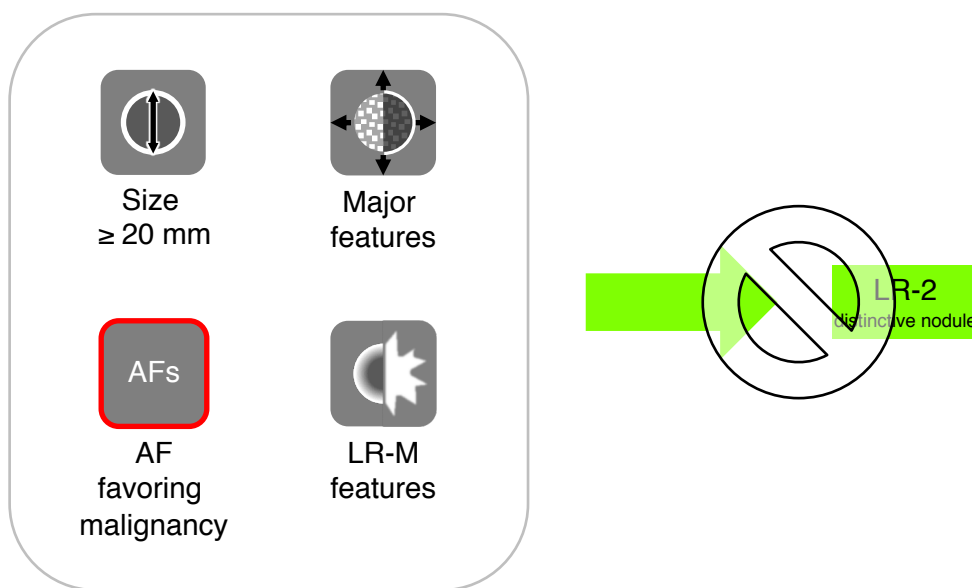
- Rationale: these are diagnoses of exclusion in patients at risk for HCC

In general, a distinctive solid nodule should not be categorized LR-1.

- Rationale: malignancy cannot be excluded with complete certainty.

Any of the following preclude categorization of a solid distinctive nodule as LR-2:

- Size ≥ 20 mm
- Any major feature of HCC
- Any LR-M feature
- Any ancillary feature favoring malignancy



Any of above

Categorization of Distinctive Nodules < 20 mm and without Major Features or LR-M features

Distinctive nodule < 20 mm:

- No APHE, “washout”, “capsule”, or threshold growth
- No feature of LR-M

	Examples	Comments
No AF of malignancy → LR-2	<ul style="list-style-type: none"> • Siderotic nodule • T1 hyperintense nodule • T2 hypointense nodule • DWI hypointense nodule • HBP hyperintense nodule 	This is a LR-2 distinctive nodule without malignant features.
≥ 1 AF of malignancy AND ≥ 1 AF of benignity → LR-2	Nodule with both <ul style="list-style-type: none"> • Fat in mass more than liver (AF of malignancy) AND • Spontaneous size reduction (AF of benignity) 	The presence of conflicting AFs precludes category adjustment.
≥ 1 AF of malignancy AND No AF of benignity → LR-3	Nodule with ONE OR MORE of the following: <ul style="list-style-type: none"> • Fat in mass, more than liver • T2 hyperintensity • Diffusion restriction • HBP hypointensity 	The presence of one or more AF of malignancy excludes LR-2 categorization and places the nodule in top left cell of the CT/MRI Diagnostic table – i.e., LR-3.

AF = ancillary feature

CT/MRI Diagnostic Table

Arterial phase hyperenhancement (APHE)		No APHE		Nonrim APHE		
		< 20	≥ 20	< 10	10-19	≥ 20
Observation size (mm)						
Count additional major features: • Nonperipheral “washout” • Enhancing “capsule” • Threshold growth	None	LR-3	LR-3	LR-3	LR-3	LR-4
	One	LR-3	LR-4	LR-4	LR-4	LR-5
	≥ Two	LR-4	LR-4	LR-4	LR-5	LR-5



Nodule-like Arterial Phase Hyperenhancement (NAPH)

RADLEX ID: N/A

Definition

Nodule-like area or focus of arterial phase hyperenhancement < 10 mm, detected at contrast-enhanced CT or MRI and occult on other phases and sequences.

