



Incidentally Detected Hepatic Lesions on Ultrasound: Correlation with CT and MRI Findings

**Yang Shin Park, Chang Hee Lee
Korea University Guro Hospital, Seoul, Korea**

Learning objectives

1. To learn the common incidentally detected focal liver lesions on ultrasound.
2. To learn typical and atypical sonographic feature of focal liver disease.
3. To learn correlation between sonographic features and CT/MR findings of focal liver disease.

Background

- The number of incidentally discovered focal liver lesions is also increasing markedly.
 - Due to the improving technical standard of ultrasound equipment
 - Due to high number of abdominal ultrasound examinations
- 57% of all liver lesions found by ultrasound are benign.
 - Focal fatty sparing (6.3%) > hepatic cysts (5.8%) > hepatic hemangioma (3.3%) >> focal nodular hyperplasia (0.2%) > hepatic adenoma (0.04%)

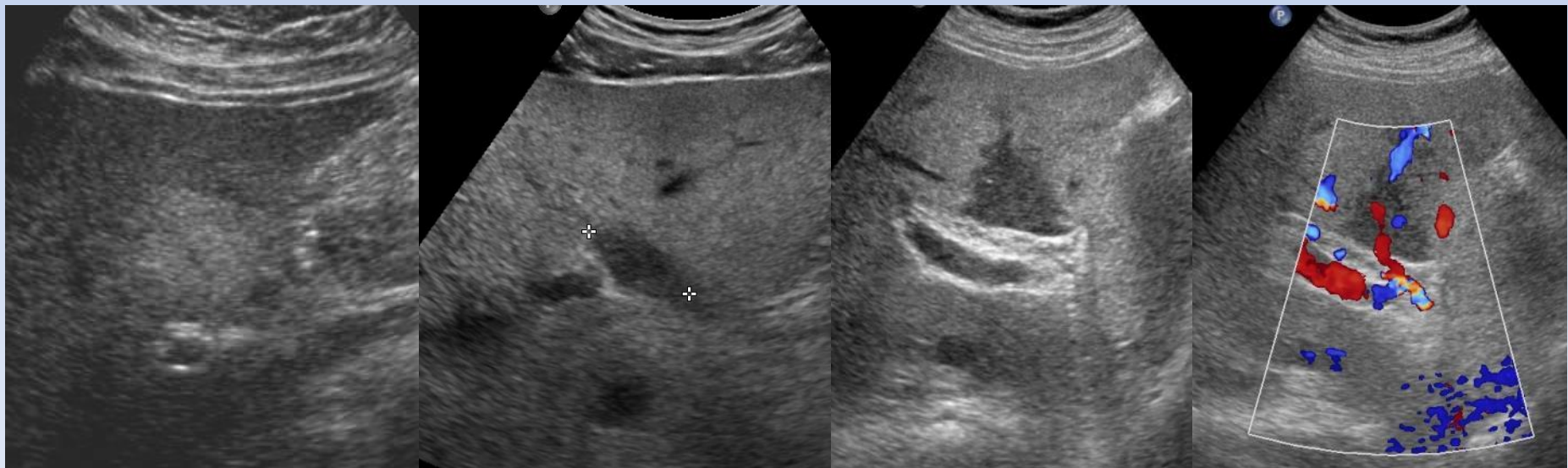
*Abdom Radiol 2016;41:25-32.
Rofo 2001;173:424-9.*

Focal liver diseases

1. Benign hepatic lesions
2. Malignant hepatic lesions

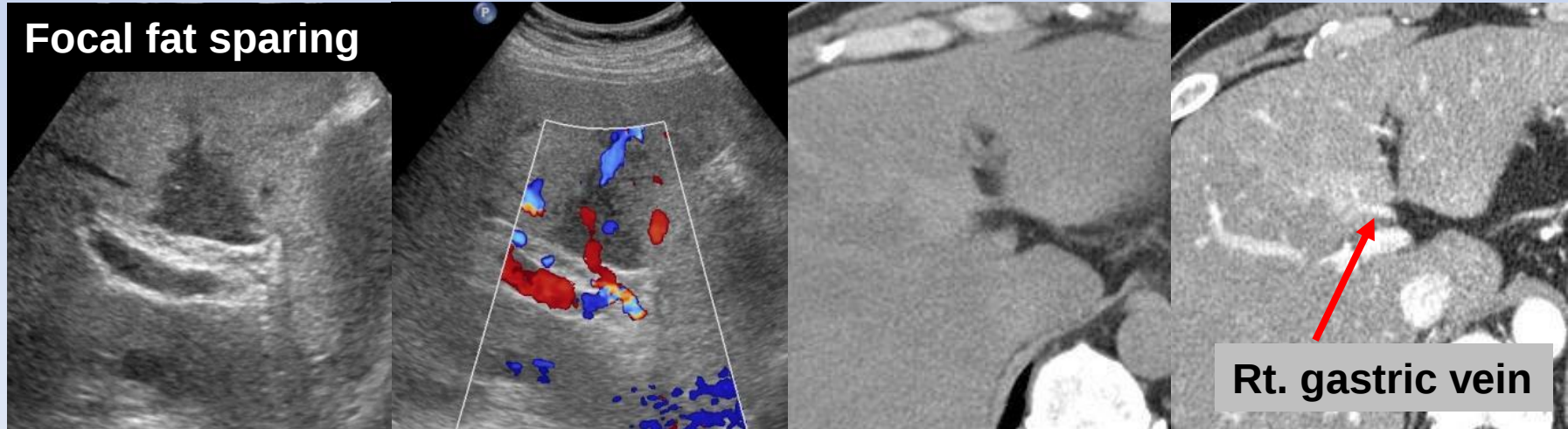
Focal fat deposition or sparing

- Easily recognized by their morphology and typical location
 - ✓ Adjacent to falciform ligament, portal veins, and GB
 - ✓ Geographic margin with no mass effect
 - ✓ Undisturbed vessels traversing through lesion



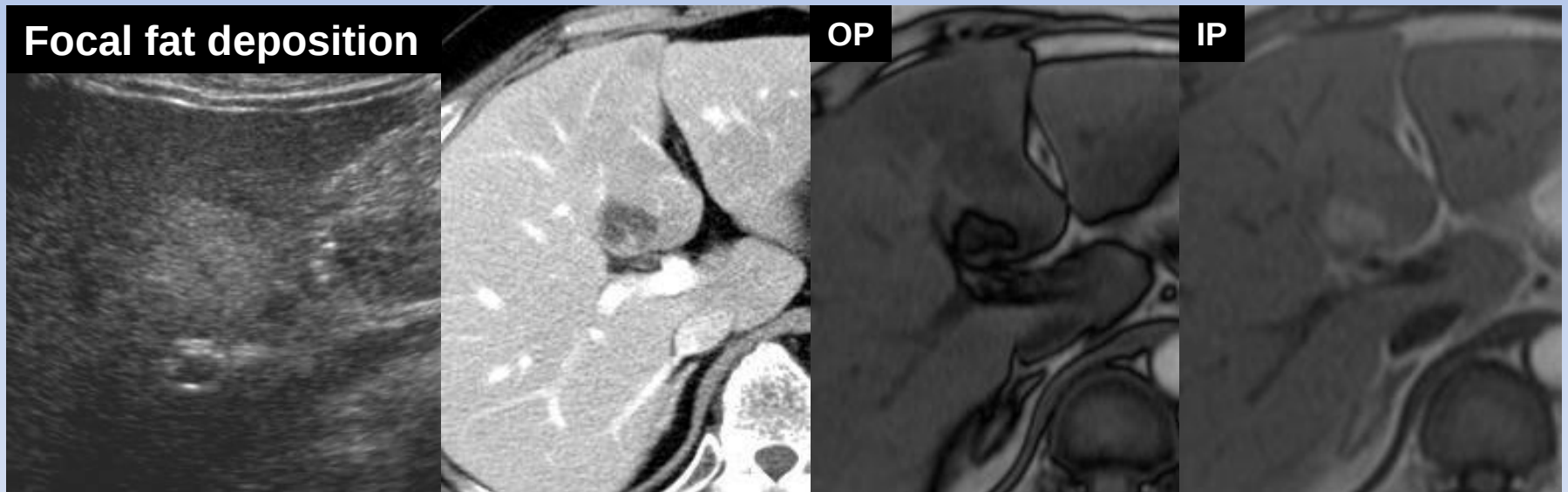
Focal fat deposition or sparing

- CT
 - Earlier enhancement during arterial phase
 - caused by its shorter pathway of nonportal venous system, such as gastric, cystic, or pancreaticoduodenal vein as compared with normal portal venous return through SMV
 - Homogeneous isoenhancement during PVP
 - Direct visualization of an aberrant vein into lesion



Focal fat deposition or sparing

- MRI
 - Chemical shift imaging: presence of fat



Focal fat deposition in hepatic S4 posterior portion

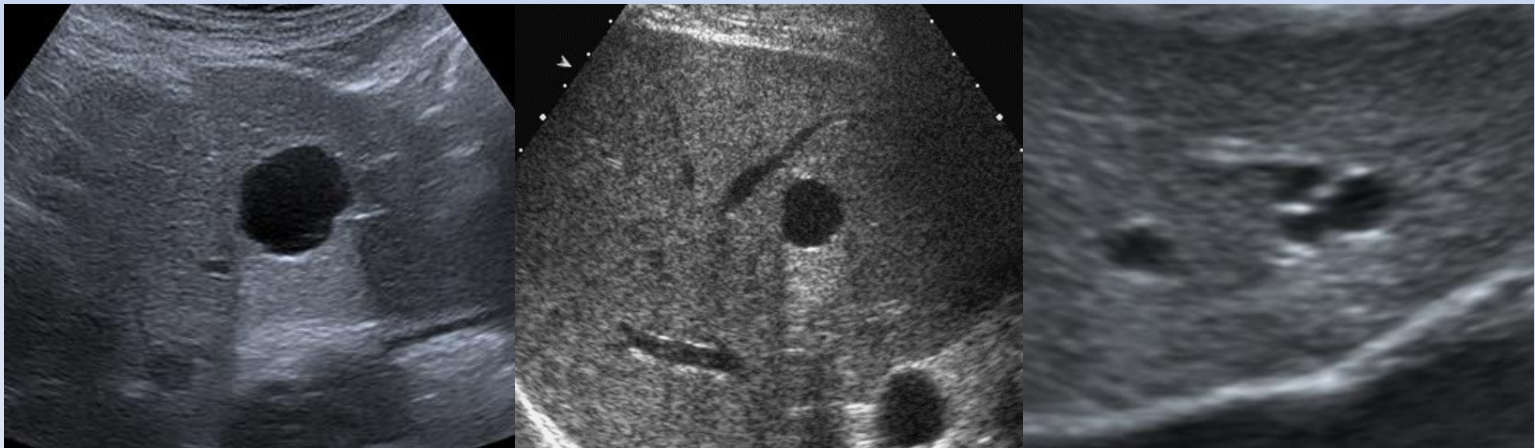
US: geographic echogenic lesion

CT: focal hypodense or fatty-attenuated lesion

MR: signal drops on the opposed phase image, compared with in phase image

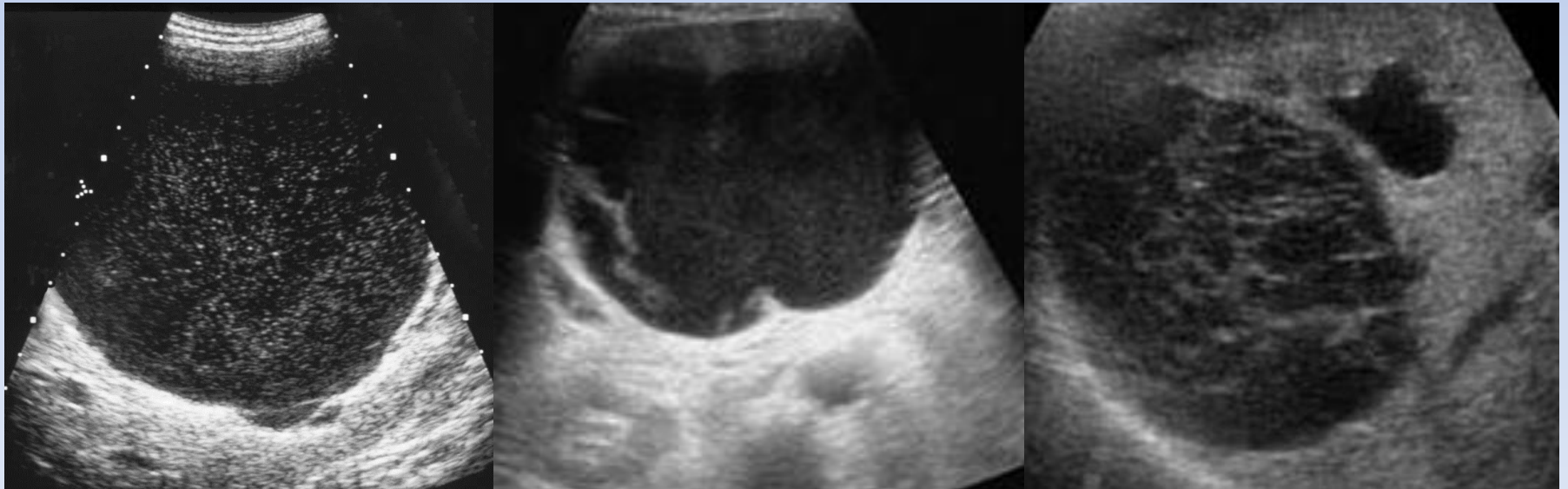
Hepatic cyst

- Simple cyst = bile duct cyst
- A single, unilocular cyst lined by a single layer of cuboidal, bile duct epithelium
- US
 - Best way to confirm the cystic nature of hepatic lesion
 - Anechoic, round, well-defined lesion with posterior acoustic enhancement and smooth borders



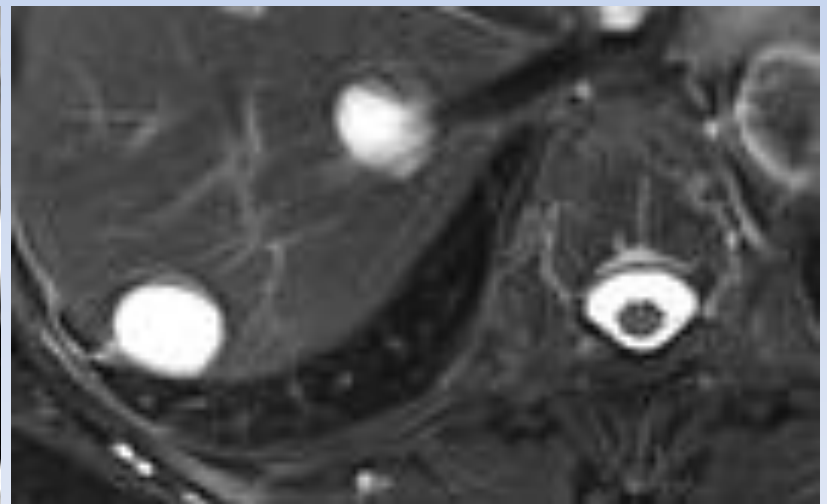
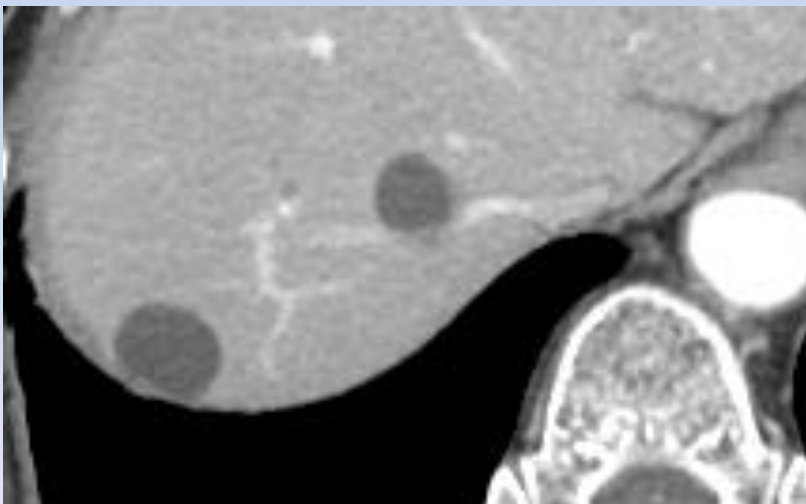
Hepatic cyst

- Complicated cyst with infection or hemorrhage
 - Diffuse low-level internal echo (internal debris)
 - Septations
 - Irregular echogenic solid-appearing areas



