

## **Instructor's Digital Curriculum Resource-**

### **For Techniques in Noninvasive Vascular Diagnosis-4th edition.**

by Robert J. Daigle, BA, RVT, RVS, FSVU, FSDMS

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## **Chapter 8. Venous Imaging of Upper Extremities**

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### **Definitions for this chapter**

- **Erythemia**
  - local redness
- **Angioplasty**
  - Vessel stenosis dilation with a saline-filled balloon catheter
- **Fibrosis**
  - formation of excess fibrous connective tissue

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### **Definitions for this chapter**

- **IAC-Intersocietal Accreditation Commission (formerly ICAVL)**
- **Rouleaux**
  - Blood cells that clump together in a swirling pattern
- **Etiology**
  - The source or the cause of a condition
- **Idiopathic**
  - Of unknown cause

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## **Venous Symptoms**

- Pain and swelling in arm or neck
- SOB, Chest pain, ? Pulmonary embolus
- Dilated superficial veins of the arm and shoulder.
- Local erythemia, palpable cord
- Catheter infusion difficulty
- Pre-operative assessment for hemodialysis access placement.

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## **Upper DVT: Etiology**

- **Intimal injury**
  - indwelling venous catheter
  - pacemaker wire
  - stents

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## Upper DVT: Etiology

- **Stasis**
  - thoracic outlet compression or effort induced
  - compression by mass
- **Other**
  - radiation induced fibrosis
  - venipuncture
  - IV drug abuse
- **Idiopathic**

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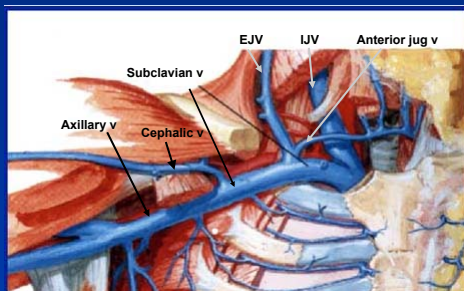
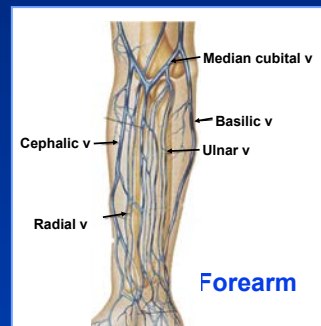
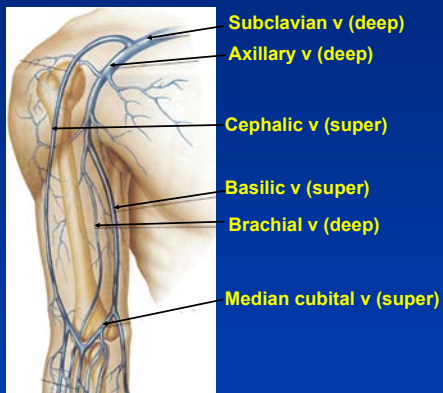
## Deep Veins

- Radial, Ulnar Interosseous
- Brachial
- Axillary
- Subclavian
- Internal Jugular
- Innominate
- SVC

## Superficial veins

- Cephalic
- Basilic
- Median cubital

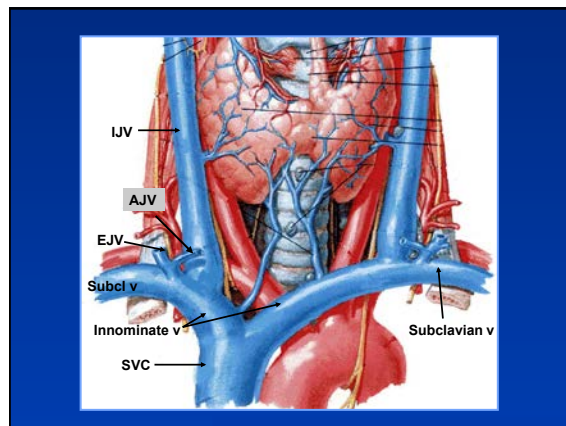
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## Other (Central) Veins

- External jugular
- Anterior jugular
- Jugular arch vein
- Transverse scapular
- Inferior thyroid
- Internal mammary

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## Exam Protocol

- **TIPS**
  - Orientation- hand to screen **RIGHT**
  - Proximal veins
    - Doppler priority
    - Shoulder abduction for access
  - Distal veins (arm)
    - Prioritize compressibility

