Venous Thrombosis & Obstruction

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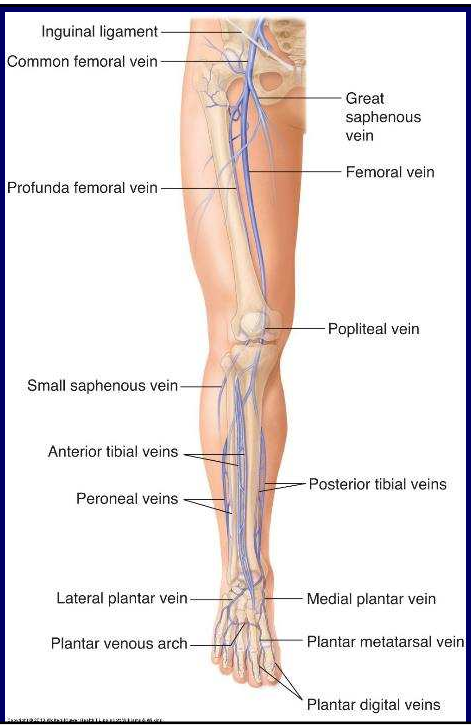
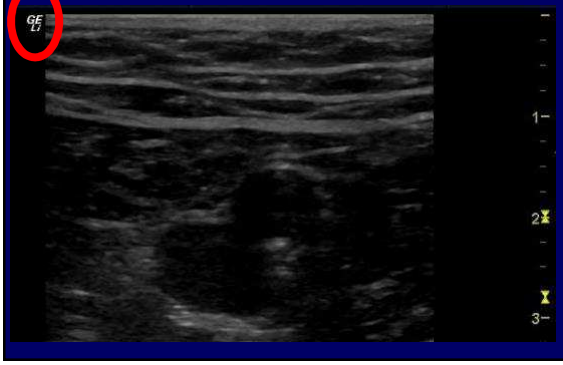
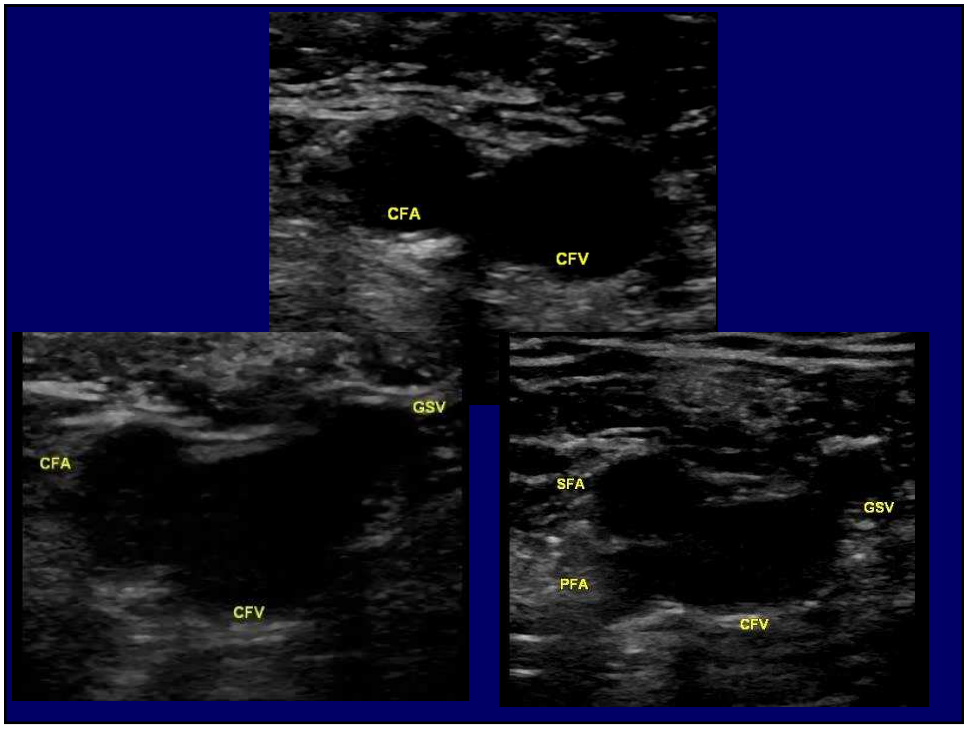
Albany Medical College
&
North Country Vascular Diagnostics

