



US in Oncology: A new gold standard for tumor diagnosis and management

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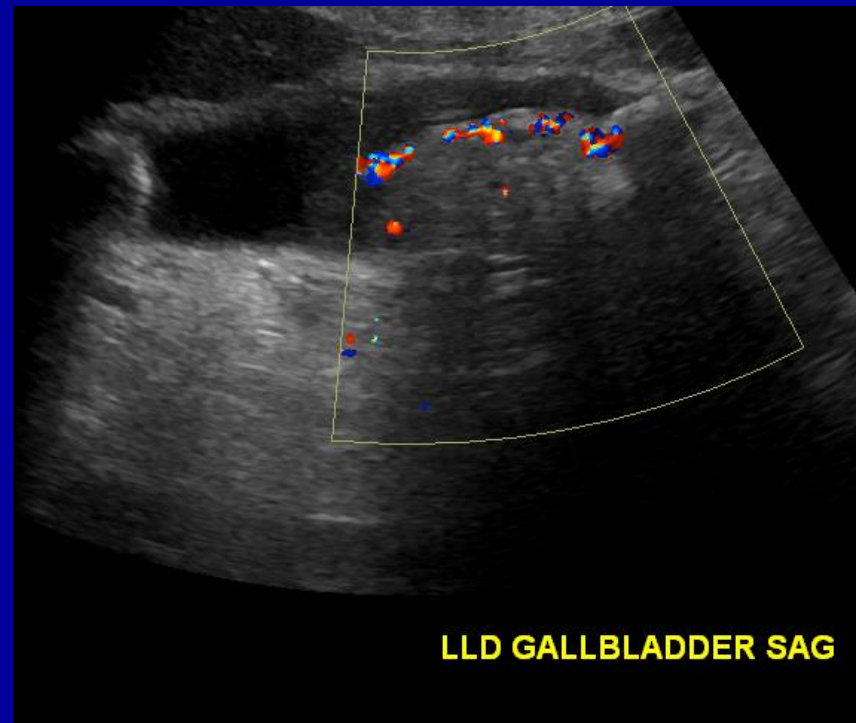
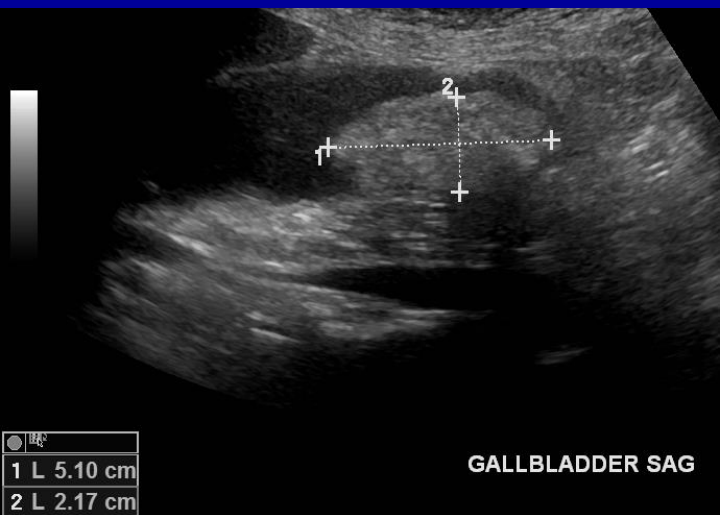
Disclosures

- None

Objectives

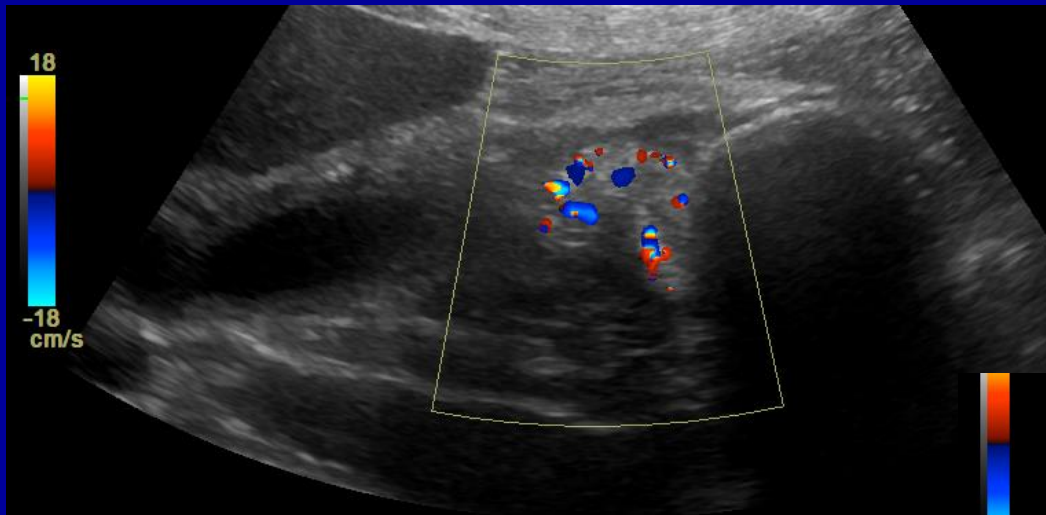
- Review some cases where US leads to correct diagnosis
- Identify important technical parameters critical to ultrasound performance
- Explore the role of US in management of oncologic patients

66 yo F RUQ pain

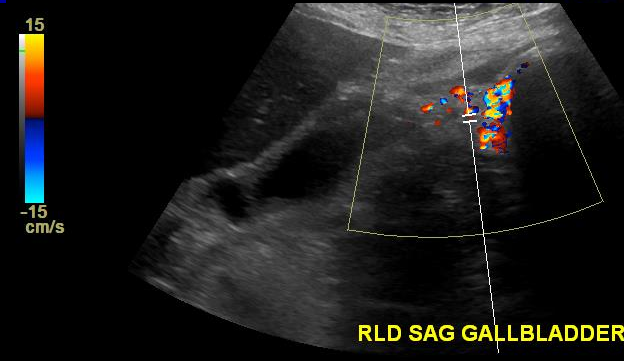


66 YO F RUQ Pain

- Repeat US with spectral Doppler



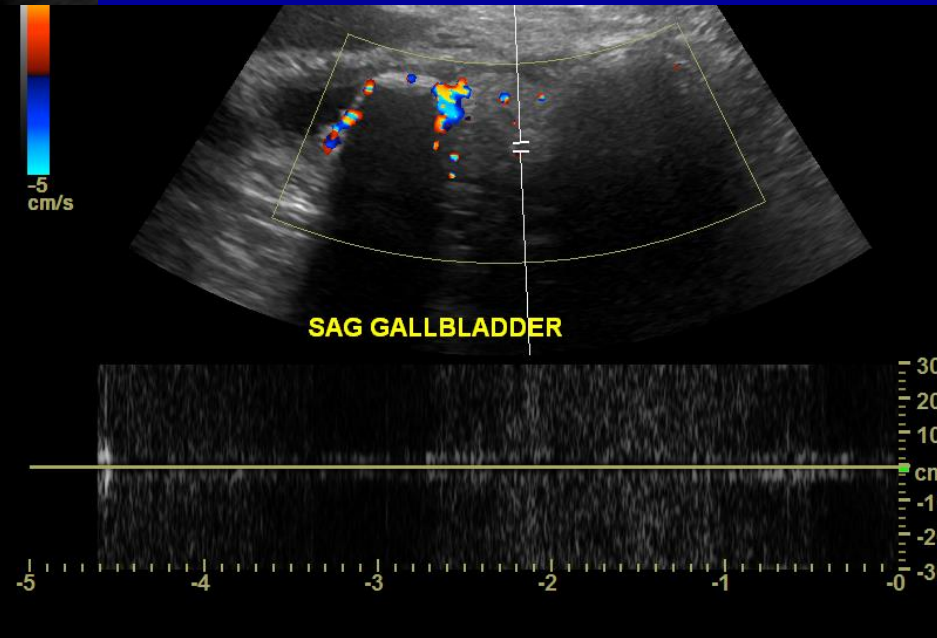
SAG GALLBLADDER



RLD SAG GALLBLADDER



RLD TRANS GALLBLADDER 3

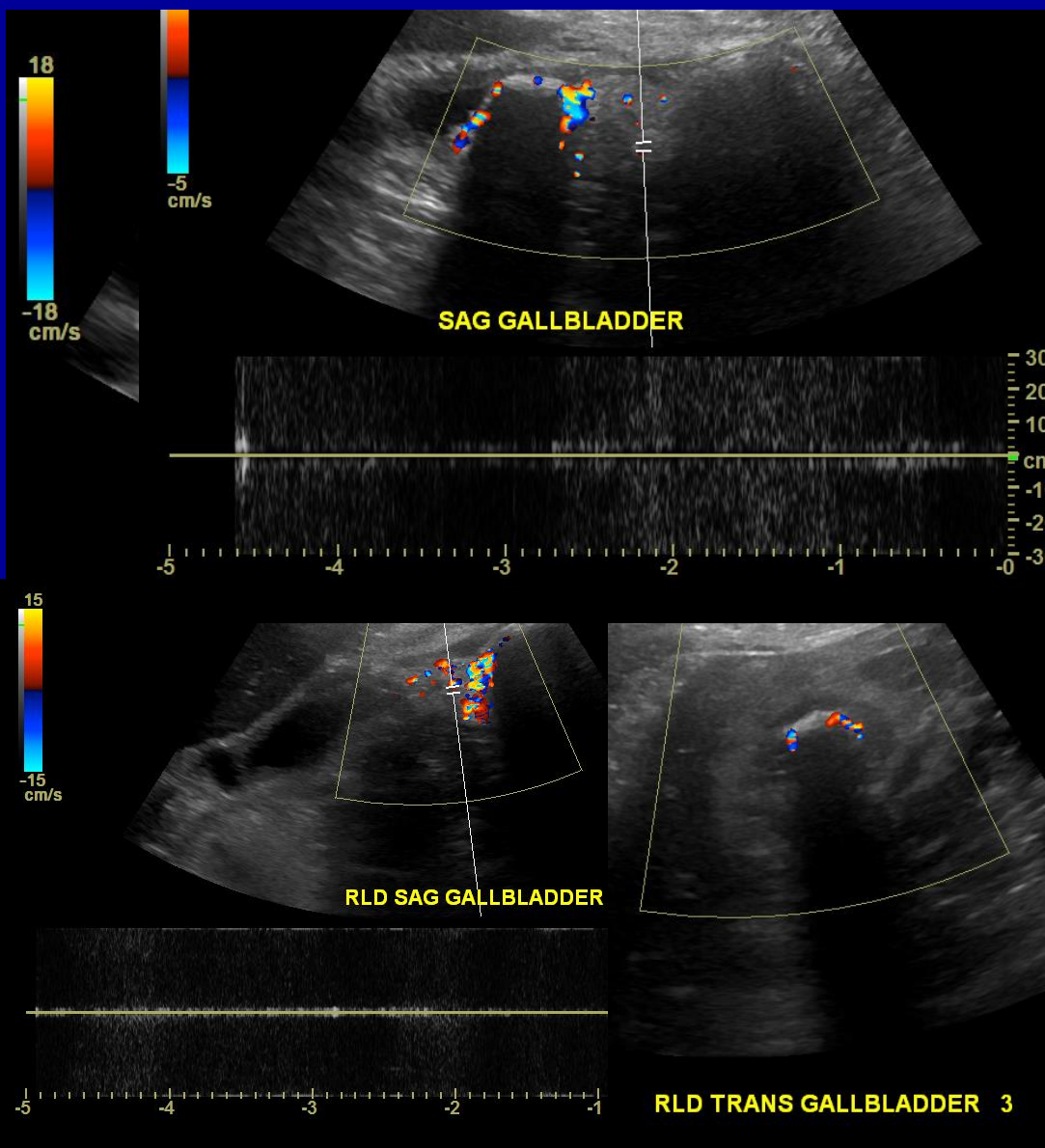


SAG GALLBLADDER

Differential diagnosis

- Adenomyomatosis
- Fungus ball
- Gallbladder carcinoma
- Gallstone
- Tumefactive sludge

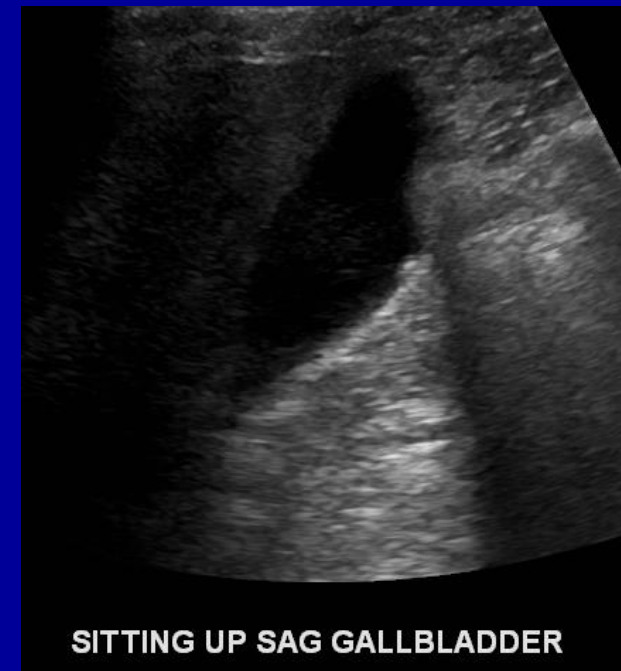
66 YO F RUQ Pain



- Repeat US with spectral Doppler
- Twinkling artifact produces color mosaic, spectral noise. No arterial flow
- Gallstone

Not all gallstones shadow!

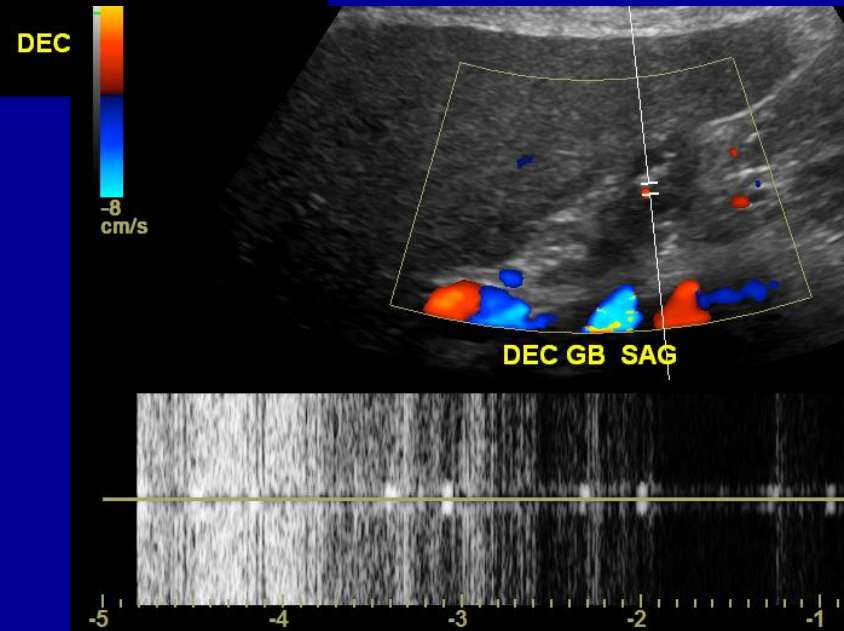
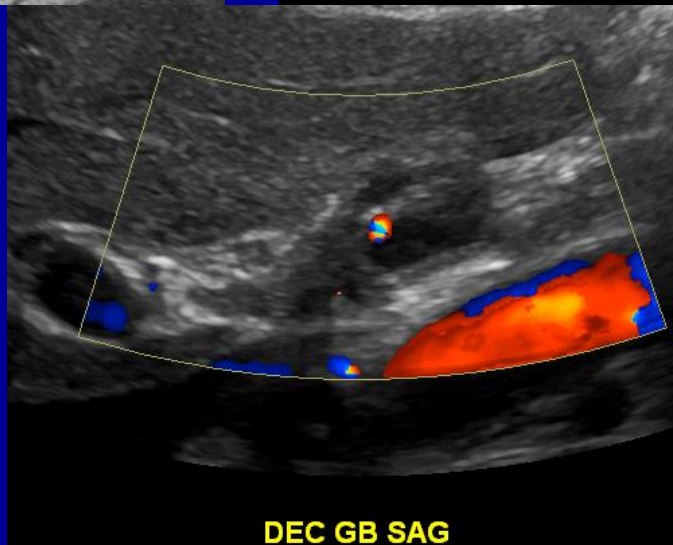
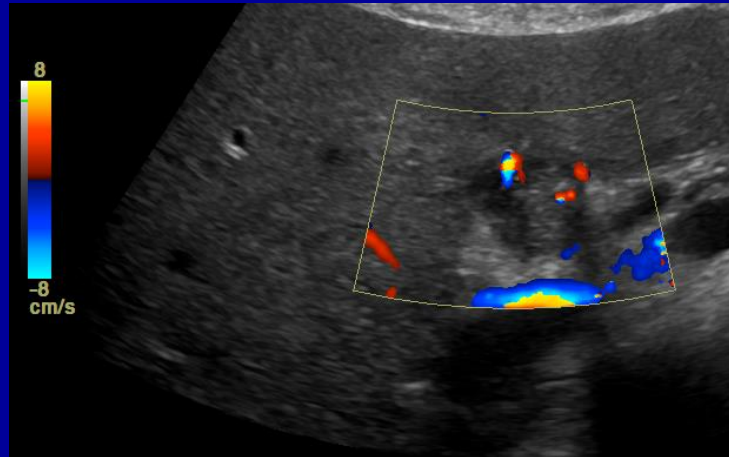
- Gallstones with minimal crystalline center may not shadow or be highly reflective
- Pigmented (bilirubinate) stones may not shadow
- Motion helps delineate from mass or polyp
- Look for additional benign features



67 yo F with Hematuria One malignancy or two?

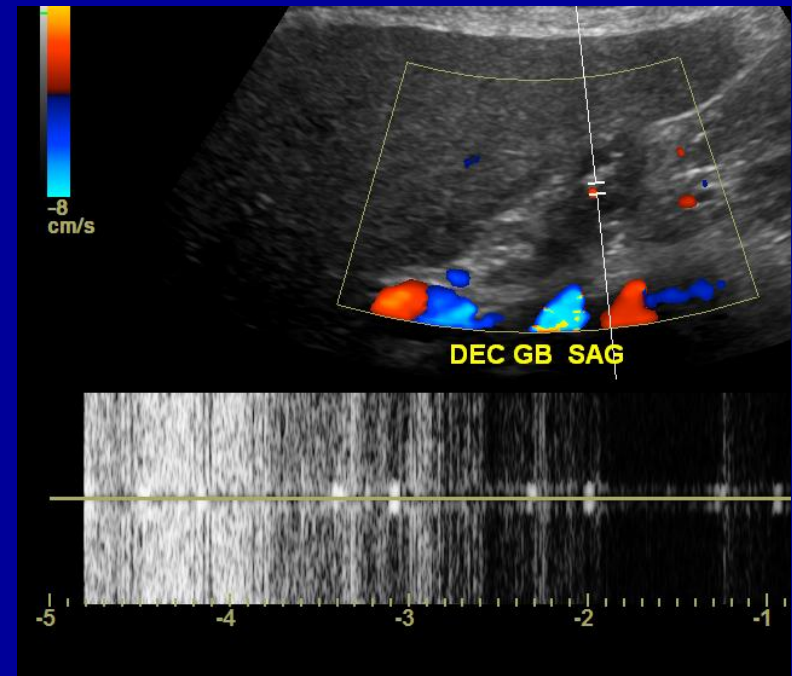


Next Step?



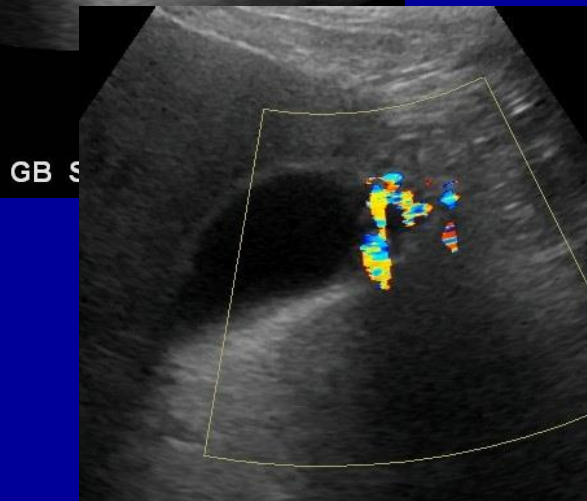
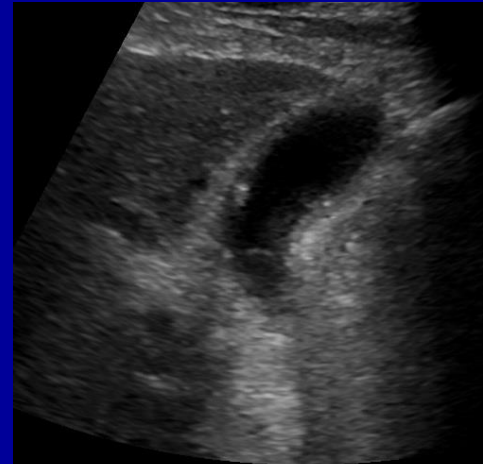
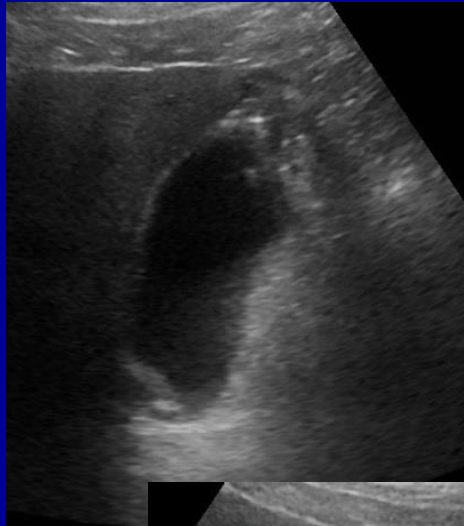
Diagnosis

- Abscess
- Adenomyomatosis
- Gallbladder Carcinoma
- Metastatic RCC to gallbladder
- Needs more imaging



ADENOMYOMATOSIS

- Common, 8.7% of cholecystectomy specimens
- Women > men
- Chronic RUQ pain
- 90% coexistent gallstones
- Three variants
 - Localized (fundal)
 - Segmental
 - Diffuse

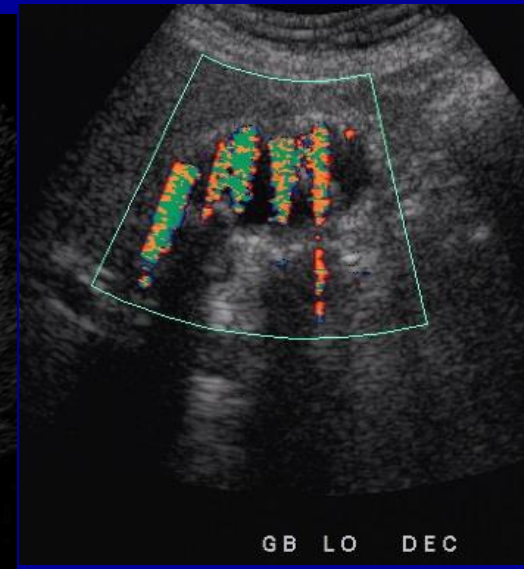
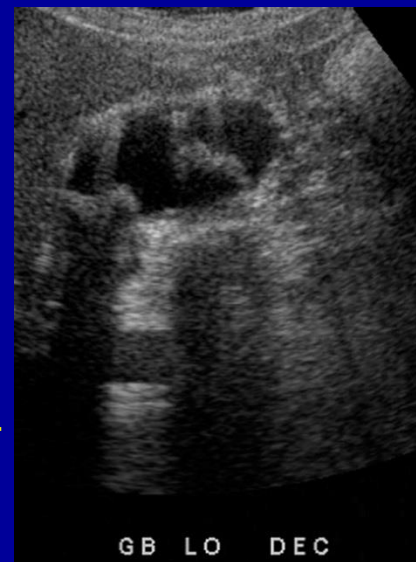
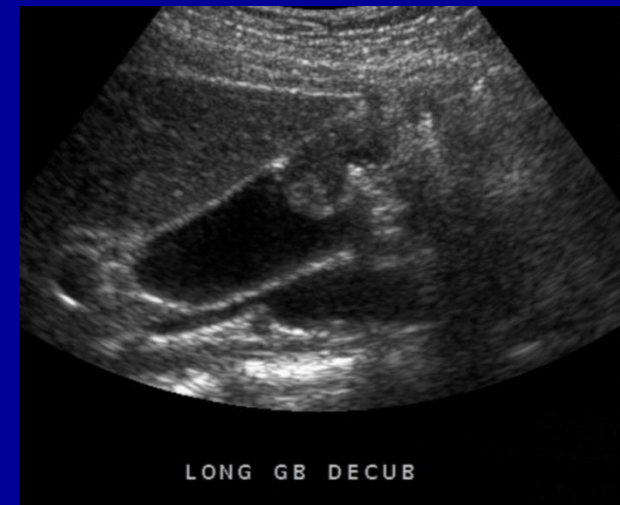


ADENOMYOMATOSIS: US IMAGING FINDINGS

- Focal or diffuse GB wall thickening or localized mass in GB fundus*
- Anechoic or echogenic spaces in GB wall (intramural diverticula)*
- Comet tail reverberation from small echogenic foci in GB wall*
- High specificity: 85-90% or greater *,**

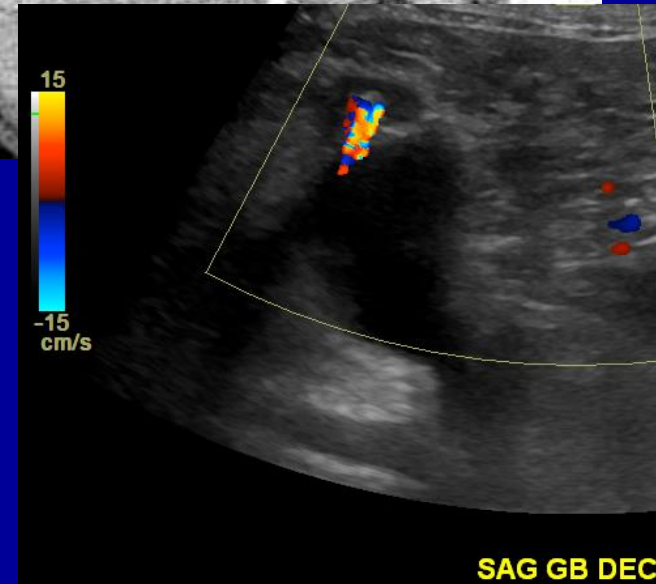
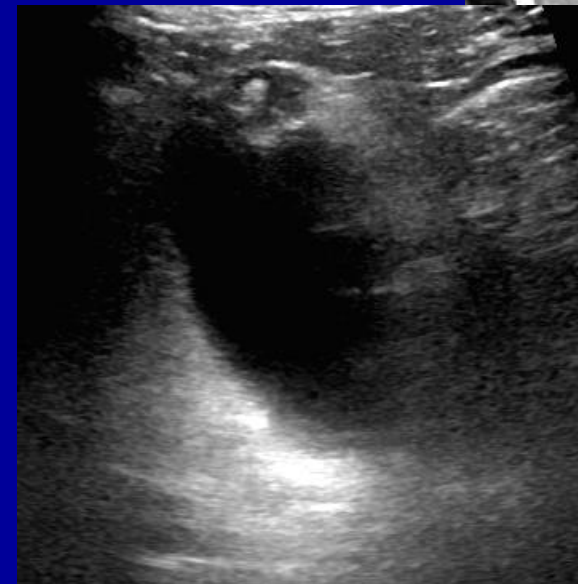
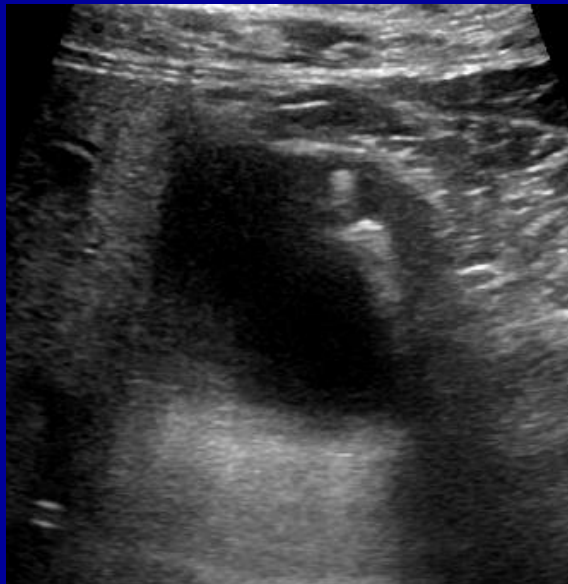
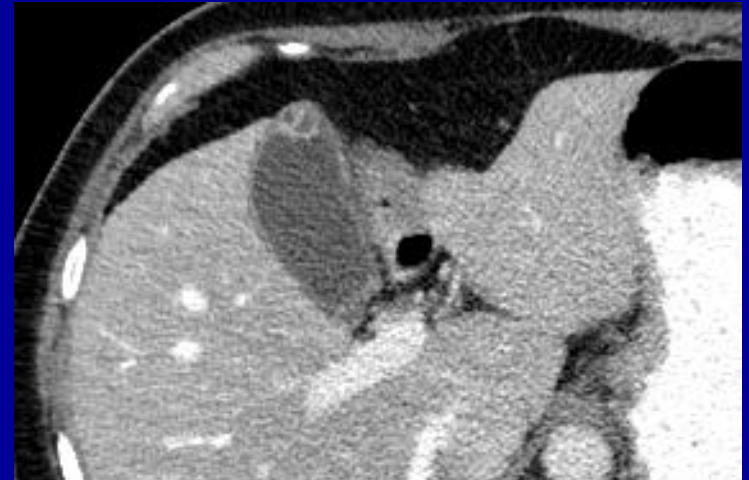
*Bang et al Korean Journal Radiology 2014

