Chapter 8

LI-RADS® Diagnostic Categories

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LI-RADS Diagnostic Categories

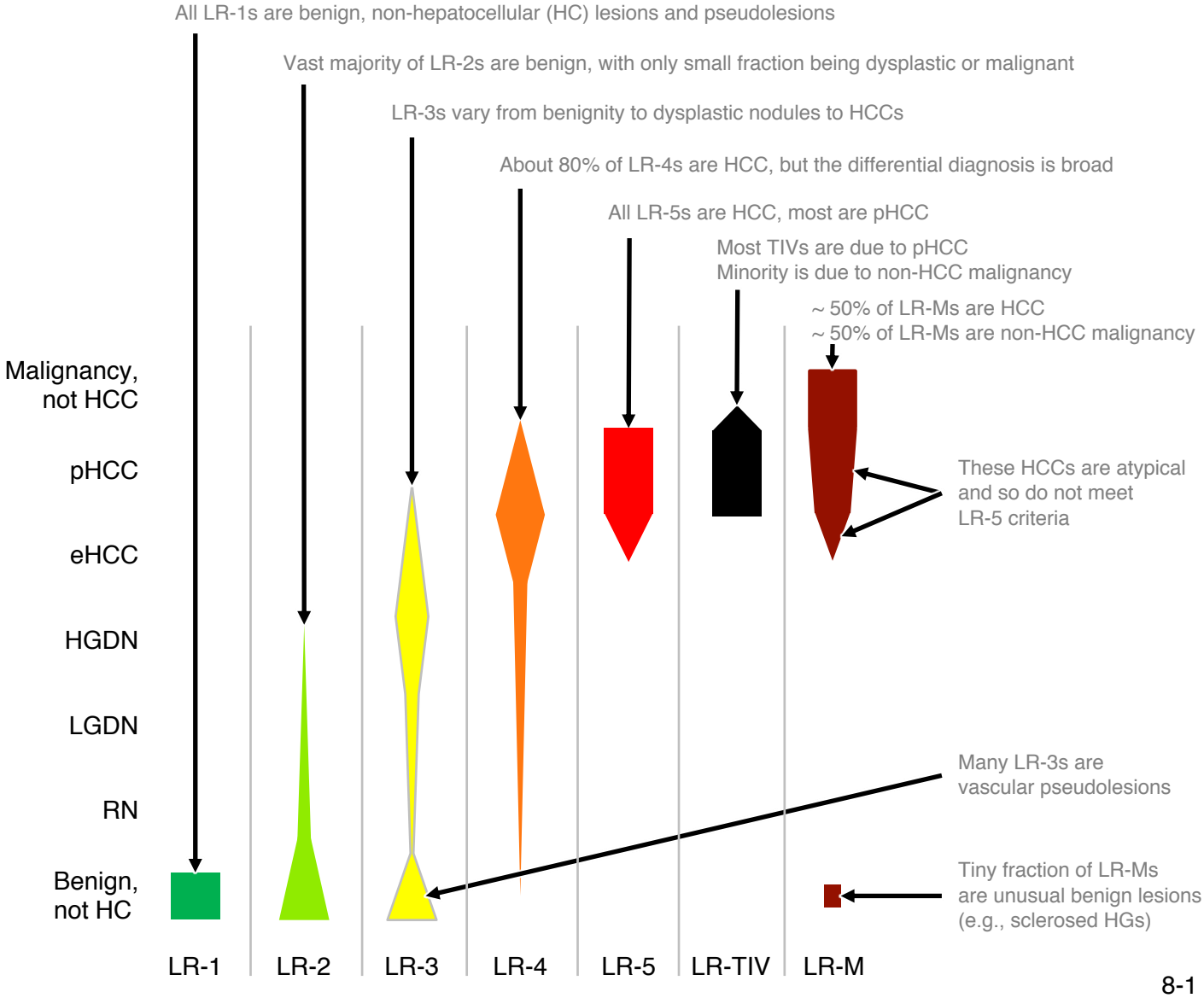
Background

Each LI-RADS diagnostic category reflects a probability of HCC, non-HCC malignancy or benignity.

LI-RADS categories do not correspond exactly to histologic categories.

- All LR-1 observations are benign, but not all benign entities can be categorized LR-1.
  - In particular, RNs and LGNDs cannot be categorized LR-1 because imaging cannot definitely exclude malignant foci in such lesions.
- Similarly, all LR-5s are HCC, but not all HCCs can be categorized LR-5.

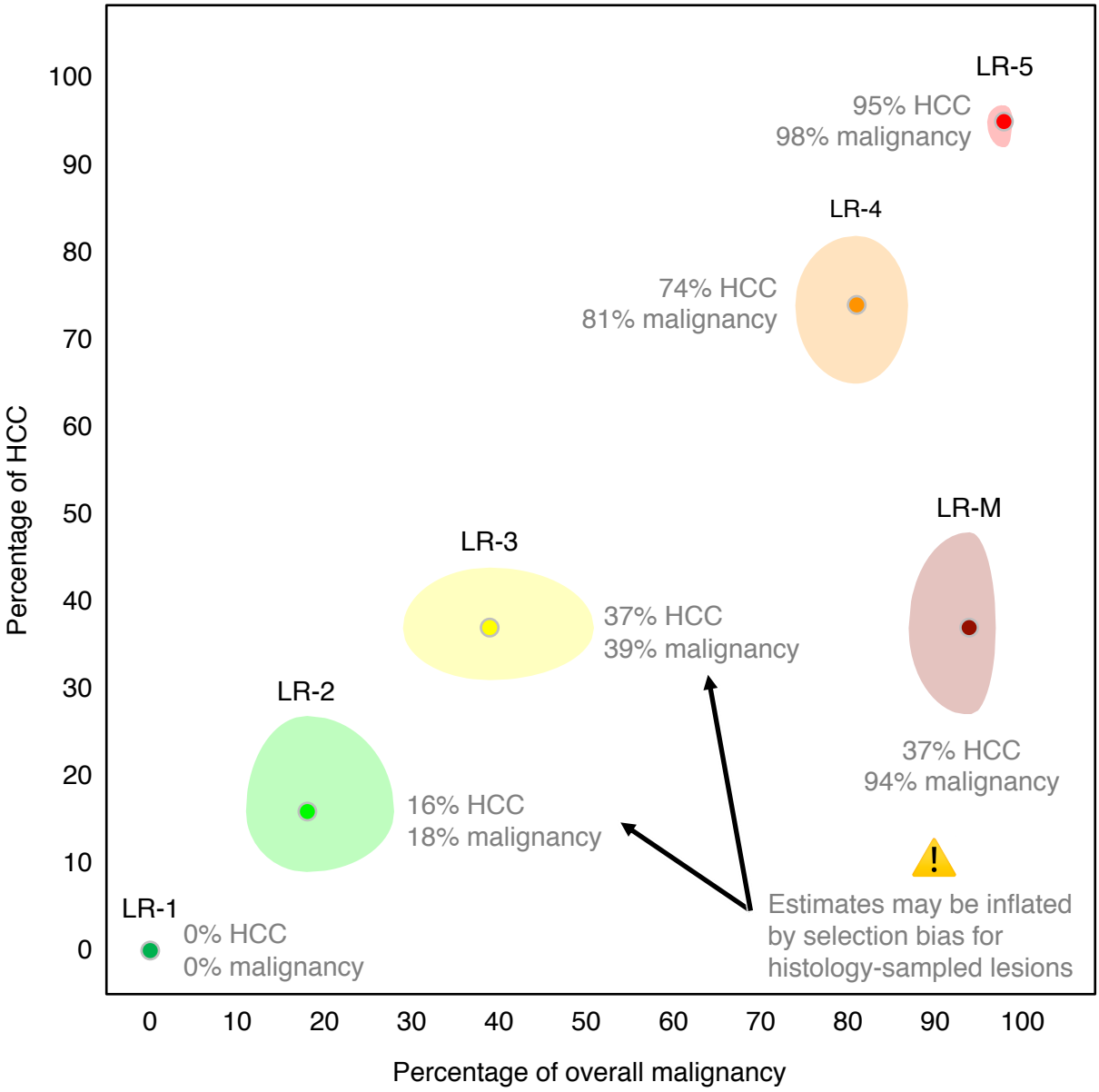
The differential diagnosis for each LI-RADS category



LI-RADS Diagnostic Categories

Percentage of HCC and malignancy associated with each LI-RADS category

The percentage (with 95% confidence intervals) associated with LR-1, LR-2, LR-3, LR-4, LR-5, and LR-M is summarized below:



The above graph represents data from the literature using versions 2014 and 2017. Data using version 2018 are not yet available.

