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Diagnosis of Deep Vein Thrombosis of Upper Extremity by Ultrasonography

Amarjit Singh, Ph.D., RDMS, RVS, RDCS

Department of Radiology, USPHS Indian Health Service Chinle Hospital, Chinle Arizona 86503, USA.

amarjit.singh@ihs.gov

***Corresponding Author:** Amarjit Singh, Ph.D., RDMS, RVS, RDCS, Department of Radiology, USPHS Indian Health Service Chinle Hospital, Chinle Arizona 86503, USA.*

Abstract

DVT of the upper extremity (DVT-UE) is far less common than DVT of the lower extremity. It occurs in only 4 to 10% of all DVTs. There are several important risk factors associated with upper extremity DVT. Studies have shown more than half of the patients with DVT-UE have a CVC or a cardiac pacemaker in the affected area of the circulation.[6, 7] In this case report, Patient A, demonstrated that DVT-UE can occur spontaneously with no known risk factors, while Patient B had a CVC in placed in his right chest which is consistent with known risk factor for upper extremity DVT. The study has shown that compression ultrasonography and color Doppler ultrasound is a fast, reliable and accurate procedure to detect upper extremity DVT.

Introduction

The incidence of deep vein thrombosis (DVT) is about 1 per 1000 persons per year.[1] DVT is most commonly seen in the lower extremity (DVT-LE) and usually involve femoral, popliteal or calf veins. DVT of the upper extremity (DVT-UE) is by far less common than DVT of the lower extremity. It is increasingly becoming more common with the use of central venous catheters and cardiac pacemakers / defibrillators, and peripheral inserted catheter (PICC) lines[2]. At present 4-10% of all DVTs are located in an upper extremity (DVT-UE).[1,2] Thrombosis in DVT-UE can occur in any of the veins of the upper extremity that includes internal jugular, brachiocephalic, subclavian and axillary as well as in the distal superficial basilic and cephalic veins. The internal jugular and more distal radial and ulnar veins are involved less frequently. Patients presenting at the ED are usually asymptomatic but commonly present with limb swelling and pain. The most serious complication that can result from any DVT is a pulmonary embolus (PE) that requires serious intervention. Upper extremity DVT can either be of primary or secondary form. The primary form is known as Paget-Schroetter syndrome (PSS). It can be idiopathic but typically occurs in the dominant arm of younger athletic patients involved in activities requiring excessive and repeated motion of the upper extremities such as wrestling, swimming, gymnastics, and sports involving repetitive ball throwing (i.e., football, baseball, and basketball). The secondary form occurs most commonly in patients with central venous catheterization which disrupts the endothelial lining of the vessels thus activating coagulation cascade or in patients with malignancy.[3,4,5] Furthermore, congenital and acquired cases of coagulation disorders such as Factor V Leiden mutation can also increase the risk for upper extremity DVT. A focused personal and family history can often reveal clinical findings that can be suggestive of upper extremity DVT. It can be confirmed with imaging modalities that include ultrasonography combined with color Doppler. In difficult cases where the findings are not clear, contrast enhanced computed tomography (CT) is recommended.

This is a federal facility 66 bed hospital in a rural setting that mainly serves Native American population. In the past 6 years I have routinely seen cases of lower extremity DVT, while upper extremity DVT cases are rare. I have seen no more than 5 cases in the past 6 years. However in the past 10 days there were 2 cases in which patient presented with upper extremity swelling and shoulder pain radiating to neck. Both patients were diagnosed with upper extremity DVT.

This case report is on upper extremity DVT recently seen in these two patients.