**Joo et al Eur J Rad 2013



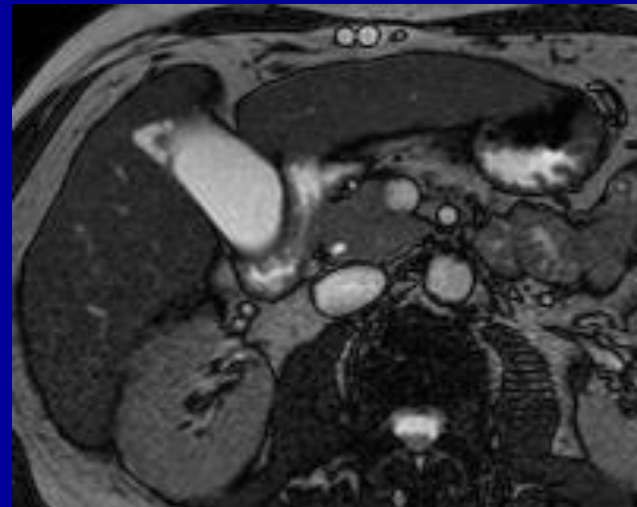
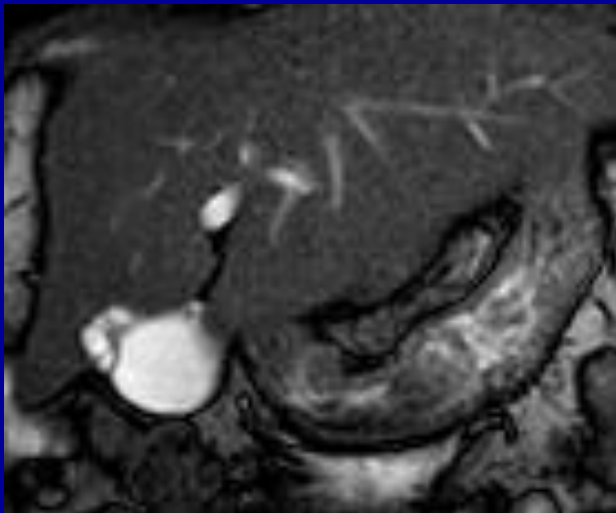
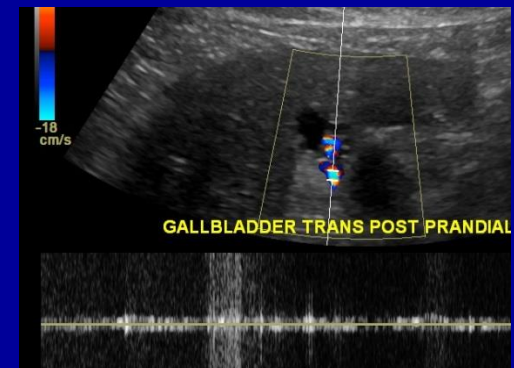
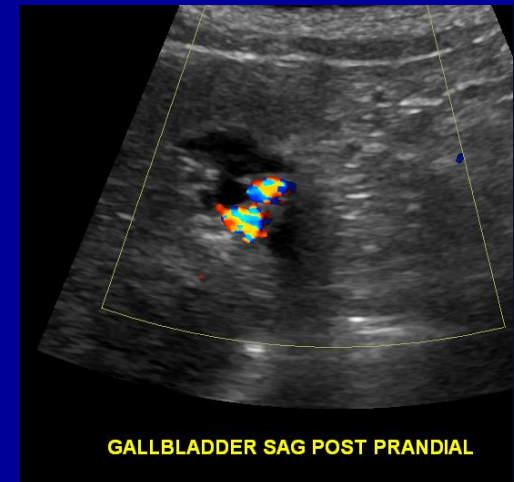
ADENOMYOMATOSIS: CT IMAGING FINDINGS

- Enhancing soft tissue mass
- Confirm by typical US findings

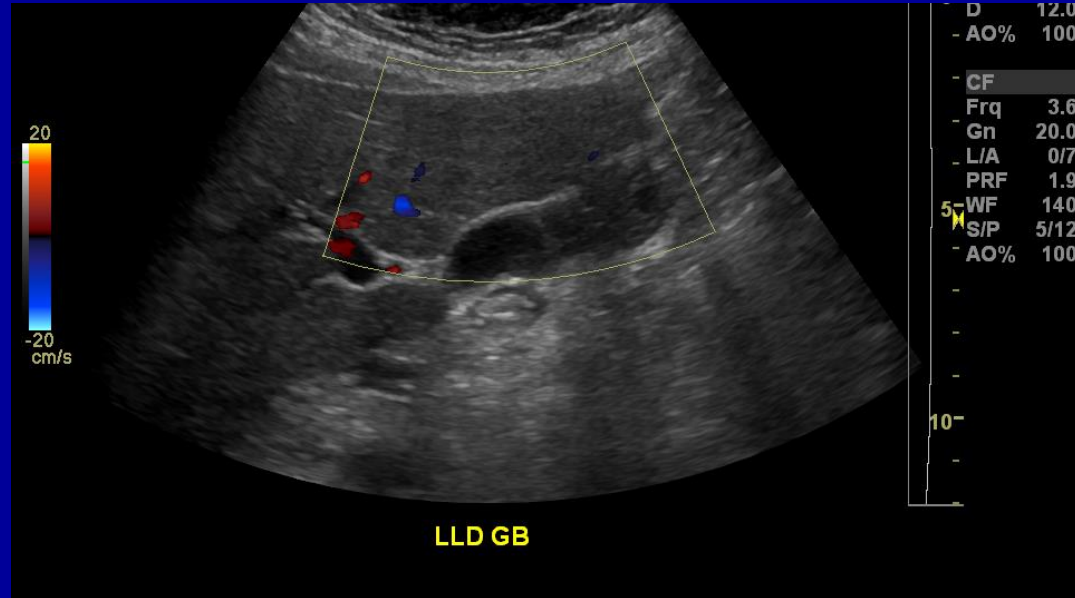
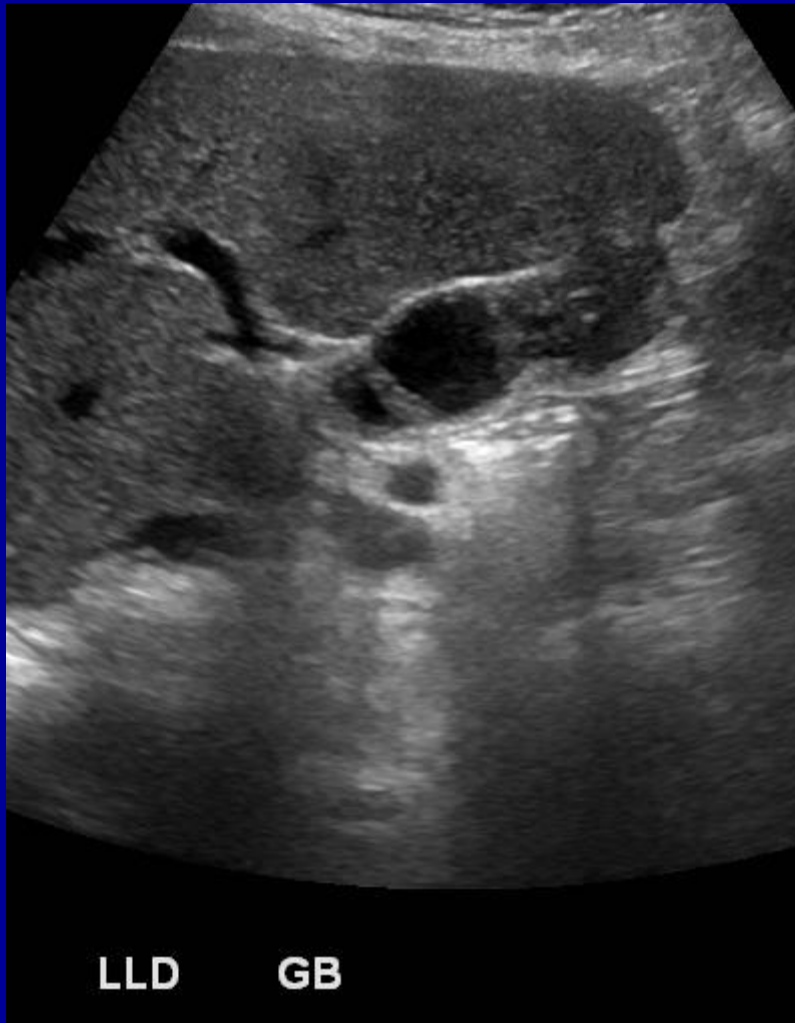


ADENOMYOMATOSIS: IMAGING FINDINGS

- US- Anechoic intramural diverticula
 - Comet tails, twinkle, spectral noise in solid component
- MR
 - High signal Rokitansky-Aschoff sinuses on T2WI
 - “String of Pearls”

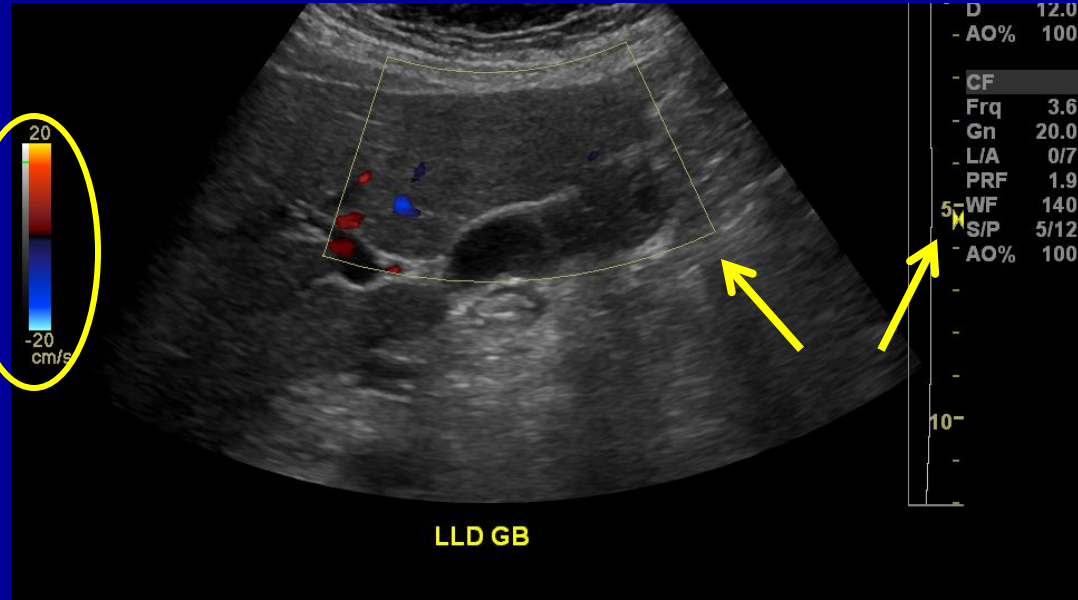
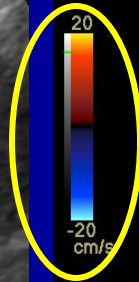
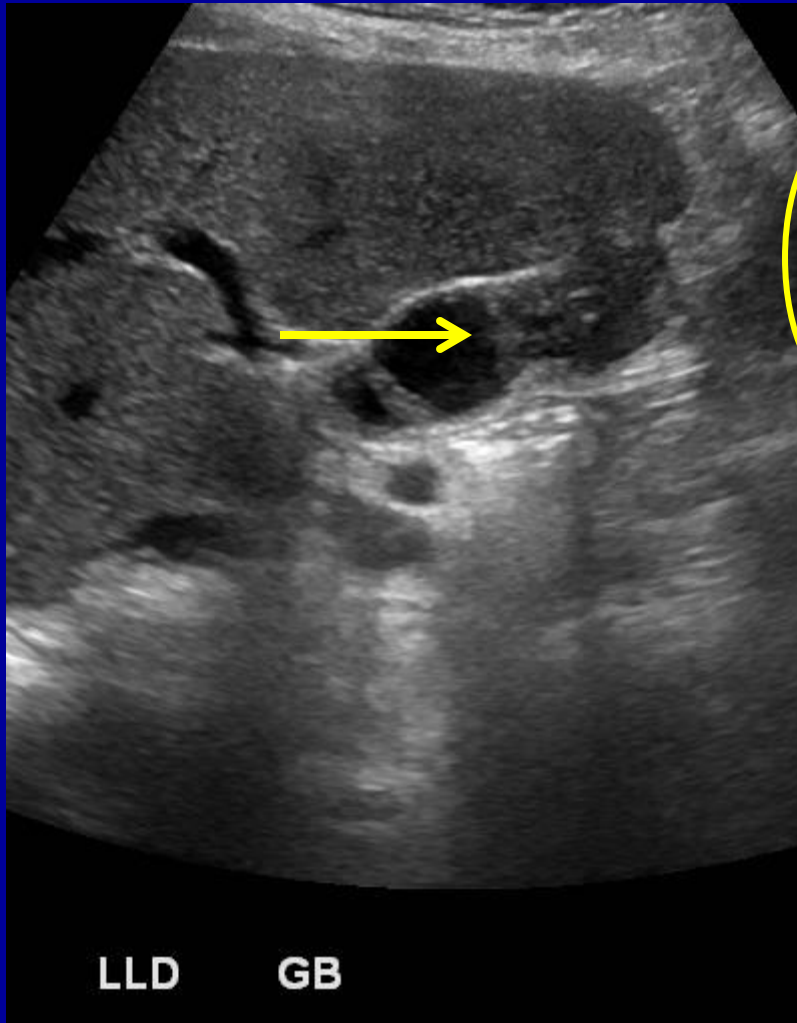


67 yo F, rising LFTs

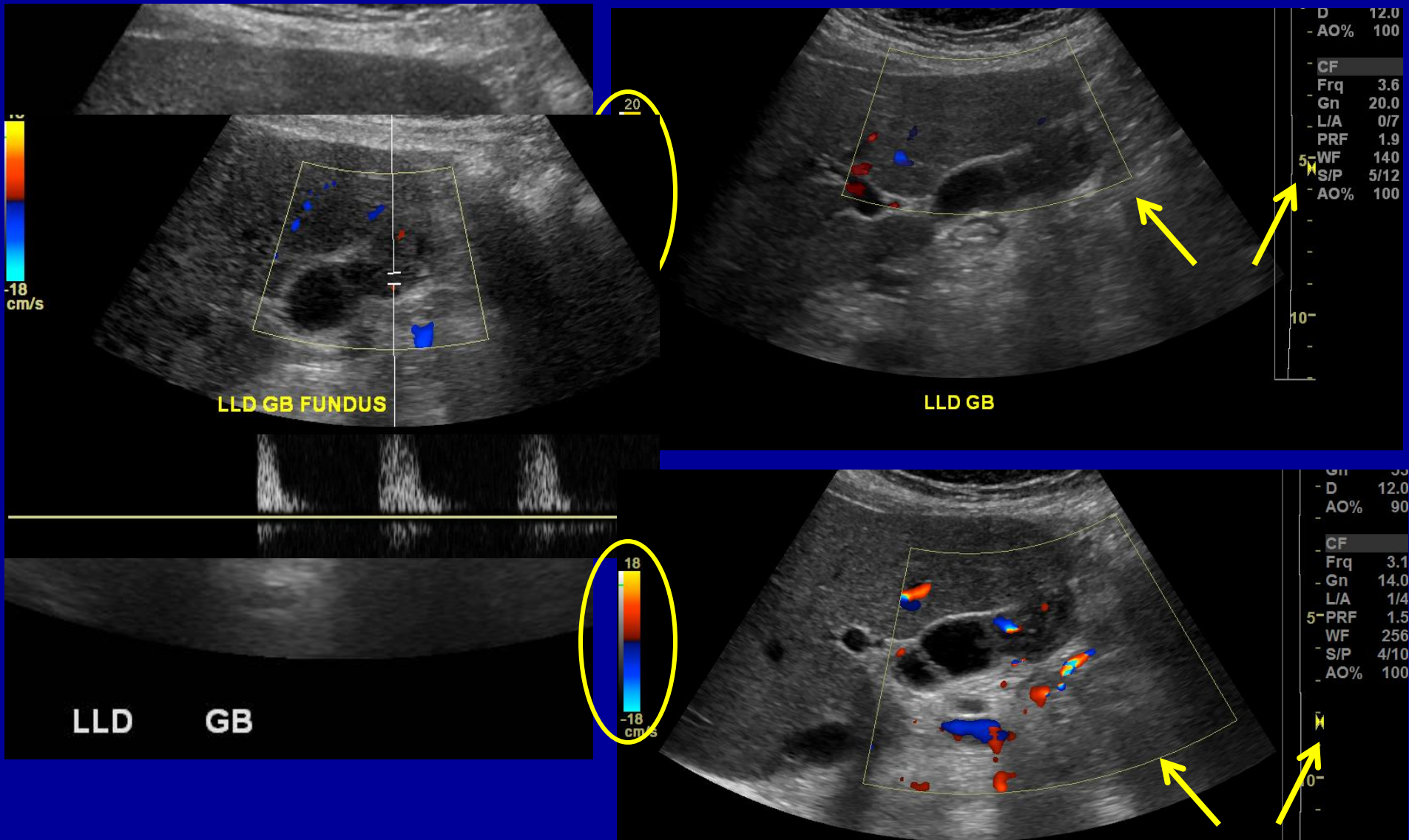


Interpreted as sludge
Do you agree?
What are the
technical errors?

67 yo F, rising LFTs

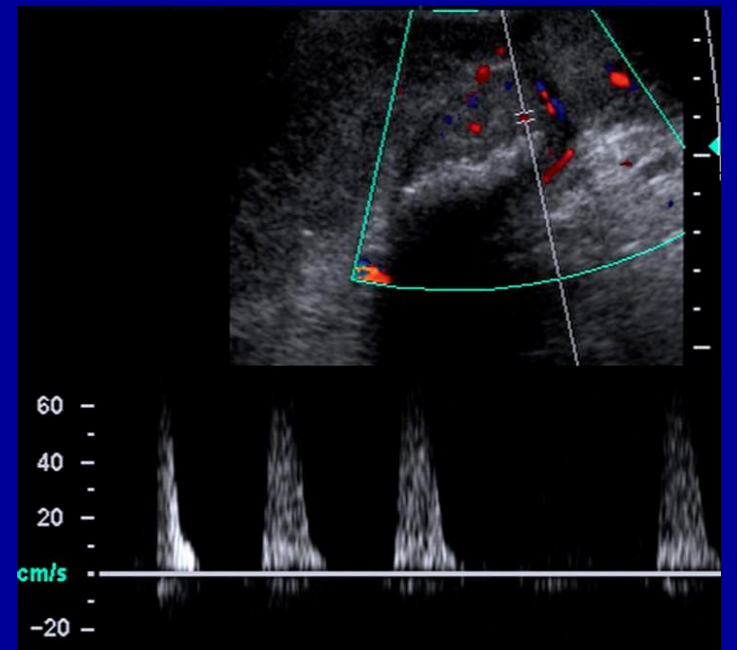
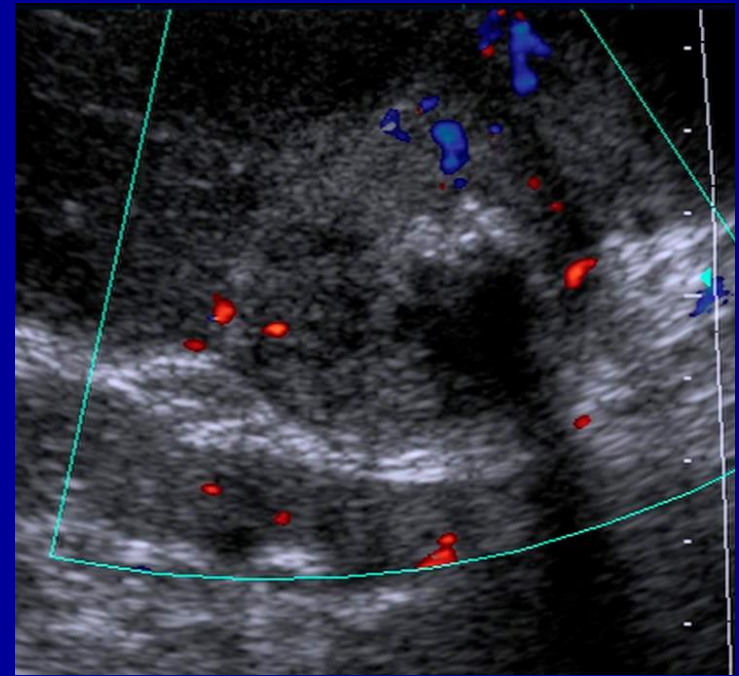


67 yo F, rising LFTs



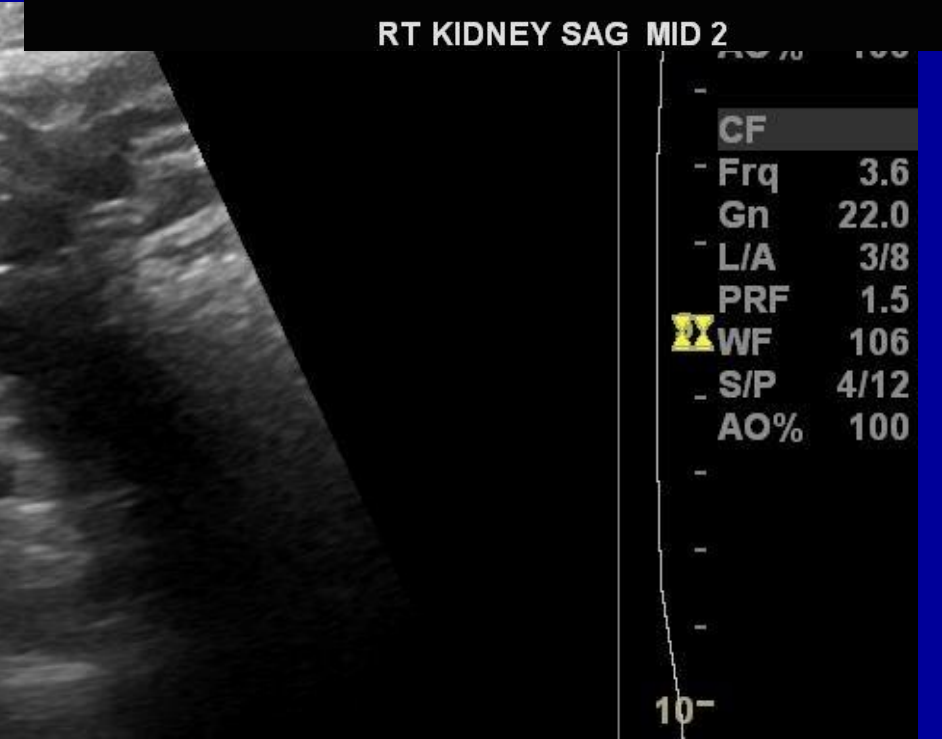
GALLBLADDER CARCINOMA

- Major risk factor: chronic cholecystitis causing dysplasia and then CIS
- Associated gallstones
- Most common presentation is a mass replacing the gallbladder
- Mass contains color Doppler signal with arterial spectral waveform.



Proving Solid Masses

- Maintain high index of suspicion
- Spectral Doppler confirmed flow essential
- Absent flow
 - Improper Doppler settings/technique, be sure to optimize
 - Necrotic lesion
- Image with another modality or use US contrast if available (off label)

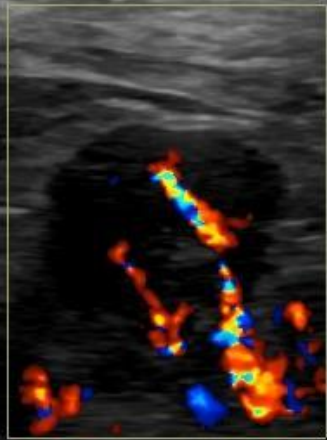


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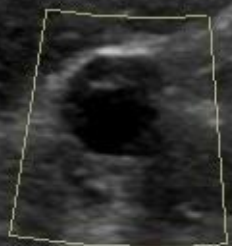
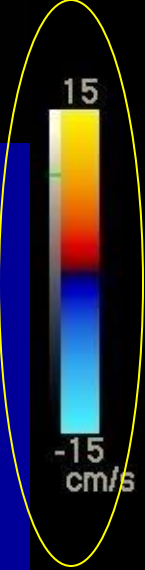
-15
cm/s

E9



- Frq	9.0
- Gn	43
- D	6.0
- AO%	100
- CF	
2- Frq	4.2
- Gn	18.0
- L/A	2/6
- PRF	0.6
- WF	87
Δ S/P	2/16
- AO%	100

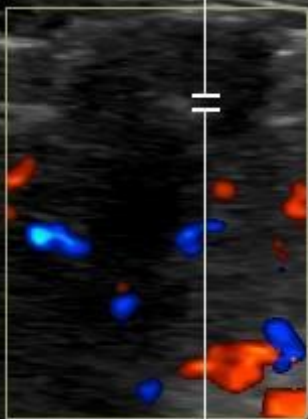
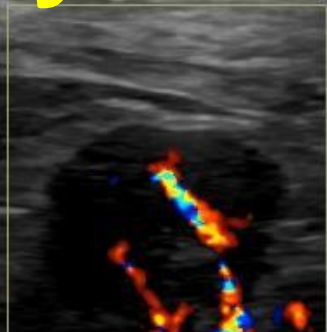
4-



- Frq	3.6
- Gn	22.0
- L/A	3/8
- PRF	1.5
Δ WF	106
- S/P	4/12
- AO%	100

10-

DX: Cystic RCC



RT KIDNEY SAG MID 2

- Frq	9.0
- Gn	43
- D	6.0
- AO%	100

CF	
2- Frq	4.2
- Gn	18.0
- L/A	2/6
- PRF	0.6
- WF	87
S/P	2/16
- AO%	100

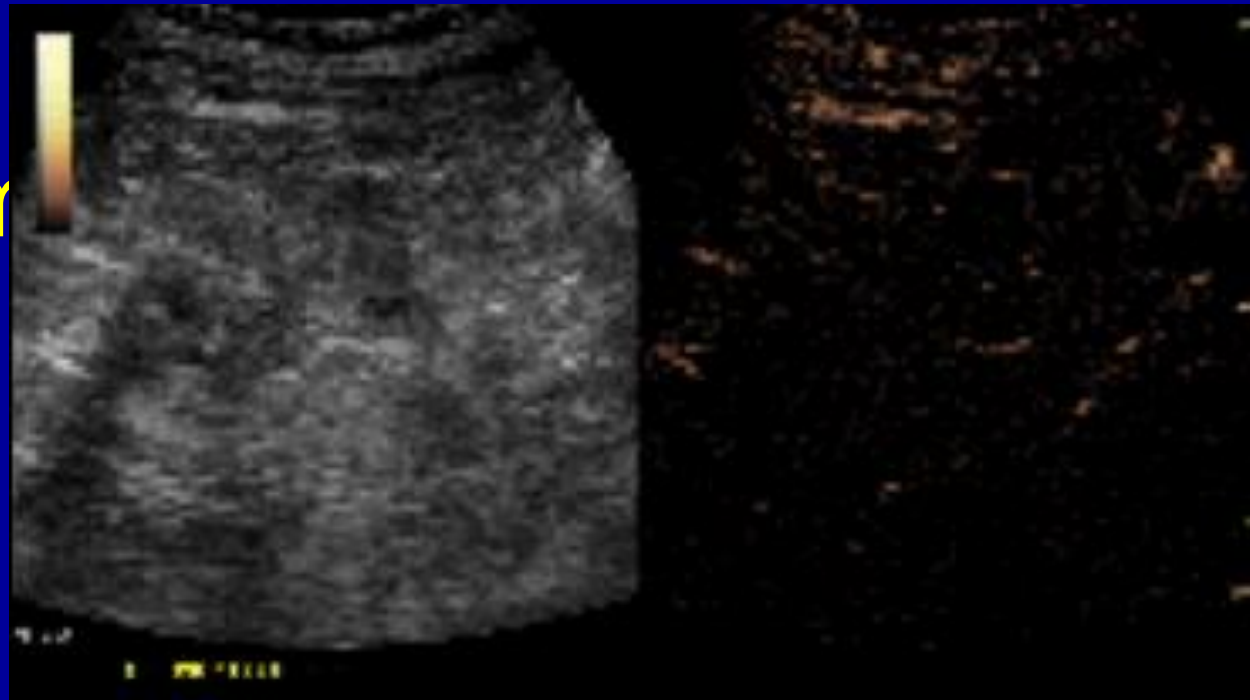
CF	
- Frq	3.6
- Gn	22.0
- L/A	3/8
- PRF	1.5
WF	106
- S/P	4/12
- AO%	100

Renal Masses- Imaging Role

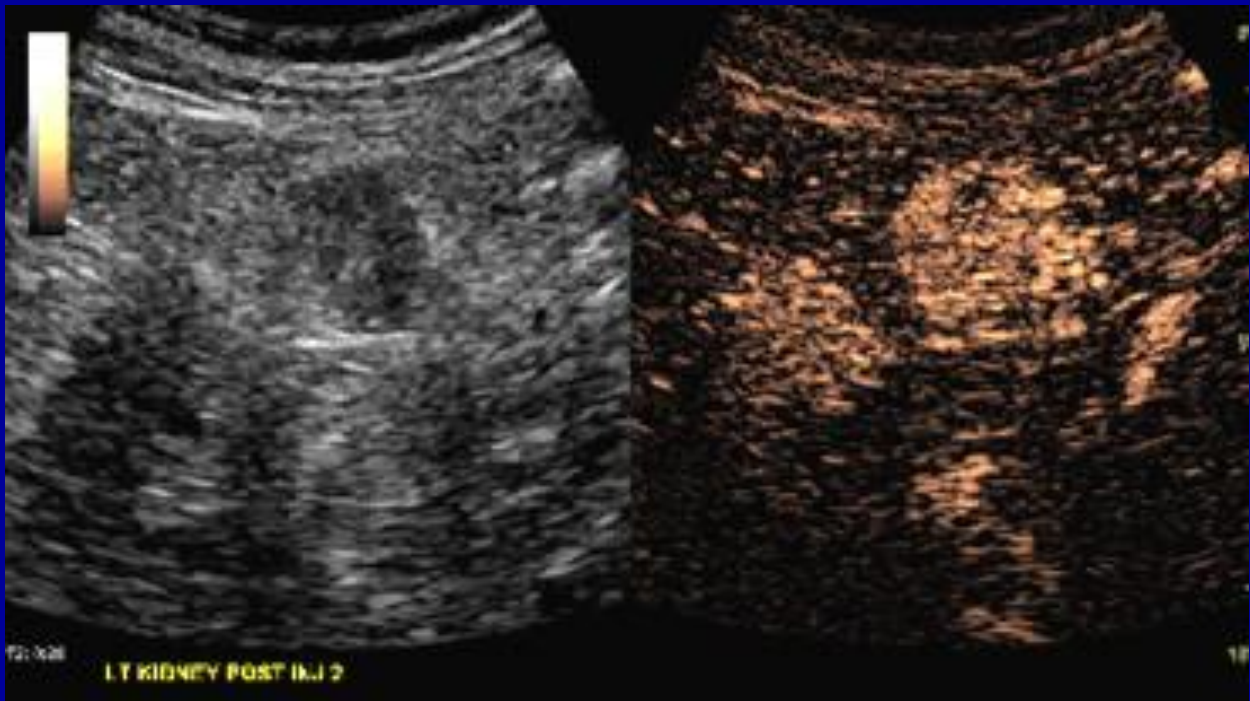
- Incidental detection
 - Over 50% RCC incidentally detected*
- Characterization (many masses not RCC)
 - Fluid attenuation, fat, vascularity, inflammation
 - Image guided biopsy of small (<3cm) masses
- Surgical planning/Staging
 - Local extent, distant disease
- Follow up (conservative, ablative rx)