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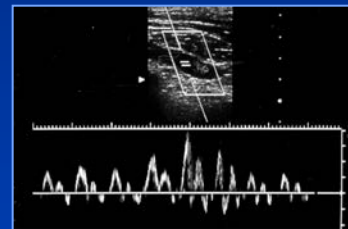
Patient position for  
evaluation of proximal veins

**Supine**

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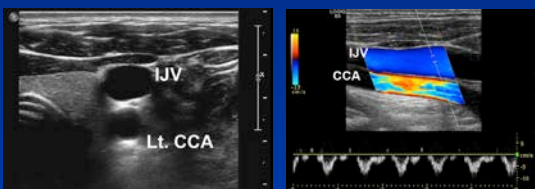
## Normal Upper Venous Flow

- respiratory phasicity
- cardiac pulsatility



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**Assess Internal Jugular Vein**  
Follow IJV to subclavian vein confluence



Transverse view of IJV, scan  
proximally to Subclavian vein  
confluence

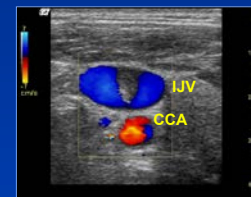
Longitudinal view of IJV, with  
normal pulsatile flow.

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Carefully image for IJV Thrombus



**IJV thrombus  
longitudinal**



**IJV thrombus  
transverse**

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## Thrombus in IJV

When in PowerPoint Show, click on link below for video demo on youtube.

<http://youtu.be/gSoZLC8AXss>



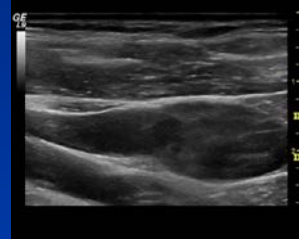
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## Caution!

- Reverberation artifact and "Rouleaux" (blood cell clumping) are commonly seen in the jugular vein.

When in PowerPoint Show, click on link below for video demo on youtube.

<http://youtu.be/O7YXsGfdgYw>



Movie- Rouleau01

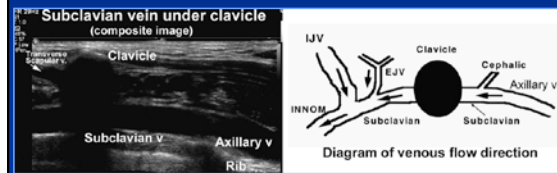
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## Supraclavicular Scan Position



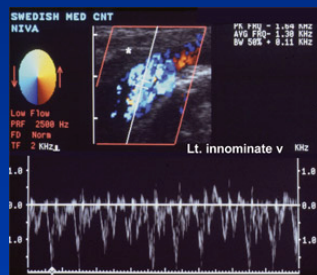
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## Subclavian Vein Assessment



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## Normal Innominate Vein Flow



Proximal subclavian vein flow will look similar

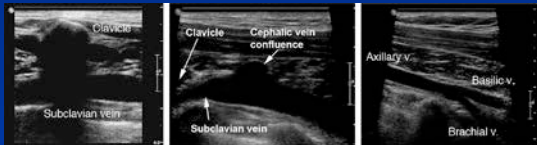
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## Infraclavicular Subclavian Vein



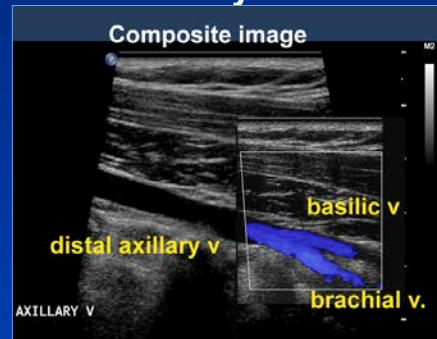
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## Infraclavicular Section



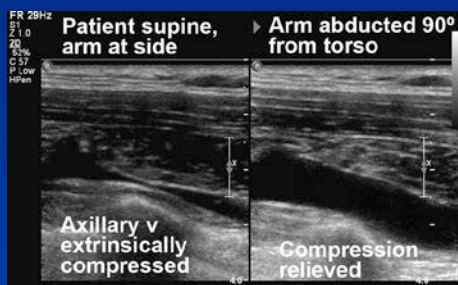
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## Axillary Vein