LI-RADS Diagnostic Categories

Cumulative incidence of progression to LR-5 or LR-M of untreated observations categorized with LI-RADS v2014

Initial category	Study	LI-RADS Scoring	Modality	N	Cumulative incidence (%) of progression to LR-5 or LR-M			
					By 3 mo	By 6 mo	By 12 mo	By 24 mo
LR-4	Tanabe 2016	Research	Mixed	52	24%	30%	36%	53%
	Sofue 2017	Research	ECA-MRI	181	7%	27%	47%	68%
	Hong (abstract)	Clinical	Mixed	133	25%	32%	44%	46%
LR-3	Tanabe 2016	Research	Mixed	166	0%	1%	3%	6%
	Hong (abstract)	Clinical	Mixed	187	3%	7%	11%	15%
LR-2	Tanabe 2016	Research	Mixed	63	0%	0%	0%	0%
	Hong (abstract)	Clinical	Mixed	43	2%	2%	6%	6%
LR-1	Hong (abstract)	Clinical	Mixed	10	0%	0%	0%	0%

N = number of observations. ECA = extracellular agent

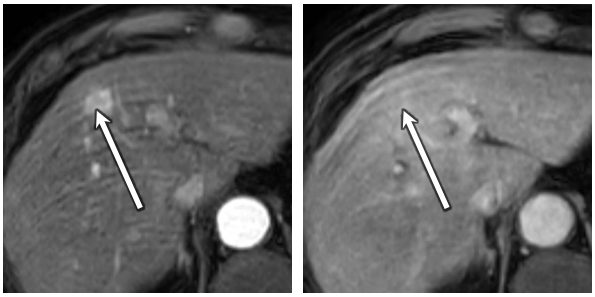
LI-RADS Diagnostic Categories

LI-RADS Categories and modality

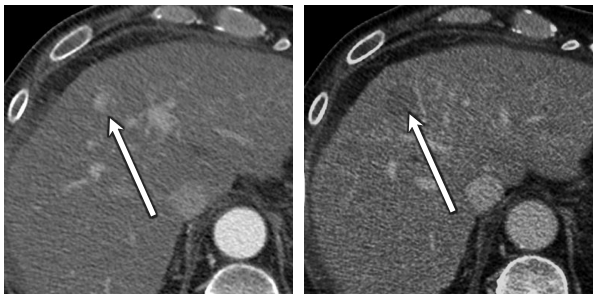
Emerging evidence (based on v2014) suggests that LI-RADS categories assigned by CT vs. MRI may be discordant:

- When the same group of observations is imaged by both CT and MRI, the LI-RADS categories are discordant in 36-71%.
- MR categorizes benign lesions as LR-1 more commonly than CT:
  - Of observations categorized LR-1 on MR, 26-30% are categorized LR-3 on CT.
- Excluding the LR-1 category, MR-assigned categories are often higher than CT-assigned categories:
  - Of observations categorized LR-5 on MRI, 12-31% are categorized LR-4, 12% are categorized LR-3, and 15-29% are not seen on CT.
  - As illustrated in Figure below, however, MR-assigned categories can be lower than CT-assigned categories.

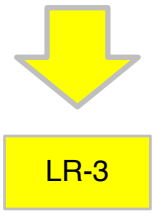
Example: Discordance between CT and Gx-MRI (performed within 3 weeks of each other)



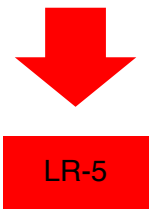
17 mm with APHE. No WO or "'capsule".



17 mm with APHE and WO. No "'capsule"



LR-3



LR-5

Burden of Proof: LR-5, LR-TIV

LR-5

LI-RADS strives to achieve high positive predictive value for HCC.

The category LR-5 is reserved for observations that, by meeting stringent LI-RADS 5 imaging criteria, can be diagnosed as HCC with 100% certainty in the appropriate patient population.

- The burden of proof lies on establishing a noninvasive diagnosis of HCC: A LR-5 category is not appropriate if there is any doubt about whether LI-RADS 5 criteria are met.
- If there is doubt, do not categorize as LR-5. Instead, categorize as LR-M, LR-4, or other as appropriate.

LR-TIV

LI-RADS strives to achieve high positive predictive value for tumor in vein.

The category LR-TIV is reserved for observations that, based on the unequivocal presence of enhancing soft tissue in vein, can be diagnosed as tumor in vein with 100% certainty in the appropriate patient population.

- The burden of proof lies on establishing a noninvasive diagnosis of tumor in vein: A LR-TIV category is not appropriate if there is any doubt about the presence of enhancing soft tissue in vein.
- If there is doubt, do not categorize as LR-TIV. Instead, categorize as LR-5, LR-M, LR-4, or other as appropriate. Also report the extent of any venous thrombosis or occlusion, if present.

Tradeoffs

To achieve such high positive predictive value for HCC and tumor in vein, stringent criteria are required and LI-RADS applies only in specified populations.

An unavoidable tradeoff of high specificity is modest sensitivity. Thus,

- Not all HCCs can be categorized LR-5
- Not all cases of tumor in vein can be categorized LR-TIV
- A category other than LR-5 does not exclude HCC
- A category other than LR-TIV does not exclude tumor in vein.

An unavoidable tradeoff of specifying certain populations is that LI-RADS does not apply to the general population or to most patients with chronic liver disease in the absence of cirrhosis. See *Chapter 2* for more information.

Observations with Pathological Diagnosis

Pathology-diagnosed lesions should not be assigned a LI-RADS category

Instead, such observations should be assigned their pathological diagnosis.

Examples:

- Path-proven HCC
- Path-proven iCCA
- Path-proven cHCC-CCA
- Path-proven metastasis to liver
- Path-proven hemangioma

Reporting:

- Report the pathological diagnosis, relevant imaging features, and any change since prior imaging

Rationale:

- LI-RADS is intended to clarify communication. Assigning a LI-RADS category to a pathologically proven lesion (in which there is now certainty about the diagnosis) may cause confusion, especially for LI-RADS categories that convey some uncertainty (i.e., LR-2, LR-3, LR-4, or LR-M).

Exception: lesions with a pathological diagnosis of a benign or premalignant hepatocellular entity should be assigned a LI-RADS category.

Examples:

- Dysplastic nodule
- Regenerative nodule

Reporting:

- Report the LI-RADS category and the path diagnosis, relevant imaging features, and any change since prior imaging

Rationale:

- Sampling error is a frequent cause of false-negative pathology in biopsied liver lesions of hepatocellular origin. While a biopsy diagnosis of a malignant entity such as HCC is definitive, a biopsy diagnosis of a regenerative or dysplastic nodule does not exclude HCC.

- Additionally, dysplastic nodules are considered premalignant and may progress to HCC. See *Chapter 6.*

- Assigning a LI-RADS category alleviates potential harm from false-negative pathology, facilitates monitoring of nodules for possible progression, and informs management decisions.

LR-NC: Noncategorizable

Conceptual definition: Observation that cannot be meaningfully categorized because image omission or degradation prevents assessment of one or more major features.

CT/MRI criteria:

Both of the following:

- One or more major features cannot be assessed because of image omission or degradation AND
- As a direct result, possible categories range from those in which cancer is unlikely (LR-1 or LR-2) to those in which cancer is likely (LR-4, LR-5, LR-M)

- Do NOT assign LR-NC if the images required for major feature characterization were of acceptable quality.
- Do NOT assign LR-NC for observations in which categorization is challenged only by unusual imaging features or by inability to characterize ancillary features.