91 yo M
incidental 3cm
renal mass
GFR 18

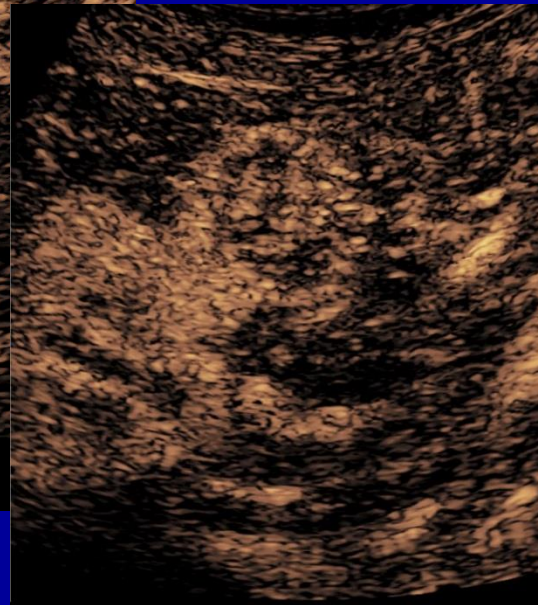
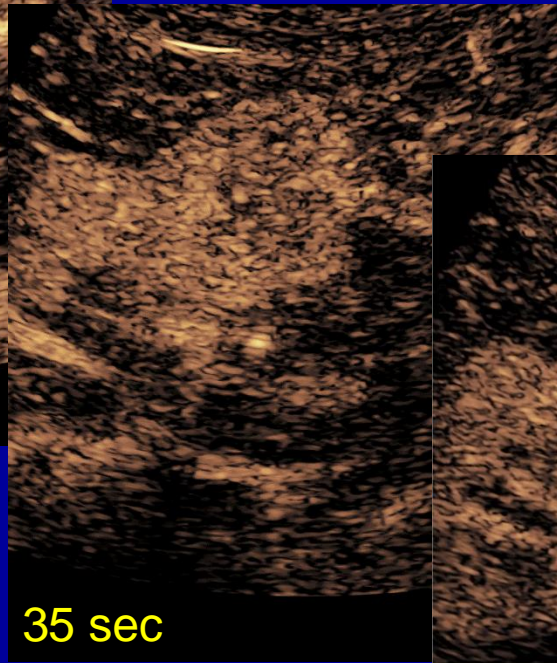
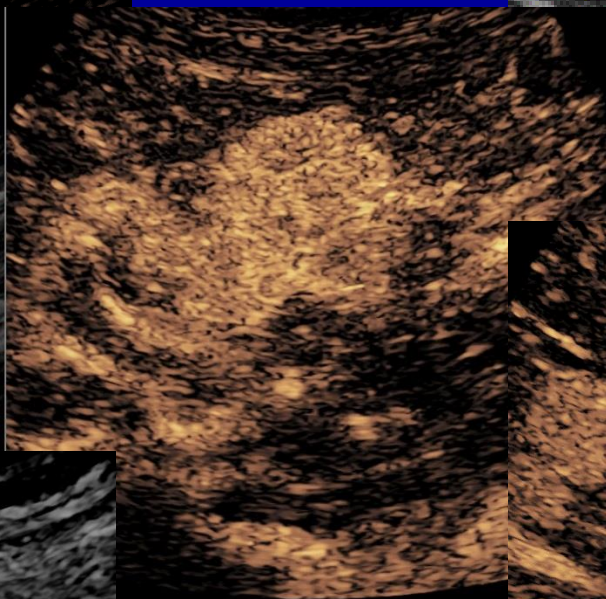
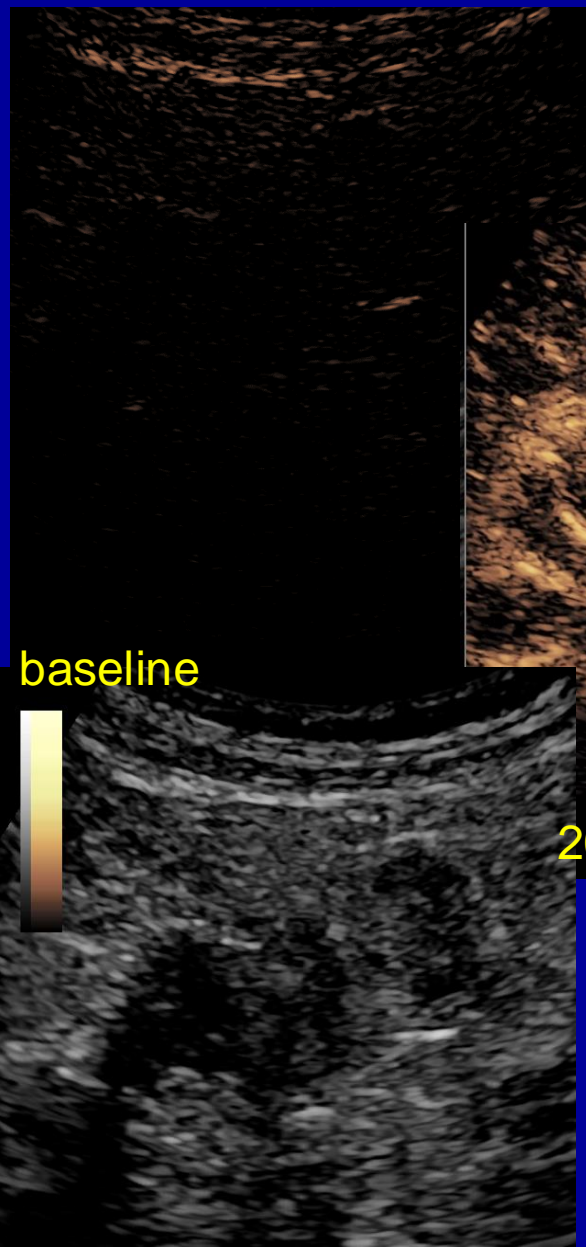
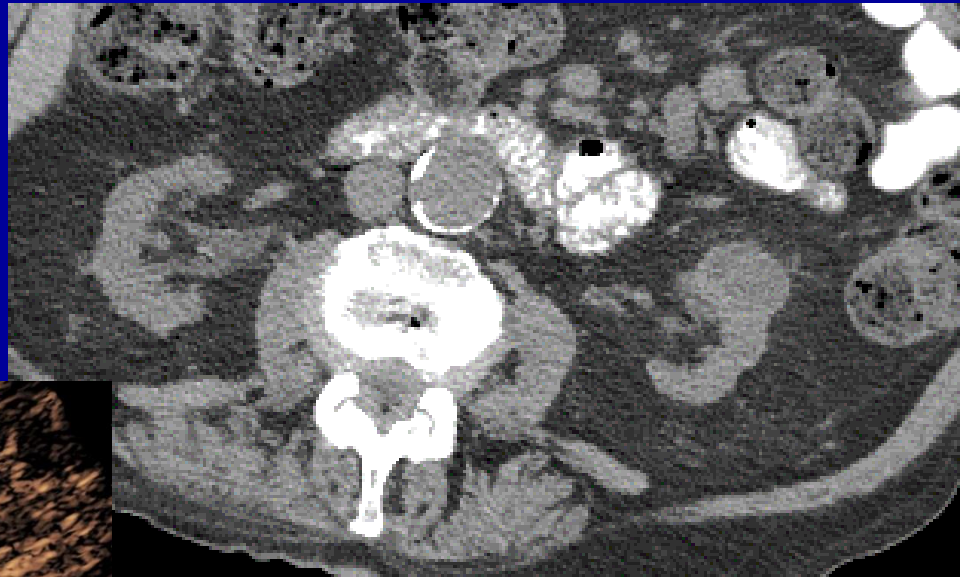
CEUS
Wash In
0-30sec



CEUS
Wash Out
30-60sec

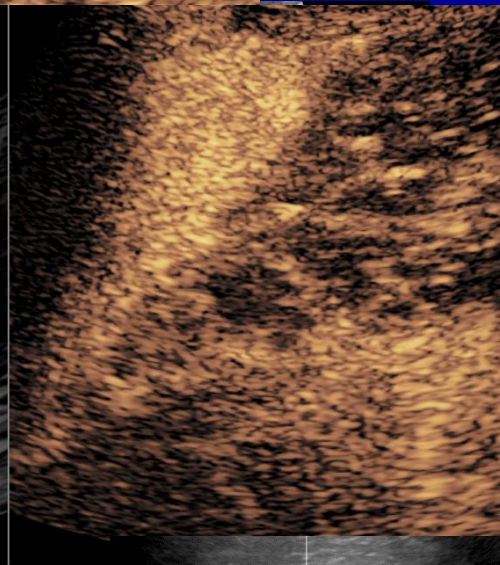
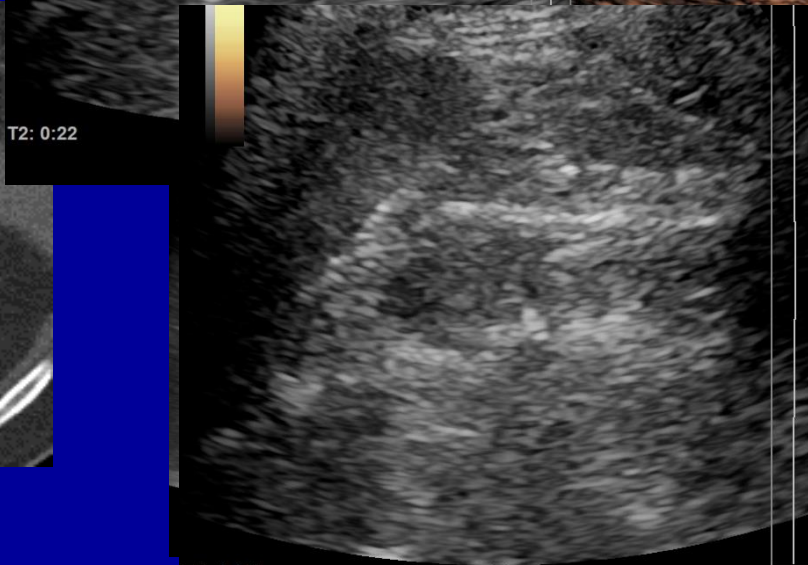
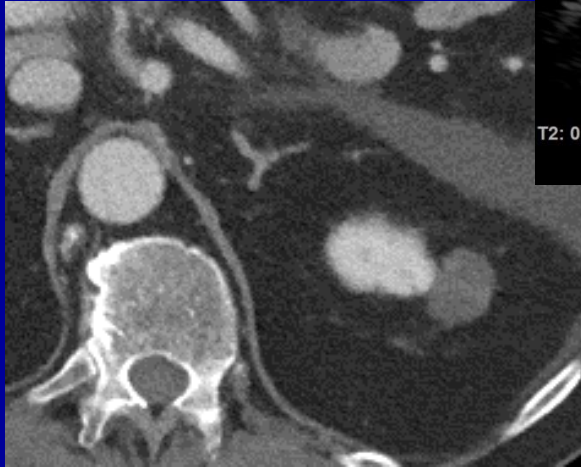
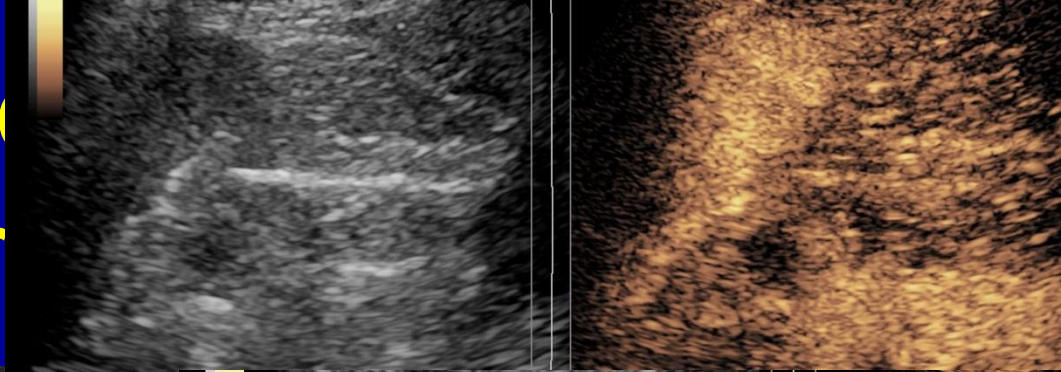


91 yo M, GFR 18

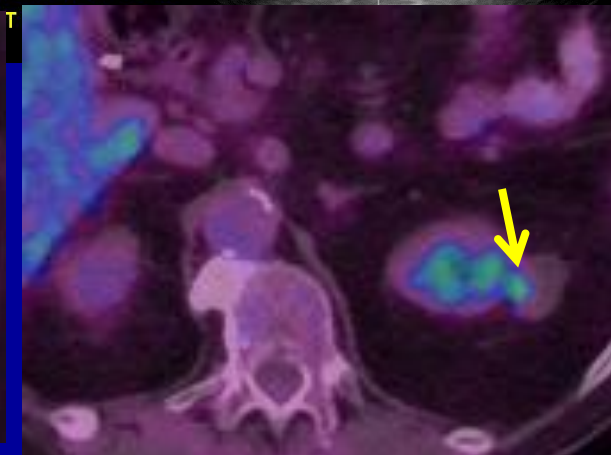
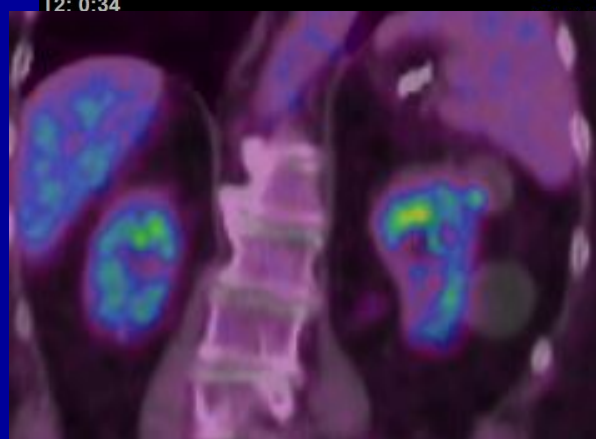
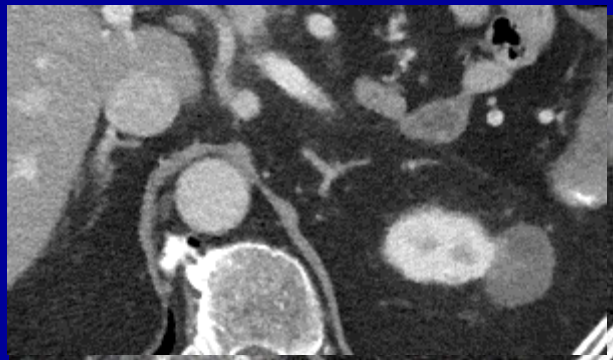


Patient elected surveillance

66 y
pancr



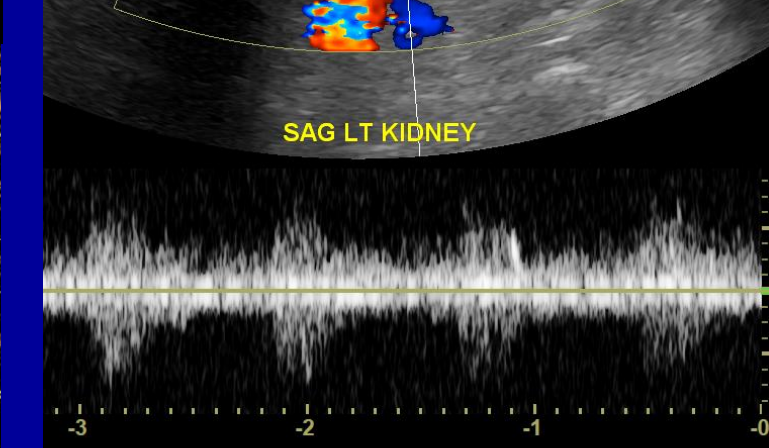
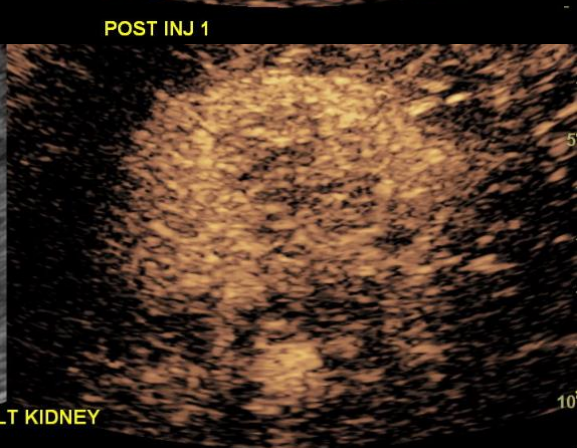
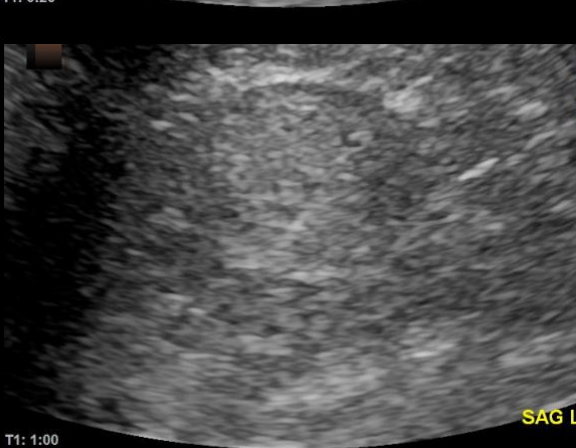
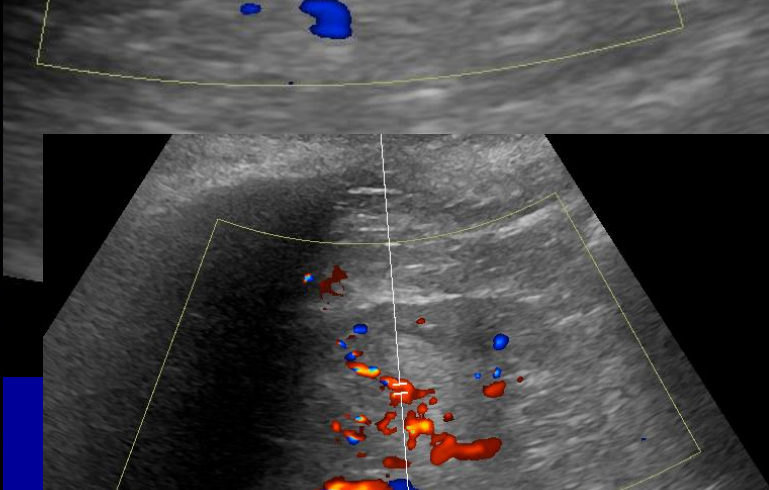
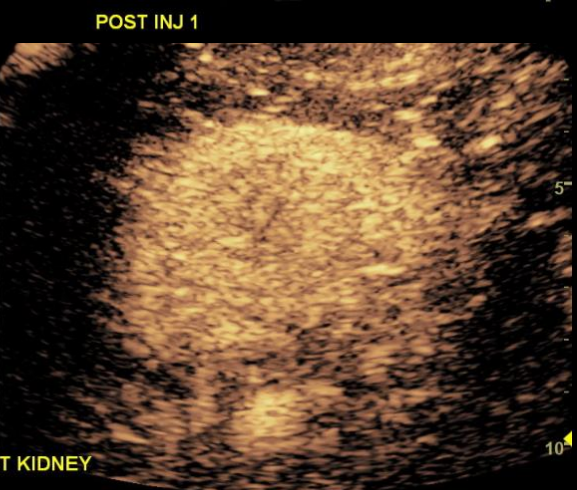
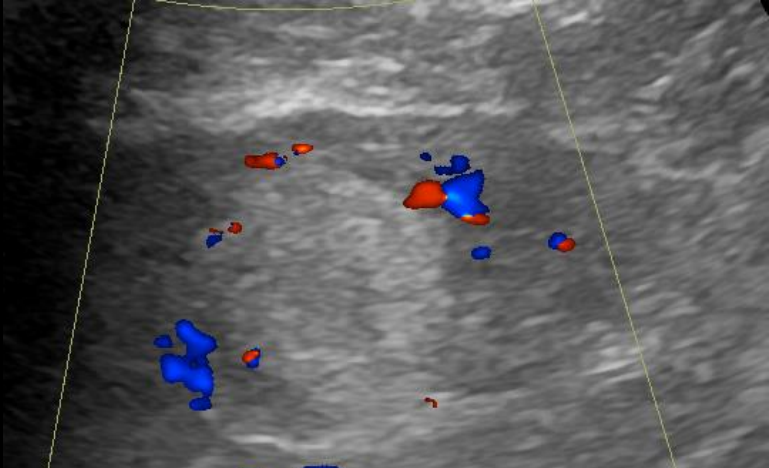
2/2018-35 HU 2.9cm



Observation elected due to
comorbidities 7/2018-3.1cm

Surveillance PET 4/2018

SAG LT KIDNEY POST INJ 2



CEUS in the Kidney

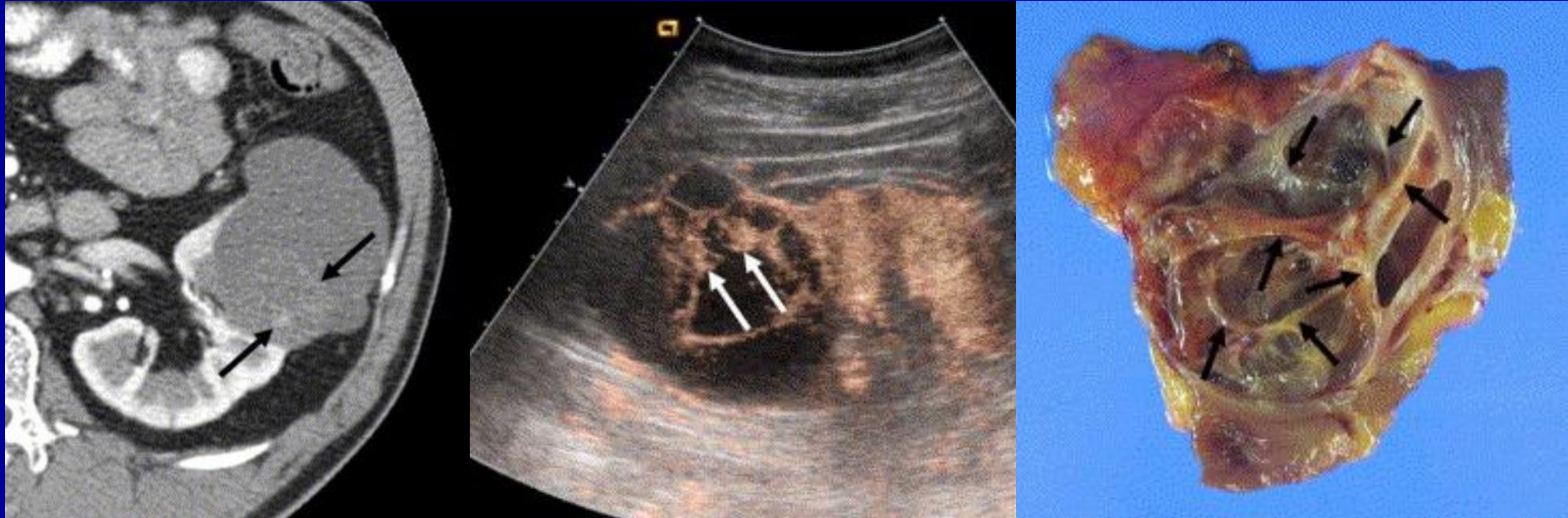
- Solid Mass characterization- equivalent to CT for Clear cell RCC, and superior for Papillary (showed minimal flow better than CT) (1)
- Bosniak II lesions seen with CEUS (31 patients, accuracy 74% by CT, 90% by US, US tended to upstage lesions (thicker septae)- (2)
- Advantage in patients with renal impairment, not MR compatible

(1) Tamai H, Takiguchi Y, Oka M, et al. *Contrast-enhanced ultrasonography in the diagnosis of solid renal tumors. J Ultrasound Med* 2005;24(12):1635–1640

(2) Park BK, Kim B, Kim SH, Ko K, Lee HM, Choi HY. *Assessment of cystic renal masses based on Bosniak classification: comparison of CT and contrast-enhanced US. Eur J Radiol* 2007;61(2):310–314.

Wilson SR, Burns PN **Microbubble-enhanced US in Body Imaging: What Role?** *Radiology* 2010, 257, 24-39.

Number of Septae US > CT



Park BK, Kim B, Kim SH, Ko K, Lee HM, Choi HY. *Assessment of cystic renal masses based on Bosniak classification: comparison of CT and contrast-enhanced US.* *Eur J Radiol* 2007;61(2):310–314.

Active Surveillance Renal Cysts

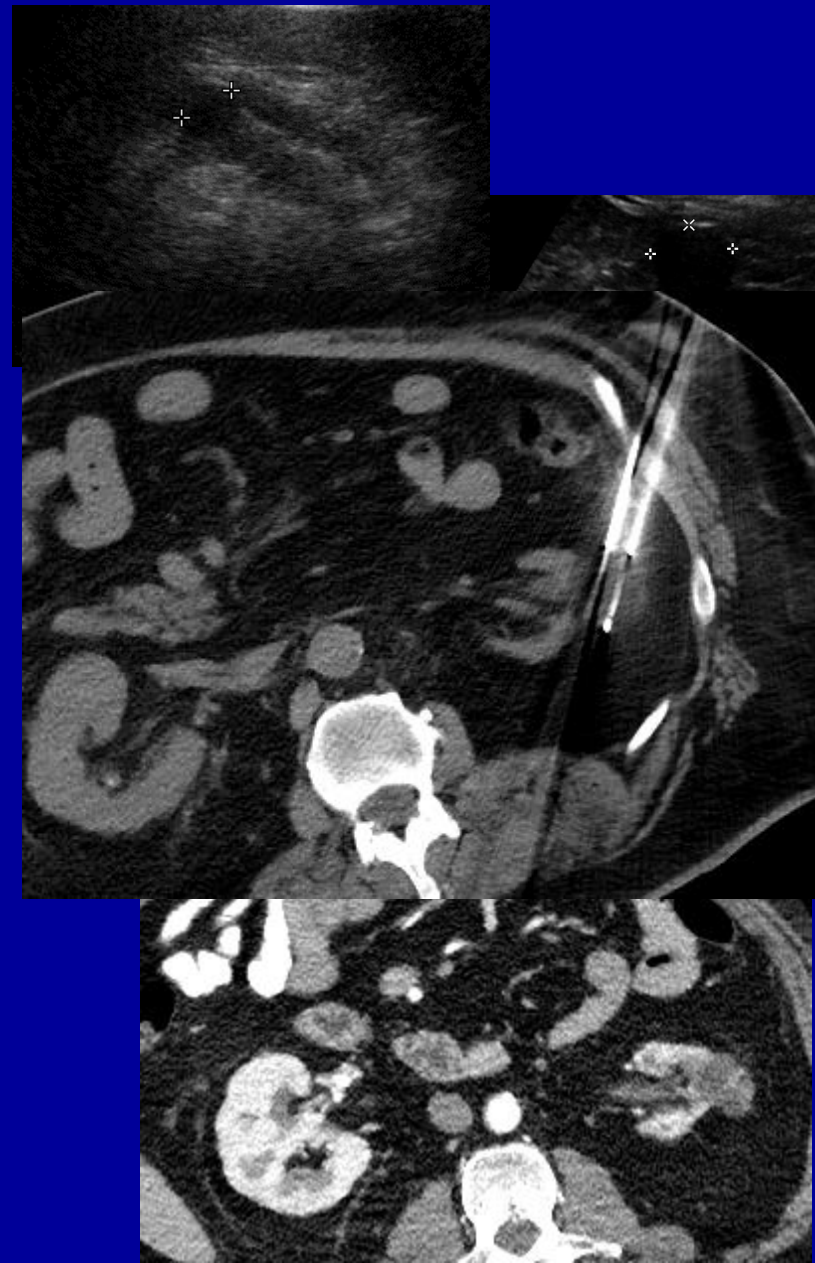
- Surgical excision results in overtreatment in 50% of patients with Bosniak III cysts *.
- Slower progression than solid RCC
- Safe to watch if more than 50% cystic**
- Observe for growth in solid components (solid greater than 50%)
- Intervene depending on comorbidities

*Chandrasekar, T., Ahmad, A.E., Fadaak, K. et al. Natural history of complex renal cysts: clinical evidence supporting active surveillance. J Urol. 2018;

