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HCC and the Role of Radiology

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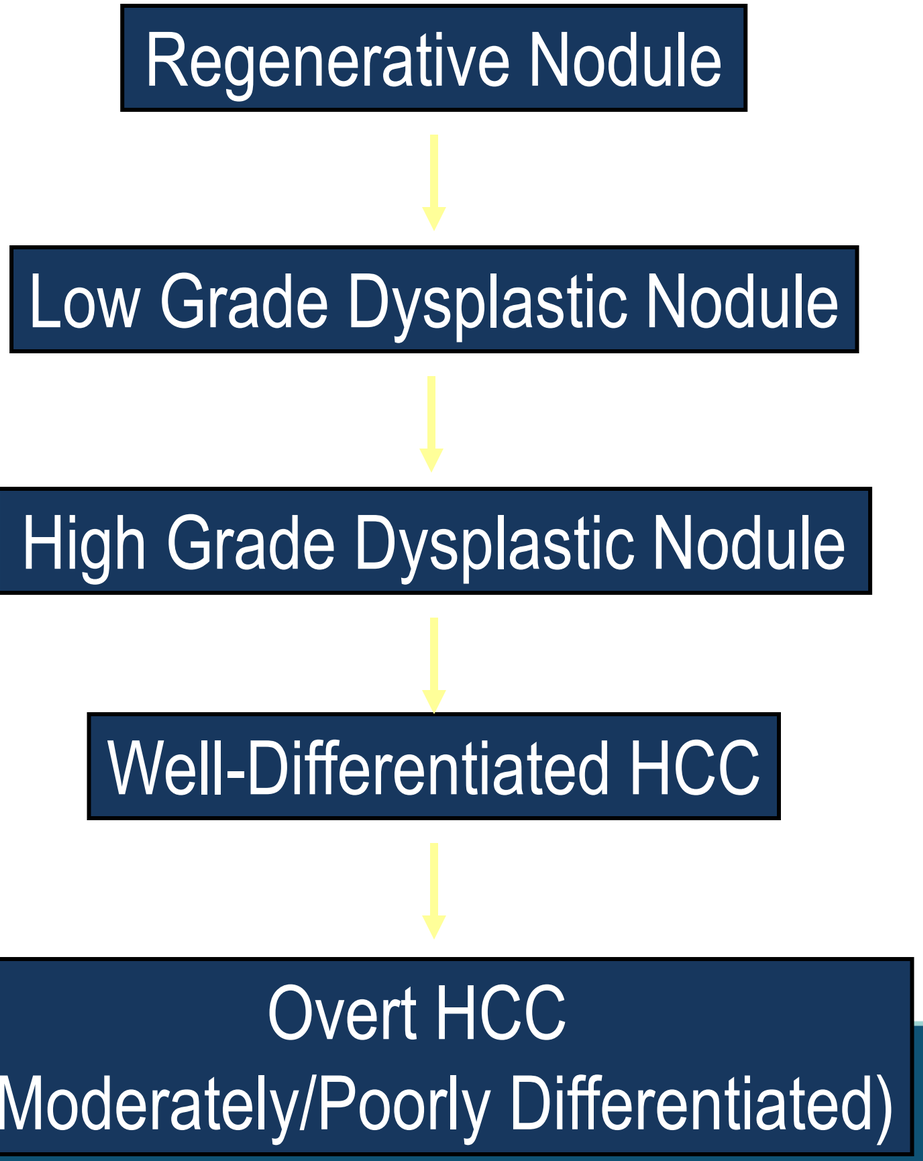
Contents

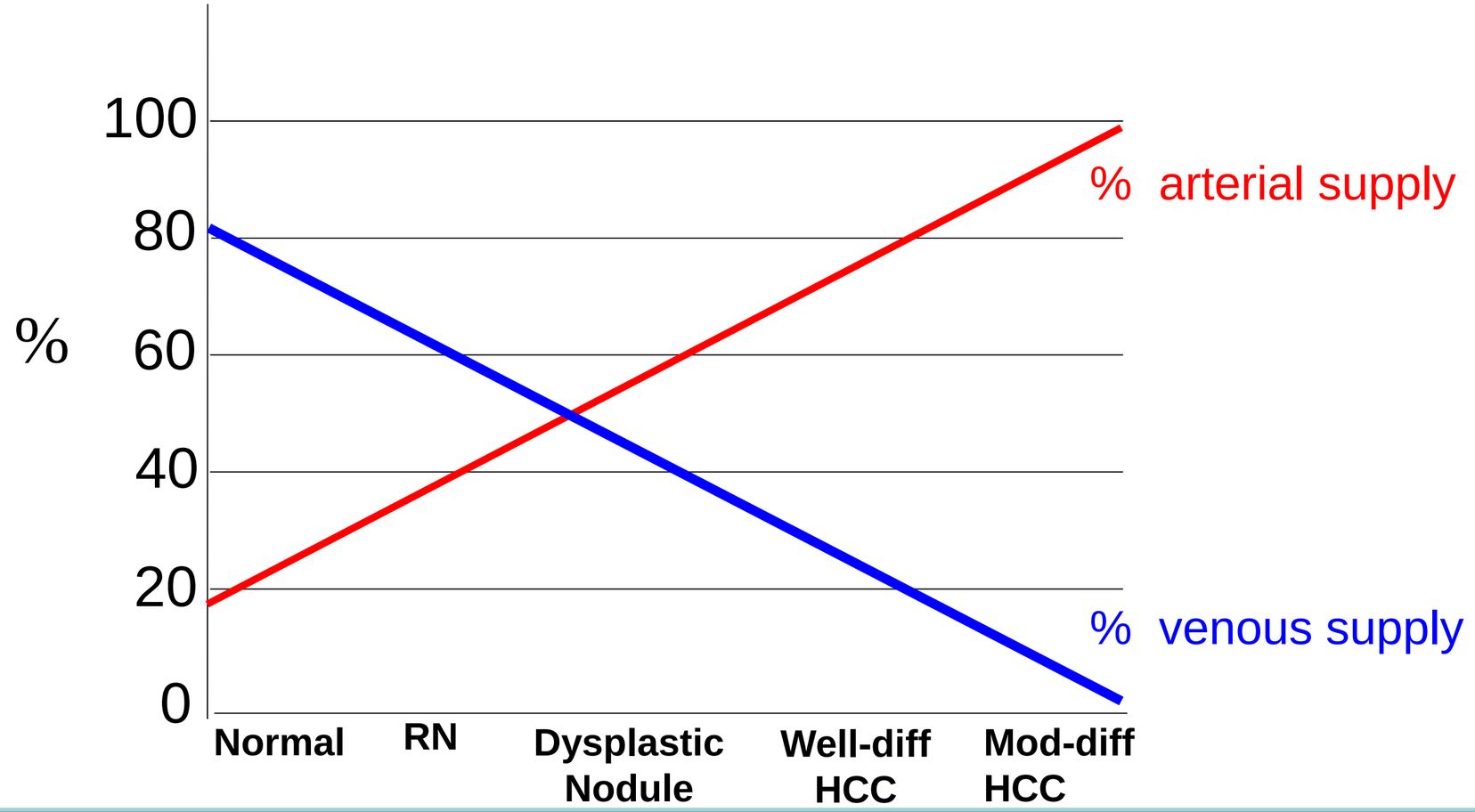
- HCC and liver nodules
- Screening/ Surveillance
- Characterisation
  - LIRADS
- Treatment options

