15 Examination of Superficial Veins in the Presence of Deep Venous Disease

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Chapter Summary

Deep venous disease may lead to secondary pathologies in the superficial veins and vice versa. A patient with existing incompetence in a superficial vein may also develop deep vein thrombosis and deep venous reflux. In this case two pathologies can occur in the same leg, namely, the aftermath of a deep vein thrombosis plus pre-existing disease in the superficial system. Regardless of the chronological order of disease and the mechanisms giving rise to them, special care must be taken when examining the superficial vein system in the presence of deep venous pathology. This is of particular importance when choosing the appropriate surgical treatment.

In functional terms, there are two possible ways in which the deep venous pathology may cause abnormalities in the superficial system:

1. The deep veins are no longer able to drain the leg in the presence of obstruction.
2. The deep veins are refluxive with retrograde flow in addition to antegrade flow.

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15.1 Superficial Veins with Deep Venous Obstruction

The deep vein system may be occluded by thrombosis without recanalisation. Other causes include injuries to the deep veins, for example:

- Direct puncture of the leg veins in non-sterile conditions for intravenous drug consumption resulting in sepsis and abscess formation
- Injury to the vessels in neonates due to repetitive cannulation of the common femoral vein
- Injuries to the deep leg veins in major trauma

Complete obstruction (occlusion) of a deep vein due to tumour infiltration (e.g. sarcoma) occurs but is rare in everyday practice. Congenital atresia of the vena cava hampers the venous drainage of the legs with the development of huge collateral veins.

In a standing patient, **complete valve incompetence** of the deep leg veins may produce a condition similar to occlusion with failure of the venous return.

During examination of the superficial veins, large diameter saphenous trunks will be noticed. The flow in these veins is antegrade in the early stages of the disease (Fig. 15.1a, b). It is remarkable that a very large blood volume flow is observed during calf-muscle systole. During diastole the flow is also antegrade and generally constant and slow. Over the course of time, the excessive volume load will cause failure of valve closure in the superficial veins. This will lead to diastolic reflux and the formation of refluxive venous tributaries (Fig. 15.1c, d).

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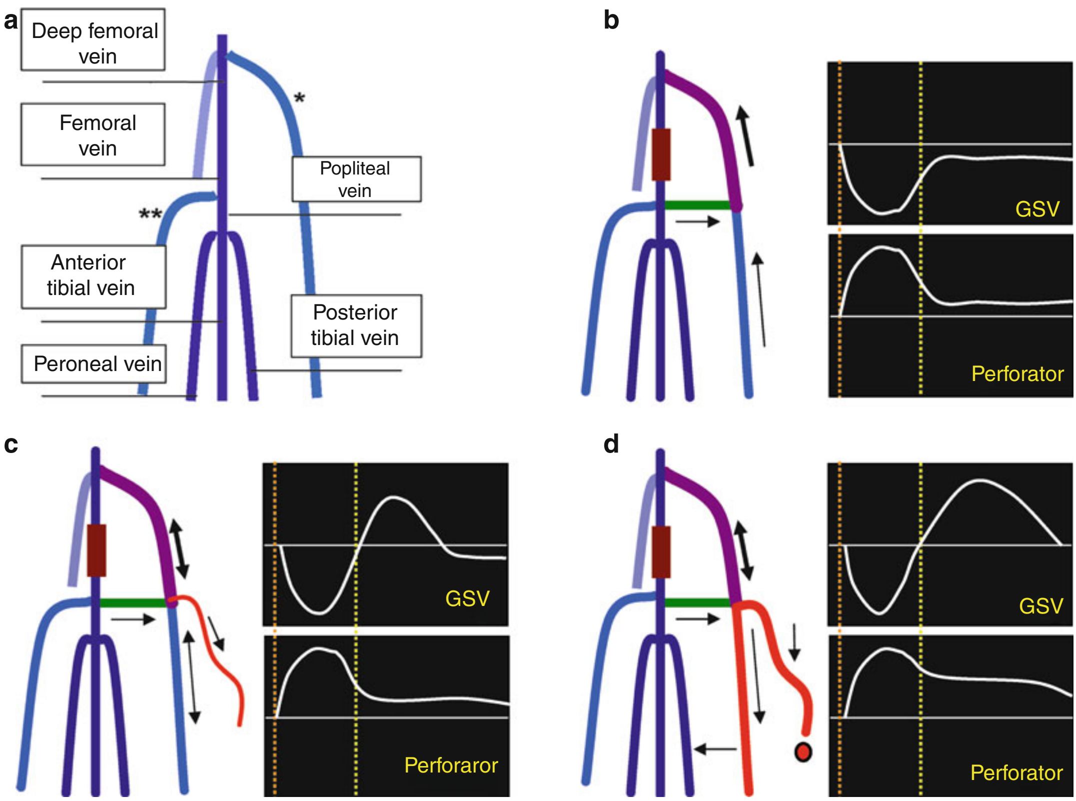