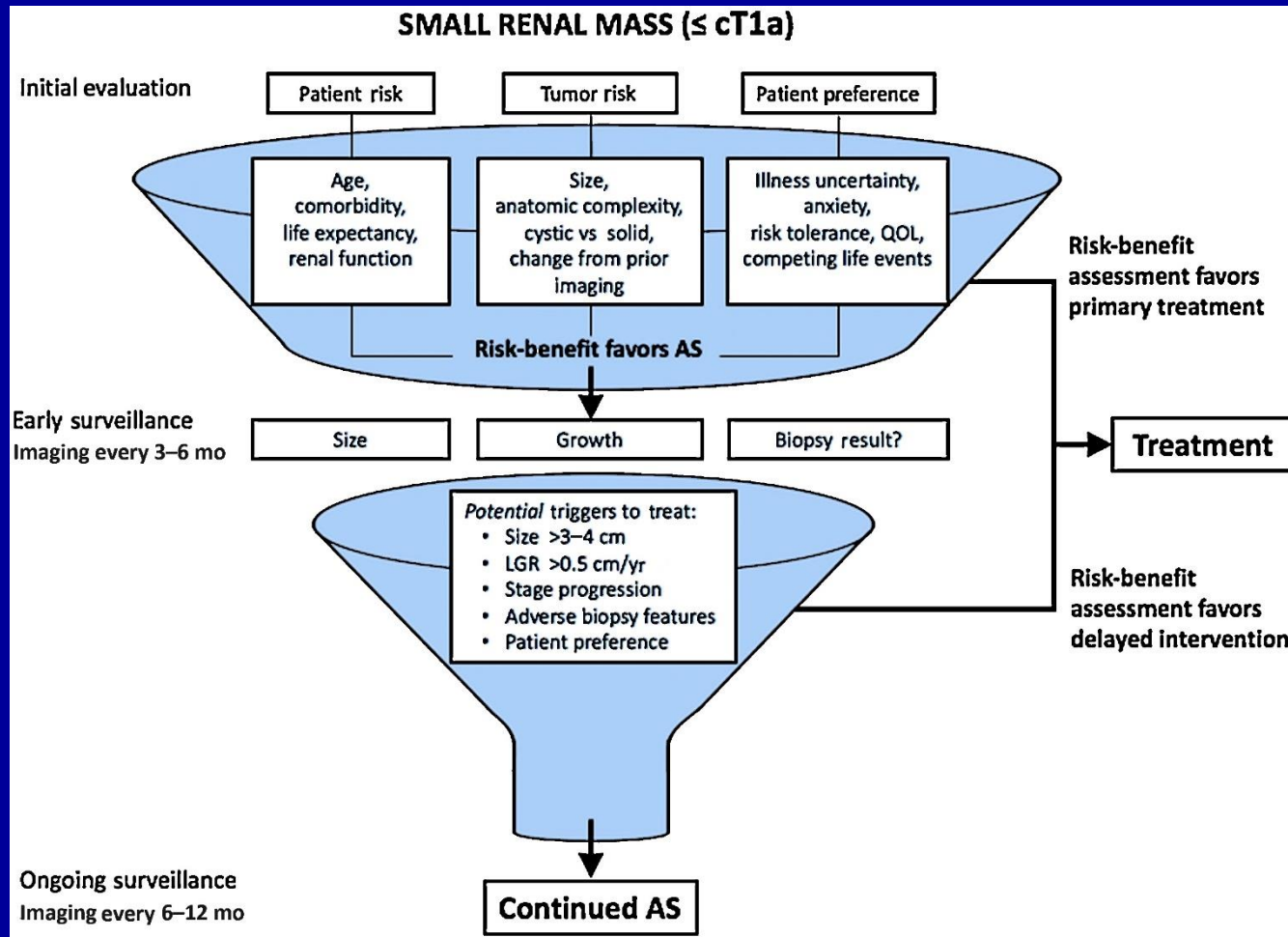
**Kashan M, Ghanaat M, Hotker am et al. Cystic Renal Cell Carcinoma: A Report on Outcomes of Surgery and Active Surveillance in Patients Retrospectively Identified on Pretreatment Imaging. J Urol 2018 Aug;200(2):275-282

62 yo M

- 1.6 cm cyst in 2009, 3cm in 2010, simple
- 2017-2.9cm but now has enhancing septa, enhances 25HU
- Patient has MS, left renal fx only 19%
- Biopsy proven RCC
- CT guided cryoablation elected



Active Surveillance for Small Renal Masses: When Less is More



Small Renal Mass is ≤ 4 cm

AUA Active Surveillance Guidelines 2017

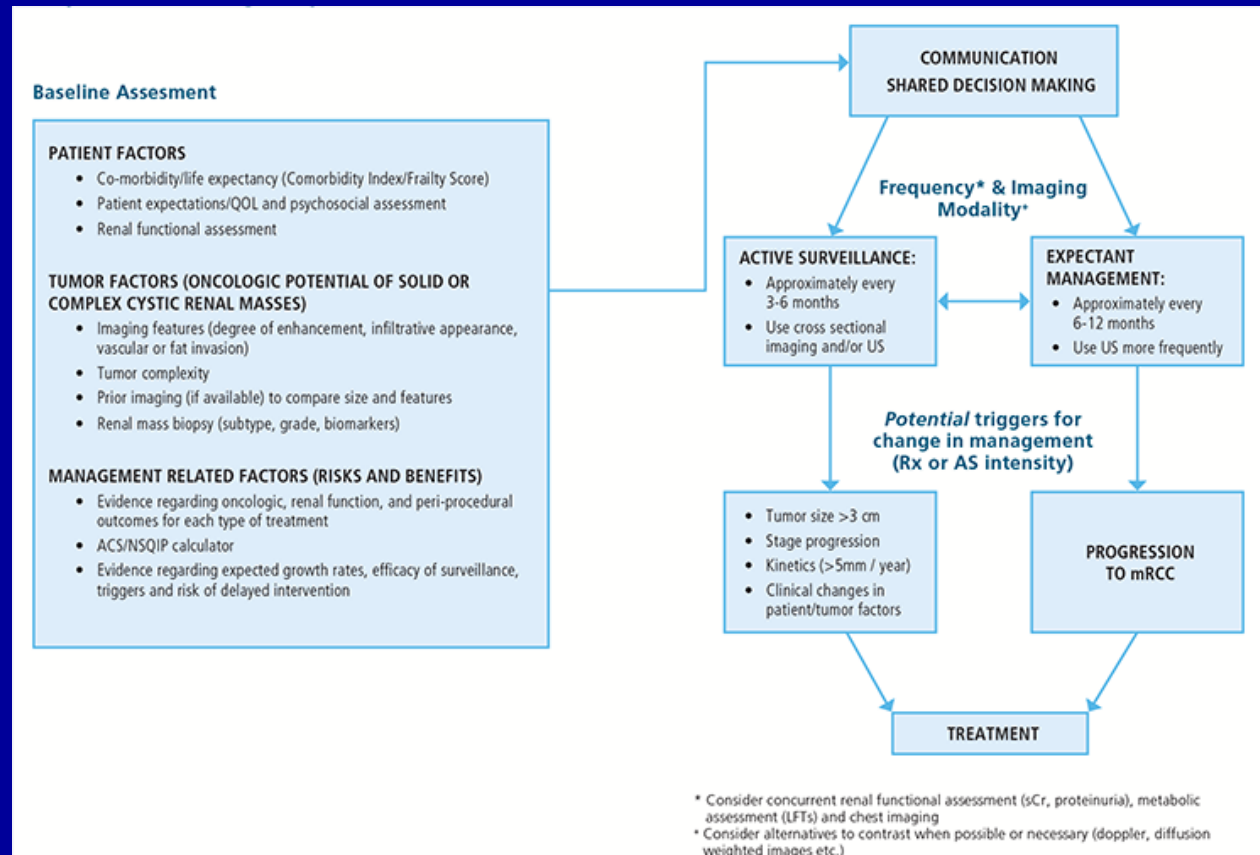


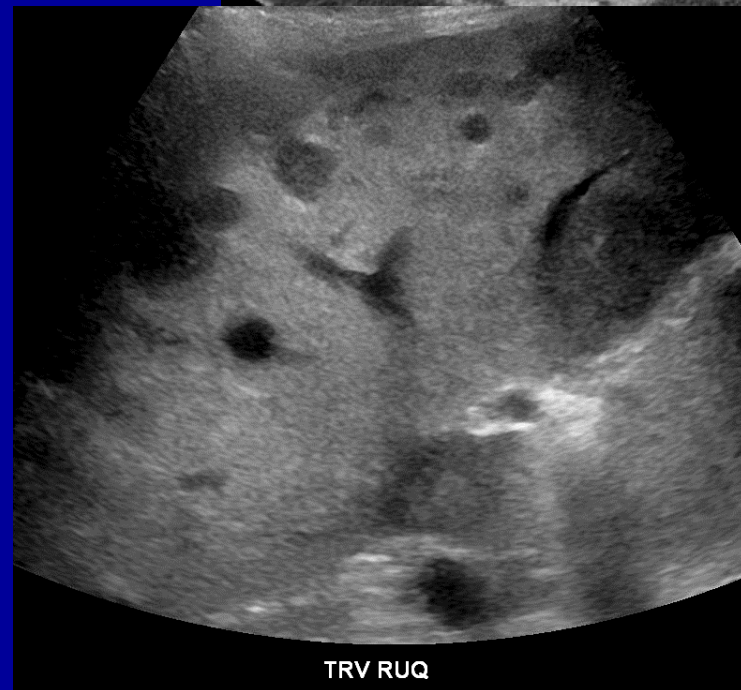
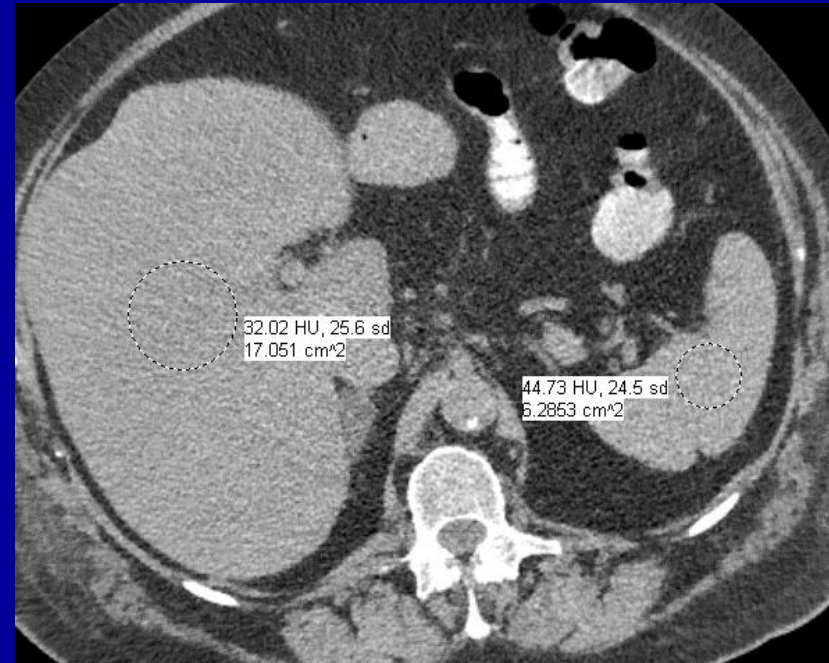
Fig 6. Algorithm for active surveillance or expectant management of localized renal masses suspicious for malignancy

61 yo F acute abdominal pain TCC Lt ureter, 3 mo p/op, low GFR

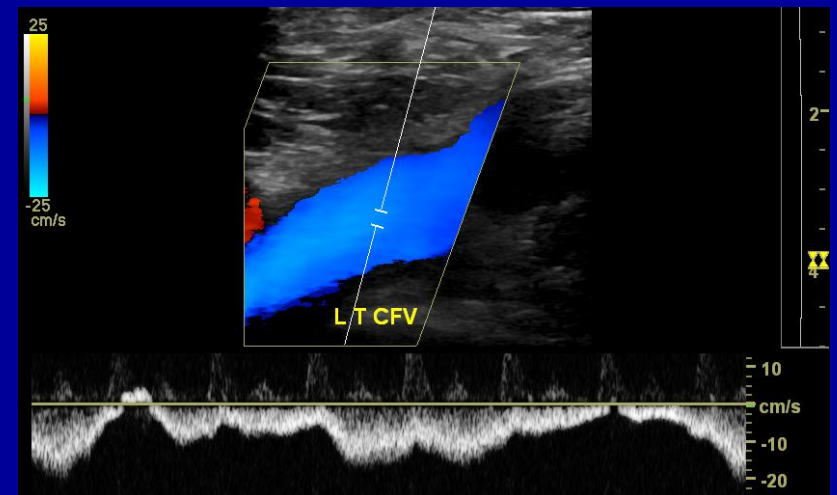
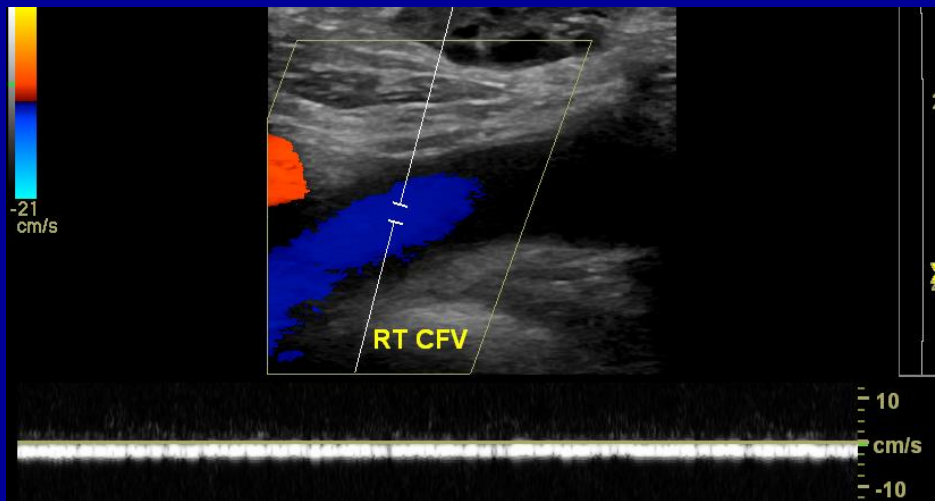
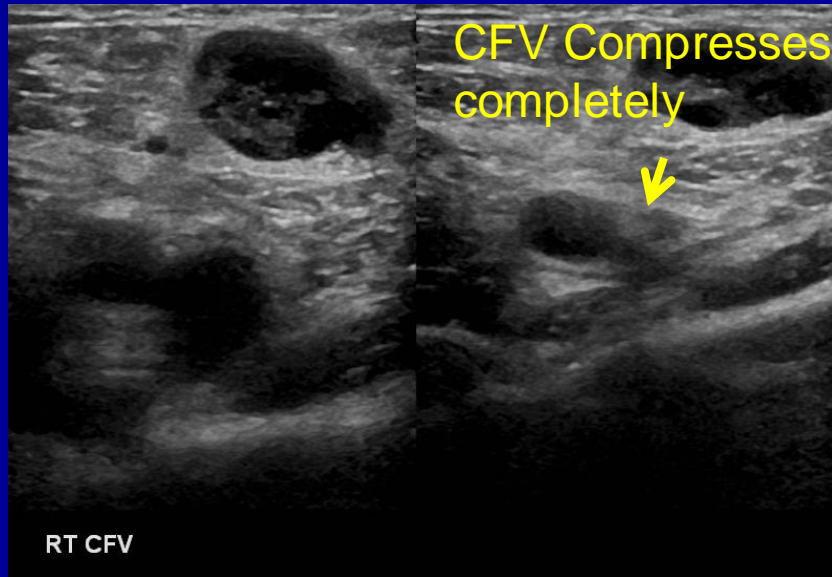
- NCCT-stable mild rt hydronephrosis, left distal recurrence
- What US study should be ordered?



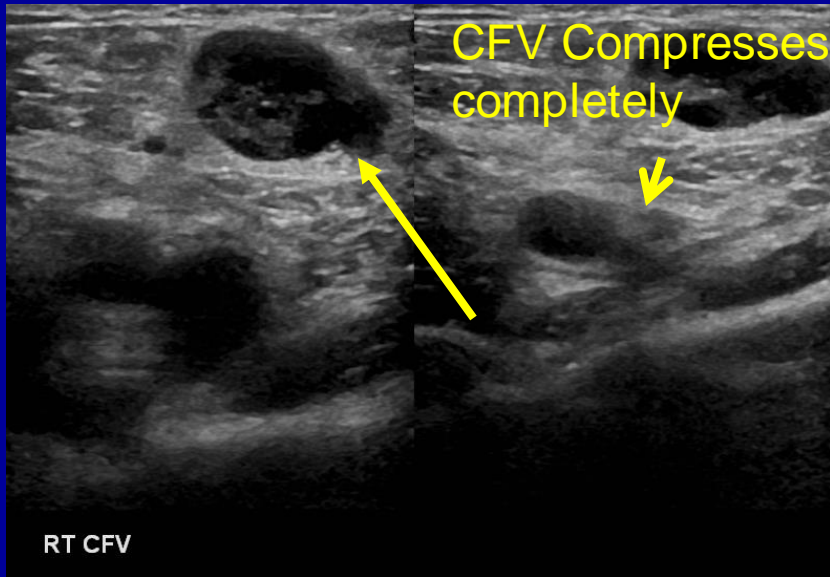
- Fatty liver on NCCT
- Lobulated contour
- Consider RUQ US for unexplained abd pain



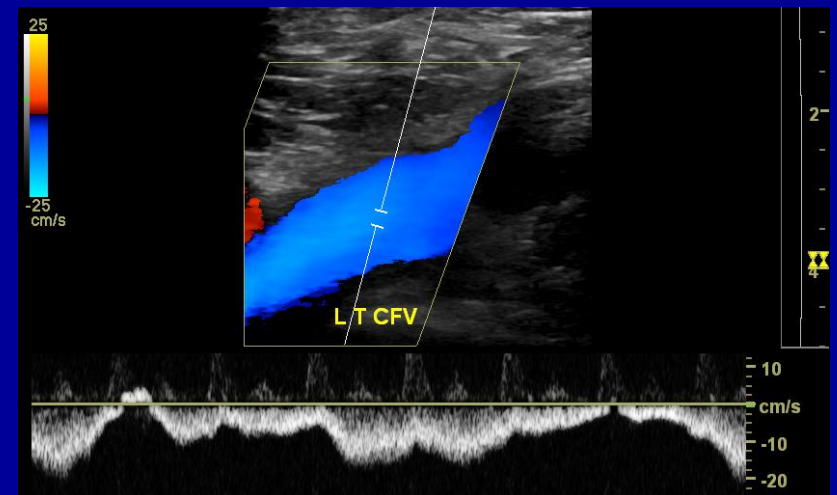
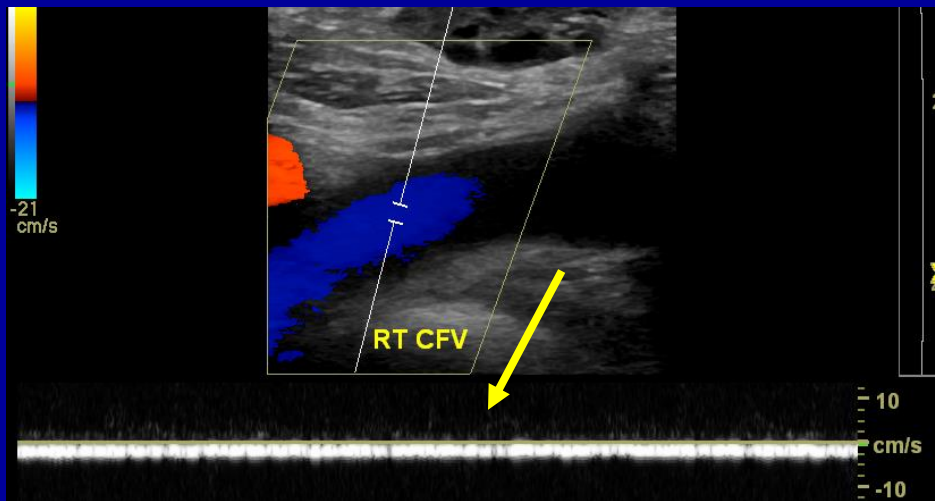
37 YO F Pain in RLE R/O DVT



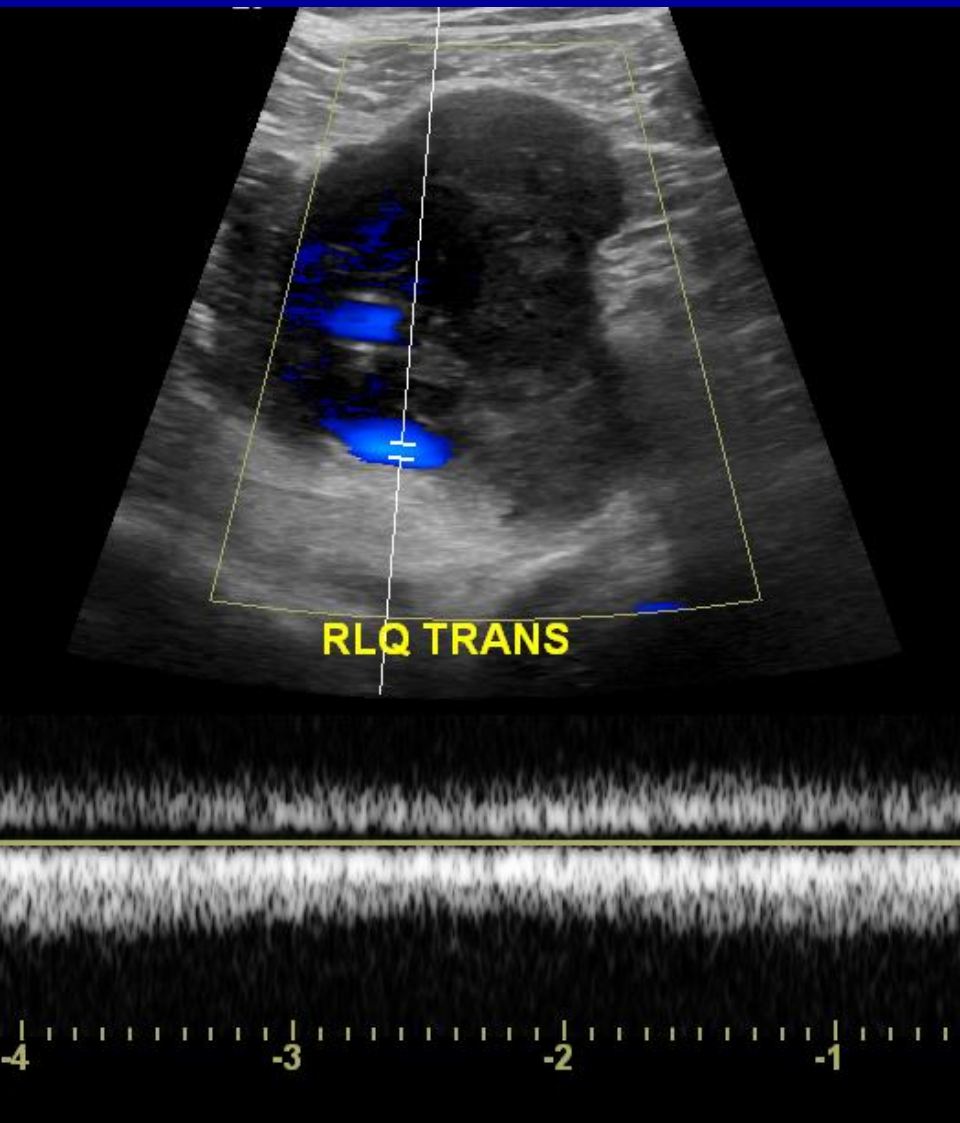
37 YO F Pain in RLE R/O DVT



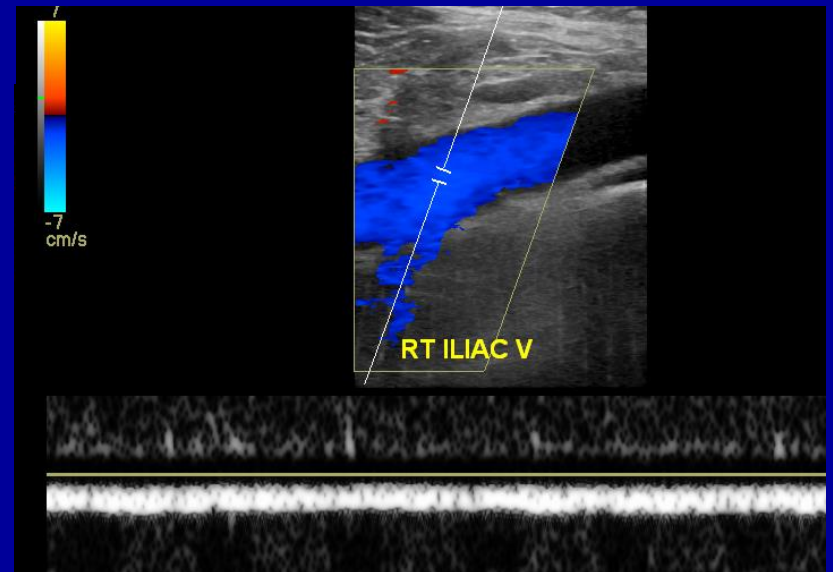
- What else do you see?



37 YO F Pain in RLE R/O DVT

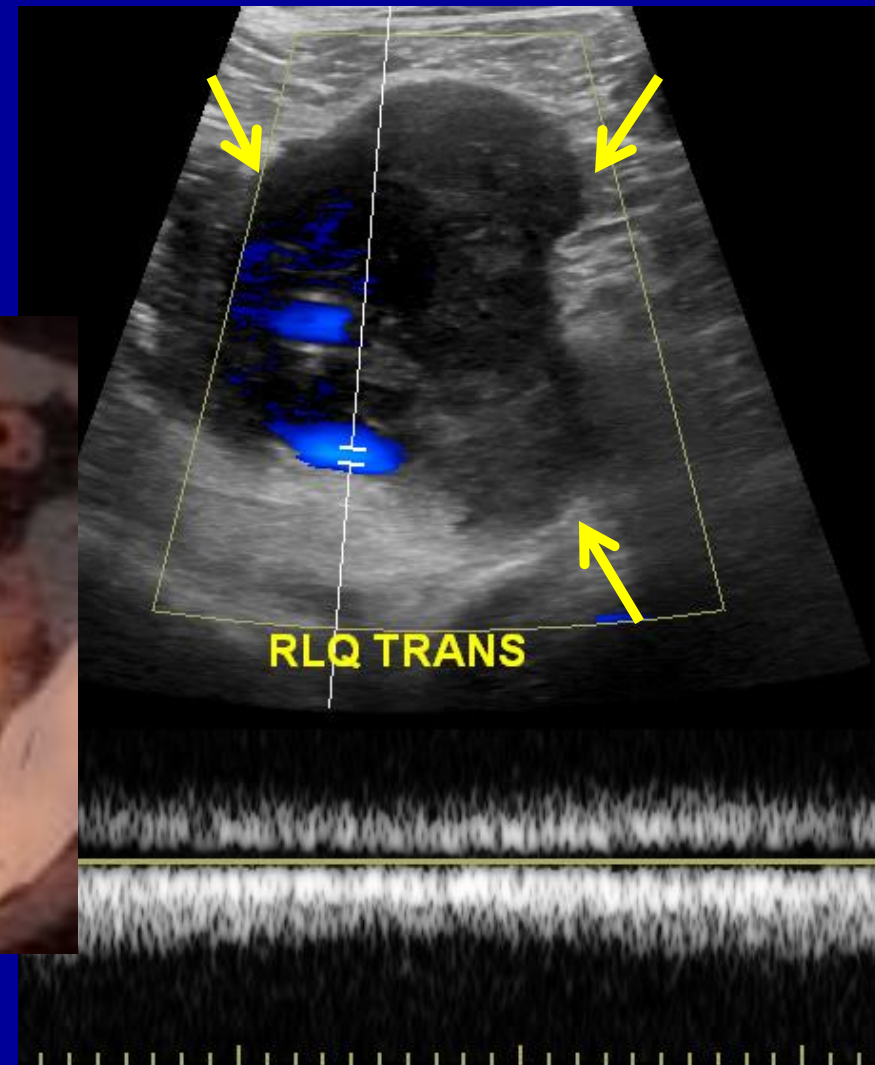
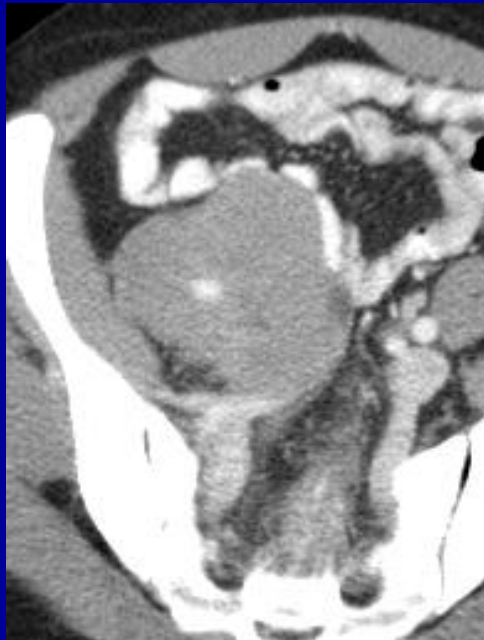


- What to do next?
- Scan superiorly



Monophasic Waveform

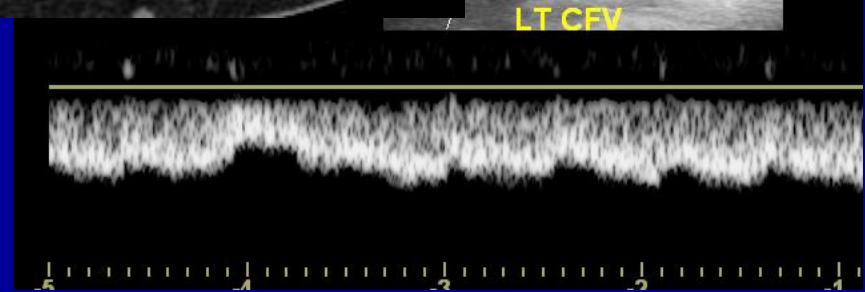
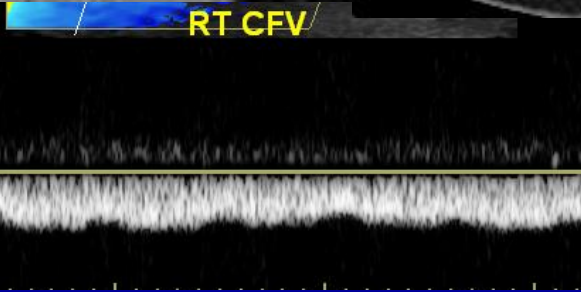
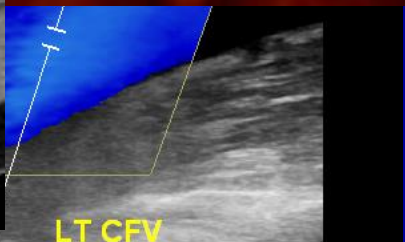
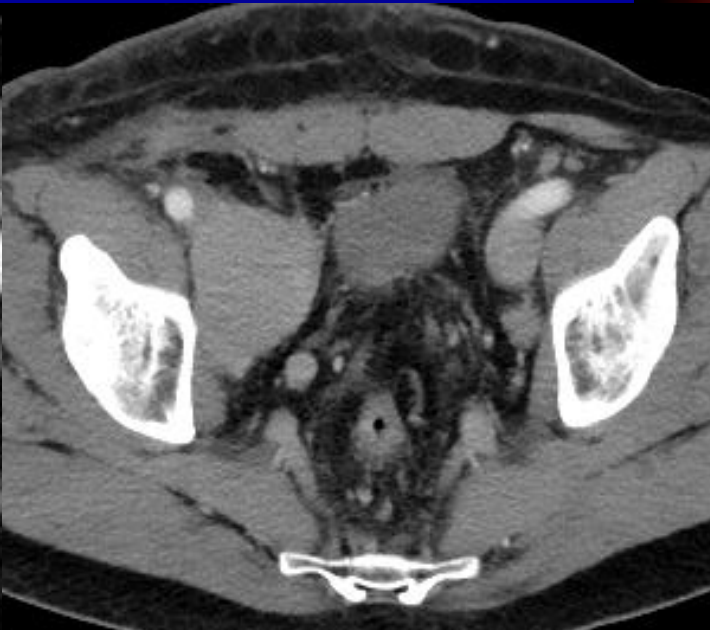
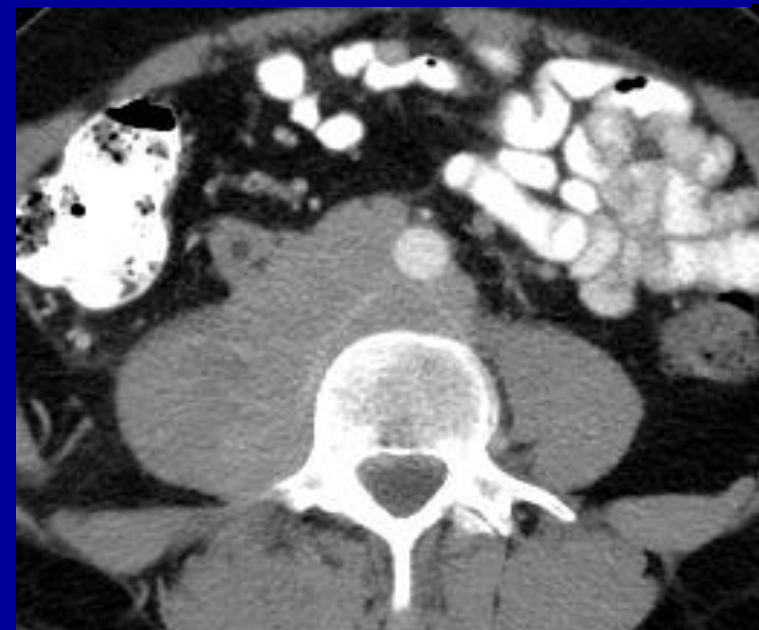
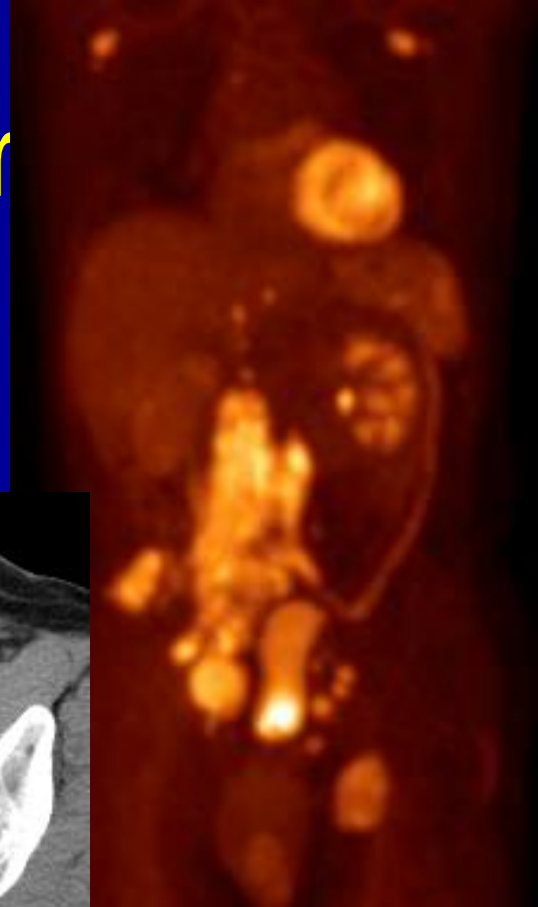
- Vessel narrowed
- Adjacent mass