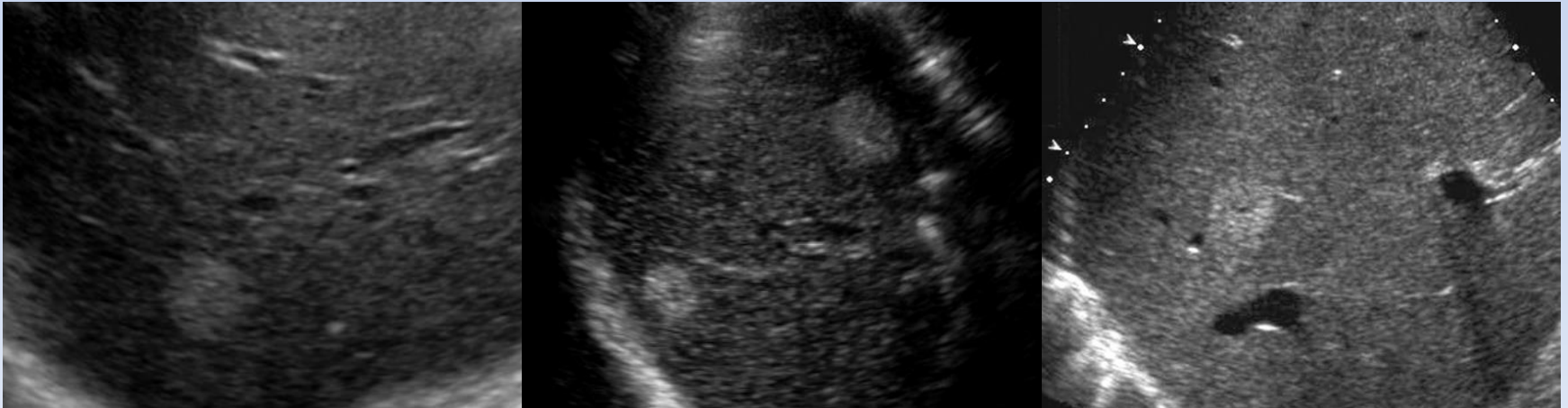
Hepatic cyst

- CT
 - Well-defined, fluid-attenuated lesion with round or oval shape, smooth, thin walls, no enhancement
- MRI
 - T1: variable SI
 - if protein and/or hemorrhage are present within the cyst
 - T2: bright high SI



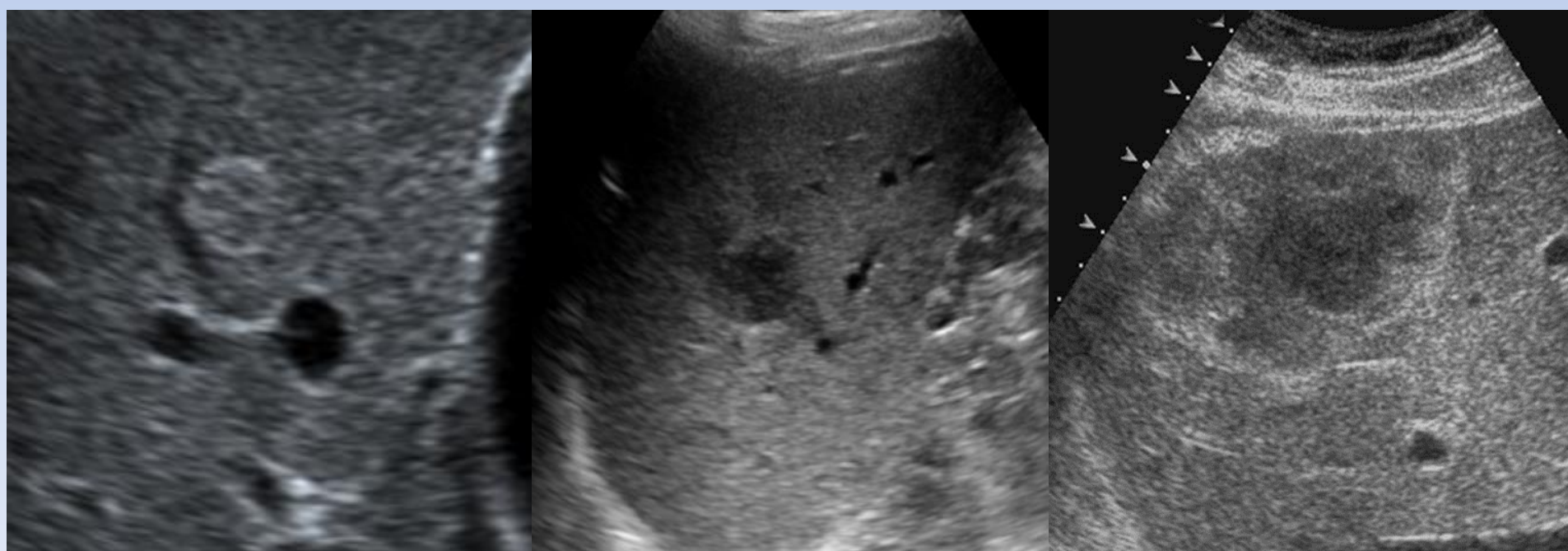
Hemangioma

- M/C benign hepatic tumor
- Composed of multiple vascular channels lined by a single layer of endothelial cells supported by a thin, fibrous stroma
- US
 - Well-defined, homogeneous and hyperechoic lesion
 - Faint posterior acoustic enhancement



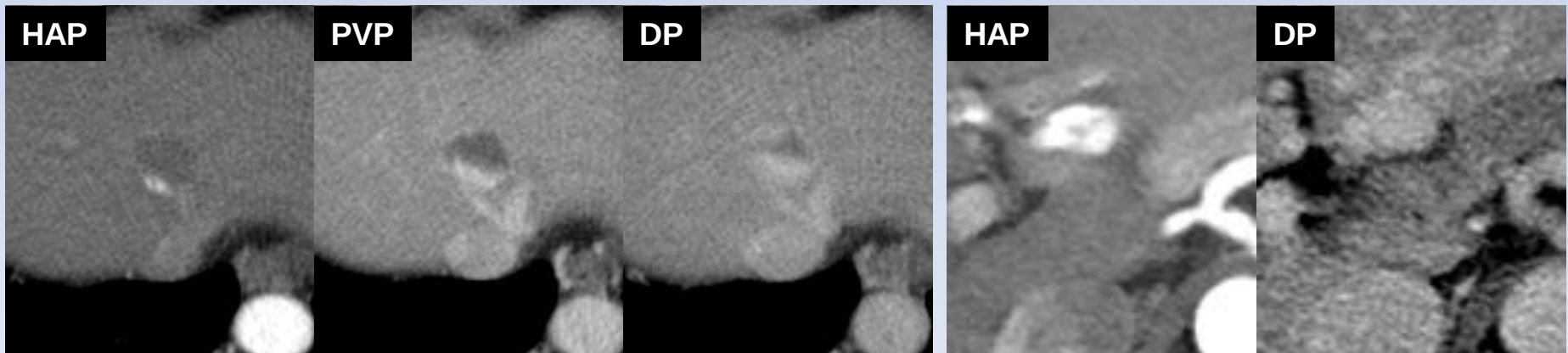
Hemangioma

- Atypical US finding
 - Echoic border, either a thin rim or thick rind
 - Hypoechoic in fatty liver background
 - Larger → heterogeneous echogenicity

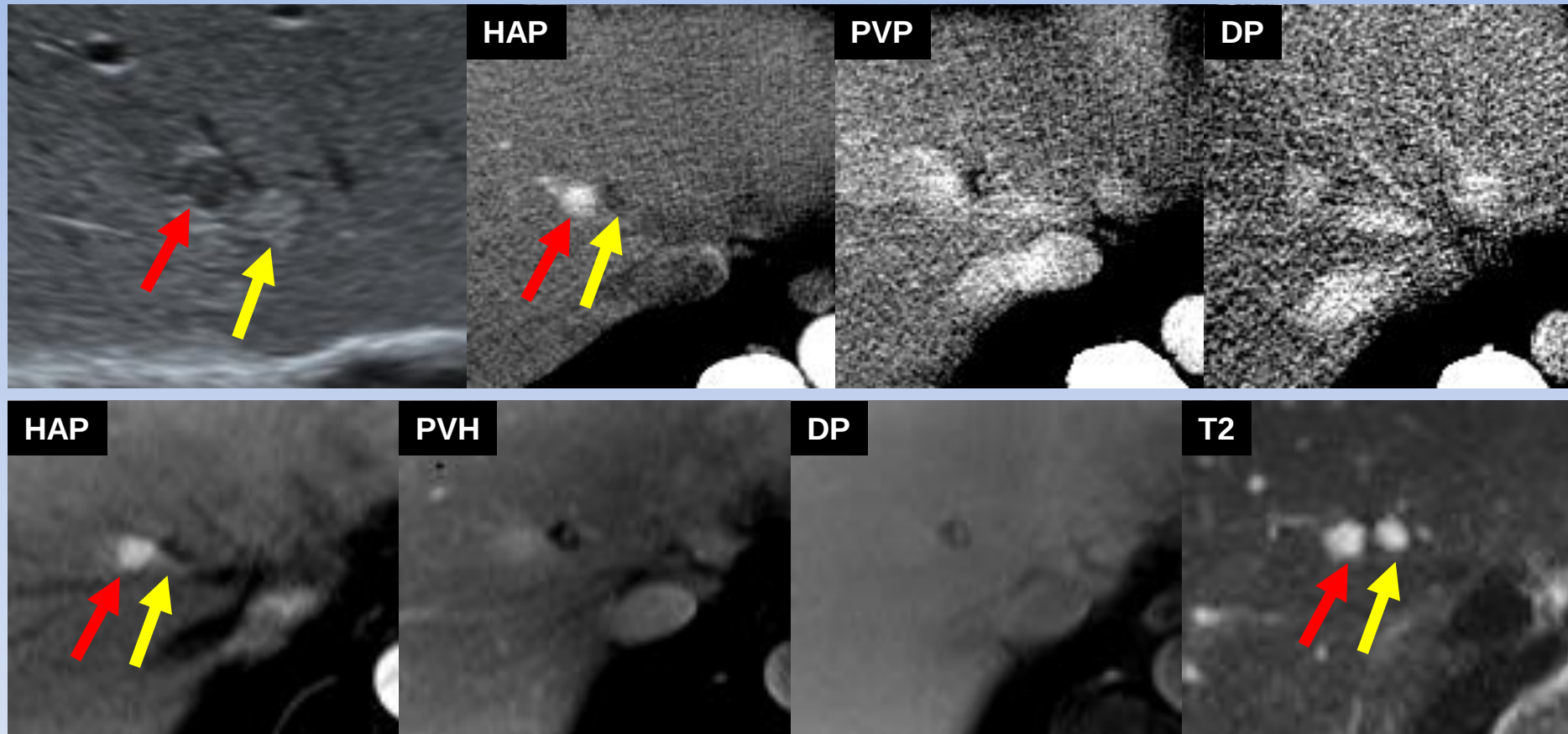


Hemangioma

- Characteristic enhancement pattern
 - Early peripheral globular enhancement and centripetal progression to uniform enhancement
 - Immediate uniform enhancement (16%) with hyperenhancement on delayed phase
 - Equal to that of aorta during all phases
- MR
 - Characteristically, T2 bright high SI



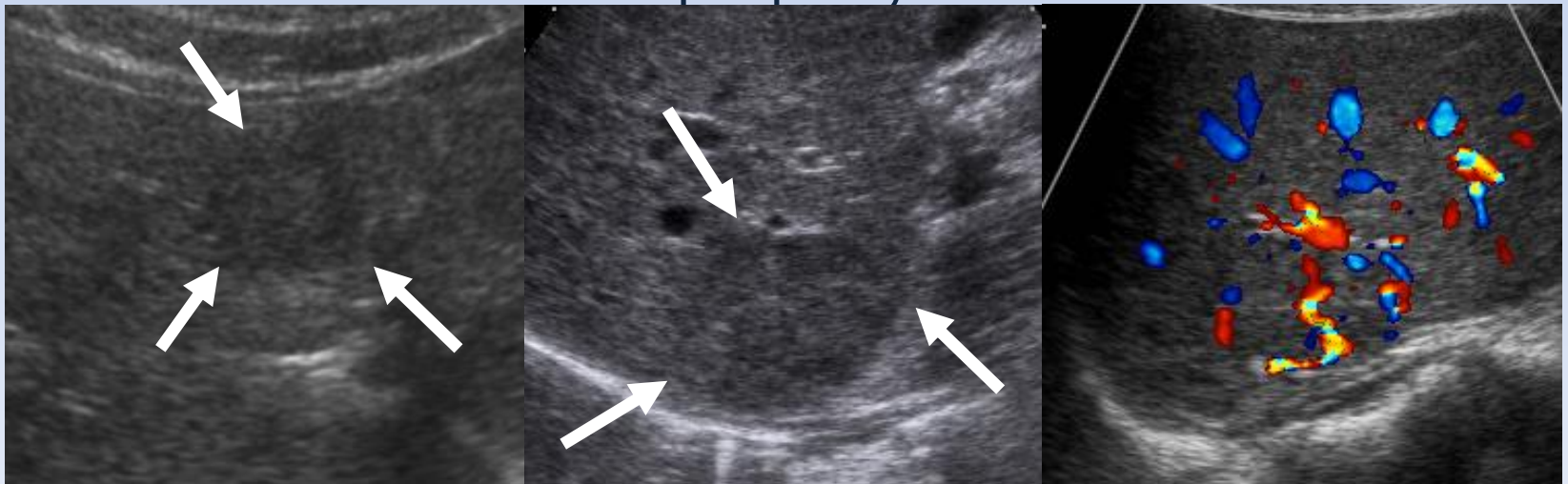
Hemangioma



Rapid-enhancing or high-flow hemangiomas (red arrow) tend to be hypoechoic on US. Slow-enhancing or slow-flow hemangiomas (yellow arrow) tend to be echogenic on US.

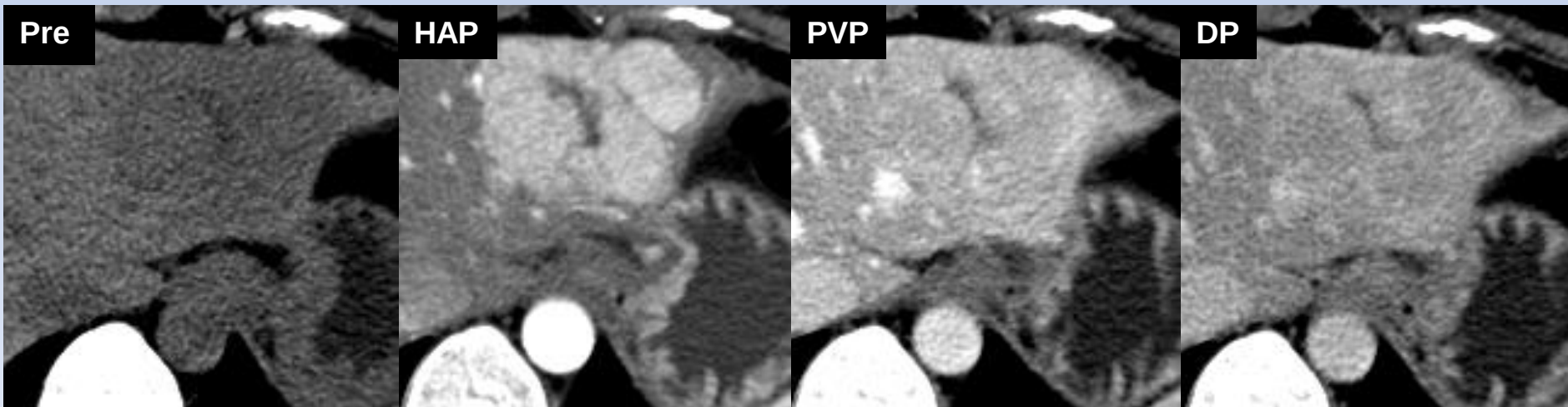
Focal nodular hyperplasia

- Hyperplastic reaction to localized vascular abnormality
- F>>M, particularly childbearing years
- US
 - Subtle liver mass that is difficult to differentiate in echogenicity from the adjacent liver parenchyma
 - Central scar : linear or stellate echogenic area
 - Doppler: spoke-wheel arterial pattern of vessels radiating from the center to the periphery