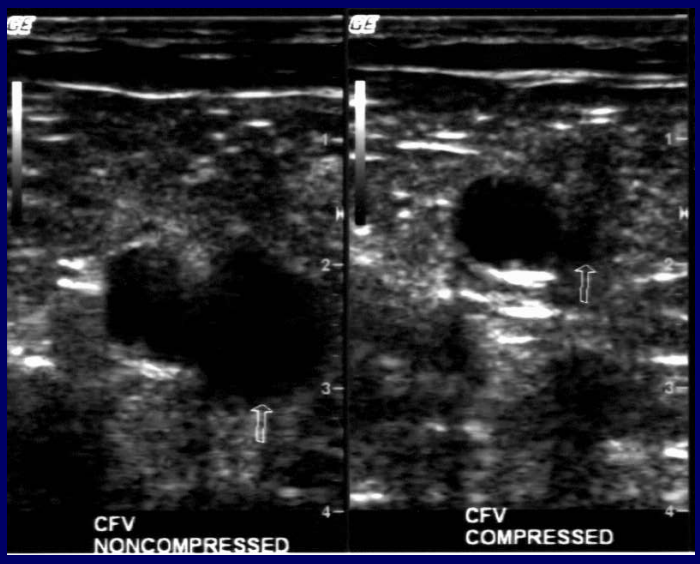
- No Disclosures



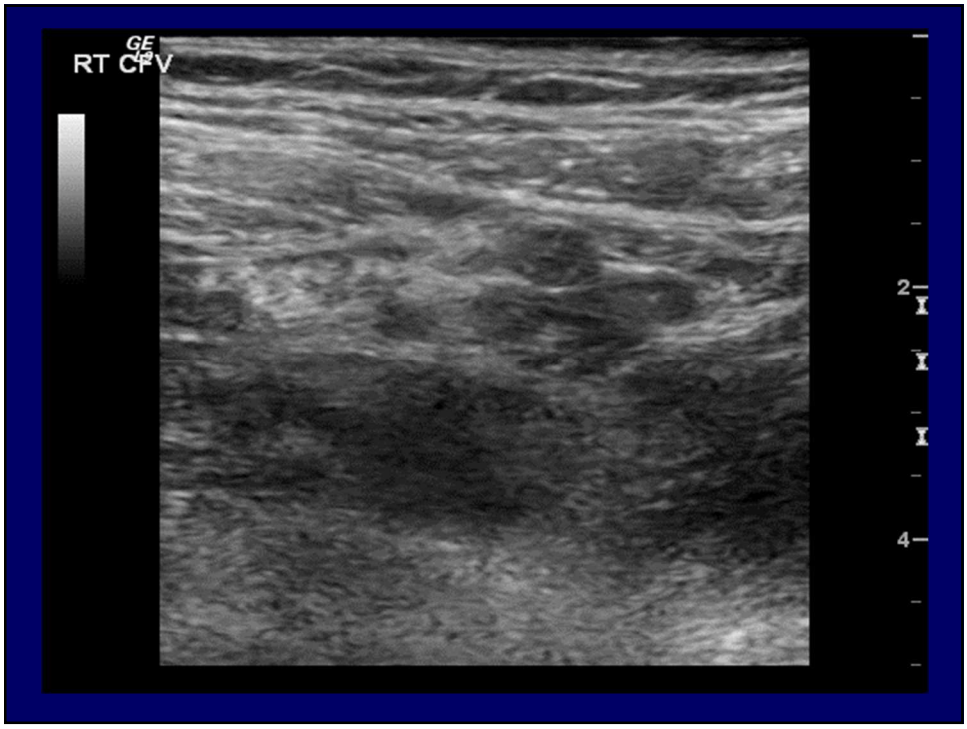
Lower Extremity Deep Veins

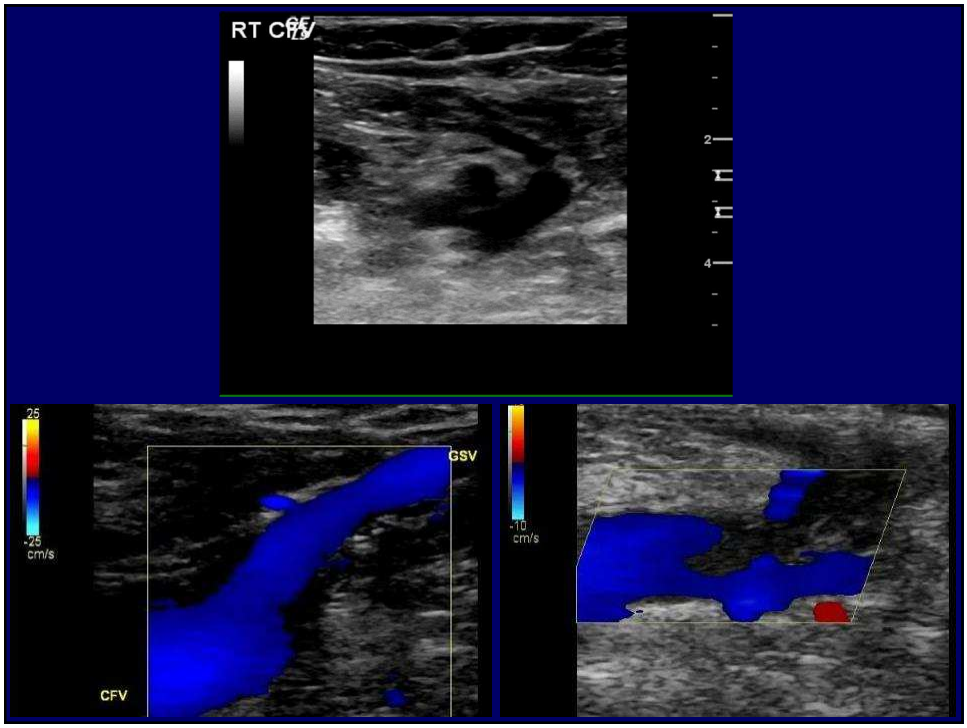






Compressions should be performed at 2 cm intervals


RT CFV
2
4

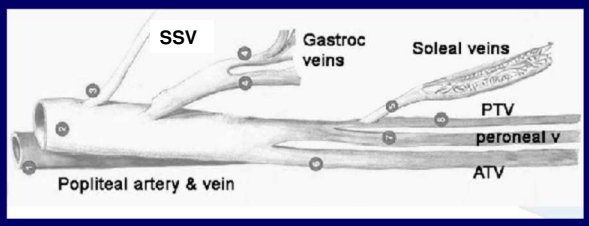

RT CFV
2
4
25
-25
cm/s
GSV
CFV
-10
cm/s

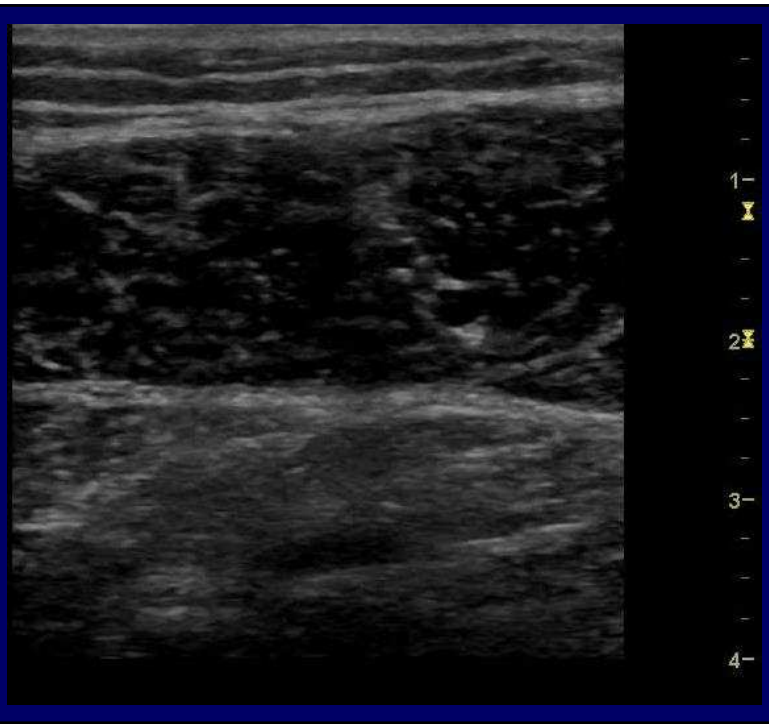
Soleal and Gastrocnemius Veins

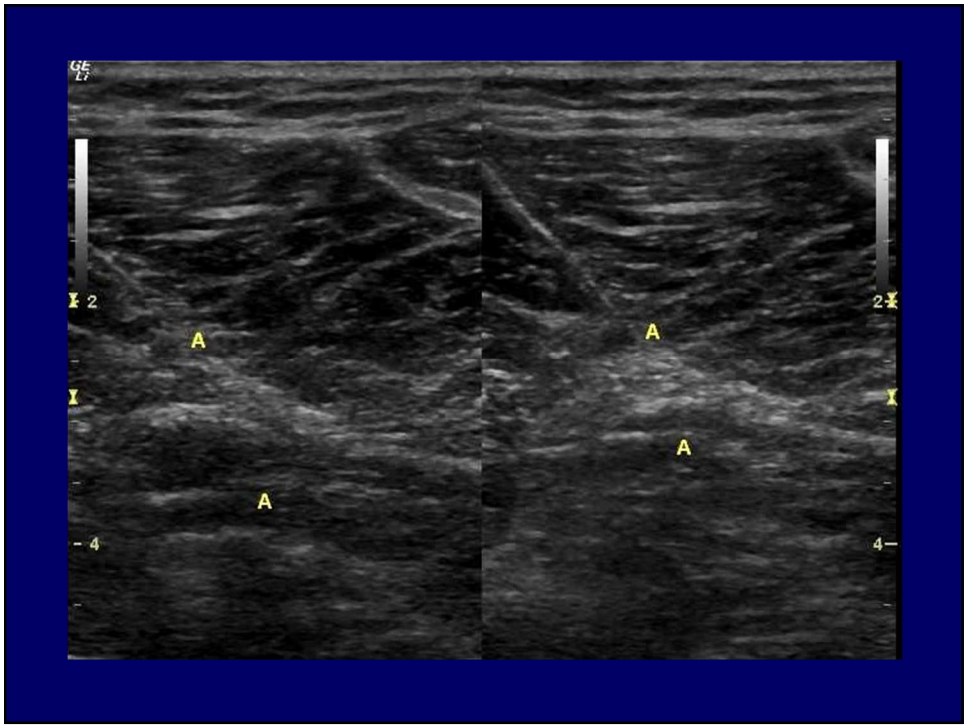
Soleal Veins drain into:

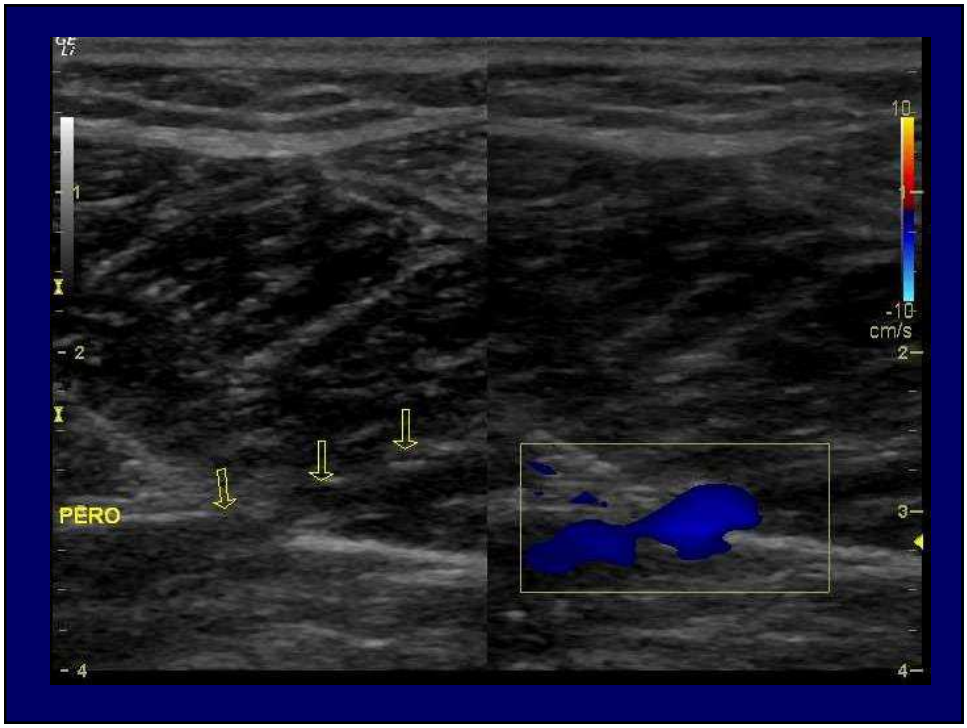
- Posterior Tibial Veins
- Peroneal Veins

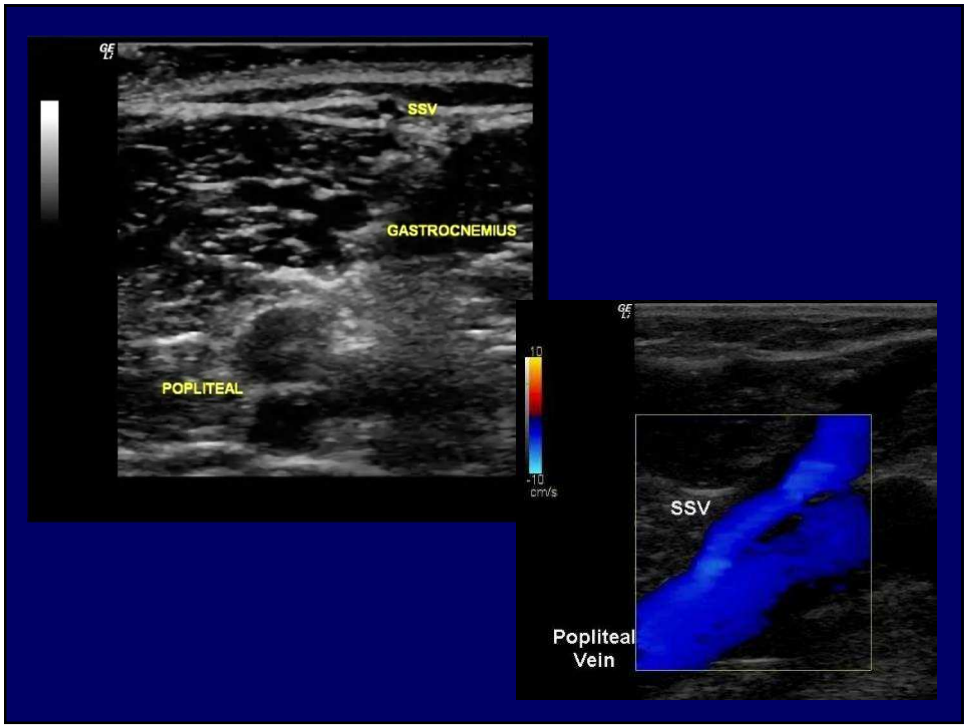
Gastrocnemius Veins drain into the Popliteal Vein





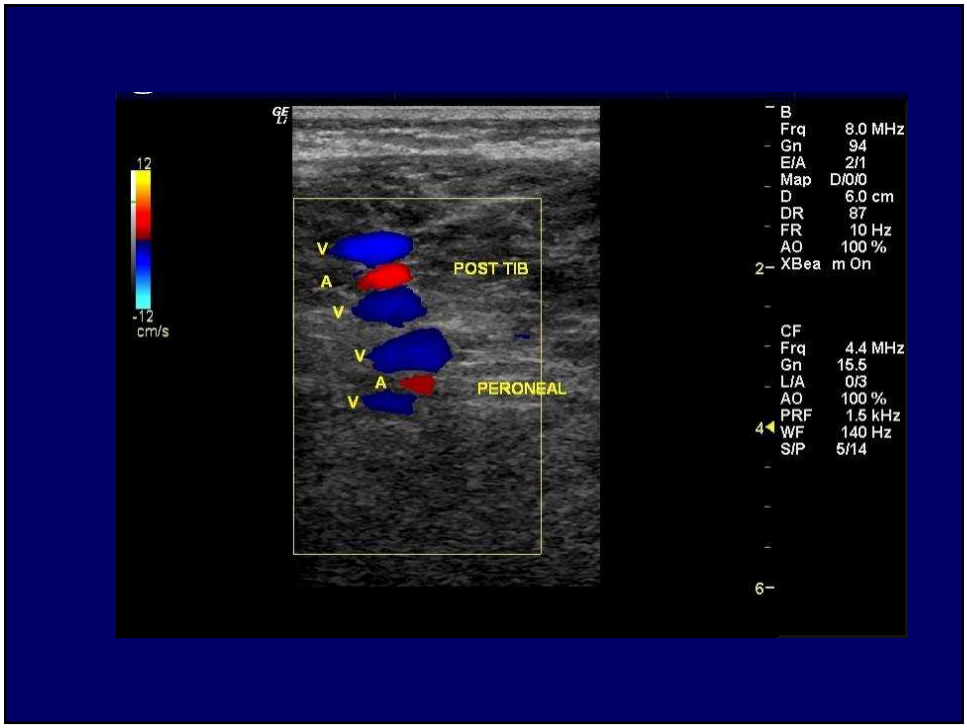

A
A
A
A

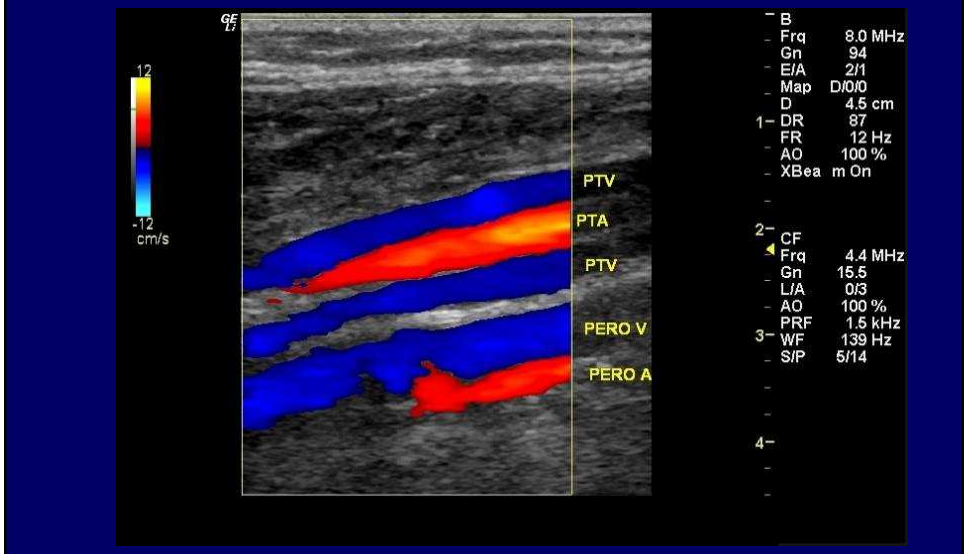

PERO
cm/s



What about Color??

