

# Focal splenic lesions: Focusing on how to differentiate malignancy from benign

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# Learning Objectives

- To evaluate the imaging findings of the focal splenic lesions and to characterize the features that may be helpful in the differential diagnosis of malignant and benign lesions

# Background

- The mass of the spleen is often found incidentally during the evaluation of trauma and metastatic cancer. In addition, the appearance of the tumor is different from that of other organs and the characteristic features are not well known. It is difficult to distinguish between malignant and benign tumors, and unnecessary procedures such as biopsy or splenectomy are frequently performed. Therefore, we aimed to evaluate the characteristic features of CT, MR, PET, and US to distinguish between benign and malignant lesions.

# Imaging Findings

- Benign
  - Congenital cyst
  - Pseudocyst
  - Lymphangioma
  - Hemangioma
  - SANT
  - Littoral cell angioma
  - Hamartoma
  - Granulomatous lesion
  - Inflammatory pseudotumor
  - Extramedullary hematopoiesis
- Malignant
  - Metastasis
  - Lymphoma
  - Angiosarcoma
  - Undifferentiated carcinoma

# Benign

- Congenital cyst
- Pseudocyst
- Lymphangioma
- Hemangioma
- SANT
- Littoral cell angioma
- Hamartoma
- Granulomatous lesion
- Inflammatory pseudotumor
- Extramedullary hematopoiesis

# Cystic lesions in spleen

- Primary (true) – epithelial lining

Parasitic :

Echinococcus

Non-parasitic :

Congenital

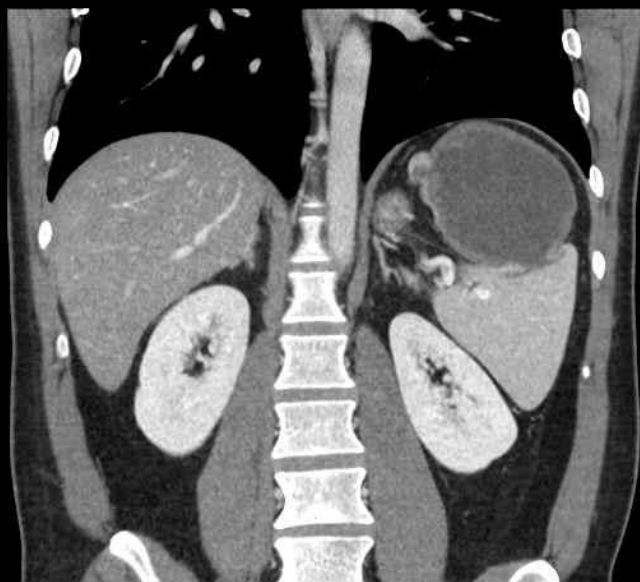
Neoplastic

- Secondary (false) – no epithelial lining

Post-traumatic

Splenic infarction

# Endothelial cyst

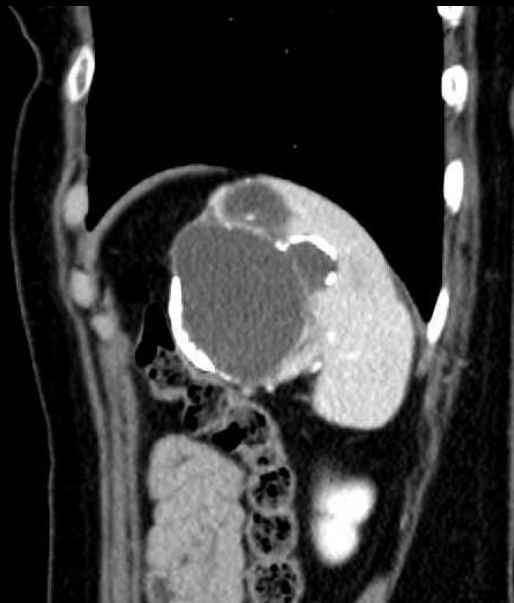
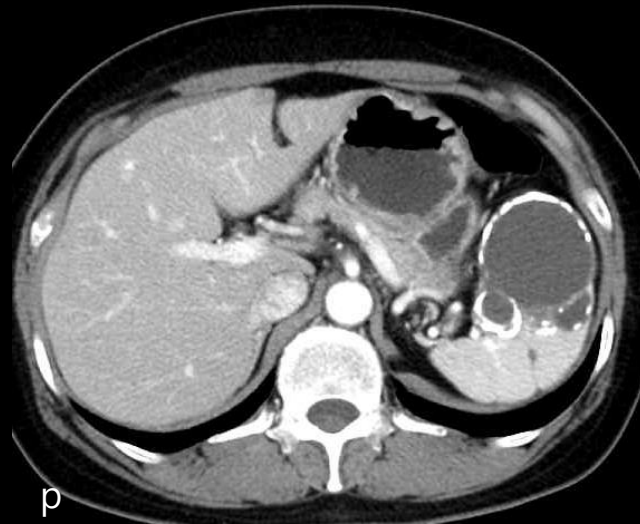


coronal

coronal

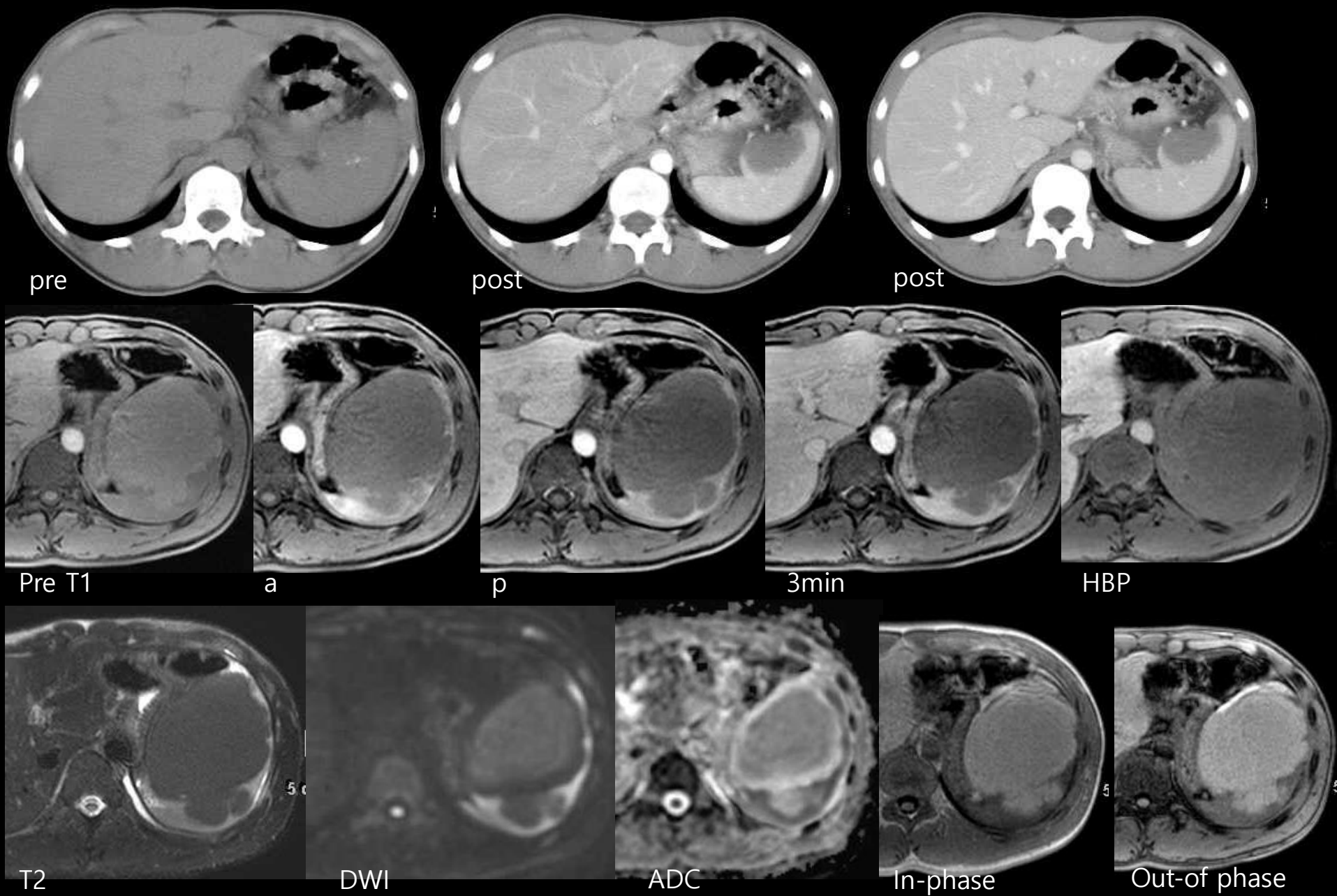
sagittal

## Epithelial cyst





# Epithelial cyst



# Pseudocyst



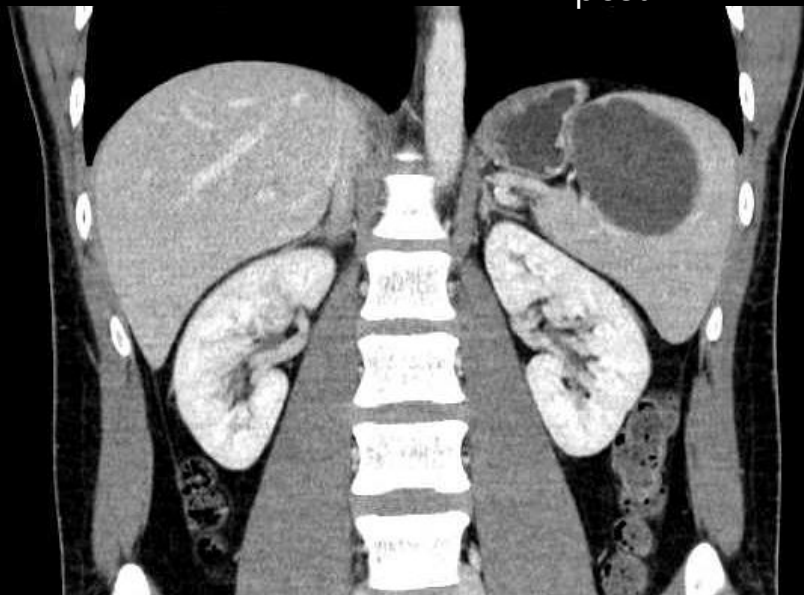
pre



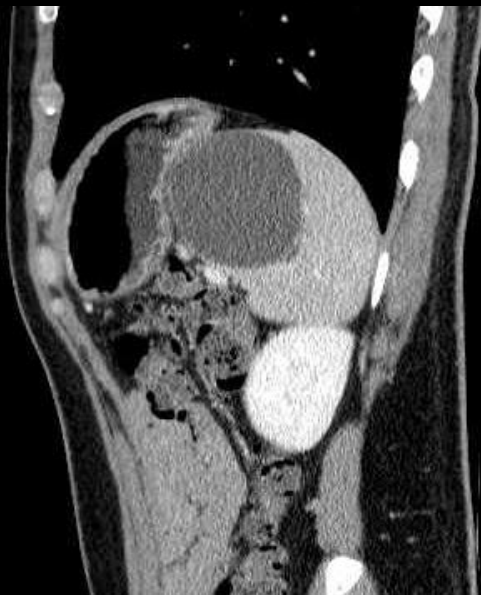
post



US



coronal



sagittal

# Lymphangioma

- Slow growing
- Histologic types (3):
  - simple lymphangioma
  - cavernous lymphangioma
  - cystic hygroma
- CT:
  - multiple, discrete, nonenhancing low-attenuation lesions
  - Usu. Subcapsular in location
  - Curvilinear peripheral mural calcifications
- MR: T1 high (internal bleeding, large amount of intracystic proteinaceous material)
- Angiography: Swiss cheese app. (well defined avascular lesion and stretching of intraparenchymal arterial branches)