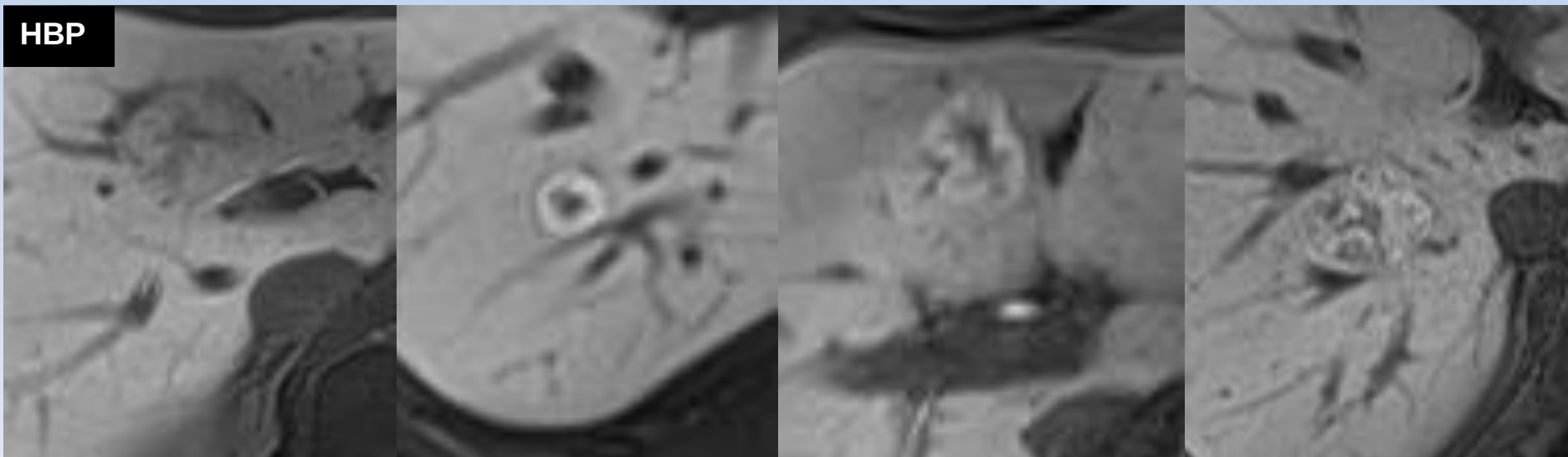
Focal nodular hyperplasia

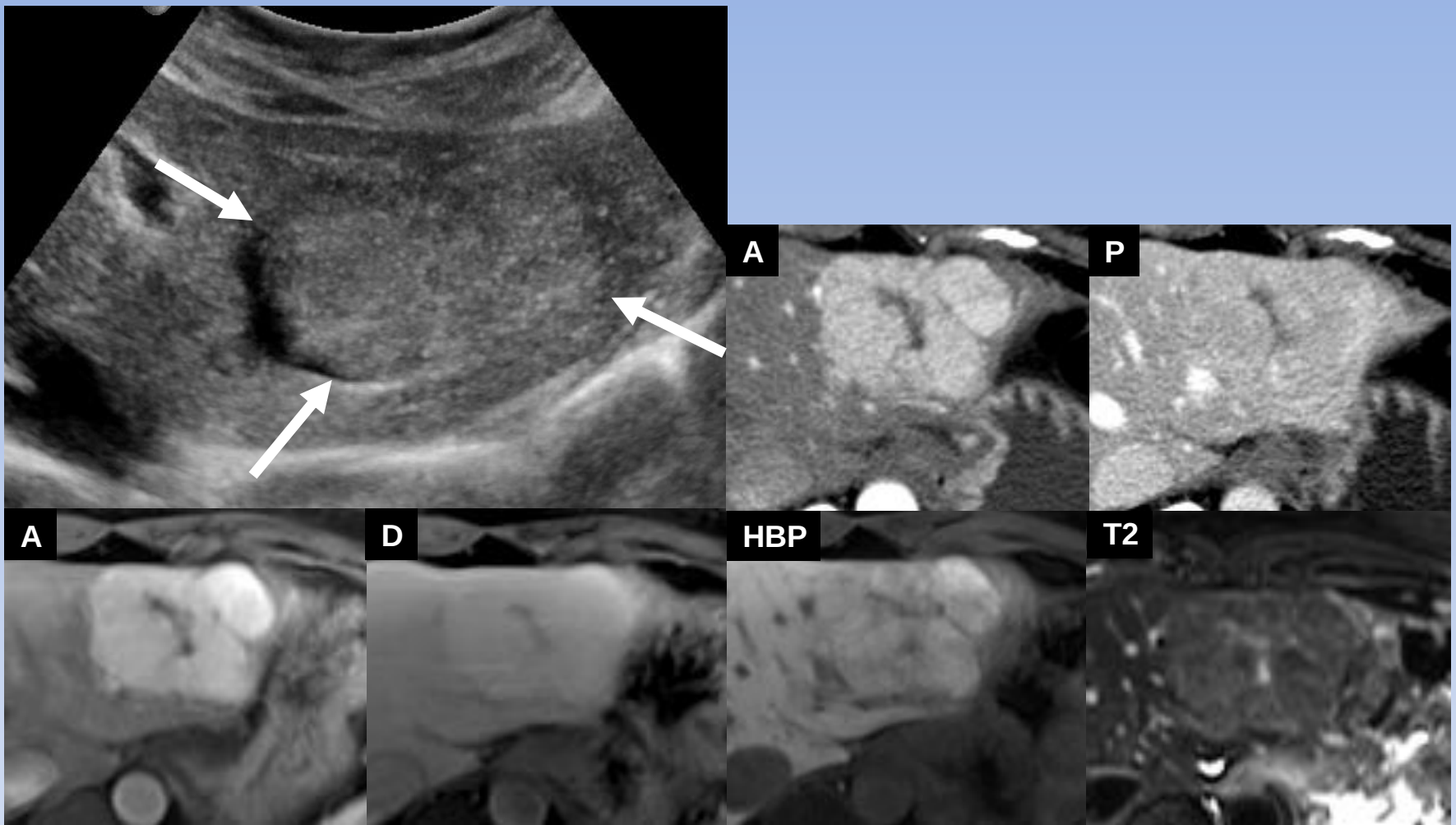
- CT
 - Lobulated or microlobulated border without a capsule
 - Strong homogeneous arterial enhancement
 - Isodense to the liver parenchyma in PVP and DP
 - Central fibrous scar: delayed enhancement



Focal nodular hyperplasia

- MR
 - T1 iso SI & T2 iso to slightly high SI
 - HBP: iso or high SI, popcorn-like enhancement
 - Central scar
 - T1 low SI & T2 high SI
 - Delayed enhancement, HBP defect





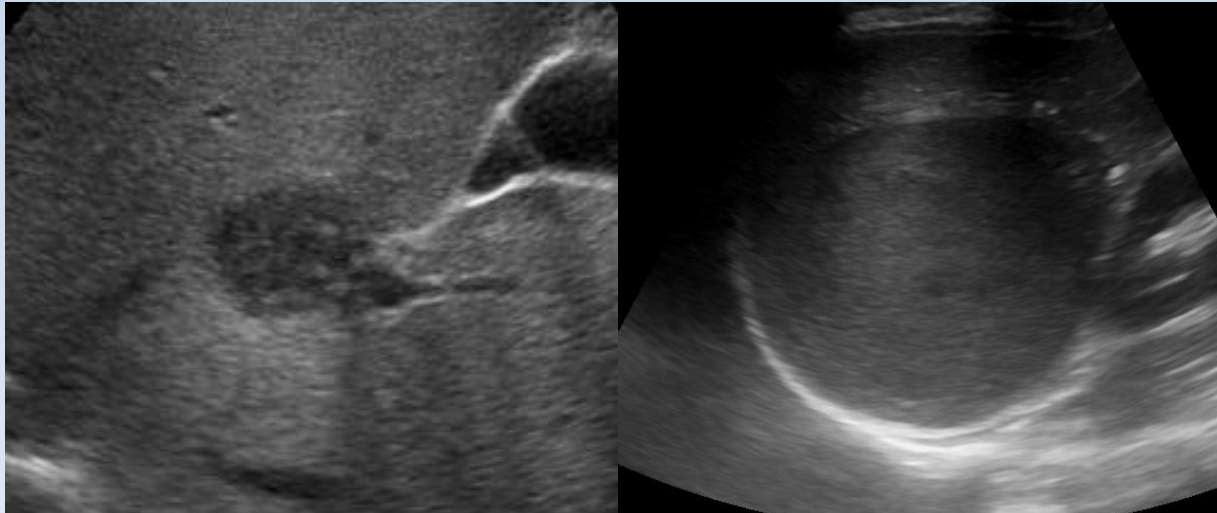
Ultrasound just reveals subtle change in echogenicity and subtle displacement of vascular structures in the liver left lateral segment.

CT shows lobulating arterial homogeneous enhancing mass with delayed enhancing central scar.

MR shows T1 iso SI and T2 subtle high SI and hepatobiliary iso SI, suggesting FNH.

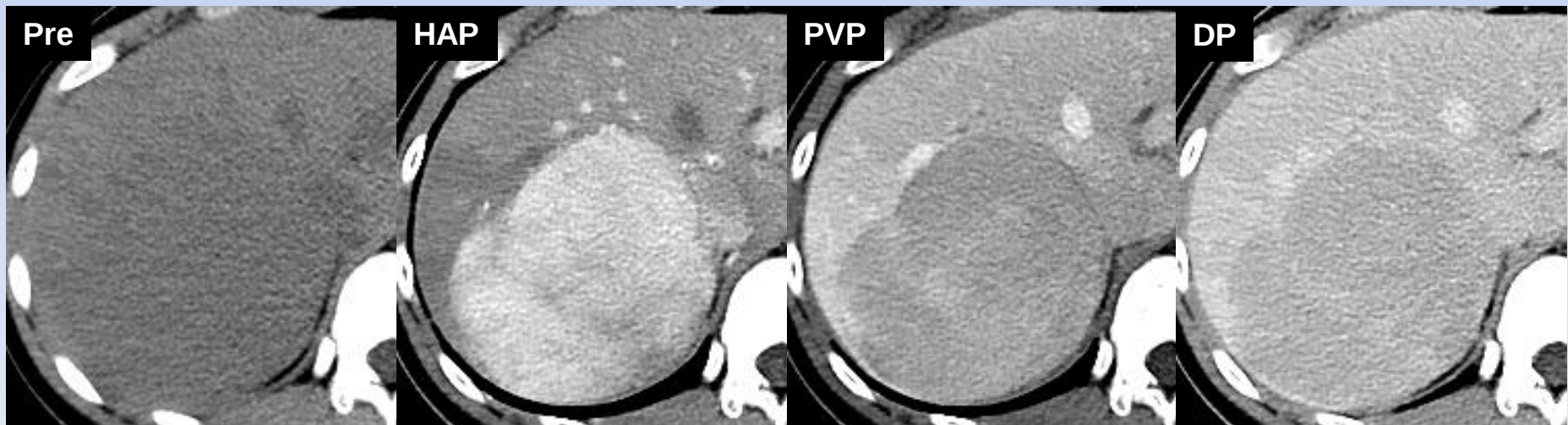
Hepatocellular adenoma

- Association with oral contraceptive use & glycogen storage dz
- Particularly in young and middle-aged women
- Complicated by hemorrhage, rupture, or malignant transformation
- US
 - Well-defined, solid mass
 - May be hyperechoic, hypoechoic, isoechoic, or mixed
 - Massive necrosis & hemorrhage → complex mass with large cystic components



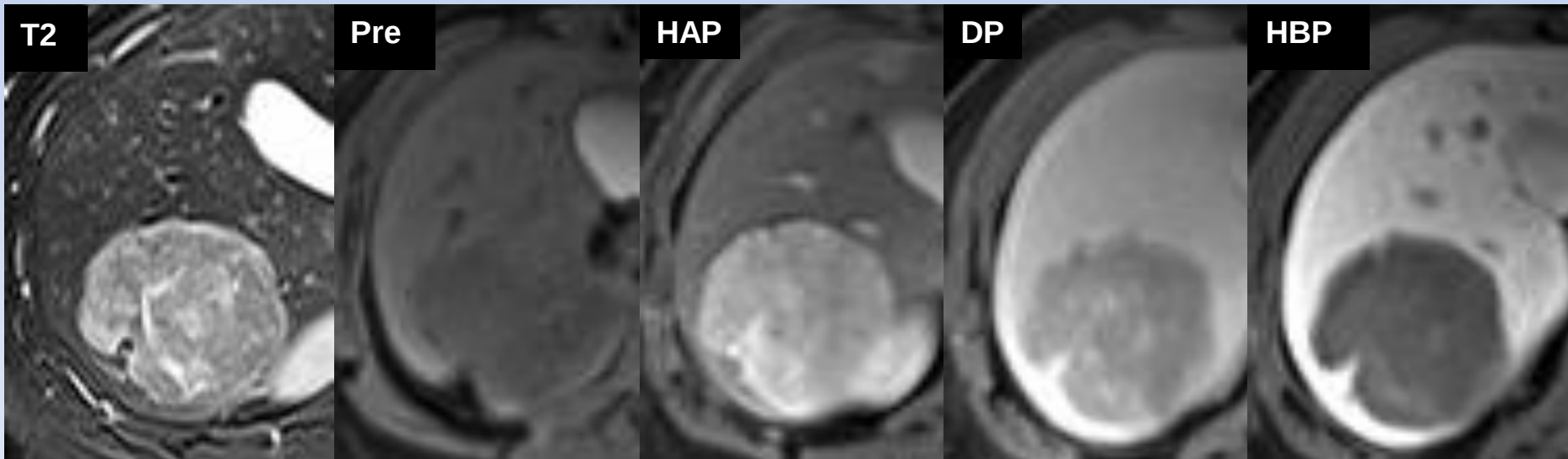
Hepatocellular adenoma

- CT
 - Pre: hypodense (fat, glycogen), hyperdense (fresh hemorrhage)
 - AP: hypervascular
 - enhancement degree: more uniform and moderate, usually less than that of FNH
 - PVP & DP: iso or hypo-attenuating



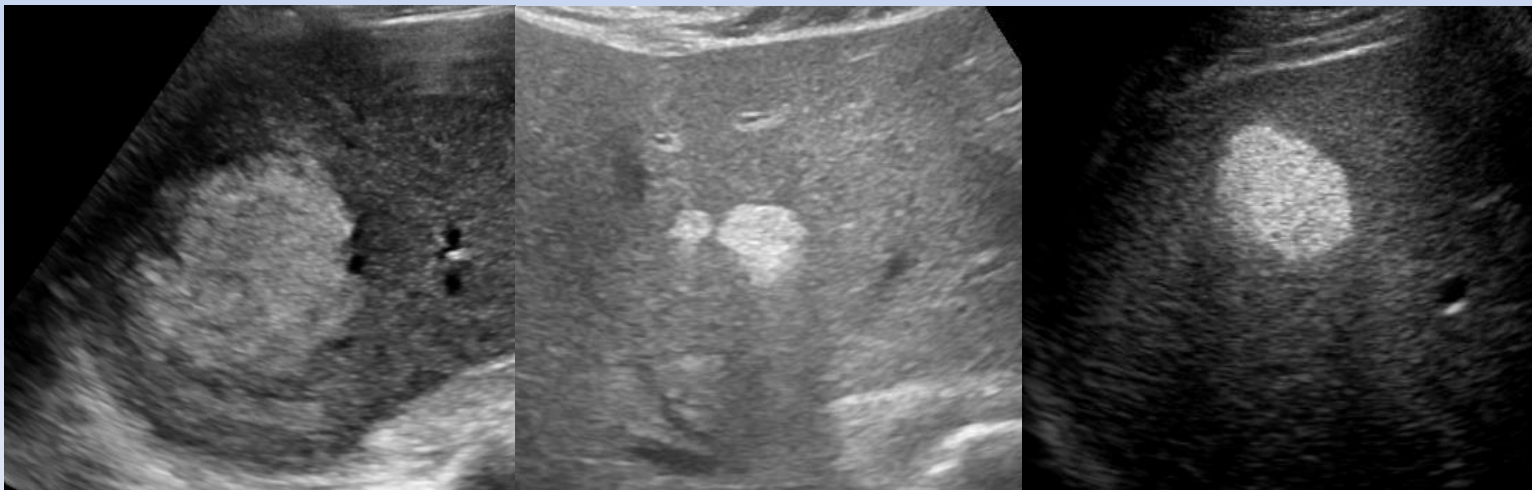
Hepatocellular adenoma

- MR
 - T1: high SI (fat, hemorrhage), low SI (necrosis)
 - T2: variable, usually high SI
 - Early arterial enhancement and rapid washout
 - HBP: low SI