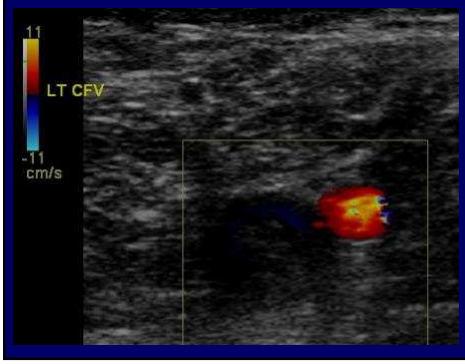
- Color flow imaging
  - Not essential
  - Considered complementary by IAC
  - Helpful in defining extent of thrombus
  - Assists with vessel localization
  - Can aid in confirming vessel patency

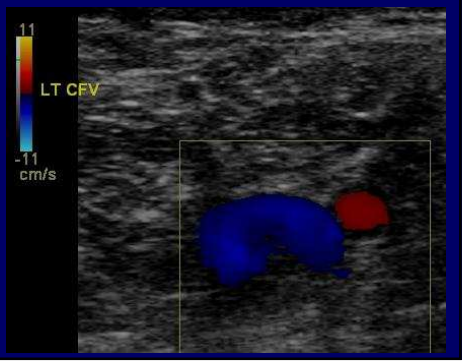

12
-12
cm/s
V
A
V
V
A
V
POST TIB
PERONEAL
B
Frq 8.0 MHz
Gn 94
E/A 2/1
Map D/0/0
D 6.0 cm
DR 87
FR 10 Hz
AO 100 %
XBea m On
CF
Frq 4.4 MHz
Gn 15.5
L/A 0/3
AO 100 %
PRF 1.5 kHz
WF 140 Hz
S/P 5/14


12
-12
cm/s
PTV
PTA
PTV
PERO V
PERO A
B
Frq 8.0 MHz
Gn 94
E/A 2/1
Map D/0/0
D 4.5 cm
DR 87
FR 12 Hz
AO 100 %
XBea m On
CF
Frq 4.4 MHz
Gn 15.5
L/A 0/3
AO 100 %
PRF 1.5 kHz
WF 139 Hz
S/P 5/14

CAUTION!!

- Absence of color does not mean the vessel is thrombosed
- Presence of color does not mean the vessel is thrombus free





Circulation 2018; 137:1505-1515

Circulation

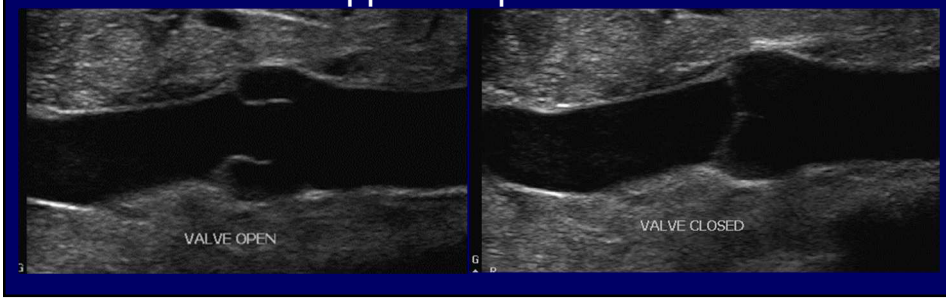
CONSENSUS REPORT

Ultrasound for Lower Extremity Deep Venous Thrombosis

Multidisciplinary Recommendations From the Society of Radiologists in Ultrasound Consensus Conference

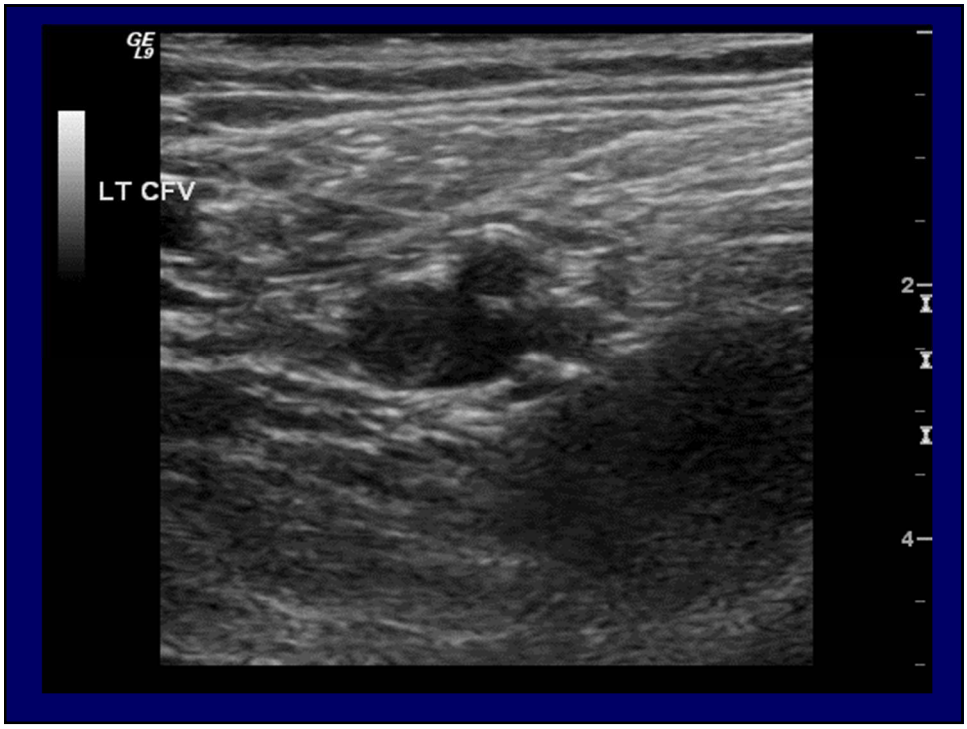
Interpretation Criteria

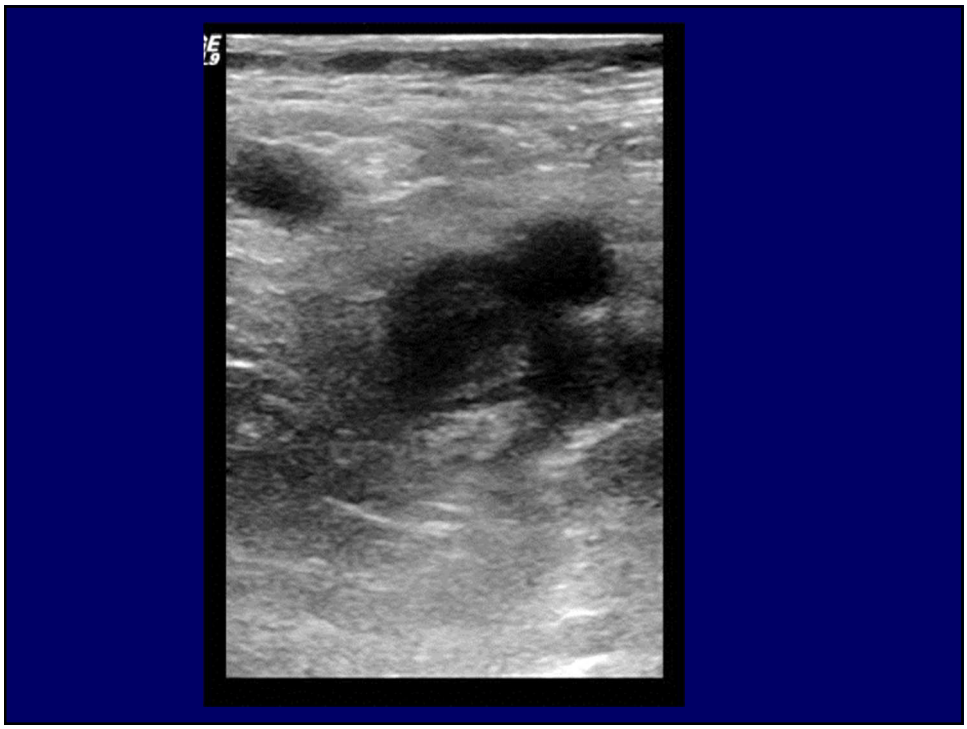
- Normal B-mode image
  - Veins appear thin-walled , smooth
  - Diameter may change with respiration
  - Minimal intraluminal echoes
  - Valve motion may be visible
  - Valves appear elliptical

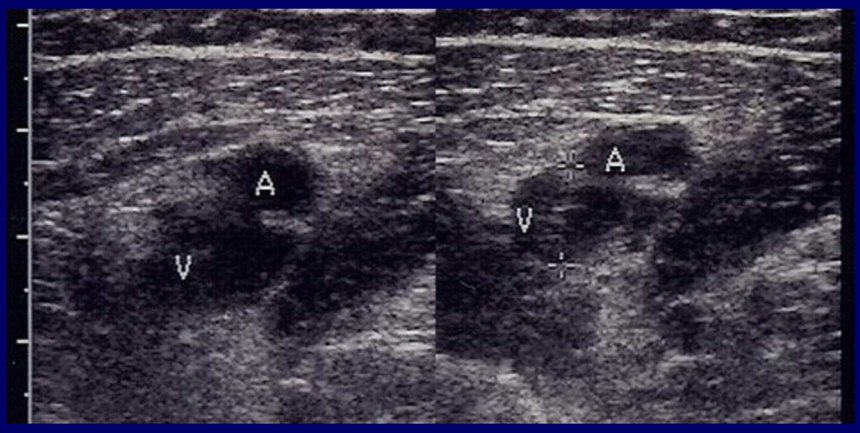


Interpretation Criteria

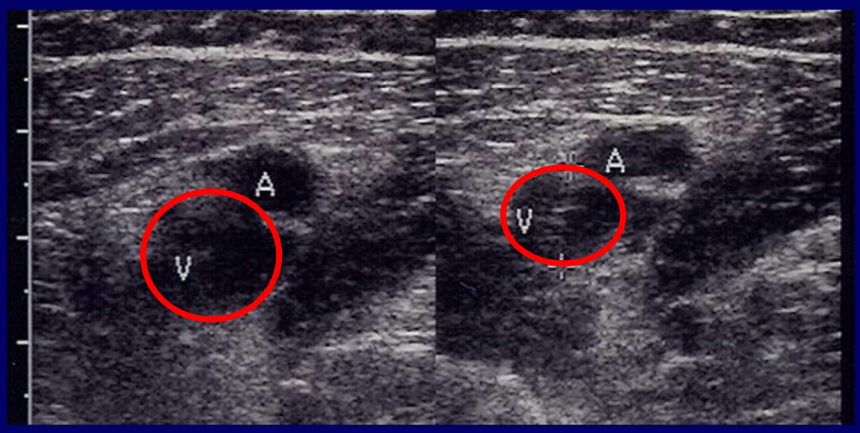
- Acute Thrombosis
  - Thrombus is poorly attached
  - Thrombus appears spongy
  - *May be* hypoechoic or anechoic
  - Thrombus has smooth borders
  - Thrombus "tip" may be visible
  - Vein is dilated