# Lymphangioma



pre



a



p



d



pre



a

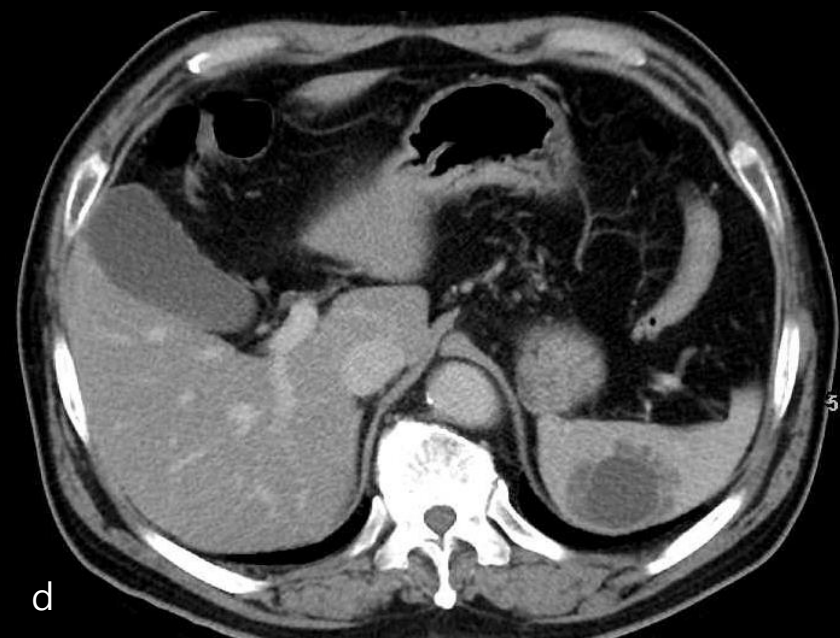
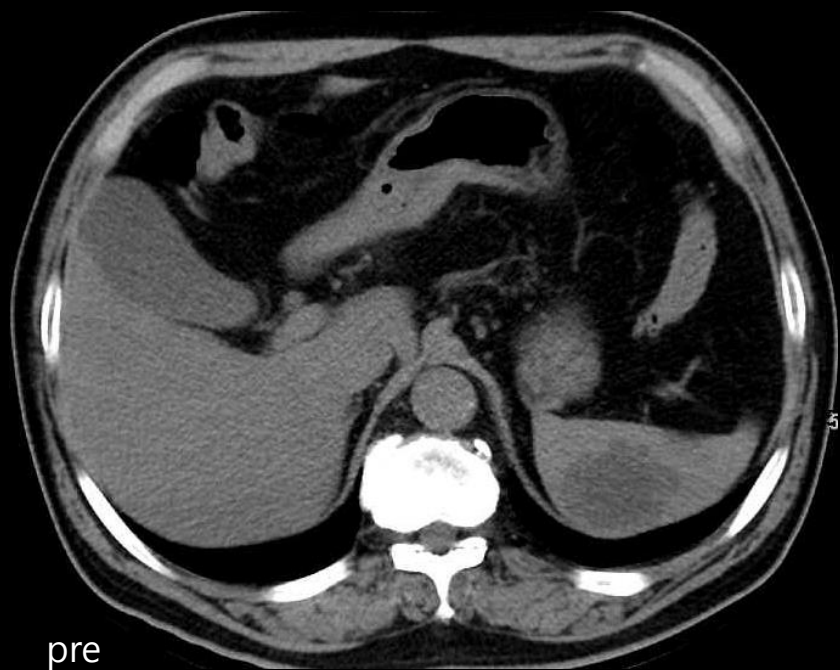


p



d

# Hemangiolympangioma

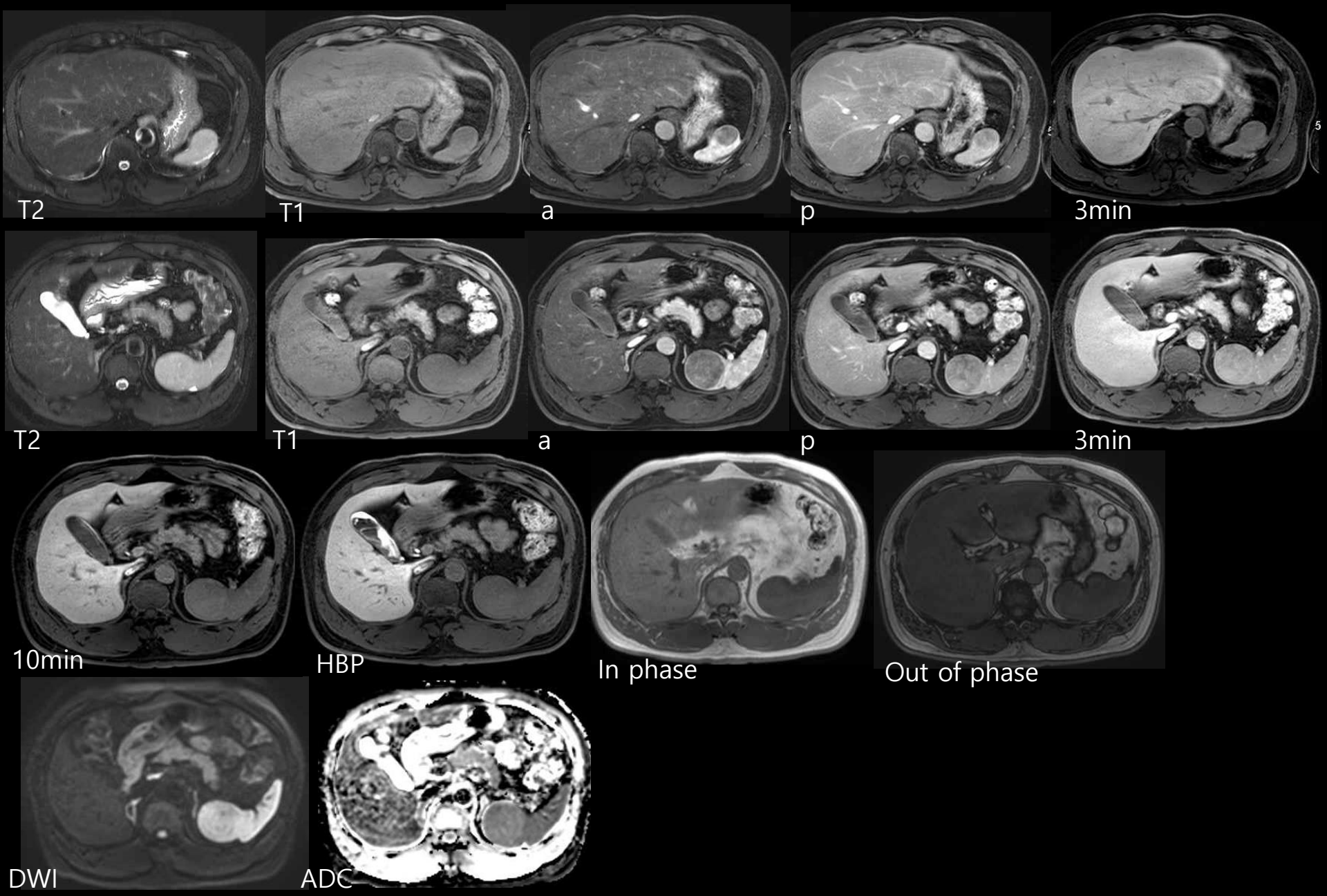


# Hemangioma

- Most common primary benign neoplasm
- Endothelial-lined vascular channels filled with blood
- T1 low, T2 high than spleen parenchyma
- Early nodular centripetal enhancement
- Uniform delayed enhancement