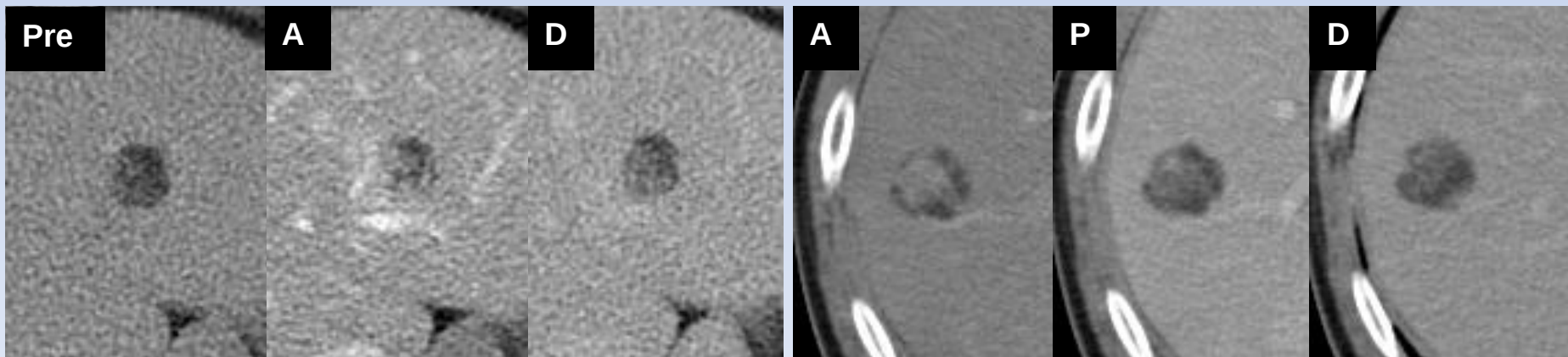
Hepatic angiomyolipoma

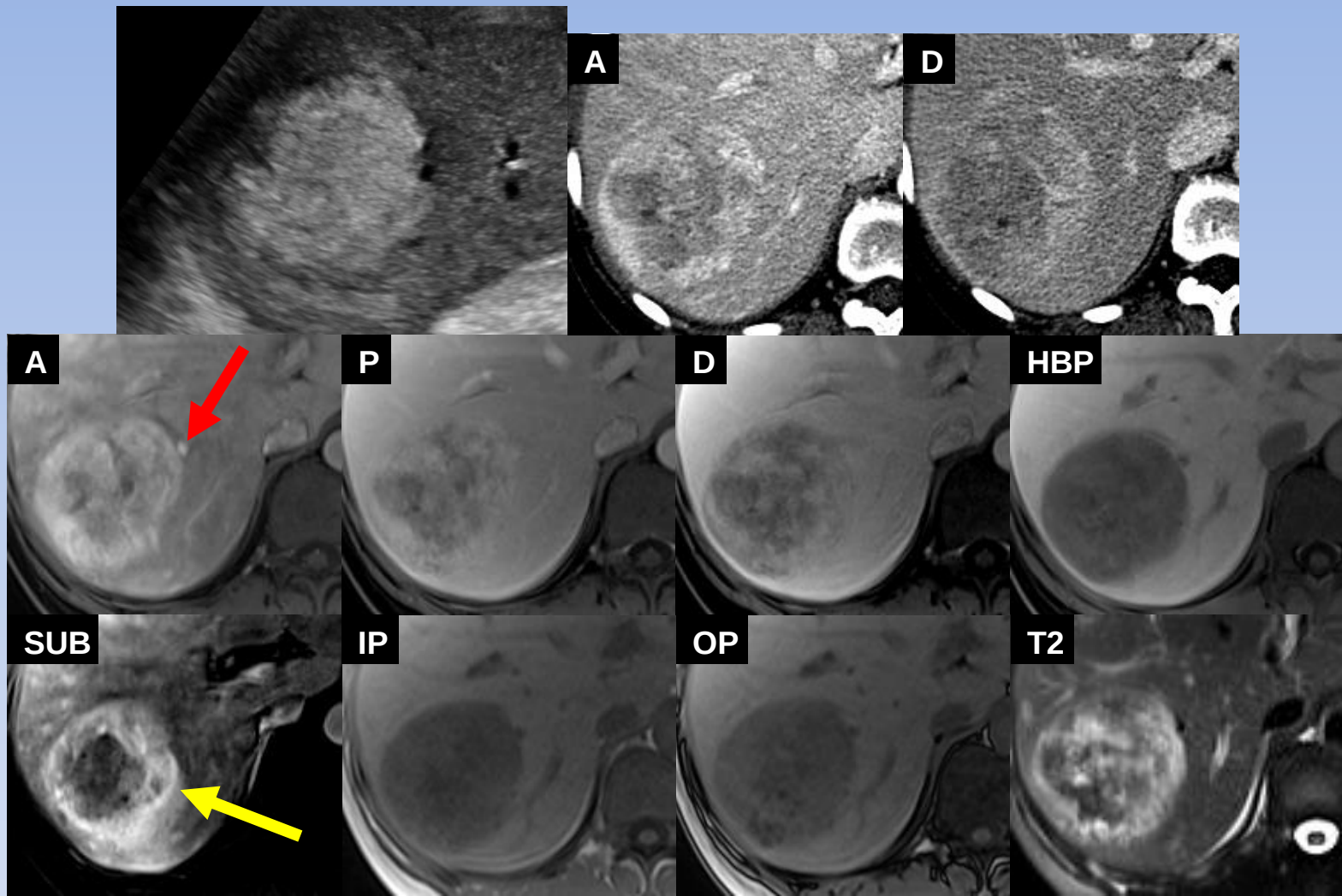
- Rare benign nonencapsulated mesenchymal tumor
- Typically develops in middle-aged women
- US
 - Hetero- or homogeneous echogenic mass
 - Indistinguishable from a hemangioma
 - Heterogeneous hypoechoic mass
 - In case of less fat content & excess vascular component



Hepatic angiomyolipoma

- CT
 - Well-defined heterogeneous mass with fatty foci
 - Fatty area of AML: well vascularized and enhance early
 - Steatotic foci of HCC: relatively avascular and less enhance
 - Early intense enhancement
 - Prolonged enhancement or washout
 - Tortuous tumoral vessels and early draining veins

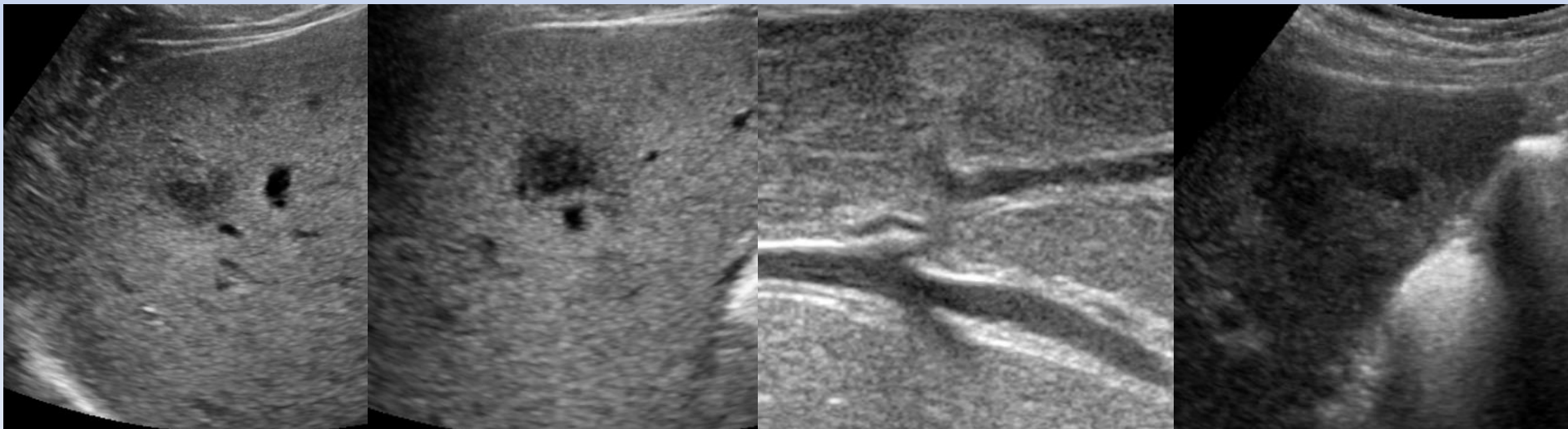




A lobulating hyperechoic mass in the right liver shows heterogeneous enhancement. It shows signal drops on opposed phase, suggesting fat component. Early enhancement of draining vein (**red arrow**) on arterial phase, which is a branch of the right hepatic vein and engorged intratumoral vessels (**yellow arrow**) on subtraction image of arterial phase are noted. They are characteristics of hepatic AML.

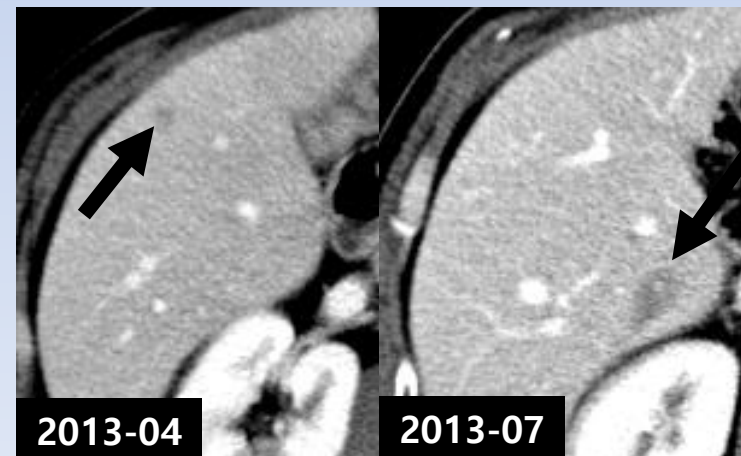
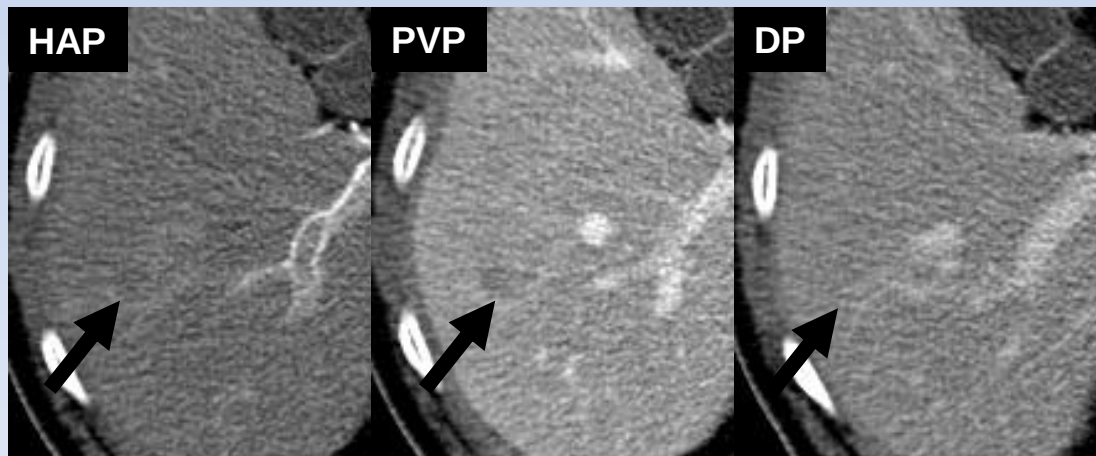
Focal eosinophilic liver disease

- Associated with parasitic infestation, allergic reaction, drug hypersensitivity, hypereosinophilic syndrome
- May accompany peripheral eosinophilia
- US
 - Small, poorly-defined, round or ovoid, hypo to slightly echogenic nodule



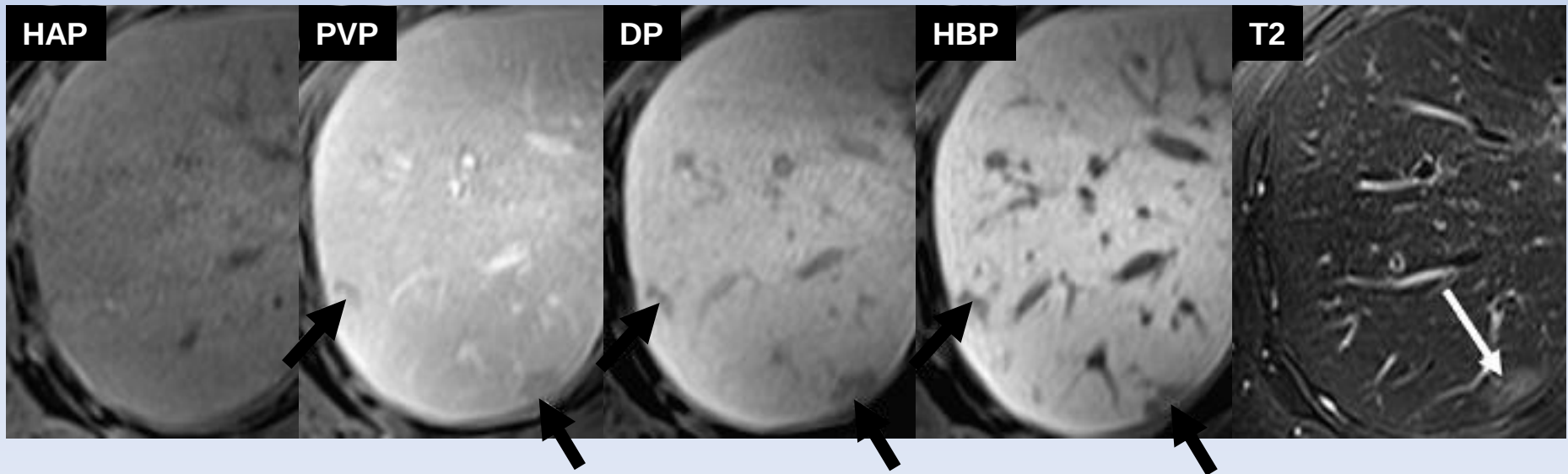
Focal eosinophilic liver disease

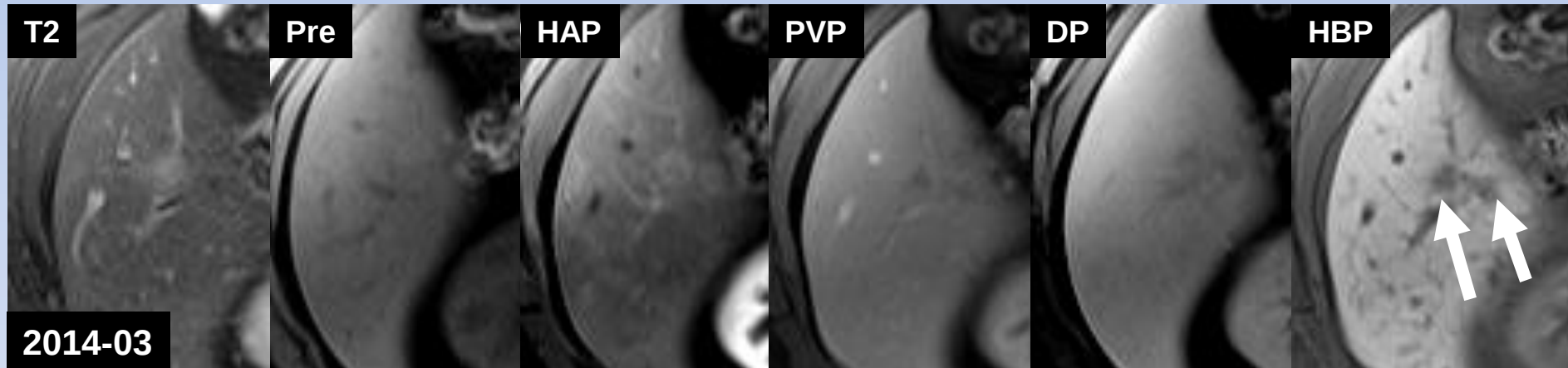
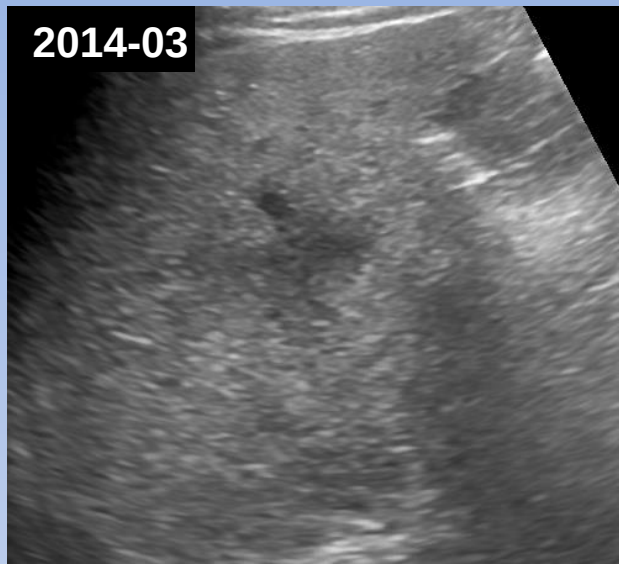
- CT
 - Multiple, small, subtle low-attenuating round or oval lesions with an ill-defined margin
 - Most conspicuous in the portal phase
 - Usually distributed multifocally in the subcapsular or periportal areas of the liver
 - Transient and migratory nature on f/u imaging



Focal eosinophilic liver disease

- MR
 - Subcapsular multiple ill-defined hypointense nodules
 - HBP: nonspherical, irregular indistinct margin, mixed hypointensity
 - Size discrepancy between pre T1WI and HBP
 - one of the important diagnostic clues for focal eosinophilic dz.