Dx: Compression by Lymphoma

Monophasic Waveform

- Unilateral or bilateral
- Indirect sign of prox. obstruction



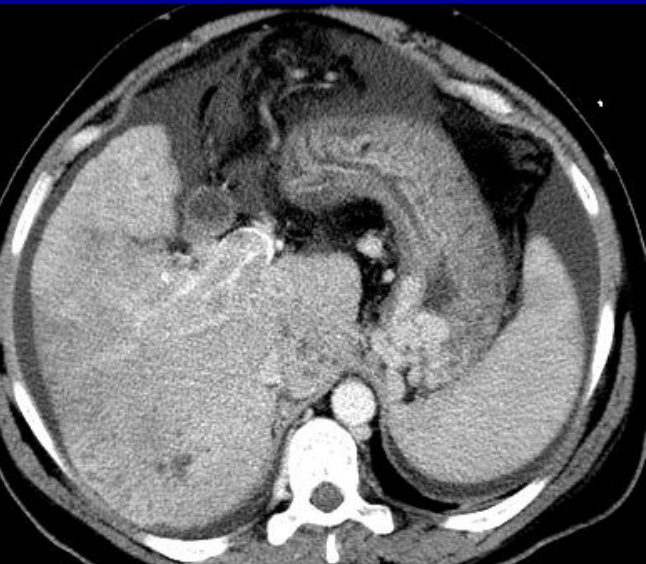
MONOPHASIC WAVEFORMS: A FIVE YEAR RETROSPECTIVE REVIEW

Number of patients Sept 1 2000-Sept 1 2005 with LEDVT exams available for review.	2963
No. of cases with monophasic waveform	124
No. of cases with CT or MR correlation	108
DVT involving iliac veins	47 (38%)
Extrinsic compression	26 (21%)
Intrinsic narrowing	6 (5%)
No explanation	45 (36%)

SIGNIFICANCE OF CFV MONOPHASIC WAVEFORMS

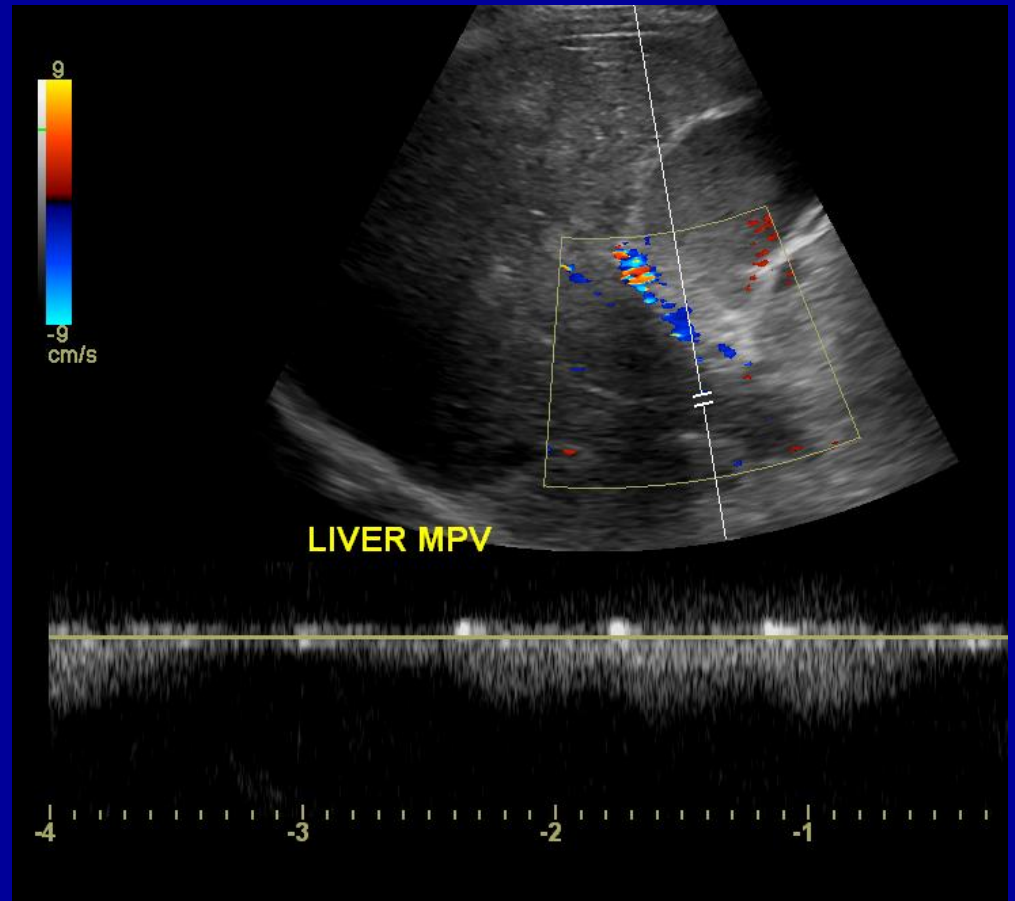
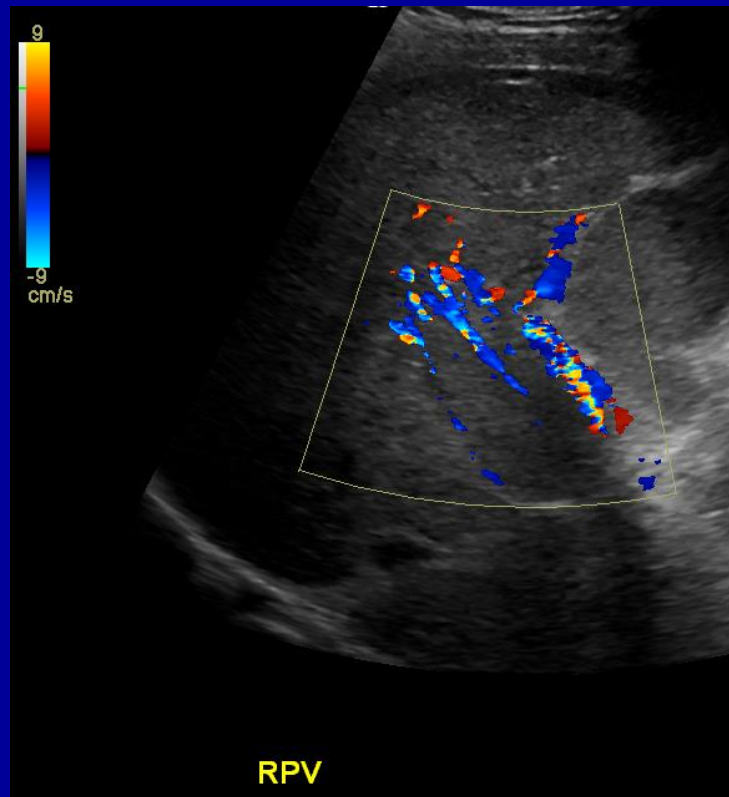
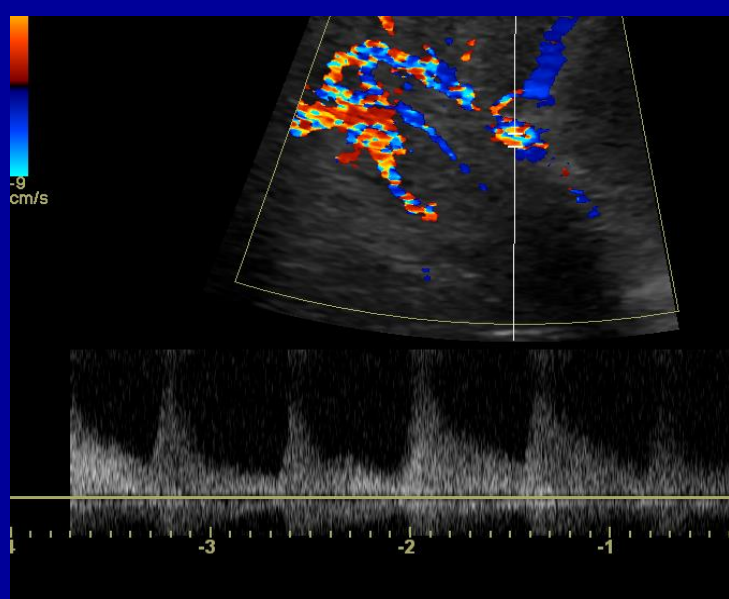
- Proximal obstruction highly likely
- 40% iliac thrombosis-high risk for PE
 - Requires surveillance of iliac vein
- 20% Extrinsic (tumor, adenopathy, fluid)
- If no cause found by US, then do CT or MRI to evaluate proximal veins and surrounding soft tissue.

48 YO Male GI Bleed



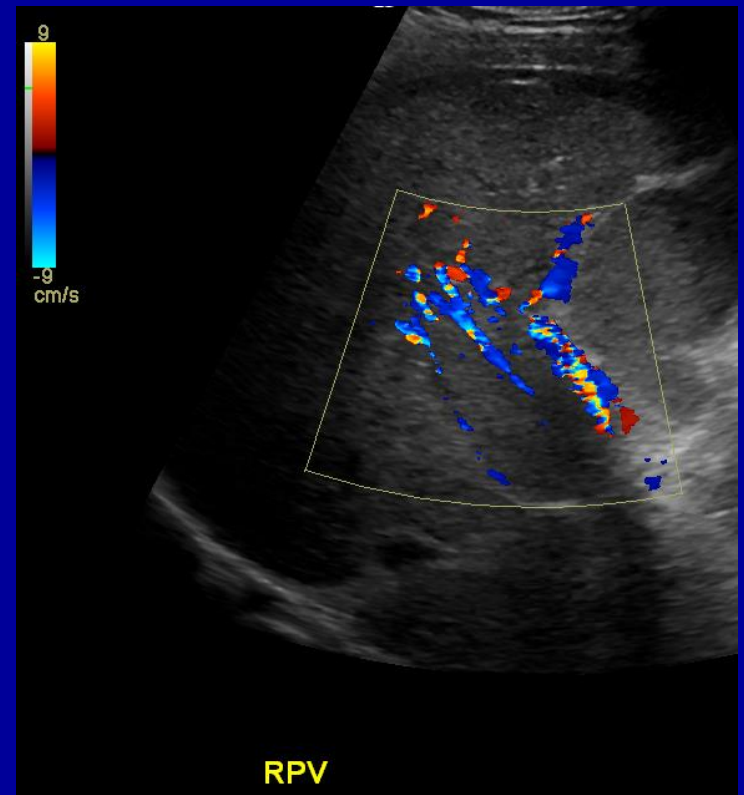
- ETOH use, esophageal bleeding, variceal banding
- CTA for bleeding
- Preliminary CT report: suspected portal vein thrombosis

US Findings: Reversed Flow in Portal Vein Thrombus



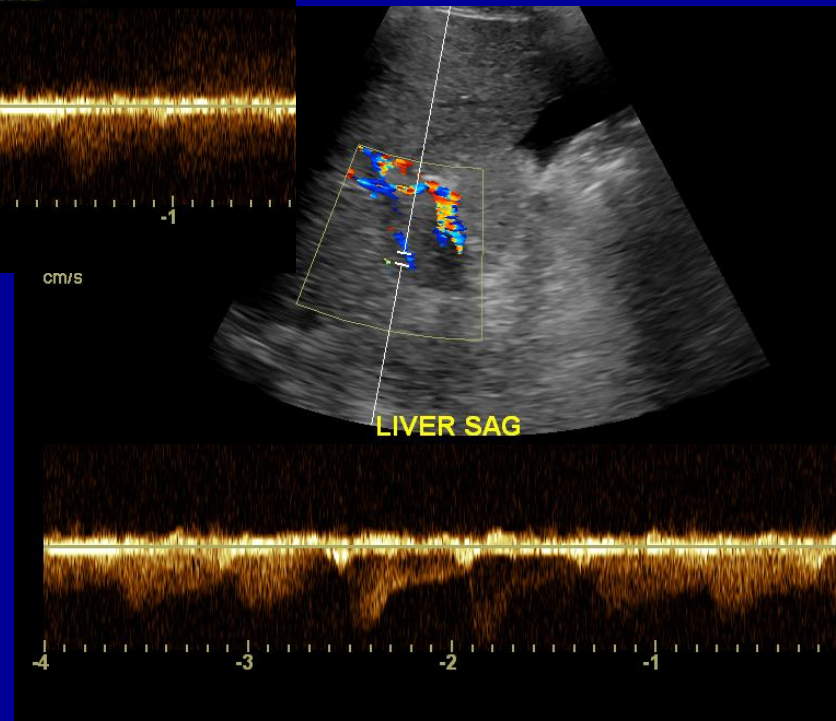
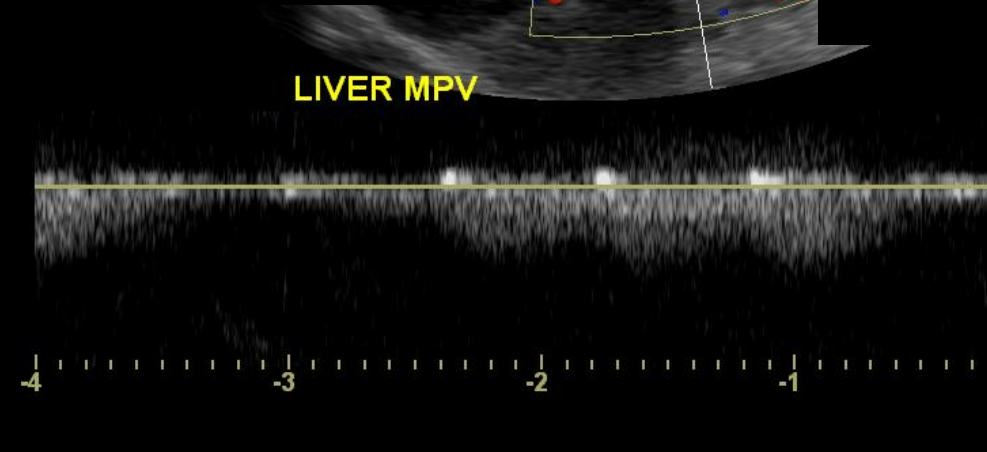
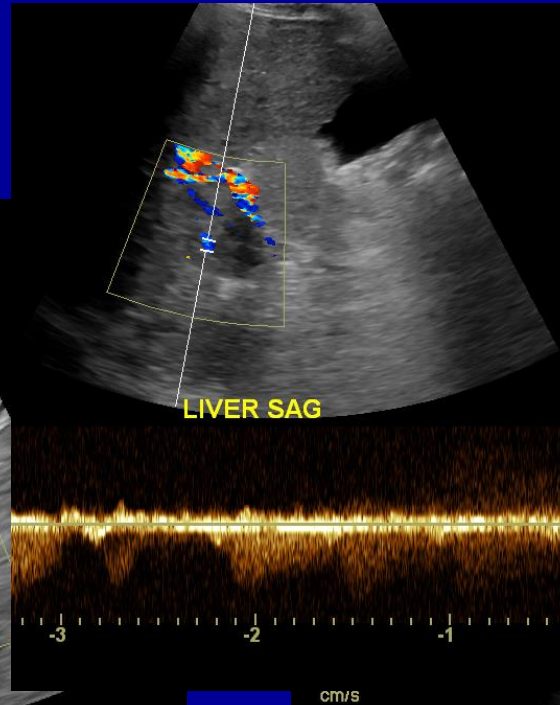
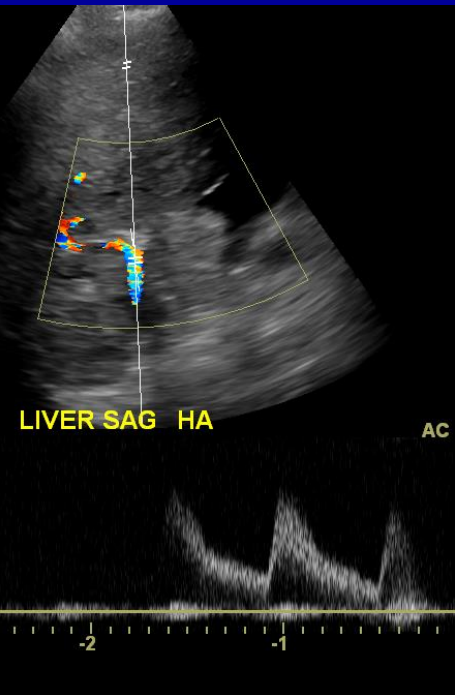
Differential Diagnosis

- Acute Thrombus with Portal hypertension
- Chronic Thrombus with Cavernous Transformation
- Tumor in vein

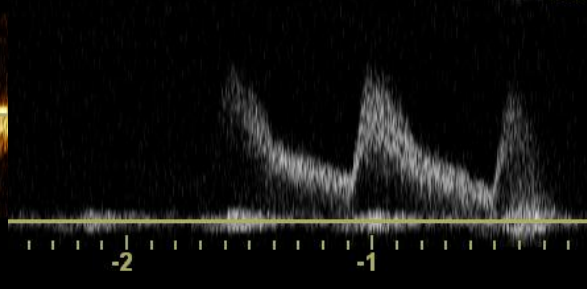
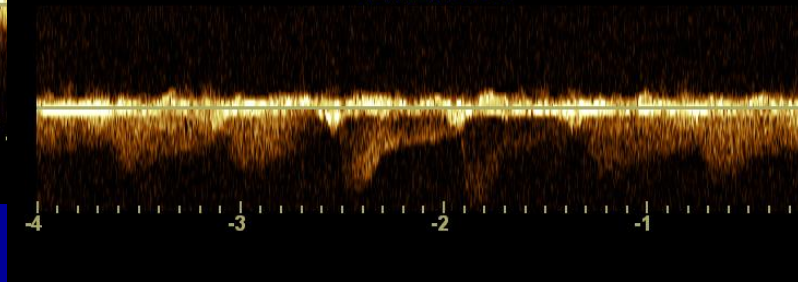
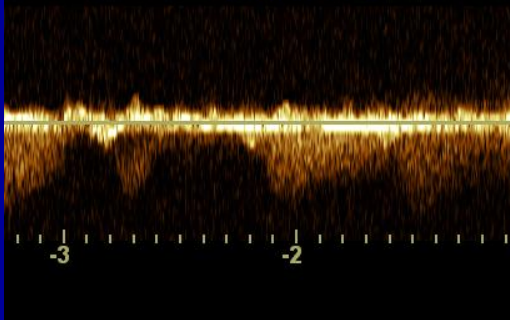
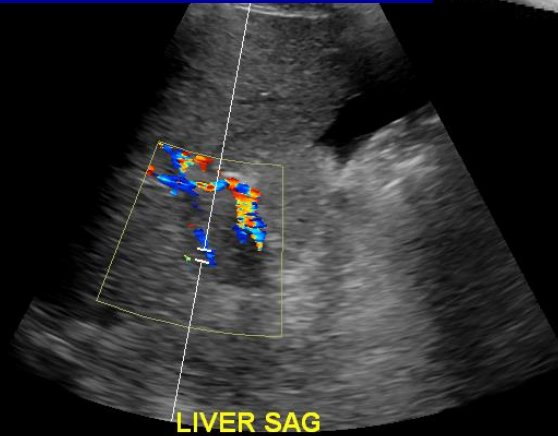
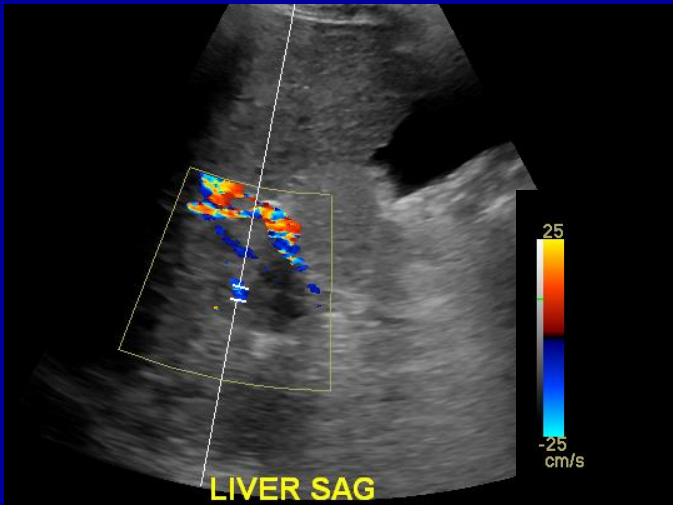
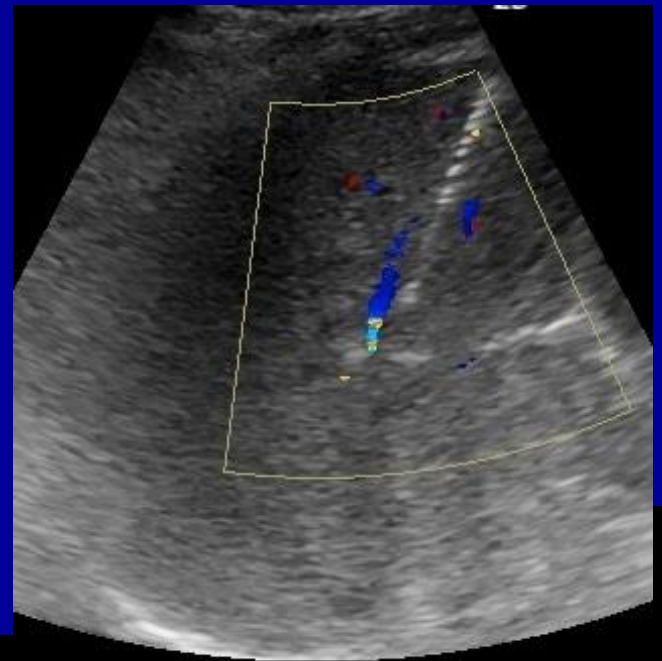


Next Step?

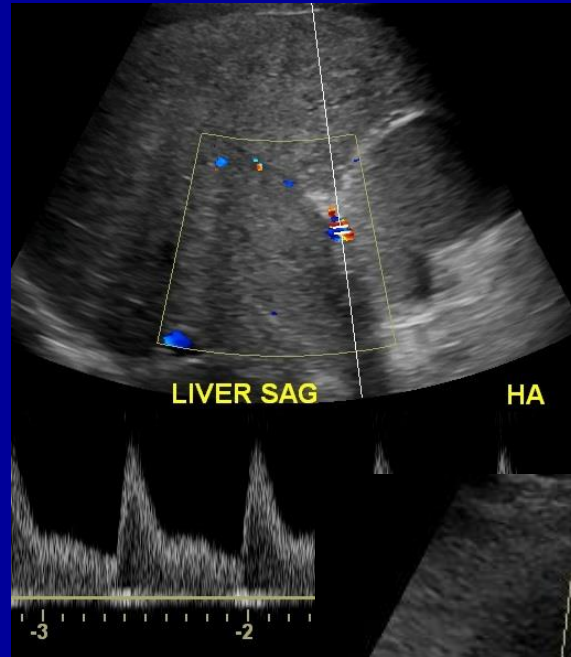
Additional Spectral Tracings



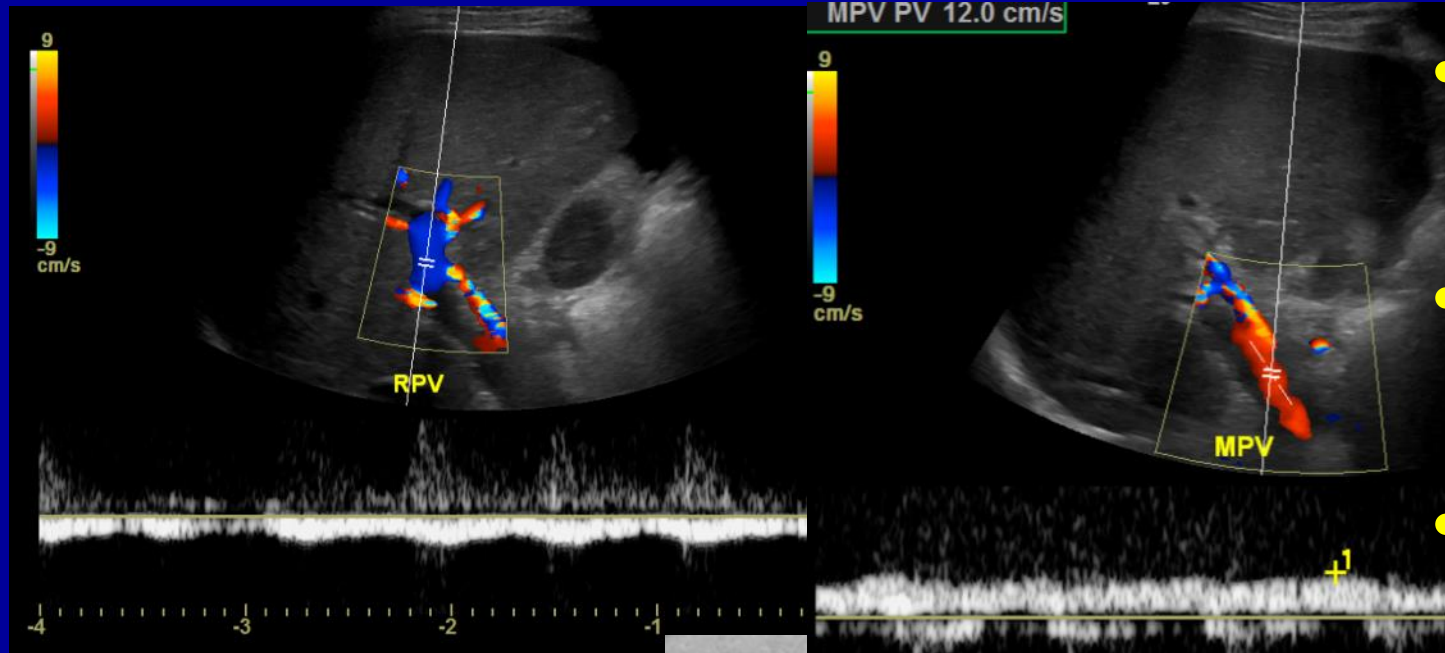
NEXT STEP? Portal Vein Biopsy



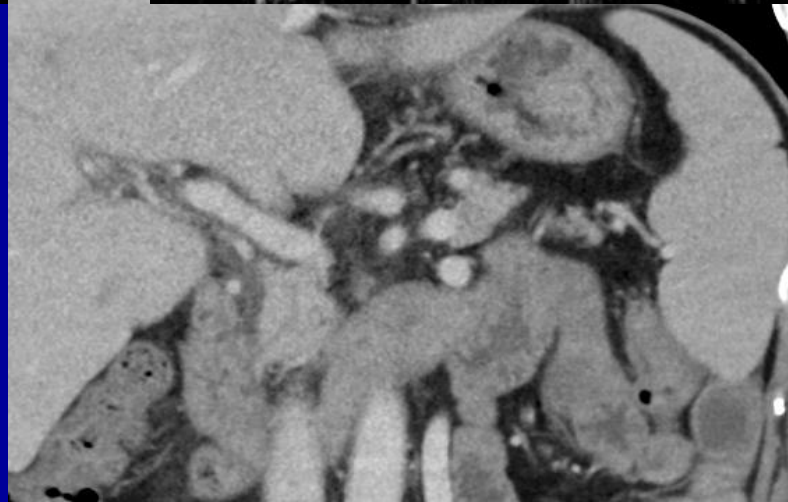
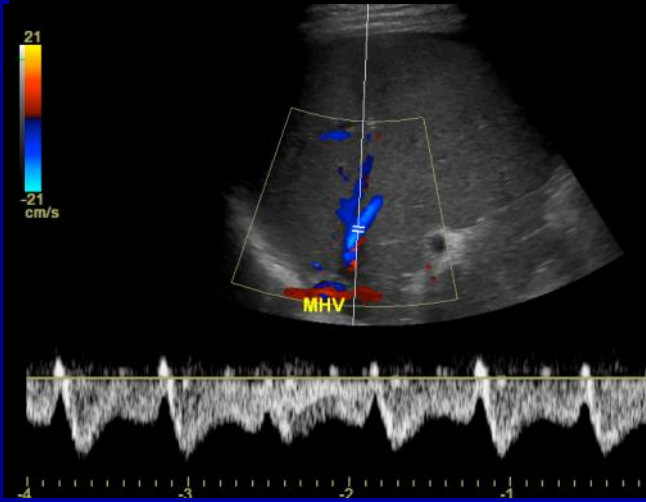
Diagnosis: Tumor in Portal Vein