Hemangioma



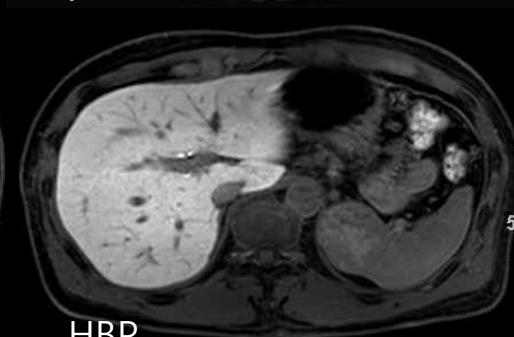
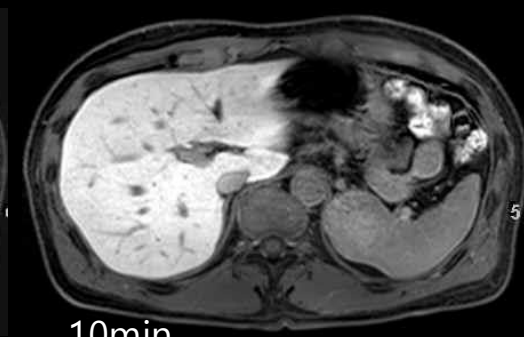
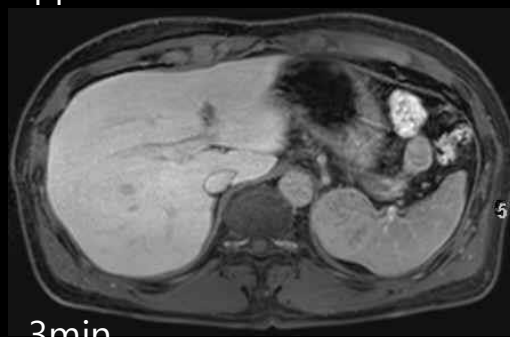
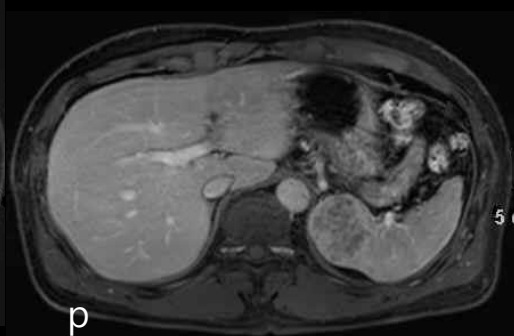
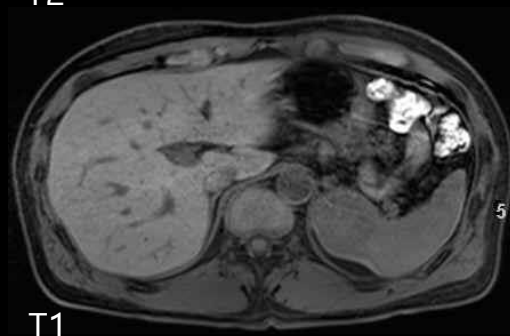
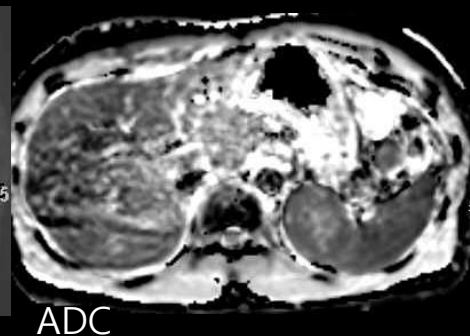
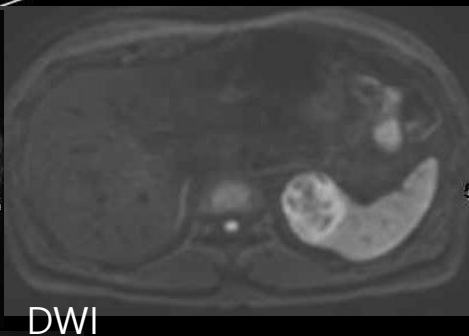
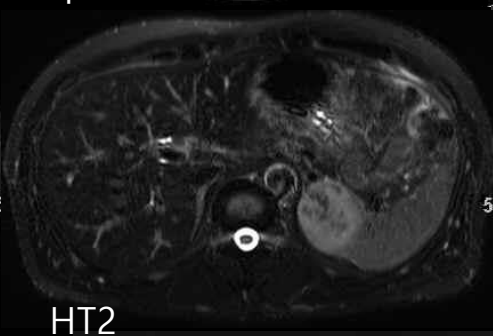
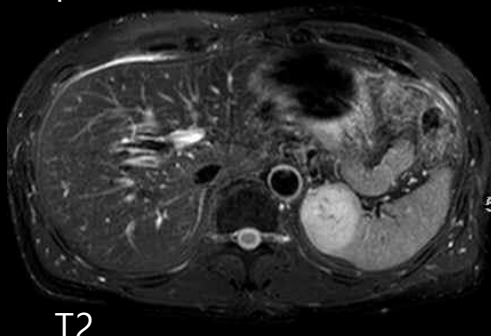
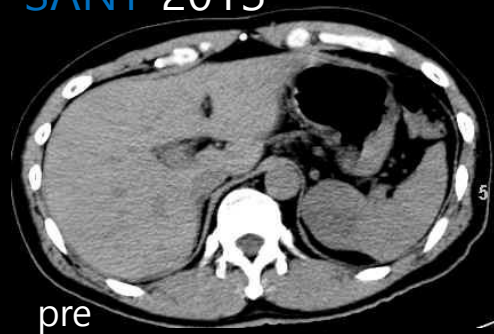
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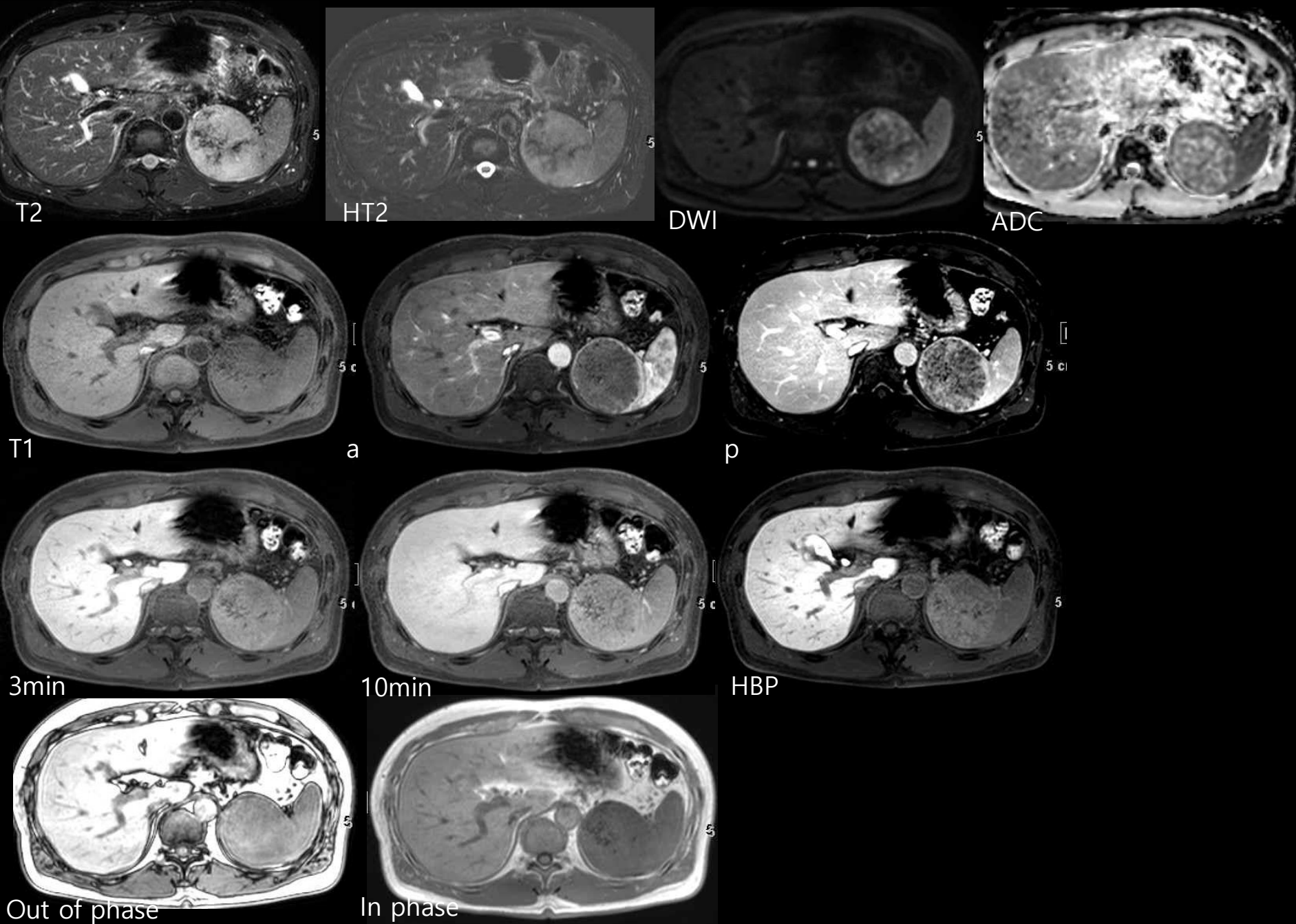
Sclerosing Angiomatoid Nodular Transformation

- Benign vascular lesion consisting of multiple angiomatoid nodules surrounded by dense fibrous tissue that often coalesces centrally to form a scar
- Pathogenesis: unclear
  - Hamartomatous response of the splenic red pulp to a vascular insult or stromal proliferation
  - Spectrum of IgG4-sclerosing disease
  - Final stage of inflammatory pseudotumor
  - Hamartoma
  - Organizing hematoma



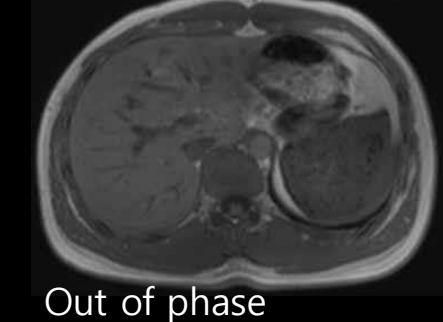
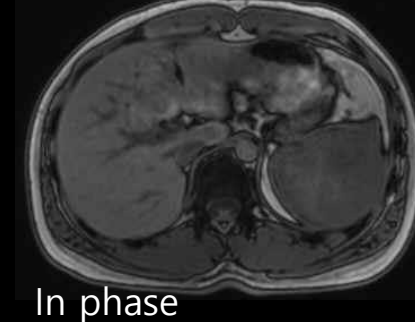
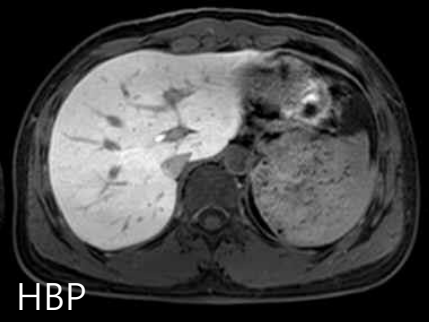
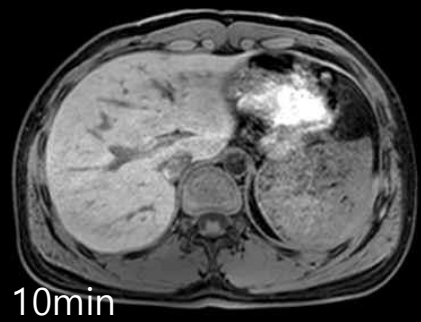
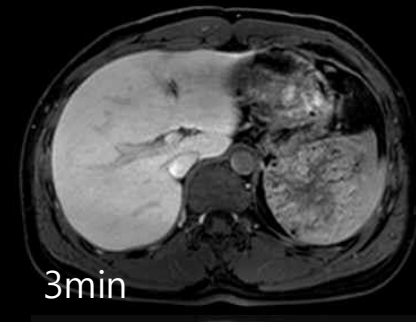
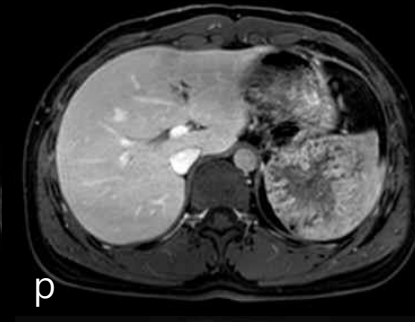
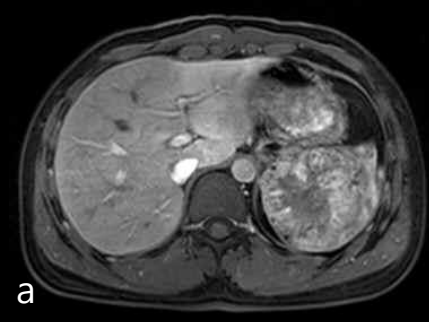
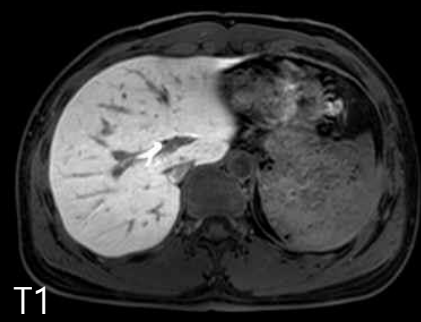
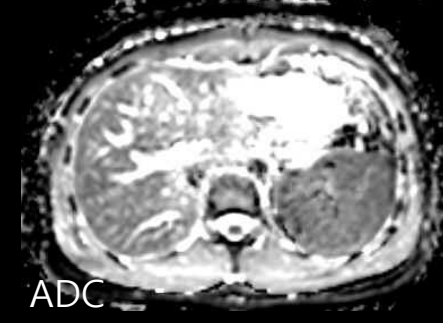
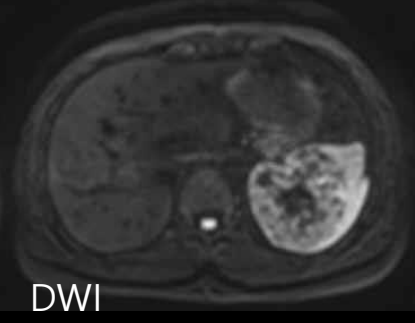
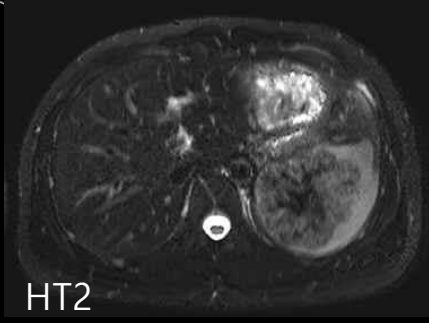
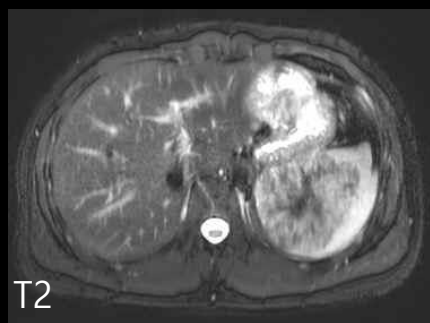
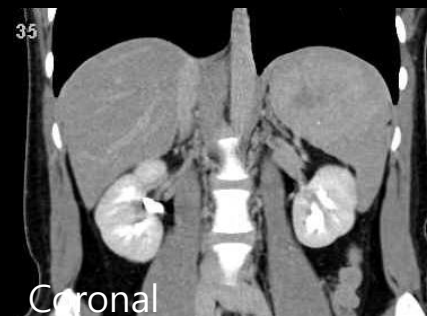
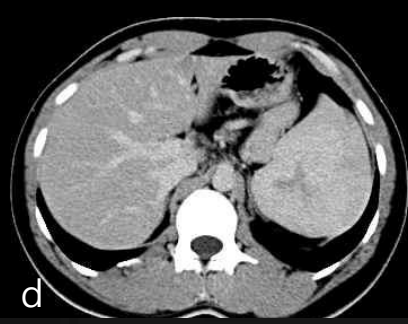
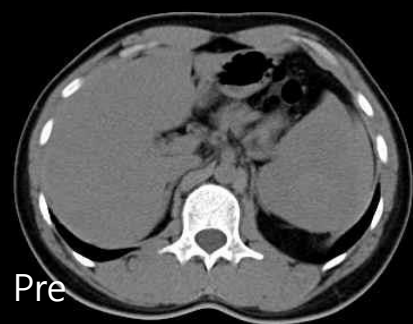
- US: hypoechoic
- CT: solitary, well circumscribed, lower attenuation relative to spleen on early and portal phase, isodense on delayed image
- MR: hyperintense at the periphery, hypointense at the center, hypointense radiation bands corresponding to fibrosis, signal drop on T1 in-phase sequence indicating iron deposition due to old hemorrhage, progressive enhancement
- Solitary mass, old hemorrhage, dense fibrosis, and centripetal enhancement lead to suspicion of SANT







