



VASCUPEDIA

Step by step ultrasound examination of varicose veins

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Step by step ultrasound examinations of varicose veins

Required technical setup:

B-mode vessel imaging combined with color coded Doppler flow measurement. An additional pulsed-wave-Doppler is useful.

Recommended transducer:

- 7 - 10 MHz linear transducer for the veins of the extremities
- 2 - 6 MHz sector transducer for the pelvic and abdominal veins

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Optimizing of the B-mode imaging by appropriate choice of¹:

- transmission power
- gain (as low as possible)
- time gain compensation (TGC)
- depth gain compensation (DGC)
- focusing on the target level

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Optimizing of the color coded duplexsonography by¹:

- using a sufficiently low puls repetition frequency (PRF). Thus it is possible to detect and image vessels with a very slow flow rate

Optimizing of the pulsed-wave-Doppler by¹:

- angle-correction (<60°)

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This questions should be answered to collect all the informations the specialist needs to know in order to treat the patient²:

- Are the deep veins in a physiologic condition ?
- Where is the source of the reflux ?
- Which path, size and eventual communication has the reflux ?



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Patient positioning³:

- Reverse Trendelenburg or standing position to achieve a hydrostatic distension of the veins
- The lower leg can be examined in a combination of standing and sitting position

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Testing for venous incompetence (reflux) by⁴:

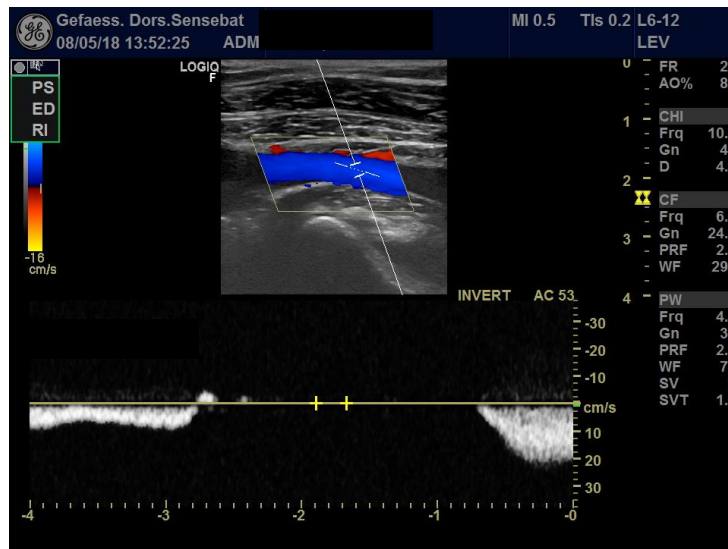
- Valsalva manoeuvre (or hand controlled Valsalva manoeuvre - the patient should take a deep breath and hold, the examiner pushes with his free hand on the abdomen and the patient has to resist the pressure)
- Manual (or automatic cuff) distal augmentation for reflux-detecting below the sapheno-femoral junction (SFJ). With this technique a large volume of venous blood is emptied out of the calf. During the quick release a large pressure gradient is created and a reflux can be detected.
- Activation of the calf muscle pump

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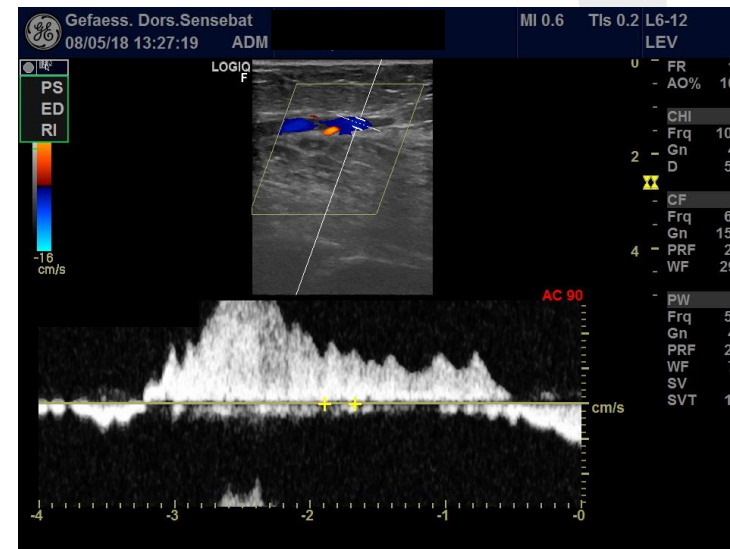
Reflux criteria in an ultrasound examination⁵:

Measurement of the reflux-time

The diagnosis of reflux is made when the retrograde flow exceeds 0.5 seconds



Sufficient valve function

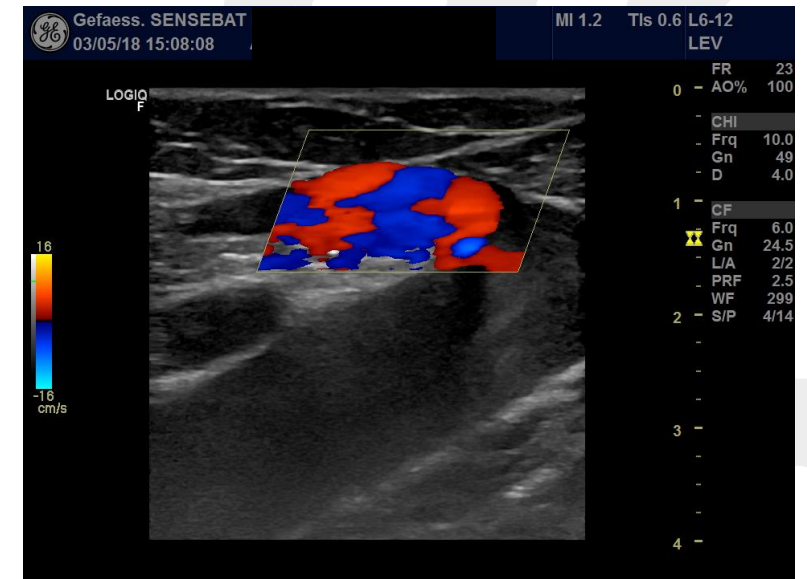


Insufficient valve function with reflux

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Recommended parts of the ultrasound examination:

- Deep vein survey
- Overview of the superficial vein anatomy
- Superficial vein reflux and their path



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- Deep vein survey⁶:

Standard DVT scan combined with reflux-testing for the distal CFV, FV and PV

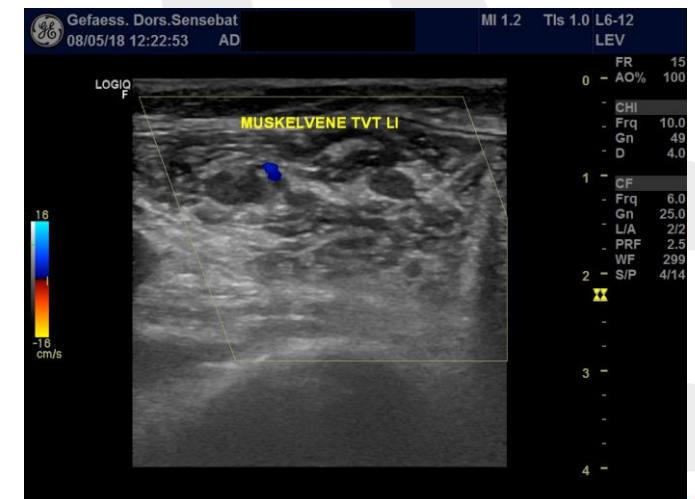
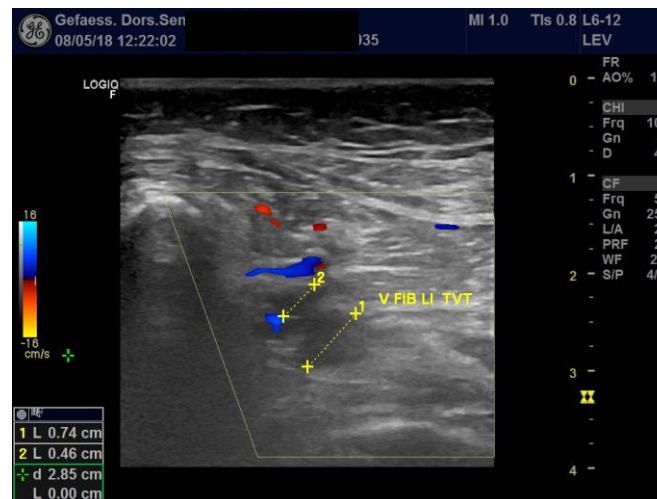
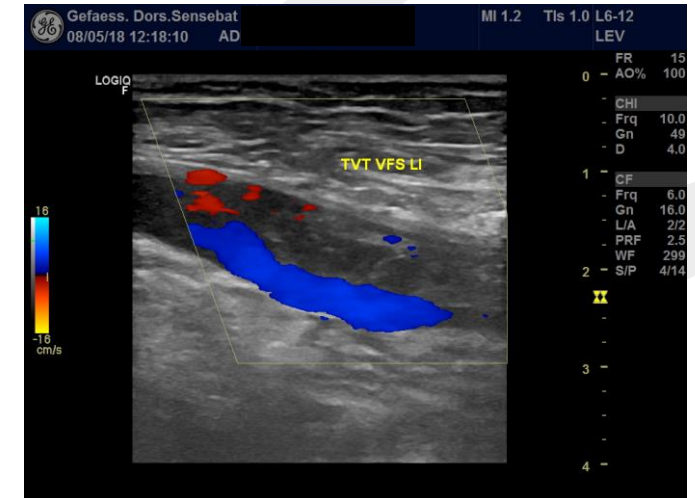
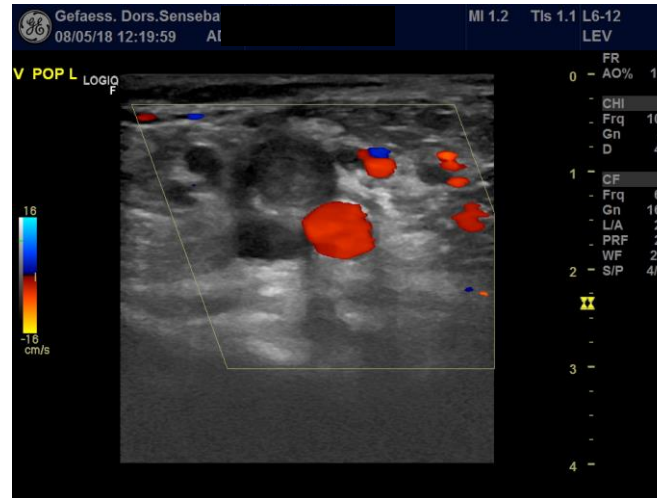
Interpretation of the Doppler-waveform. Absence of the respiratory phasicity may imply an obstruction or compression of the iliac veins

Pulsatile waveforms are associated with a right heart failure

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- Deep vein survey⁶:

DUS images of a DVT on different levels



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- Overview of the superficial vein anatomy⁷:

High number of anatomic variants

Detection of accessory saphenous veins

Duplications of the GSV and SSV

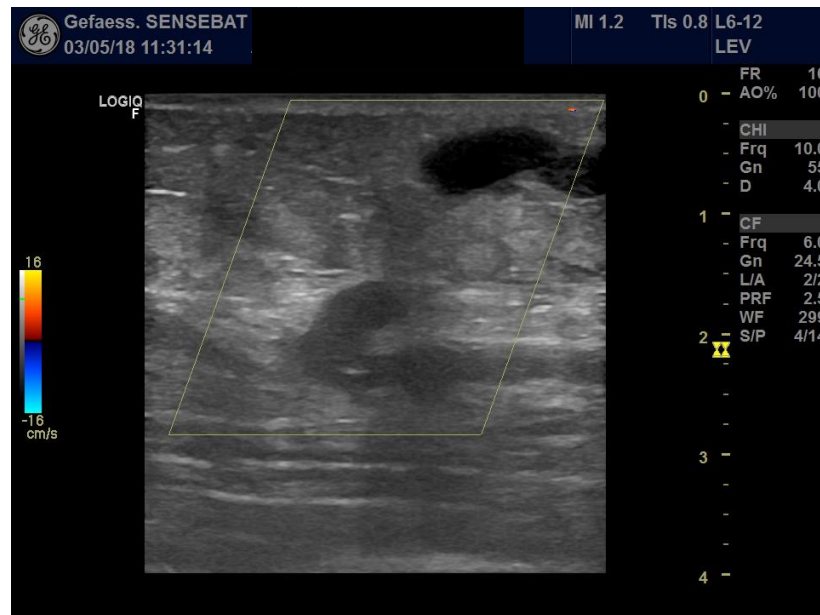
The sapheno-femoral-junction (SFJ) is relatively constant but the sapheno-popliteal-junction (SPJ) has multiple variations and an individual anatomic behavior

Detection of intersaphenous connections between GSV and SSV (Giacomini anastomosis)

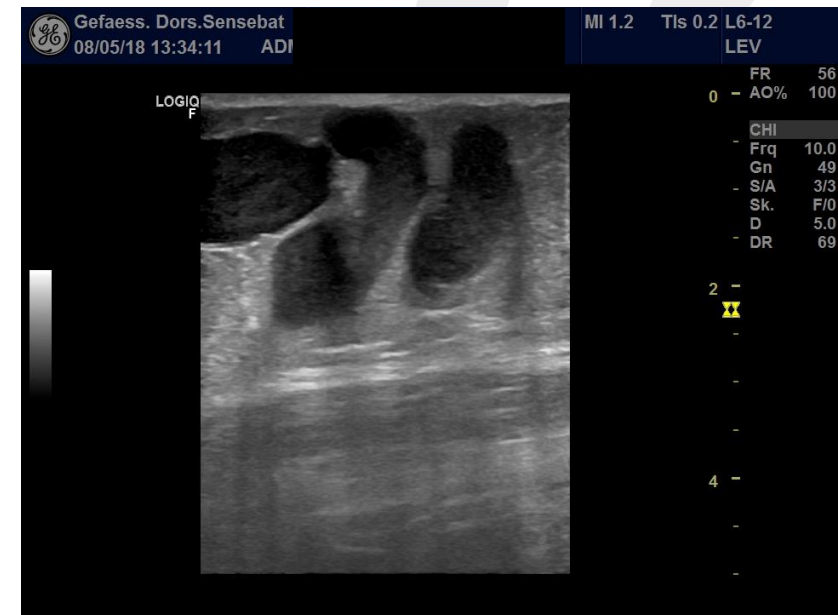
Detection of (post-) phlebitic veins

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- Overview of the superficial vein anatomy⁷:



Phlebitis of a Cockett-perforator with dvt of a crural muscle vein



Typical varicose veins of the lower leg

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- Superficial vein reflux and their path²:

The normal reflux pattern is „from top to down“

The failure of a valve increases the pressure on the next valve. This valve has to do the job of two valves and will fail also („domino-effect“). So the insufficiency follows down the lower extremity

Insufficient superficial veins dilate and loose their straight anatomy. They transform into tortuous varicose veins

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- Superficial vein reflux and their path²:

Rare reflux patterns:

Isolated perforator insufficiency

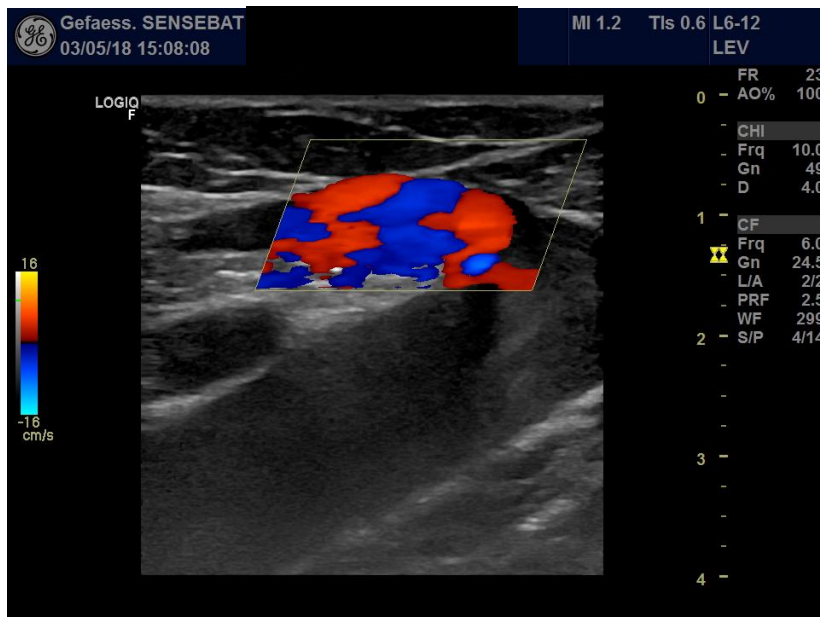
Refluxing pelvic veins can communicate by inferior epigastric, pudendal or other veins with the GSV and trigger an incompetent GSV while the SFJ is competent

Communication between GSV or SFJ and SSV (Giacomini anastomosis)

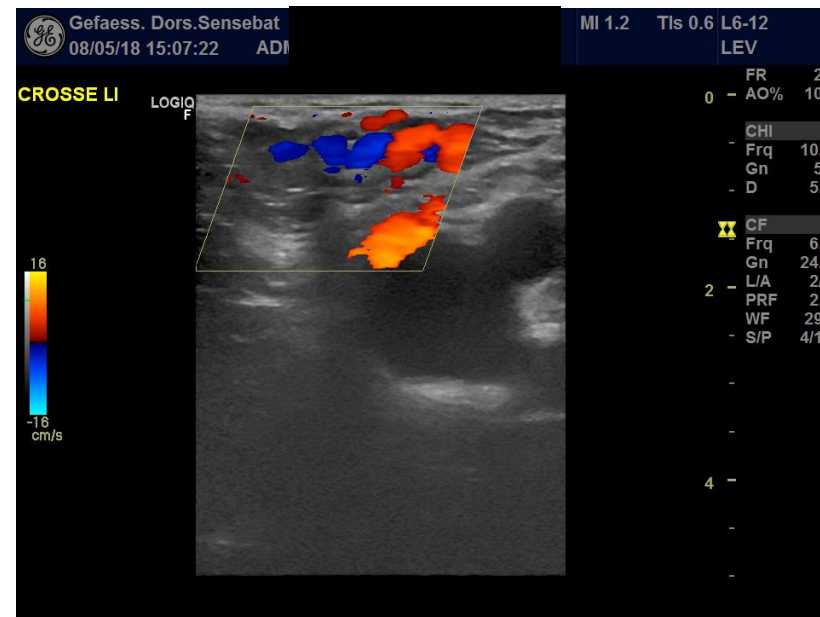
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- Superficial vein reflux and their path²:

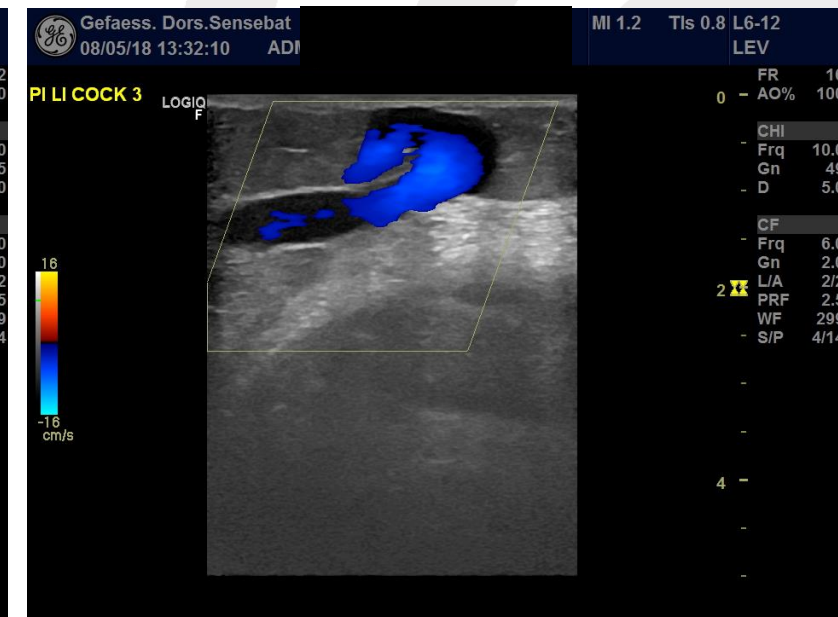
Different Reflux patterns



Reflux of the sapheno-femoral-junction



Recurrent reflux of the SFJ



Isolated reflux of a Cockett-perforator

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Structured ultrasound examination:

- First get a general overview:

Is there a CVI? Do not start with the assessment of each tributary

- Reflux source and path:

The main aim is to detect the source of the reflux and to understand the path it follows

- Examine from the top to the down:

EIV -> FV -> SFJ -> GSV -> PV -> SPJ -> SSV -> crural veins and perforators

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Structured ultrasound examination:

- Use the color coded Doppler flow for the general survey. The pulsed-wave-Doppler is for the documentation of the reflux-time
- Look for dilated veins. Superficial veins > 5 mm are nearly always incompetent
- If tributaries are refluxing, they may be communicators. This is necessary to understand the path of reflux
- Perforators > 3 mm are suspicious for reflux

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Reporting

The result of the ultrasound examination is the key diagnosis for a treatment planning. Therefore the result should be documented in a high-quality graphic report.

This report should contain:

- detailed informations about the superficial and deep veins
- characteristics of the reflux and their path
- anatomic description of the superficial veins (vessel size, duplication, location, e.g.)
- incidental findings (thrombus, phlebitis, anatomic variants, e.g.)

The report should be saved on a worksheet with sonography images and standardized sketches.

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Conclusion

The treatment of varicose veins requires a detailed understanding of the source and path of the reflux. It is not possible to develop a strategy and therapy planning for the patients individual varicose pattern without this knowledge.

Therefore the ultrasound examination is the most important part of diagnosis. This implies that the specialist has to be experienced in vascular ultrasound imaging and in its pathophysiological interpretation.

Beside a proper technical setting the physician should perform the ultrasound examination in comprehensibly and structured steps. The result has to be fixed on a standardized report.

References

1. Noppeney T., Hüllen H., Brunner A., Lang W., Sonographische Diagnostik, Varikosis, 94-100, Springer, 2010
2. Nenas M, Duplex ultrasound in the assessment of lower extremity venous insufficiency, Australas J Ultrasound Med., 13(4), 2010 Nov
3. M. Marshall, C. Ichwahn-Schreiber, M.-W. Kleine, Patient positioning for duplex ultrasound scanning of leg vessels, Phlebologie 2014; 43: 201-205
4. S. Krishnan, S. C. Nicholls, Chronic Venous Insufficiency: Clinical Assessment and Patient Selection, Semin. Intervent. Radiol. 2005 Sep; 22(3): 169-177
5. V. Balinan, S. Taymir, S.S. Hedgire, S. Ganguli, A.M. Prabhakar, Lower extremity venous reflux, Cardiovasc Diagn The. 2016 Dec; 6(6): 533-543
6. E.P.L. Turton, P.A. Coughlin, D.C. Berridge and K.G. Mercer, A Survey of Deep Venous Thrombosis Management by Consultant Vascular Surgeons in the United Kingdom and Ireland, Eur J Vasc Endovasc Surg **21**, 558–563 (2001)
7. C.M. Black, Anatomy and physiology of the lower-extremity deep and superficial veins, Tech Vasc Interv Radiol. 2014 Jun; 17(2):68-73.