GE
L9
LT CFV
2
4





R FV noncompressed compressed

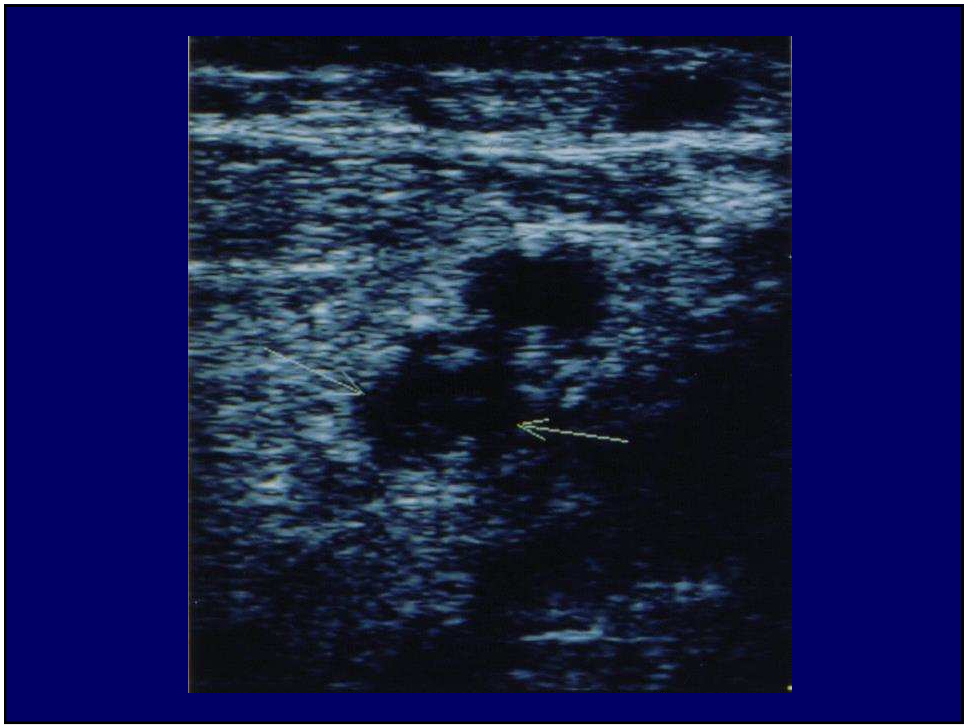


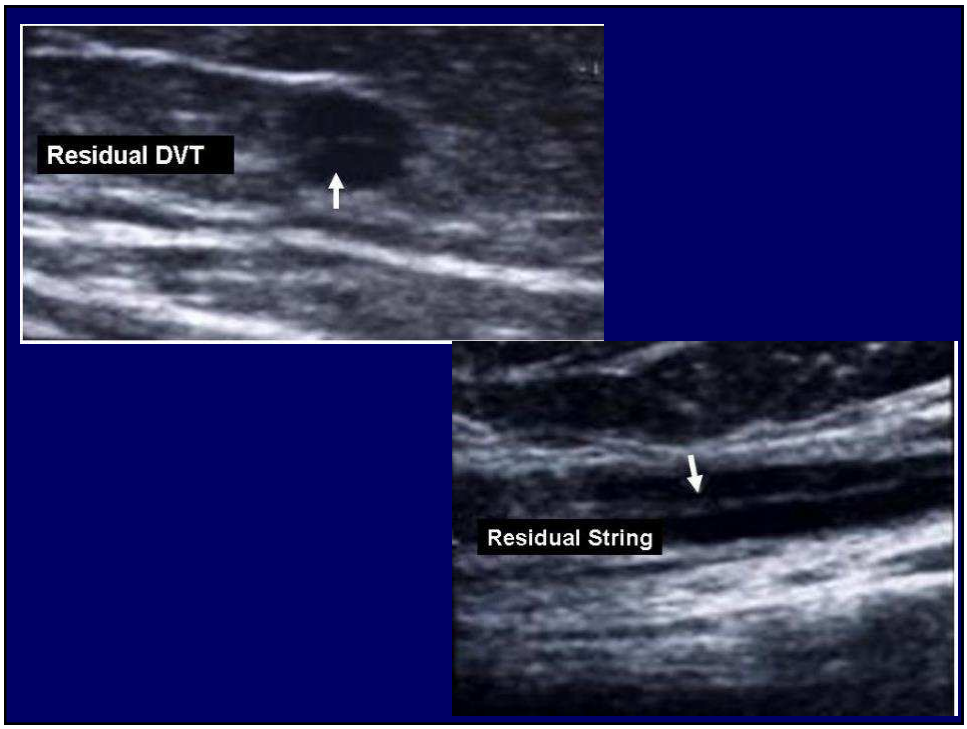
R FV noncompressed compressed

Interpretation Criteria

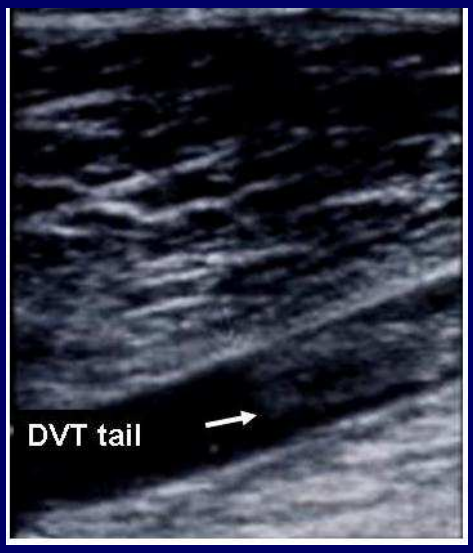
Chronic Post-thrombotic Changes
(Chronic DVT, Scarring or Residual Venous Thrombus)

- Rigid, nondeformable
- Vein size is normal or contracted
- Surface may be irregular
- Thin webs (synechiae) or thicker flat fibrous bands may be present




Residual DVT
Residual String

Hypoechoic vs hyperechoic is not always reliable

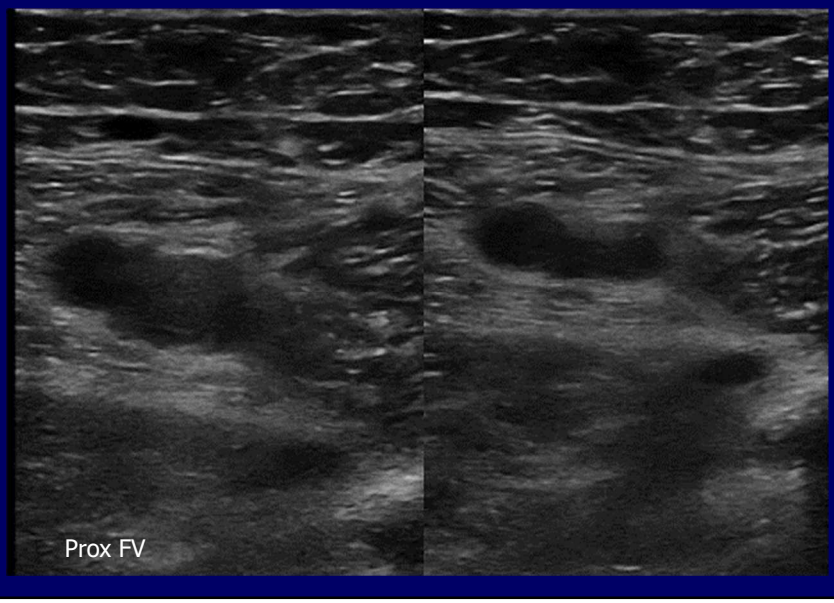


Grey-scale Findings
recommended terminology

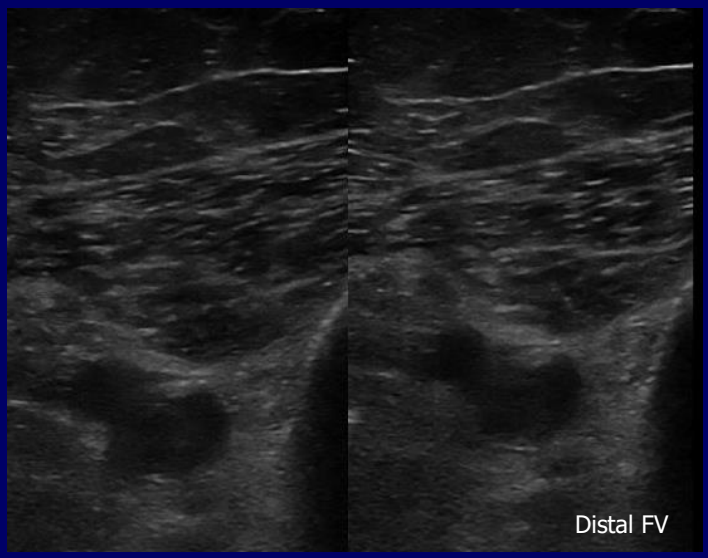
- Acute
- Chronic Post-thrombotic Changes
- Indeterminant (or equivocal)

