What's Hidden Behind- Vascular Abnormalities

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B.S in Biomedical Science and Diagnostic Medical Sonography

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Objectives

1. Highlight a case of pseudo aneurysm as in incidental finding.
2. Explore clinical relevance and connect ultrasound findings to patient symptoms, management decisions and outcomes.
3. Familiarize with normal and abnormal Spectral doppler flow patterns.
4. Present interesting vascular cases and understand the value of vascular sonography in evaluating vascular compression syndrome
5. Highlight the value of thinking outside the box.

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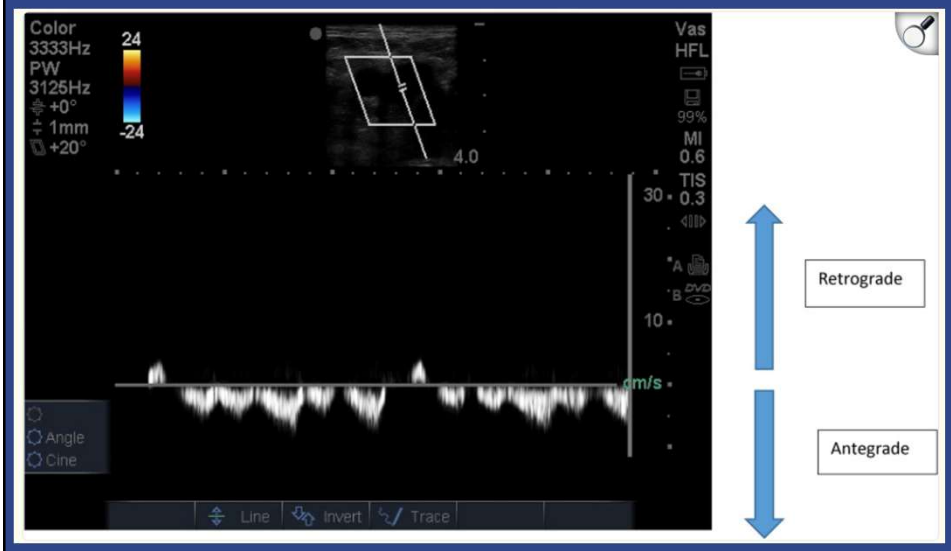
Normal FV Waveform



Normal FVD waveform antegrade flow more than retrograde flow with respiratory variation and the flow can be described as antegrade mildly pulsatile uninterrupted pattern

Bhardwaj V, Rola P, Denault A, Vikneswaran G, Spiegel R. Femoral vein pulsatility: a simple tool for venous congestion assessment. *Ultrasound J.* 2023;15(1):24. Published 2023 May 10. doi:10.1186/s13089-023-00321-w

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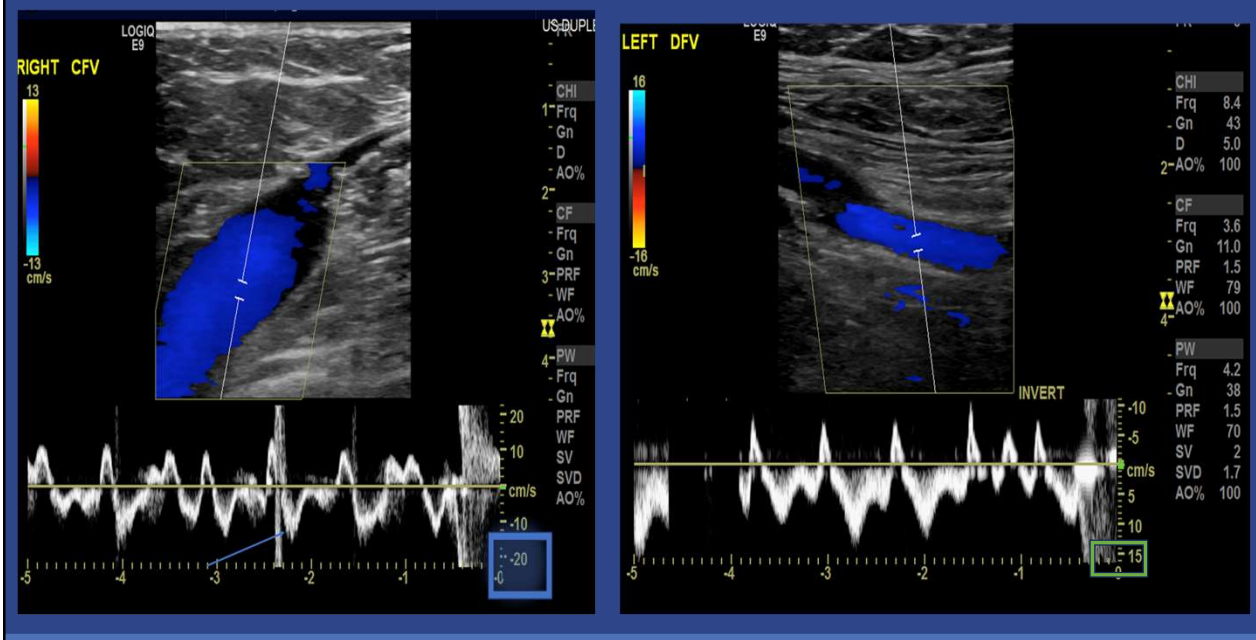

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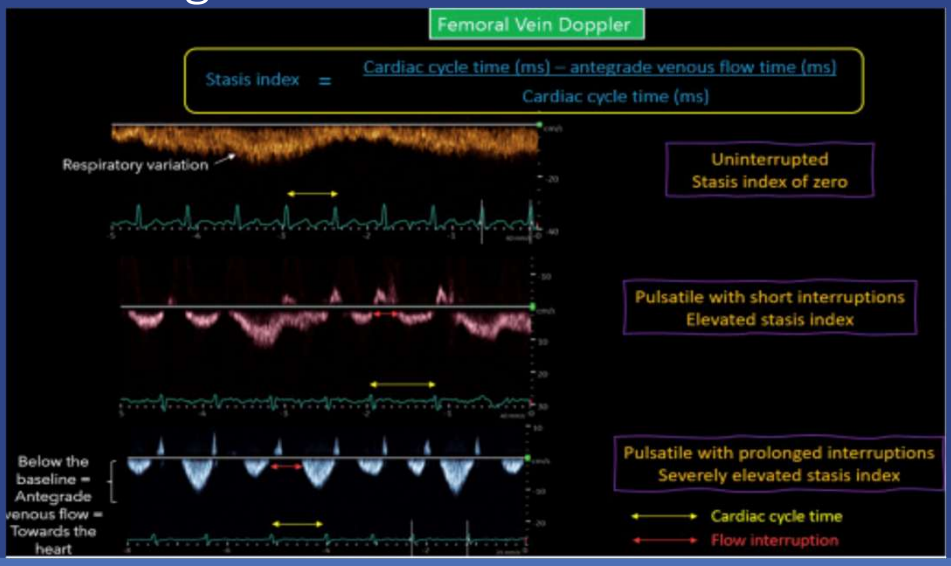
Calculating FVSI



Femoral Vein Doppler for Guiding Ultrafiltration in End-Stage Renal Disease: A Novel Addition to Bedside Ultrasound. https://www.sciencedirect.com/science/article/pii/S2468644124001440. Accessed [Mar 22,2025]

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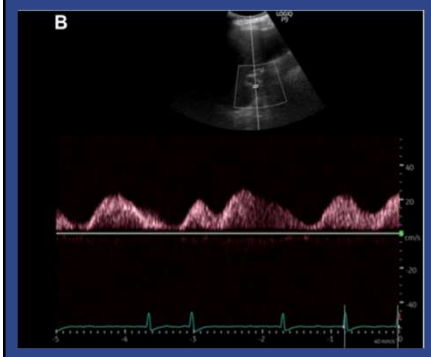
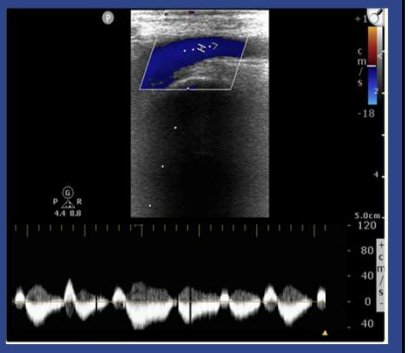
Doppler Indices





- FVSI is calculated as [cardiac cycle duration (ms) – anterograde venous flow time (ms)] Over cardiac cycle duration (ms).

FVD suggestive criteria of congestive heart disease

Femoral Vein Doppler for Guiding Ultrafiltration in End-Stage Renal Disease: A Novel Addition to Bedside Ultrasound. https://www.sciencedirect.com/science/article/pii/S2468644124001440. Accessed [Mar 22,2025]

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Anatomy & Physiology

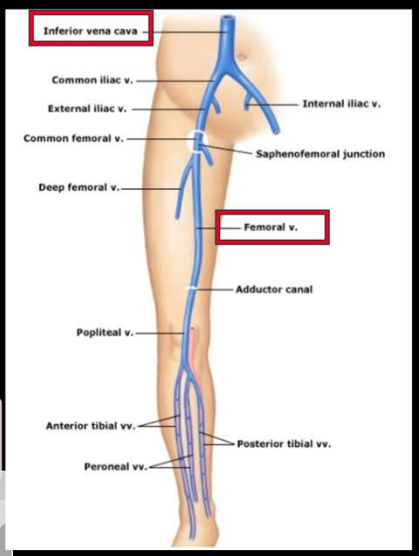
Right atrium pressure elevates

Causing venous congestion

Dampening of central pulsatility attenuates

Normal flow get converted into an interrupted pulsatile venous flow

essentially the CVP tracing becomes reflected in the peripheral venous system



Venous Thromboembolism. https://imbus.anwresidency.com/txtbook/18_vte.html. Accessed [Mar 25,2025]

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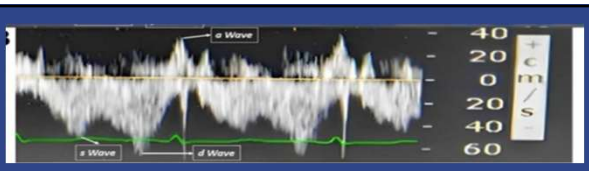
Cont. 'Physiology



As the intraluminal pressure rises due to venous congestion the vein rounds out and the Doppler profile exhibits a pulsatile pattern with less respiratory variation

Therefore, it becomes a representation of the CVP waveform.

With severe congestion and impaired right ventricular systolic function and tricuspid regurgitation, the CVP waveform shows prominent V and Y waves, giving it a bidirectional pulsatile pattern on FVD.