Fig. 15.1 (**a**) Diagram of the deep veins in the previously used scheme of the superficial leg veins with great saphenous vein (*) and small saphenous vein (**). (**b**) Development over time of flow in the great saphenous vein (*VSM*) with an occluded femoral vein (formerly superficial). *Dark red*, vertical obstruction; *orange dotted line*, beginning of muscular systole (toes raised); *yellow dotted line*, beginning of muscular diastole (toes lowered). The blood flows from the distal calf through a paratibial perforating vein (formerly Boyd; *green*). The flow is antegrade at first into the great saphenous vein causing its dilatation (*violet*). (**c**) Commencement of oscillating volume flow as valve closure starts to fail in the over-dilated great saphenous vein. Furthermore, a deep to superficial drainage flow develops within this segment of refluxive great saphenous vein. This drainage during calf systole can occur either via an incompetent great saphenous vein or an incompetent venous tributary. (**d**) Refluxive venous tributaries are seen receiving flow volumes from the great saphenous vein. Although the vein is technically refluxive, the considerably large volume of blood with antegrade flow is remarkable. Meanwhile, several refluxive venous tributaries have formed, and the lower part of the great saphenous vein has yielded and become refluxive. This reflux volume fills the deep system at the ankle during muscular diastole. As a result of this increased flow and pressure, the perforating vein dilates and an outward flow may also be recorded in the perforating vein during calf systole Copyright: [Author]

The flow of blood leaves the deep vein system through a perforating vein. The blood flow in this vein is retrograde, refluxive and outwards. It brings blood from deep to superficial veins (Fig. 15.2) and serves to drain the lower segments of the deep veins because they no longer have a drainage route due to higher obstruction.

Blood will flow upwards in the superficial veins and then re-enter the deep veins above the point of closure. This occurs usually after femoral vein (formerly superficial) occlusion through the saphenofemoral junction. This pathway is called an open compensatory (vicarious) shunt (Franceschi and Zamboni 2010).

When the common femoral vein or the iliac vein is blocked, the blood finds a way to the contralateral pelvic veins through an anastomosis via the saphenofemoral junction. Large calibre veins can be seen above the pubic bone which drain into the saphenofemoral junction of the contralateral leg. Drainage of the diseased leg takes place through the contralateral saphenofemoral