# SANT



# Littoral cell angioma

- Arising from littoral cell, normally line the splenic sinuses of the red pulp
- Splenomegaly
- Numerous, low-attenuating nodules on portal phase
- Histology: anastomosing vascular channels lined with tall endothelial cells and papillary fronds
- DDx: hemangioma(similar enhancement pattern of liver hemangioma), lymphoma(adenopathy or disease in other organ), disseminated infection, granulomatous disease
- Diagnosis : Biopsy in pts. Without clotting function abnormality



# Littoral cell angiosarcoma

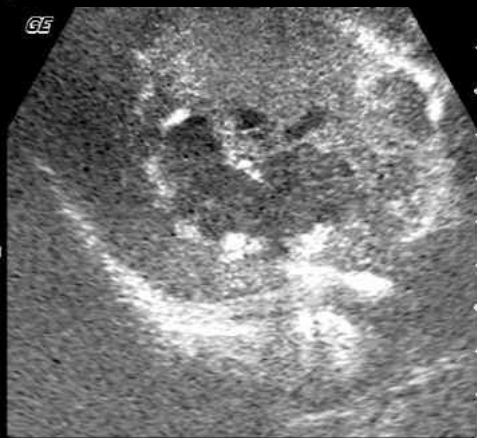
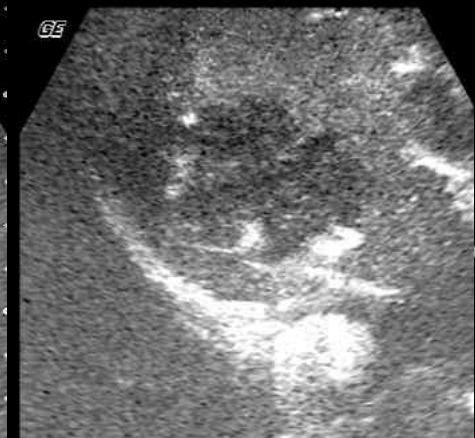
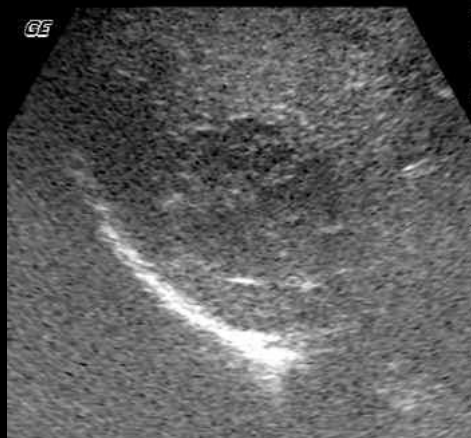


CEUS-Pre

CT-a

CT-p

CT-d

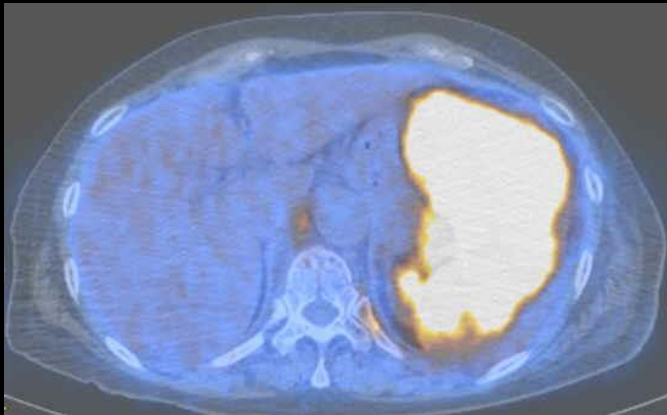


CEUS-post

# Hamartoma

- Mixture of normal splenic structures such as white and red pulp
- Commonly associated with tuberous sclerosis
- NECT: isodense to splenic parenchyma, contour distortion
- Occasionally: calcification, cystic change and fat in mass
- T1 iso, T2 heterogeneously high relative to the spleen
- Immediate diffuse enhancement on early and more uniform enhancement on delayed image

# Hamartoma



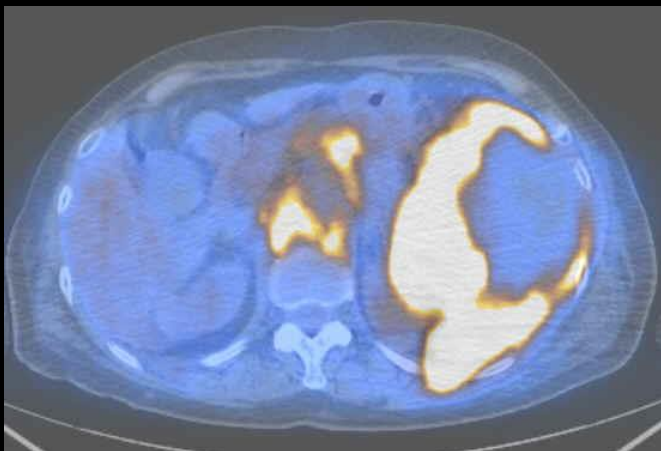
PET-CT



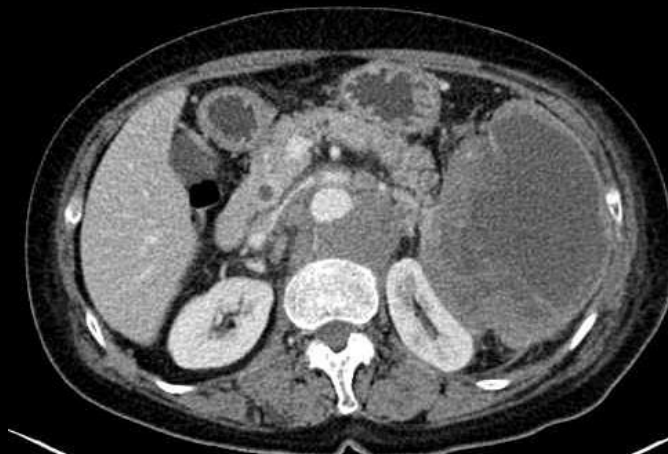
Pre



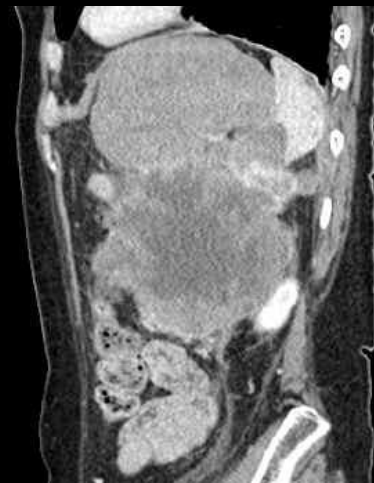
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PET-CT



p



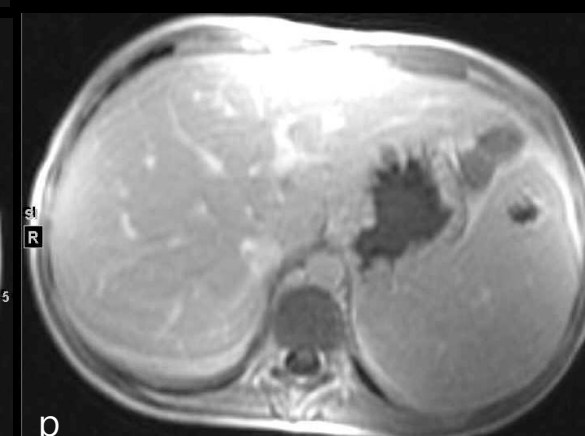
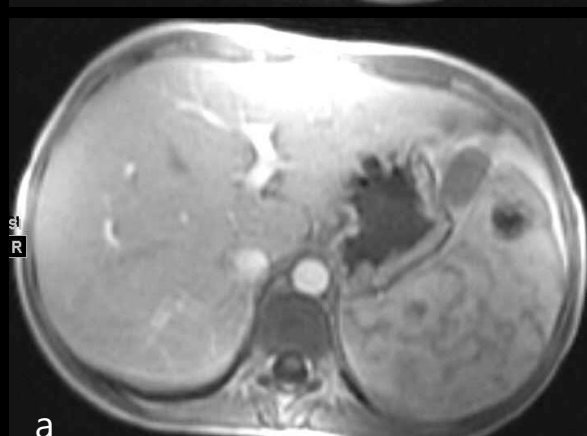
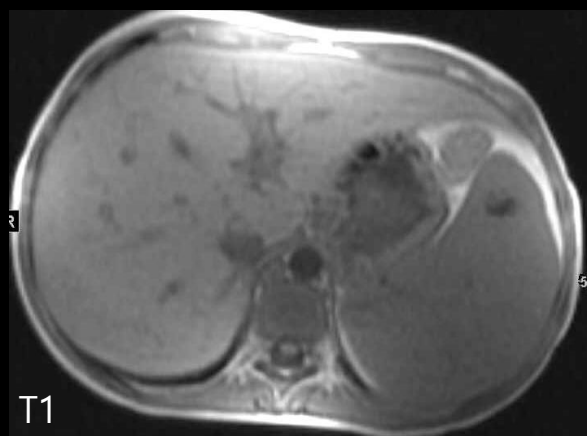
sagittal