- Avoid using sub-acute

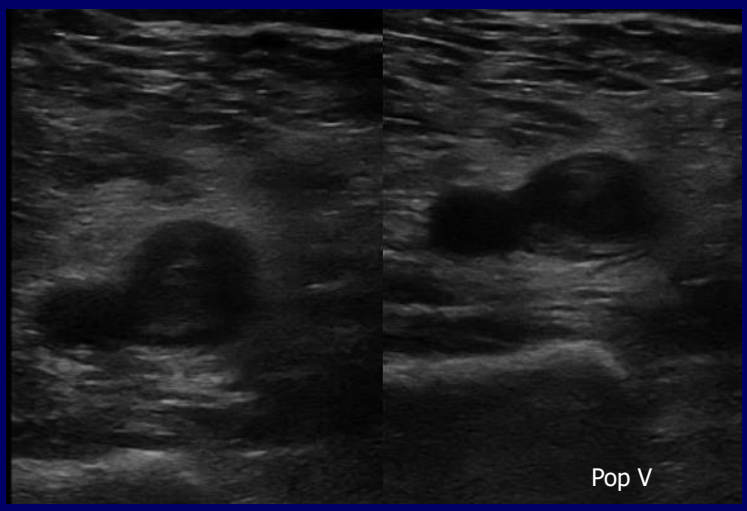
Case study TA: Left calf pain x 4 days



Case study TA

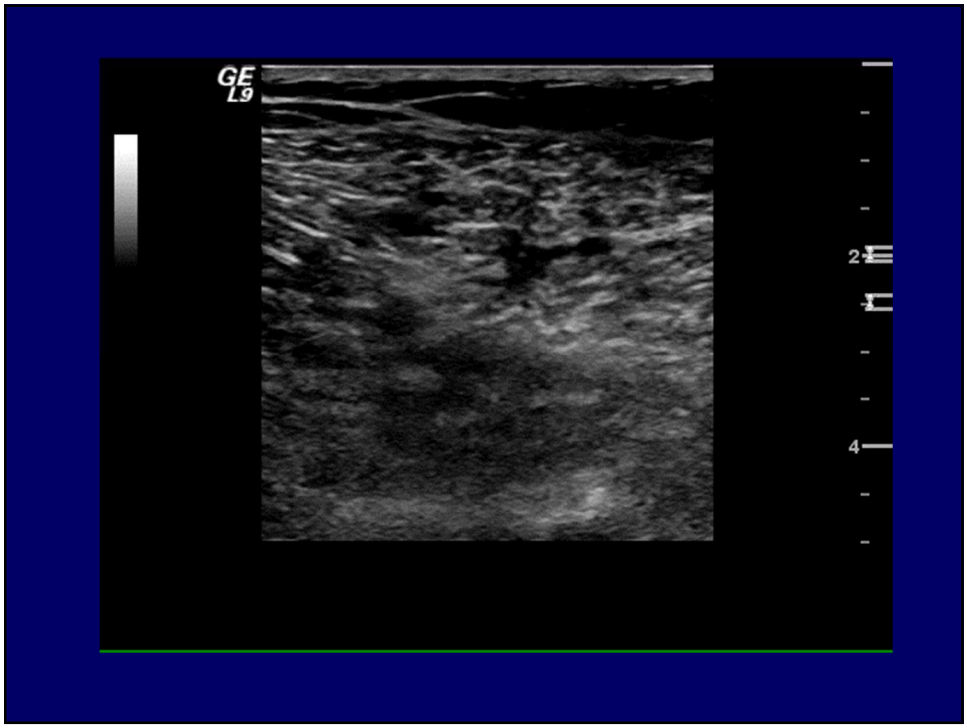


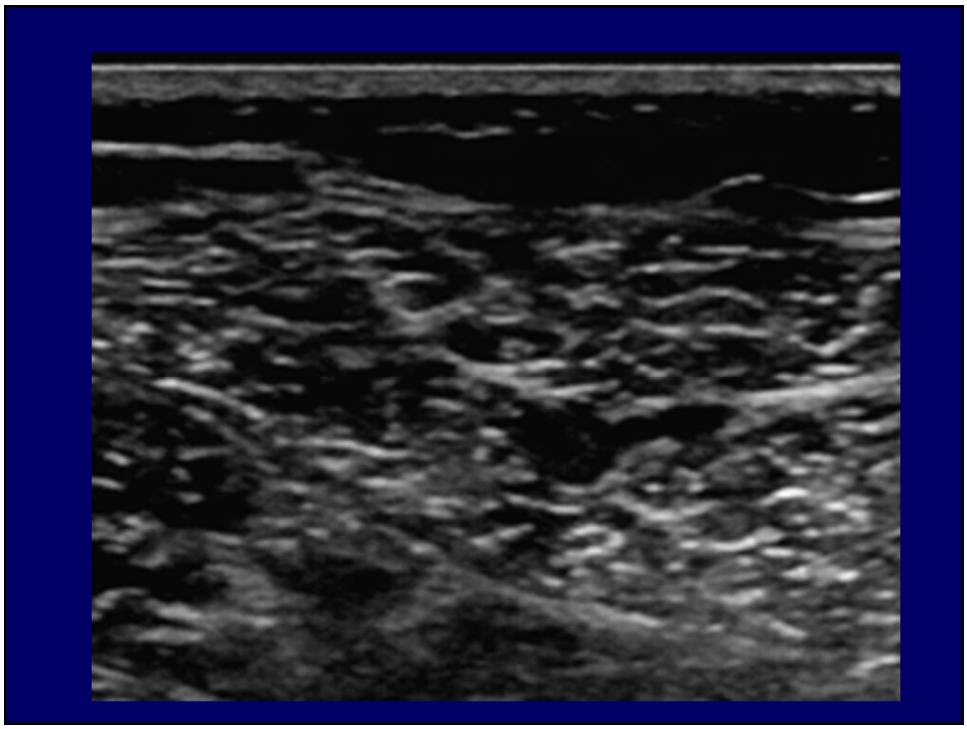
Case study TA



Clinical Presentation

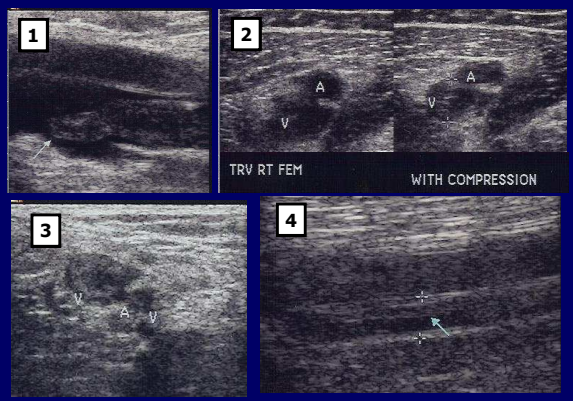
- 45 year old female
- Presents with left calf pain
- No prior history of DVT
- No medications
- No swelling


GE
L9
2
4



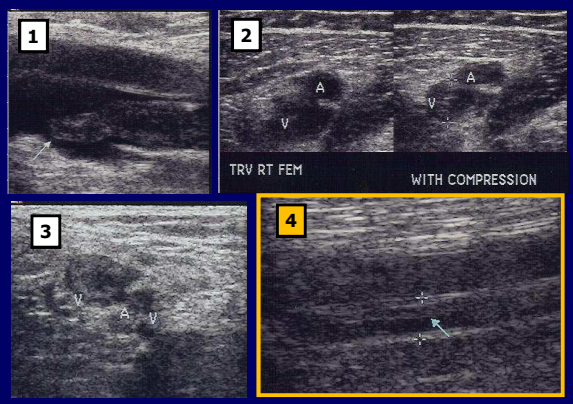
Question #1

Which of the following images is least consistent with acute venous thrombus?



Question #1

Fibrous strand-consistent with chronic post-thrombotic changes

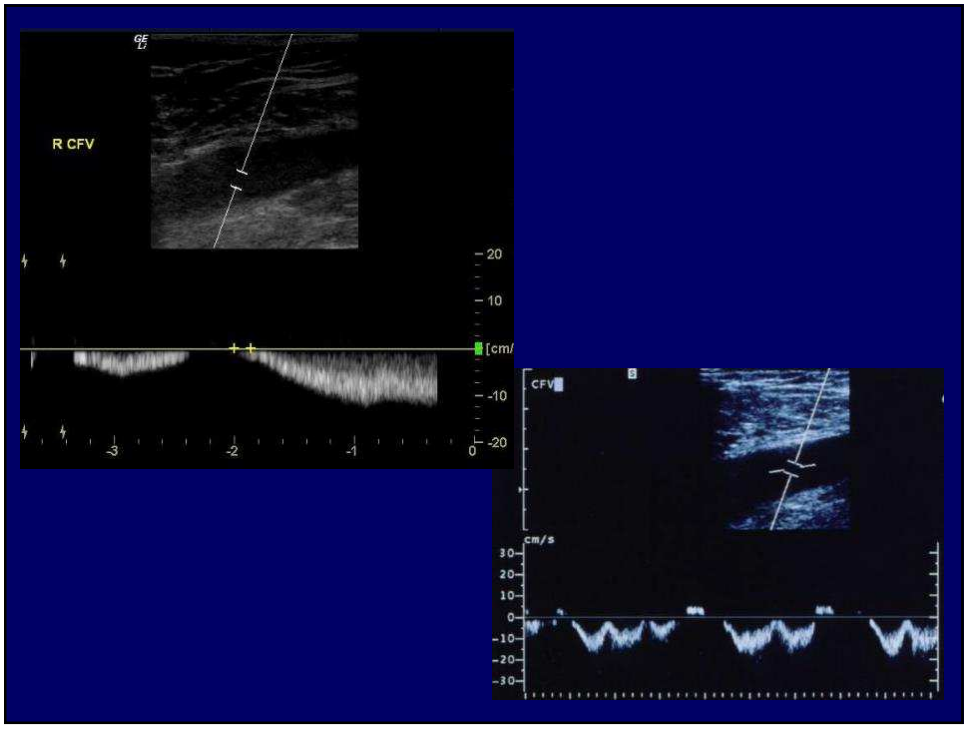


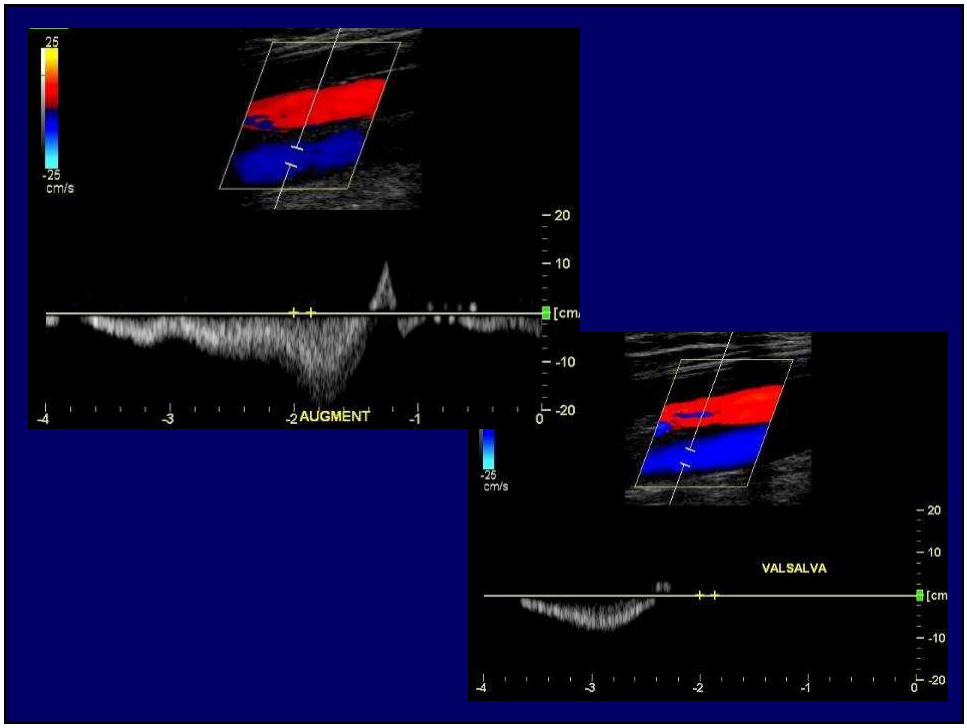
Lower Extremity Protocol

- Doppler Spectral Analysis
  - Record from all major vessels, at least the CFV and Popliteal veins
  - Record at rest and with augmentation (either Valsalva or distal compression)
  - Bilateral recording must be made
  - Required by IAC

Interpretation Criteria

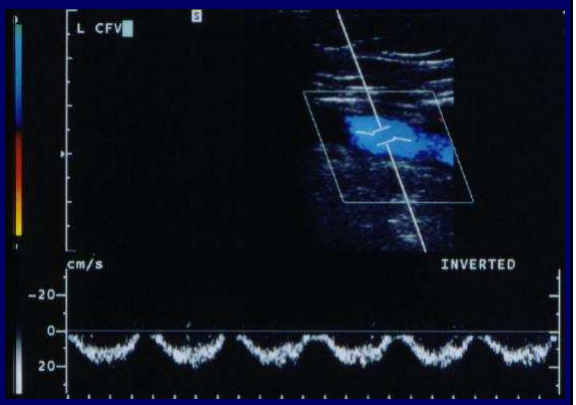
- Normal venous Doppler signals
  - Spontaneous
  - Phasic with respiration
  - Ceases with proximal compression
  - Augmented by distal compression
  - Unidirectional toward the heart