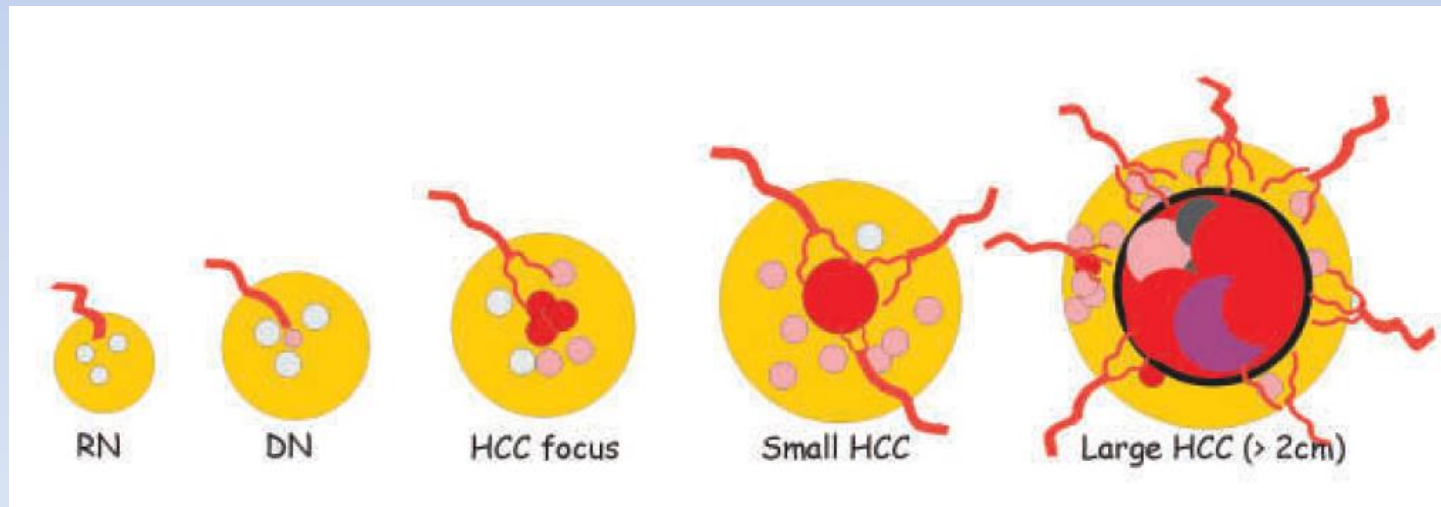




Ultrasound shows a poorly-defined irregular hypoechoic lesion in the right liver. Portal phase CT scan shows a small subtle hypodense lesion. On MRI, it is T2 high SI, arterial enhancement, portal and delayed low SI. On HBP, it is irregular indistinct margin, non-spherical shape and mixed hypointensity. At that time, this patient had peripheral eosinophilia of 13 %. Four month later, it disappeared on follow up CT,

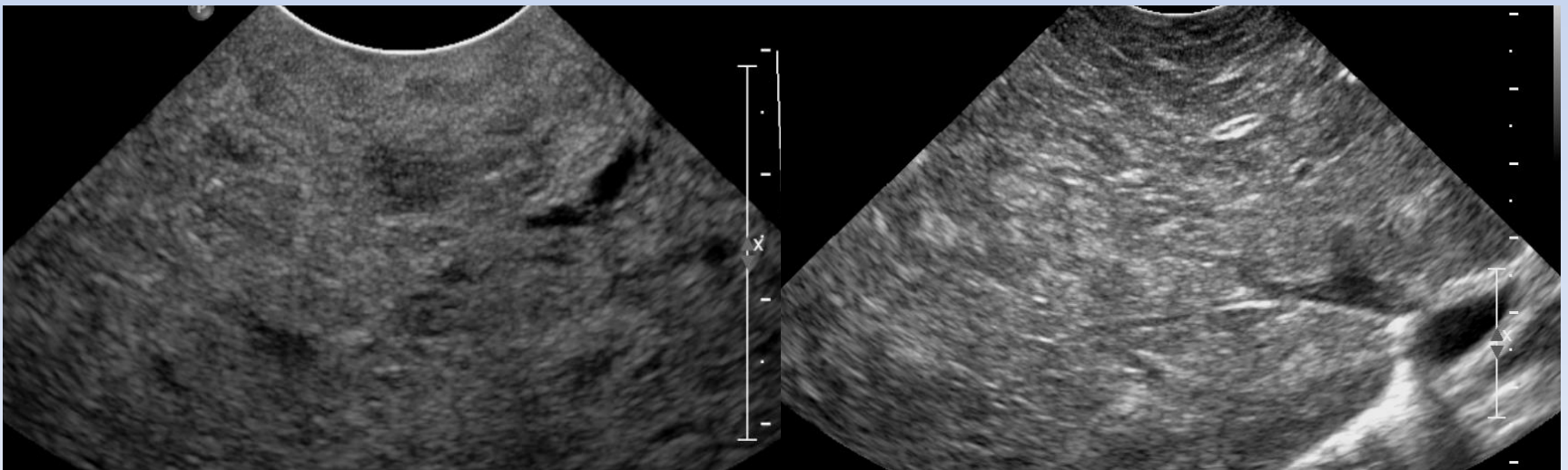
DN/RN and HCC

- Cirrhosis is characterized by the progressive fibrosis of the liver parenchyma and a spectrum of hepatocellular nodules that mark the progression from RNs to low- and high-grade DNs to, eventually, HCC.



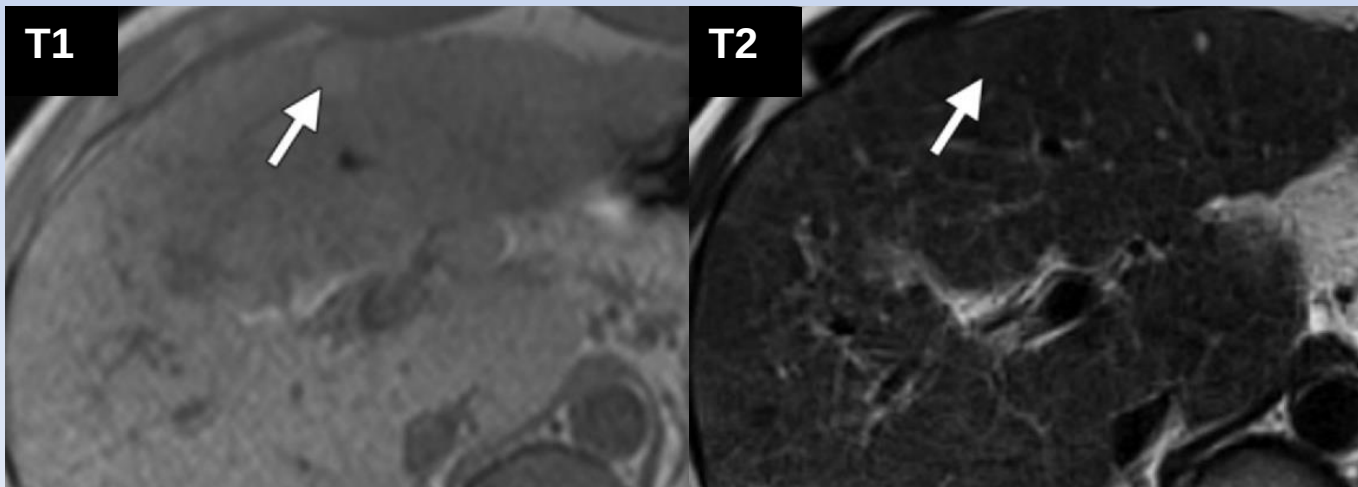
Regenerative nodule

- Consist of proliferating normal hepatocytes with surrounding fibrous septa
- Size < 10 mm
- US
 - Iso- or hypoechoic appearance
 - High in numbers and uniform distribution



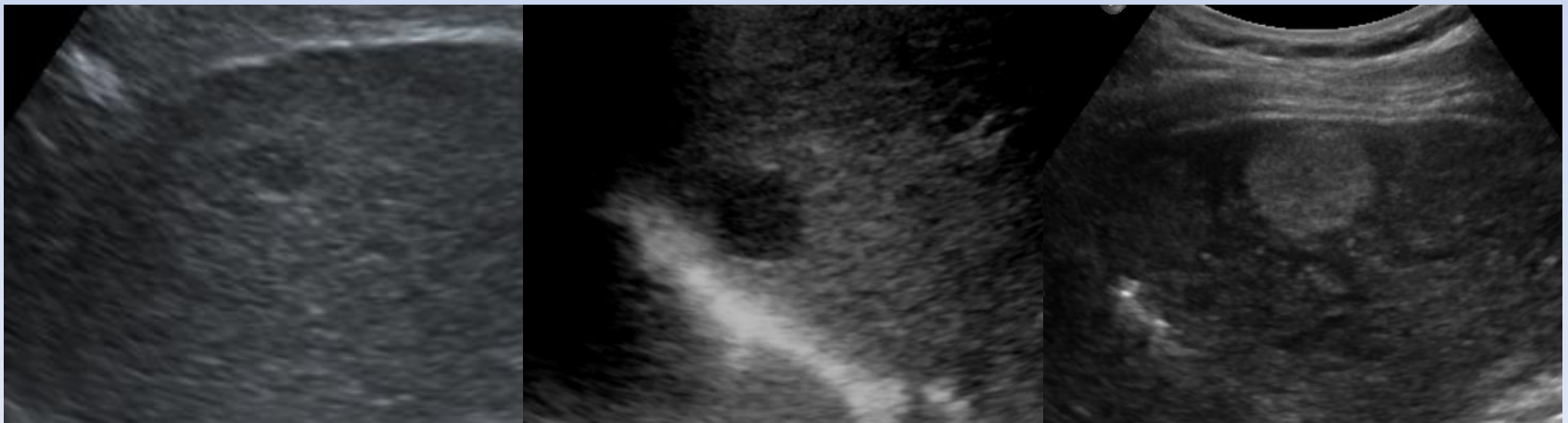
Regenerative nodule

- CT
 - Not distinguishable in a cirrhotic liver
- MRI
 - Mostly, indistinct and invisible on both T1 and T2
 - T1 high SI: due to lipid, protein or copper
 - T1 & T2 low SI: due to iron
 - HBP: iso SI to surrounding liver



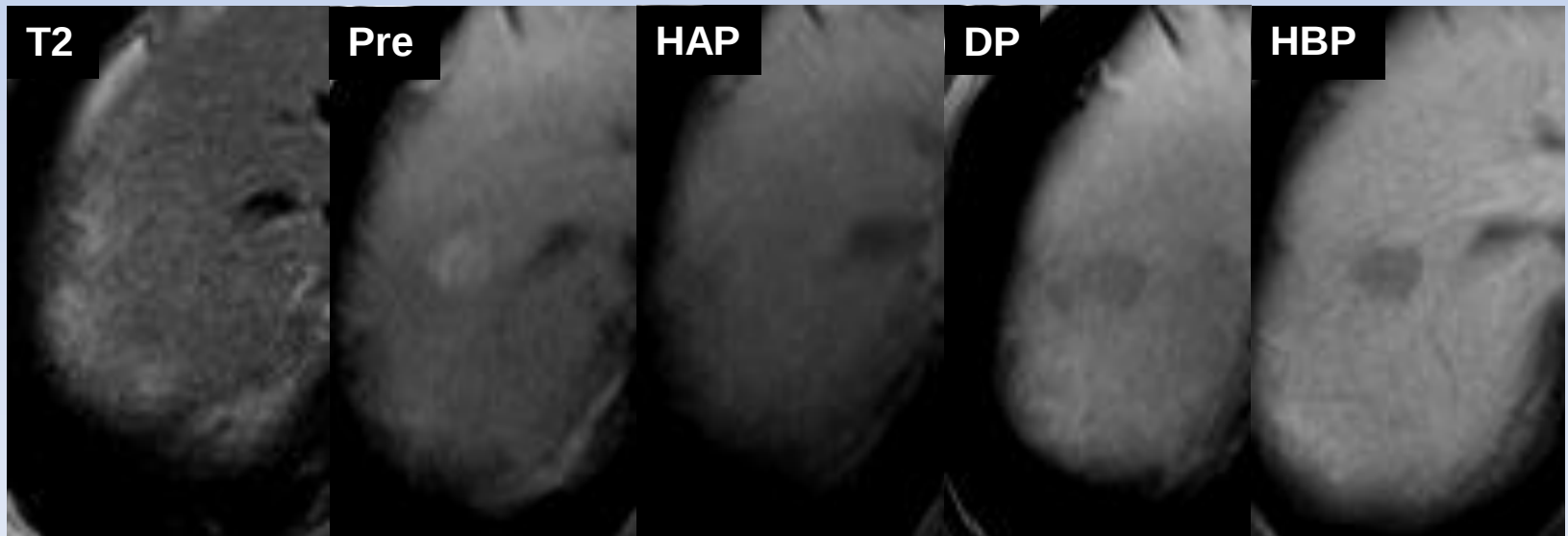
Dysplastic nodule

- Nodular hepatocellular proliferations containing dysplasia without any histologic malignancy
- Size: 1-1.5 cm
- US
 - Larger than RN
 - Hypo- and hyperechoic nodules
 - Echogenicity relates to the fat content in the nodule.