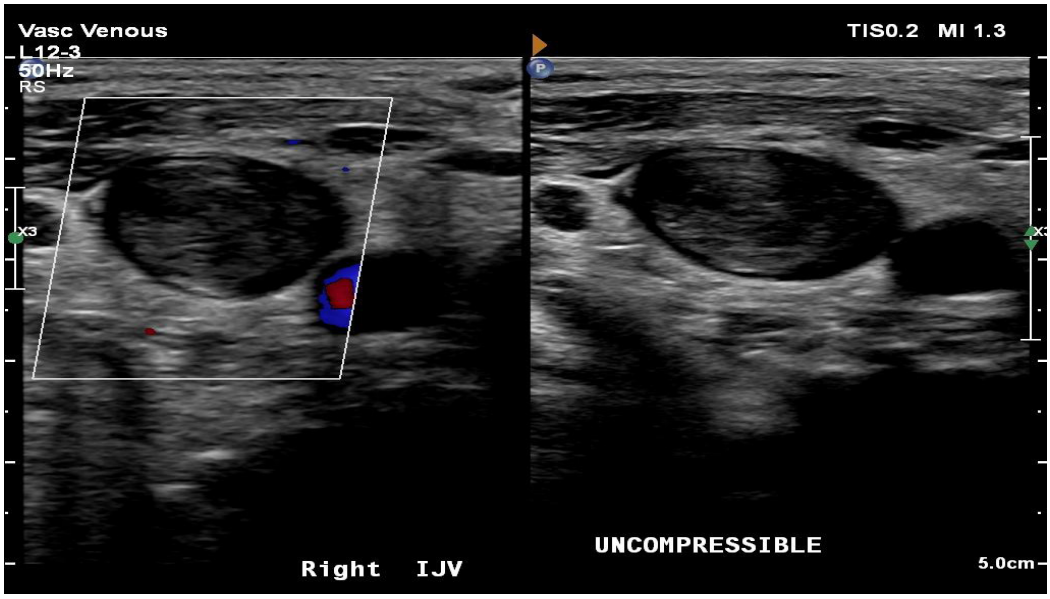
Case Report

Patient A is a 66 year old male who presented to the ED (12/11/2019) in the morning with swelling to his right upper extremity. Patient stated that it started in the night and denies any trauma or repetitive motion the night before. He just "woke up that way". He's able to move all extremities, no decreased ROM. The right arm was swollen both over the forearm and the bicep/tricep area. The deltoid muscles were unremarkable. Additionally there was no redness or bruising over the right arm. Patient was then referred to radiology for a venous Doppler scan of the upper extremity to rule out DVT.

Patient B is a 69 year old male who presents to the ED (25/11/2019) complaining pain in the right forearm and shoulder. Patient is on dialysis with end stage renal disease (ESRD). Dialysis access is via permacath in-placed in right chest. He was dialyzed one day before his visit to ED. He reports that over the last week they have started using his left arm fistula for dialysis. He has had increasing edema of his RUE for the past week but no pain. Several hours ago he awoke with sharp intermittent pain in his R shoulder which was not there previously. It becomes worse when he moves the arm or takes a deep breath. Denies shortness of breath, falls or trauma, patient has a history of CAD, CABG x 4, revascularization of bilateral lower extremity and mild pulmonary HTN.

Sonographic grey scale images, color and pulse Doppler spectrum was obtained on a Philips EPIQ 5G ultrasound machine using a high frequency L12.3 linear transducer.

Patient A has no known risk factor for DVT-UE, however, ultrasound exam showed right internal jugular vein, subclavian v and axillary vein all uncompressible and thrombosed. The thrombosis was visible within the internal lumen of the internal jugular vein and appeared somewhat echogenic. Thus the clot is probably a few days old. There was no flow on the pulse Doppler confirming total occlusion. The sonographic images of the internal jugular vein in transverse and long axis plane are shown in Figure 1. Note the lack of compression and echogenic clot within the lumen is visible in transverse and long axis plane. The key sonographic finding in excluding venous thrombosis is complete compressibility of the vein which is lacking in this case. Figure 2 shows no pulse wave Doppler flow in IJV. Absence of phasic flow is suggestive of total occlusion of the vein. Lack of complete compressibility and no Doppler flow in subclavian and axillary vein is shown in Figure 3 and 4. Grey scale sonographic image of basilic and cephalic veins show theyare distended and completely compressible, as shown in Figure 5, thus excluding any clot in the superficial veins.



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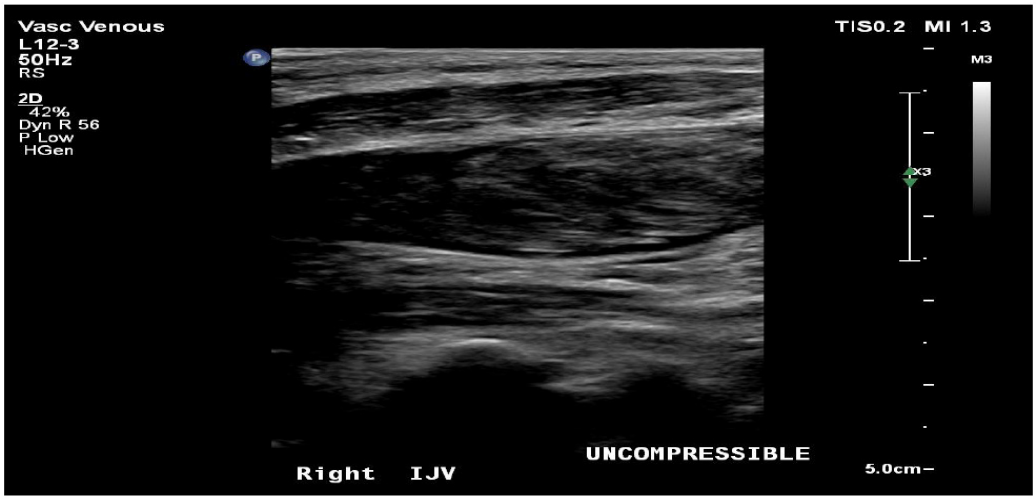