R CFV
20
10
-10
-20
-3
-2
-1
0
CFV
cm/s
30
20
10
0
-10
-20
-30


25
-25
cm/s
20
10
-10
-20
-4
-3
-2
AUGMENT
-1
0
VALSALVA

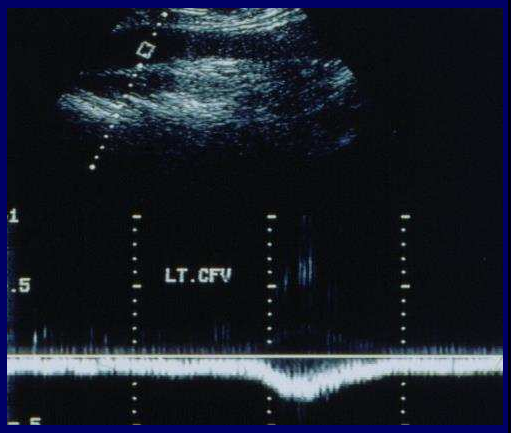
Interpretation Criteria

- Bilateral pulsatile signals
  - Systemic venous hypertension
- Unilateral pulsatile signals
  - Congenital AVF
  - Traumatic AVF
  - Iatrogenic AVF



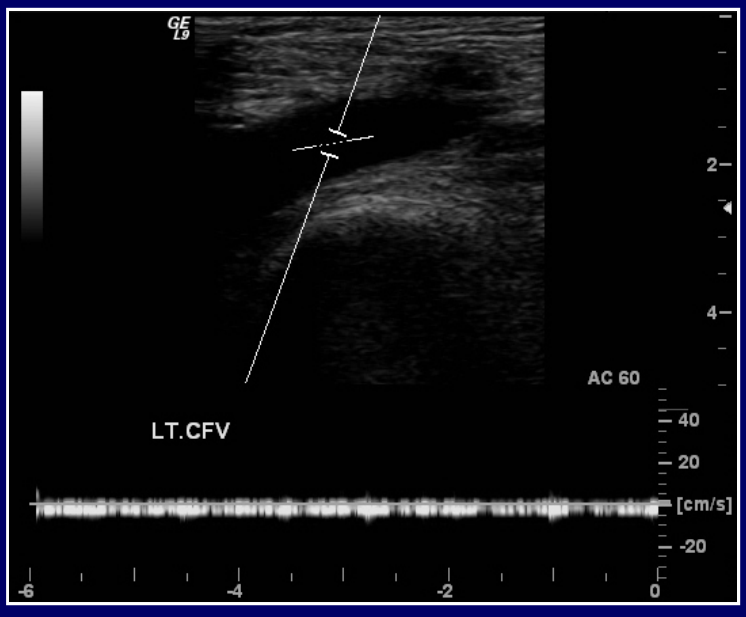
Interpretation Criteria

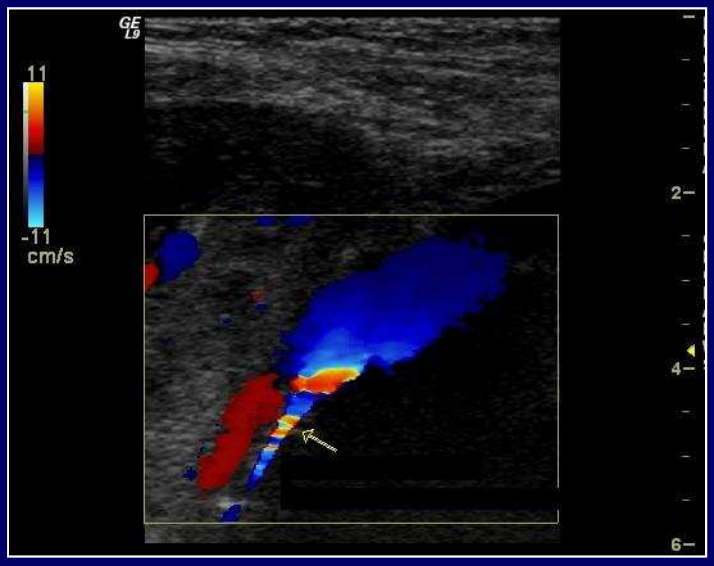
- Unilateral continuous Doppler signals
  - Previous DVT
  - Partial iliac DVT
  - Extrinsic compression
- Bilateral continuous Doppler signals
  - IVC thrombus
  - IVC compression



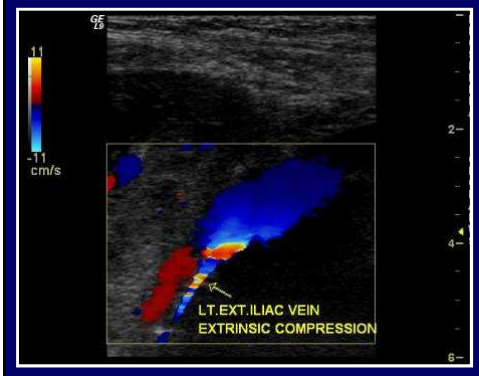
Clinical Presentation

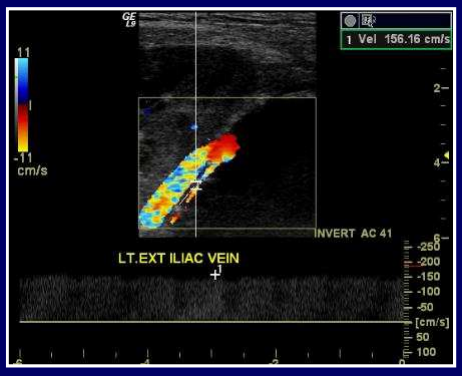
- 63 year old female presents with left lower extremity swelling
- HTN, Non-smoker, Non-diabetic
- All left lower extremity veins found to be fully compressible



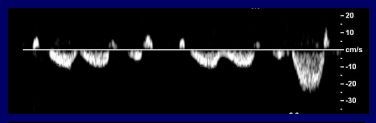


No evidence of DVT in left lower extremity however abnormal venous Doppler signal suggestive of outflow obstruction

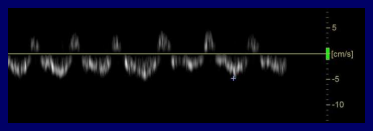




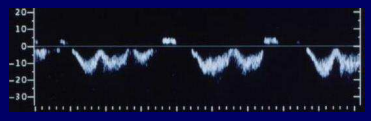
A



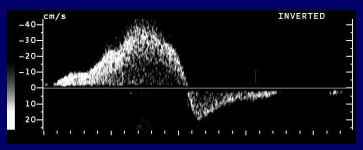
B



C

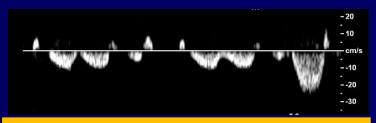


D

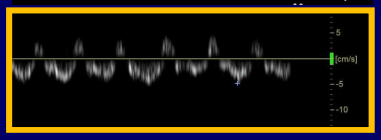


Which one of these is most consistent with venous hypertension?

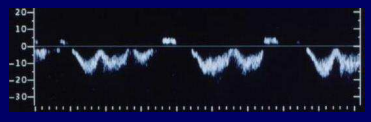
A



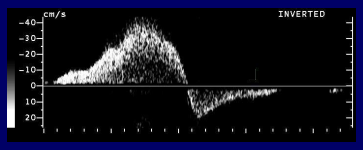
B



C



D



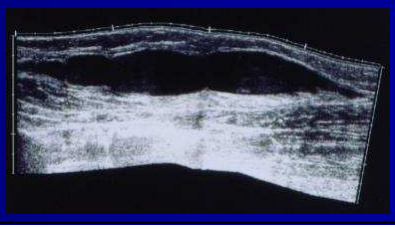
Pulsatile with no respiratory phasicity

Non-Venous Pathology

- Pain and swelling can be caused by non-venous pathology
  - Arterial aneurysms
  - Cysts
  - Hematomas
  - Tumors

Common Finding: Popliteal cyst

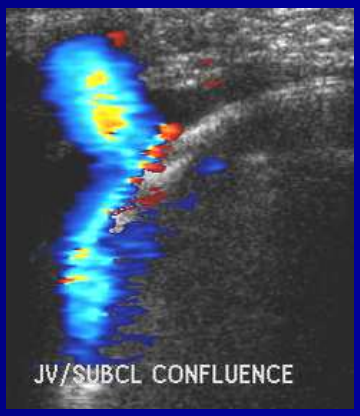
- Popliteal Cyst
  - Hypo or anechoic
  - Posterior enhancement
  - 50% observed to communicate with popliteal fossa (mushroom shaped)
- Ruptured Popliteal Cyst
  - Elongated
  - Pointed edges
  - Extends along gastrocnemius muscle



Unknown Mass:
Make sure to determine presence of blood flow

Upper Extremity Venous

- Approximately 10 % of all DVT cases involve the upper extremity
- Annual incidence of 0.4-1 case per 10,000 people

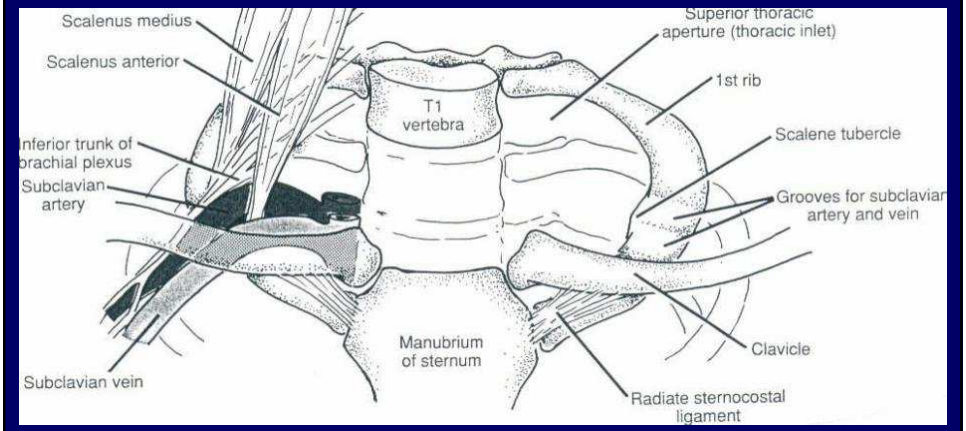


There are 3 major considerations for upper extremity venous imaging:

1. Many LE DVT are caused by stasis but this is not true for the UE - no counterpart to the soleal veins
2. Superficial veins are more affected in the arms as compared to the legs –they are larger than LE superficial veins
3. UE venous anatomy is more variable

Pathogenesis

- Primary
  - 20% of all cases
  - Venous thoracic outlet syndrome
  - Effort-related thrombosis (Paget-Schroetter Syndrome)
  - Idiopathic thrombosis



Effort-related Thrombosis (Paget-Schroetter Syndrome)

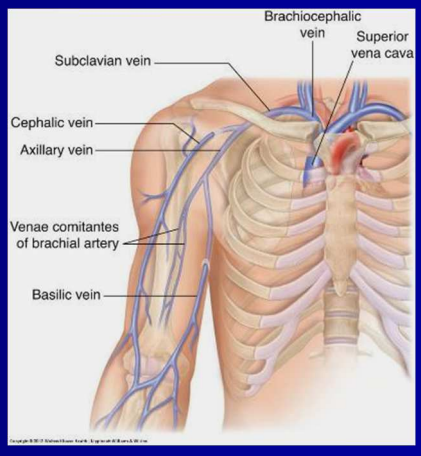
- SCV injury due to repetitive trauma and intermittent compression
  - Overhead arm movements (painting)
  - Vigorous exercise (pitching a baseball, lifting weights, rowing, wrestling)
  - Young, athletic males
  - Anatomical abnormalities may be present but this is only found in 5% of cases