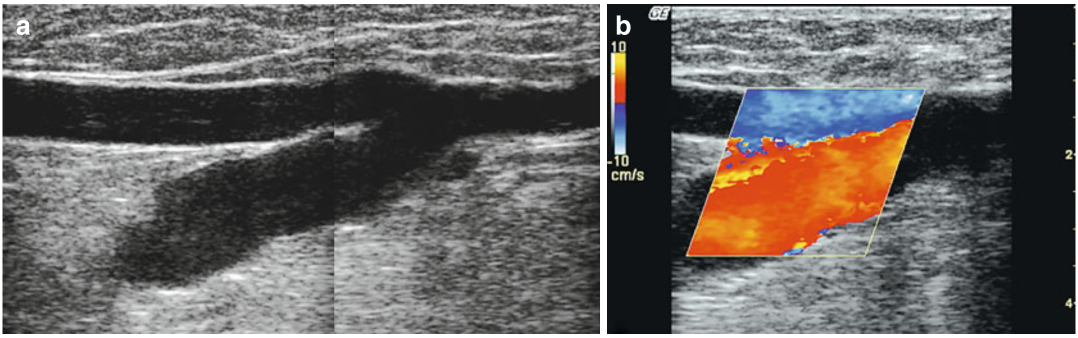

Fig. 15.2 The aftermath of occlusion of the common femoral vein in the right leg due to an abscess in an iv heroin abuser. Dilated perforating veins are seen in the adductor canal (formerly Dodd). These carry blood outwards into the great saphenous vein. This increase in flow causes saphenous dilatation in an attempt to bypass the femoral occlusion. Although most of the blood in the upper part flows antegrade, the lower segment also becomes refluxive which can give rise to several refluxive venous tributaries. (**a**) Longitudinal view of the inner thigh. Dilated perforating vein in the adductor canal (formerly Dodd) which drains into the great saphenous vein. *Right*, in the picture, refluxive lower segment of great saphenous vein; *left*, dilated great saphenous vein with antegrade flow. (**b**) The same leg in colour duplex during calf-muscle systole. Outward flow is seen in the perforating vein with antegrade flow up to the great saphenous vein. See accompanying online material Copyright: [Author]

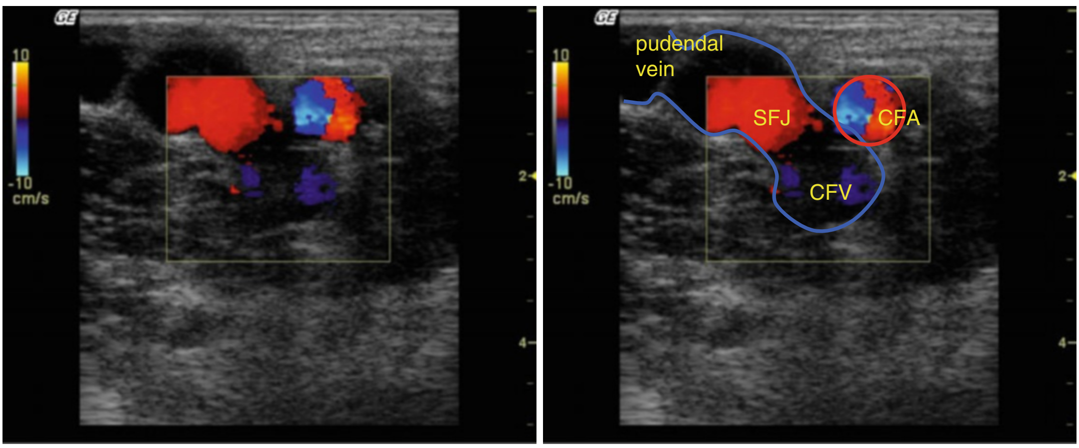

Fig. 15.3 Flow in the saphenofemoral junction with a spontaneous Palma shunt. This occurs several days after a thrombosis with occlusion of the left iliac vein and common femoral vein. The femoral vein (formerly superficial) is partly recanalised. Drainage of the diseased left leg occurs through the right side. Blood is bypassed to the right side via the ipsilateral pudendal vein. Here it reaches the contralateral pelvic veins through the confluence of the great saphenous vein (*GSV*). See accompanying online material Copyright: [Author]

junction into the contralateral common femoral vein. These cross-pelvic collaterals are often called as **spontaneous Palma shunt** (Fig. 15.3).