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Figure 1. *Sonograhic image of the right internal jugular vein (IJV) (a) transverse plane (b) long axis plane. Note the echogenic clot within the lumen and lack of complete compressibility*

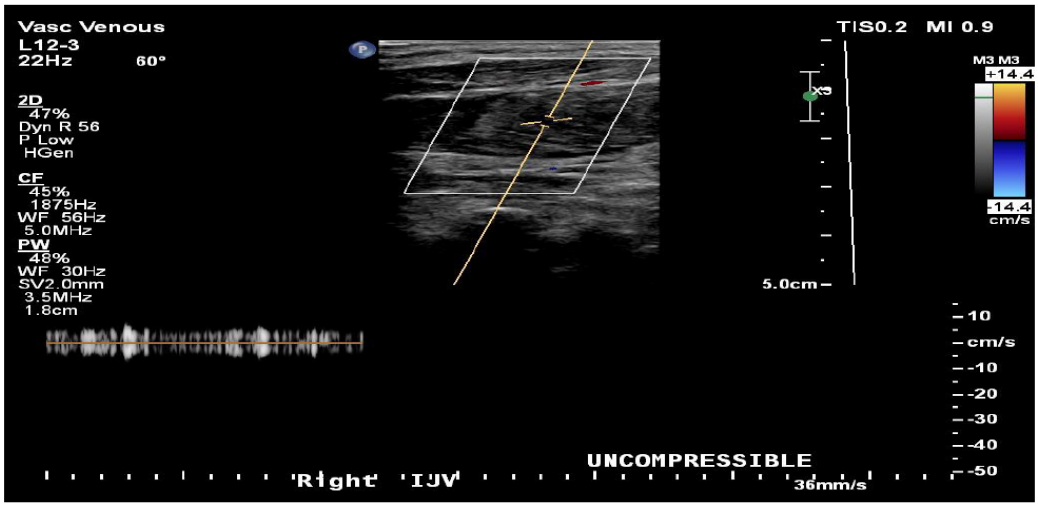
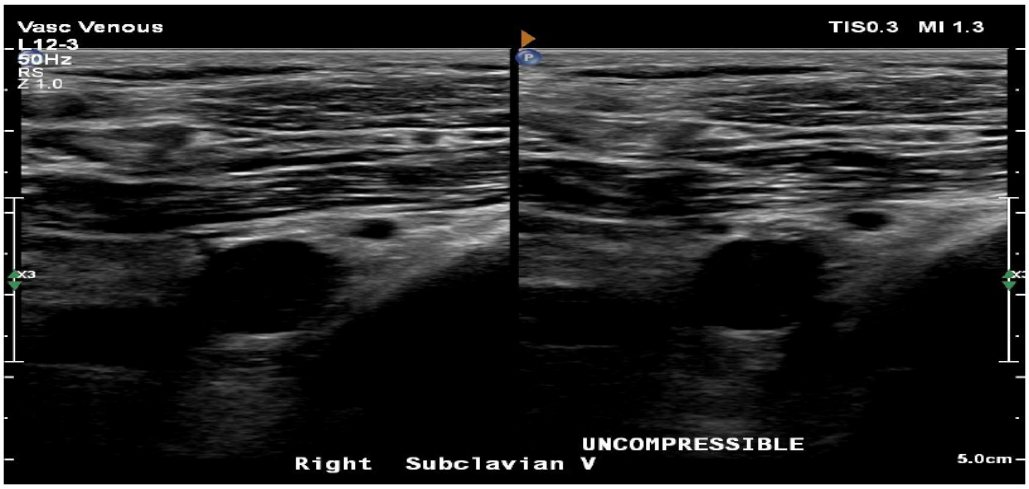


Figure 2. *Color Doppler and pulse wave Dopplerimage of the internal jugular vein in patient A. Note there is no color within the lumen and no pulse wave signal which is suggestive of total occlusion.*