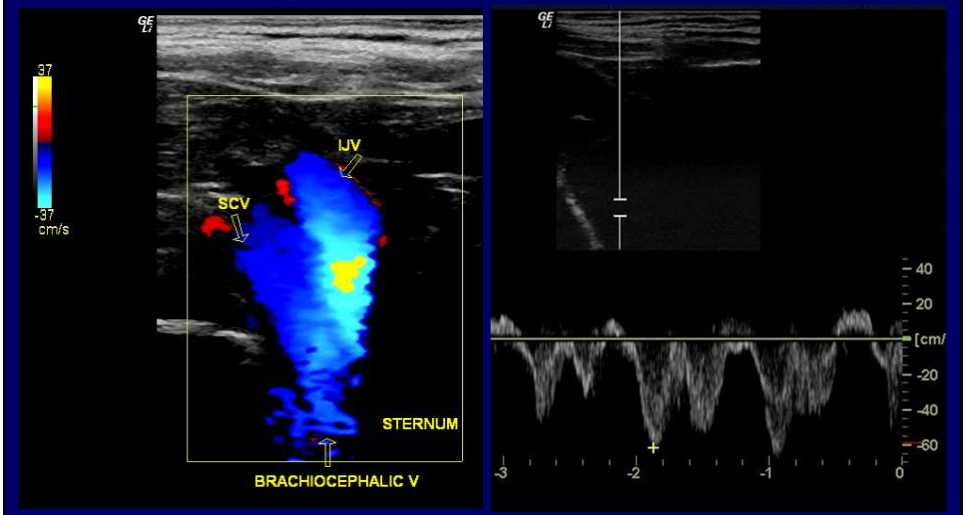
Pathogenesis

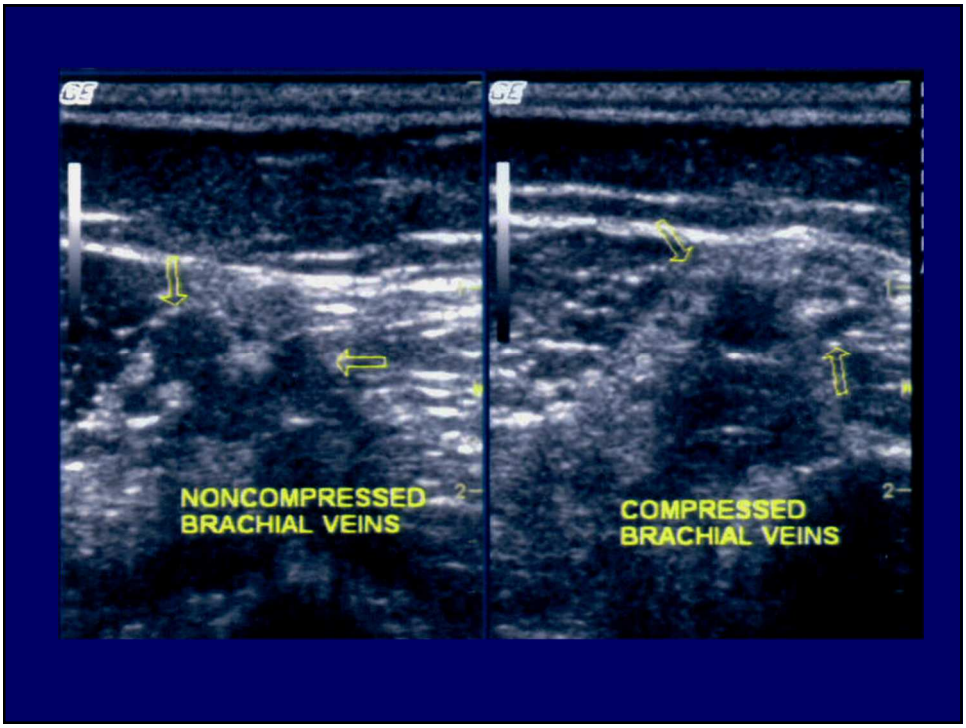
- Secondary
  - 80% of all cases
  - Catheter-associated thrombosis
    - Central line
    - Pacemaker leads
    - Defibrillator leads
  - Coagulation abnormalities
  - Surgery, trauma, IV drug use

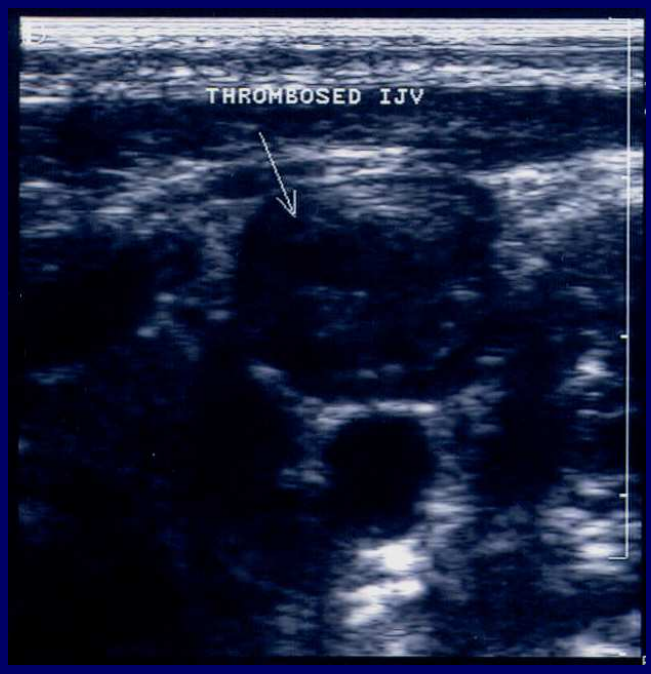
Vessels to be examined:

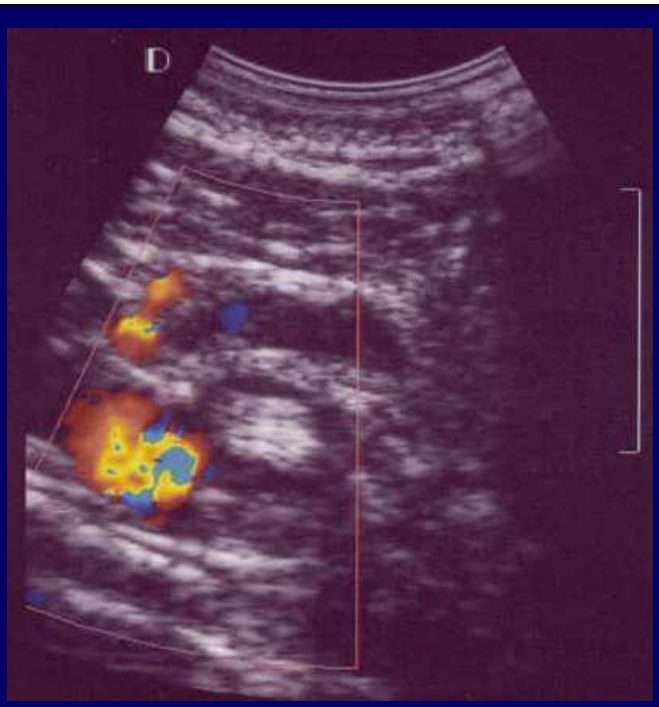
- IJV
- Brachiocephalic
- Subclavian
- Axillary
- Brachial
- Cephalic & basilic
- Forearm vessels if indicated




37
-37
cm/s
IJV
SCV
STERNUM
BRACHIOCEPHALIC V
40
20
-20
-40
-60
-3
-2
-1
0

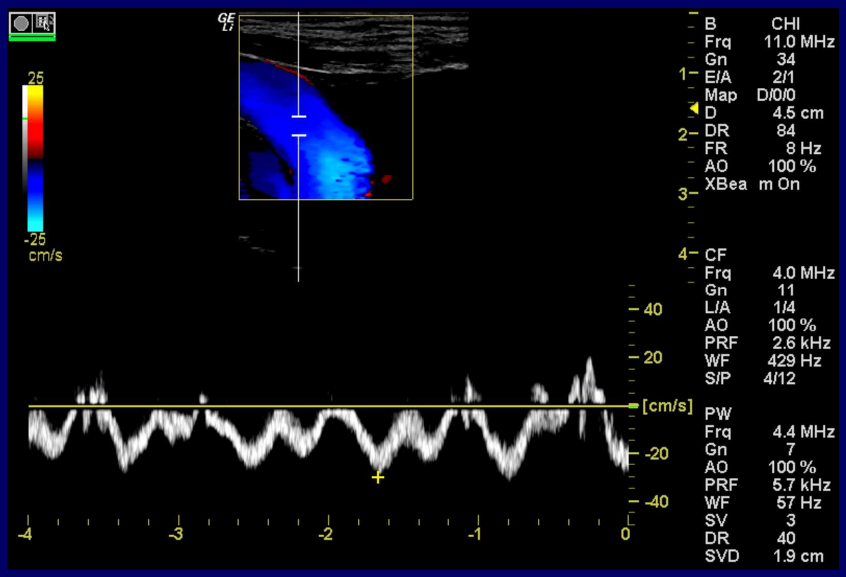

NONCOMPRESSED
BRACHIAL VEINS
COMPRESSED
BRACHIAL VEINS


THROMBOSED IJV


D

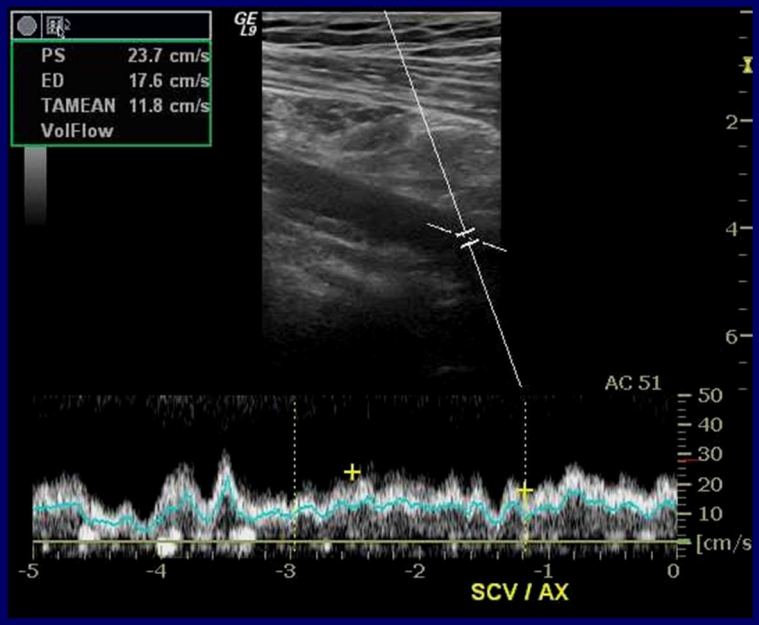
Interpretation Criteria

- Central to the clavicle, Doppler signals should be pulsatile
- Respiratory phasicity may be superimposed over cardiac pulsations
- Peripheral to the clavicle, Doppler signals may be pulsatile or phasic with respiration