Management options	Repeat diagnostic imaging if the technical limitation can be resolved. Alternative diagnostic imaging if imaging with alternative modality or alternative contrast agent is reasonably likely to confer diagnostic advantage. Multidisciplinary discussion if no alternative imaging is appropriate. See *Chapter 11* for more information.	Usually ≤ 3 months

LR-1: Definitely Benign

Conceptual definition: 100% certainty observation is nonmalignant

Criteria: LI-RADS does not provide criteria for most entities that may be categorized LR-1, but instead provides examples

Examples:

Definite:
- Cyst (*Chapter 15, page 2*)
- Hemangioma (*Chapter 15, page 4*)
- Perfusion alteration (e.g., arterioportal shunt) (*Chapter 15, page 25*)
- Hepatic fat deposition or sparing (*Chapter 15, pages 14* and *16*)
- Hypertrophic pseudomass (*Chapter 15, page 21*)
- Confluent fibrosis or focal scar (*Chapter 15, pages 18* and *23*)

Definite spontaneous disappearance

List above not meant to be exhaustive

Pathways to LR-1	LR-1 not modified by ancillary features LR-2 downgraded to LR-1 with ancillary features favoring benignity
If unsure	LR-1 vs. LR-2 → LR-2
Management options	Return to routine surveillance at standard time interval (usually 6 months). See *Chapter 11* for more information.
Pathological correlation	• 0% of LR-1 are HCC. • 0% of LR-1 are malignant.

Caution: Nodules with features suggestive of FNH or HCA usually should **NOT** be categorized LR-1. With caution, they may be categorized LR-2.

Rationale: these are diagnoses of exclusion in high-risk patients.

LR-2: Probably Benign

Conceptual definition: High probability but not 100% certainty observation is nonmalignant

Criteria: LI-RADS does not provide criteria for most entities that may be categorized LR-2, but instead provides examples

Examples:

Probable:
- Cyst (*Chapter 15, page 2*)
- Hemangioma (*Chapter 15, page 4*)
- Perfusion alteration (e.g., arterioportal shunt) (*Chapter 15, page 25*)
- Hepatic fat deposition or sparing (*Chapter 15, pages14* and *16*)
- Hypertrophic pseudomass (*Chapter 15, page 21*)
- Confluent fibrosis or focal scar (*Chapter 15, pages 18 and 23*)

Distinctive nodule without malignant imaging features (*Chapter 15, page 26*)

List above not meant to be exhaustive

Pathways to LR-2	LR-2 not modified by ancillary features LR-1 upgraded to LR-2 with ancillary features favoring malignancy LR-3 downgraded to LR-2 with ancillary features favoring benignity
If unsure	LR-2 vs. LR-1 → LR-2 LR-2 vs. LR-3 → LR-3
Management options	Return to routine surveillance at standard time interval (6 months) Consider repeat diagnostic imaging in ≤ 6 months Consider multidisciplinary discussion for individualized workup. See *Chapter 11* for more information.
Pathological correlation	• ~ 13% (8-22%) of LR-2 are HCC. • ~ 14% (9-21%) of LR-2 are malignant.
Natural history	0-6% of LR-2 observations progress to LR-5 or, rarely, to LR-M by 12 months.

⚠ **Caution:** Nodules with features suggestive of FNH or HCA usually should **NOT** be categorized LR-1. With caution, they may be categorized LR-2.

Rationale: these are diagnoses of exclusion in high-risk patients.

LR-3: Intermediate probability of malignancy

Conceptual definition: Nonmalignant & malignant entities each have moderate probability

CT/MRI criteria:

Nonrim arterial phase hyperenhancement:

- < 20 mm with no additional major features

Arterial phase hypo- or isoenhancement:

- < 20 mm with ≤ 1 additional major feature OR
- ≥ 20 mm with no additional major features

Additional major features:

Nonperipheral "washout"	Enhancing "capsule"	Threshold growth

Pathways to LR-3	LR-3 not modified by ancillary features LR-2 upgraded to LR-3 with ancillary features favoring malignancy LR-4 downgraded to LR-3 with ancillary features favoring benignity
If unsure	LR-3 vs LR-2 → LR-3 LR-3 vs LR-4 → LR-3 LR-3 vs LR-M → LR-3
Management options	Repeat diagnostic imaging in 3-6 months. Alternative diagnostic imaging in 3-6 months. MDD for individualized workup (if MDD is likely to be beneficial or is required for LR-3 by institutional guidelines). See *Chapter 11* for more information.
LR-3 examples	See *page 8-21*.
Pathological correlation	• ~ 38% (31-45%) of LR-3 are HCC. • ~ 40% (31-50%) of LR-3 are malignant.
Natural history	3-11% of LR-3 observations progress to LR-5 or, rarely, to LR-M by 12 months

LR-4: Probably HCC

Conceptual definition: High probability but not 100% certainty observation is HCC

CT/MRI criteria:

Nonrim arterial phase hyperenhancement:

- < 10 mm with ≥ 1 additional major feature OR
- 10-19 mm with "capsule" as the only additional major feature OR
- ≥ 20 mm with no additional major feature

Arterial phase hypo- or isoenhancement:

- < 20 mm with ≥ 2 additional major features OR
- ≥ 20 mm with ≥ 1 additional major feature

Additional major features:

Nonperipheral "washout"	Enhancing "capsule"	Threshold growth

Pathways to LR-4

LR-4 not modified by ancillary features
LR-3 upgraded to LR-4 with ancillary features favoring malignancy
LR-5 downgraded to LR-4 with ancillary features favoring benignity

If unsure

LR-4 vs LR-3 → LR-3
LR-4 vs LR-5 → LR-4
LR-4 vs LR-M → LR-M

LR-4 observations should be of hepatocellular origin. If there is reasonable doubt about hepatocellular origin, categorize as LR-M.

Management options

MDD may be needed for consensus management. If neither biopsy nor treatment is planned: repeat or alternative diagnostic imaging in ≤ 3 mo.

See *Chapter 11* for more information.

Pathological correlation

- ~ 74% (67-80%) of LR-4 are HCC
- ~ 80% (75-85%) of LR-4 are malignant.
- LR-4 does not exclude non-HCC malignancy. A small non-HCC malignancy may fail to demonstrate LR-M imaging features

Natural history

~36-47% of LR-4 observations progress to LR-5 or, rarely, to LR-M by 12 months.

LR-5: Definitely HCC

Conceptual definition: 100% certainty observation is HCC

CT/MRI criteria:

Nonrim arterial phase hyperenhancement AND:

- 10-19 mm with nonperipheral “washout” OR
- 10-19 mm with threshold growth OR
- ≥ 20 mm with ≥ 1 additional major feature

Additional major features:

Nonperipheral “washout”	Enhancing “capsule”	Threshold growth

Pathways to LR-5	LR-5 not modified by ancillary features
If unsure	LR-5 vs LR-4 → LR-4 LR-5 vs LR-M → LR-M LR-5 vs LR-TIV → LR-5
Management options	Multidisciplinary discussion for staging and individualized treatment. Biopsy is not needed to confirm the diagnosis of HCC but may be obtained in some settings (e.g., for clinical trials requirements or molecular characterization). See *Chapter 11* for more information.
Differential diagnosis	There is no DDx. LR-5 is intended to convey 100% certainty of HCC. Emerging data suggests the actual specificity of LR-5 is < 100%, however (see below).
Pathological correlation	• ~ 94% (92-96%) of LR-5 are HCC. • ~ 97% (95-99%) of LR-5 are malignant. • LR-5 has modest sensitivity for HCC. • Not all HCCs can be categorized as LR-5.

LR-TIV: Malignancy with tumor in vein (TIV)

Conceptual definition: 100% certainty there is malignancy with tumor in vein

CT/MRI criterion:

Presence of definite enhancing soft tissue in vein, regardless of visualization of parenchymal mass

Suggestive but not definitive features of tumor in vein :

- Occluded vein with ill-defined walls
- Occluded vein with restricted diffusion
- Occluded or obscured vein contiguous with malignant parenchymal mass
- Heterogeneous vein enhancement not attributable to artifact

Hint: If any of these features are present, scrutinize vein for enhancing soft tissue.

Pathways to LR-TIV	Tumor in vein with detectable parenchymal mass Tumor in vein without detectable parenchymal mass Tie-breaking rules and ancillary features do not lead to a diagnosis of TIV, as TIV must be unequivocally present.
If unsure	LR-TIV vs LR-5 → LR-5 LR-TIV vs LR-M → LR-M
Management options	Multidisciplinary discussion for staging and individualized treatment. Biopsy may be needed to determine type of malignancy (HCC, ICC, other). See *Chapter 11* for more information.
Differential diagnosis	Most LR-TIVs are HCC. Some are iCCA or cHCC-CCAs. There should be no uncertainty about the presence of tumor in vein. LR-TIV is intended to convey 100% certainty for tumor in vein.
Pathological correlation	• LR-TIV has modest sensitivity for malignancies with macrovascular invasion. • Not all macrovascular-invasive malignancies can be categorized as LR-TIV.