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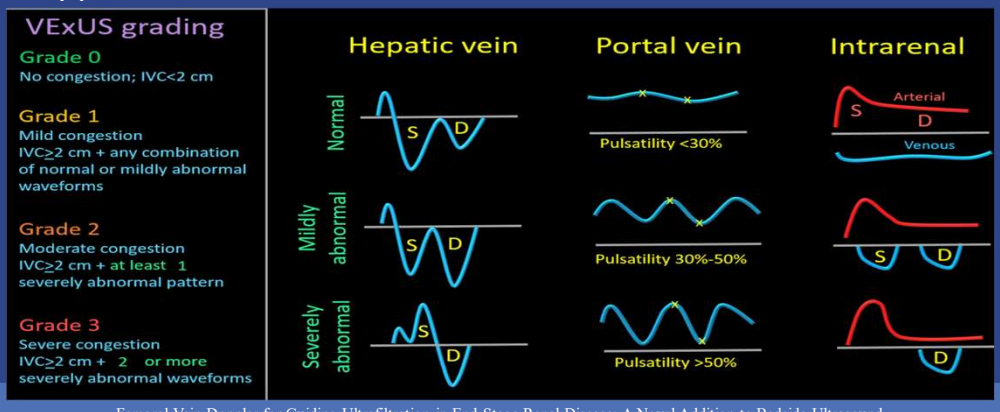
Vex US scoring system (Venous excess ultrasound)

- Proposed by Beaubien-Souligny *et al.*[1,2] in 2020.
- Quantifies venous congestion using hepatic, portal, and intrarenal vein Doppler.



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Pitfalls and limitations of Femoral Venous Doppler

1. FVD measurement is advocated in supine position hence might not be feasible in orthopneic patient
2. FVD mirrors IVC hence the fallacies of IVC as a marker of venous congestion specifically in higher intraabdominal pressure, cirrhosis and respiratory distress make it unreliable
3. Deep venous thrombosis
4. Varicose veins with saphenofemoral junction incompetence might give confounding results
5. Femoral venous pulsations can be seen in healthy individuals but typically without systolic reversal. We have used CVP as the gold standard which has its own limitations in the clinical settings.

Bhardwaj V, Rola P, Denault A, Vikneswaran G, Spiegel R. Femoral vein pulsatility: a simple tool for venous congestion assessment. *Ultrasound J.* 2023;15(1):24. Published 2023 May 10. doi:10.1186/s13089-023-00321-w

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Interesting cases
Pseudoaneurysm

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Synopsis of patient history

Current,
84 YO male patient who is known to have aortic valve disease, S/P mechanical aortic valve replacement in 1999 maintained on warfarin therapy. EF 55%. Status post leadless pacemaker implantation January 2025 (For marked sinus bradycardia with intermittent Mobitz 2 heart block).
Diabetes mellitus, hypertension and subclinical hypothyroidism.
The patient admitted under the care of the neurosurgery team as a case of spinal cord injury for spinal fixation.

Concerns,
Inpatient consult to Cardiology Ordered.
Reason of Consultation:
84YO patient post cervical laminectomy, post pacemaker insertion 10 days prior to request, recurrent atypical left side chest pain, no EKG chains with elevated troponin, H/O aortic valve replacement on warfarin, for kind assessment

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Prior to our US scan

Plan of Care (Goal Orientated):

-Seen by cardiology, to keep on Warfarin same dose
-Hemoglobin drop from 9 to 7.4: repeat CBC q12h
-Patient developed mild hypoxemia on room air, currently maintaining SpO2 of 98% on nasal cannula 2 lpm; do CXR STAT
-All his extremities are warm, not cyanotic, capillary refill 2 seconds except the left lower foot capillary refill 3 seconds. left dorsalis pedis pulse is intact
-Popliteal duplex as per vascular
-Keep in step down for today

CNS assessment
Any change in LOC?no
CVS assessment

Vital signs for last 24 hours:
Temp: [36.8 °C-37.5 °C] 36.8 °C
Heart rate: [70-76] 70
Resp: [15-37] 28
Blood Pressure: (94-134)/(51-72) 134/63

Respiratory system assessment & plan:

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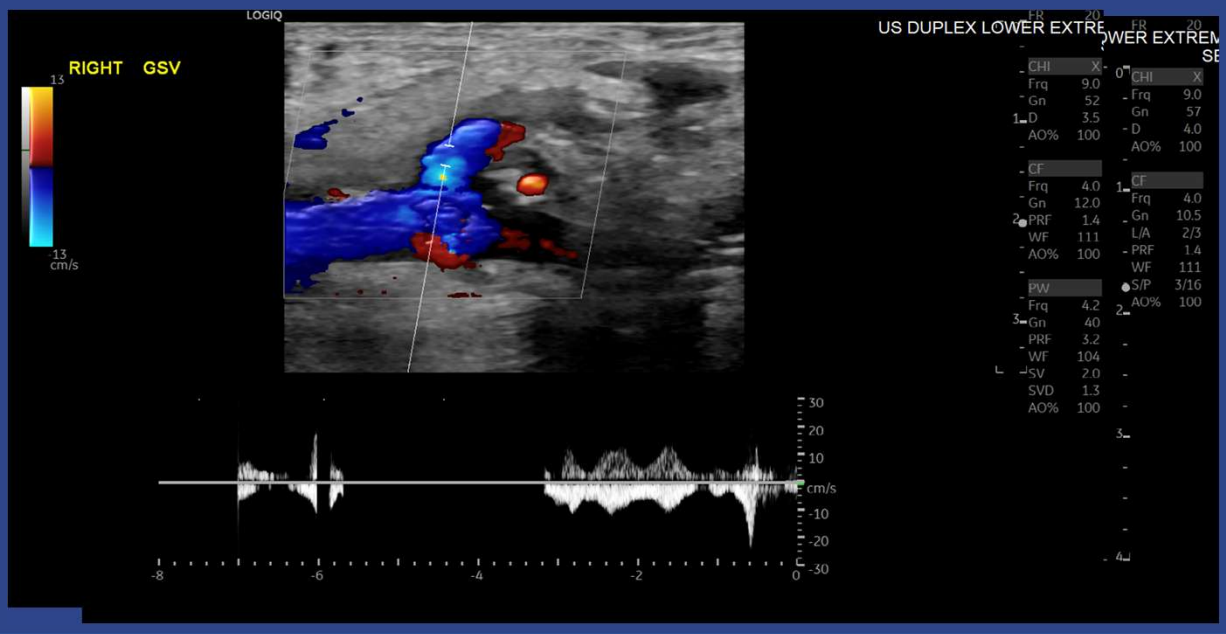

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Defining pseudoaneurysm

- Is an extraluminal collection of blood with a turbulent flow that communicates with flowing arterial blood through a defect in the arterial wall.
  - The normal artery wall contains three layers: the tunica intima, the tunica media, and the tunica adventitia.[8]The development of a pseudoaneurysm is due to an extraluminal blood collection that has a turbulent communication through an arterial wall defect.[1]
- Lower extremity pseudoaneurysms (PsAs) are mostly developed after traumatic or injury to the arteries; is more common after an arterial intervention.
- According to most of the publications available so far, the femoral pseudoaneurysm prevalence is usually between 0.2% and 8% of all patients treated using interventional procedures

Babiker MS. Uterine Artery Pseudoaneurysm: A Case Report. *Journal of Diagnostic Medical Sonography*. 2020;36(3):273-276. doi:10.1177/8756479320908204

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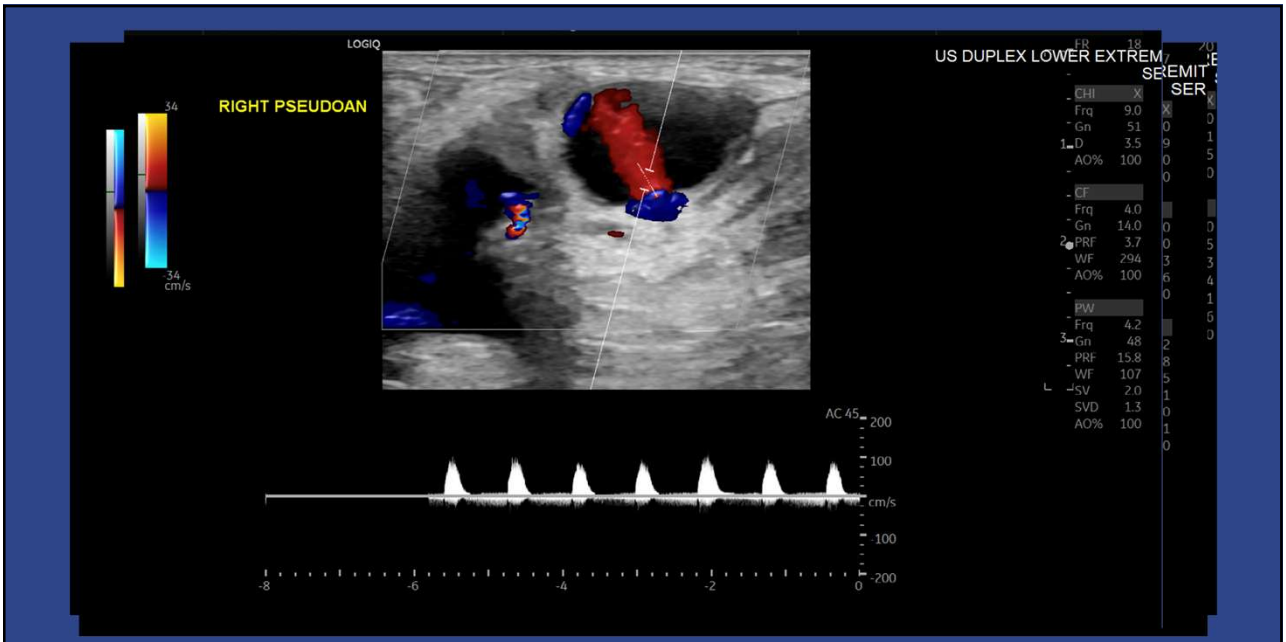

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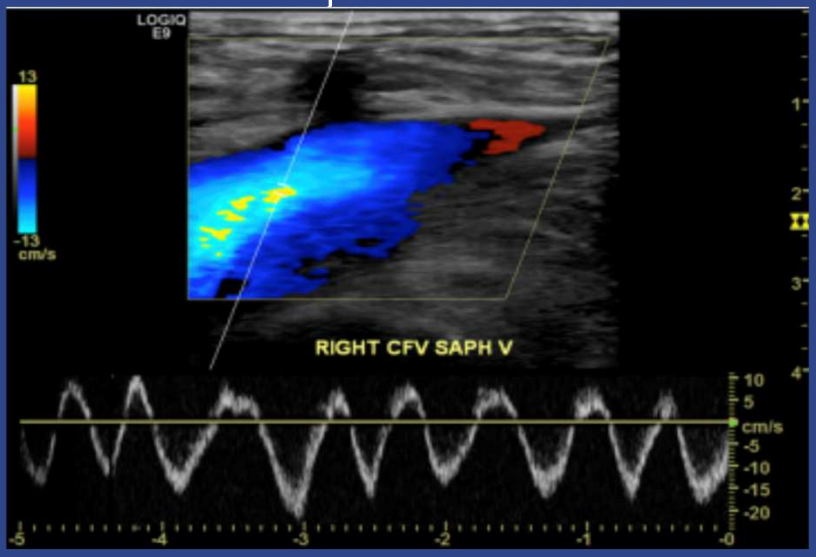
To and “Fro” patterns



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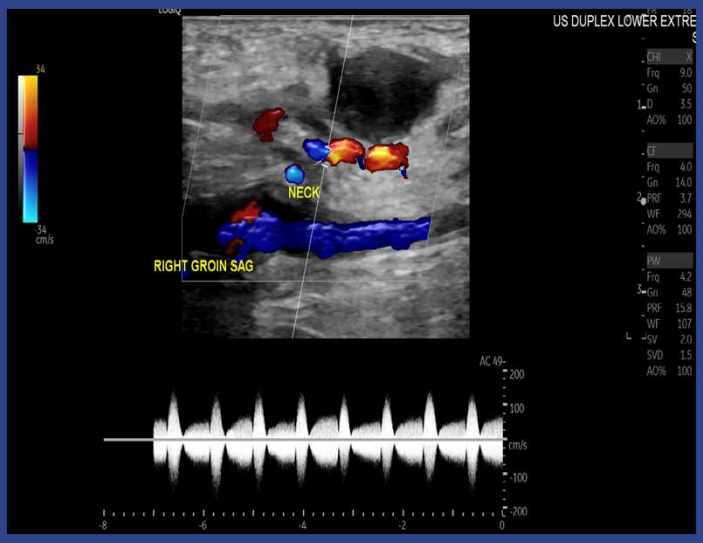
To and “Fro” waveform patterns



- ✓ The “to” represents the arterial blood going into the pseudo aneurysmal sac in systolic cycle
- ✓ While “fro” illustrate blood exiting the sac in diastolic cycle.