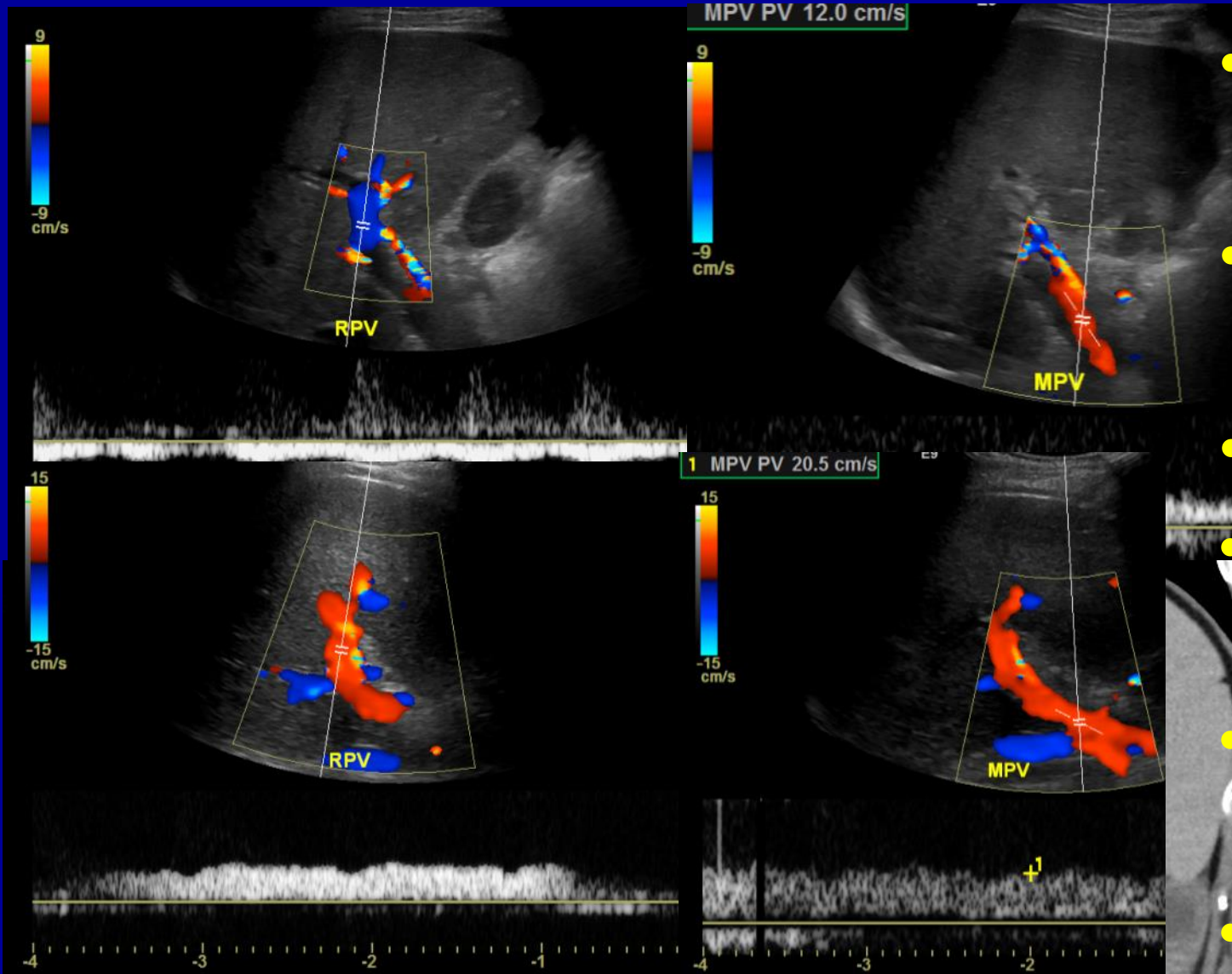
60 yo M, AML, BMT 6 weeks ago



- Reversed RPV
- Slow flow MPV
- NI HV's

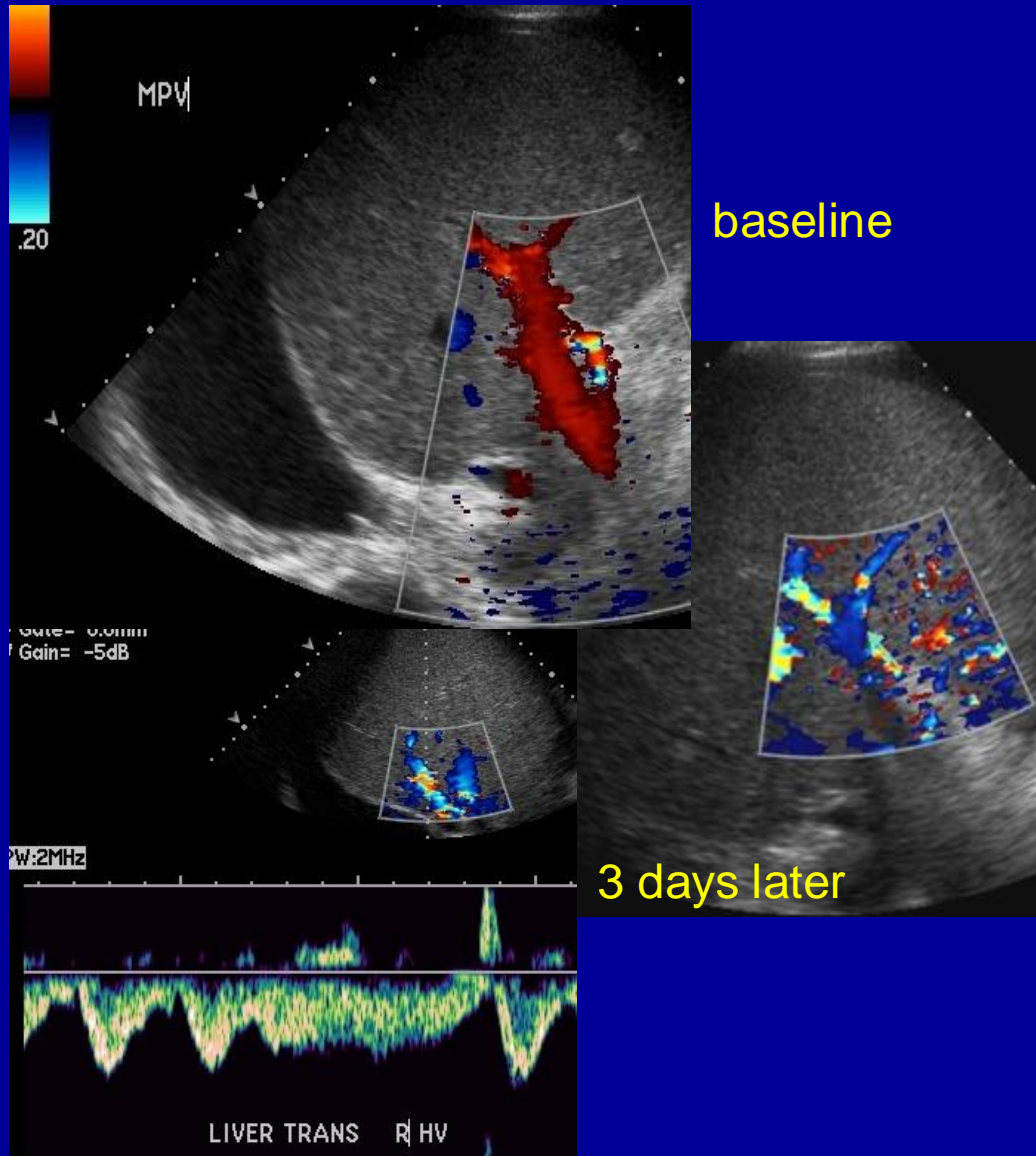


60 yo M, AML, BMT 6 weeks ago



- Reversed RPV
- Slow flow MPV
- NI HV's
- 4 weeks later
- Normal RPV
- MPV nl

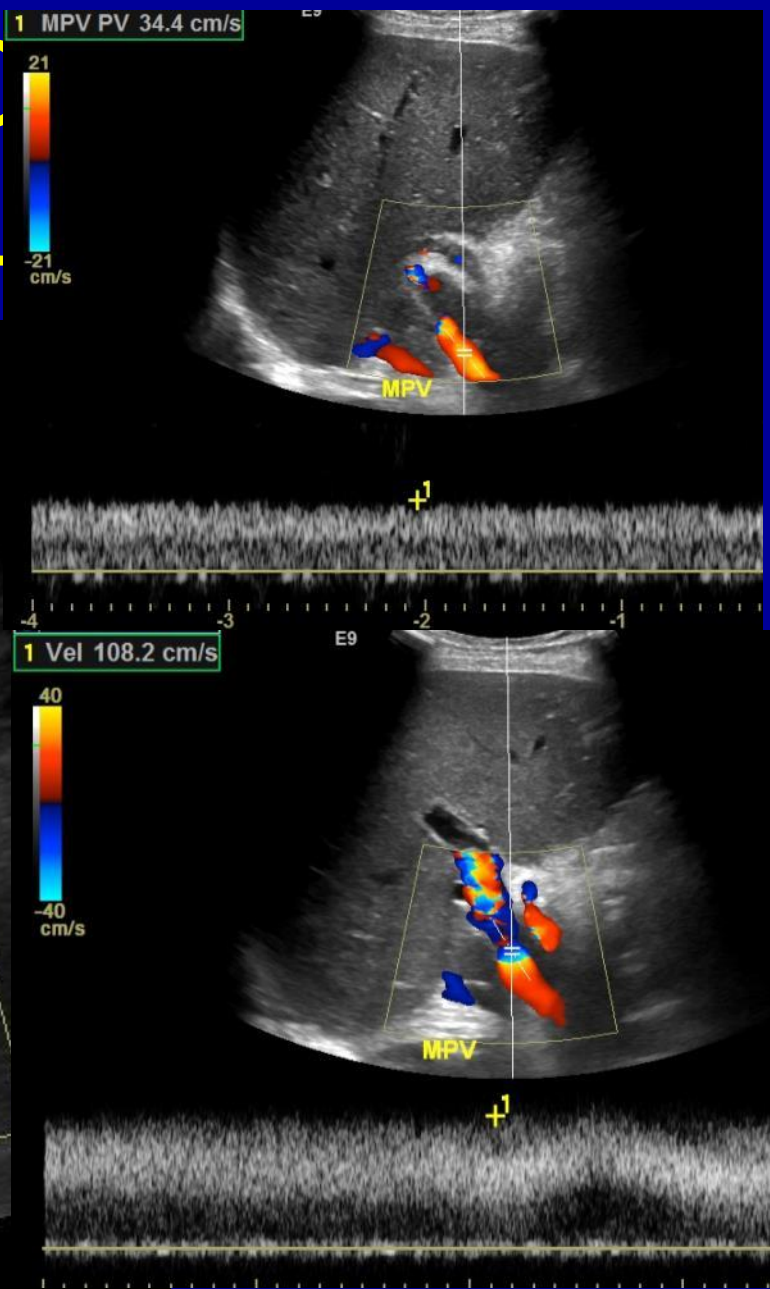
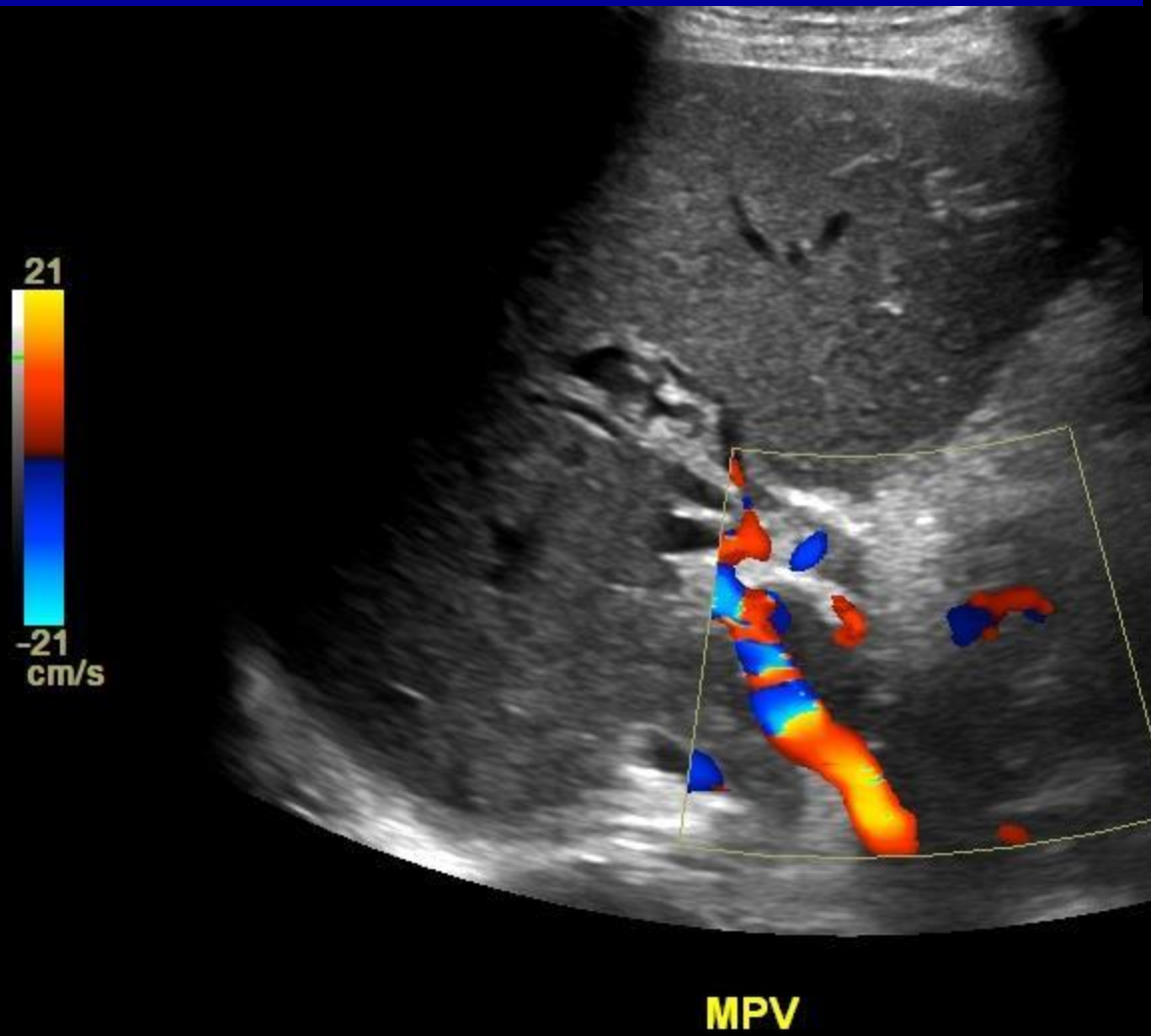
PATIENT WITH AML AND RISING LIVER FUNCTION TESTS



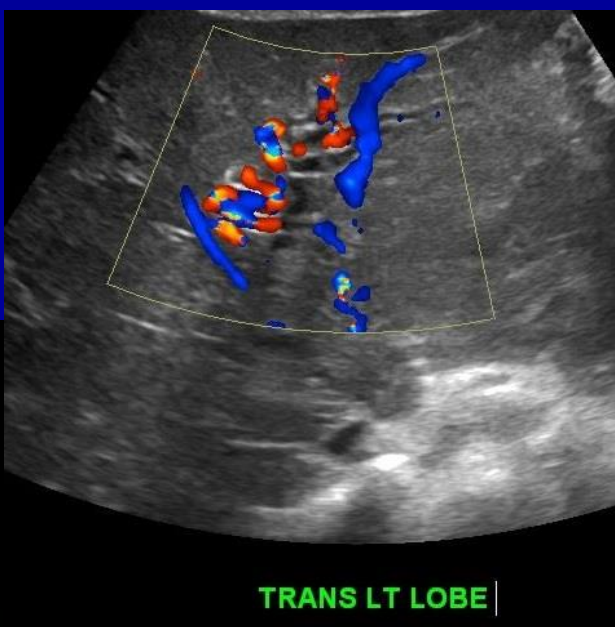
- DX=Hepatic veno-occlusive disease (HVOD)
- HVOD involves hepatic venules in bone marrow transplant patients
- Major veins appear normal. Histologic dx by liver biopsy
- Rapid development of hepatofugal portal venous flow is also diagnostic of HVOD and saves the patient a liver biopsy*

*Brown BP, Abu-Yousef M, Farner R, La Brecque D, Gingrich R. AJR 1990;154:721-4.

Patient with DLBC with rising L



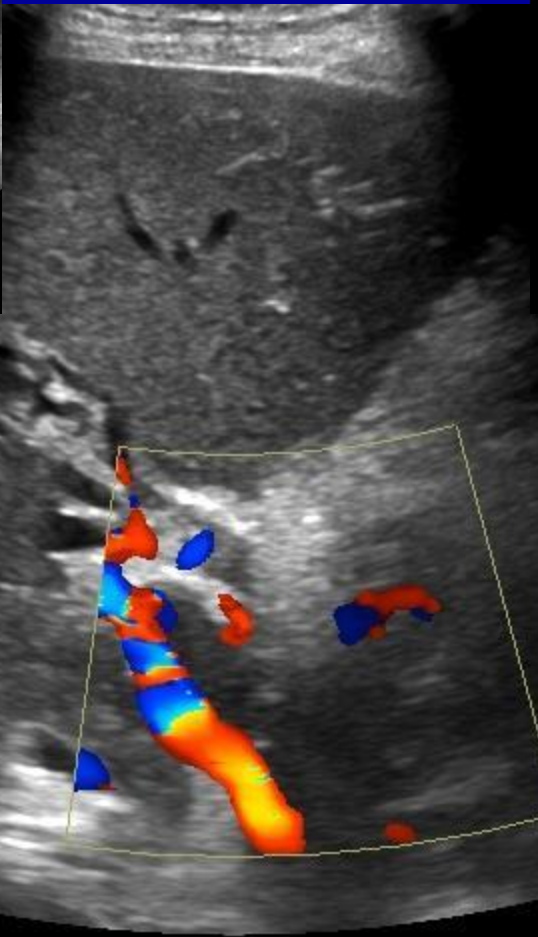
with DLBC
with rising L



TRANS LT LOBE

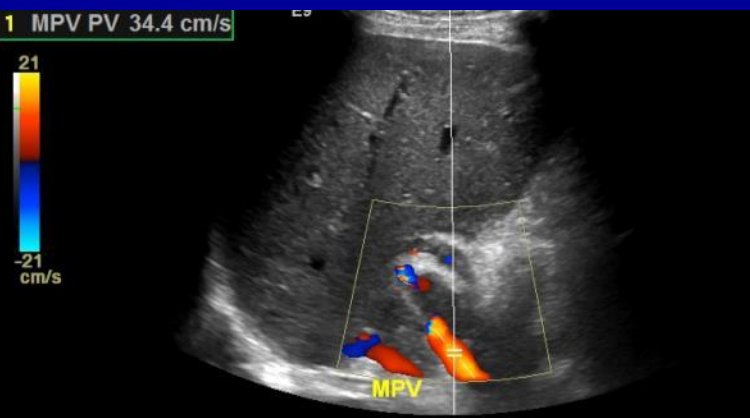


-21
cm/s



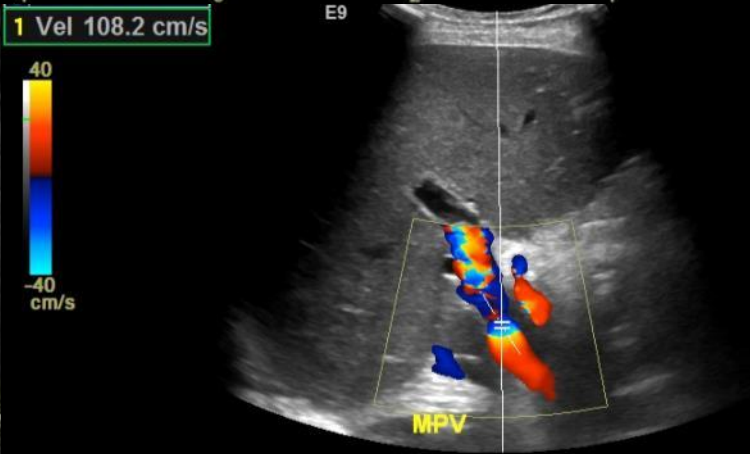
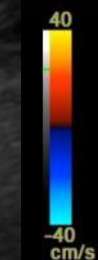
MPV

1 MPV PV 34.4 cm/s



MPV

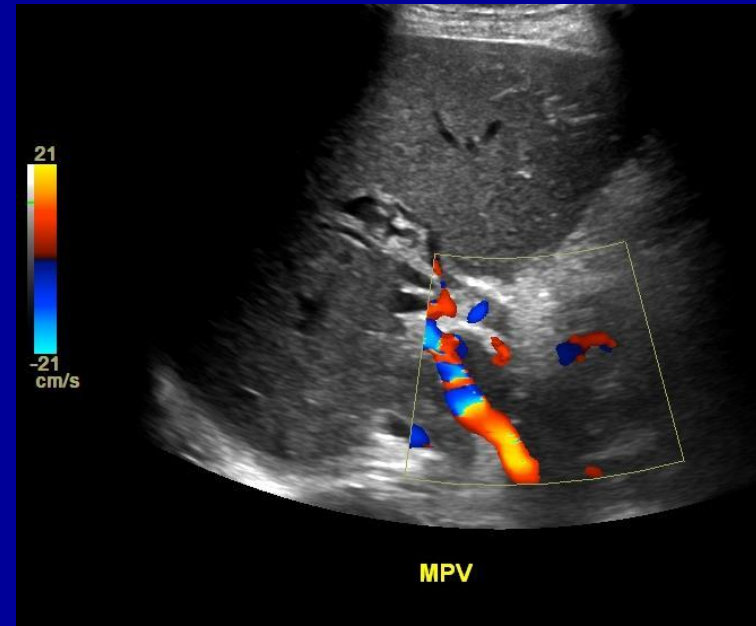
1 Vel 108.2 cm/s



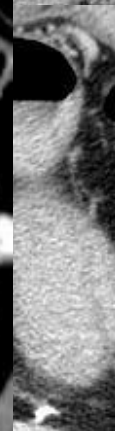
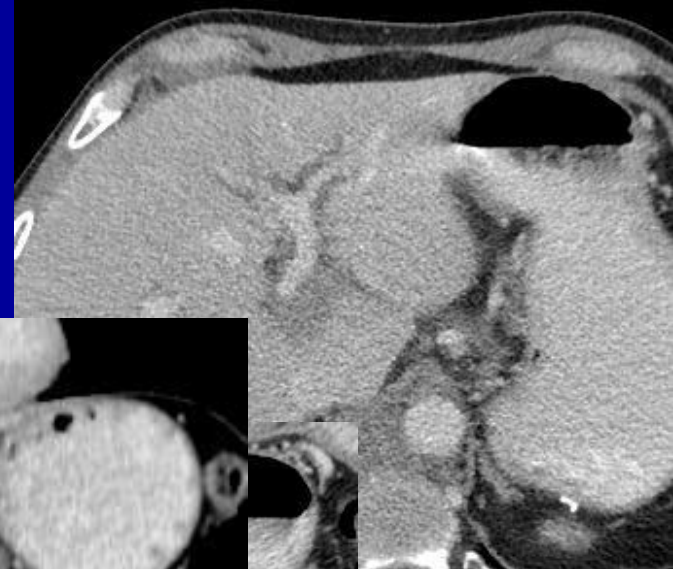
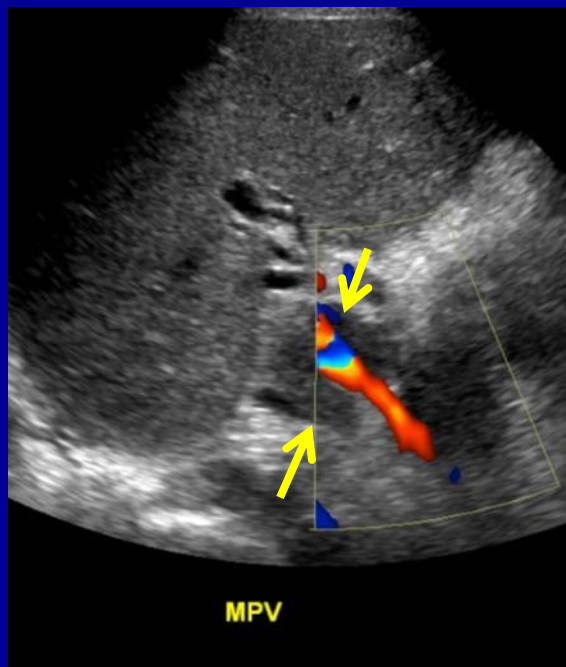
MPV

Diff dx

- Mass lesion
- Partial PV thrombosis
- Portal hypertension
- PV stenosis
- Veno-occlusive disease



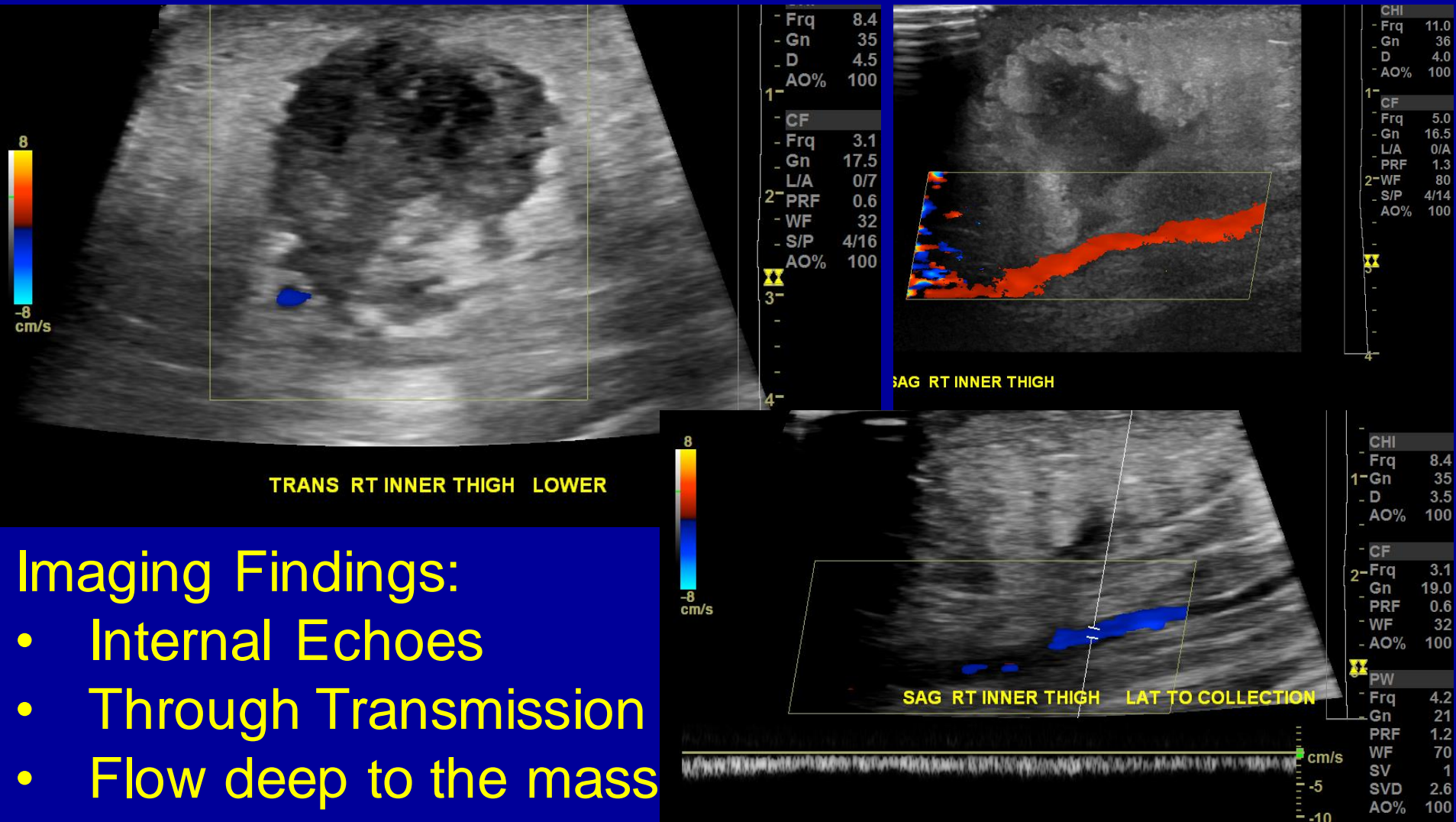
DIAGNOSIS



Relapsed DLBCL

MPV

52 yo F s/p surgery for melanoma 2 mo ago with persistent lump

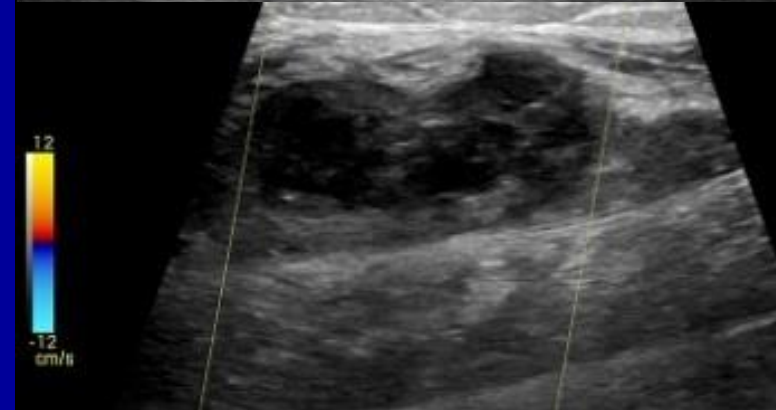
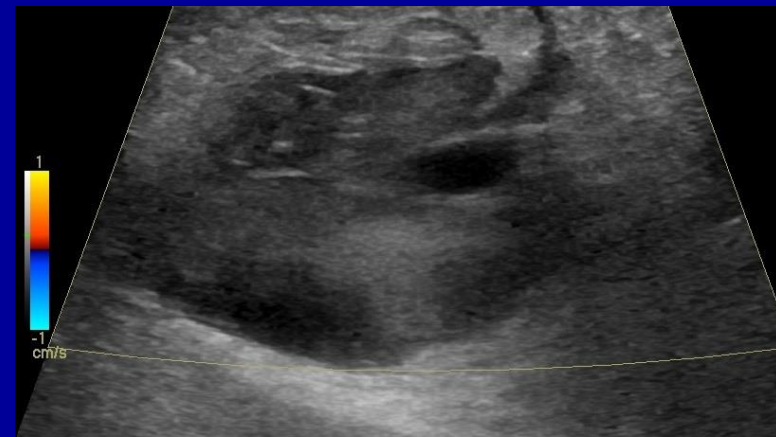