LR-M: Probably or definitely malignant, not HCC specific

Conceptual definition: High probability or 100% certainty observation is malignant but features are not HCC specific

CT/MRI criteria:

OR

Targetoid mass with any of following Imaging appearance on various phases or sequences:

- Targetoid dynamic enhancement, any of following:
  - Rim APHE
  - Peripheral washout appearance
  - Delayed central enhancement
- Targetoid diffusion restriction
- Targetoid TP or HBP signal intensity

No tumor in vein
Not meeting LR-5 criteria

Nontargetoid mass with one or more of the following:

- Infiltrative appearance
- Marked diffusion restriction
- Necrosis or severe ischemia
- Other feature suggesting non-HCC malignancy (specify in report)

Pathways to LR-M	Meets LR-M criteria and there is no definite tumor in vein
If unsure	LR-M vs LR-3 → LR-3 LR-M vs anything else (LR-4, LR-5, LR-TIV) → LR-M
Management options	Multidisciplinary discussion for staging and individualized treatment. Biopsy may be needed to determine malignancy type (HCC, ICC, other). See *Chapter 11* for more information.
Differential diagnosis for LR-M	• HCC not meeting LR-5 criteria • iCCA or cHCC-CCA • Other: metastases to liver, undifferentiated carcinoma or sarcoma, lymphoma • Rarely, a benign entity
Pathological correlation	• ~ 36% (25-48%) of LR-M are HCC. • ~ 93% (87-97%) of LR-M are malignant. • LR-M does not exclude HCC. • Some HCCs and rare benign lesions may be categorized as LR-M. .

LR-TR Nonevaluable

Conceptual definition: Treatment response cannot be meaningfully evaluated due to inappropriate imaging technique or inadequate imaging quality.

Criterion:

Lesional enhancement cannot be characterized because of omission of recommended contrast phases or image degradation.

- Do NOT assign LR-TR Nonevaluable evaluable if the recommended contrast phases were acquired and are of acceptable quality.
- Do NOT assign LR-TR Nonevaluable for treated lesions in which response categorization is challenged only by unusual imaging features.

Management options

Continue posttreatment monitoring with same modality in ≤ 3 months.
- Preferred option if the nonevaluability was due to a correctable technical error or artifact.

Continue posttreatment monitoring with alternative modality in ≤ 3 months.
- Suggested option if imaging with a different modality or contrast agent would confer diagnostic advantage.

See *Chapter 11* for more information.

LR-TR Nonviable

Conceptual definition: Low or negligible likelihood of viable tumor after treatment

Criteria:

One of the following:

- No lesional enhancement OR
- Treatment-specific expected enhancement pattern

Treatment-specific expected enhancement patterns:

Depending on the treatment, expected post-treatment patterns include:

- Thin rim of enhancement around ablation zone or embolized tumor
- Geographic zone(s) of perilesional enhancement without washout appearance
- Non-masslike foci of perilesional enhancement without washout appearance

If unsure	LR-TR Nonviable vs. LR-TR Equivocal → LR-TR Equivocal
Management options	Continue posttreatment monitoring with same modality in ≤ 3 months. • Preferred option in most cases. Continue posttreatment monitoring with alternative modality in ≤ 3 months. • Suggested option if imaging with a different modality or contrast agent would confer diagnostic advantage. See *Chapter 11* for more information.
Pathological correlation	• The absence of lesional enhancement does not imply complete pathologic response. • Imaging is insensitive to microscopic or small foci of residual tumor that may be detectable only at histologic evaluation.

LR-TR Equivocal

Conceptual definition: The presence and the absence of viable tumor after treatment each have moderate probability

Criterion:

Enhancement not expected for specific treatment and not meeting criteria for probably or definitely viable

⚠ Equivocal viability should be applied only when confident differentiation of viable vs nonviable tumor cannot be made despite technically adequate imaging.

If unsure

LR-TR Equivocal vs. LR-TR Nonviable→ LR-TR Equivocal
LR-TR Equivocal vs. LR-TR Viable → LR-TR Equivocal

Management options

Continue posttreatment monitoring with same modality in ≤ 3 months.
- Preferred option in most cases.

Continue posttreatment monitoring with alternative modality in ≤ 3 months.
- Suggested option if imaging with a different modality or contrast agent would confer diagnostic advantage.

See *Chapter 11* for more information.

Examples of equivocal viability

- Rim APHE thicker than expected but not discretely nodular
- Progressive or mild enhancement within lesion that on pre-treatment imaging showed APHE and “washout” (may represent fibrosis)
- Arterial phase is inadequate but portal venous phase shows enhancement
- Resolving lesional enhancement days to weeks after ablation*

** Tumor enhancement may resolve gradually after treatment. Differentiating resolving enhancement from viable tumor may be difficult, especially in the days to weeks after treatment. Follow up to document resolution may be needed.*

LR-TR Viable

Conceptual definition: High or definite likelihood of viable tumor after treatment

Criteria:

Nodular, mass-like, or thick irregular tissue in or along the treated lesion with any of the following:

- Arterial phase hyperenhancement OR
- Washout appearance OR
- Enhancement similar to pre treatment

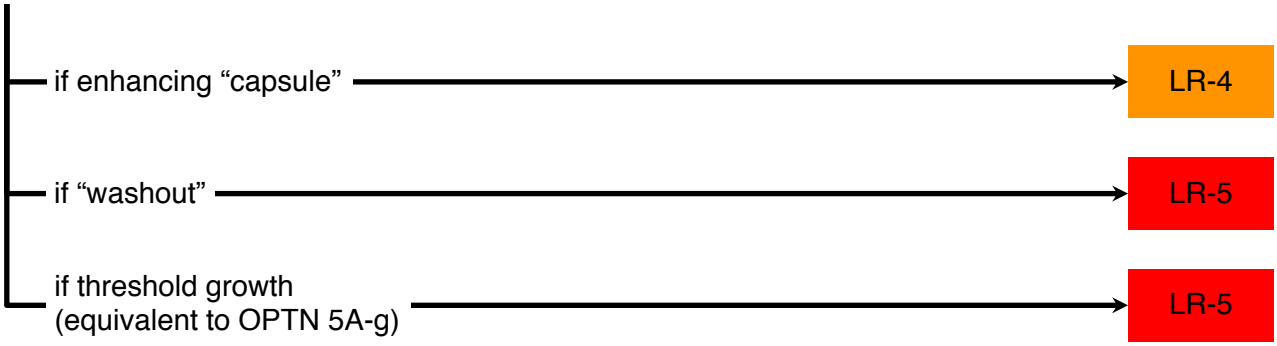
If unsure	LR-TR Viable vs. LR-TR Equivocal → LR-TR Equivocal
Management options	Multidisciplinary discussion for consensus management. Often includes retreatment. See *Chapter 11* for more information.
Enhancement similar to pretreatment	Even if still viable, tumors that on pretreatment imaging lacked APHE or washout appearance are unlikely to show these features after treatment. In such cases, lesional dynamic enhancement similar to pretreatment usually indicates viable tumor.