1)From personal files of Alsukairi R. (On file with author).
2)Polak JF. The peripheral arteries. In: Rumack CM, Wilson SR, Charboneau JW, editors. Diagnostic ultrasound. St Louis: Mosby; 1998. pp. 921–941. [Google Scholar]

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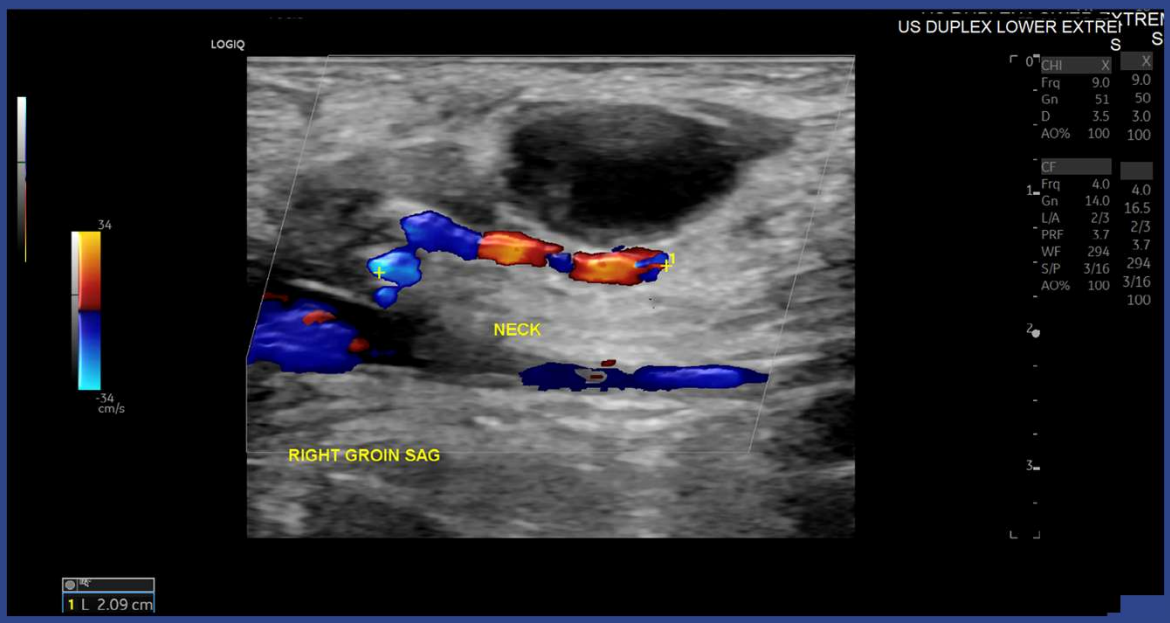

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Radiologist Report

- ❑ Narrative: Clinical Information: Suspected deep vein thrombosis in a high-risk patient suspected deep vein thrombosis.
- ❑ Findings:
  - The deep venous system of both lower extremities evaluated from the level of the external iliac vein down to the distal popliteal vein
  - Examination reveals normal antegrade flow with normal response of the veins augmentation and compression techniques.
  - Incidentally noted is the presence of 2.3 x 1.97 x 0.97 cm pseudo aneurysm is connected to the artery thought quite long neck measuring 2.1 cm in length
- ❑ Impression:

No evidence of acute thrombosis of the deep venous system of both lower extremities
Incidental finding of 2.3 cm right common femoral artery patent pseudo aneurysm.

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Labs

Today			
Today at 13:42	CBC (Without Diff)		Active - Needs to be C...
Today at 13:42	CBC (Without Diff)		Active - Standing
Today at 10:19	POCT Glucose Random	Abnormal	Completed - Final result
Today at 08:00	Troponin High Sensitive (Dhahran Only)		Active - Needs to be C...
Today at 05:57	Lactic Acid		Completed - Final result
Today at 05:56	Troponin High Sensitive (Dhahran Only)	Abnormal	Completed - Final result
Today at 05:41	POCT Glucose Random	Abnormal	Completed - Final result
Today at 05:10	Creatine Kinase (CK)	Abnormal	Completed - Final result
Today at 05:10	Coagulation Profile (PT, PTT)	Abnormal	Completed - Final result
Today at 05:10	CBC (Without Diff)	Abnormal	Completed - Final result
Today at 05:10	BUN/Creatinine/Lytes	Abnormal	Completed - Final result
Recent			

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Treatment plan

Patient underwent venous duplex study which showed no deep vein thrombosis. However, there is an accidentally discovered small right common femoral pseudoaneurysm.

Case was discussed with the on call interventional radiologist for possibility of thrombin injection.

The team decided to agree that the intervention will be delayed until warfarin is replaced by heparin and the INR returns to normal value

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Follow up pt chart

Radiologist was informed about the INR 2.5 (Which is above desired value for thrombin injection)

Radiologist advised to reschedule the procedure until the INR is 1.4

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Follow up US scan 14 days post the initial scan

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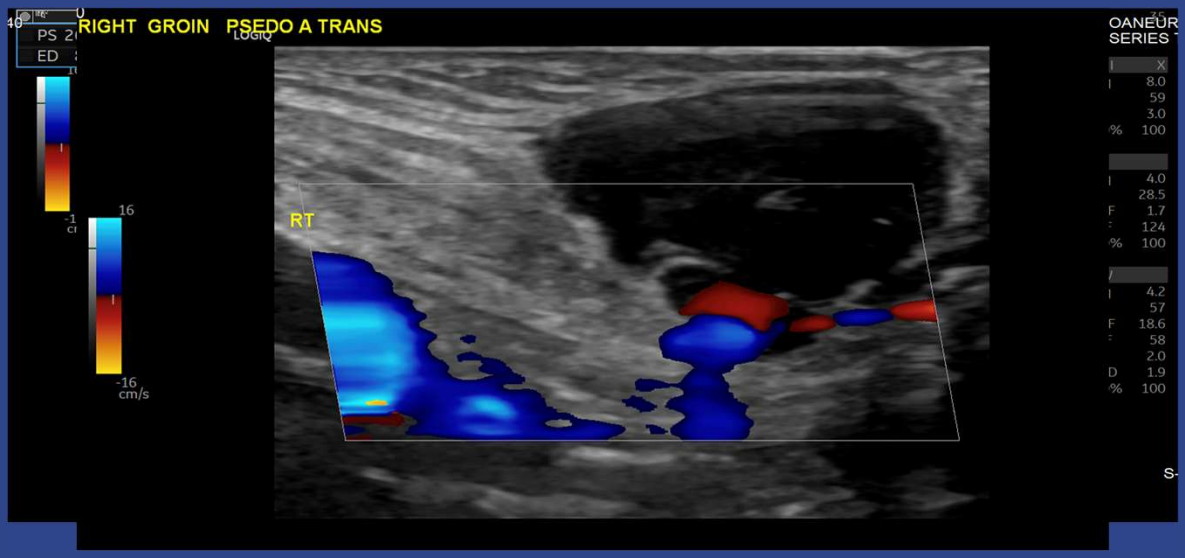
3 days follow up



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Recommendation & Treatment

Routine nursing care	Tab. Escitalopram to continue for 5 days.	Heparin infusion ongoing at 732 unit/her.
CBC Bid and PPT to be repeated	Heparin bag to be changed at 110.0 H	To be seen by SLP and dietitian.

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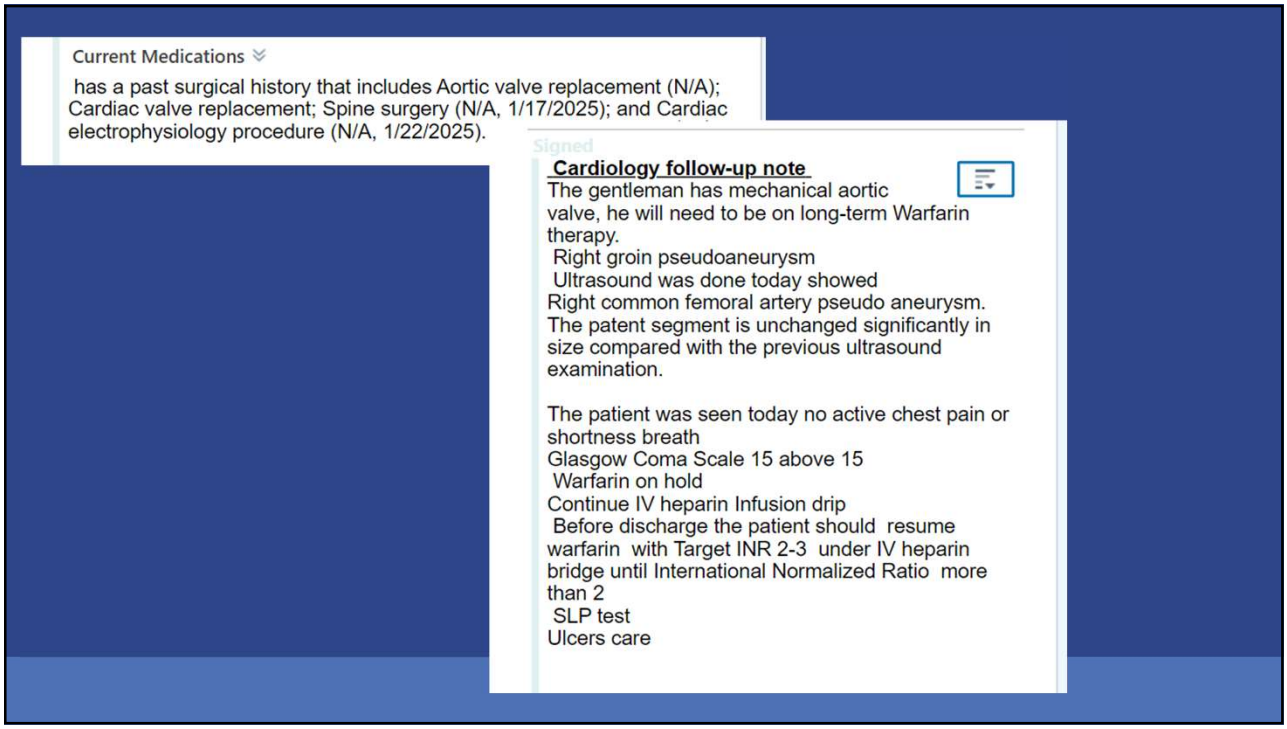