Differential diagnosis

Most NAPHs are benign vascular pseudolesions caused by arterioportal shunts in the hepatic microcirculation.

- Although most arterioportal shunts manifest as geographic or wedge-shaped peripheral foci of arterial phase hyperenhancement, they sometimes have a rounded shape and manifest as NAPHs.
- Arterioportal shunts may vary in apparent size depending on timing of the arterial phase, dose and injection rate of contrast material, slice obliquity, and other factors. For these reasons, arterioportal shunts may appear larger on one exam than on a prior, potentially causing misinterpretation as “growth” and diagnostic confusion.
- Uncommonly, NAPHs are small arterialized nodules that happen to be occult on other phases and sequences due to small size and/or fortuitous isointensity/isoattenuation.
- The differential diagnosis for these small arterialized nodules include malignant neoplasms (HCC, iCCA, cHCC-CCA, etc.), dysplastic nodules, and rapidly enhancing hemangiomas.
- Although the above entities are true masses, small size complicates interpretation of this feature.

Differentiation of nodule-like arterioportal shunts from small arterialized true nodules can be difficult on routine CT or MRI. In such cases, consider further evaluation with hepatobiliary phase MRI and/or CEUS.

Typical imaging features

- < 10 mm
- Rounded or oval (nodule-like)
- Nonrim APHE
- Occult on other phases and sequences



Nodule-like Arterial Phase Hyperenhancement (NAPH)

RADLEX ID: N/A

Categorization

NAPHs < 5 mm should be categorized LR-2.

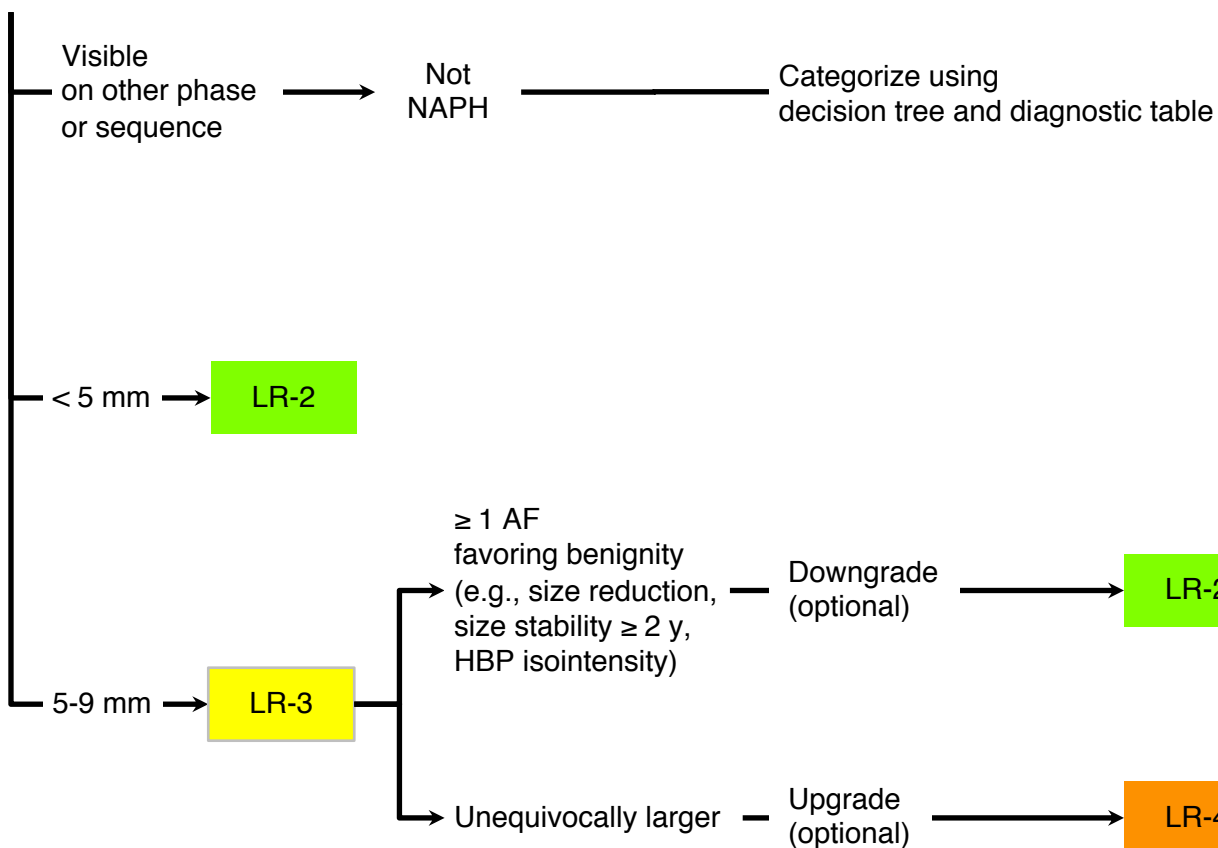
- Rationale: most tiny NAPHs are benign vascular pseudolesions