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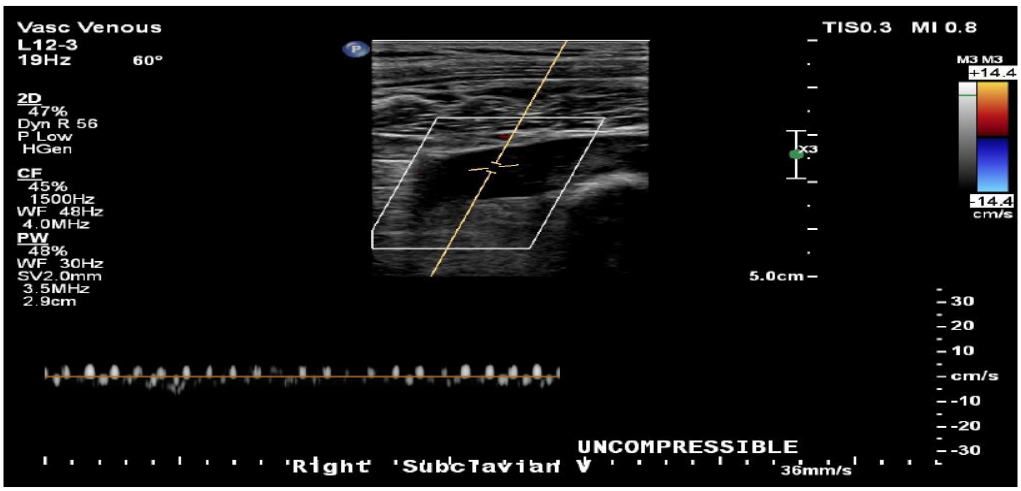
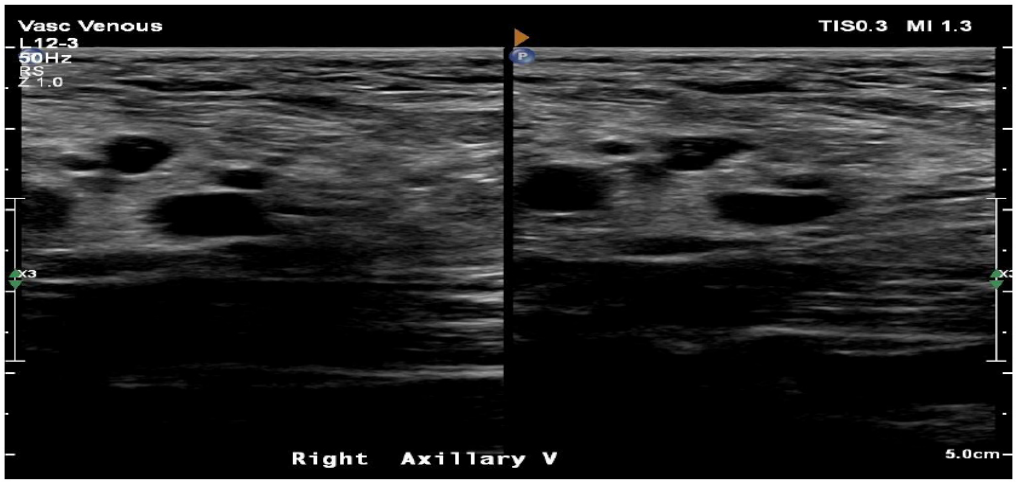


(b)

Figure 3. *Sonograhic image of the right subclavian vein in Patient A (a) transverse plane (b) color Doppler and pulse wave spectrum. Note echogenic clot and lack of compressibility and no flow suggestive of clot and total occlusion*