# Extramedullary hematopoiesis

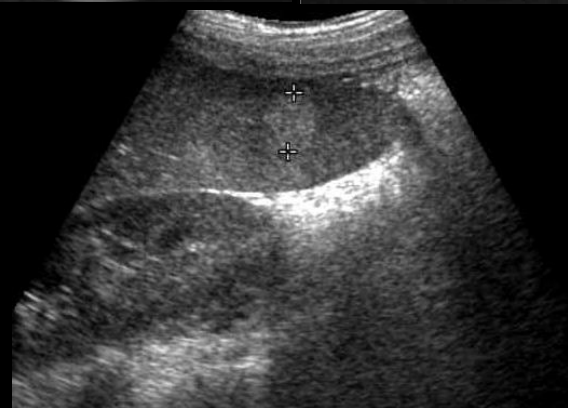
- Compensatory response to deficient bone marrow cells
- Predominantly affect the spleen and liver
- Active lesion: T1 intermediate, T2 high , some enhancement
- Old lesion: T1, T2 low, reduced SI on in-phase T1WI owing to iron deposition



# Extramedullary hematopoiesis



US





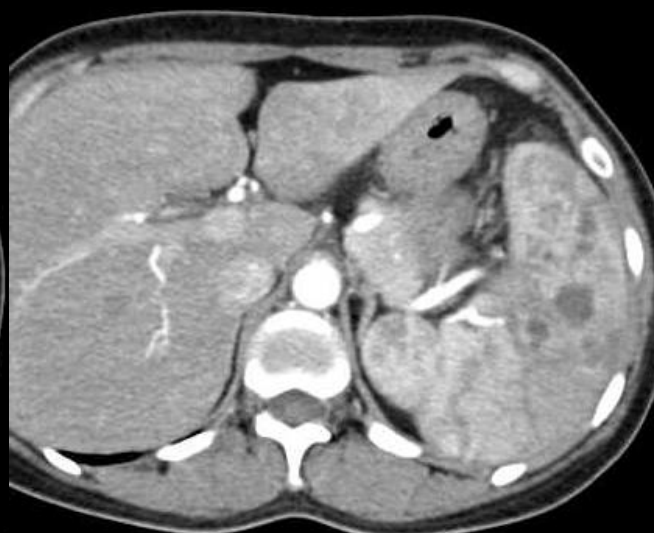
# Infection

- Infection:
  - metastatic infection (sepsis, infective endocarditis)
  - Contiguous infection (perinephric abscess, necrotic pancreatitis)
- Infarction with superimposed infection
- Trauma
- Immunodeficiency condition
- Low attenuation with rim enhancement

# Abscess



Pre



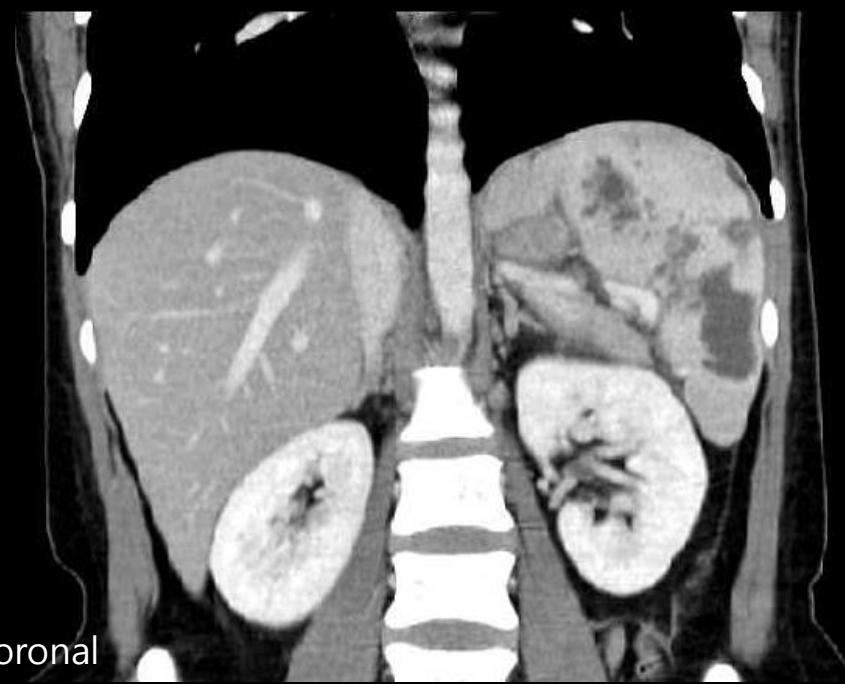
a



p

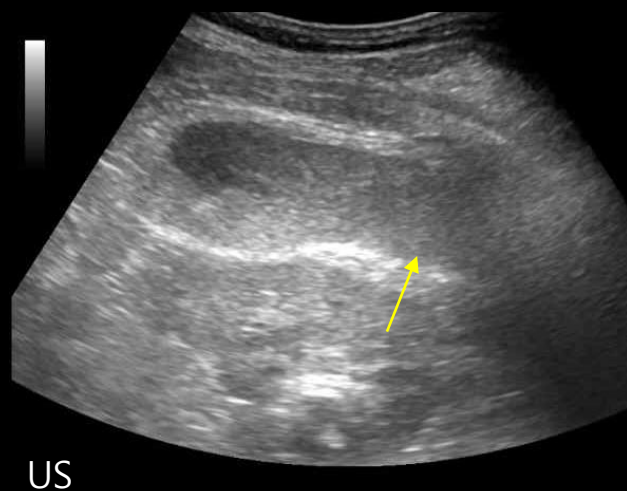
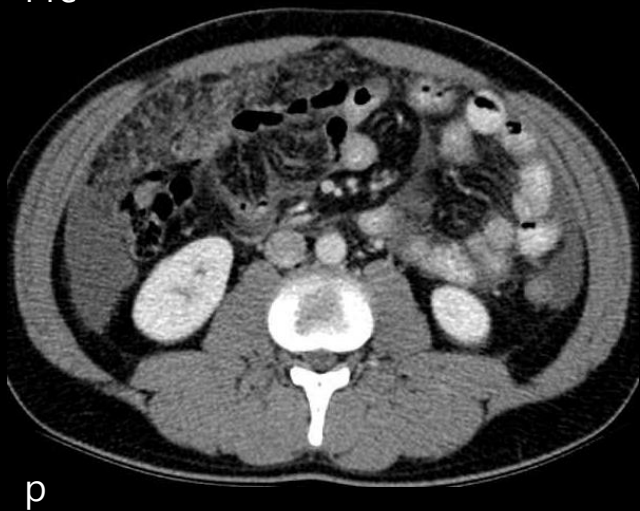
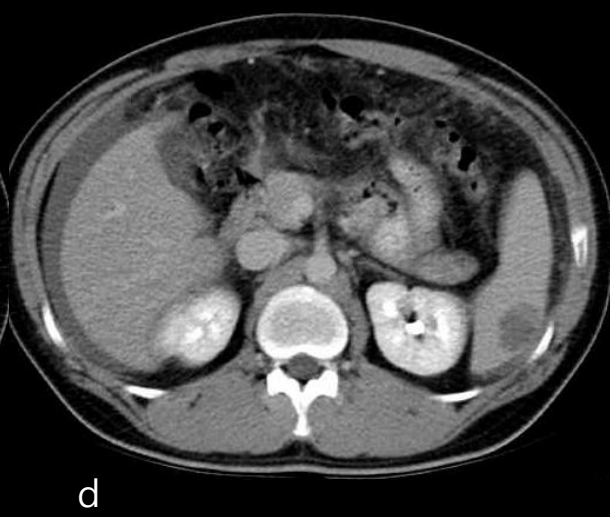
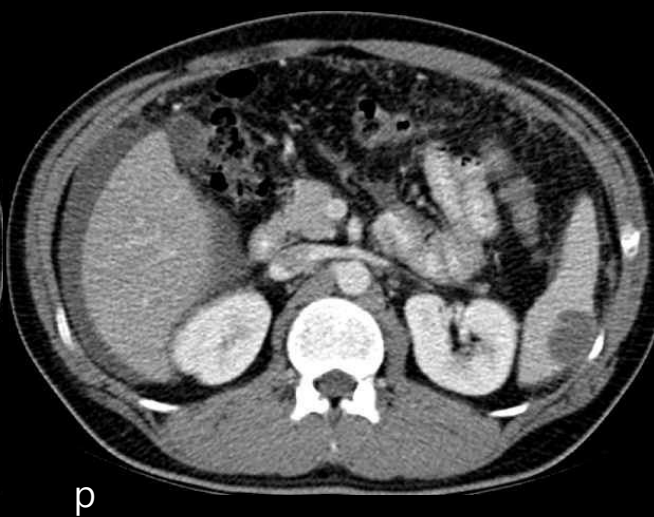


p



coronal

## Chronic granulomatous inflammation

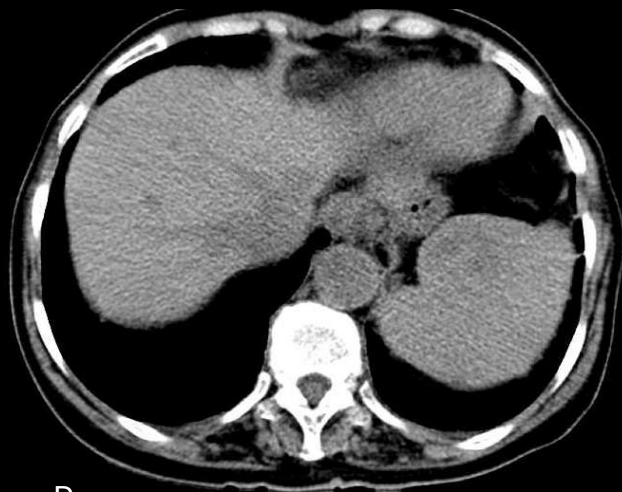


# Inflammatory pseudotumor

- Spectrum of inflammatory lesions: plasma cell granuloma, plasma cell pseudotumor, myofibroblastic tumor
- Underlying inflammatory disease process
- 2 theories:
  - Primary reactive and inflammatory process
  - Low-grade neoplastic process with secondary inflammation
- Hypergammaglobulinemia and elevated inflammatory markers
- Imaging alone is of limited value in differentiating from IPT from other splenic lesions
- Nonspecific enhancement pattern because of amount of fibrosis and cellular infiltrations
- Typically a large, well circumscribed single mass in spleen