The LR-4 / LR-5 Diagonal Cell

Categorization

As shown in the *LI-RADS CT/MRI Diagnostic Table*, observations that measure 10-19 mm, have nonrim APHE, and have exactly one additional major feature* are categorized as follows:

10-19 mm observation with nonrim APHE and exactly one additional major feature*



** Additional major features = nonperipheral “washout”, enhancing “capsule”, threshold growth*

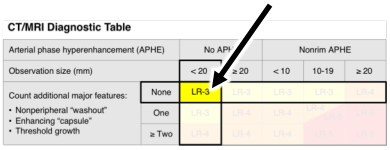
Categorization of Distinctive Nodules < 20 mm and Without Major Features or LR-M features

Distinctive nodules < 20 mm and without major features or LR-M features can be categorized LR-2 or LR-3, as shown below:

Distinctive nodule <20 mm:

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

		Examples	Comments
No AF of malignancy	LR-2	• 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 • Intralesional fat (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: • Intralesional fat • T2 hyperintensity • Diffusion restriction • HBP hypointensity	The presence of one or more AF of malignancy excludes LR-2 categorization and places the nodule in the top left cell of the CT/MRI Diagnostic table – i.e., LR-3



AF = ancillary feature

** In general, a distinctive solid nodule should **not** be categorized LR-1 because malignancy cannot be excluded with complete certainty.*

Common LR-3 Examples

< 20 mm NAPH (see *Chapter 15, page 30*), otherwise occult
< 20 mm, “washout”, no APHE or “capsule”
< 20 mm, hepatobiliary phase hypointensity, otherwise occult
< 20 mm, hypersteatotic, no APHE, no “washout”, no capsule”
< 20 mm, restricted diffusion, no APHE, no “washout”, no capsule”

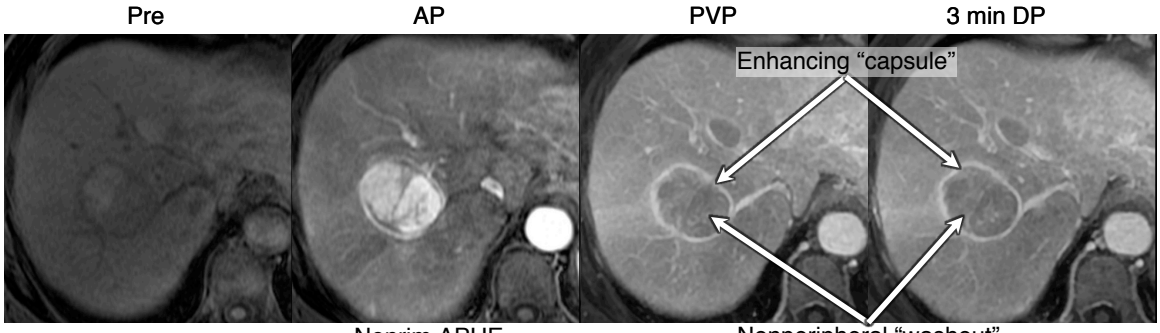
** In general, a distinctive solid nodule should **not** be categorized LR-1 because malignancy cannot be excluded with complete certainty.*

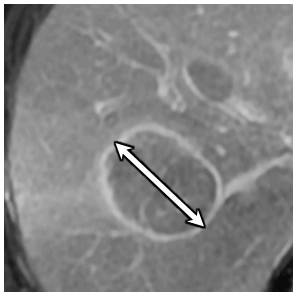
Cases illustrating Cells in LI-RADS Diagnostic Table

The following pages illustrates every cell in the CT/MRI LI-RADS Table

LR-5: Definite HCC

Example: Example: 47 mm observation in a 68 year-old man with cirrhosis





Note:
This case also illustrates mosaic architecture (AF-M)

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

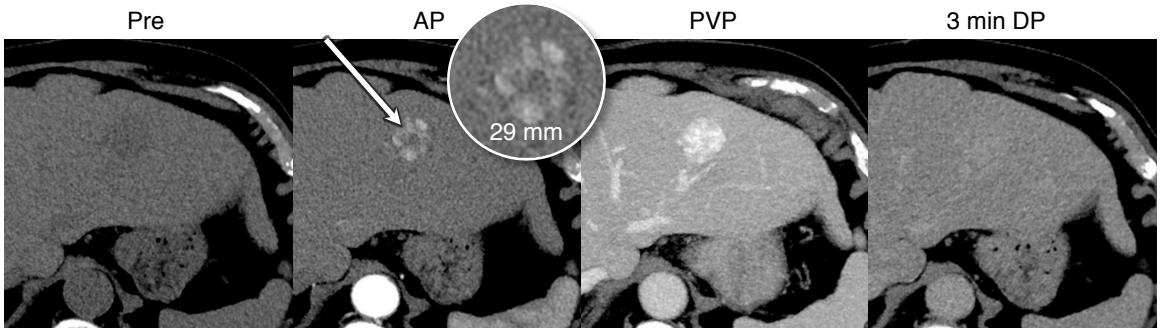
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing “capsule”
- LR-5 – if nonperipheral “washout” **OR** threshold growth

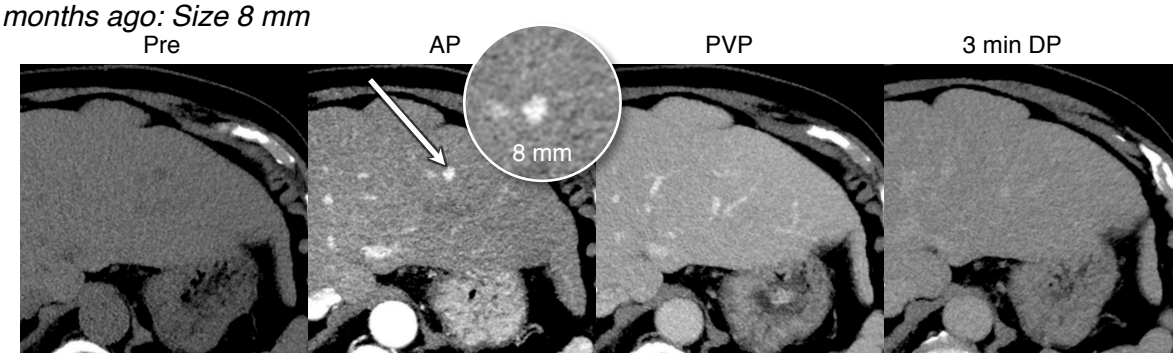
If unsure about the presence of any major feature: characterize that feature as absent

LR-5: Definite HCC

Example: 29 mm observation in a 85 year-old man with cirrhosis



CT 3 months ago: Size 8 mm



Note: In this case, size is measured in the AP as the observation is only visible in the AP.

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

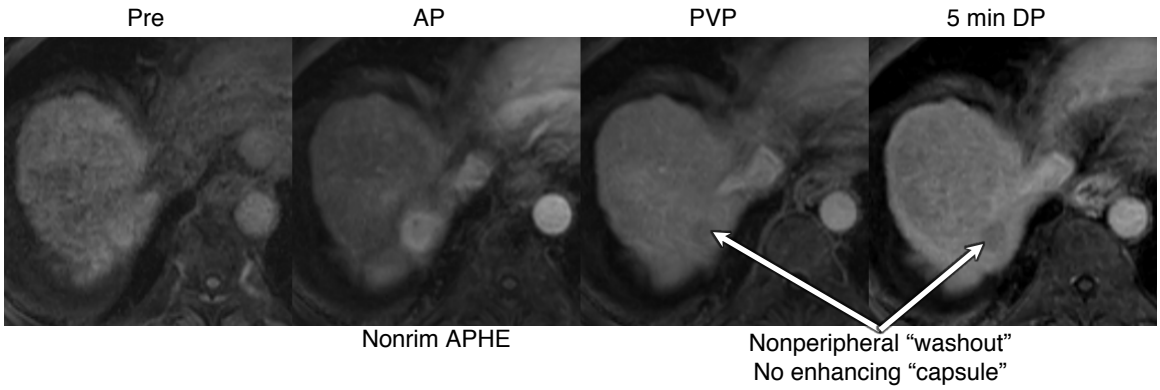
LR-4 / LR-5

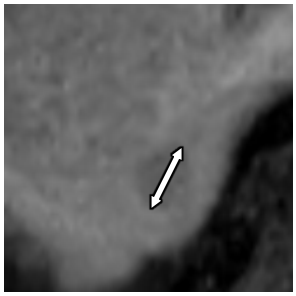
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-5: Definite HCC

Example: 17 mm observation in a 78 year-old man with cirrhosis





LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

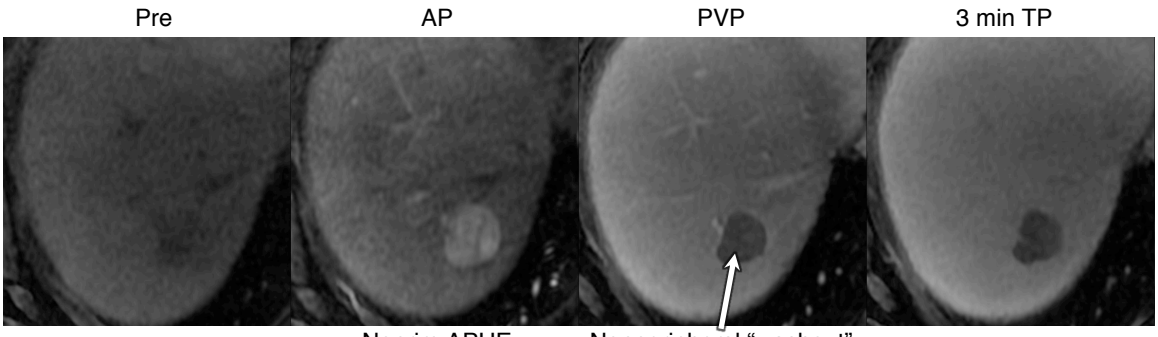
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