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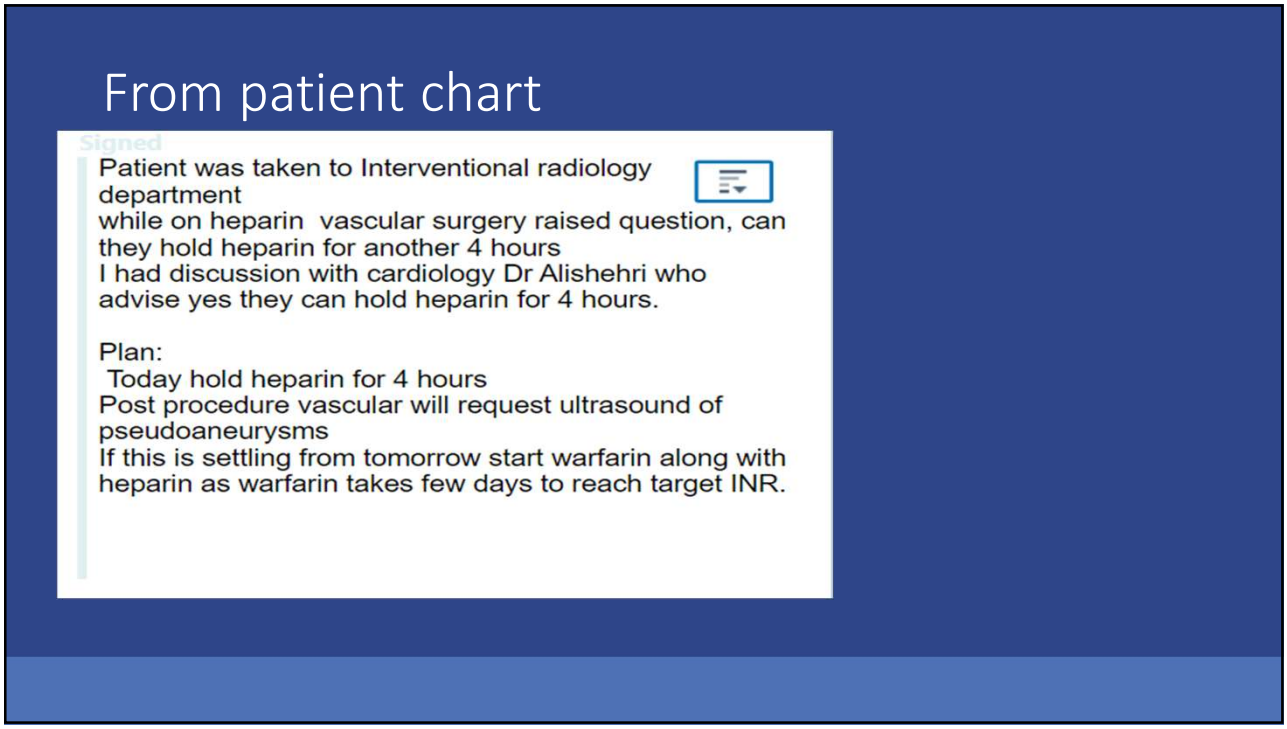

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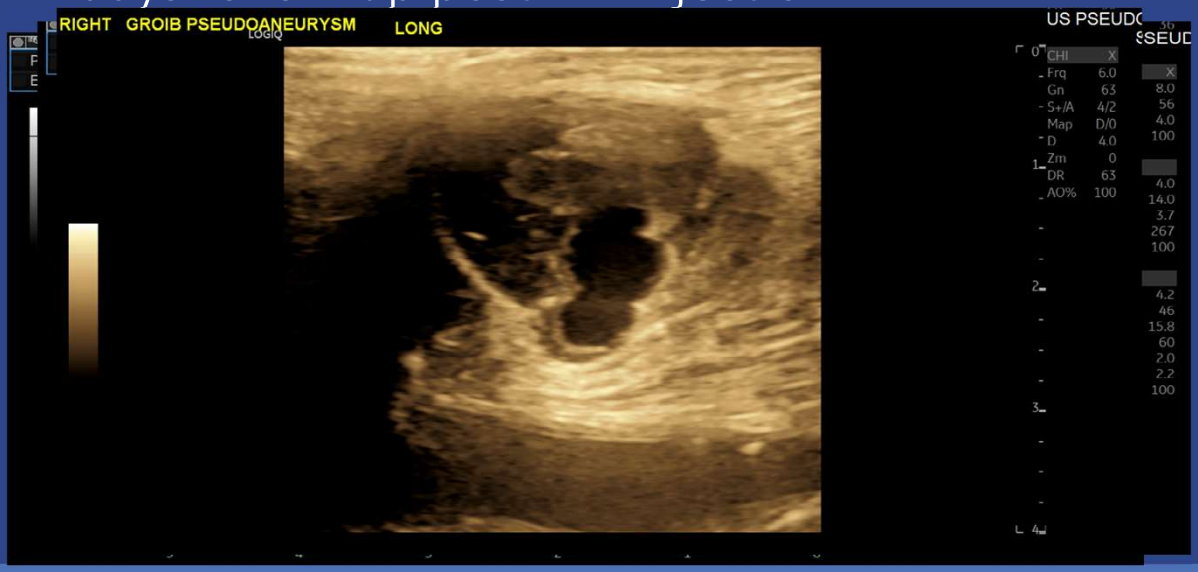
2 days follow up post 2nd injection



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Note from Internal Medicine

- After the US scan pt went again for another thrombin injection
- Patient was taken to interventional radiology department while on heparin vascular surgery raise question, can they hold heparin for another 4 hours.
- Internal medicine discussed the case with the cardiologist who advised holding heparin for 4 hours.

Plan:

- Holding heparin for 4 hours.
- Post procedure vascular will request ultrasound of pseudoaneurysm. If it's settling, they will start warfarin along with heparin as warfarin takes few days to reach target INR.

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Follow up scan post 3rd injection

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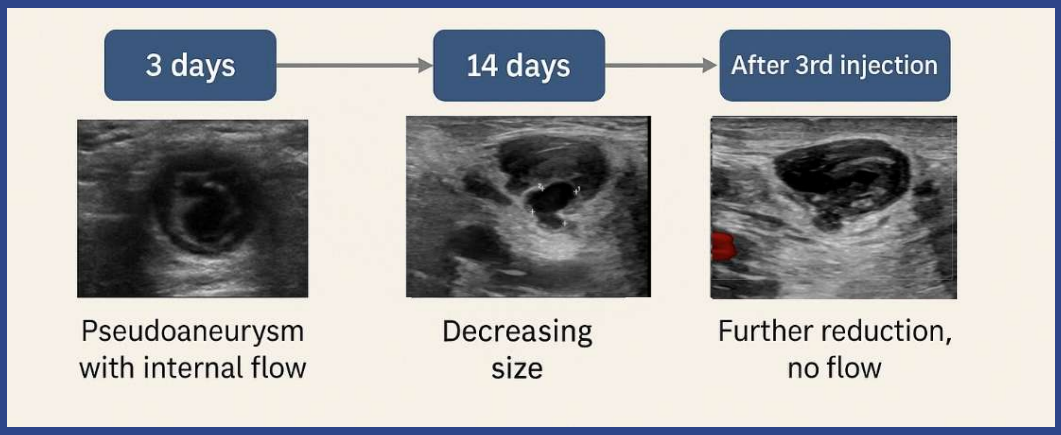
Follow up Ultrasound Timeline



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Another case

Case Report

In October 2019, a 33-year-old pregnant woman was admitted to the antenatal care unit at a Sudanese obstetric hospital for a planned caesarian section. After a successful delivery, the patient experienced postpartum vaginal bleeding 3 days after the caesarian section. Her hemoglobin was very low, with severe anemia and hypotension. Four units of red blood cells, crystalloids, and antibiotics were used to stabilize her situation. The U/S examination showed a hypoechoic area in the uterine cervical region. Color Doppler demonstrated a focal dilated right uterine artery, which measured 1.9 cm, and the blood flow pattern in the lesion area was a to-and-fro pattern (Figure 1; Video 1), indicating an arterial pseudoaneurysm. These findings led to the suspicion of a UAP, as a diagnosis for the patient. Angiography was conducted to confirm the diagnosis. The angiographic procedure was conducted by inserting a catheter through the right femoral artery, and the angiogram images showed a focal dilatation of the right uterine artery (Figures 2 A and B), which is a typical feature of a UAP. The condition was treated by transarterial catheter embolization using metallic coils. The patient had an uneventful recovery.

UC Davis Health Vascular Center. *Pseudoaneurysm evaluation and treatment*. UC Davis Health. 2014. Accessed June 8, 2025. https://health.ucdavis.edu/vascular/lab/exams/pseudoaneurysm.html

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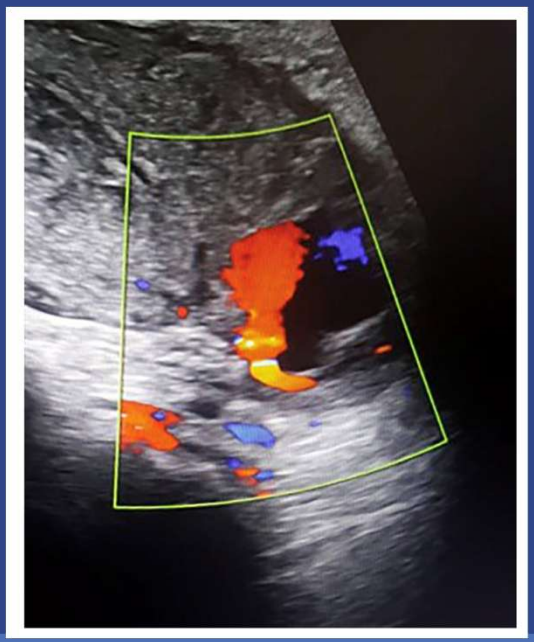

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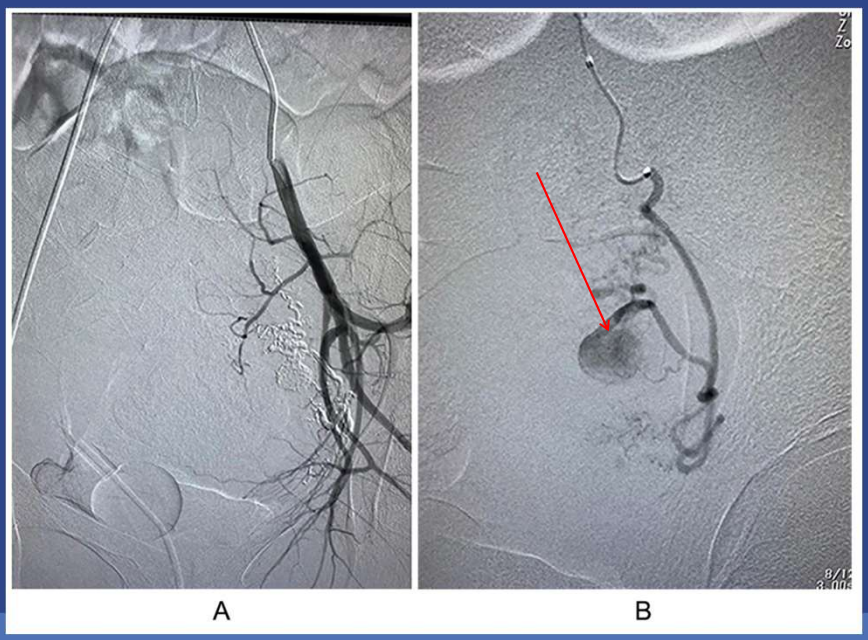
The angiogram images showed a focal dilatation of the right uterine artery



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Treatment for post partum pseudoaneurysm

- transcatheter arterial embolization is an effective and secure technique for the treatment of severe postpartum hemorrhage due to uterine or vaginal artery pseudoaneurysm.