HCC and liver nodules in Cirrhosis



(*Sakamoto hypothesis, 1991*)

Simplified Approach to Liver Hemodynamics
increased dysplasia = more arterial, less portal



Regenerative Nodules

- Usually too small to detect by imaging
  - May be surrounded by fibrotic septa
  - May contain iron, copper
- Siderotic nodules
  - Hyperdense on NCCT, disappear on HAP & PVP
  - Hypointense on T2 MR, “bloom” on GRE
- Tend to mirror vascularity of background liver
- Larger or vascular/enhancing RN
  - Take up liver specific contrast agents
  - Can be difficult to distinguish from dysplastic nodule or HCC

Dysplastic nodules

- Can appear relatively hypovascular
- More likely to be higher signal on T1WI
- Lower signal T2WI
- High grade dysplastic nodules considered premalignant
  - Difficult to differentiate from HCC on imaging

HCC

- Among the most prevalent solid organ cancers
- 90% of liver primary cancers
- Age standardised incidence 2.1/100000 US to 80/100000 China
- Viral hepatitis and NASH most common causes
- 50-70% 5 year survival if diagnosed early

HCC - Radiographic appearance

- Neovascularisation gives the enhancement characteristics
- Massive (focal)
  - large mass
  - may have necrosis, fat and /or calcification
- Nodular (multifocal)
  - multiple masses of variable attenuation
  - may also have central necrosis
- Infiltrative (diffuse)
  - may be difficult to distinguish from associated cirrhosis – they also have been called cirrhotomimetic-type HCC or cirrhosis-like HCC

SURVEILLANCE

Surveillance

- EASL Guidelines:
  - Cirrhotic patients (Child-Pugh A and B)
  - Cirrhotic patients (Child C awaiting transplant)
  - Non-cirrhotic HBV carriers with active hepatitis or FHx of HCC
  - Non-cirrhotic patients with chronic hepatitis C and advanced liver fibrosis
- US 6 months
- Shorter follow-up after resection or locoregional therapies or if detection of nodule <1cm

US

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- Routine surveillance
- Cheap and easily accessible
- Allows evaluation of PV flow and presence of PHT
- Can provide evaluation of enhancement (CEUS)
- Guide for tissue sample (biopsy)
- Sn 60-80%, Sp 45-94%

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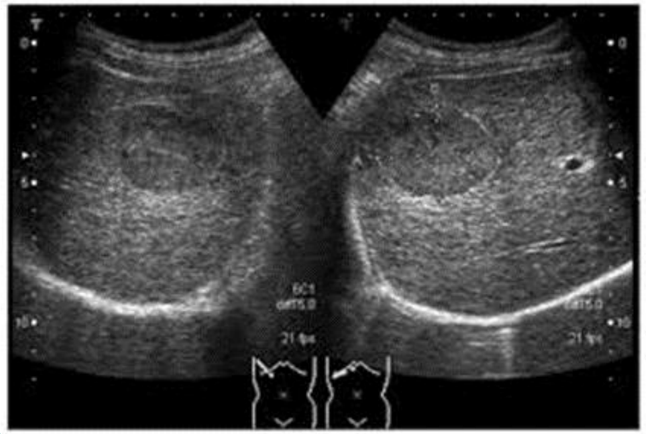
- Subjective
- Can be difficult dependent on body habitus
- Not diagnostic



LI-RADS surveillance

US category

US-1	Negative
US-2	Subthreshold
US-3	Positive

Category	Concept	Definition
US-1 Negative	No US evidence of HCC	No observation **OR** Only definitely benign observation(s)
US-2 Subthreshold	Observation(s) detected that may warrant short-interval US surveillance	Observation(s) < 10 mm in diameter, not definitely benign
US-3 Positive	Observation(s) detected that may warrant multiphase contrast-enhanced imaging	Observation(s) ≥ 10 mm in diameter, not definitely benign, including area(s) of parenchymal distortion **OR** New thrombus in portal or hepatic vein

Surveillance ultrasound in patient at high risk for HCC

US visualization score

VIS-A	No or minimal limitations
VIS-B	Moderate limitations
VIS-C	Severe limitations

Score	Definition	Examples
VIS-A No or minimal limitations	Limitations if any are unlikely to meaningfully affect sensitivity	Liver homogeneous or mildly heterogeneous Minimal beam attenuation or shadowing Liver visualized in near entirety
VIS-B Moderate limitations	Limitations may obscure small (< 10 mm) observations	Parenchymal heterogeneity that may impact detection of small (< 10 mm) observation(s) Moderate beam attenuation or shadowing Some portions of liver or diaphragm not visualized
VIS-C Severe limitations	Limitations significantly lower sensitivity for liver observations	Liver severely heterogeneous Severe beam attenuation or shadowing Majority (> 50%) of right or left lobe not visualized Majority (> 50%) of diaphragm not visualized

LI-RADS® US Surveillance Management

Patient[a] at high risk for HCC[b]

Surveillance US

if **US-3** Positive → Diagnostic MRI, CT, or CEUS

Otherwise

if **AFP positive[c]** (but not US-3) → Diagnostic MRI or CT[d]

Otherwise

if **VIS-C** Severe limitations → Repeat US within 3 months x 1 **OR** consider alternative surveillance modality[e]

Otherwise

if **US-2** Subthreshold[f,] → Repeat US in 3 to 6 months x 2[g]

Otherwise

US-1 Negative[f] → Repeat US in 6 months

notes

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CHARACTERISATION

CT

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- Quick
- Readily available
- Good contrast resolution
- Allows evaluation of enancement characteristics
- Presence of PHT
- Visualisation of vasculature
  - Anatomy
  - Vessel patency
- Can be a strong guide to diagnosis
- Sn 81%, Sp 93%

- ve

- Ionising radiation
- Spatial resolution less good than MRI
- Diagnostic accuracy less good than MRI