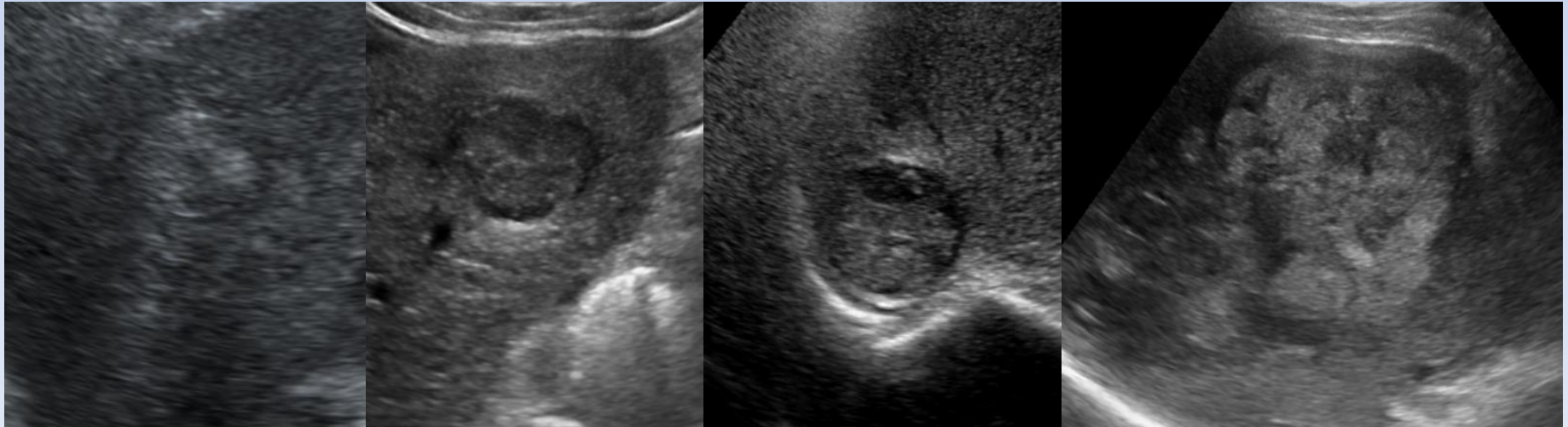
Dysplastic nodule

- CT
 - Slight hypoattenuation in delayed phase
- MR
 - T1: variable SI
 - T2: iso to low SI
 - DP and HBP: iso or low SI



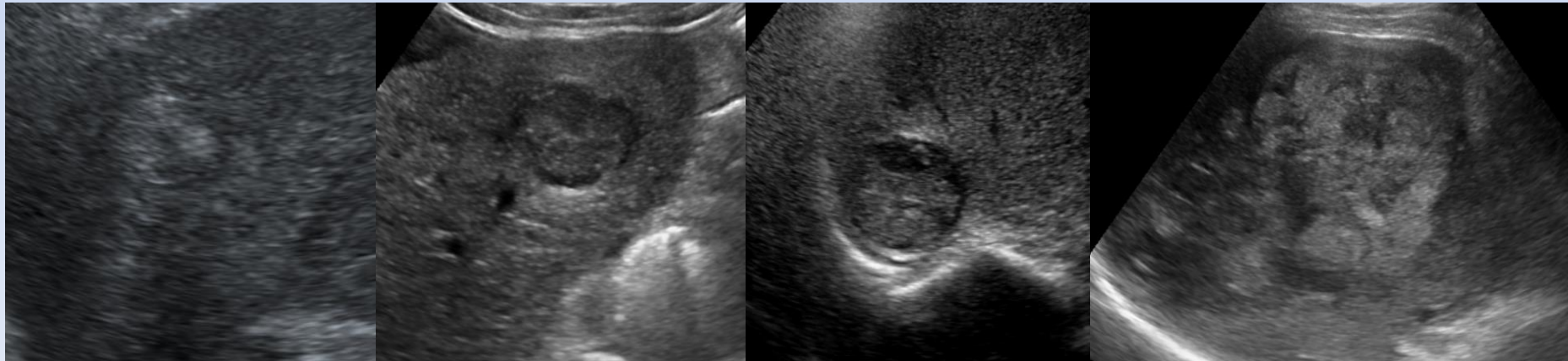
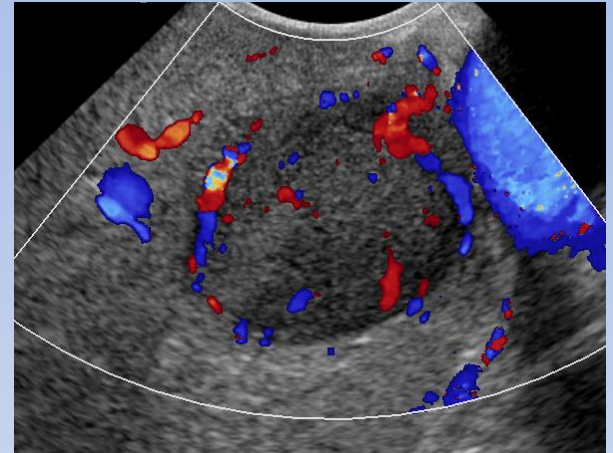
Hepatocellular carcinoma

- M/C primary malignant hepatic tumor
- US
 - Frequently hyperechoic, if there is fatty change or marked sinusoidal dilatation
 - Small HCC (< 3cm)
 - Often hypoechoic and posterior acoustic enhancement
 - Larger HCC (> 3cm): mosaic or mixed pattern



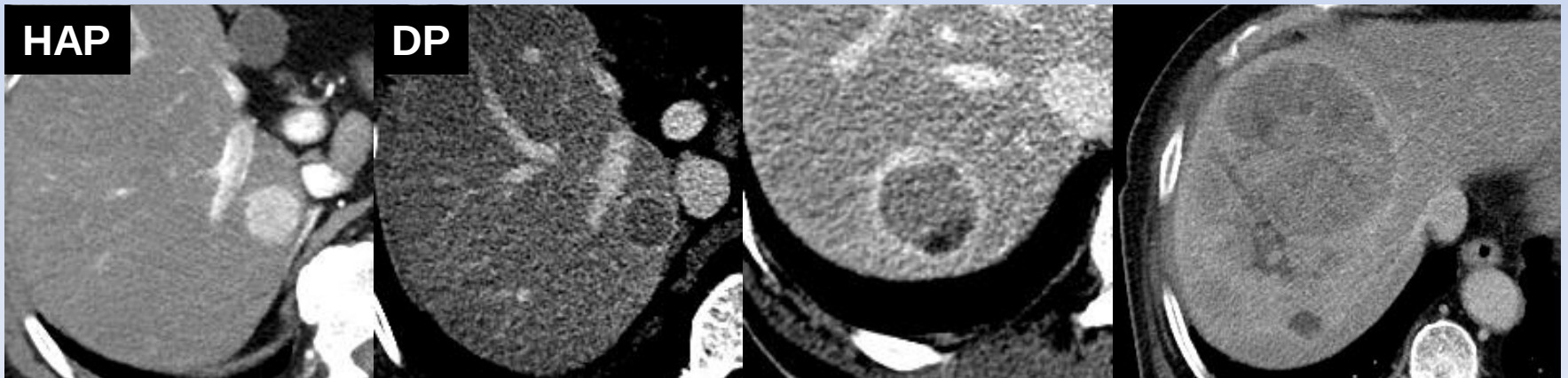
Hepatocellular carcinoma

- US
 - Peripheral hypoechoic halo
 - Lateral shadowing
 - Posterior enhancement
 - Mosaic pattern
 - “basket” pattern on color Doppler
 - Fine peripheral network of vessels surrounding and penetrating a lesion



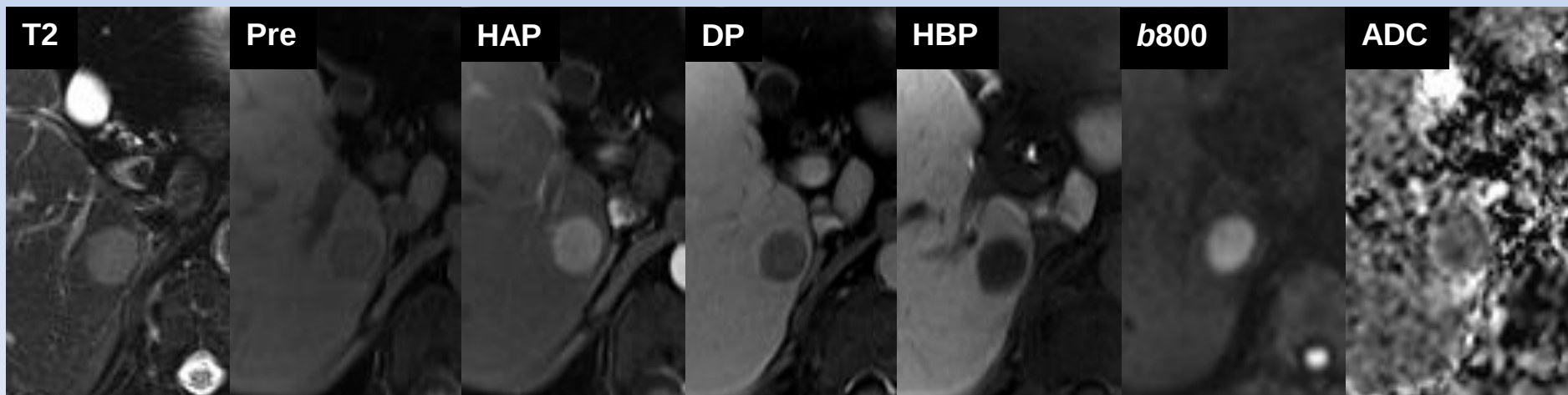
Hepatocellular carcinoma

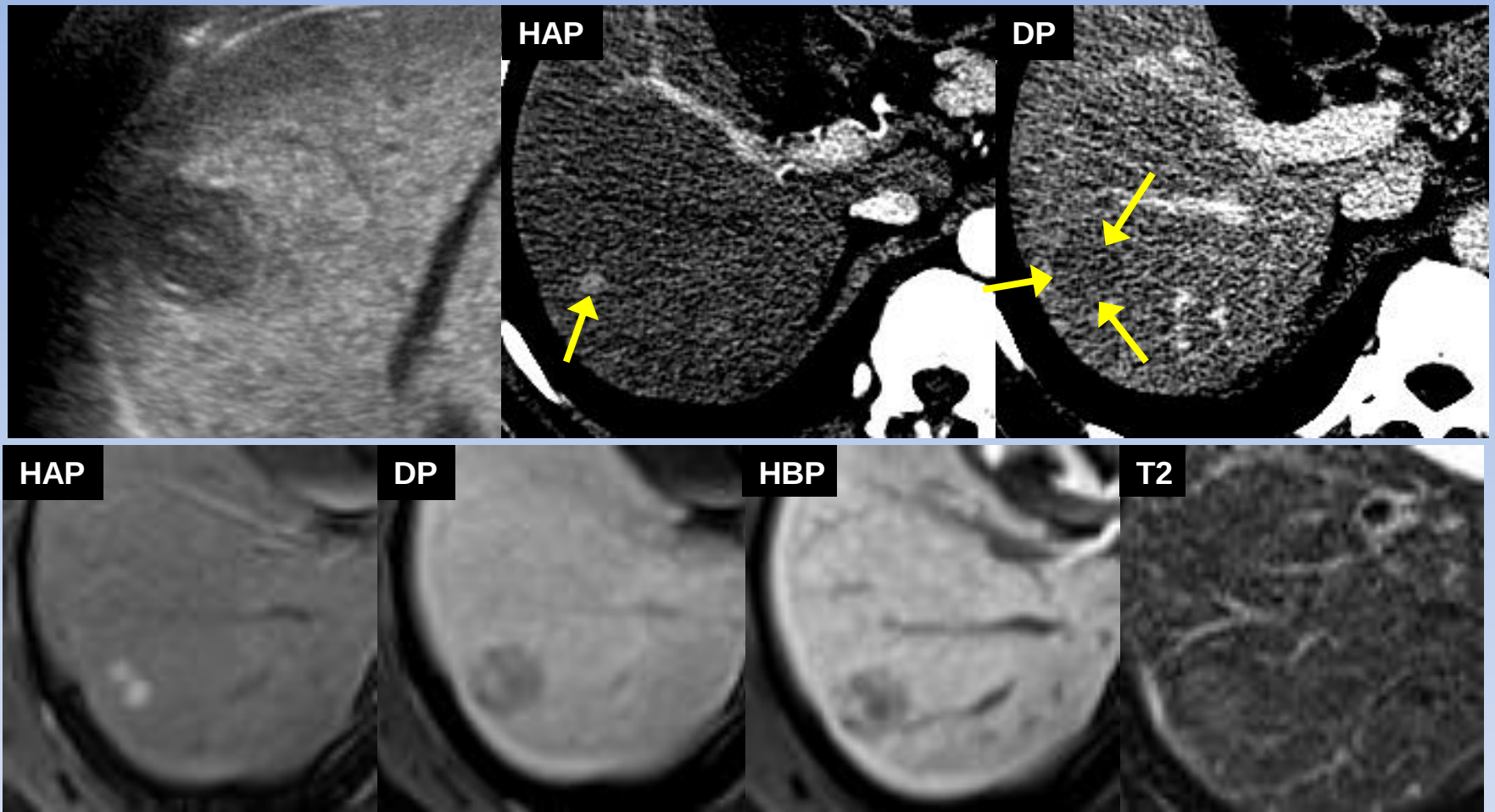
- CT
 - Intense arterial enhancement & delayed washout
 - Capsule or pseudocapsule (70%)
 - Nodule in nodule appearance
 - suggesting the emergence of a progressed HCC within a DN
 - Mosaic appearance
 - attributed to intratumoral heterogeneity
 - more common with larger HCCs



Hepatocellular carcinoma

- MRI
 - Intense arterial enhancement & delayed washout
 - HBP: low SI
 - T2: mid to moderately high SI
 - T1: variable (iron, fat, or hemorrhage)
 - DWI: restriction



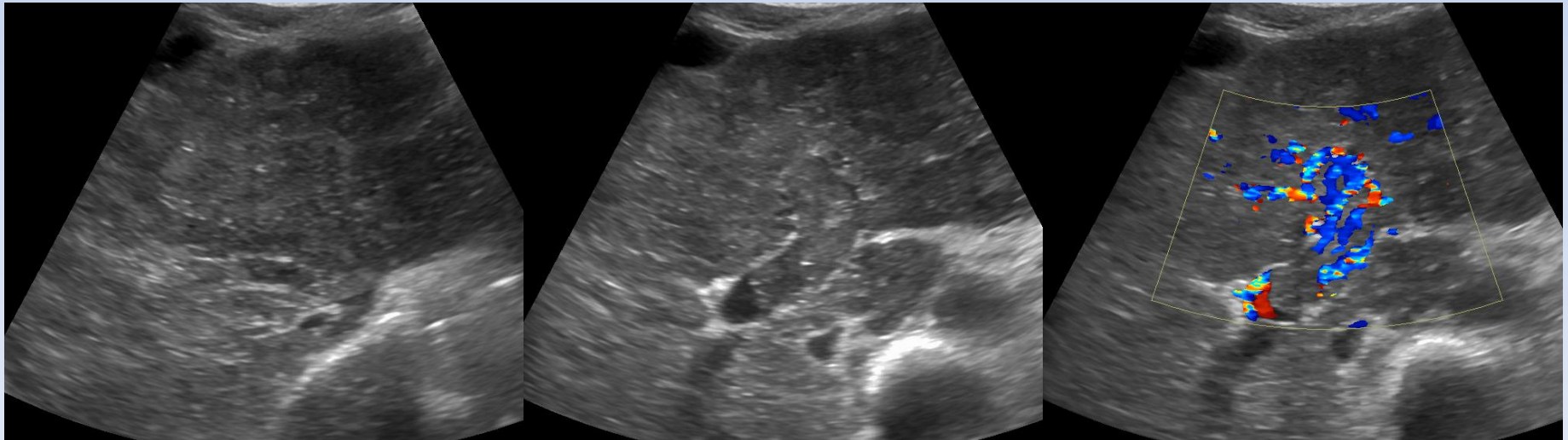


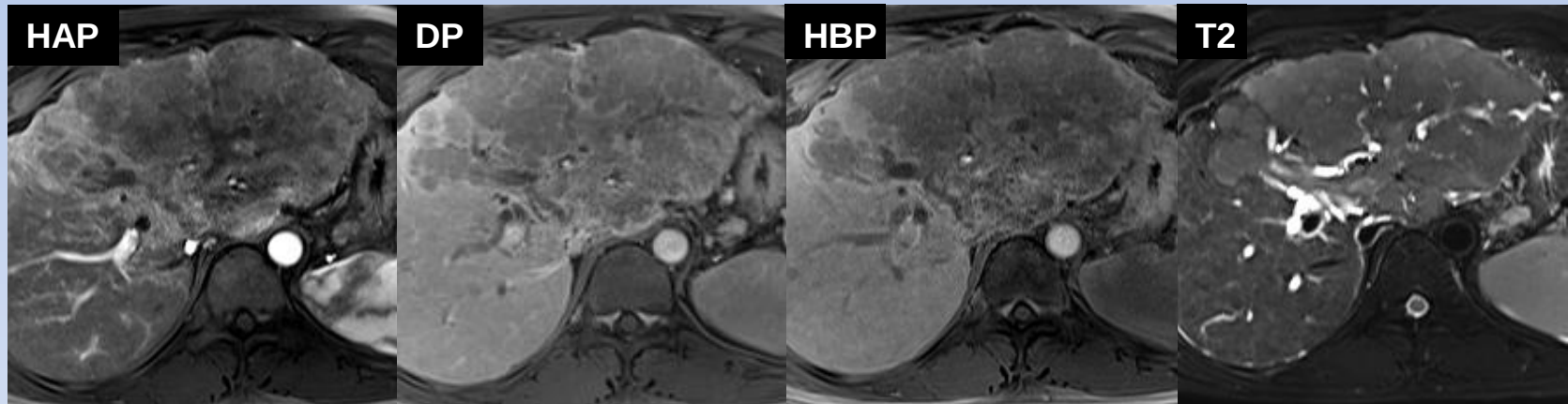
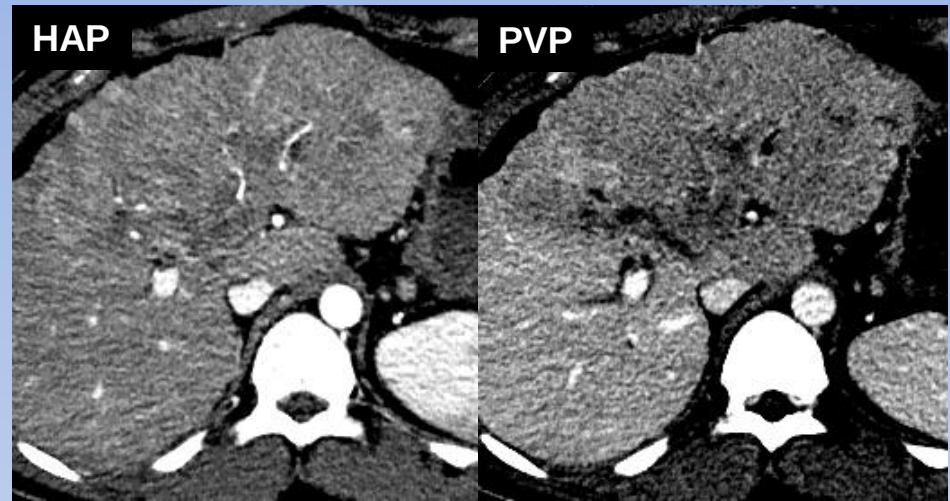
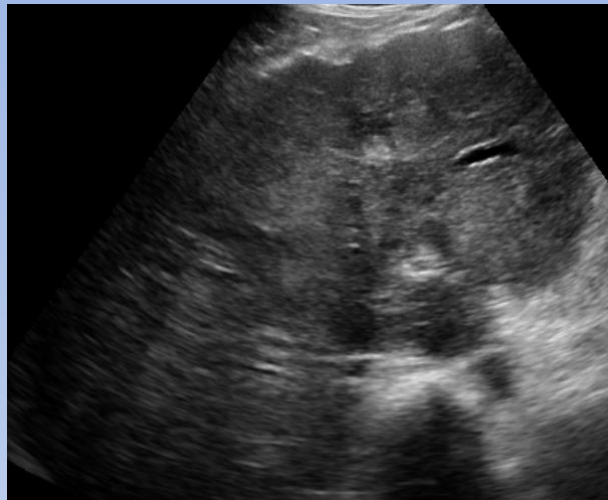
Screening ultrasound identified about 2.5-cm well-defined, round hypoechoic nodule. The nodule shows subtle peripheral hypoechoic rim and internal more hypoechoic foci. On CT and MRI, you can see small arterial enhancing foci within delayed and hepatobiliary hypointense nodule. Finally, it was diagnosed as HCC of nodule-in-nodule pattern.