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Treatment

- Surgery is sometimes required, but most pseudoaneurysms at arterial puncture sites can be treated with a brief, minimally-invasive procedure performed under local anesthesia.
- Preparation takes a few minutes. The procedure will be explained and informed consent obtained. Ultrasound imaging guides placement of a needle into the pseudoaneurysm and then thrombin is injected.
- A complete diagnostic study usually takes about 30 minutes. Treatment, if required, takes less than 30 minutes. A brief period of observation in the recovery area may follow.

UC Davis Health Vascular Center. *Pseudoaneurysm evaluation and treatment*. UC Davis Health. 2014. Accessed June 8, 2025. https://health.ucdavis.edu/vascular/lab/exams/pseudoaneurysm.html

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Follow up ultrasound post treatment

- A follow-up duplex scan is generally performed three to seven days after successful treatment.
- Further evaluation or treatment may be recommended if thrombin injection does not completely eliminate the pseudoaneurysm.

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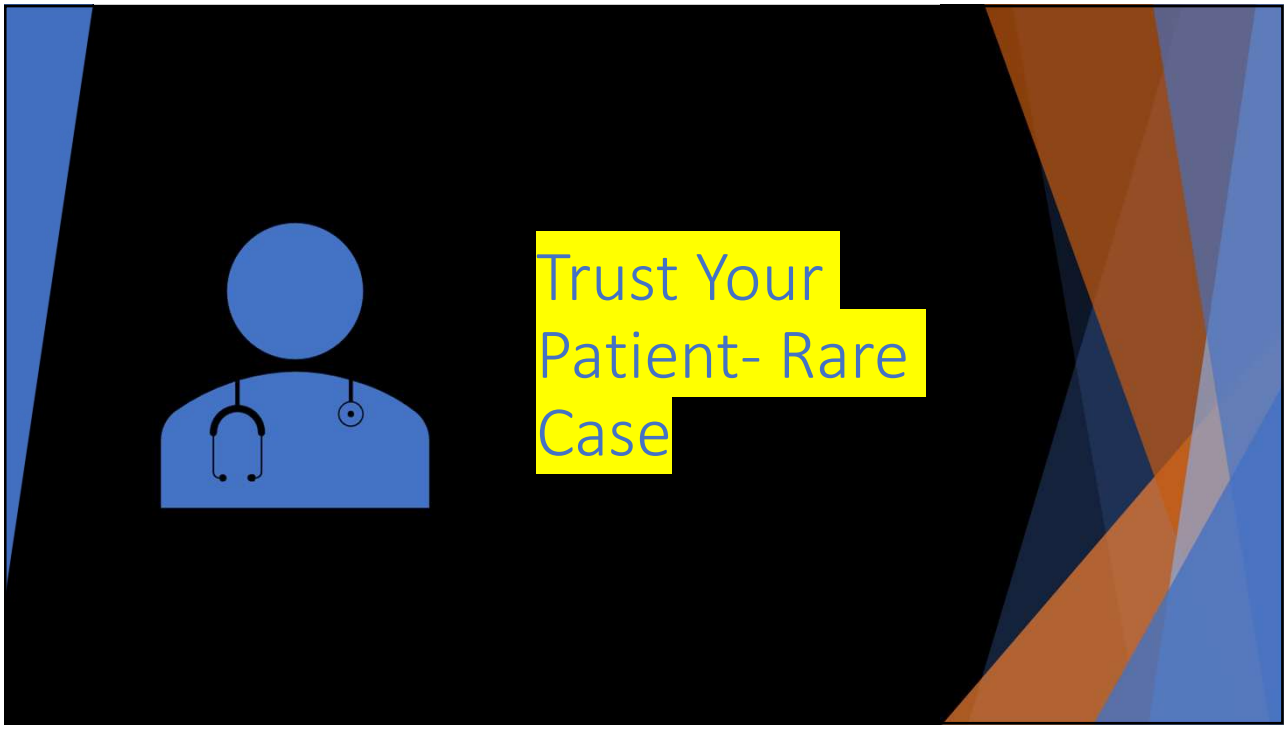

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Dr note about the palpating aneurysm in the hip

Patient is complaining of chronic back pain,
On-off radiation to lower limbs but without typical dermatomal distribution,

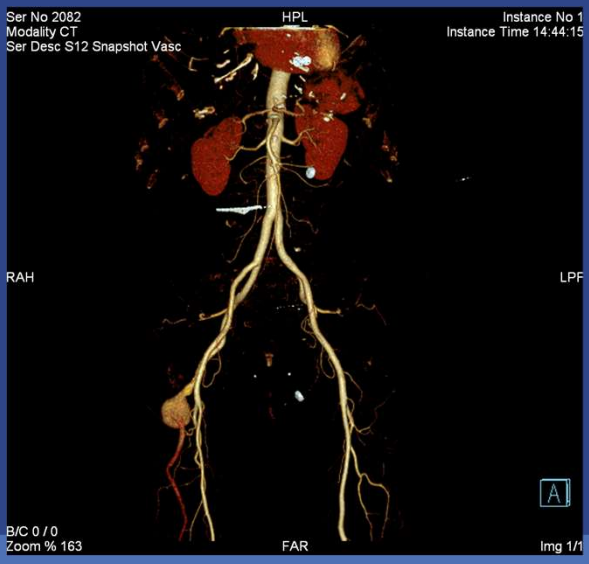
History of trauma and falling down sitting from standing position 4 months ago,

The patient noticed right hip pulsating mass during the last few months, (relation to trauma is not clear?)

On exam
No neurological deficit,
Right hip pulsating mass, (examined together with Dr. Tariq Brakat - referring vascular surgeon and clinic nurse Manal)

MRI LSS - stenosis L4-L5

Plan:
CT abdomen pelvis as per recommendations of vascular surgery - STAT. --- and then follow up with Dr. Tariq on Monday next week as per his recommendations



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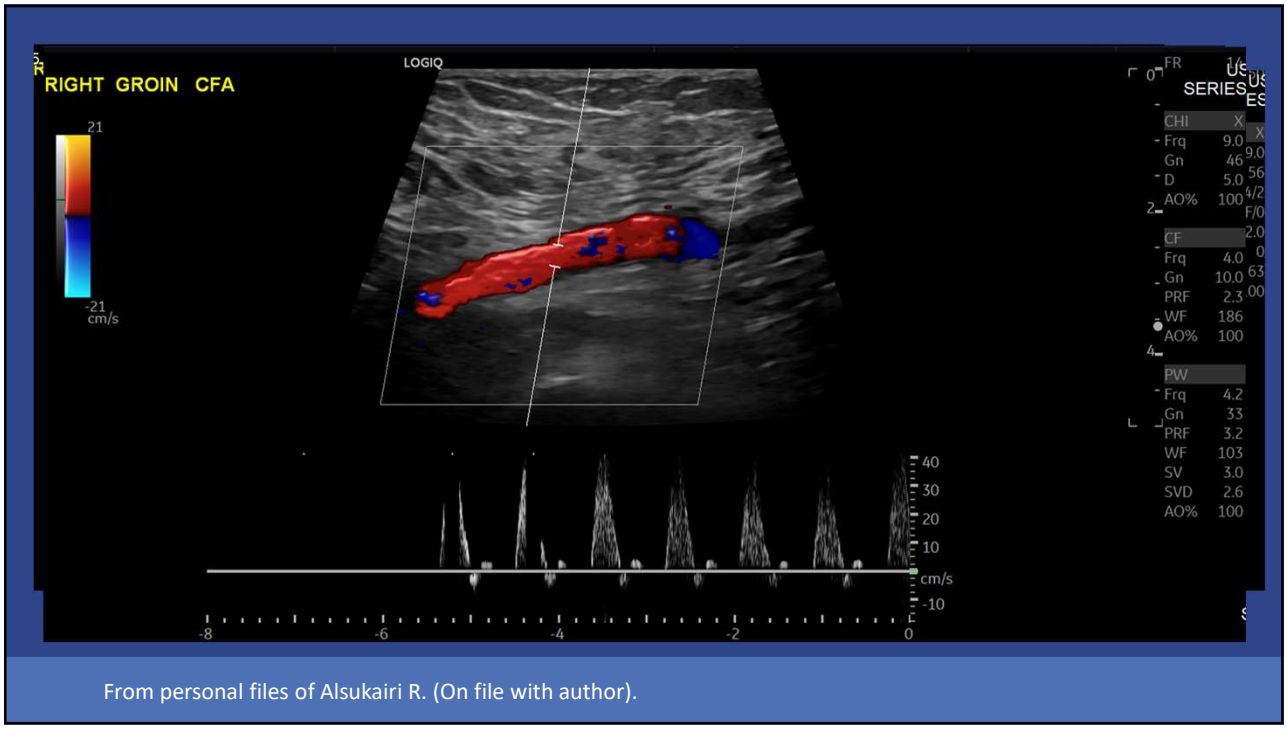