NAPHs ≥ 5 mm and < 10 mm should be categorized LR-3.

- The category may be downgraded to LR-2 if there are ancillary features favoring benignity (e.g., size reduction, size stability for ≥ 2 years, HBP isointensity) OR
- Upgraded by one category if the NAPH appears unequivocally larger on current than prior exam.

NAPH:

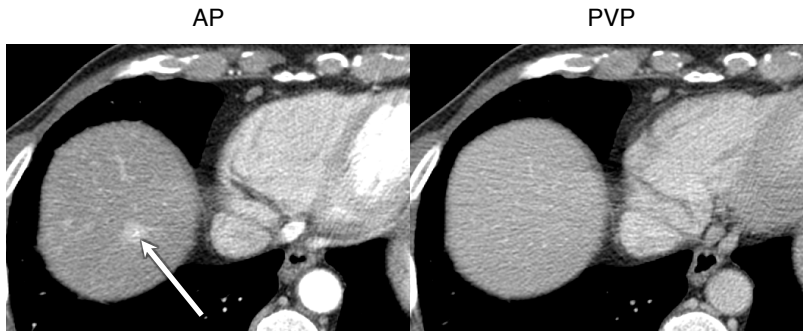
- Nodule-like area of APHE < 10 mm
- Occult on other phases and sequences



Nodule-like Arterial Phase Hyperenhancement (NAPH)