MRI

+ ve

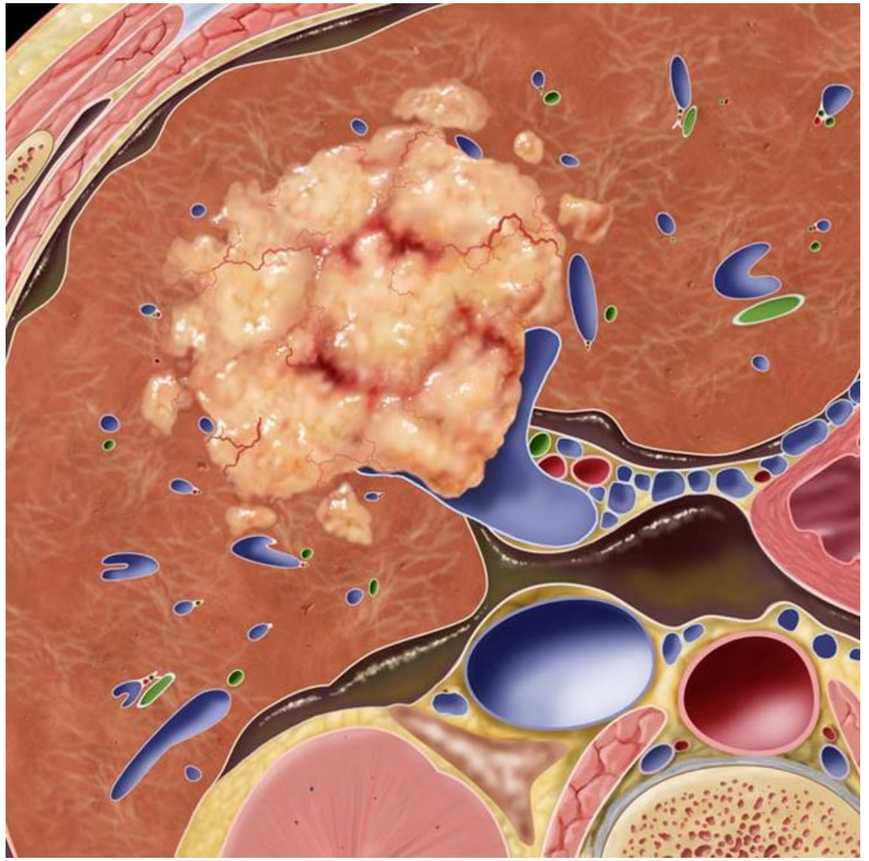
- High spatial resolution
- Better tissue characterisation
- Allows functional imaging
- Ability to identify intralesional fat
- Hepatobiliary contrast agents
- Sn 91%, Sp 95%

- ve

- Availability
- Length of study
- Issues with low ps/ inability to lie still/ inability to hold breath
- Cirrhosis in itself can affect lesional conspicuity

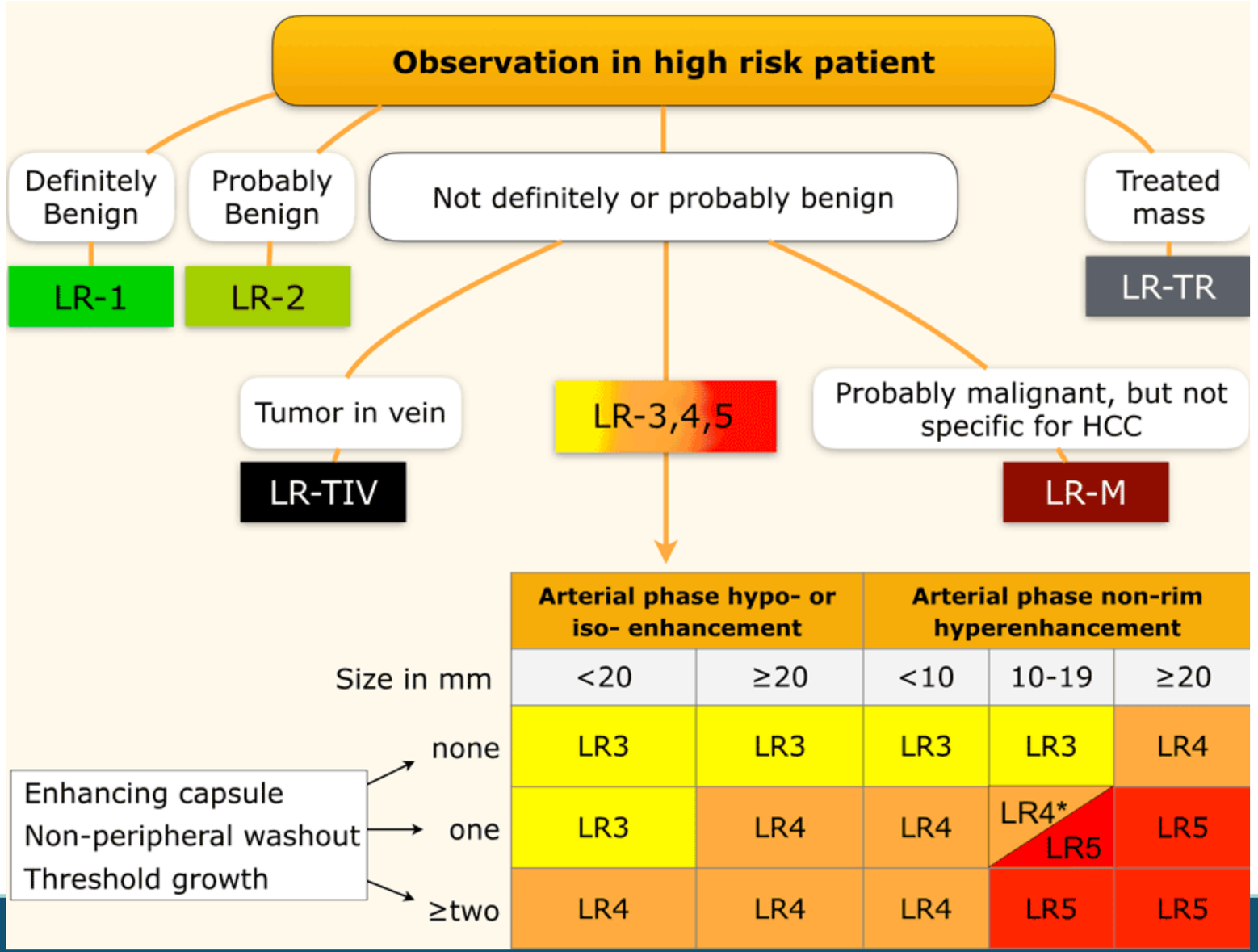
HCC imaging characteristics

- Heterogeneously hypervascular mass
- Can be encapsulated
- Washes out on venous phase
- Invades veins (portal > hepatic)
- MRI
  - Can contain fat
  - Does not take up Primovist
  - Restricts



Federle: *DI: Abdomen*

LI-RADS characterisation (CT/ MRI v2018)



	Arterial phase hypo- or iso- enhancement		Arterial phase non-rim hyperenhancement		
Size in mm	<20	≥20	<10	10-19	≥20
none	LR3	LR3	LR3	LR3	LR4
one	LR3	LR4	LR4	LR4* / LR5	LR5
≥two	LR4	LR4	LR4	LR5	LR5