15.2 Superficial Veins with Deep Venous Reflux

A refluxive deep system after the destruction of valves by thrombosis is more common than a permanent occlusion. When blood is pumped upwards during calf-muscle systole, a part will leave the leg while a part will reflux back into the deep vein system. This results in oscillating flow patterns back and forth in the deep veins like a see-saw.

This increases the pressure during muscular diastole which impedes the superficial to deep drainage pathway (Sect. 3.1.2). The result is a permanent dilatation of the perforating and superficial veins whose valve leaflets no longer meet. The ensuing reflux is termed **secondary** incompetence (Fig. 15.4a).

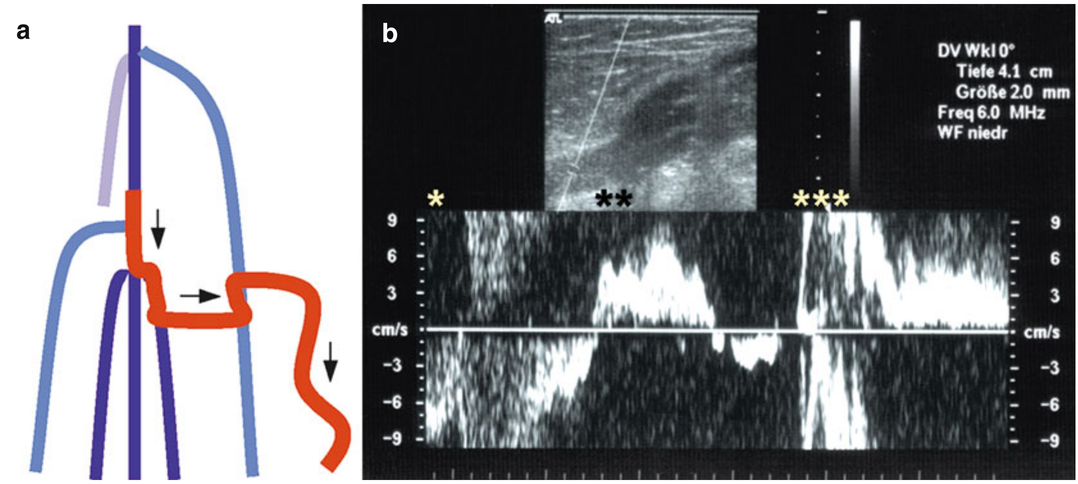

Fig. 15.4 (**a**) The aftermath of a thrombosis of the posterior tibial vein. Reflux is seen descending from the popliteal vein down to the posterior tibial and the paratibial perforating veins (formerly Boyd) and then into the great saphenous vein. Blood then refluxes from the great saphenous vein into varicose tributaries. (**b**) Longitudinal view through the popliteal vein using PW duplex with digital occlusion of the refluxive perforating vein. The reflux pathway is temporarily abolished (* toes raised, ** toes lowered, *** pressure on perforating vein released). See accompanying online material Copyright: [Author]