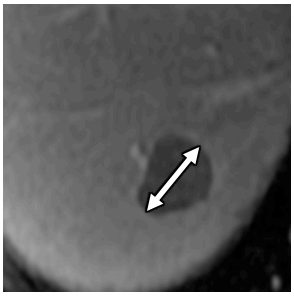
LR-5: Definite HCC

Example: 24 mm observation in a 55 year-old man with cirrhosis



Nonrim APHE

Nonperipheral "washout"
No enhancing "capsule"



Size = 24 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

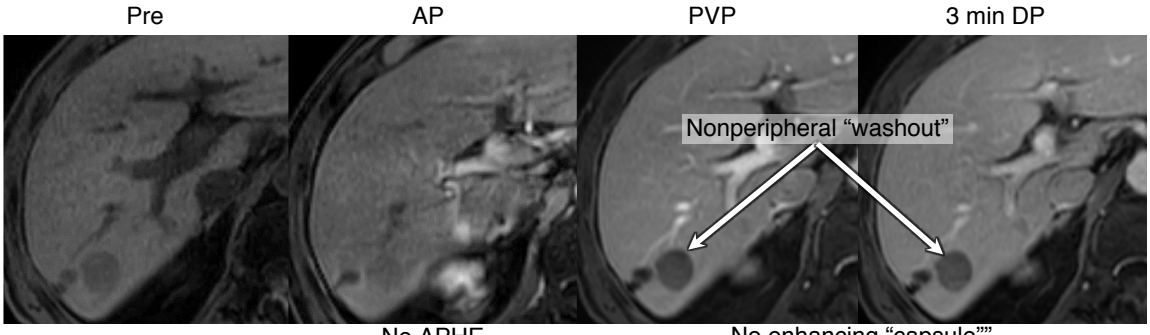
LR-4 / LR-5

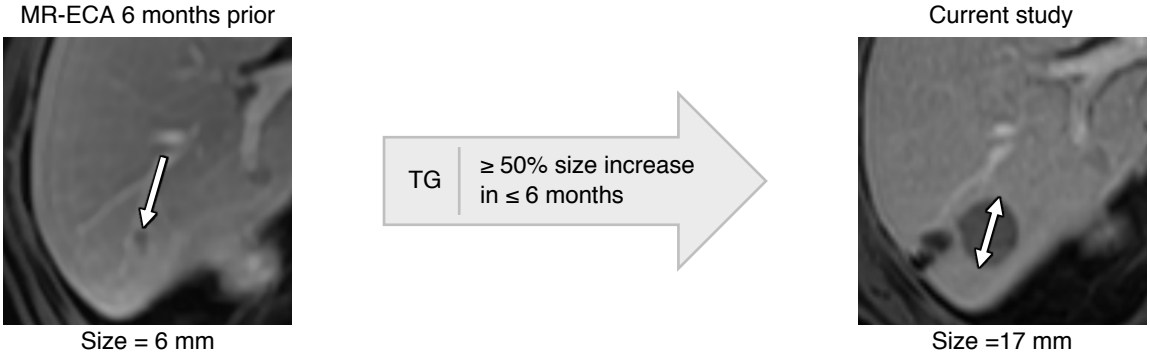
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-4: Probable HCC

Example: 17 mm observation in a 69 year-old man with chronic hepatitis B





LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

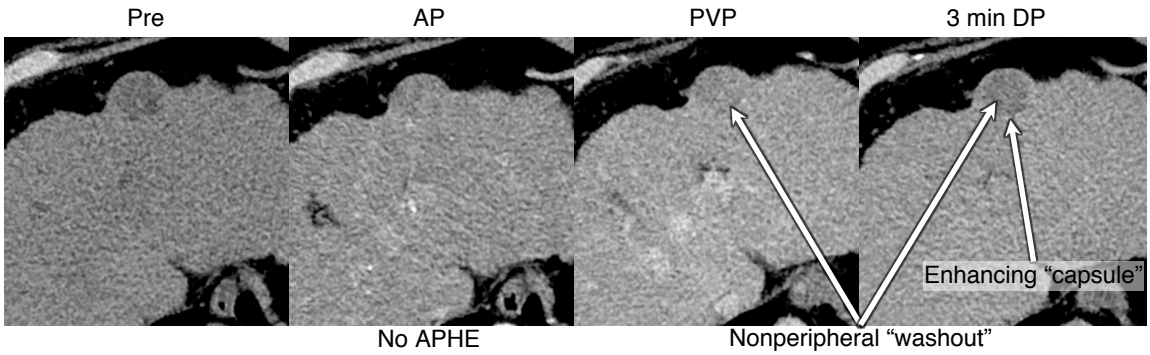
LR-4 / LR-5

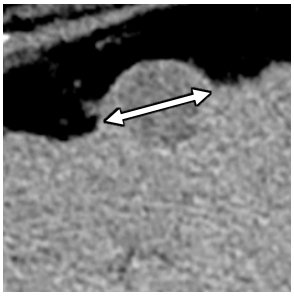
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing “capsule”
- LR-5 – if nonperipheral “washout” **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-4: Probable HCC

Example: 32 mm observation in a 67 year-old man with cirrhosis





LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

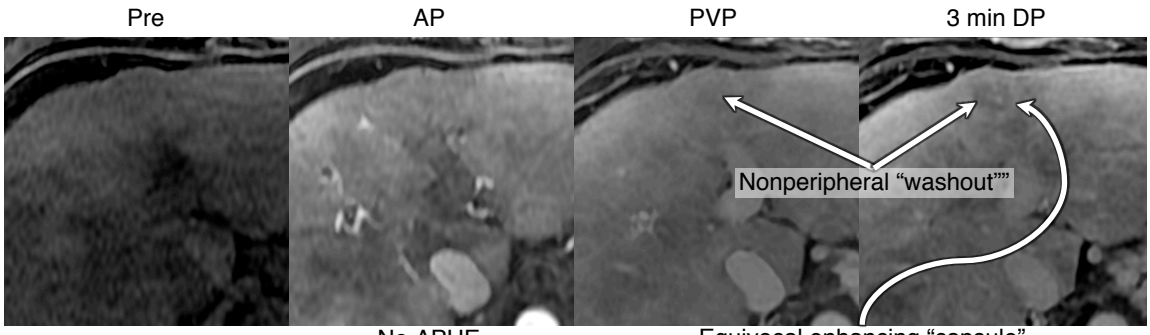
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

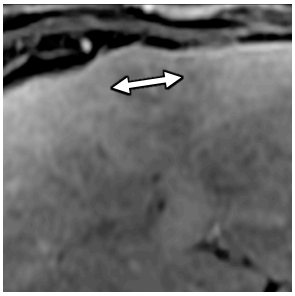
LR-4: Probable HCC

Example: 21 mm observation in a 63 year-old man with cirrhosis



No APHE

Equivocal enhancing "capsule"
= NO enhancing "capsule"



Size = 21 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

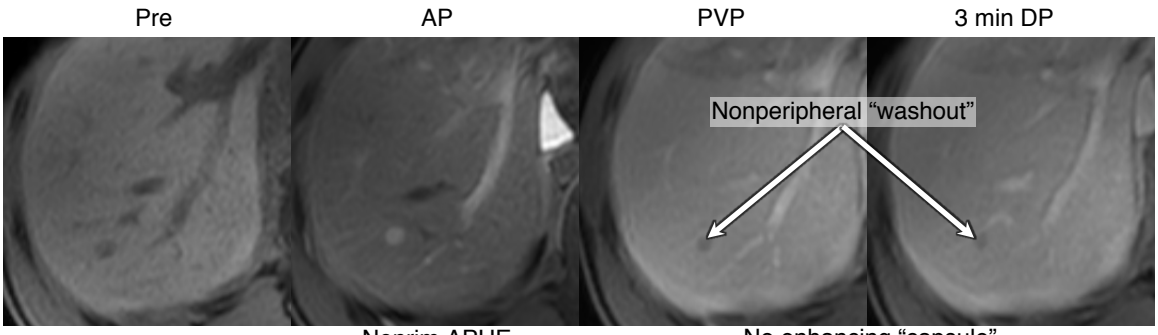
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