Differential Diagnosis

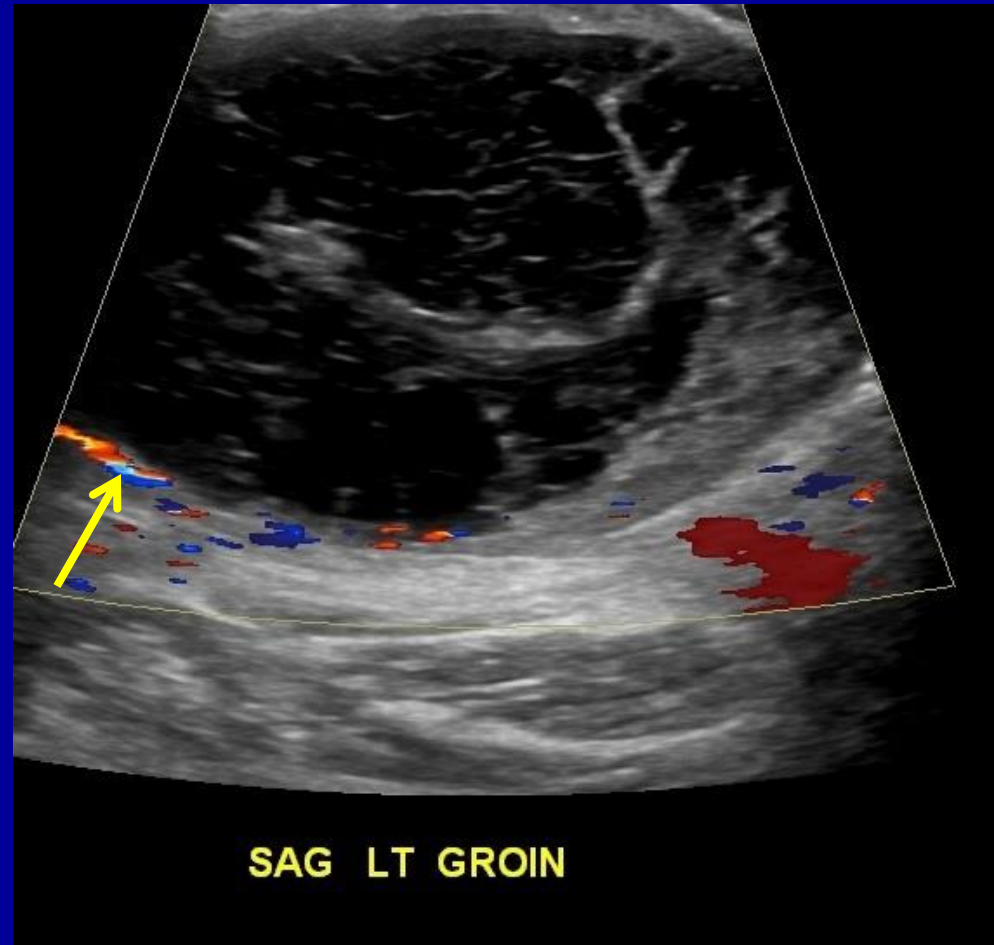
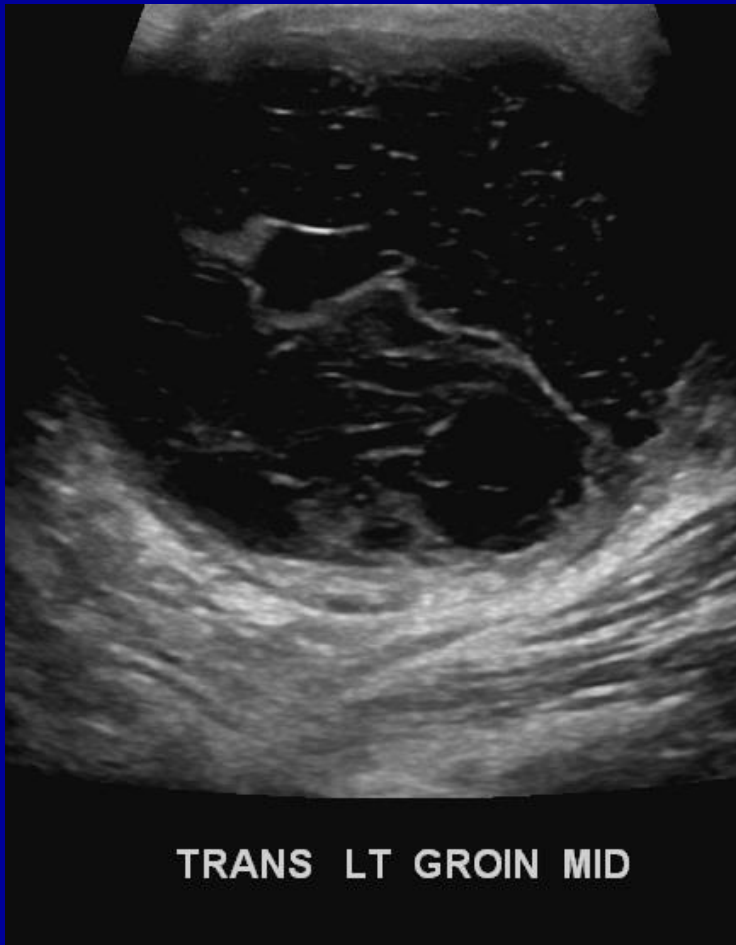
- Abscess-drain
- Hematoma/seroma- leave alone
- MRI
- Repeat US 4 weeks
- Repeat US today

Hematoma

- Acute- Heterogeneous irregular collections
 - Lack defined wall
 - Contain debris and/or fluid-fluid levels
 - Posterior enhancement
- Chronic- (healing)
 - Anechoic as it liquefies
 - May exhibit vascularity in adjacent soft tissue



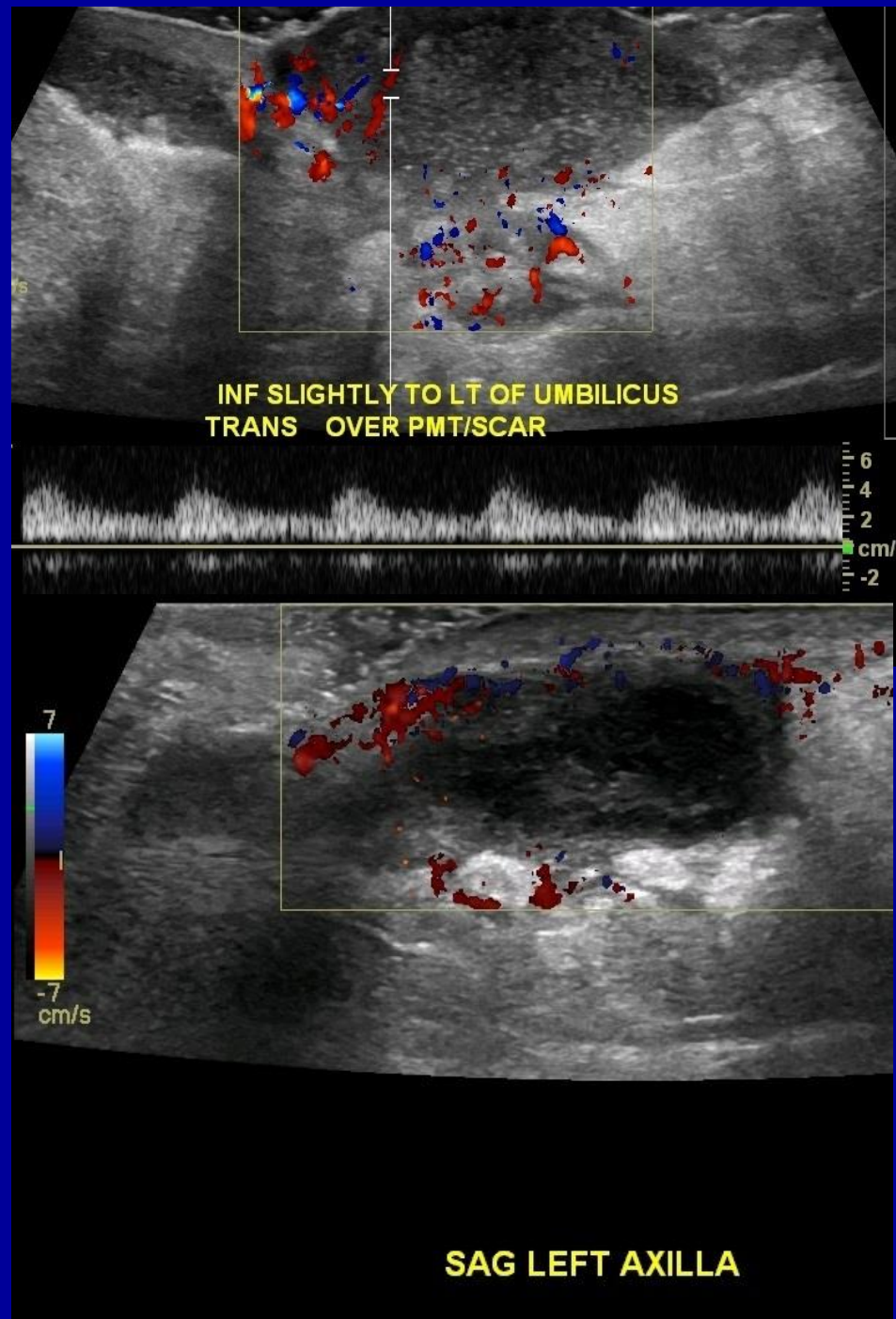
72 yo M: Leg Swelling s/p Inguinal Hernia Repair



- Note peripheral vascularity in adjacent tissue

Abscesses

- Irregular, less well-defined
- Contain internal debris or gas,
- Peripheral hypervascularity

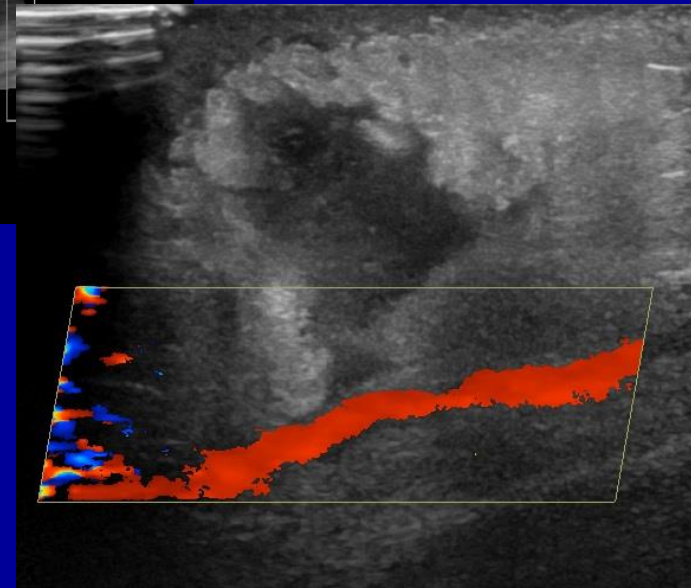


Repeat Exam



- Frq	8.4
- Gn	35
- D	4.5
- AO%	100
1-	
- CF	
- Frq	3.1
- Gn	17.5
- L/A	0/7
2- PRF	0.6
- WF	32
- S/P	4/16
- AO%	100
3-	

TRANS RT INNER THIGH LOWER

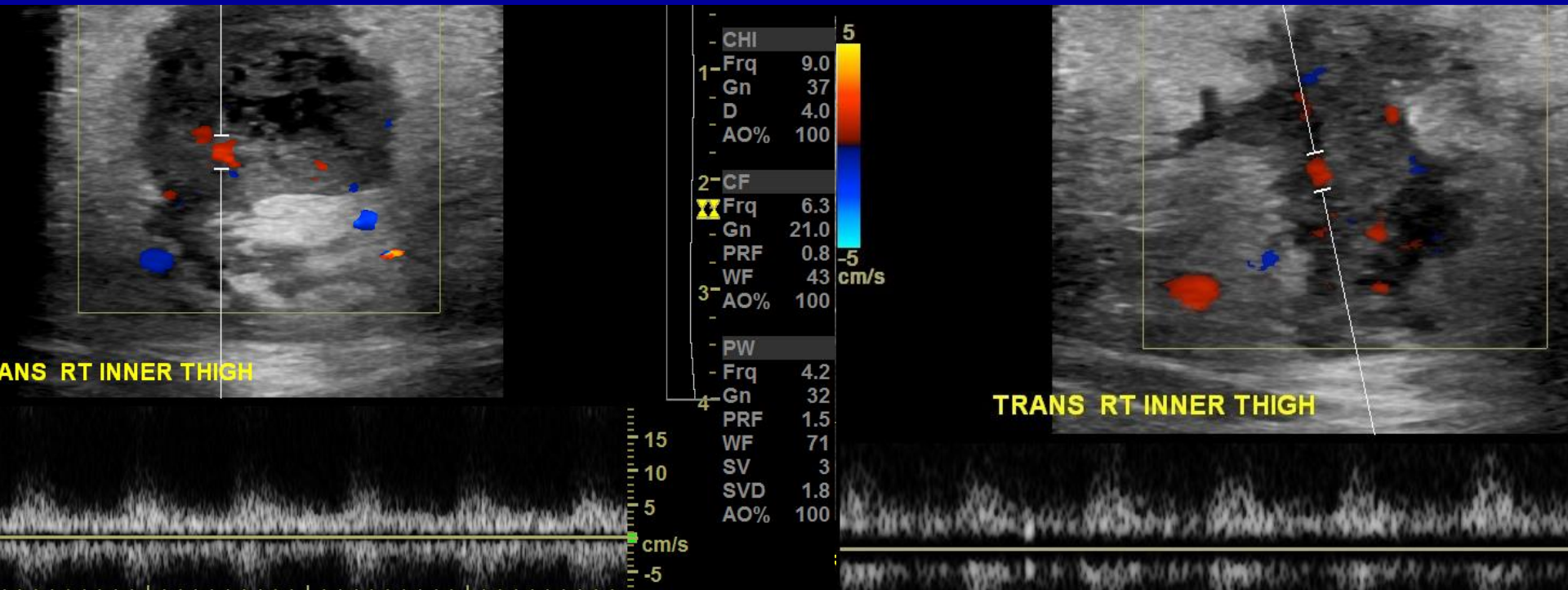


CHI	
- Frq	11.0
- Gn	36
- D	4.0
- AO%	100
1-	
- CF	
- Frq	5.0
- Gn	16.5
- L/A	0/A
- PRF	1.3
2- WF	80
- S/P	4/14
- AO%	100
3-	
4-	

SAG RT INNER THIGH

- Not hematoma or abscess- how to prove tumor?

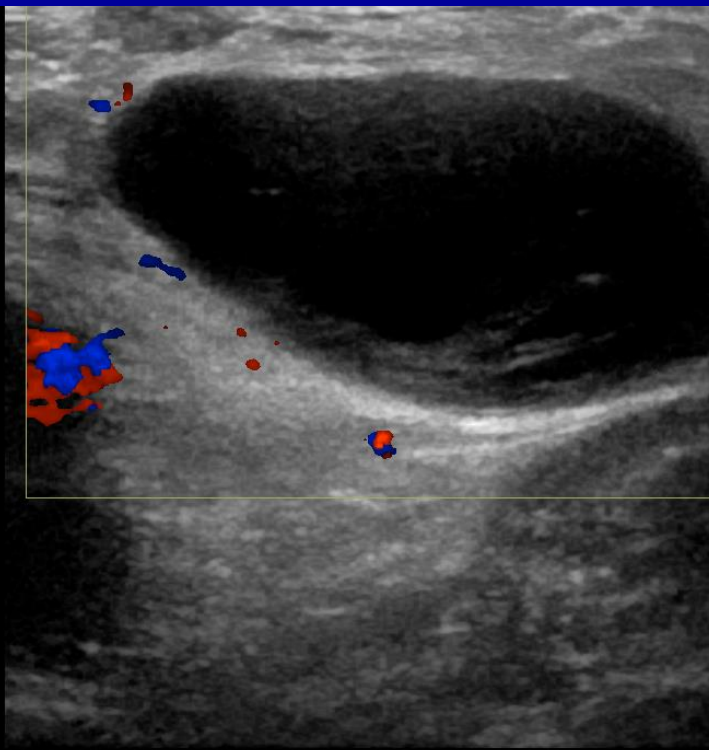
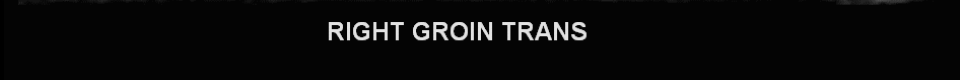
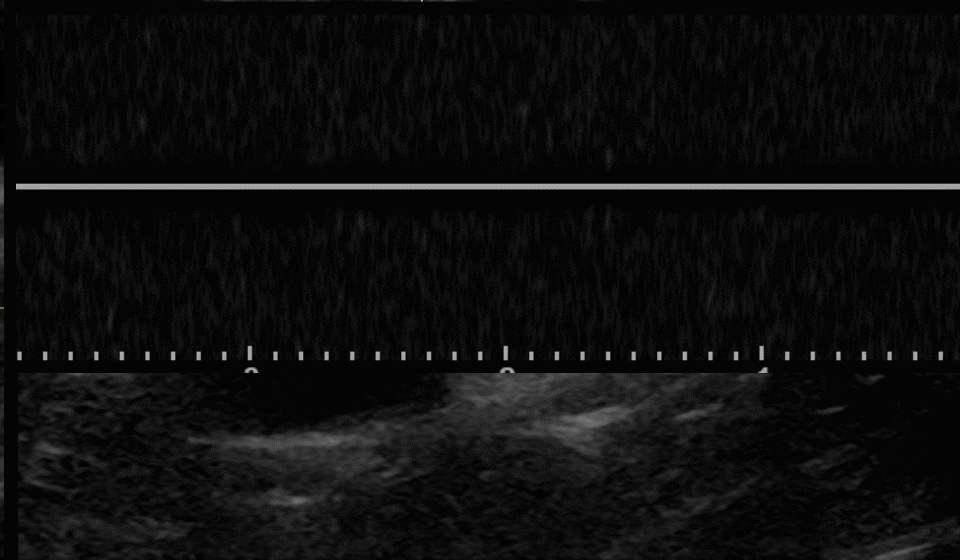
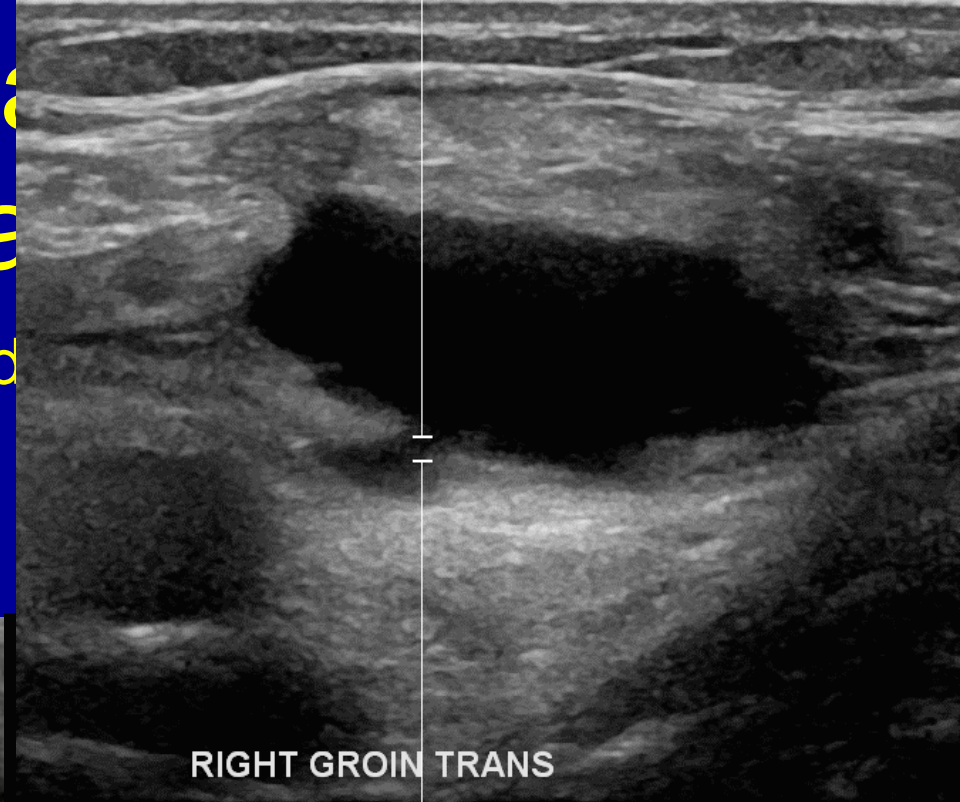
Repeat exam at higher Doppler frequency



- Tumor vessels small, low flow state
- Needs higher frequency for better color Doppler sensitivity
- Confirm with spectral Doppler
- Melanoma recurrence

77 yo M Metastatic Restenosis

- Read as necrotic enlarged node
- Referred for Biopsy
- US Performed

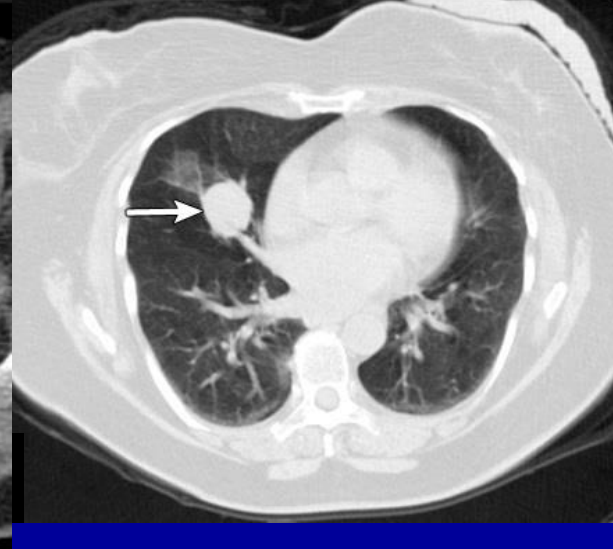
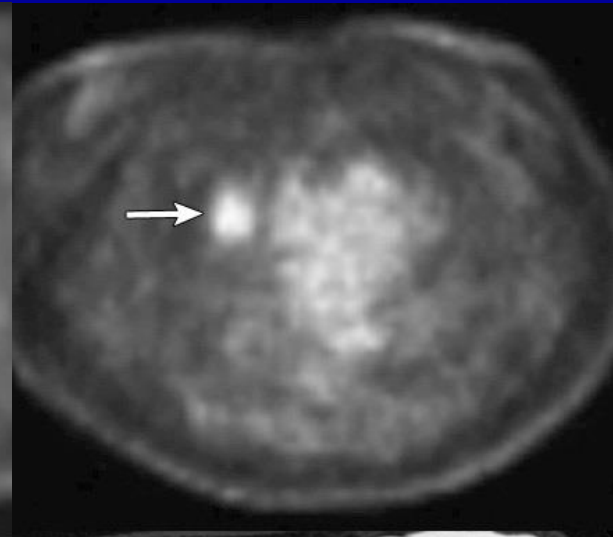
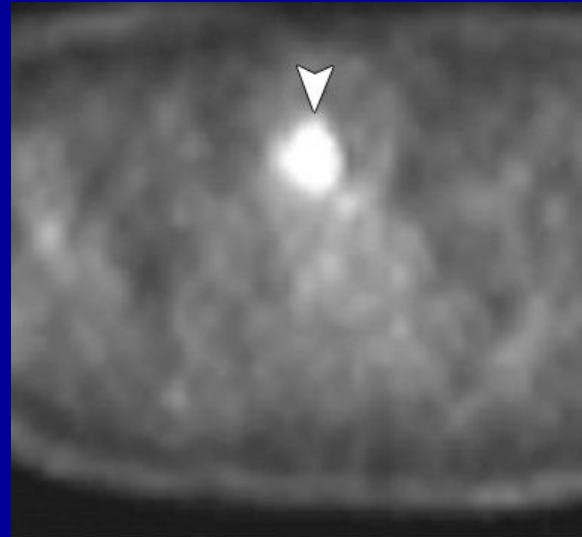


RIGHT GROIN TRANS

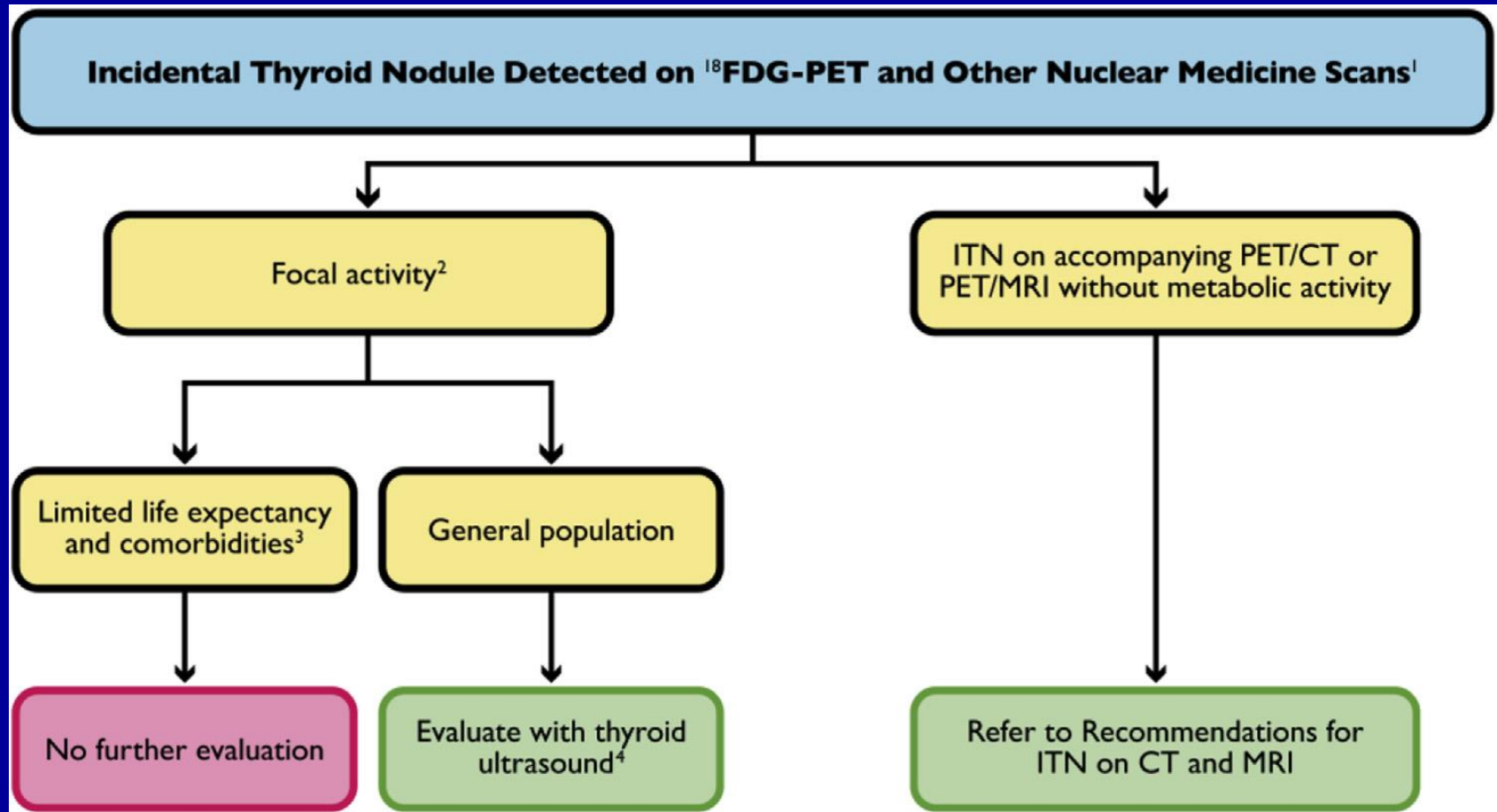
RIGHT GROIN TRANS

PET/CT detected thyroid lesion

- 66 yo F
- Staging PET/CT for lung mass
- Hypermetabolic lung and thyroid lesions
- Next step?