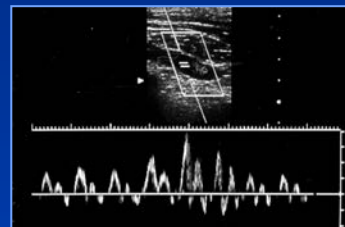
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## Abduct arm to alleviate transient axillary vein compression



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## Axillary Vein. Rely on Waveform Morphology



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## Contralateral Assessment

- Because subclavian waveform assessment is critical, it is important (& required by IAC) that a comparison be made with the contralateral subclavian vein

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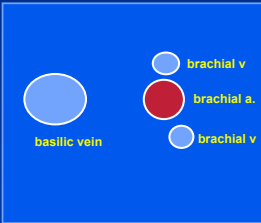
## Arm Veins

- Use compression-release method
- Pulsatile- phasic flow may be absent
- Very superficial veins need "standoff" gel



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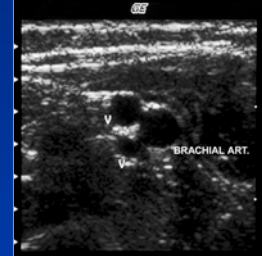
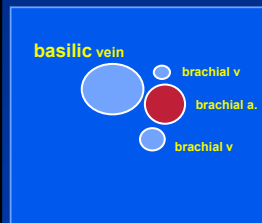
## Mid-upper Arm Transverse



At mid-arm the basilic vein lays away from the brachial complex

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## Proximal Upper Arm Transverse



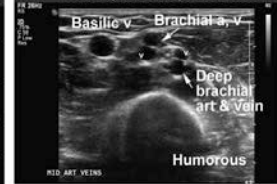
In the axilla or proximal arm, the basilic vein may be adjacent to the brachial art.

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Trans. Axilla: Basilic and Brachial veins are close to the artery



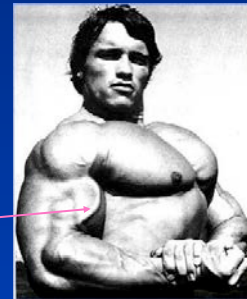
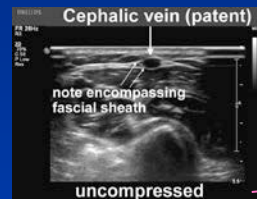
Trans., medial, mid-arm



Often the deep brachial veins are seen as well.

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Cephalic veins are small and hard to image, unless, of course, you're a ex-governor.

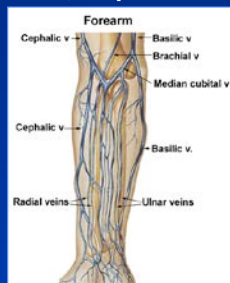


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**Forearm Veins:**  
scan these under the following conditions, otherwise, skip.

- Local, palpable cord; suspicion of superficial thrombophlebitis.
- Infusion difficulty with peripherally inserted central catheters (PICC lines)

continued



**Forearm Veins:**  
scan these under the following conditions, otherwise, skip.

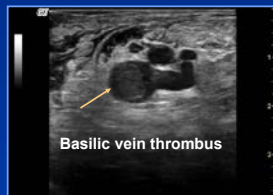
- Pre-op assessment for hemodialysis access placement, (scan the superficial veins only).
- Pre-op for vein harvest for arterial bypass (determine patency and size).





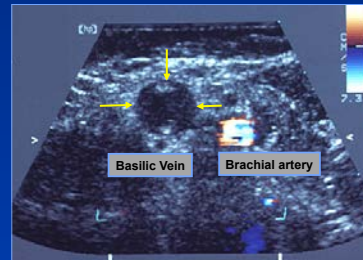
## Criteria For Venous Thrombosis Upper Extremities

- Visualization of thrombus
- Lack of vein coaptation
- No flow : color and spectral Doppler
- Abnormal flow patterns and flow direction in central veins.



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## Basilic Vein Thrombus



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## Paget -Schroetter Syndrome

- Spontaneous thrombosis of subclavian - axillary vein
- Effort induced
- Anatomical factors
- Hypercoagulability

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## Paget - Schroetter Syndrome

- Patient: Van W.
- 38 yr old body builder
- left arm swelling x 3 weeks



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## Paget-Schroetter?