Enhancing capsule
Non-peripheral washout
Threshold growth

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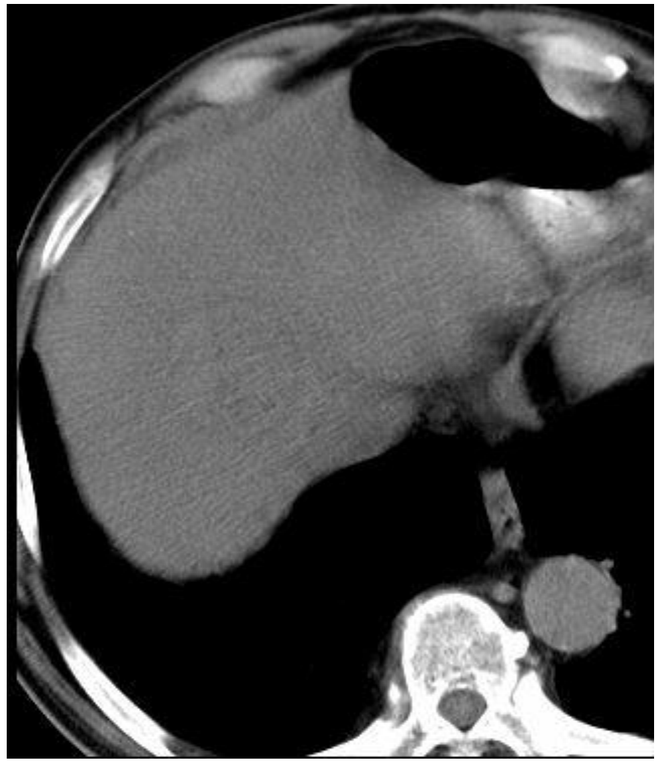
LI-RADS categories

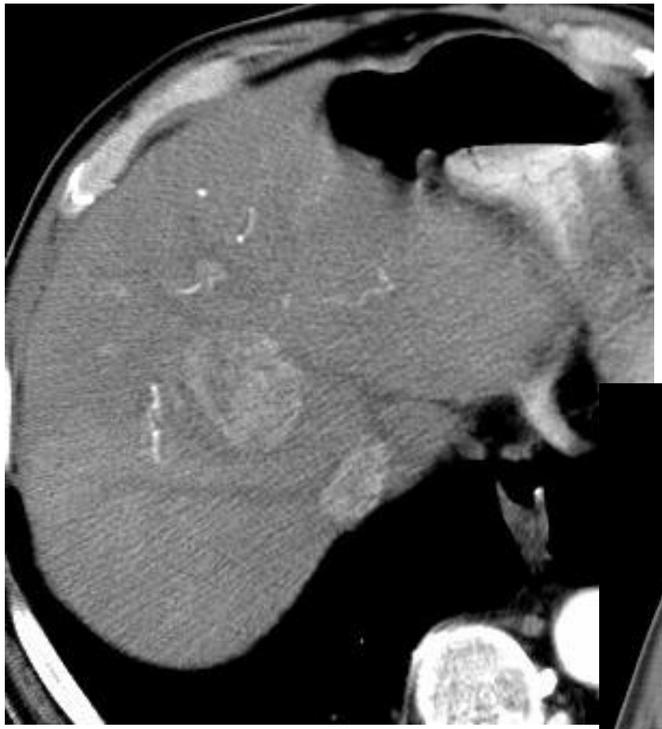
LI-RADS	Description	Management
Negative	no observations detected	return to surveillance in 6 months
LR-NC	not categorizable due to image degradation or omission	repeat or alternative imaging in < 3 mo
LR-1	definitely benign observation	return to surveillance in 6 mo
LR-2	probably benign	consider repeat diagnostic imaging in 6 mo.
LR-3	intermediate probability of malignancy	repeat or alternative imaging in 3-6 mo
LR-4	probably HCC	multidisciplinary discussion for further work-up
LR-5	definitely HCC	multidisciplinary discussion for management consensus
LR-M	probably/definite malignancy not HCC specific	multidisciplinary discussion. consider biopsy
LR-TIV	definite tumor in vein	multidisciplinary discussion, may include biopsy