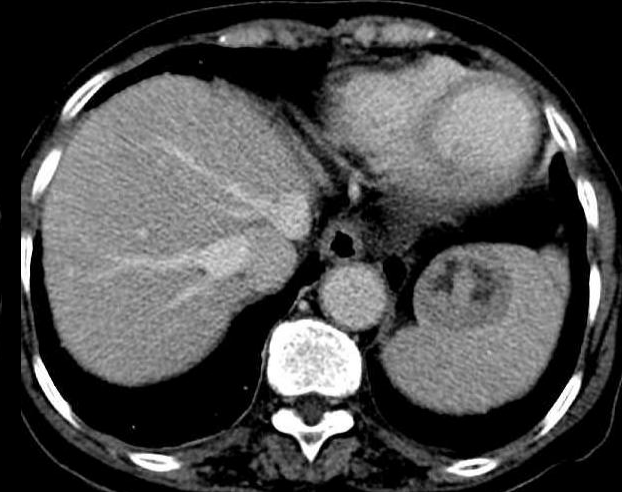
# Inflammatory pseudotumor



Pre



a



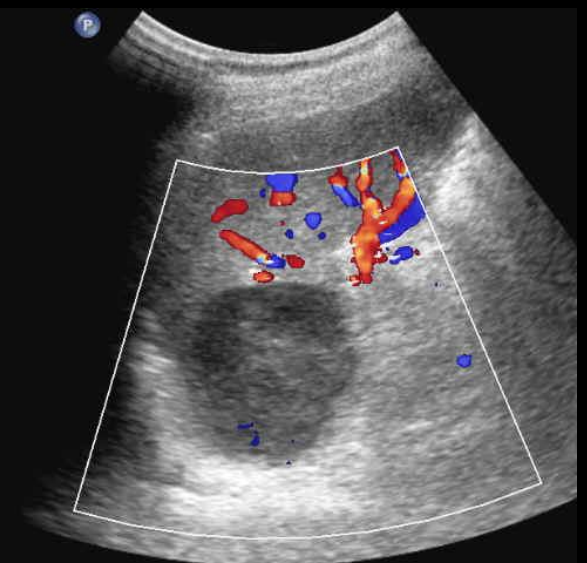
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US



US



US color Doppler

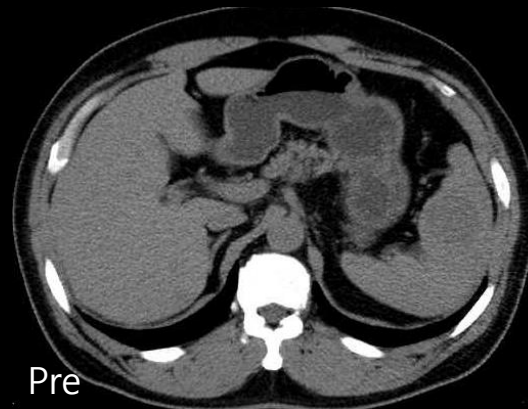
# Inflammatory pseudotumor

2009

2010



p



Pre



a



p



coronal



sagittal



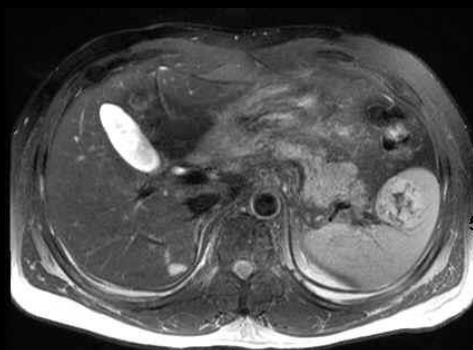
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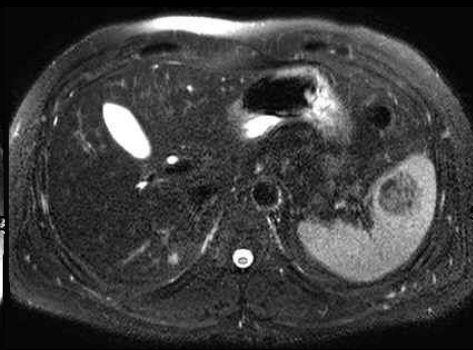
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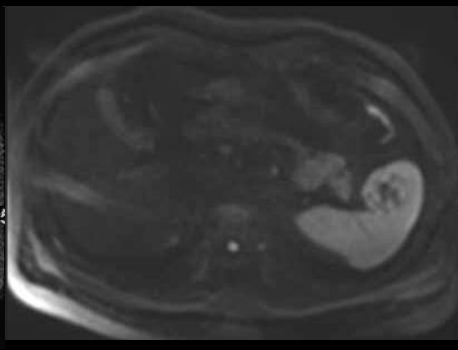
# Inflammatory pseudotumor 2009



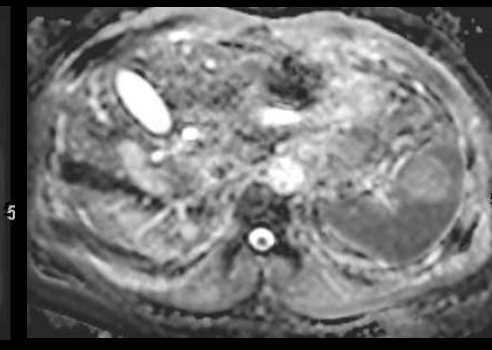
T2



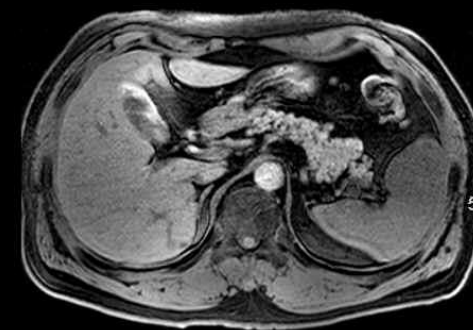
HT2



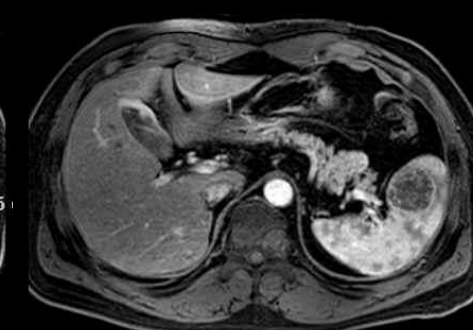
DWI



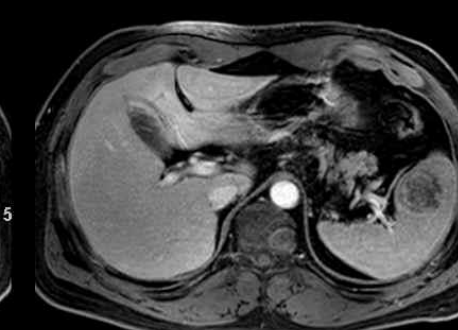
ADC



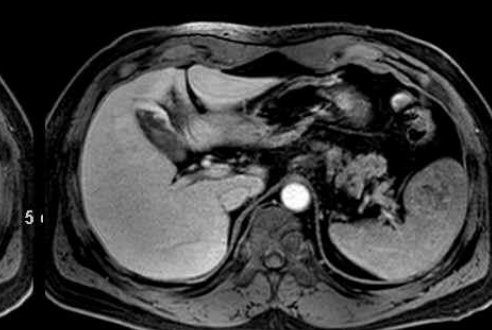
T1



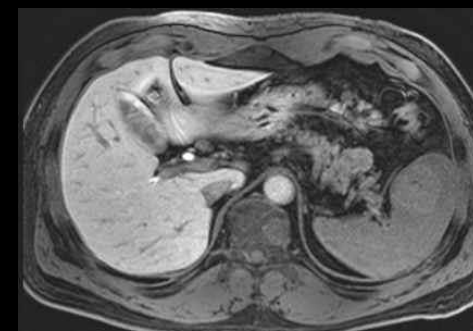
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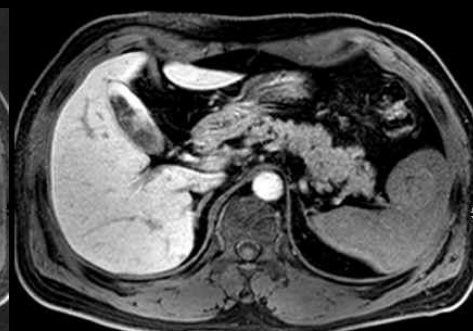
p



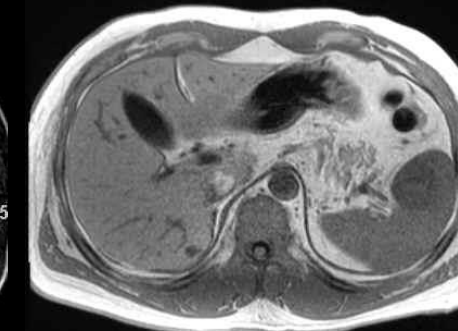
3 min



10 min



HBP



In phase



Out of phase

# Malignant

- Metastasis
- Lymphoma
- Angiosarcoma
- Undifferentiated carcinoma



# Metastases

- Melanoma, cancer of breast, lung, ovary, stomach, and prostate
- Typically hypoechoic on US and hypodense on CT
- MR: T1 low, T2 high, diffusion restriction, various enhancement
- Capsular deposition from most commonly with gynecologic malignancy

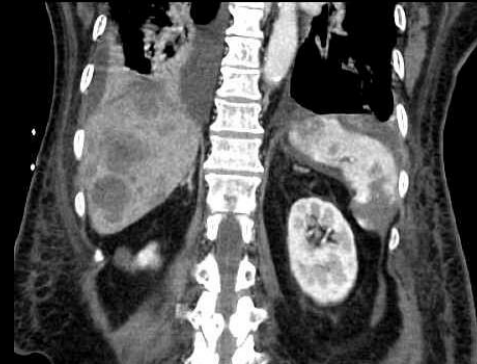
# Angiosarcoma metastases



Pre



a



coronal



sagittal



p



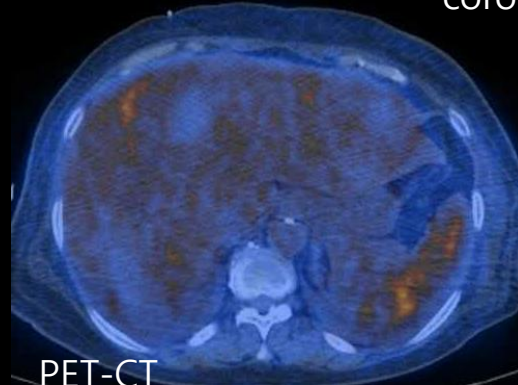
d



coronal



Pre



PET-CT

## Metastasis from intrahepatic cholangiocarcinoma



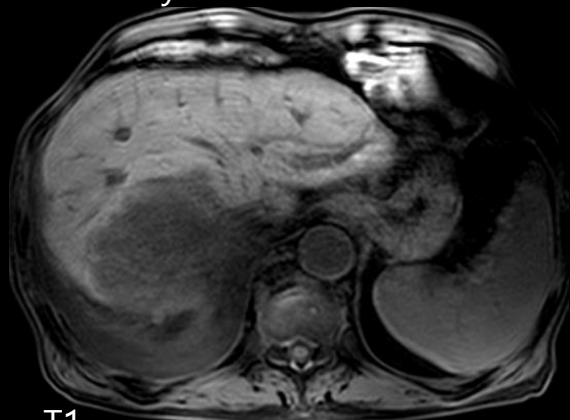
CT early a.