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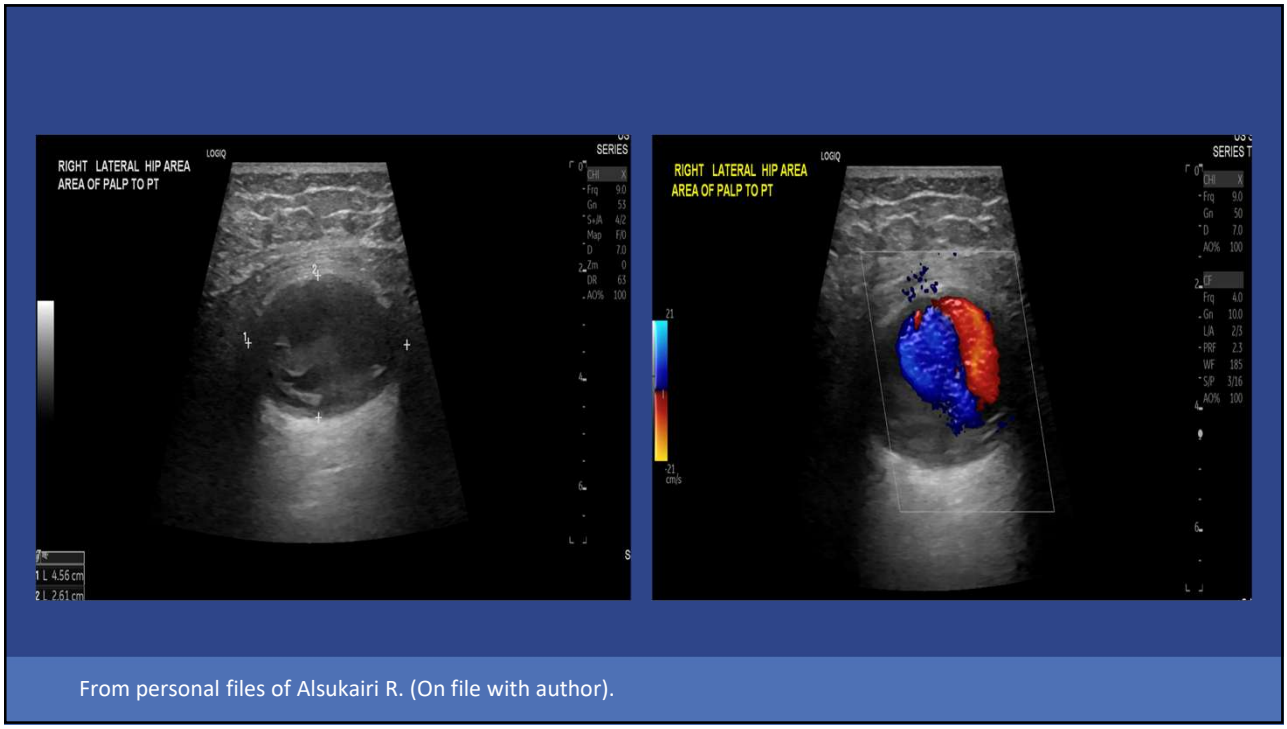

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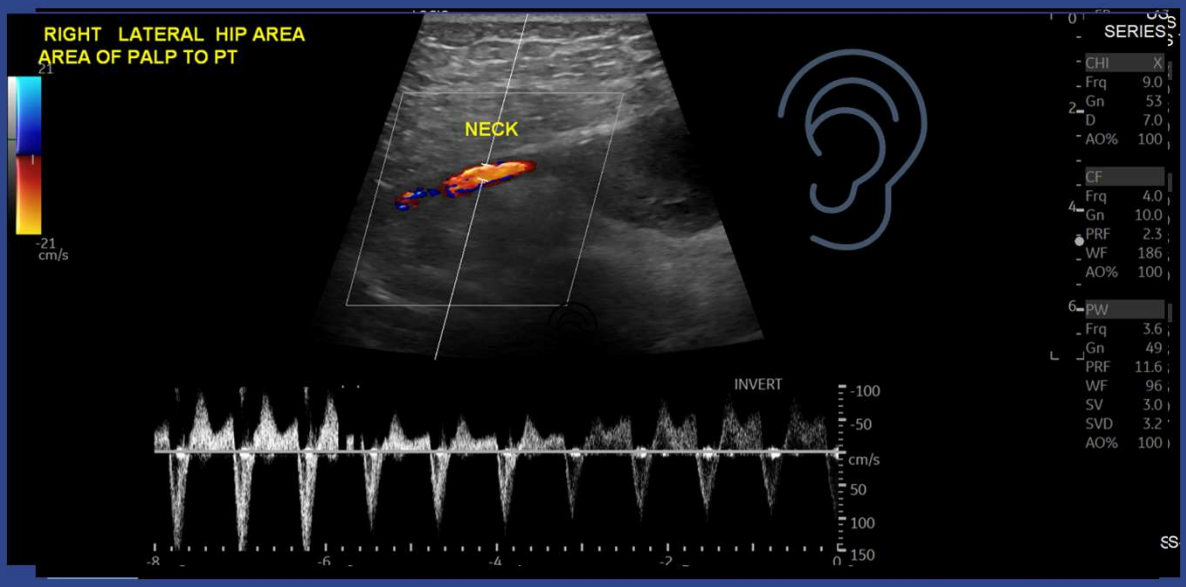

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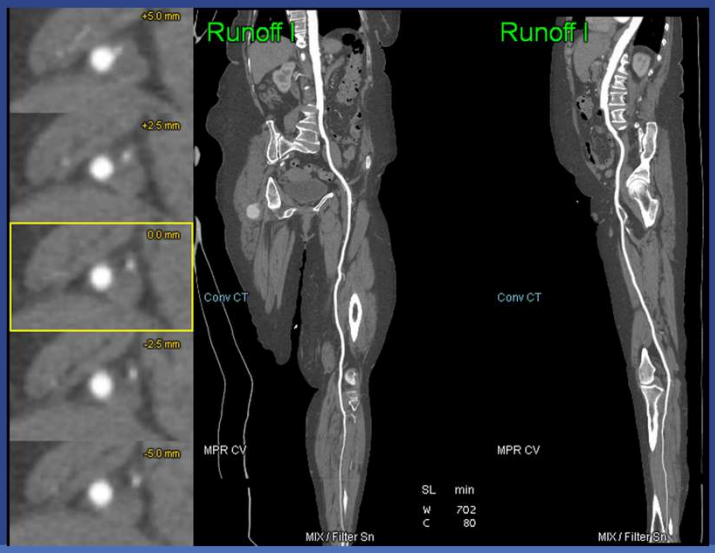
CT Scan



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CT scan study result

Study Result

Narrative & Impression
Clinical Information:
? Aneurysm evaluation
Findings:
Pre and post contrast-enhanced helical scan was performed.

There is 3.8 x 3.6 cm aneurysm arising from persistent right sciatic artery. The sciatic artery is patent distal to the aneurysm and continues to join the popliteal artery which is formed by both the femoral and sciatic arteries.

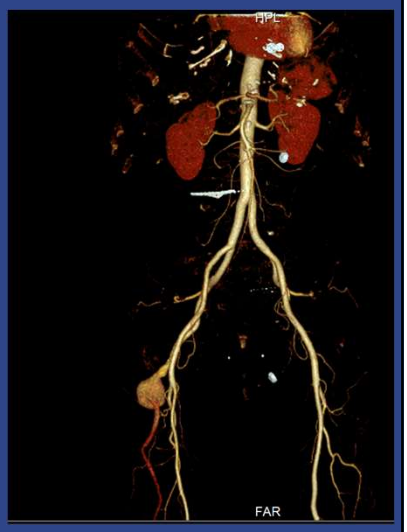
No significant aortoiliac disease seen.

On the right side, normal common femoral and profunda femoris arteries. There is small SFA with delayed enhancement in the distal part. The popliteal artery is formed by the continuation of small SFA and persistent right sciatic artery. There are 2 runoff vessels via the anterior tibial and peroneal arteries, these continues to the ankle joint.

On the left side, normal femoral and popliteal arteries with 3 runoff vessels via the anterior tibial and peroneal arteries, this continues to the ankle joint.

Within the limitation of the arterial phase study no significant abnormality seen in the solid intra-abdominal organs.
No masses or lymph node enlargement seen.
No free fluid or gas seen in the peritoneal cavity.
Normal visualized bony skeleton.

Conclusion:
3.8 cm aneurysm of the persistent right sciatic artery as described.
No leak or ischemia.



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US report

- There is a pseudoaneurysm in the right groin with arterial waveform analysis. It measures 1.9 x 1.1 cm with internal vascularity in ying-yong pattern. The neck measures 2.3 cm in length.
- There is a large pseudoaneurysm in the right lateral hip that measures 4.6 x 2.6 cm with internal vascularity in ying Yong patter. The wall is partially thrombosed. The neck measures 3.2 cm in length.
- **Impression:**

Two pseudoaneurysm as described.

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Case of testicular finding

• Testicle Pain

HPI

This 12 years old pleasant boy has presented to the emergency department with a complaint of right testicular swelling and pain.

Patient woke up around midnight with complaint of right testicular swelling and pain.

It was tender to touch.

He has been getting mild right testicular pain intermittently for a week. however tonight he had sudden onset of severe pain with swelling.

No complaint of nausea or vomiting.

Denied dysuria, frequency, hematuria.

No complain of fever.

No history of trauma.

Medical History

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From personal files of Alsukairi R. (On file with author).

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From personal files of Alsukairi R. (On file with author).

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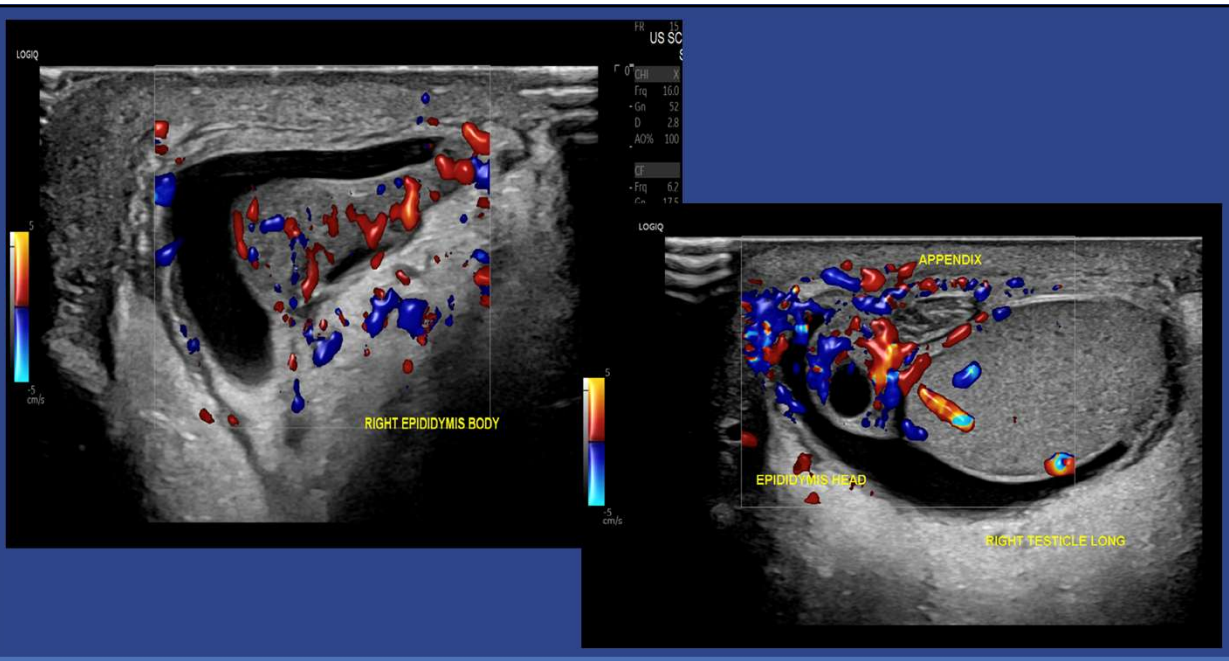