HCC with capsule

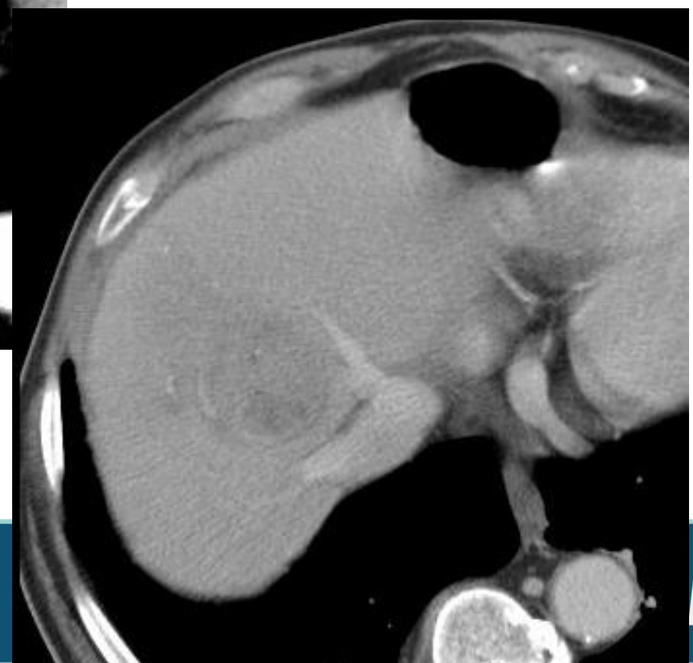
NC

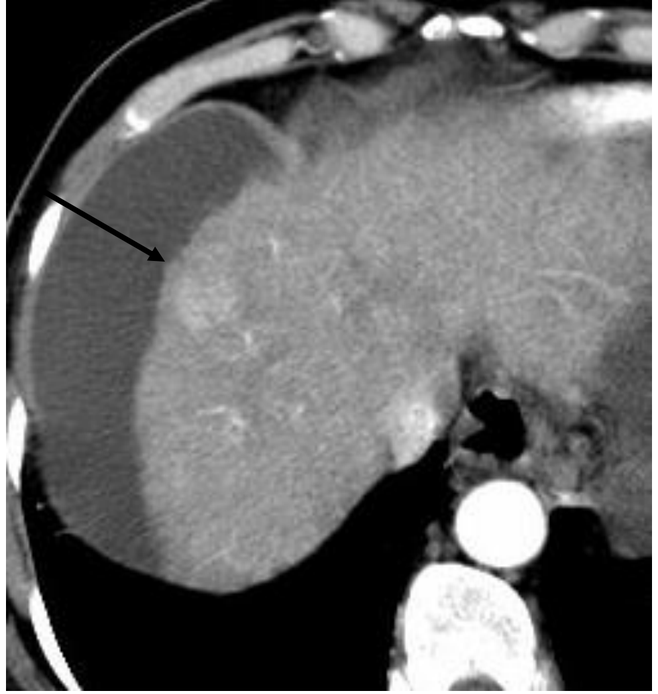


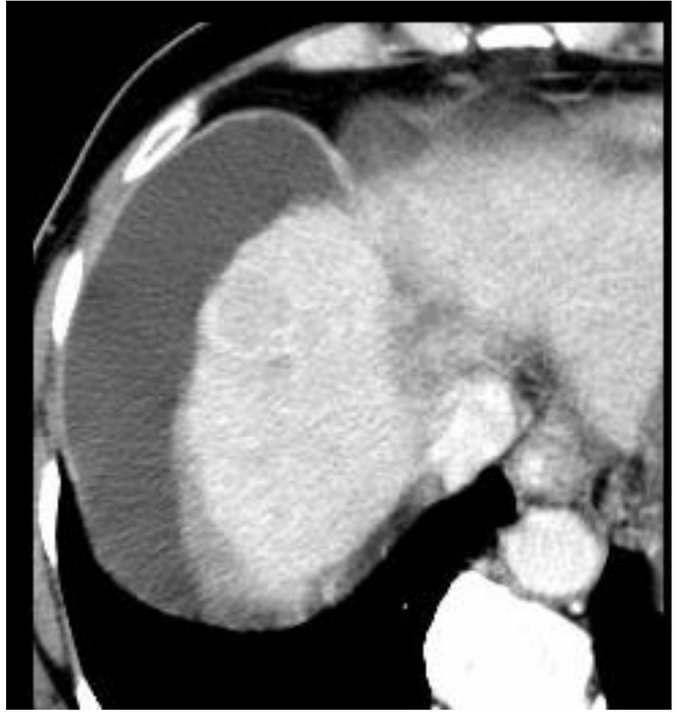
HAP



PVP

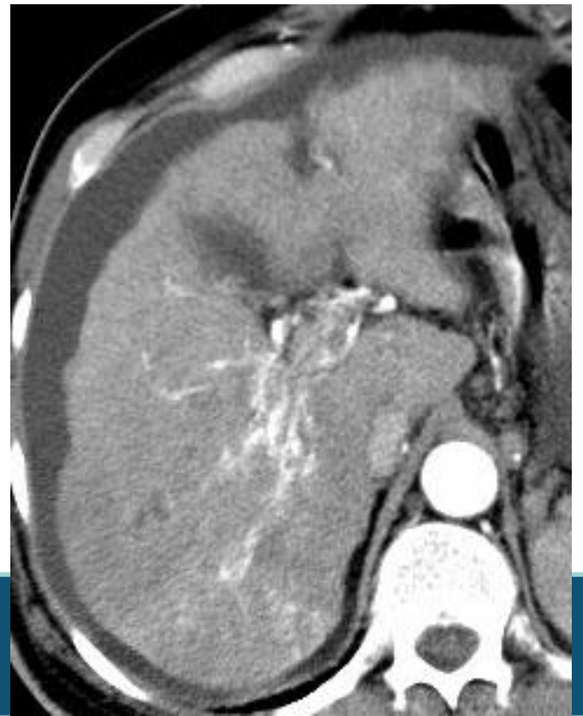


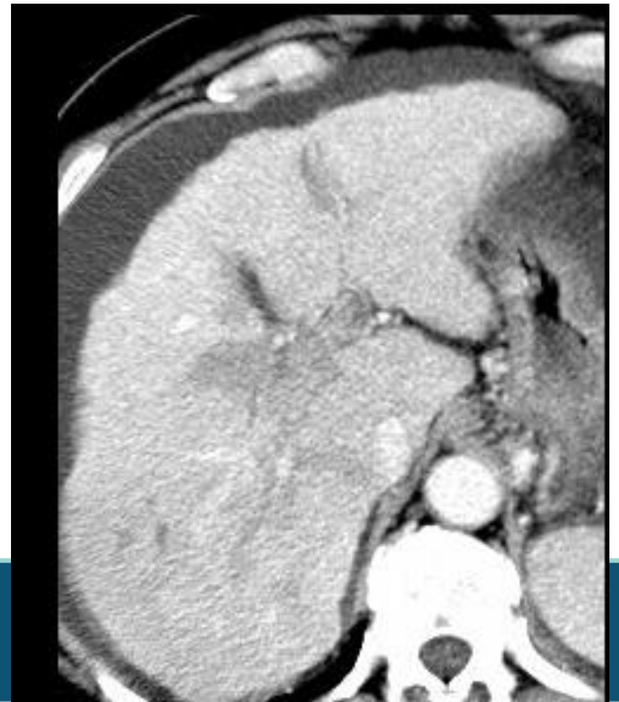




HCC

- small tumor
- PV invasion





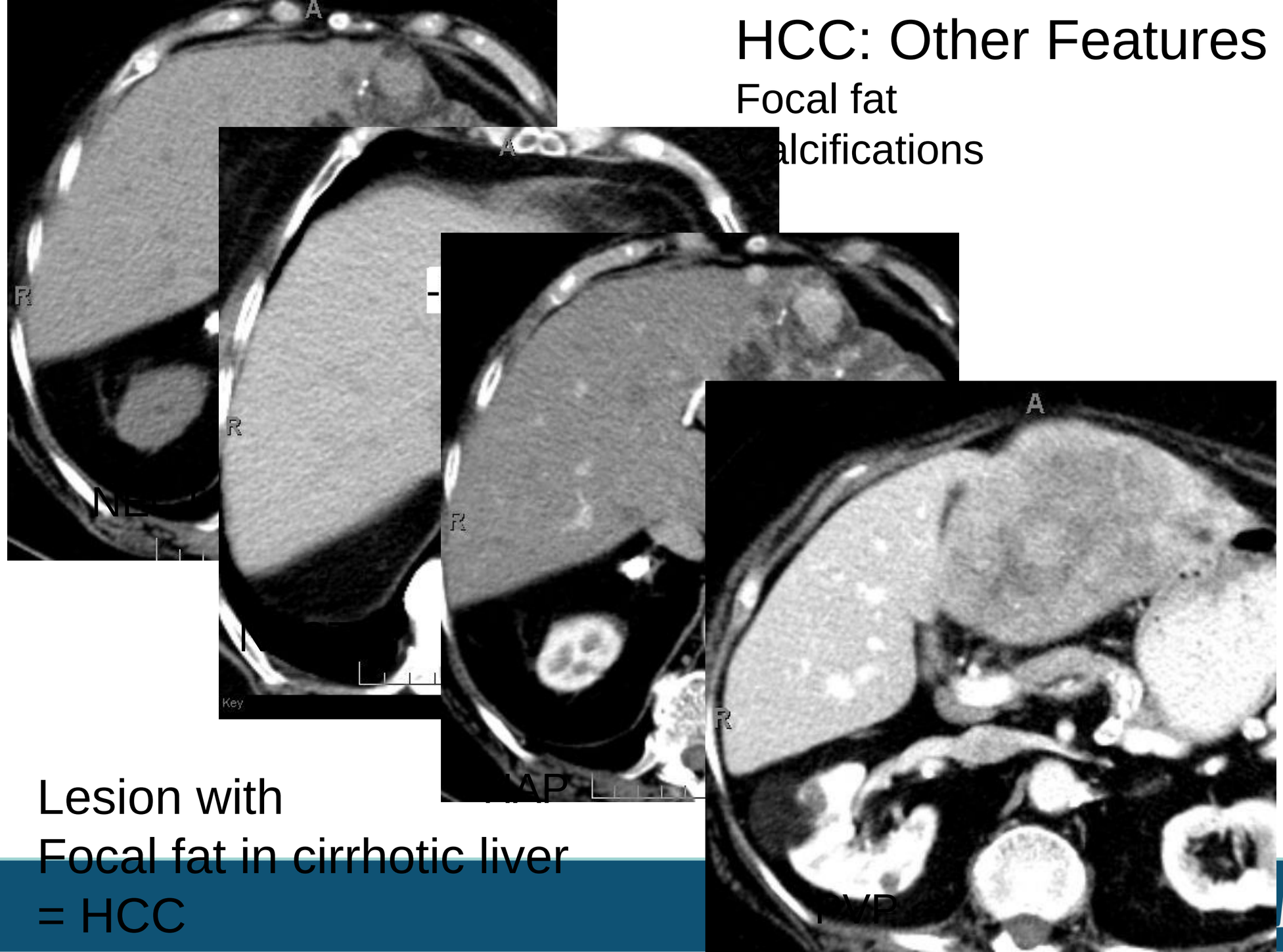
Tumor Thrombus:

- Contiguity w tumor
- Expansion of lumen
- Enhancing thrombus

HCC: Other Features

Focal fat

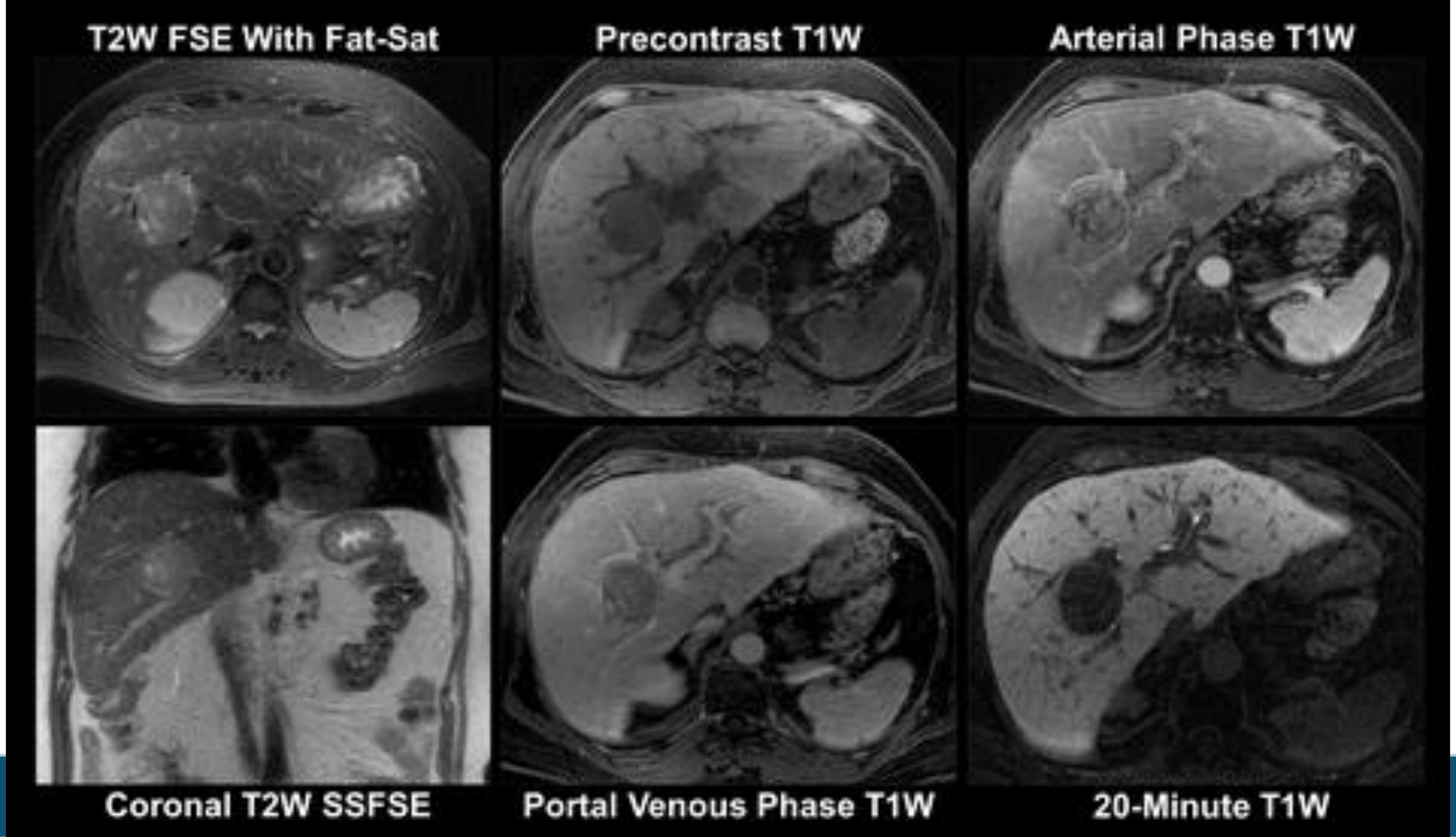
alcifications

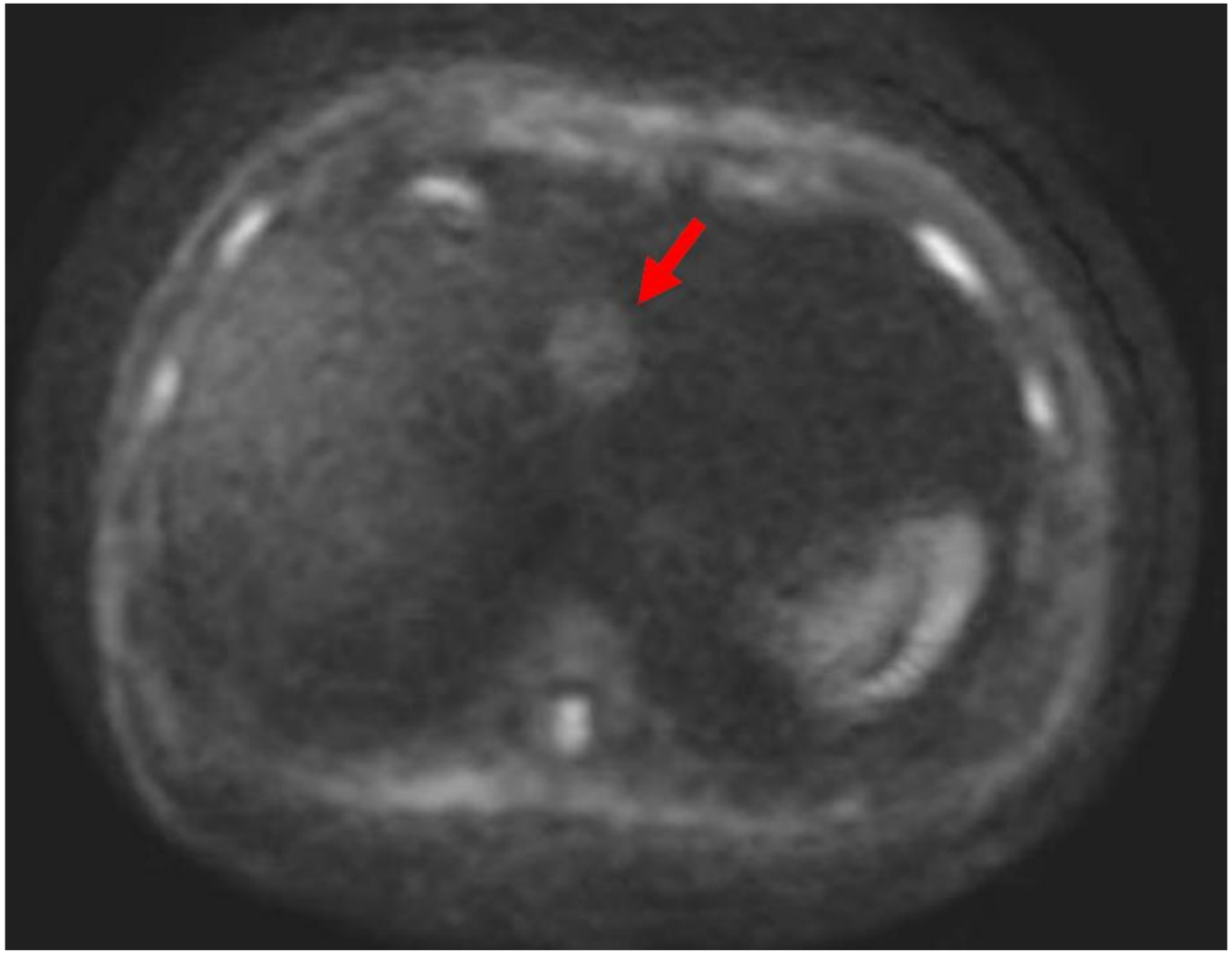


Lesion with
Focal fat in cirrhotic liver
= HCC

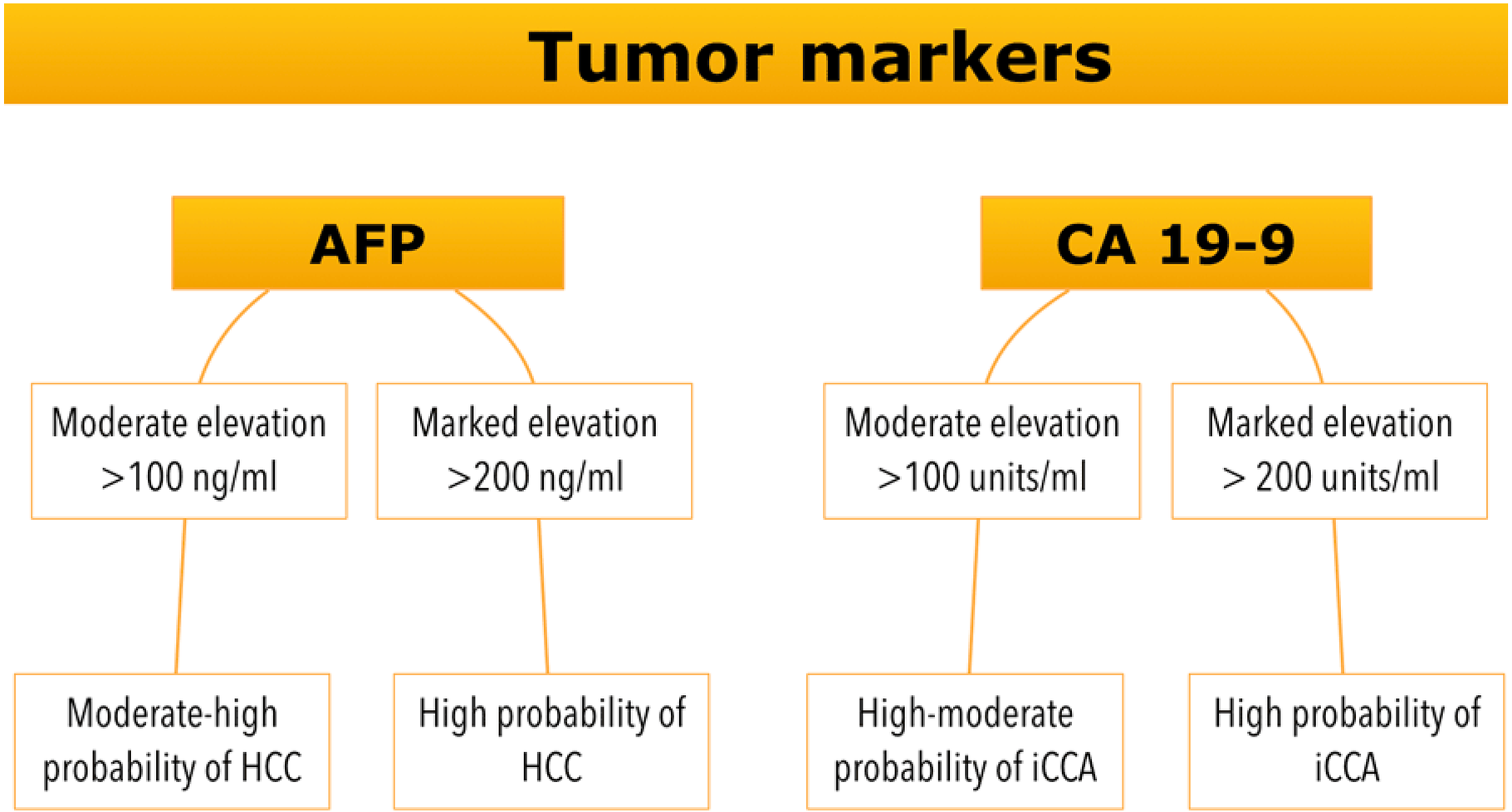
MRI Contrast agents

- **Extracellular gadolinium contrast agents:**
  - Excreted through the kidneys
  - Allows dynamic T1WI including arterial, portal venous and delayed phase
- **Hepatobiliary contrast agents:**
  - Gadotexate disodium (Gd-EOB-DTPA - Primovist, Eovist)
  - 50:50 biliary-renal excretion
  - Biphasic distribution:
    - **Blood pool phase:** extracellular compartment, similar to coventional agents
    - **Hepatocyte phase:** Taken up by functioning hepatocytes by the OATP receptor
    - Allows for hepatobiliary phase imaging 20 minutes post injection
    - Improves detection and characterisation of hepatic lesions compared to unenhanced MRI and dynamic CT