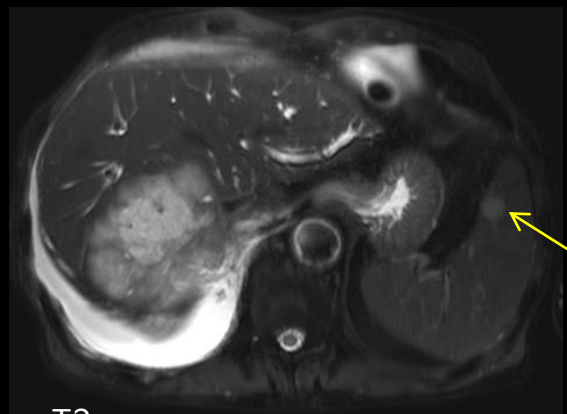
CT late a.



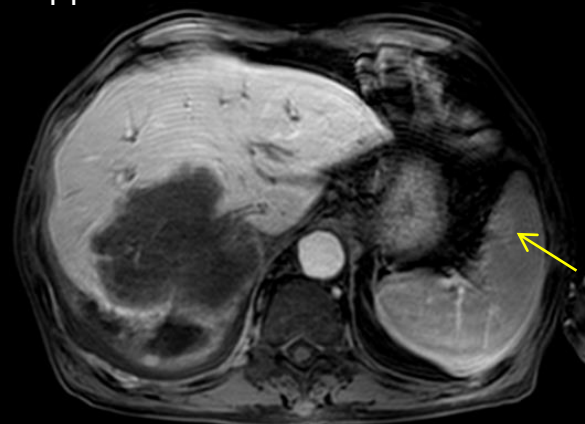
CT p



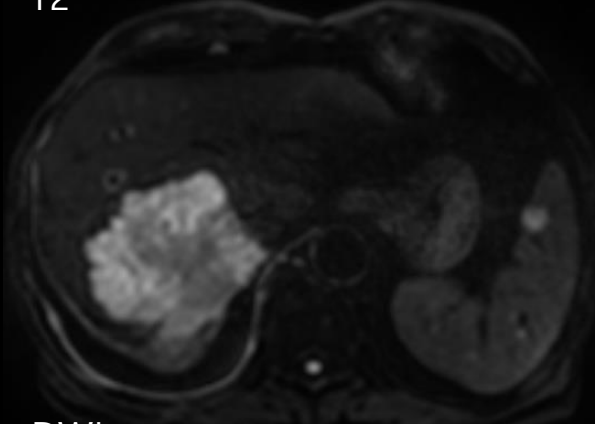
T1



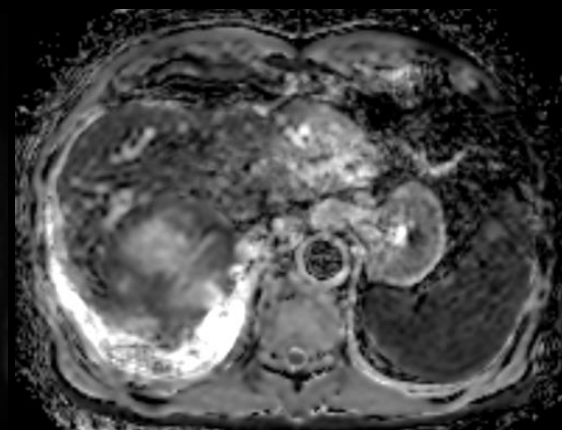
T2



p



DWI



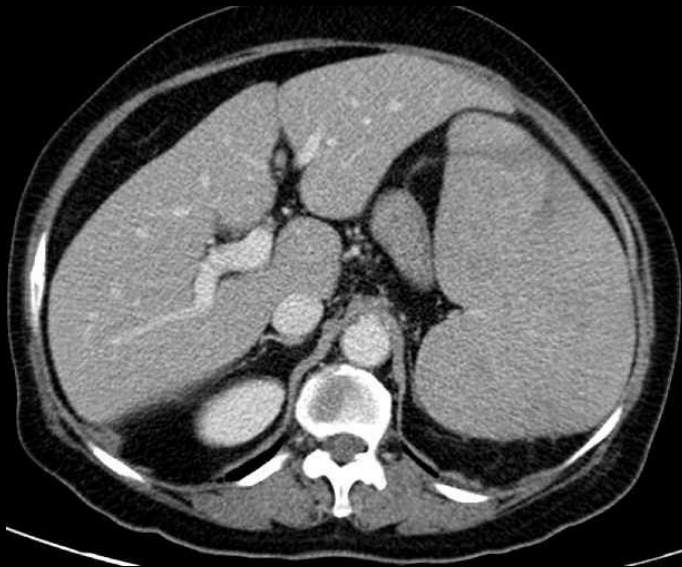
ADC

# Lymphoma

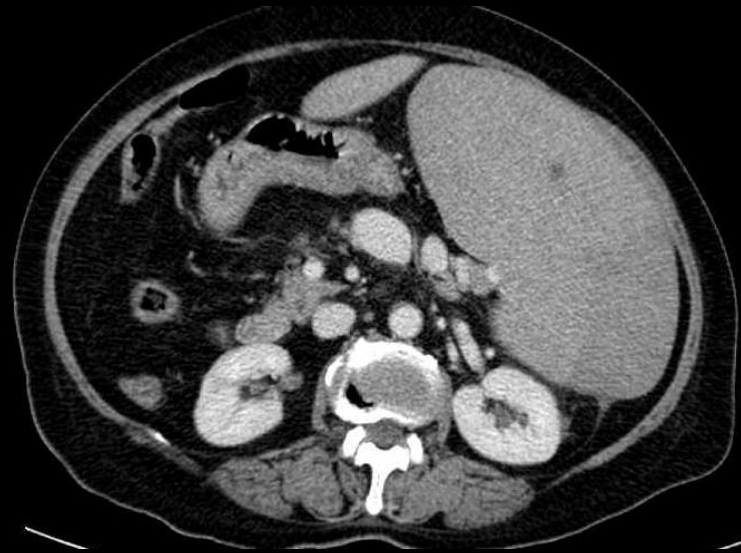
- Mc malignant tumor
- Secondary involvement:
  - Hodgkin lymphoma(33%)
  - Non-Hodgkin lymphoma(30-40%)
- Diffuse infiltration with splenomegaly, or discrete nodules or masses
- Necrosis is rare, infarction can occur
- US(hypoechoic), CT(hypodense) MR(T1 low, T2 high)
- Marked FDG avidity on FDG PET/CT



# Lymphoma



p



p

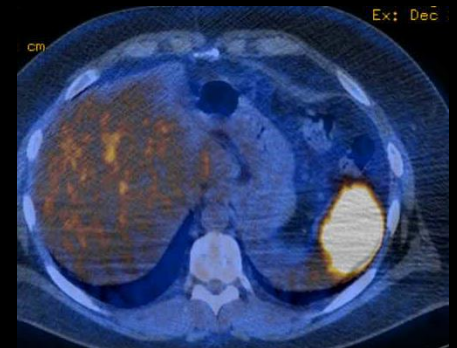
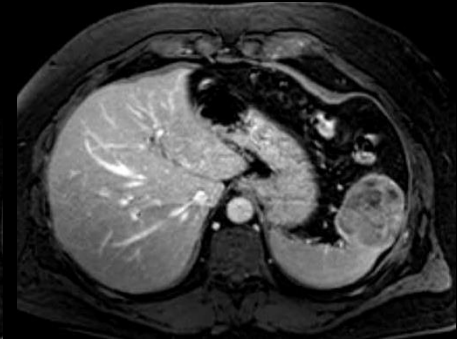
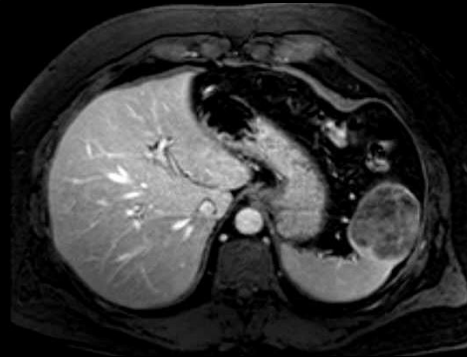


p



coronal

# Lymphoma



# Angiosarcoma

- Most common primary malignant neoplasm of the spleen
- Arising from endothelial lining
- Well defined mass or diffusely infiltrative in appearance
- No association with chemical exposures
- Sx.: LUQ pain, anemia, thrombocytopenia
- US: splenomegaly with a heterogenous echogenic mass
- CT: enlarged spleen with area of lower and high attenuation due to acute hemorrhage or hemosiderin deposits, calcification
- MRI: T1 low , T2 high, heterogenous enhancement with multiple nodular enhancing foci.
- 30% intraperitoneal rupture
- Metastasis: liver > lung, bone, BM, and lymphatic system