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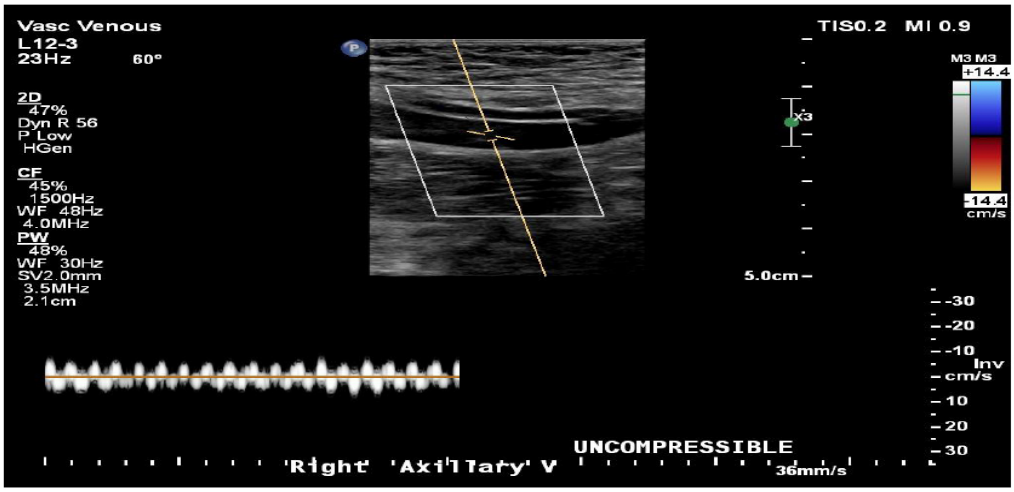
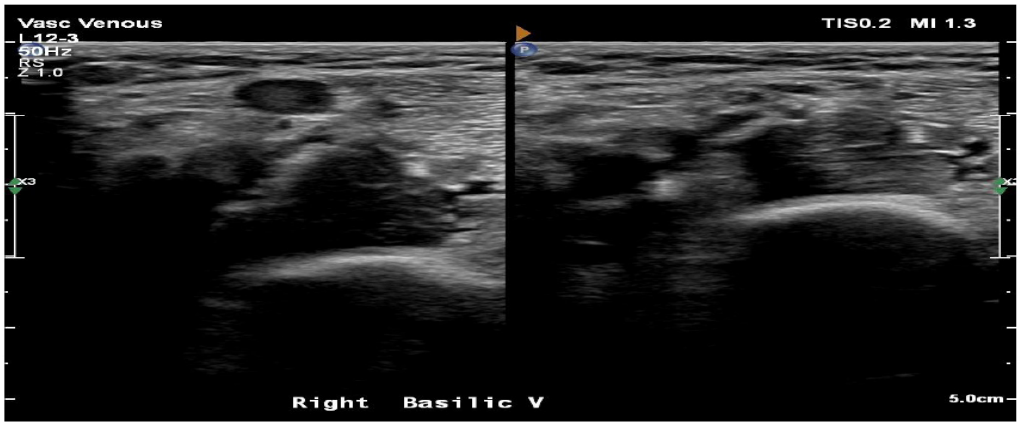


(b)

Figure 4. *Sonograhic image of the right axillary vein in Patient A (a) transverse plane (b) color Doppler and pulse wave spectrum. Note lack of compressibility and no flow suggestive of clot and total occlusion*



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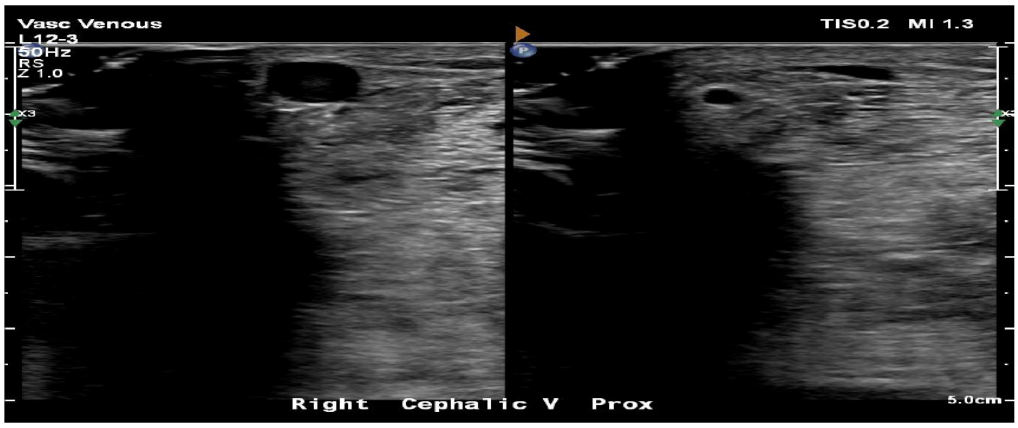
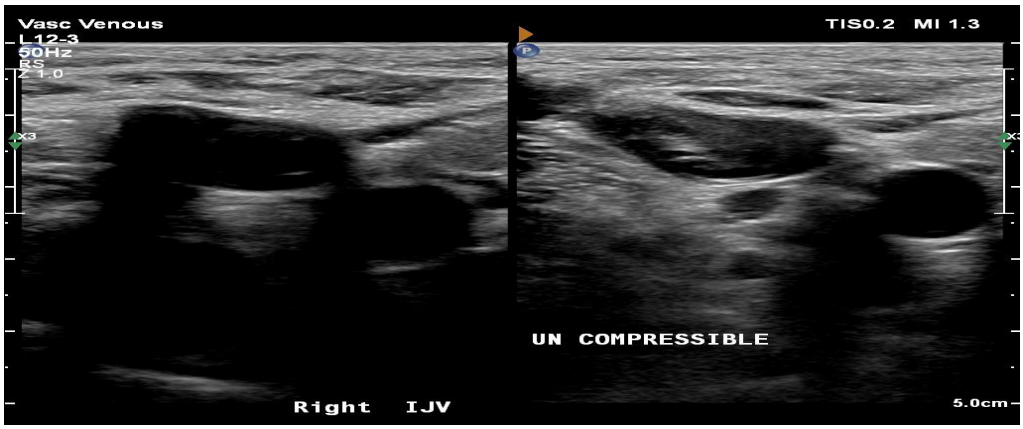