T2W FSE With Fat-Sat
Precontrast T1W
Arterial Phase T1W
Coronal T2W SSFSE
Portal Venous Phase T1W
20-Minute T1W



Other diagnostic aids



Diagnosis

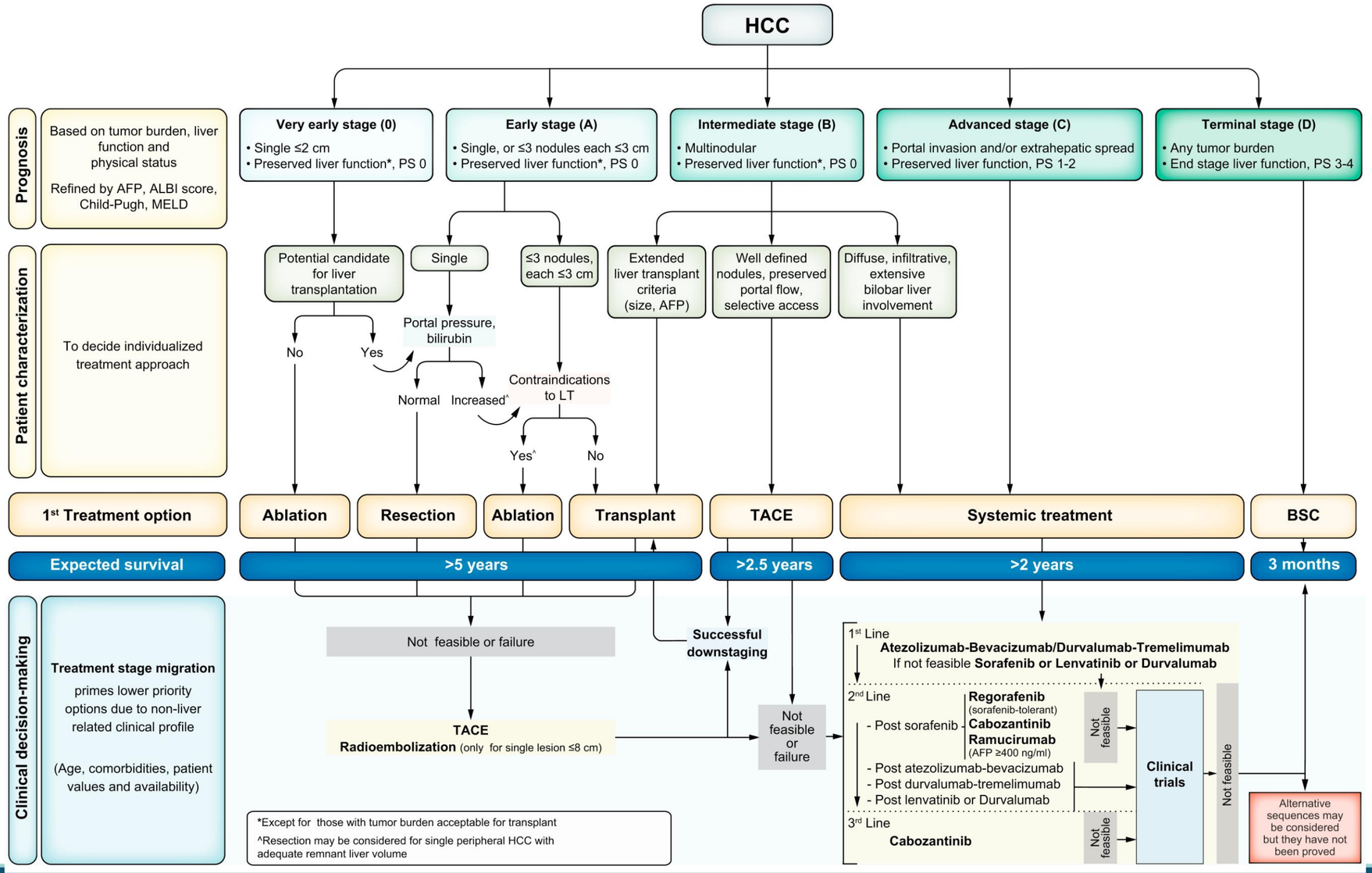
- Optimal imaging is essential
  - High flow rate multiphase CT
  - We need to know the arterial anatomy
    - Variants
    - Extrahepatic supply
- Biopsy
  - For systemic therapy
  - If any doubt on imaging criteria/ AFP

TREATMENT

Treatment options

- Curative:
  - Transplant
  - Resection
  - Ablation
  - ?? Radiation segmentectomy with SIRT/ TARE
- Disease control/ downstaging/ palliation:
  - TACE
  - SIRT/ TARE
  - Systemic

BCLC guidelines 2022



J Hepatol 2022;76:681-693

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Child-Pugh score

	Classification		
	A	B	C
Total points	5-6	7-9	10-15
1 year survival	100%	80%	45%

Clinical and Lab Criteria	Points*		
	1	2	3
Encephalopathy	None	Mild to moderate (grade 1 or 2)	Severe (grade 3 or 4)
Ascites	None	Mild to moderate (diuretic responsive)	Severe (diuretic refractory)
Bilirubin (mg/dL)	< 2	2-3	>3
Albumin (g/dL)	> 3.5	2.8-3.5	<2.8
Prothrombin time			
Seconds prolonged	<4	4-6	>6
International normalized ratio	<1.7	1.7-2.3	>2.3

Child-Turcotte-Pugh Class obtained by adding score for each parameter (total points)
Class A = 5 to 6 points (least severe liver disease)
Class B = 7 to 9 points (moderately severe liver disease)
Class C = 10 to 15 points (most severe liver disease)

Transplant criteria

UNOS Stage T3N0M0 HCC

One tumor > 5 cm

Two or three tumors with at least one > 3 cm

No imaging evidence of vascular invasion

No imaging evidence of extrahepatic metastatic disease

Milan criteria

One tumor ≤ 5 cm

Two or three tumors ≤ 3 cm

No imaging evidence of vascular invasion

No imaging evidence of extrahepatic metastatic disease

UCSF criteria

One tumor ≤ 6.5 cm

Two or three tumors ≤ 4.5 cm

Sum of longest diameter of each tumor ≤ 8 cm

No imaging evidence of vascular invasion

No imaging evidence of extrahepatic metastatic disease

Conclusion

- Surveillence and Diagnosis of HCC still image guided
- US good surveillance tool
- Lesion characterisation and treatment planning needs cross sectional imaging
- Image optimisation essential
- Where curative surgery not an option consider biopsy
  - Diagnostic uncertainty
  - Prior to oncological/ systemic therapy
  - ? More generally as cancer subtype specific treatments come on line