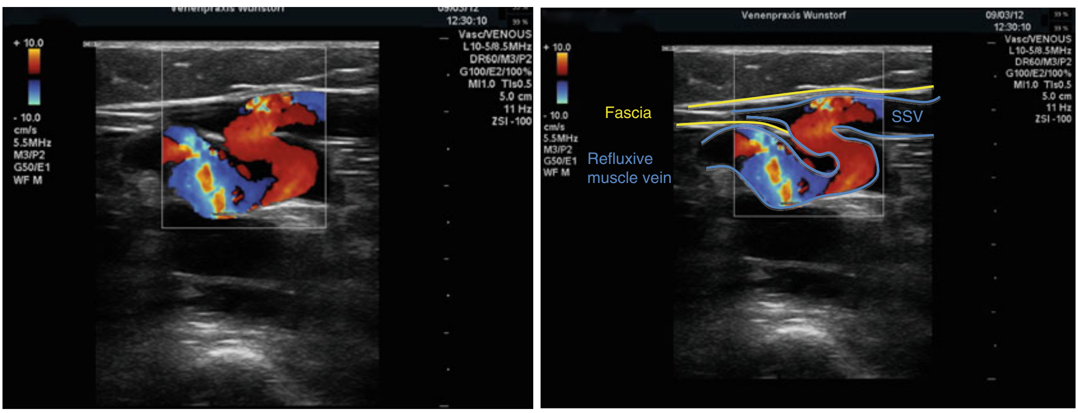

Fig. 15.5 Reflux is seen arising from a post-thrombotic muscle vein and into the small saphenous vein. This remains competent at its upper end but becomes refluxive at the point of entry of the perforating vein Copyright: [Author]

As the number of secondary varicosities increases, this has the effect of increasing the venous volume and varicose reservoir. The resulting pressure in the deep and superficial veins can no longer be eased by the calf-muscle pump. This leads to the post-thrombotic syndrome and **chronic venous insufficiency** (see also Sect. 14.4). The influence of the individual perforating veins on the volumes of reflux in the deep vein system (and thus also the prospects for clinical success in interrupting the perforating veins) can be established semi-quantitatively by digital compression of the perforating veins during examination in PW mode (Fig. 15.4b).

A common **special form** of secondary varicose veins is found in post-thrombotic valve destruction of a muscular vein. This results in retrograde flow with reflux outwards via a perforating vein and then into the small saphenous vein (Fig. 15.5, see also Figs. 8.15 and 8.17). The small saphenous vein becomes secondarily refluxive.

15.3 Duplex Ultrasound as a Tool to Direct Treatment

In the presence of an existing pathology of the deep veins, the diagnosing doctor must decide whether treatment of the superficial veins will improve the haemodynamic condition of the leg. In such a situation, ultrasound is preferable to phlebography (Nicolaides 2000). One axiomatic rule must be followed.

> If a superficial vein serves to drain the deep system, it must never be interrupted or removed.

The following **ultrasound criteria** will help to determine whether a superficial vein serves to drain the deep system:

- Dilated superficial vein with large antegrade systolic blood volumes irrespective of the presence of reflux
- Distally located perforating vein which fills the superficial vein from the deep vein system, in other words antegrade superficial flow via an outward perforating vein during calf systole (Fig. 15.2b)

Additional Criteria

- Worsening of findings in volume measurement methods like air plethysmography. If the calf-muscle pump ejection fraction and the outflow fraction reduce on digital occlusion of targeted veins, they should not be removed.
- A blue-red discolouration of the leg with pain of the vein on digital compression in the standing patient.

On the other hand, refluxing superficial veins which also fill the leg in a retrograde flow will act to increase the calf-diastolic pressure in the ankle region (Sect. 15.2). These veins should be treated only if their contribution to symptoms from reflux is much greater than their potential role as a deep drainage pathway. This evaluation requires much skill and experience. The venous filling index of air plethysmography is a useful test which may help because it can quantify the degree of reflux (Lattimer et al. 2012). Perforating veins should be interrupted if they do not contribute to drainage and are shown to increase the volume of reflux in the deep veins (Fig. 15.4b).

If the volume of reflux in the deep vein system is diminished in pulsed-wave mode (PW mode) under compression of the perforating vein, interruption should be considered (Fig. 15.4).

Exclusively refluxive tributaries must always be treated to reduce the venous reservoir as should refluxing saphenous veins which do not have a drainage function.

References

Franceschi C, Zamboni P (2010) Principles of venous haemodynamics. Novapublishers, New York

Lattimer CR, Azzam M, Kalodiki E, Geroulakos G (2012) Venous filling time using air-plethysmography correlates highly with great saphenous vein reflux time using duplex. Phlebology. PMID: 230350010. [in print]

Nicolaides AN (2000) Investigation of chronic venous insufficiency – a consensus statement. Circulation 102:126–163