(b)

Figure 5. *Sonograhic image of the superficial veins in Patient A (a) proximal basilic vein (b) proximal cephalic vein in transverse plane. Note the veins are completely compressible suggestive of no thrombosis*

Patient B has one known risk factor for DVT-UE because of the CVC in his right chest. Sonographic grey scale transverse image of right internal jugular vein (IJV) is shown in Figure 6. IJV is uncompressible and echogenic clot is visible within its lumen. Total absence of flow on color Doppler and pulse wave is shown in Figure 6a which is suggestive of total occlusion. Proximal subclavian vein is patent and pulsatile/phasic flow is seen on pulse Doppler, as shown in Figure 7. Proximal and distal cephalic vein is patent showing total compressibility and flow, as shown in Figure 8. Since patient was in considerable pain and couldn't move his arm, had bandage over the catheter site therefore axillary and basilic veinscould not beinterrogated.



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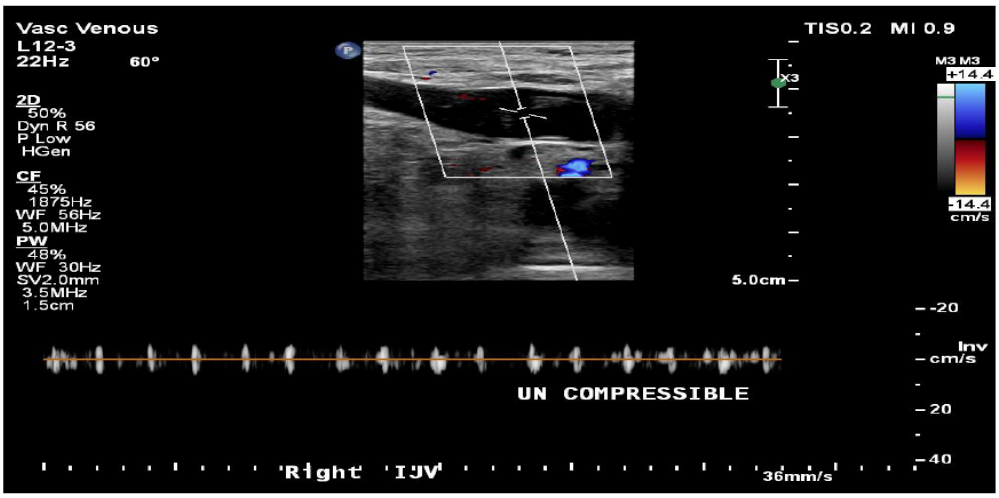


(b)

Figure 6. *Sonograhic image of the right internal jugular vein in Patient B (a) transverse plane (b) color Doppler and pulse wave spectrum. Note echogenic clot and lack of compressibility and no flow suggestive of clot and total occlusion*

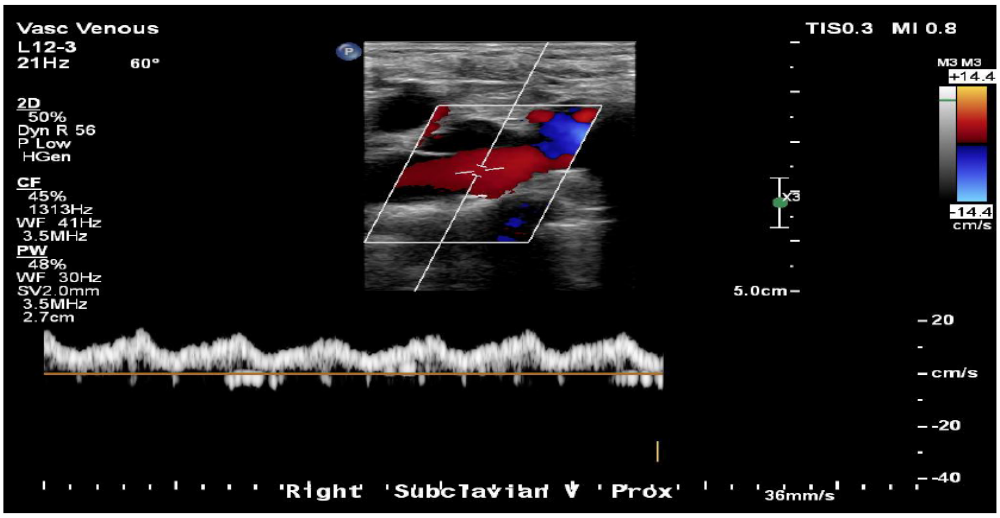
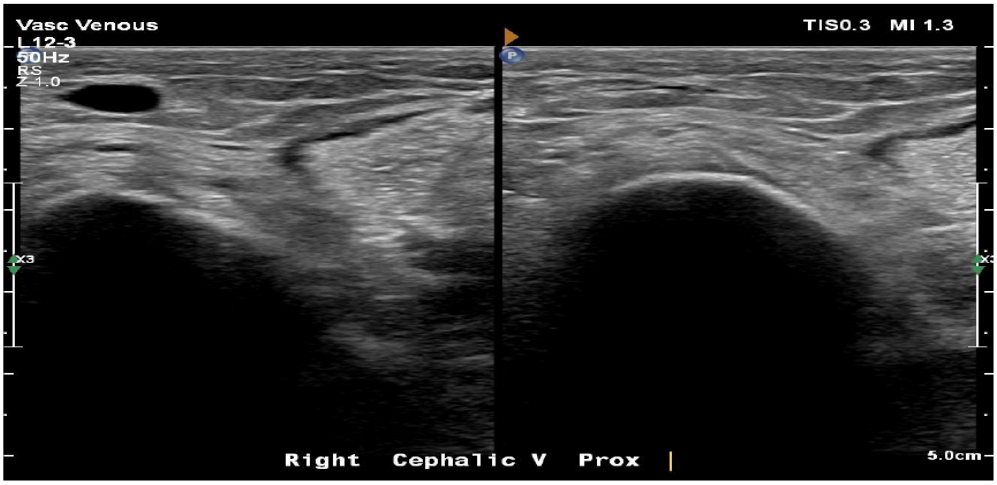