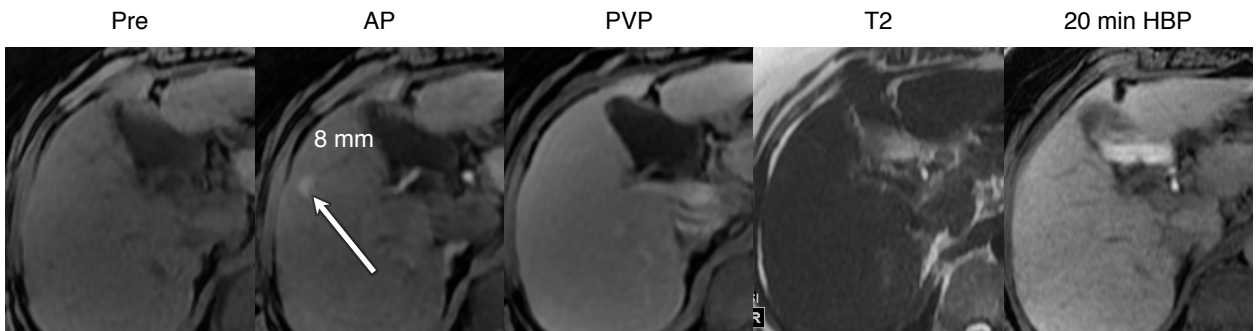
RADLEX ID: N/A

Example: CT

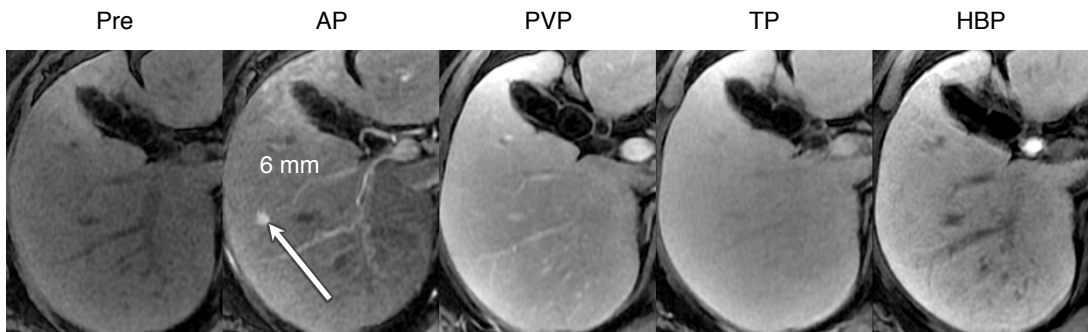


9-mm nodular area of enhancement is seen on AP only (arrow), without corresponding abnormality PVP. This NAPH is categorized LR-3.

Example: MRI x 2



8-mm nodular area of enhancement is seen on AP only (arrow), without corresponding signal abnormality on any other sequence. This NAPH is categorized LR-3; if HBP isointensity (AF of benignity) is applied, the observation is categorized LR-2.



6-mm nodular area of enhancement is seen on AP only (arrow), without corresponding signal abnormality on any other sequence. This NAPH is categorized LR-3; if HBP isointensity (AF of benignity) is applied, the observation is categorized LR-2.

Liver Abscess

RADLEX ID: RID39455

Definition

Purulent collection in the liver parenchyma resulting from bacterial, fungal, or parasitic infection.

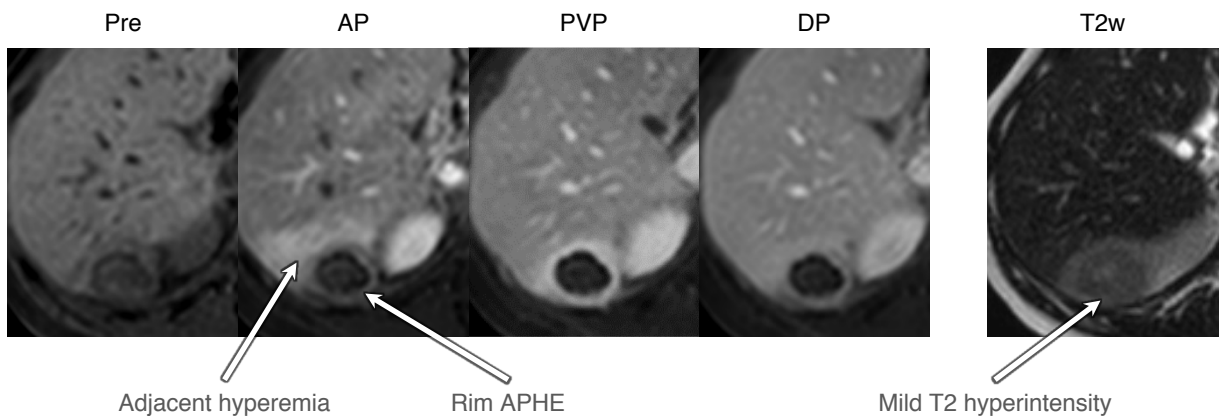
Categorization

- Observations thought to definitely represent a liver abscess should be categorized LR-1.
- Observations thought to probably represent a liver abscess should be categorized LR-2.
- Observations that are indeterminate for a liver abscess should be categorized according LI-RADS diagnostic algorithm (see [CT/MRI Diagnostic Table](#)).

Typical imaging features

- Rounded or irregular cystic lesion(s), often with clustered appearance
- Presence of rim and septations
- Rim and septations show progressive enhancement
- Lack of internal enhancement
- Lack of solid components
- Surrounding parenchymal edema and/or hyperemia

Example: MR



Liver Abscess

RADLEX ID: RID39455

Typical imaging features (Cont'd)

Pitfalls and practical considerations

Features atypical for abscess: delayed central enhancement, solid components, peripheral washout, markedly restricted diffusion.

Abscesses may have high signal on DWI in part due to T2 shine through but rarely have markedly restricted diffusion.

Rarely, an abscess may have solid-appearing phlegmonous components, making imaging-based differentiation from malignancy difficult. Such abscesses may be categorized LR-M.