Hepatocellular carcinoma

- **Infiltrative HCC**

- Area of heterogeneity and is often difficult to recognize as a tumor.
- Portal venous thrombosis is frequently associated with infiltrative HCC.
- It is important to evaluate portal veins within any suspicious heterogeneous area on US.





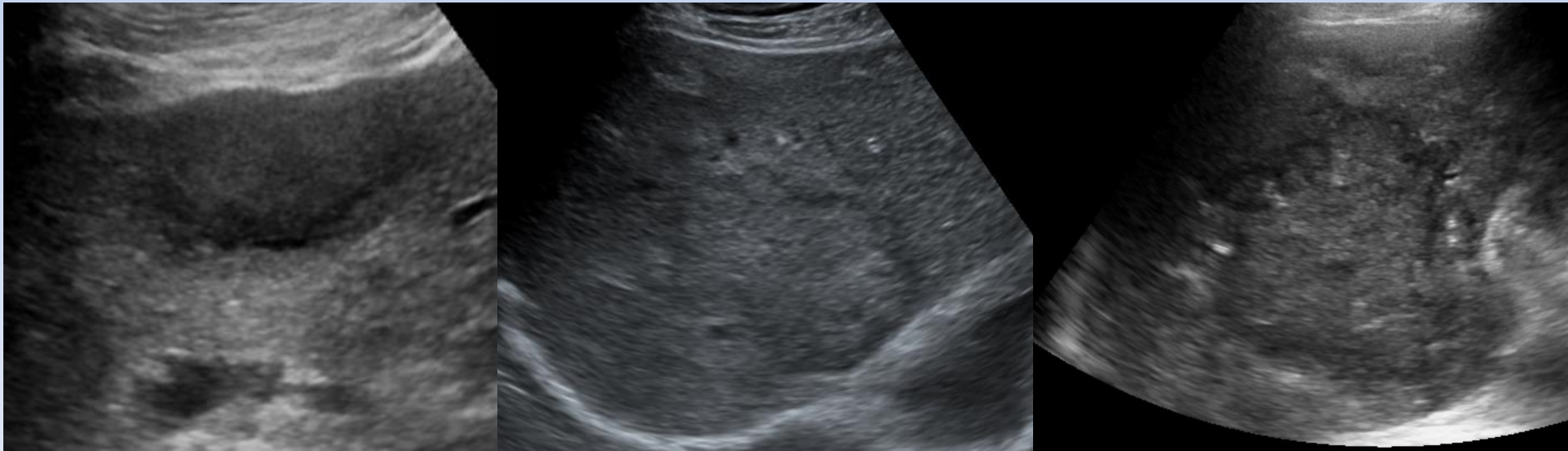
On ultrasound, there was no visible mass in the liver. But, heterogeneous change in echogenicity and echotexture was suspected in the left liver. Also, left portal vein was obstructed with thrombus.

CT and MRI show ill-defined delayed hypodense or hypointense tumors in the left liver, left portal vein tumor thrombus and bile duct dilatation.

It was diagnosed as infiltrative HCC.

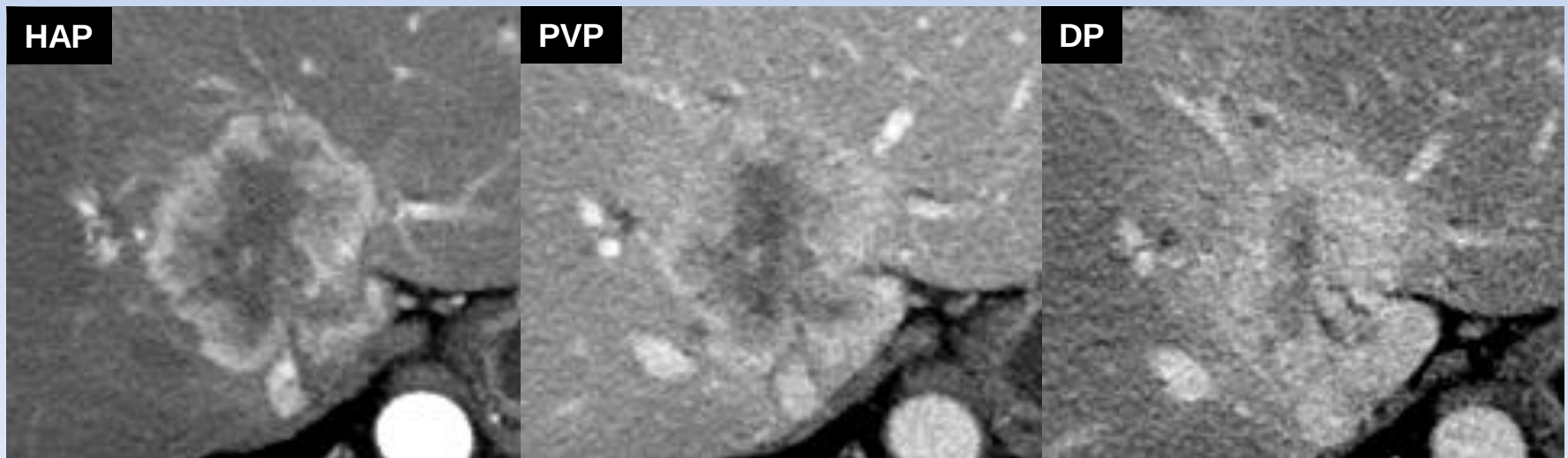
Peripheral cholangiocarcinoma

- 2nd m/c primary hepatic malignancy
- US
 - Homogeneously hypoechoic mass
 - Various echo with peripheral hypoechoic rim
 - Satellite nodules



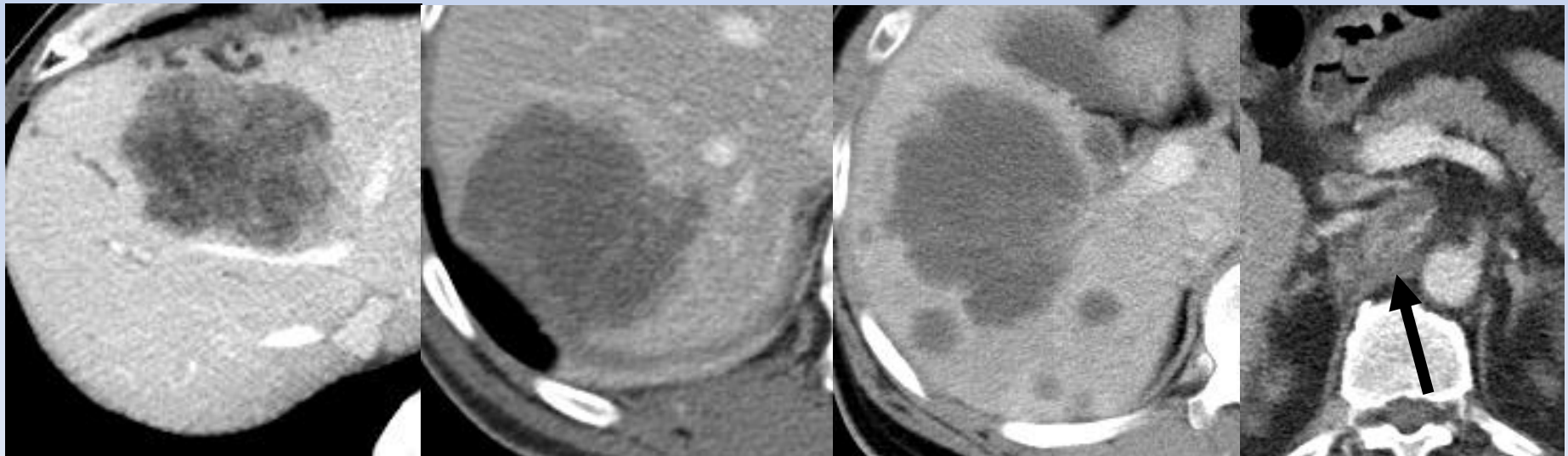
Peripheral cholangiocarcinoma

- CT
 - Peripheral portion
 - viable cancer cells
 - enhancement on arterial and portal phases
 - Central portion
 - more fibrous tissue
 - mild centripetal progression of enhancement over time



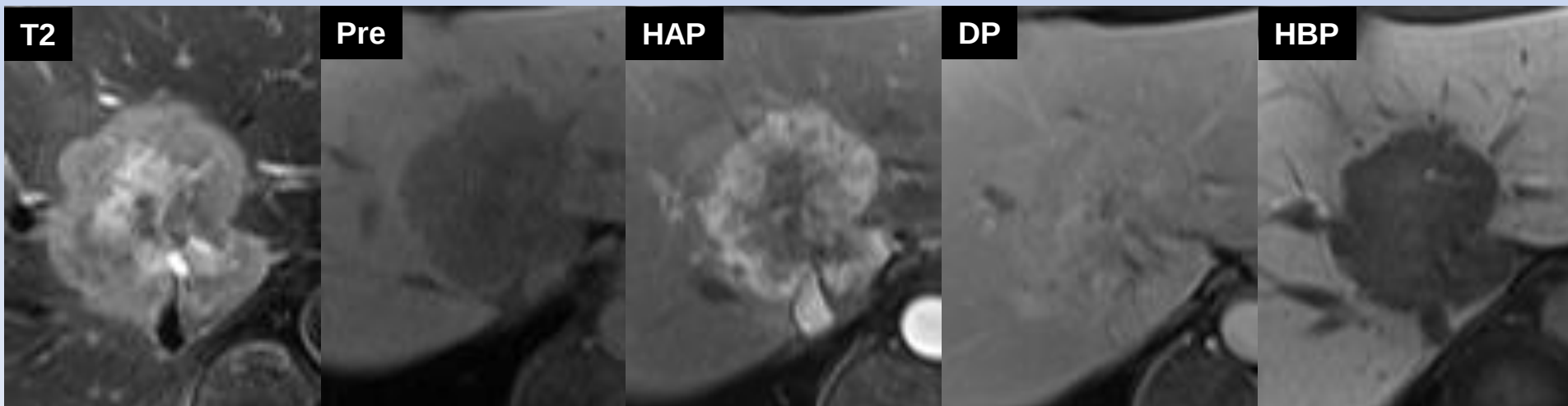
Peripheral cholangiocarcinoma

- CT
 - Dilatation of IHD distal to the mass
 - Capsular retraction (desmoplastic reaction)
 - Satellite nodules
 - Lymphadenopathy



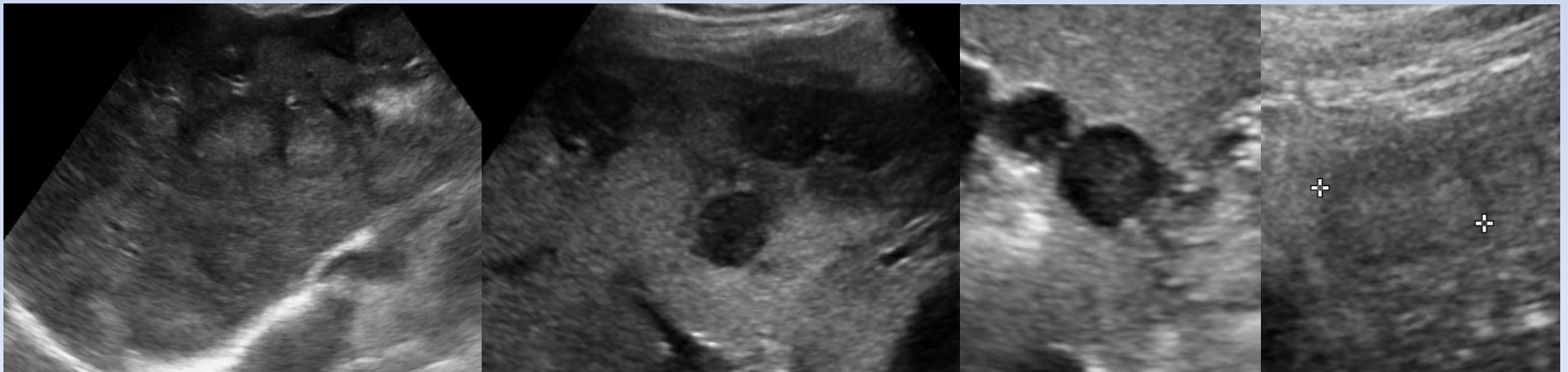
Peripheral cholangiocarcinoma

- MR
 - T1: low SI
 - T2: heterogeneously high SI
 - central necrosis, fibrosis, calcifications, and mucin and myxoid degeneration
 - Enhancement pattern: similar to CT
 - DDx. metastasis of adenocarcinoma from GI tract



Metastasis

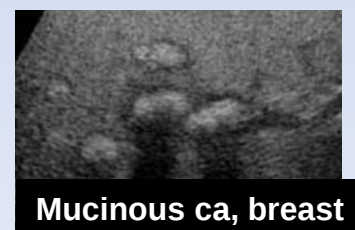
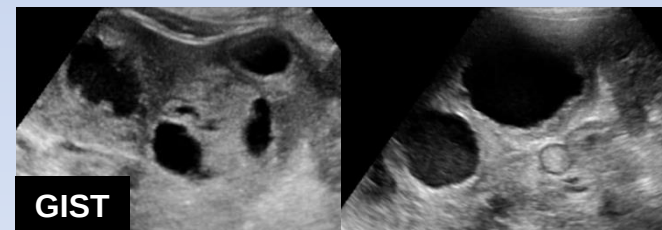
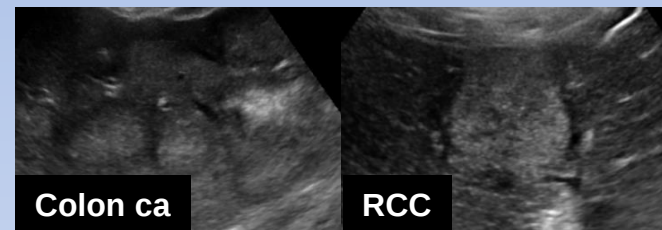
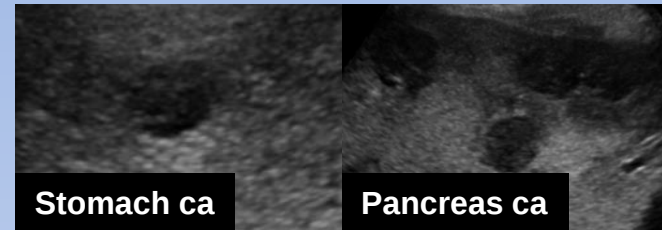
- M/C cause of malignant focal liver lesions
- M/C primary neoplasm
 - Colon > stomach > pancreas > breast > lung
- US
 - Multiple solid lesions of varying size
 - Various echo: Hypoechoic > isoechoic, hyperechoic
 - Surrounding hypoechoic halo