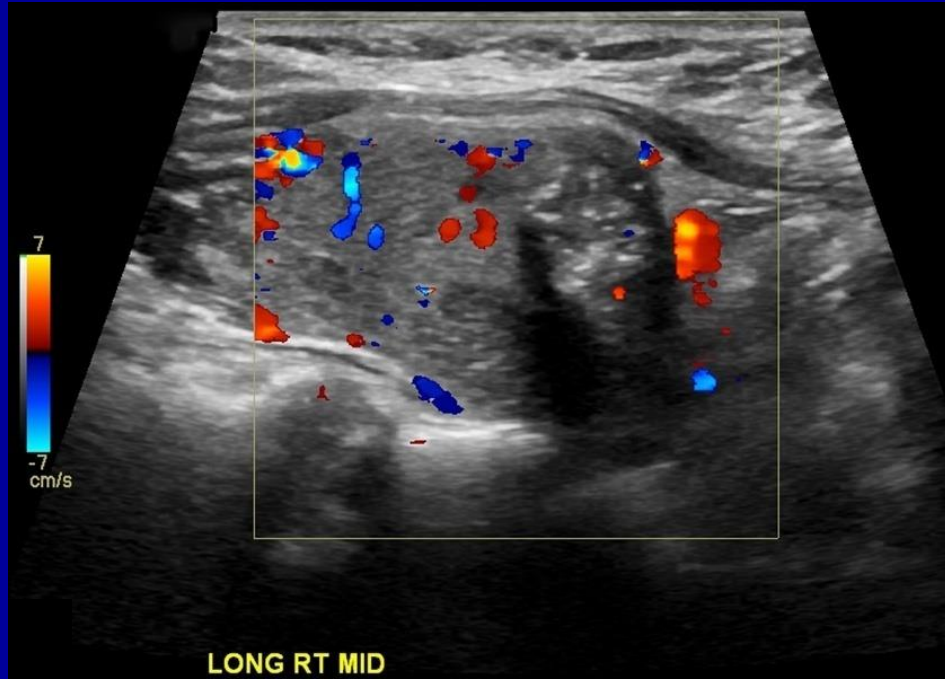
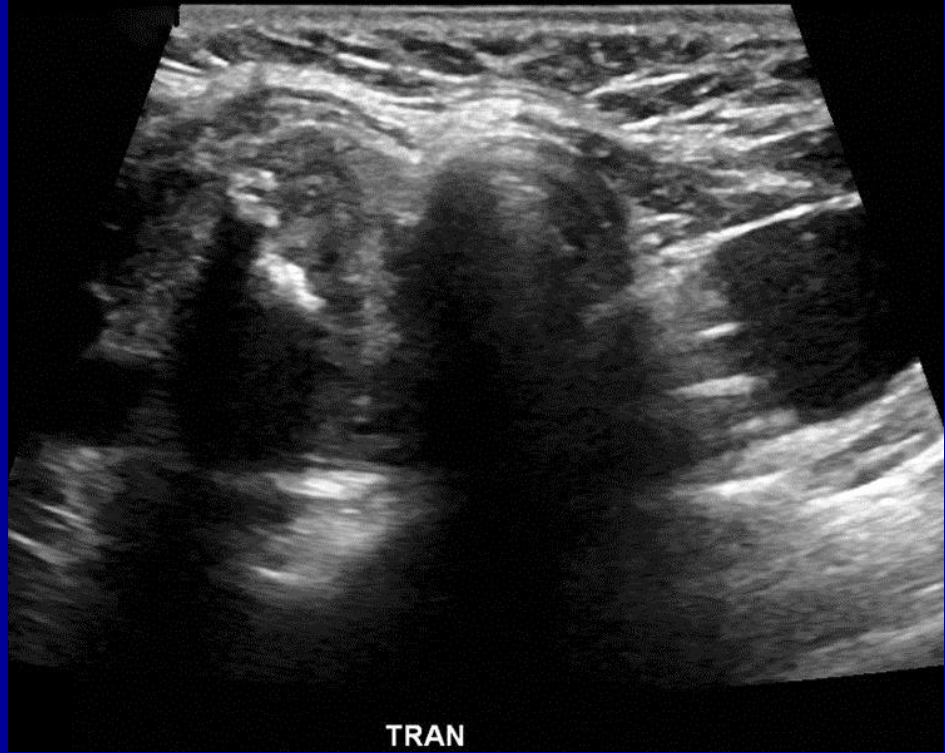
Management of Incidental Thyroid Nodule on PETCT



Hoang et al-Managing Incidental Thyroid Nodules Detected on Imaging: White Paper of the ACR-2015

US Findings

- Hypoechoic nodule
- Taller than wide
- Calcifications
 - Large, shadowing
 - Punctate
- Hypovascular



Differential diagnosis

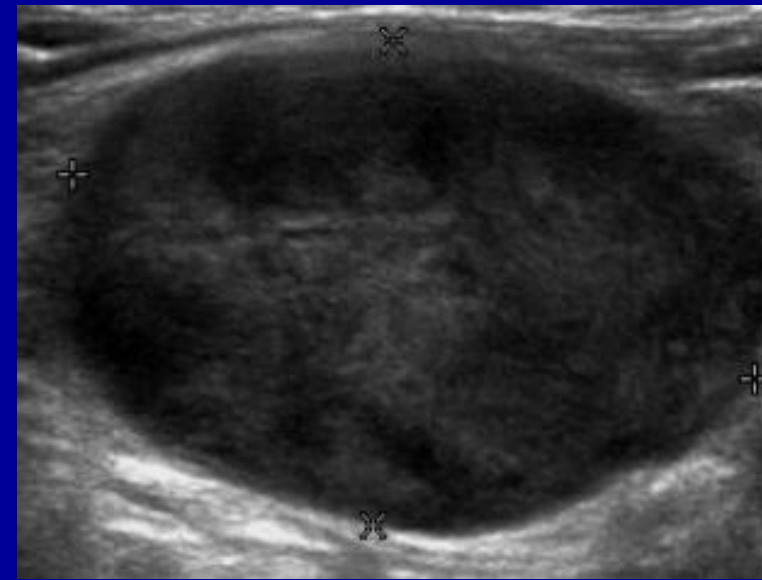
- Lung cancer metastasis
- Lymphoma
- Nodular hyperplasia
- Papillary thyroid carcinoma

Incidental FDG avid Thyroid Nodules on FDG PET/CT

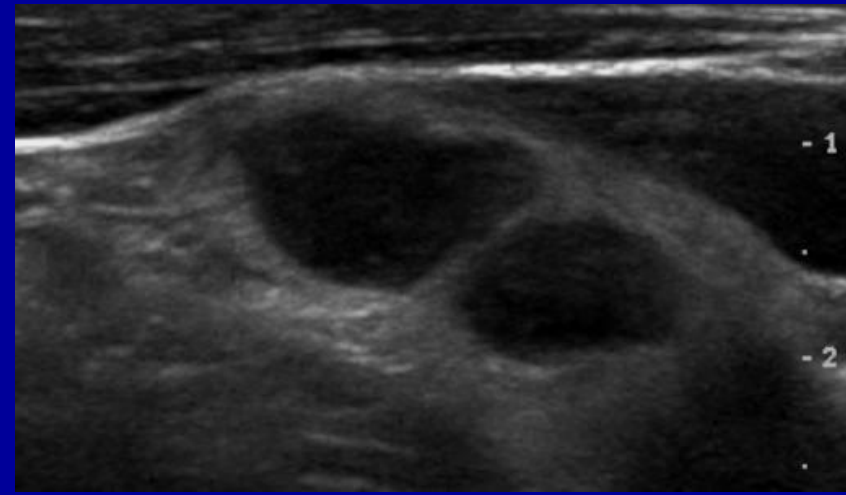
- Incidence 4% (patients with known thyroid CA excluded)
- Cancer risk for focal uptake 31%
- Mostly papillary (>90%), also follicular CA, lymphoma, metastases
- Malignant lesions tend to have higher SUV, but there is overlap so bx needed

Thyroid Metastases

- Relatively rare
- Hypoechoic, lack calcification
- Lymphoma most common, also FDG avid



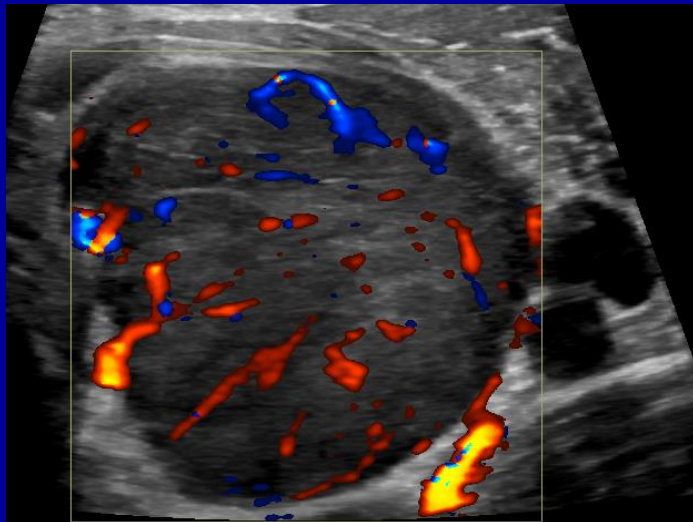
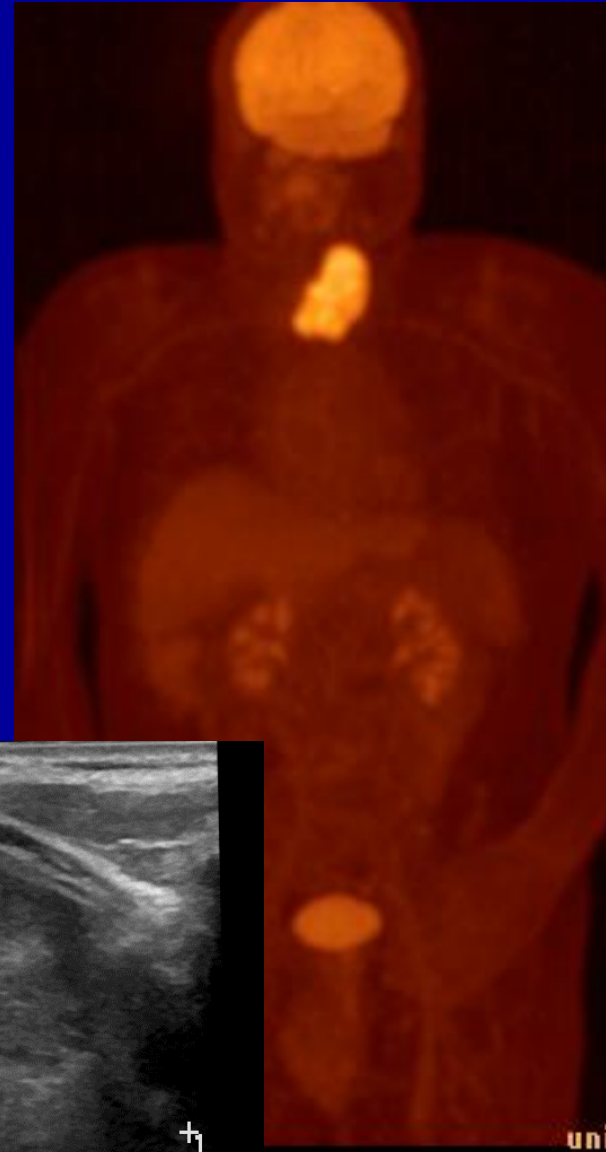
Lung Cancer



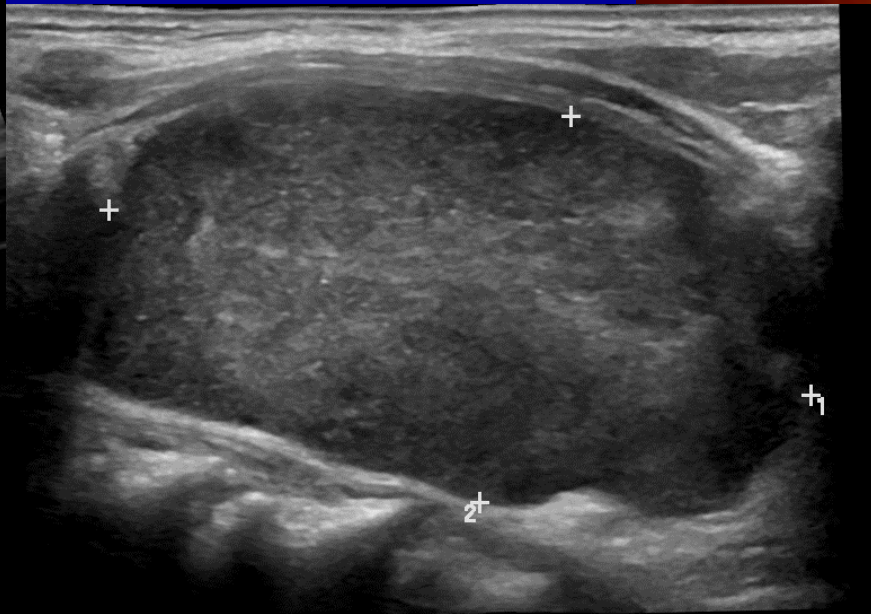
Squamous Cell Ca

c/o Dr Lynwood Hammers and Dr
Leslie Scoutt

57 yo M
Neck Mass
Diffuse
Large
B Cell



TRANS LEFT

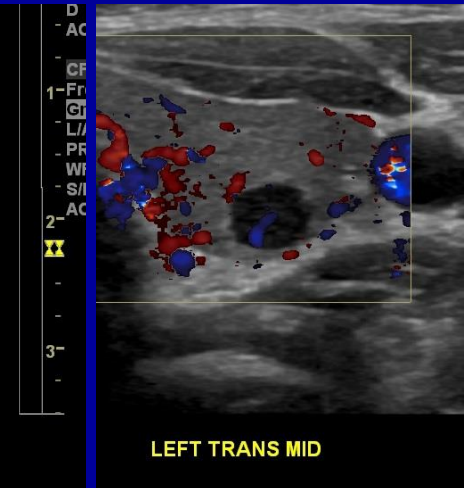
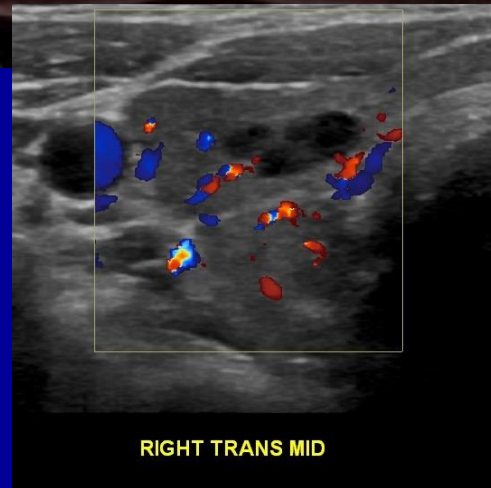
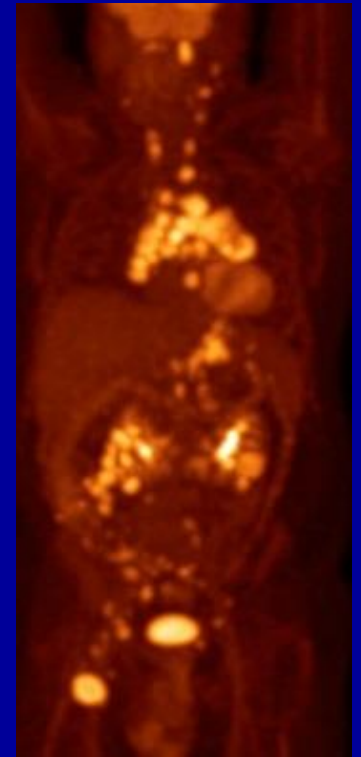
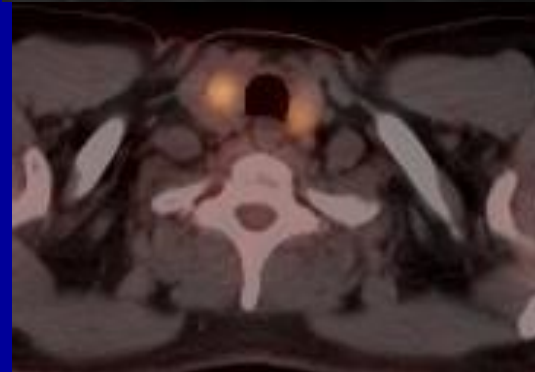


SAG LEFT

1 L	7.13 cm
2 L	3.89 cm

Lymphoma

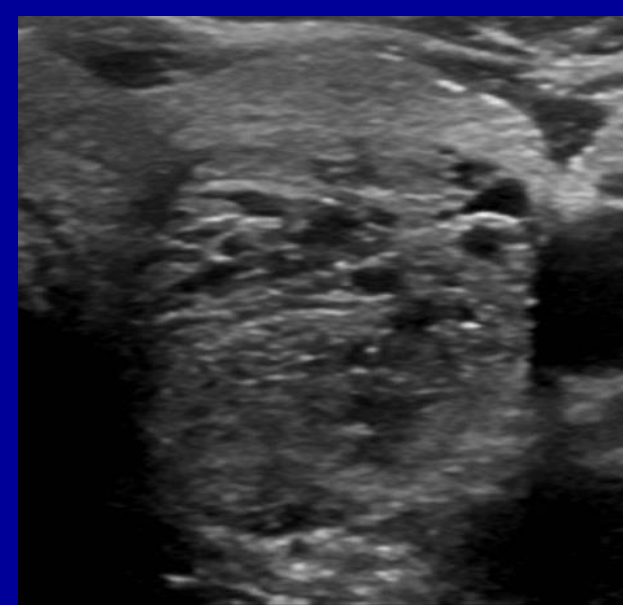
- Very FDG avid
- Hypoechoic
- Vascular



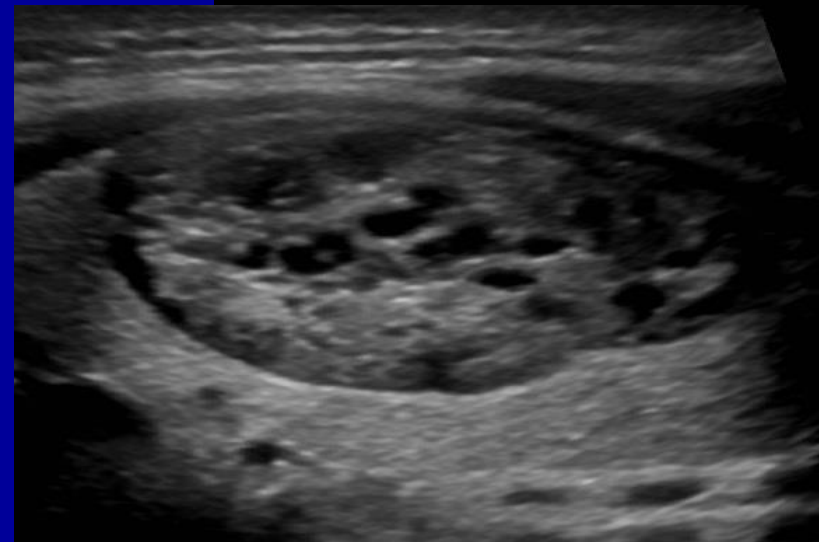
Multifocal transformed large B cell lymphoma (from follicular)

Hyperplastic Nodule

- FDG avid
- Multiple, confluent cystic spaces gives honey-comb or spongiform pattern
- Extremely high likelihood of benignity
- Do not biopsy unless >2cm

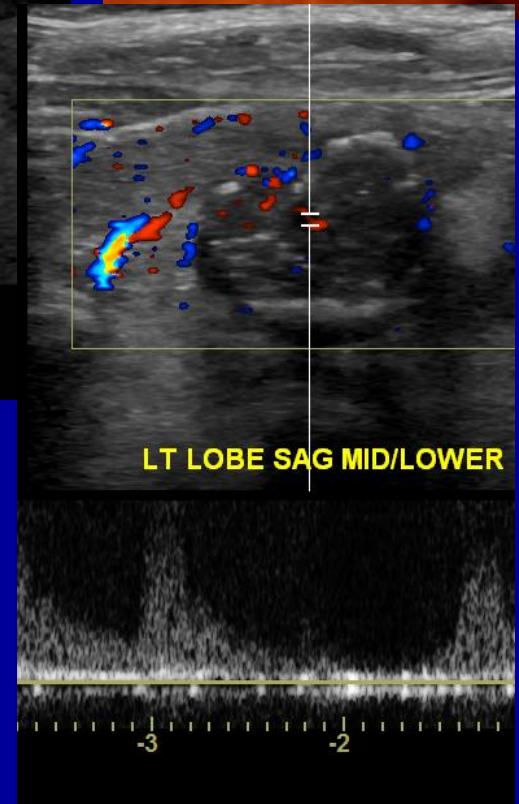
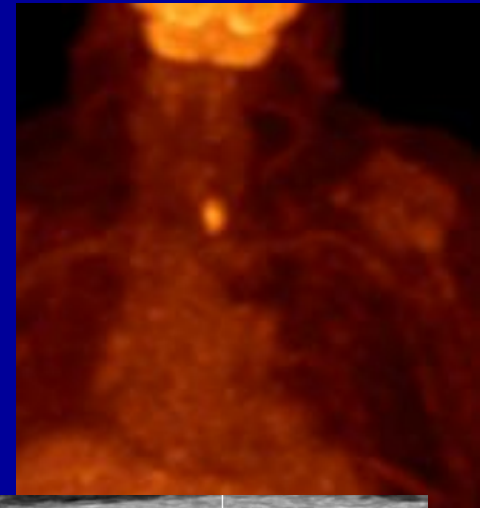
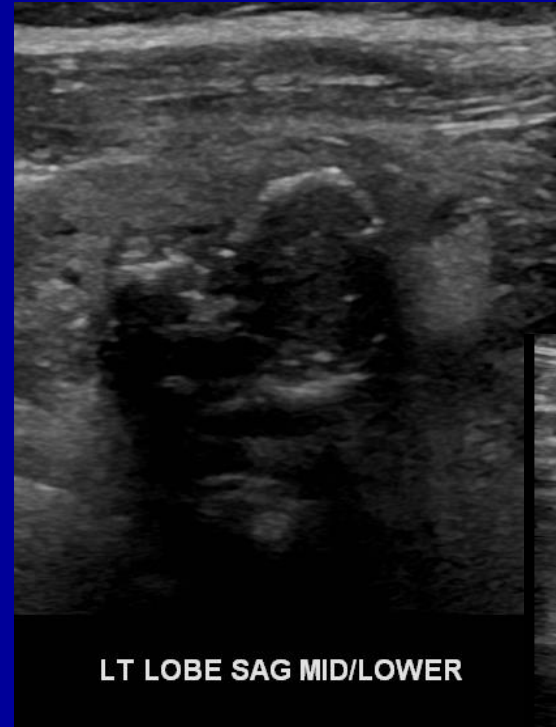


TRANS LT MID



Indeterminate US Nodule

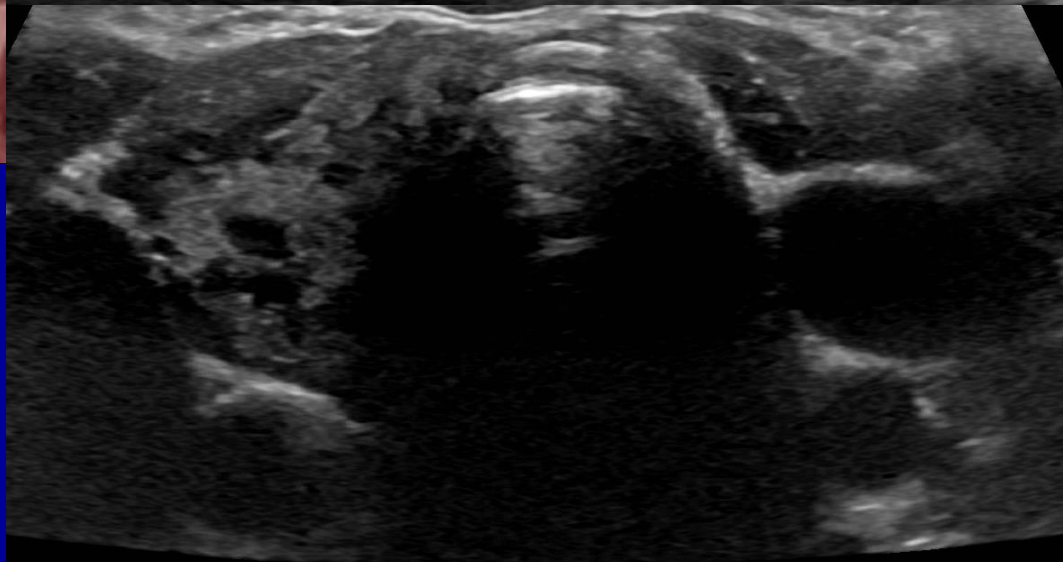
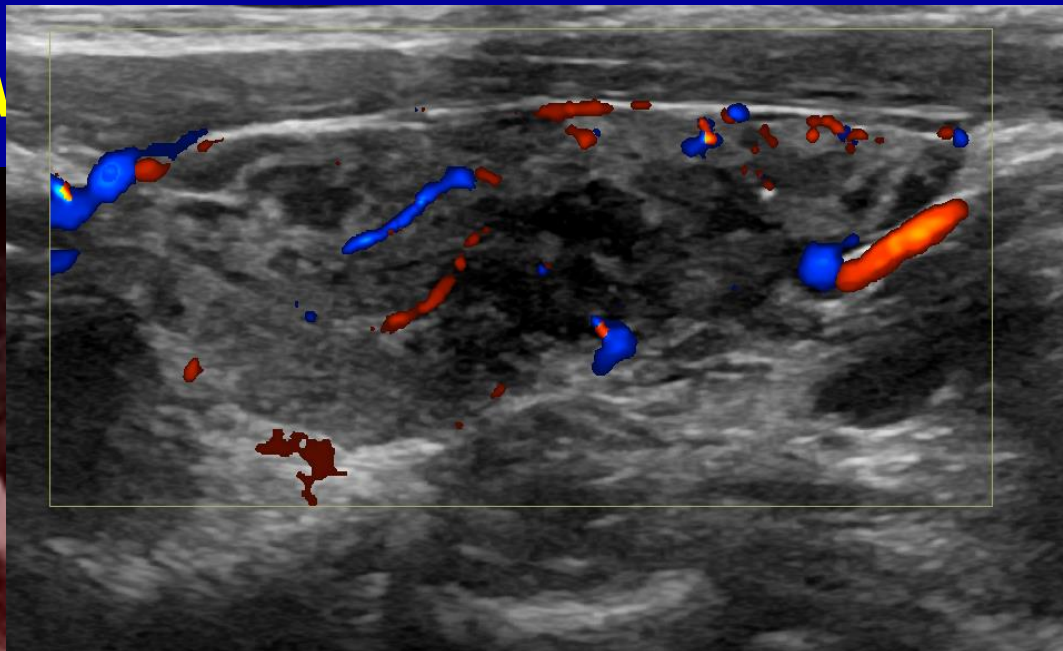
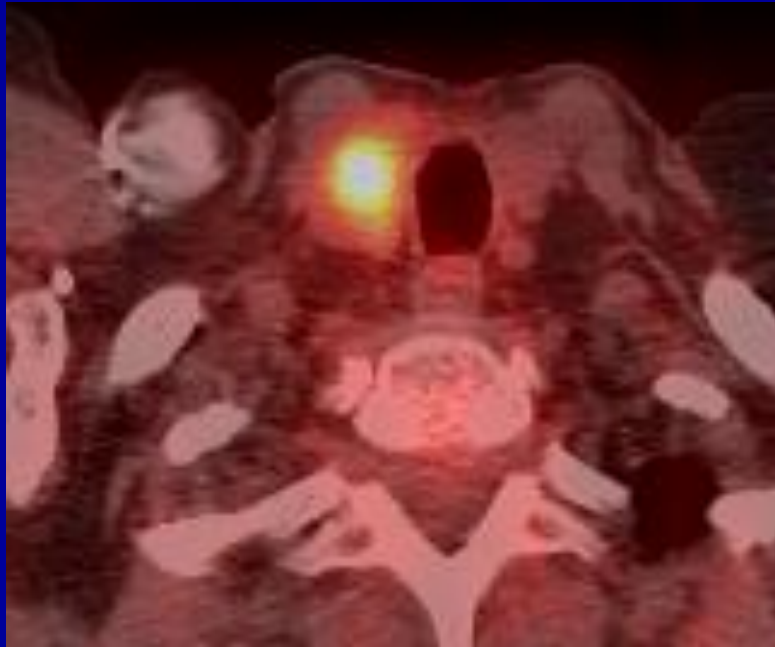
- FDG avid (SUV 6.7)
- Solid, Ca⁺⁺
- > 60% benign
- Need path dx



BENIGN

Suggestive of nodular goiter with cellular evidence of cystic degeneration.

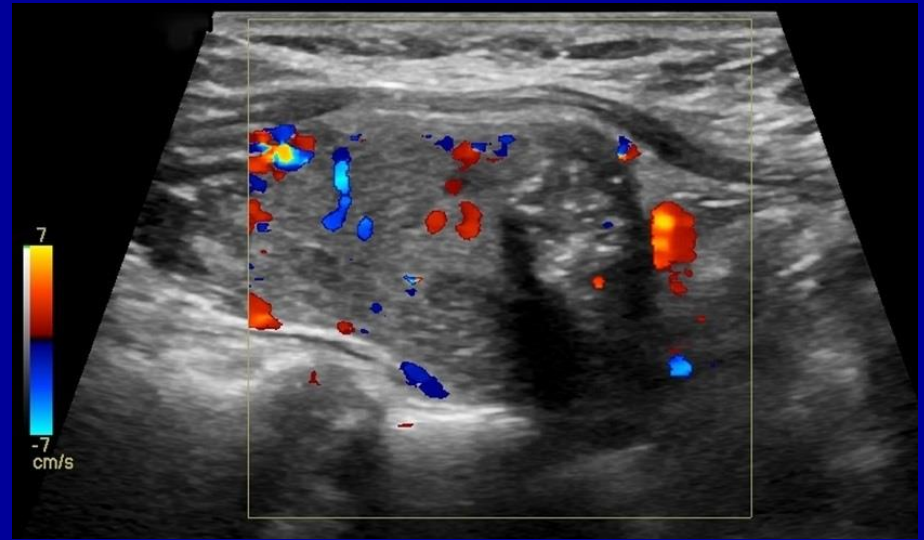
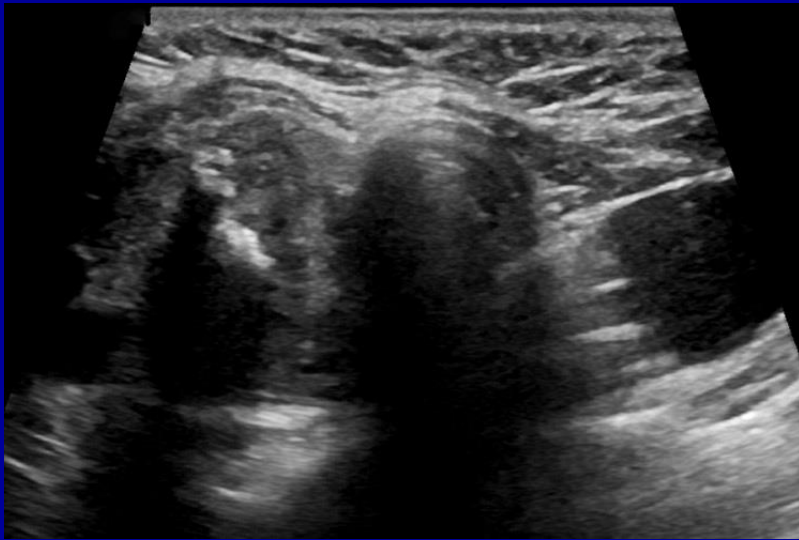
70 yo F w



- Absent left lobe
- Thyroiditis on right, nothing to biopsy

TRANS THYROID ML

Diagnosis: Papillary Thyroid Ca Discovered Incidentally on PET/CT



- Incidental focal FDG avid lesion
- High risk US features- Taller than wide, hypoechoic, Ca++
- Micro and macrocalcifications on US, highly specific for papillary cancer

Conclusions

- US frequently identifies unsuspected abnormalities leading to oncologic dx
- US is useful to choose lesions for biopsy and to perform biopsy
- Proper technical parameters critical to ultrasound performance
- US is an essential component in management of oncologic patients to detect residual disease, recurrence, and new disease

THANK YOU