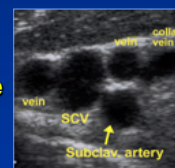
- Most likely!
- Notice the dilated superficial veins of the right shoulder, i.e. collateral pathways.



- Precursor to Paget-Schroetter syndrome???

- Extensive collateral development in the presence of SCV compression.

- Infraclavicular, transverse view looks like Swiss Cheese on this patient!



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## Superior Vena Cava Syndrome

- Occlusion or compression of SVC
- Increased venous pressure
- Edema of neck, face and arms, usually bilaterally

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## SVC Syndrome Patient with constrictive "web" in SVC

Pre-angioplasty

Post - stent placement



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## More Case Studies

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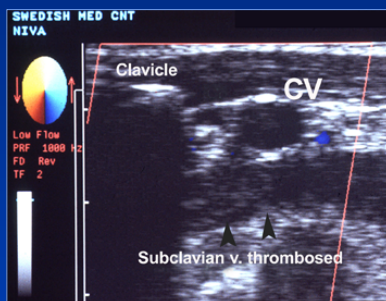
## Patient: Case 1

- 28 year old female
- Awoke w/ Lt arm pain & swelling
- History (Hx) venous thrombosis right arm 2-years prior.

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### Case 1

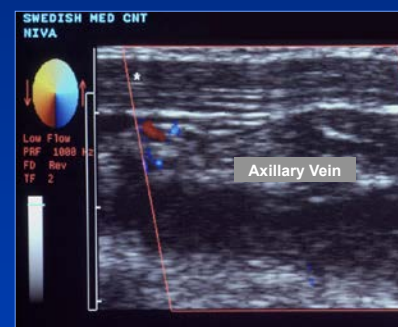
Subclavian and axillary vein distal to clavicle



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### Case 1

Thrombosis extended to basilic-brachial confluence



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Case 1

### Transverse, distal to clavicle



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Case 1

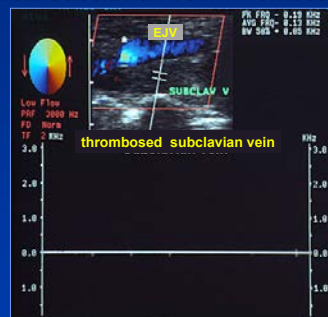
### Proximal End of Thrombus



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Case 1

### Prox. Subclavian Vein Thrombosis



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Case 1

### Potential Pitfall

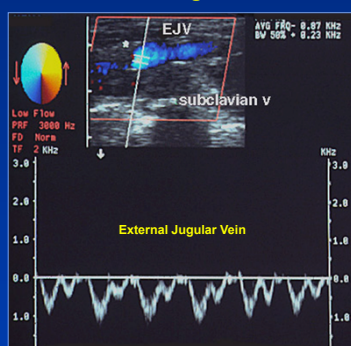


In the presence of subclavian thrombosis the external jugular vein carries a lot of flow, is large, and could be misidentified as the subclavian v.

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Case 1

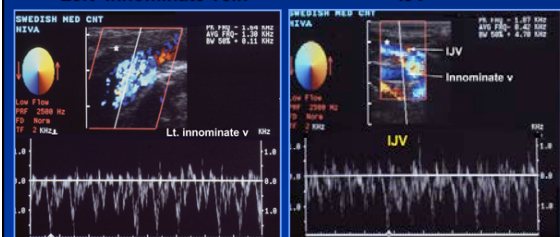
### External Jugular Vein



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Case 1

### Left Innominate vein



Both Normal.

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## Case 1. Study Summary

- Lt. arm acute venous thrombosis
- Extended from proximal SCV to distal axillary vein
- Thrombosed proximal cephalic vein
- Collateralization via EJV
- Pt. was hospitalized and treated with heparin

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## Case # 2

- Patient presents with left arm swelling
- History of shoulder fracture
- No known HX of DVT.