Metastasis

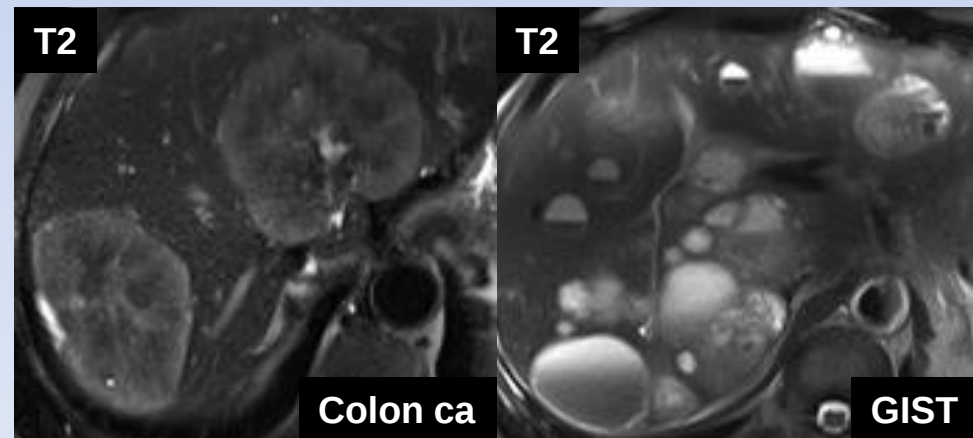
- US

- 1) Hypoechoic (m/c)
 - Usually hypovascular and highly cellular
 - Lung, breast, pancreas, stomach
- 2) Hyperechoic metastasis
 - Usually have fibrosis or hypervascular
 - Colon, RCC, NET
- 3) Bull's eye or target pattern
 - Lung, GI tract, breast
- 4) Cystic metastasis
 - Mucin-producing tumors
 - Necrosis: sarcoma, GIST
- 5) Calcified metastasis
 - Mucin-producing tumors



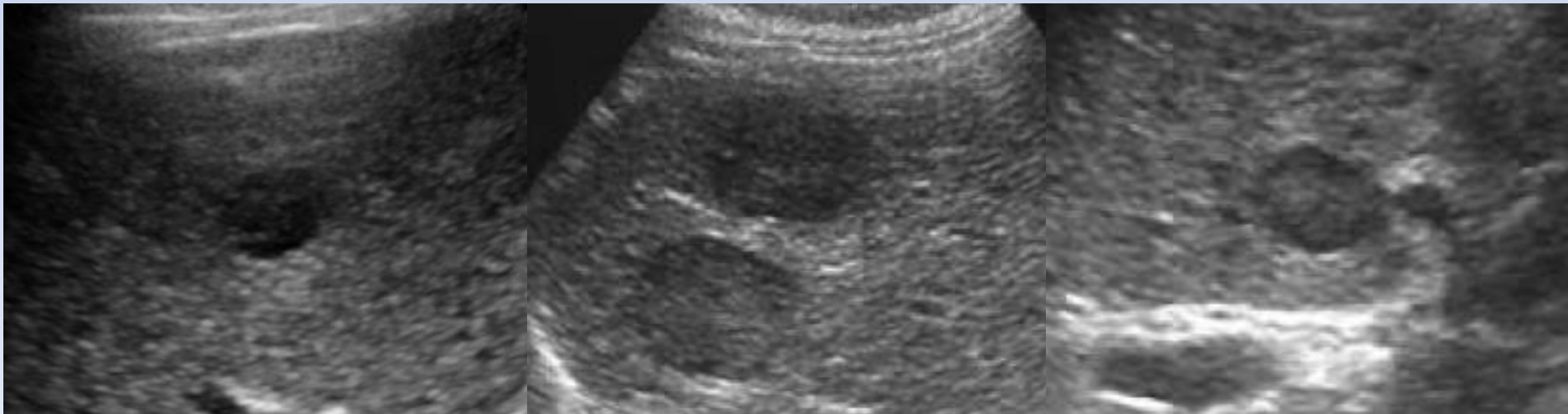
Metastasis

- CT
 - Hypovascular: GI tract, lung, prostate
 - Hypervascular: RCC, NET, melanoma, pheochromocytoma, some breast and lung ca
- MR
 - Variable SI depending on vascularity, hemorrhage, fibrosis, necrosis, and fat



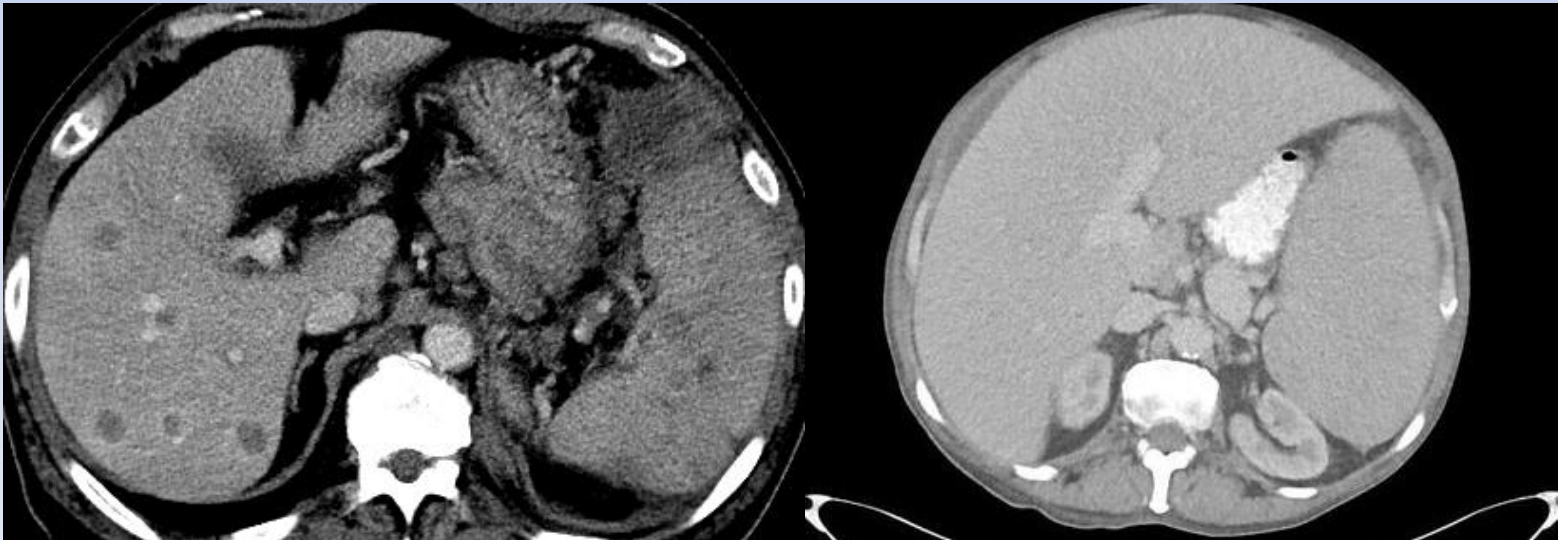
Lymphoma

- Secondary > primary
- US
 - Nodular form
 - Multiple or single, well-defined hypoechoic lesion
 - Diffuse form
 - Normal echogenicity or altered hepatic architecture
 - Hepatomegaly



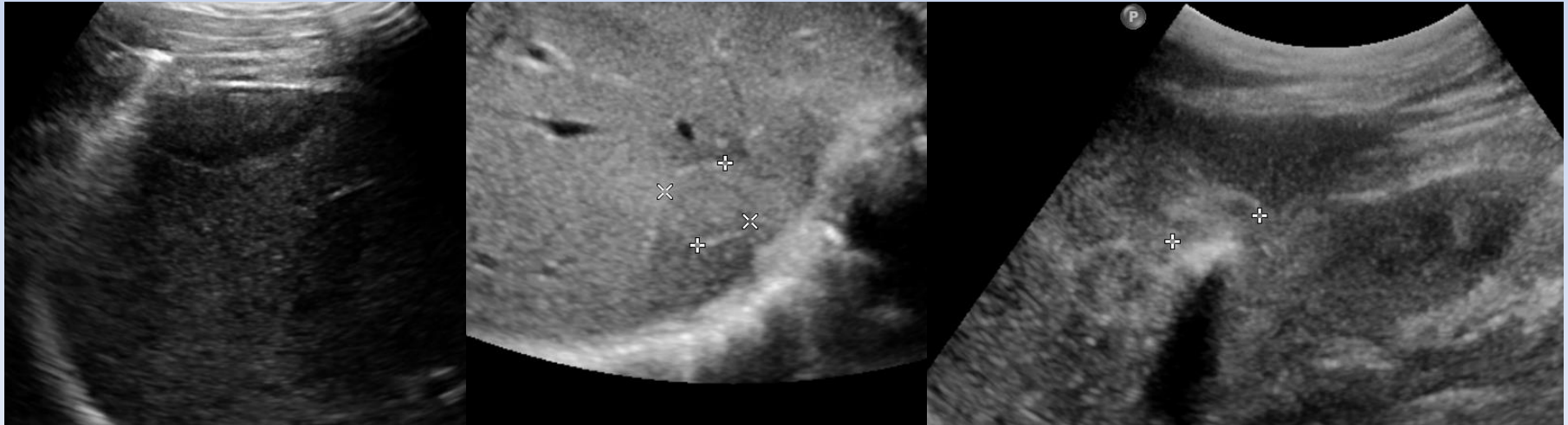
Lymphoma

- CT/MRI
 - Nodular form
 - Multiple, well-defined, homogeneous low density masses
 - Diffuse form
 - Hepatomegaly
 - Other involvement of spleen, kidneys and lymph nodes



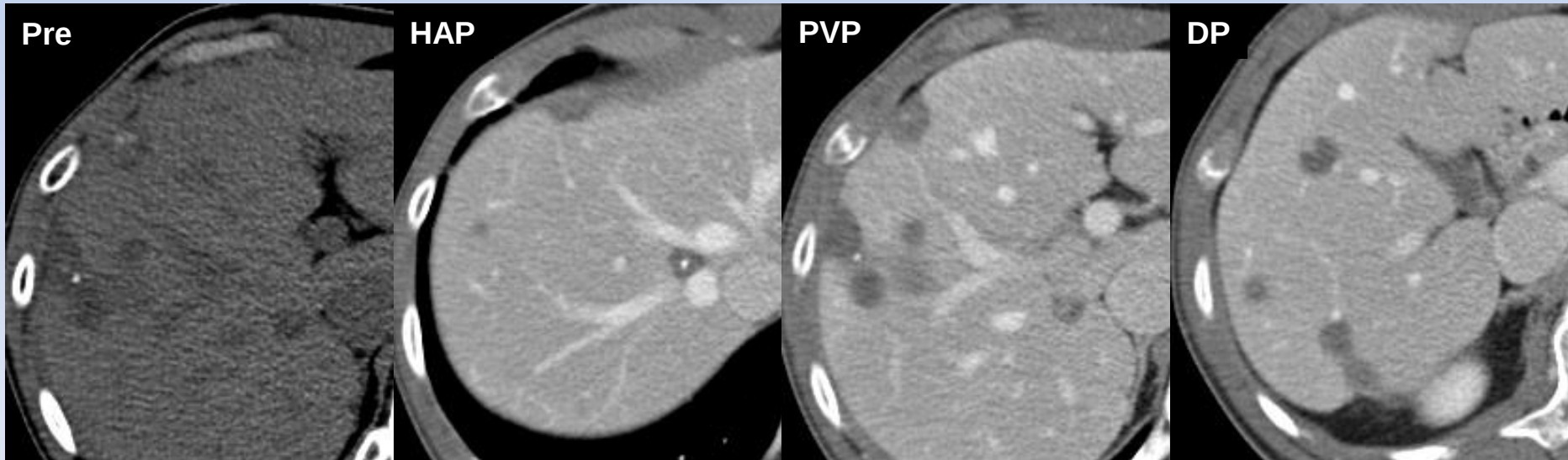
Epithelioid hemangioendothelioma

- Rare vascular tumor with low to intermediate grade malignancy
- Prognosis: variable, more favorable than angiosarcoma
- US
 - Begins as multiple hypoechoic nodules
 - Over time, the nodules grow and coalesce, forming larger confluent hypoechoic masses.

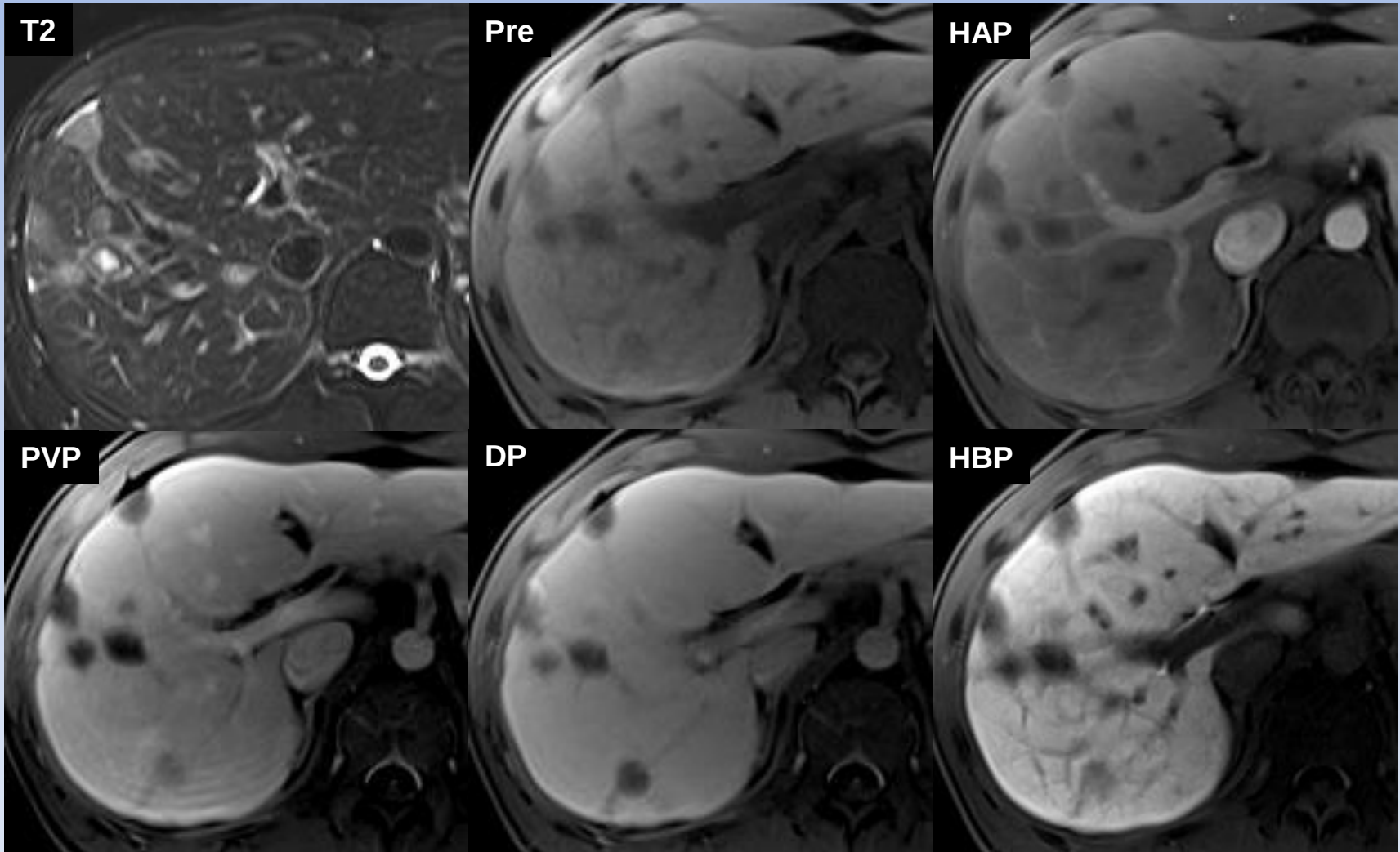


Epithelioid hemangioendothelioma

- CT/MRI
 - Full spectrum of growth may be seen from multiple nodules to large confluent masses.
 - Usually develop in periphery of the liver
 - Capsular retraction and calcification



Epithelioid hemangioendothelioma



Conclusions

- US findings of focal hepatic lesions are relatively well correlated with CT and MRI findings.
- However, it is important to recognize when additional examination or further evaluation is required, because US is only a screening tool and there are limitations to final diagnosis by US.
- Except for typical hemangioma and focal fat deposition/sparing, the remaining solid hepatic lesions detected in the non-cirrhotic liver require further evaluation with CT or MRI.

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