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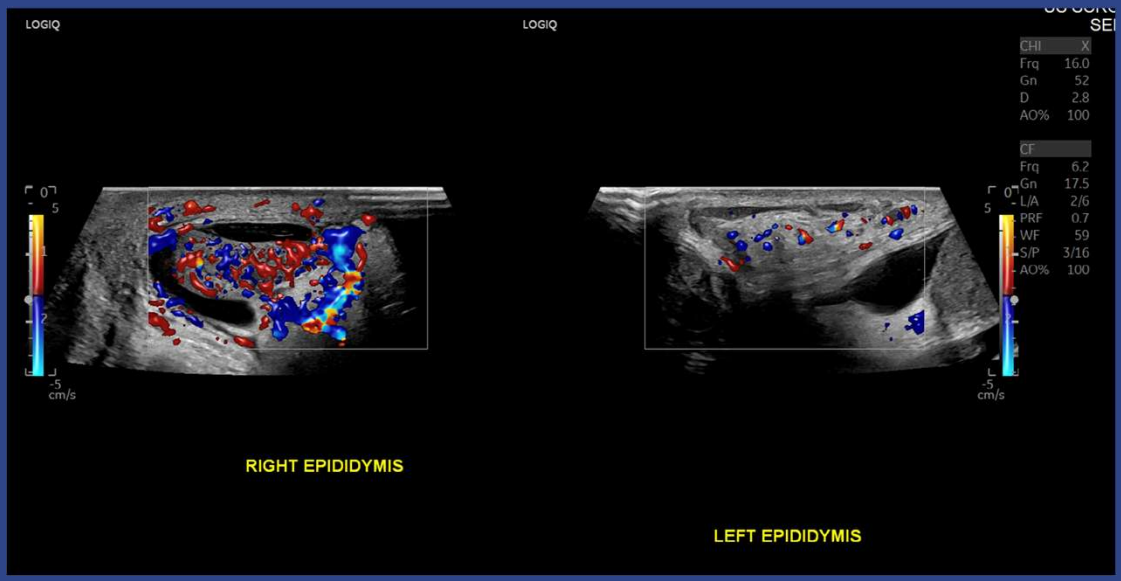

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Available access | Research article | First published online August 11, 2024

The Impact of the Sonographic Findings Within the Epididymis on the Differential Diagnosis of Acute Scrotum

Elham Shabani, MD, Hosein Tanha, MD, [...], and Seyed Ali Alamdaran, MD +2 View all authors and affiliations

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Table 2. Ultrasonographic Findings Most Likely in Favor of Testicular or Appendage Torsion.

	Testicular torsion	Appendage torsion
Echo pattern	Heterogeneous	Normal
Testicle size	Increased	Normal
Testicular vascular flow	Decreased	Normal or increased
Epididymis vascular flow	Decreased	Increased
Epididymis position	Abnormal	Normal
Epididymis shape	Mass-like	
Blue-dot sign		√

1. Shabani E, Tanha H, Moradi A, Khoroushi F, Alamdaran SA. The Impact of the Sonographic Findings Within the Epididymis on the Differential Diagnosis of Acute Scrotum. *Journal of Diagnostic Medical Sonography*. 2024;41(2):127-134. doi:10.1177/87564793241267841

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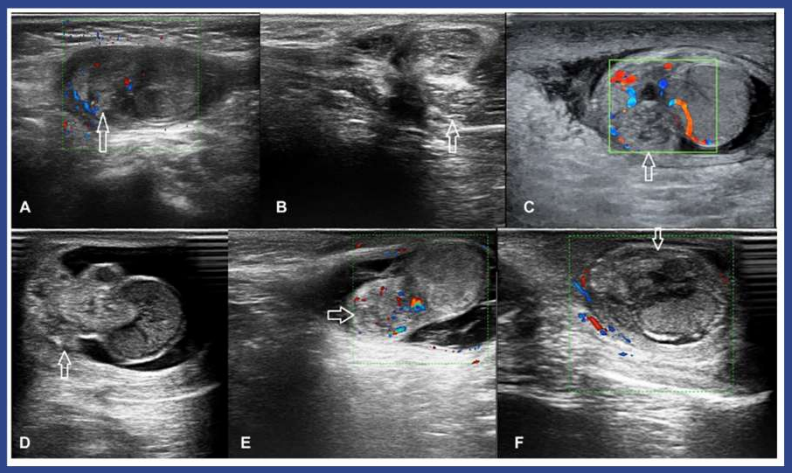
Testicular Torsion



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Plan pre discharge from EMS

Signed

Re-assessed by MD

- Instruct the child parents to come back ems if symptoms will persists.
- pain subsided.
- health teaching given.
- home medication prescribed.
- patient discharged in stable condition.

Arputham, Anto, RN
02/17/25 02:41

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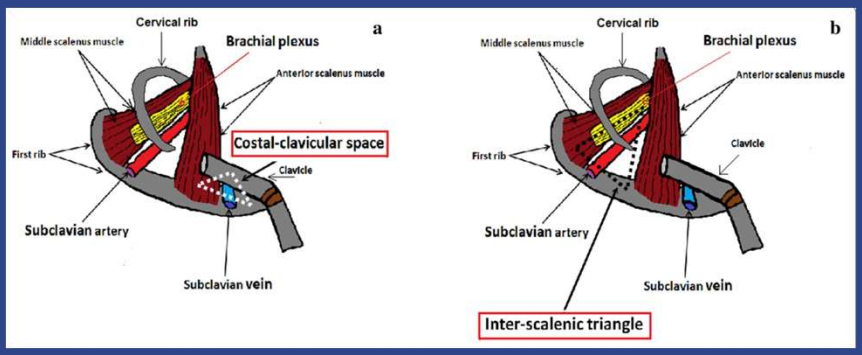
Vascular Compression Syndromes: Why They Matter

- Rare vascular alterations from external structural compression
- May be congenital or acquired.
- Symptoms often nonspecific; therefore, ultrasound plays key diagnostic role



The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J.* Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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Types of Vascular Compression Syndromes

The most common types

- Thoracic Outlet Syndrome (TOS)
- Nutcracker Syndrome (NCS)
- May-Turner Syndrome (MTS)
- Dunbar Syndrome (Median Arcuate Ligament Syndrome-MALS)

The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J.* Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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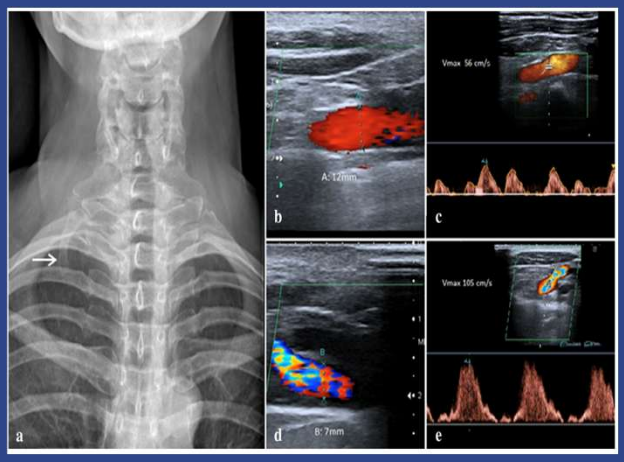
Role of Ultrasound in Diagnosing Compression Syndromes

- Ultrasound plays a very important role in identifying alteration in vascular flows.
- First line tool (Noninvasive, dynamic)
- It allow complete diagnostic classification.
- Uses color Doppler & Spectral analysis under dynamic maneuver



The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J.* Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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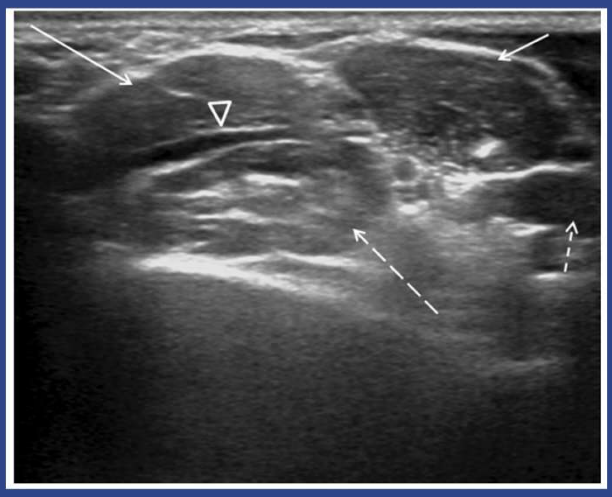
Thoracic Outlet Syndrome (TOS)

- Compression site: cervical rib or scalene muscle hypertrophy
- Doppler evaluation with arm movement (Adson test)
- Key findings:
  - Altered flow velocity
  - Waveform change with arm elevation



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Doppler Evaluation of Subclavian Vessels

- The Subclavian Vein
  - Evaluated at the level of "Costal-clavicular space", where compression occurs, which is delimited below by 1st rib, and above by clavicle and anteriorly by anterior scalene muscle.
- The Subclavian Artery
  - Evaluated at the level of the "inter-scalene triangle" which is delimited inferiorly by clavicle, medially by anterior scalene muscle and laterally by middle scalene muscle.
- During Adson test, the caliber and flow of vessels must be measured
  - In subclavian vein compression upstream of the stenosis, a slowing of the peak flow with consequent venous hypertension is observed

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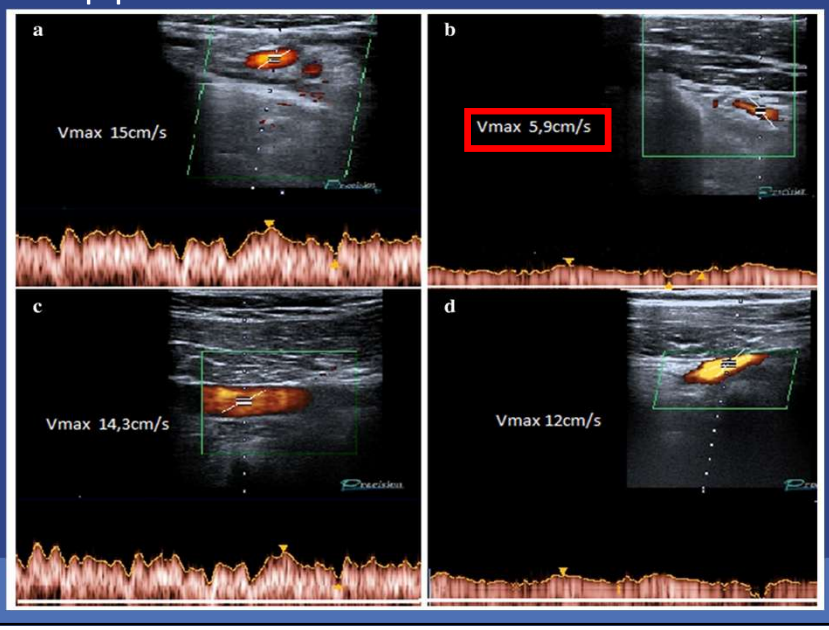
Doppler Evaluation of Subclavian



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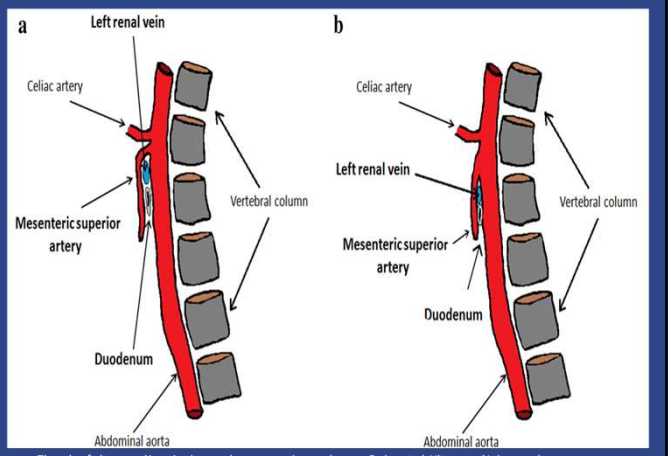
Nutcracker Syndrome (NCS).