Figure 7. *Color Doppler and pulse wave Doppler image of the subclavian vein in patient B. Note there is color within the lumen and pulse wave signal which is suggestive of patency and no clot.*



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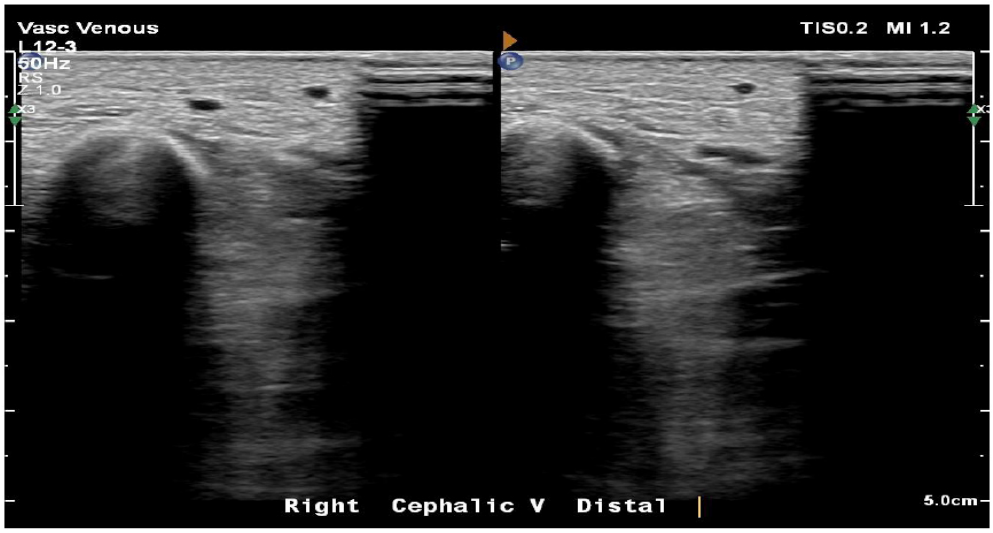

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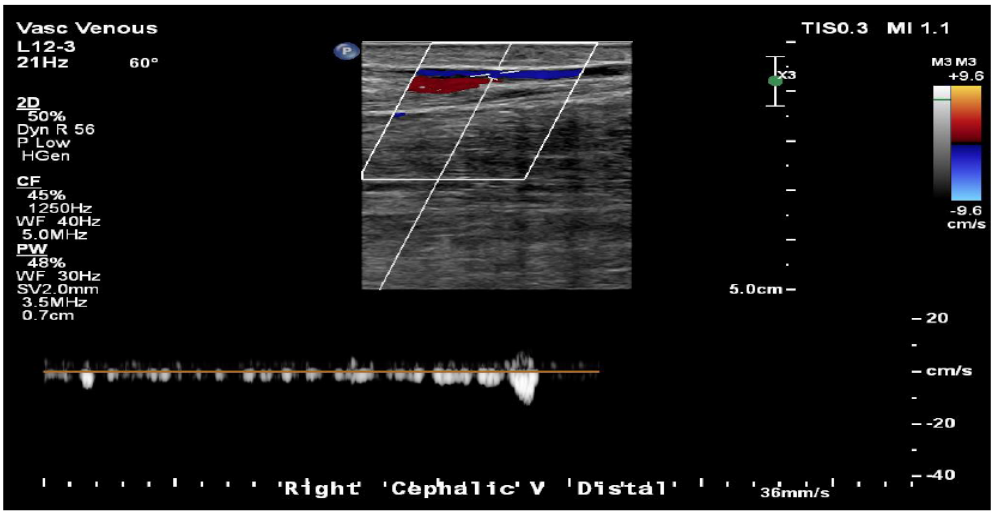