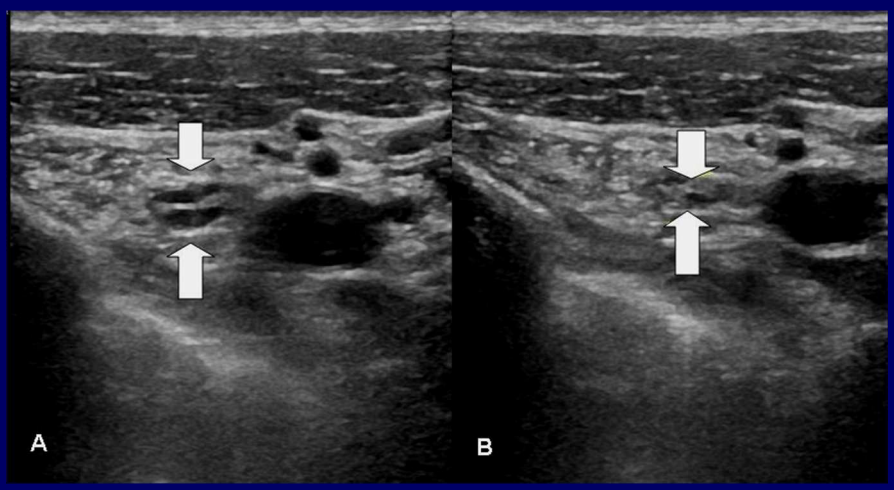


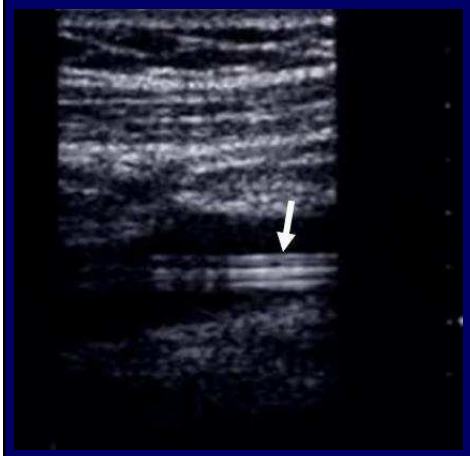
Interpretation Criteria

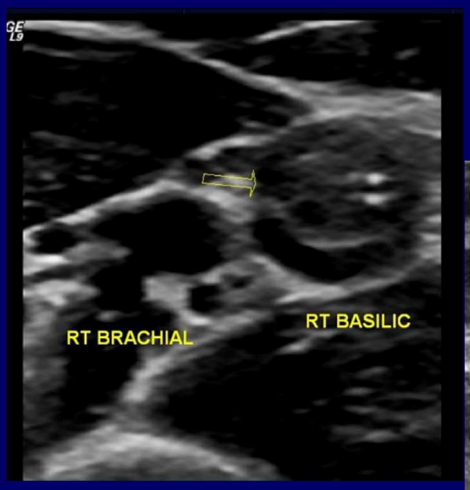
- Pulsatile venous signals may be present with an AVF
- Continuous venous signals may be present with
  - Recanalized veins
  - Partial DVT
  - Extrinsic compression

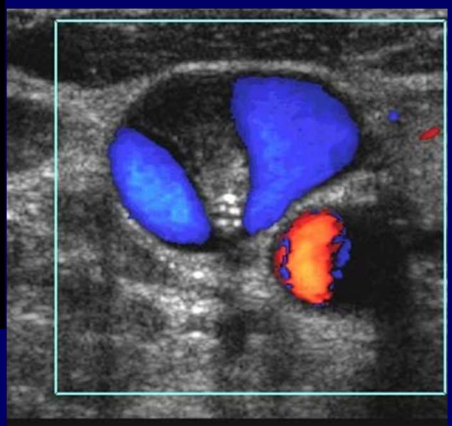


Left Brachial-Basilic AVF


A
B





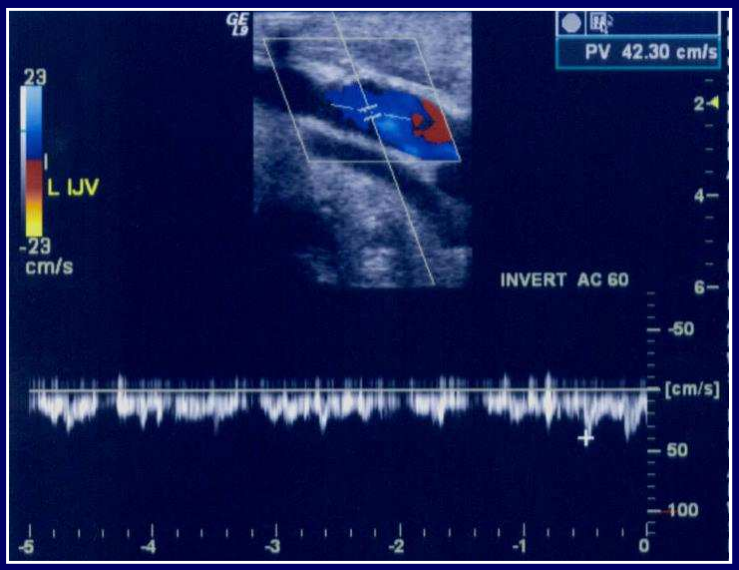


THROMBOSIS SURROUNDING
JUGULAR VEIN PERMACATH

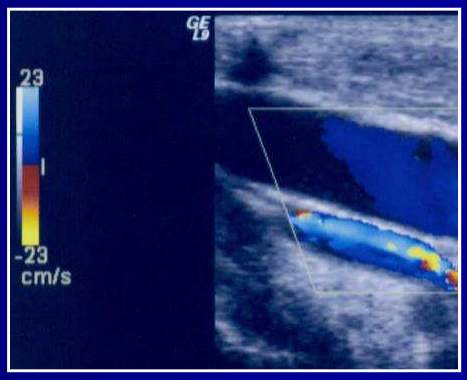
RT AX

Clinical Presentation

- 51 year old male presents with a swollen left upper extremity
- Diabetic, ESRD
- Multiple prior hospital admissions

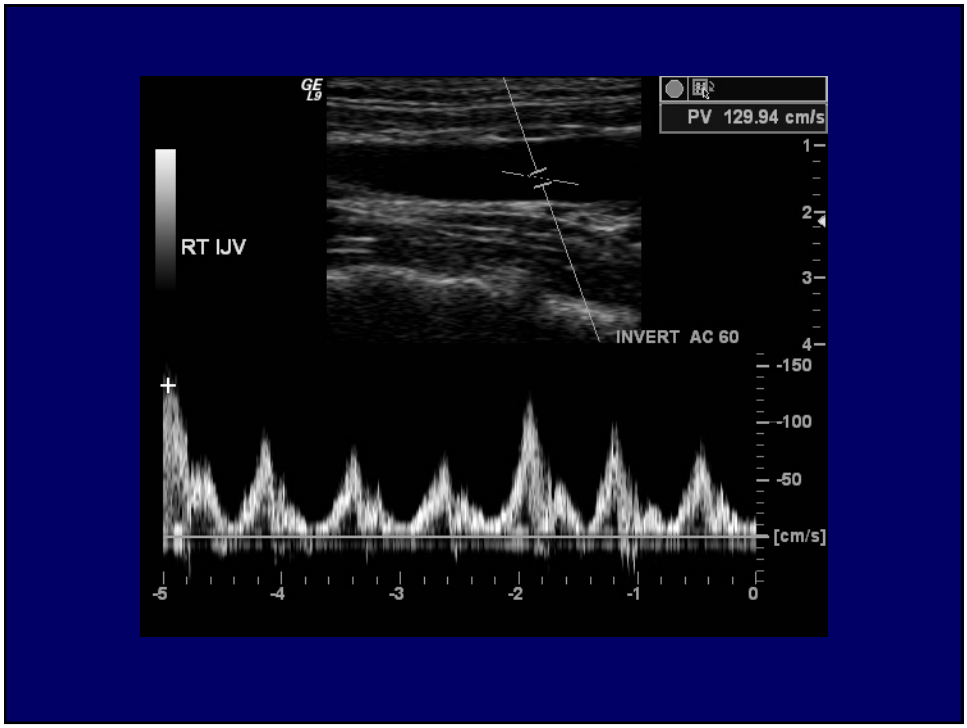


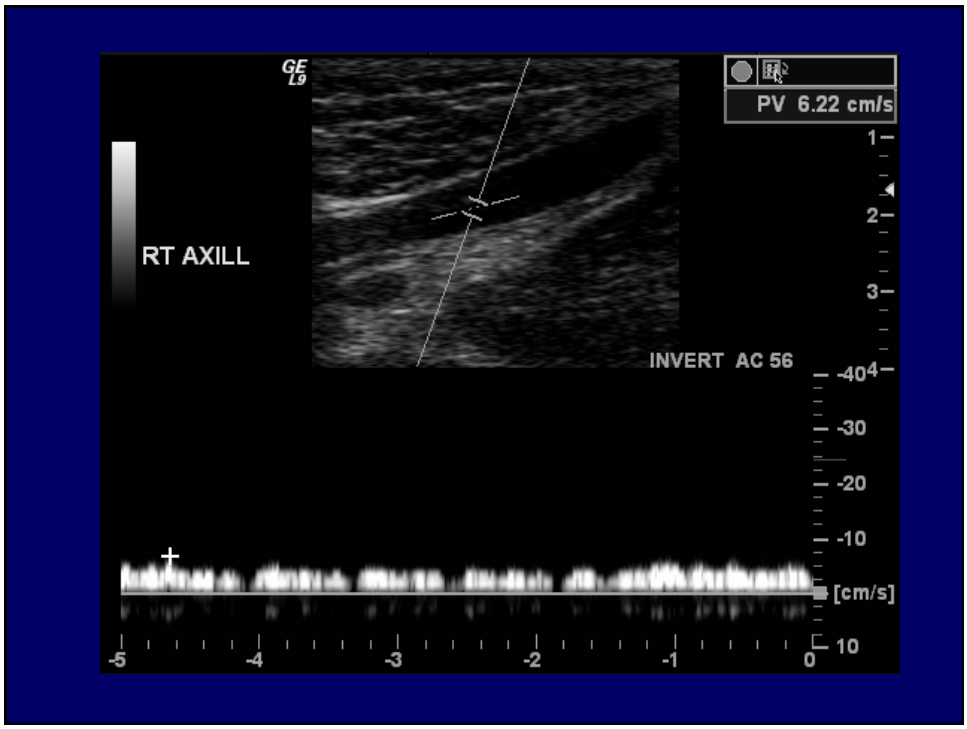
- Retrograde flow in jugular vein likely associated with brachiocephalic vein obstruction



Clinical Presentation

- 48 year old male
- Chronic renal failure
- Several past UE venous catheters
- Right UE swelling


GE
L9
PV 129.94 cm/s
RT IJV
INVERT AC 60
1
2
3
4
-150
-100
-50
[cm/s]
-5
-4
-3
-2
-1
0


GE
L9
PV 6.22 cm/s
RT AXILL
INVERT AC 56
1
2
3
4
-40
-30
-20
-10
[cm/s]
10
-5
-4
-3
-2
-1
0

Abnormal Doppler signals consistent with subclavian vein thrombus

Conclusion

- Ultrasound can easily be used to confirm venous patency and identify pathology
- Criteria:
  - Normal: Thin-walled, compressible, Doppler signals are phasic and augmentable
  - Acute: Dilated, spongy
  - Chronic Post-thrombotic Changes: Rigid, contracted, scarring
- Venous Doppler patterns help identify local and remote pathology