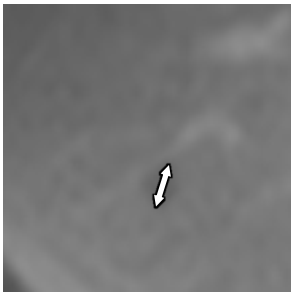
LR-4: Probable HCC

Example: 7 mm observation in a 32 year-old man with chronic hepatitis B



Nonrim APHE

No enhancing “capsule”



Size =7 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

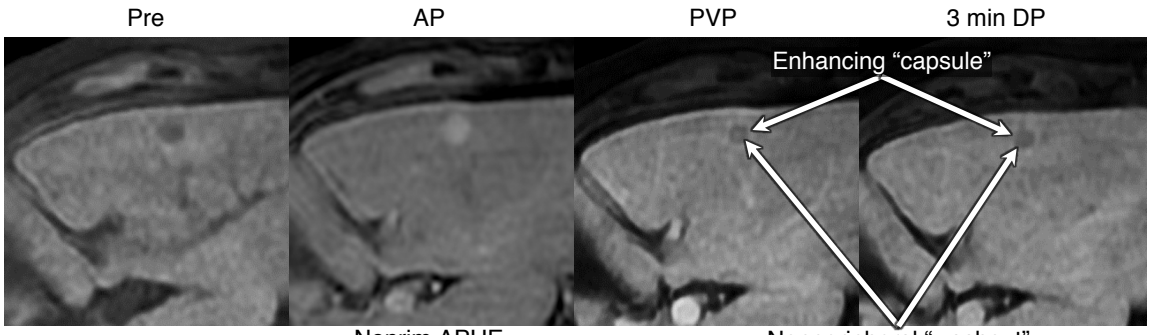
LR-4 / LR-5

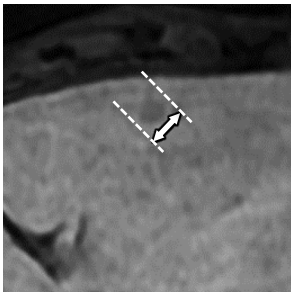
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing “capsule”
- LR-5 – if nonperipheral “washout” **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-4: Probable HCC

Example: 8 mm observation in a 90 year-old man with cirrhosis





LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

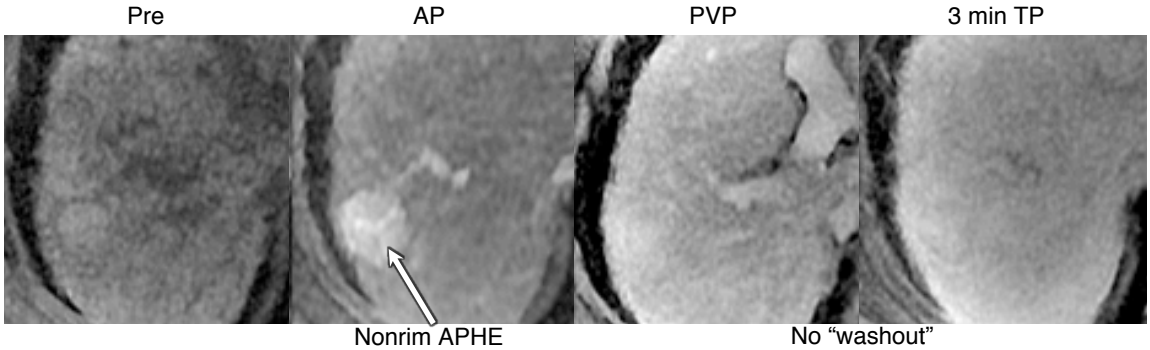
LR-4 / LR-5

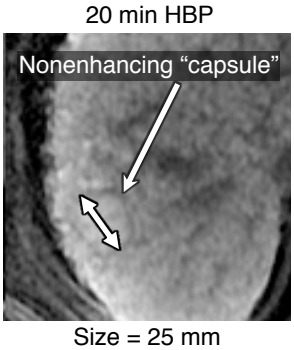
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing “capsule”
- LR-5 – if nonperipheral “washout” **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-4: Probable HCC

Example: 25 mm observation in a 57 year-old man with cirrhosis





Note:
Observation has nonenhancing "capsule".
This is AF favoring HCC in particular
But it cannot be used to upgrade to LR-5

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

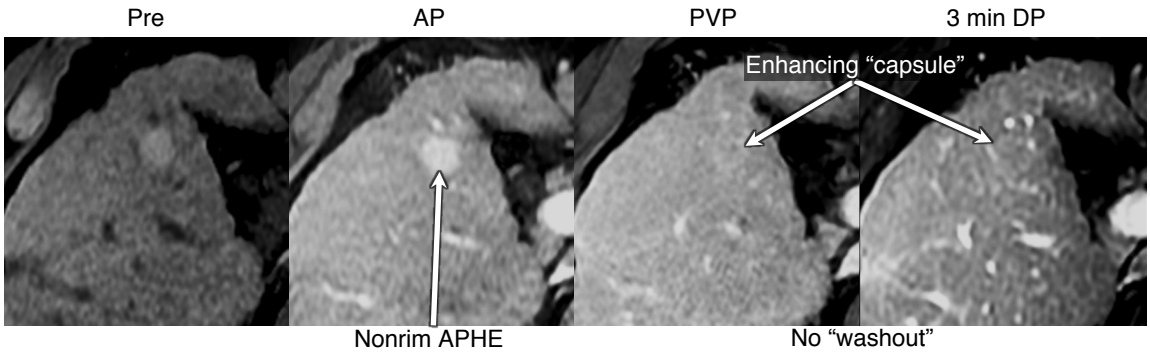
LR-4 / LR-5

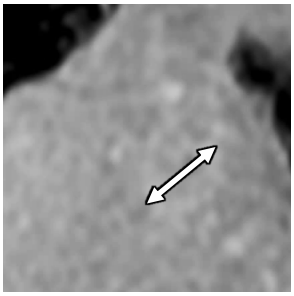
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-4: Probable HCC

Example: 19 mm observation in a 54 year-old man with cirrhosis





LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

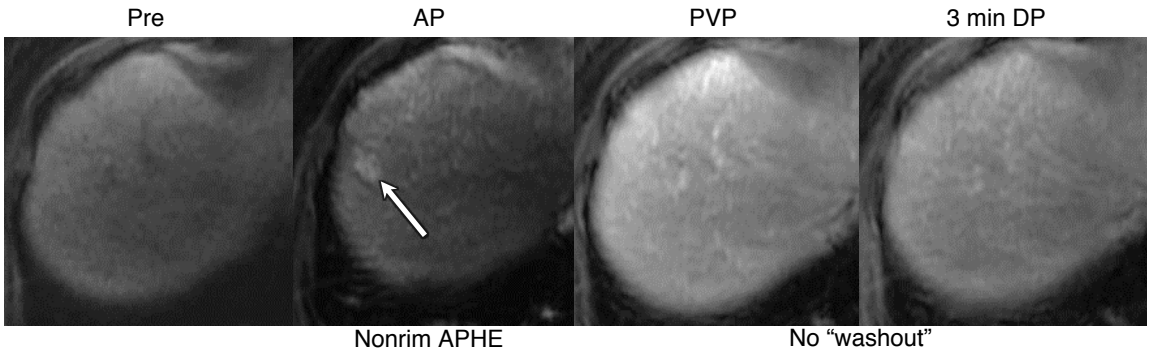
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-3: Intermediate Probability of Malignancy

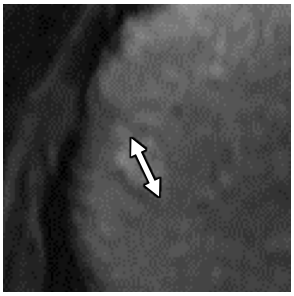
Example: 14 mm observation in a 50 year-old woman with hepatitis B



Nonrim APHE

No "washout"
No enhancing "capsule"