(c)

Figure 8. *Sonographic image of the cephalic vein in Patient B (a) proximal (b) distal (c) color Doppler and pulse wave spectrum. Note the total compressibility and flow within the lumen which is suggestive of no clot*

Discussion

There are several important independent risk factors associated with upper extremity DVT. First, the presence of foreign body, such as central venous catheter (CVC) or a cardiac pacemaker, in the vascular system increases the risk of DVT-UE. More than half of the patients affected with DVT-UE have a CVC or a cardiac pacemaker.[6, 7]In this case-report one of the patient (Patient B) had a permacath in-placed in the right chest for dialysis access. The presence of a CVC increases the risk of DVT-UE sevenfold (odd ratio 7.3), 95% confidence interval, $p < 0.0001$.[7] DVT-UE was demonstrated in 60% of patients with pacemaker at 6 months follow-up.[8]

The second independent risk factor for DVT-UE is malignant disease. Having a malignant disease increases the risk by a factor of 18 compared with patients who do not have a malignancy.[9,10]Up to 49% of patients with DVT-UE have tumor.[11]

The third independent risk factor for DVT-UE is surgical intervention. It has been shown that 27% of patient with DVT-UE had a history of surgical intervention.[11]

It is difficult to detect DVT-UE by just clinical examination and from a complete personal history. A common sign in patients with DVT is venous congestion such as swelling, redness, pain, edema, cyanosis, and dilation of the superficial veins.[12, 13]Further, localized neck or shoulder pain may point to the thrombosis

in the subclavian or axillary vein. In our case Patient B complained about localized right shoulder pain radiating towards the neck. On examining DVT-UE was confirmed in the jugular vein. These are typical, but not specific, symptoms of DVT-UE.[12,13]

In my own experience, ultrasound exam on patients with above clinical signs is usually negative in most cases. A large percentage of DVT-UE ~ 33 to 60% patients are asymptomatic and may well go undetected.[12] The specificity of detecting DVT-UE based on only clinical examination is low ~ 33%.[9] This can be increased by using diagnostic imaging procedures, such as ultrasonography and/or contrast enhanced computed tomography (CT).[14]There is significant radiation associated with CT. Thus ultrasound is much preferred over CT and it is the best modality for detection. It is accurate in detecting DVT-UE, with 97% sensitivity and 96% specificity, in the distal veins.[15]Veins that cannot be compressed for reasons of anatomy, such as proximal brachiocephalic and subclavian veins, color Doppler sonography is used. In patient B the color Doppler sonography was used to assess the patency of proximal subclavian vein that arises from the brachiocephalic vein. Veins are easily compressed under small external force as opposed to the arteries which have muscular walls and are at higher pressure. Thus lack of total compression of the vein is a positive finding for venous occlusion. Ultrasonography is a radiation free, fast and accurate method to evaluate patients suspected of upper extremity DVT.

Though there are three important independent risk factors that can lead to DVT-UE. However, in the case of Patient A there were no known risk factors. He woke up in the morning and felt swelling on his forearm with no other clinical sign or family history. Thus DVT-UE in his case can be idiopathic or of the primary form. Patient B had one independent risk factor of CVC in-placed in his right chest for dialysis and had history of renal and heart disease. The presence of a CVC increases the risk of DVT-UE, which is of secondary form, by seven-fold[7].Moreover, patients with catheter-associated DVT-UE show a higher rate of recurrence than patients without venous catheters.[16]

Conclusion

DVT of the upper extremity (DVT-UE) is far less common than DVT of the lower extremity. DVT-UE occurs in only 4 to 10% of all DVTs. Though there are several important independent risk factors associated with upper extremity DVT. In this case report, Patient A, demonstrated that DVT-UE can occur spontaneously with no known risk factors, while Patient B had a CVC in placed in his right which is a known risk factor for upper extremity DVT. The study has shown that compression ultrasonography and color Doppler ultrasound is a fast, reliable and accurate method to evaluate patients suspected of upper extremity DVT.

Acknowledgement

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