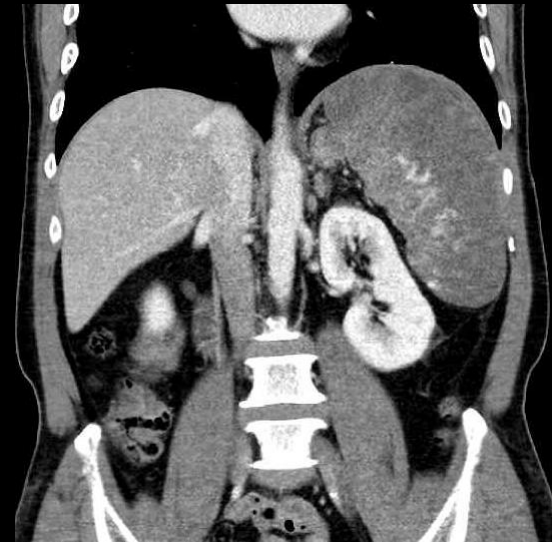
# Angiosarcoma



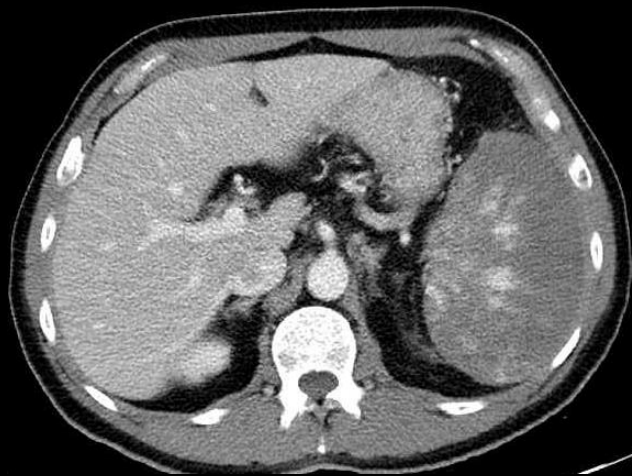
Pre



a



coronal



p



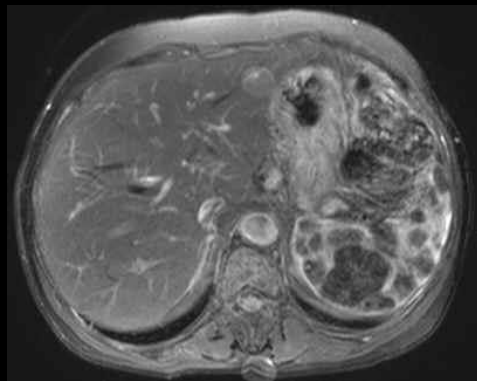
d



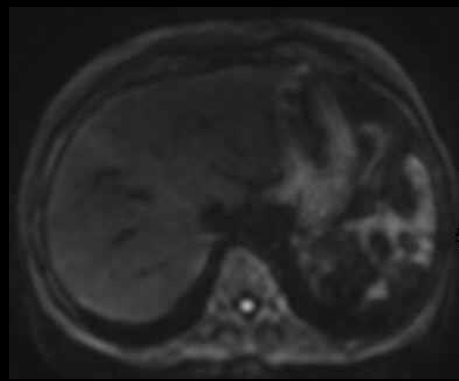
PET-CT



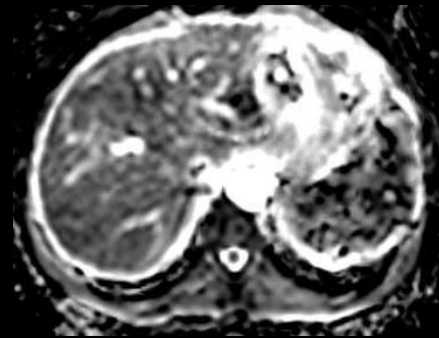
# Angiosarcoma



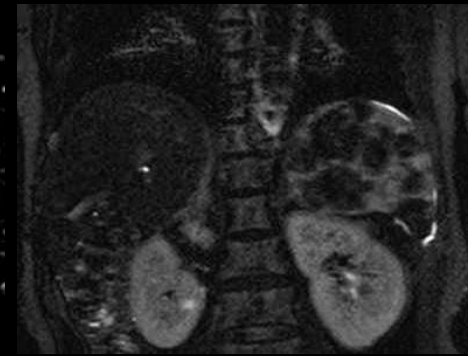
T2



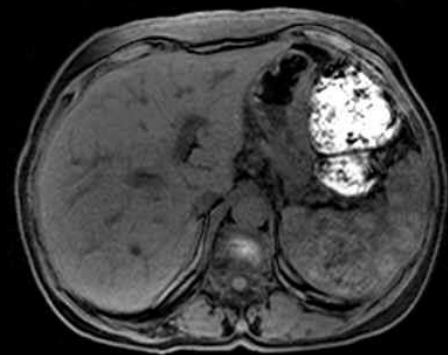
DWI



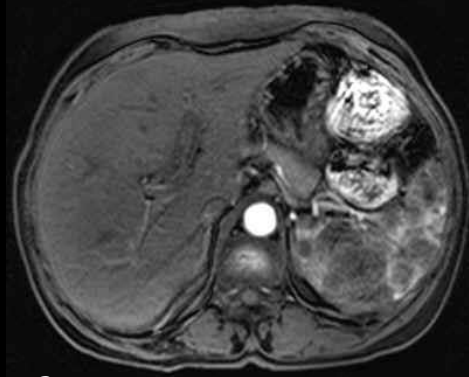
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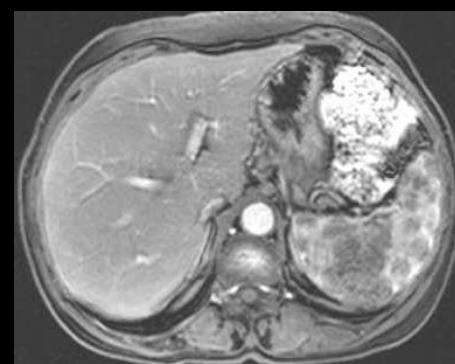
T2 coronal



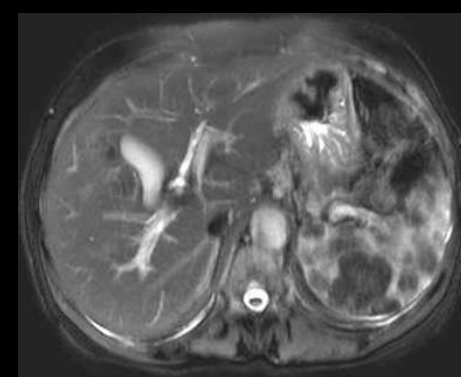
T1



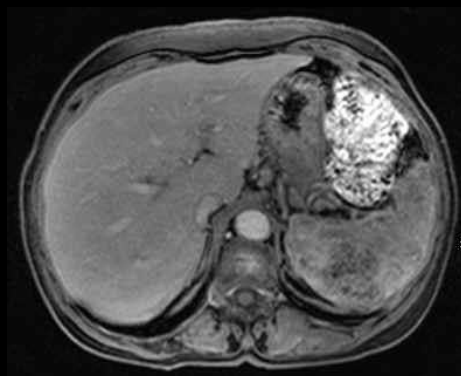
a



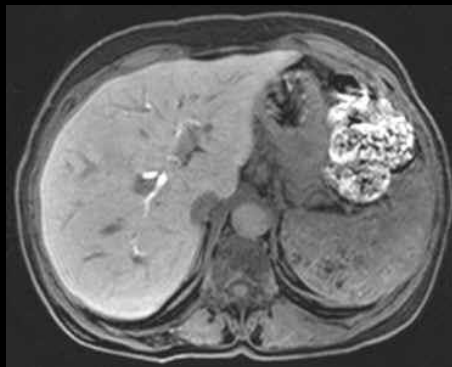
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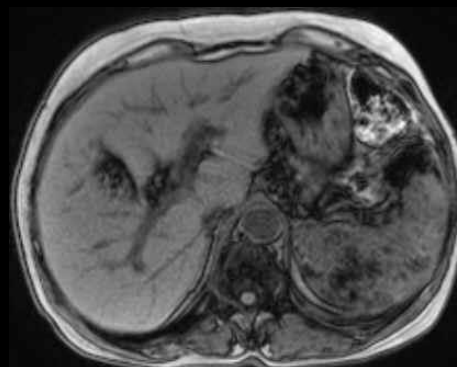
T2 SS



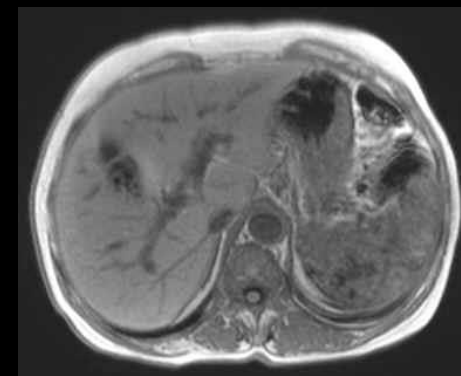
3min



HBP



In phase

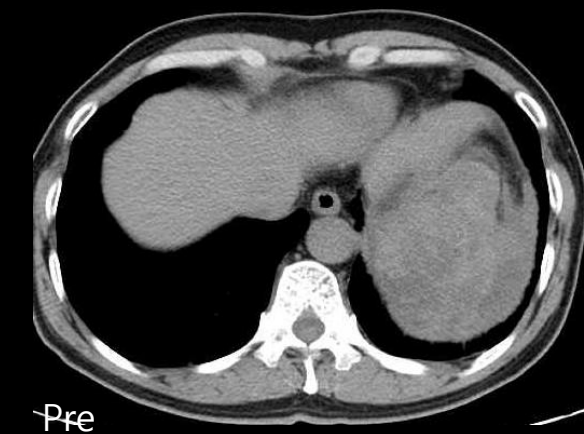
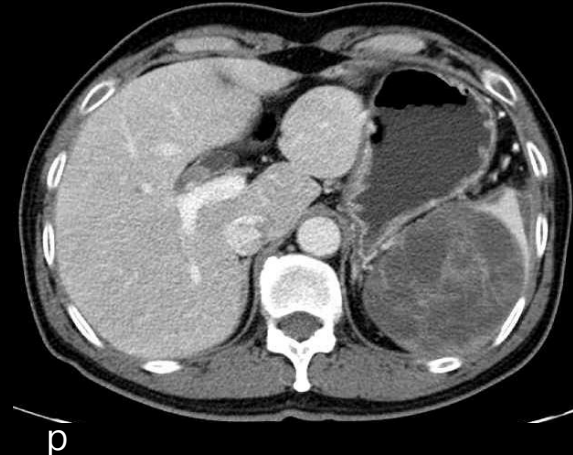
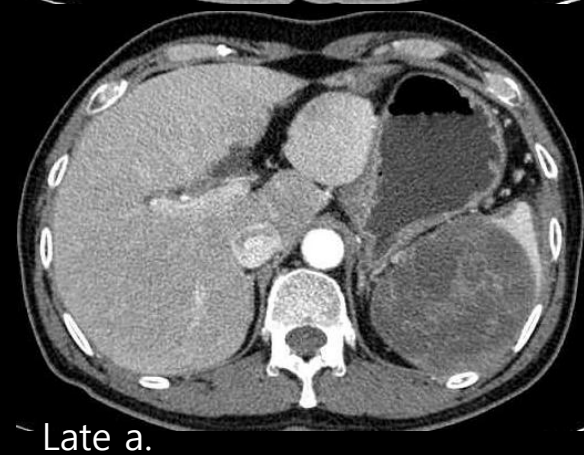
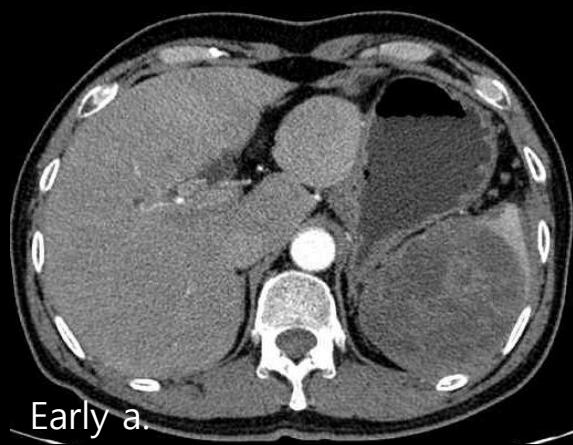
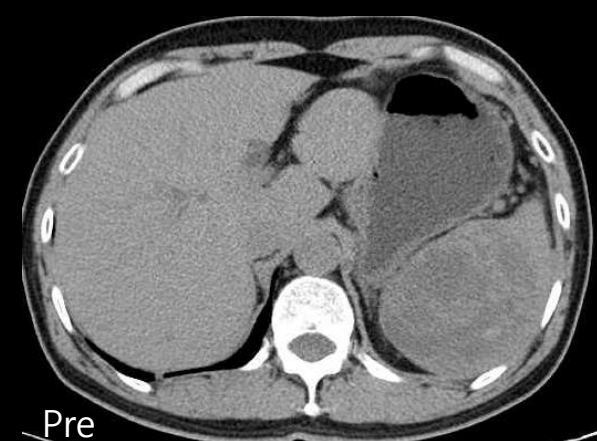


Out of phase

# Undifferentiated carcinoma

- Pattern-less solid, sheet-like growth of tumor cells
- Aggressive clinical course
- No nest, papillae, glands, trabeculae or spindled pattern
- No squamous or mucinous metaplasia and no/minimal neuroendocrine differentiation
- If area of differentiated component are found, the tumor is called dedifferentiated carcinoma

## Undifferentiated carcinoma



# Conclusions

- Cystic lesion and wall calcification are the most likely benign findings, and malignant lesions are common in cases of diffusion restriction, spontaneous rupture, and irregular margin.
- By using up-to-date imaging techniques, it is possible to minimize unnecessary surgery or invasive procedure because of the characteristic imaging findings of focal splenic lesions.