Note:
This observation is an example of a NAPH (see *Chapter 15, page 30*)



Size = 14 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

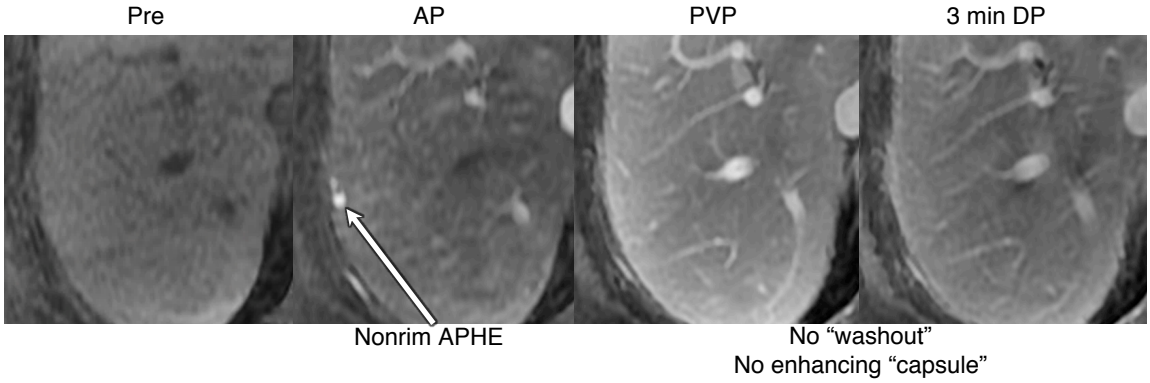
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

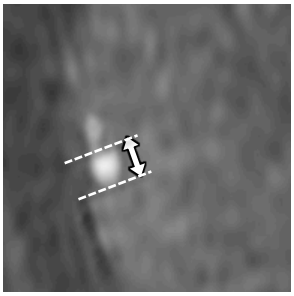
If unsure about the presence of any major feature: characterize that feature as absent

LR-3: Intermediate Probability of Malignancy

Example: 6-mm observation in a 76 year-old woman with chronic hepatitis B



Note:
This observation is an example of a NAPH (see *Chapter 15, page 30*)



LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

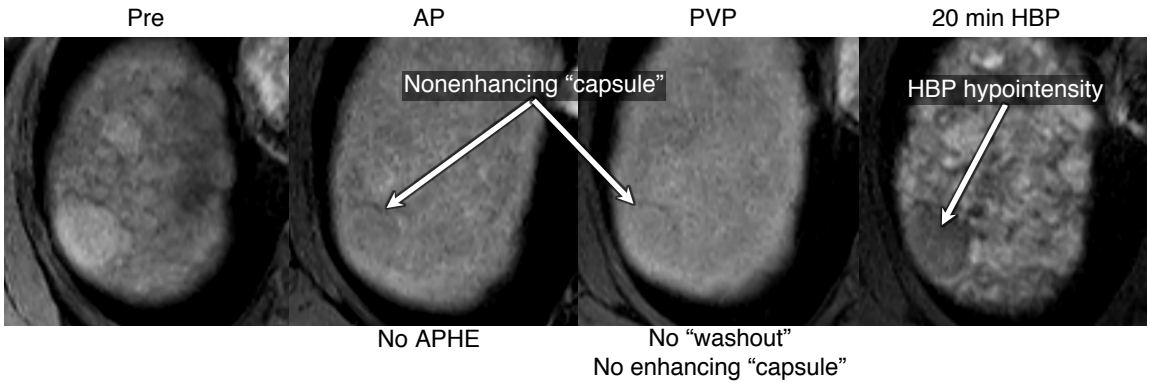
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

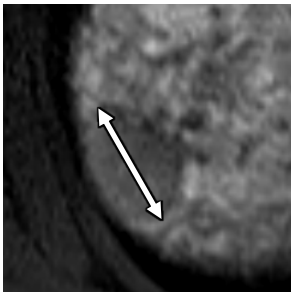
LR-3: Intermediate Probability of Malignancy

Example: 37 mm observation in a 66 year-old man with cirrhosis



Note:
Observation has two AFs favoring malignancy:
- nonenhancing "capsule"
- HBP hypointensity

Radiologists at their discretion may apply these features to upgrade to LR-4



Size = 37 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

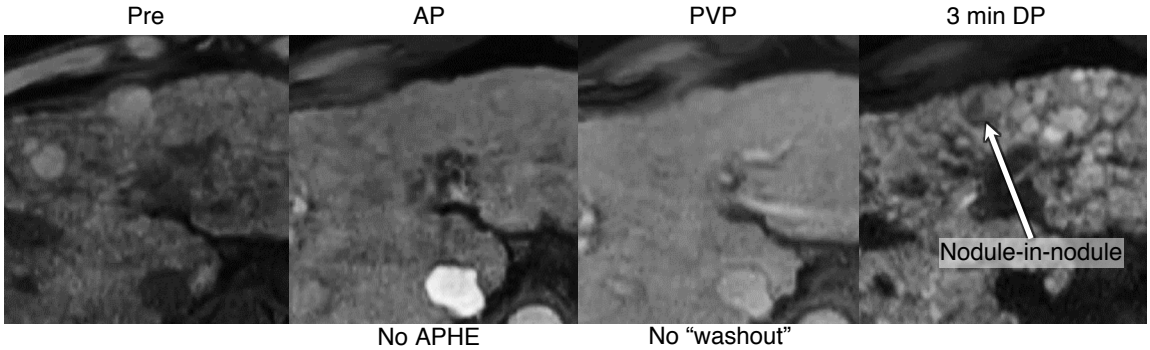
LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

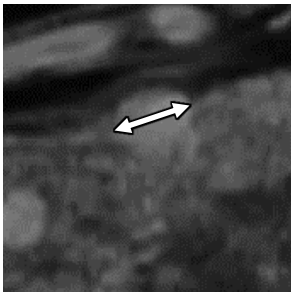
LR-3: Intermediate Probability of Malignancy

Example: 17 mm observation in a 66 year-old man with cirrhosis



No APHE

No "washout"
No enhancing "capsule"



Size = 17 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

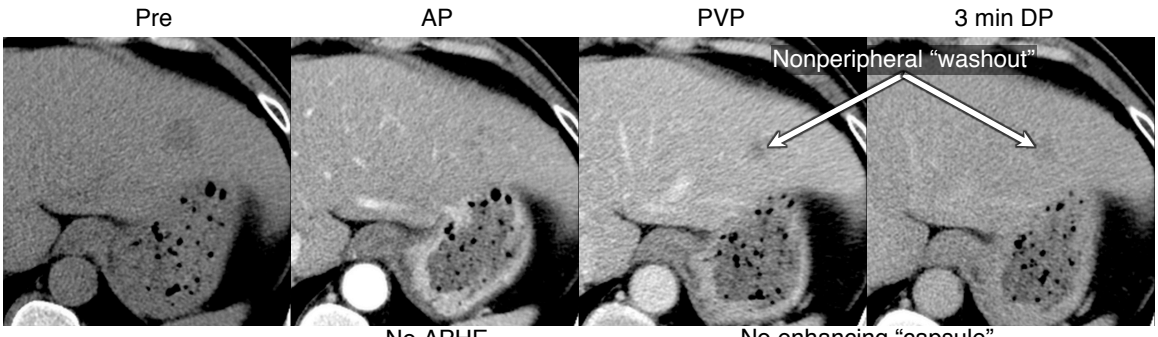
LR-4 / LR-5

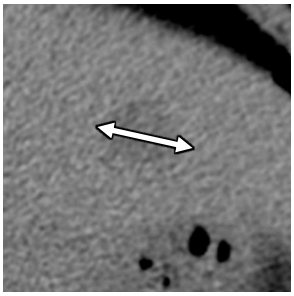
Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

LR-3: Intermediate Probability of Malignancy

Example: 18 mm observation in a 46 year-old man with cirrhosis




Size =18 mm

LI-RADS diagnostic table assigns LR-3, LR-4, and LR-5

MRI Diagnostic Table

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

LR-4 / LR-5

Observations in this cell are categorized based on one additional major feature:
- LR-4 – if enhancing "capsule"
- LR-5 – if nonperipheral "washout" **OR** threshold growth

If unsure about the presence of any major feature: characterize that feature as absent

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