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### Case 2

#### Left distal subclavian vein



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### Case 2

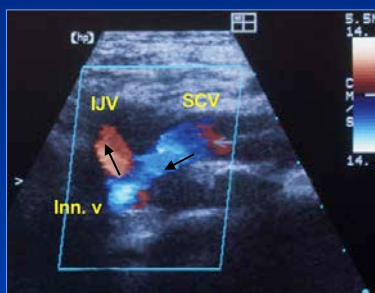
#### Right distal subclavian vein



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### Case 2

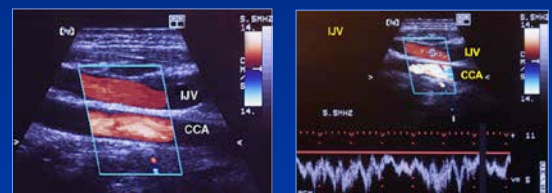
#### IJV and subclavian vein confluence



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### Case 2

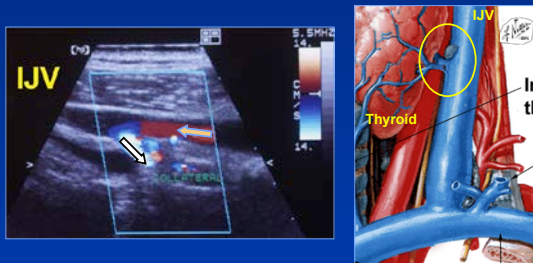
#### Retrograde flow left IJV



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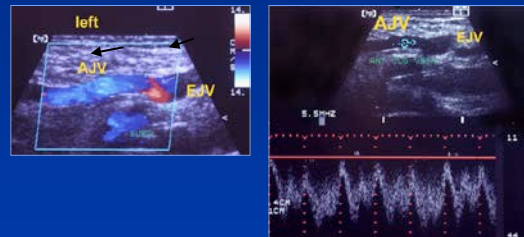
Case 2

Left IJV retro flow - thyroid collaterals



Case 2

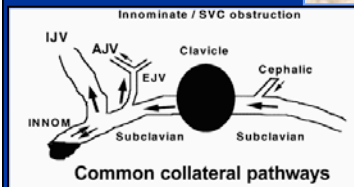
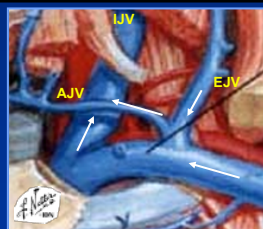
Retrograde anterior jugular vein flow



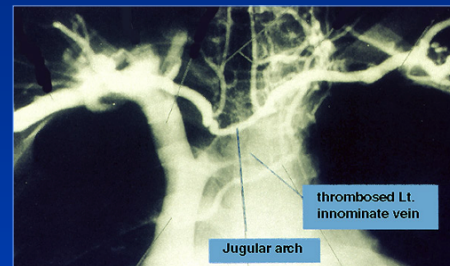
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Case 2

Collateral pathways - left arm



Extensive collateralization occurs in the upper extremity, venous return from the left arm in this patient is via anterior jugular v, jug. arch, into the Rt. innominate v.



Case #2. Summary

- Thrombosis of left innominate vein
- Venous inflow in arm supported by collateralization involving IJV, AJV, and jugular arch vein
- Patient was not treated for VT- it was thought to be chronic DVT
- Important to note flow direction in central vessels, as well as flow patterns

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Catheter-induced Thrombosis



Multi-lumen PICC line in IJV with thrombus on catheter



Pacemaker wire in Subcl. vein

Images courtesy of Wayne Lombardi, RDMS, RVT

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## UPPER EXTREMITY VENOUS INTERPRETATION

### Normal.

1. All veins central to the axillary vein, including the IJV, demonstrate cardiac pulsatility, superimposed respiratory phasicity, and central flow direction
2. Color Doppler demonstrates complete intraluminal venous filling
3. No intraluminal thrombus is seen.

Continued

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## UPPER EXTREMITY VENOUS INTERPRETATION

### Normal.

4. Subclavian vein flows are symmetrical with the contralateral venous segment
5. Veins below the axilla are easily compressed and coapted with transducer pressure, and demonstrate complete filling with color when augmented distally.

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## UPPER EXTREMITY VENOUS INTERPRETATION

### Abnormal.

1. Visualization of thrombus
2. The presence of echogenic material within the vein that moves in response to light transducer pressure may indicate a partially obstructive clot.
3. In the proximal veins, absence of spontaneous flow and/or absence of cardiac pulsatility

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## UPPER EXTREMITY VENOUS INTERPRETATION

### Abnormal.

4. Persistent retrograde flow in the IJV or EJV suggests obstruction in the innominate vein
5. Lack of coaptation of any vein below the axilla, confirmed by the absence of flow with color or spectral Doppler
6. Absence of flow, or a filling defect in veins above the axilla.

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