AKA Left Renal Vein Entrapment Syndrome

- Is a rare vascular alteration due to compression of the left renal vein in the transition between the abdominal aorta and superior mesenteric artery.[1]
- Key ultrasound :
  - Aorto-mesenteric angle less than 22 degree
  - Velocity ratio pre/post compression greater than 4:1
- Symptoms
  - Hematuria, flank pain.



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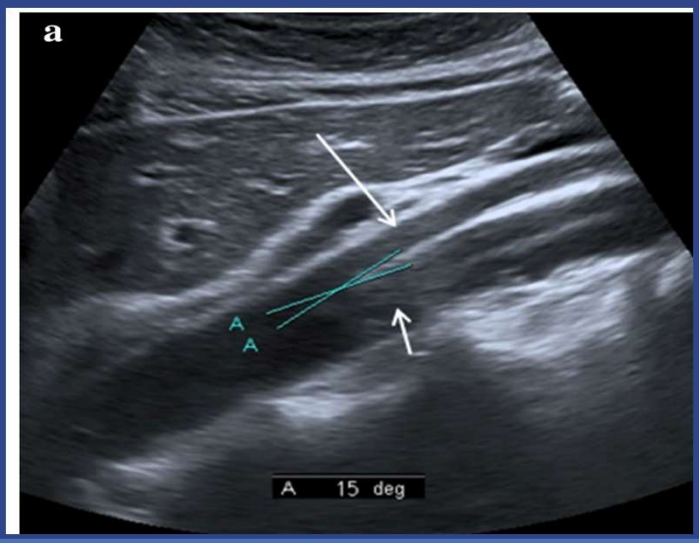
Sonography in Diagnosing NCS

- It can also measure speed of flow and caliber of pre stenotic tract of the left renal vein.



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Duplex Doppler Ultrasound

The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J*. Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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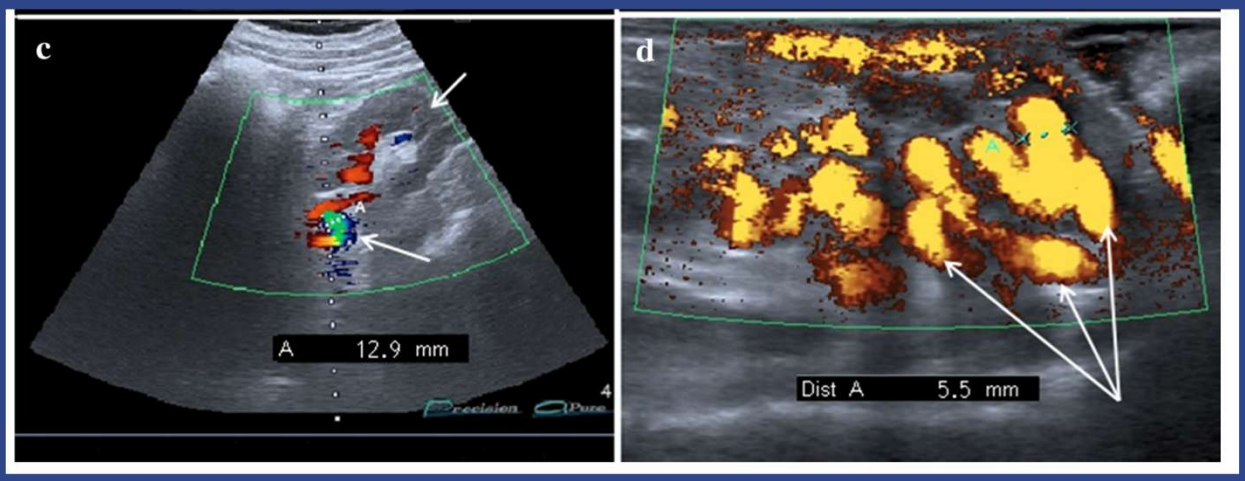
Role of Ultrasound in Diagnosing NCS



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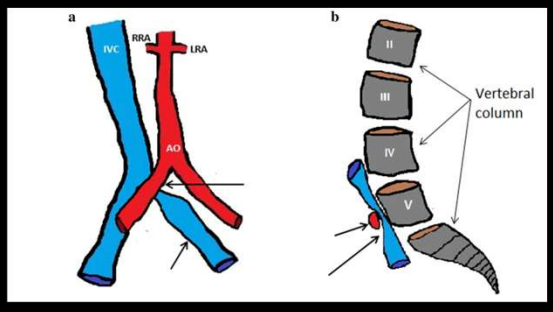
May-Turner Syndrome (MTS) AKA Cockett Syndrome

- Left common iliac vein compressed by the right common iliac artery.
- Key ultrasound:
  - Pre-stenotic dilatation
  - AND velocity changes
  - Often associated with DVT risk



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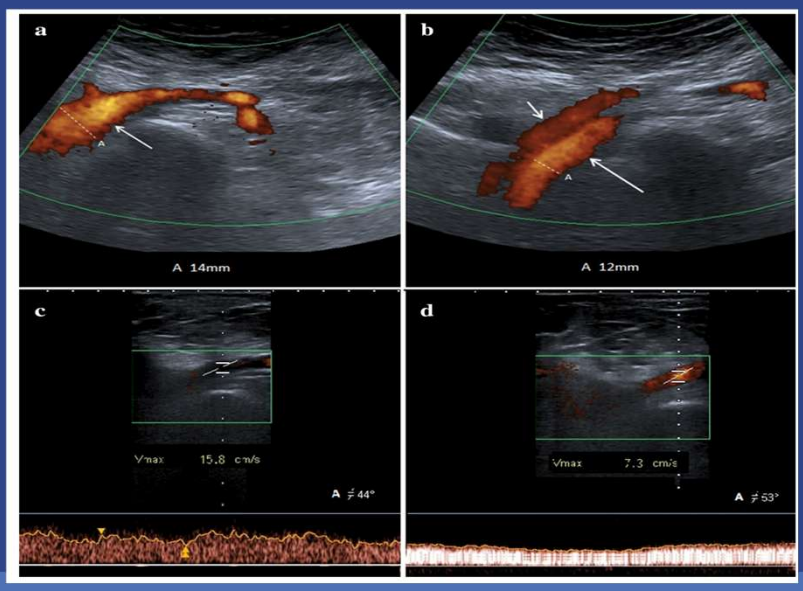
Doppler Diagnosis of MTS



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Dunbar Syndrome(DS) AKA (MALS)

Compression of the celiac artery (CA) by the median arcuate ligament.

Key ultrasound:

- Elevated PSV> 150 cm/s with inspiration/ expiration variation.

Symptoms:

- Post prandial pain
- Weight loss

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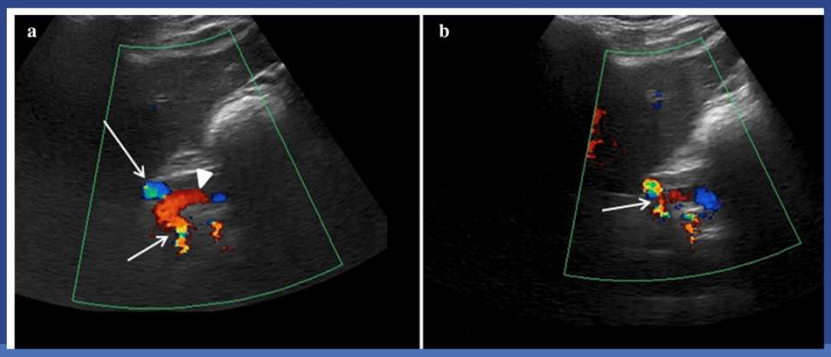
Instrumental Diagnosis

- To be considered DS, it must be symptomatic.
- Color Doppler and Spectral Doppler are the first level of diagnosis



The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J.* Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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Instrumental Diagnosis

- The high PSV > 150 cm/s is due to stenosis of CA.

The role of ultrasound imaging in vascular compression syndromes. Farina *et al. Ultrasound J.* Accessed [Apr 6th, 2025]. https://doi.org/10.1186/s13089-020-00202-6.

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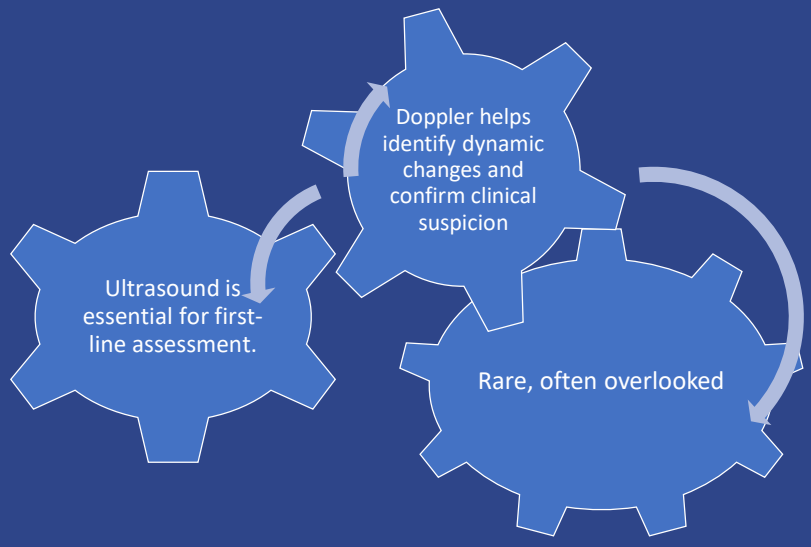
Key Points of Compression Syndromes



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Key Takeaways

- Doppler sonography is a powerful tool to uncover subtle and unexpected vascular abnormalities.
- Understanding flow patterns such as to and “fro” or reversed venous flow enhances diagnostic accuracy.
- Pseudoaneurysm cases highlight the importance of vigilance, clinical correlation, and timely intervention.
- Vascular compression syndromes can present with non-specific symptoms.
  - Sonographers play a key role in their detection
- Always approach vascular evaluation with an open mind and curiosity. Sometimes what’s “Hidden” can significantly impact patient care.
- Thinking outside the box transforms routine imaging into life-changing diagnostic insight.

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