Doppler evaluation of recurrence after varicose vein surgery

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Learning objectives

To describe the methodology and terminology to be used for Doppler ultrasound assessment of incompetent superficial and perforator after treatment in the lower limb by ultrasound imaging.

To report the most frequent patterns of recurrent varices after surgery.

Background

Postsurgical varicose veins recurrence is a common, complex, and costly problem.

Duplex scan is the reference standard in assessing the morphology and hemodynamics of the lower limb veins that often vary widely between patients.

Nowadays with a pre-operatory careful duplex mapping, the surgeons are able to perform more selective ligation procedures, at the proximal origin of key points of reflux, and not only classic saphenofemoral ligation or stripping of the above-knee great saphenous vein.

After treatment duplex ultrasound is able to detect the early stages of recurrent varicose veins, before they become apparent clinically.

Imaging findings OR Procedure details

To perform the sonographic evaluation of lower limb veins a device with B-mode, color and spectral Doppler ultrasound is required. Almost in all cases a high frequency linear array transducer of 7.5-12MHz is used but in large or edematous limbs a curvilinear array transducer might be necessary.

In B-mode the focus should be directed at the level of the vein under investigation, adjusting dynamic gain so that the lumen is dark (in absence of thrombosis and slow flow).

To perform color and spectral Doppler low flow settings must be selected, to match the low velocities of venous flow, with a Doppler range of about 5-10cm/s. Conventionally the orthograde venous flow towards the heart is represented in blue and the reflux in red.

The angle of insonation should be kept between 35-60° to optimize the color and spectral signals. Patients should be examined in the standing position whenever possible, with
the limb to be examined in a relaxed non-weight-bearing position, with the leg externally rotated and in a slight knee flexion.

A detailed pre-surgical evaluation should be available as also the report of any treatment to allow accurate follow-up.

Following surgical treatment, recurrence is assessed as refluxive veins following a Valsalva or compression/release calf manoeuvre in connection with the deep veins (escape point) or by filling by its tributaries.

Tailored Doppler evaluation should focus on:

1. **Saphenofemoral junction**

   - common site of recurrence following surgery.

   --> After classic SFJ disconnection (flush saphenofemoral ligation and ligature-section of the related SFJ tributaries)

   **a) Normal:**

   CFV without connection to the residual segment of GSV or to any incompetent superficial vein in the groin; (FIG.1)

   The GSV terminal valve is no longer visible.

   **b) Residual stump:**

   If GSV ligation has been performed to low. (FIG.2)

   **c) Refluxive residual stump:**

   There might be reflux associated to residual tributaries (FIG.3) or AASV (FIG.4) particularly when the AASV anastomoses directly with the CFV independently of the arch of the GSV.
Doppler evaluation:

The diameter of a residual stump should be measured and reflux in the stump or any of its connections should be assessed.

d) Neovascularization or groin varicose network:

Multiple dilated tortuous veins in the site of the previous SFJ ligation (newly formed or arising from dilation of existing veins that were invisible before the operation). (FIG.5)

Doppler evaluation:

Measure the largest diameter of the vein(s) of the vascular network in the groin.

Check for reflux during calf compression/release manoeuvre - if present à fill from the subcutaneous abdominal venous network towards the groin, thigh and leg veins, without a direct communication (escape point) with the deep veins.

Check for reflux during Valsalva manoeuvre - if present à the escape point usually lies in the SFJ area. In some cases, there is a connection with incompetent pelvic veins.

2. Above-knee GSV and AASV

--> After stripping of the above-knee GSV

a) Normal

The saphenous compartment is empty (FIG.6)

b) A venous trunk is still completely or partially present within the GSV compartment (FIG.7)

c) multiple venous channels in the saphenous compartment

revascularization with the presence of multiple convoluted channels in the track of the previously stripped GSV (FIG.8)
d) Persistent reflux in varicose veins or dilatation of the varicose network after surgery (FIG.9)

e) AASV reflux (FIG.10)

Identified parallel to the GSV compartment anteriorly and laterally in its own compartment, identified by the alignment sing with the femoral artery and vein.

If the AASV drains directly into the GSV or into the JSF it is usually ligated during GSV stripping but if it drains directly into the CFV below or above the SFJ arch it may persist as an independent cause of reflux.

Connections with any possible escape point(s) should be identified (a residual stump, refluxing pelvic veins, lymph node vein network (LNVN), perforators, etc.). (FIG.11)

f) Incompetent abdominal-pelvic veins connect directly with residual GSV segments or superficial tributaries in the thigh (FIG.12)

Typically in multiparous women.

--> After Tributaries and/or perforator ligation

a) Persistent reflux in JSF (and GSV trunk) (Fig. 13)

If the residual GSV is dilated (usually > 6-8 mm) there might be reflux recurrence

Doppler evaluation:

the diameter and length of the residual GSV segment should be recorded;
reflux should be assessed using a calf compression/release manoeuvre.

3. Below-knee GSV

--> After SFJ disconnection or stripping of the thigh GSV
a) Residual reflux in part or all of the saphenous trunk below the knee

In patients who underwent SFJ ligation or GSV stripping from the groin to just below the knee; the residual GSV diameter should be measured. (FIG.14)

The below-knee GSV reflux may result from connections to distal tributary veins (FIG.15), varices or deep veins via incompetent perforators.

However, GSV reflux within the saphenous compartment below the knee may re-enter the deep venous system through a distal re-entry perforator, without a connection to any superficial varicose veins.

4. SPJ and SSV

--> After saphenopopliteal junction ligation flush

Findings are similar to those at the SFJ after GSV surgery.

It is fundamental to have a detailed preoperative anatomical and haemodynamic evaluation (level of the SPJ in relation to the popliteal skin crease, the potential presence of a thigh extension of SSV or a Giacomini vein, the possible junction of the SSV with one of the gastrocnemius veins before joining the popliteal vein, the presence of a popliteal fossa perforator).

a) Normal

- Ligation at the level of the popliteal vein (PV) - PV without connection to the residual segment of SSV or to any incompetent superficial vein. (FIG 16)

- Ligation at the confluence with gastrocnemius veins - residual stump representing the common track between gastrocnemius vein(s) and the proximal SSV (FIG.17)

b) Incompetent residual stump

An incompetent residual stump is frequently seen after SSV surgery. This may arise from the great variation in level of the SPJ incompetence of the popliteal fossa perforator or gastrocnemius vein incompetence (FIG.18)
c) **Neovascularization, or popliteal fossa varicose network**

The neovascular veins may connect directly to the popliteal vein, or they may connect with incompetent veins in the posterior thigh (e.g., Giacomini vein, thigh extension of the SSV, pelvic or gluteal veins, sciatic nerve varices and sciatic veins). (FIG.19)

d) **Incompetence of the popliteal fossa perforator** (FIG.20) or of the gastrocnemius vein (FIG.21)

e) **Incompetent proximal veins** (e.g., pelvic or gluteal veins, sciatic nerve varices and sciatic veins, Giacomini vein or incompetent perforators) connect directly with residual SSV segments (FIG.22)

5. **Perforators**

These are veins that connect the superficial and deep systems directly by piercing the aponevrosis or indirectly, through muscular tributaries, and are described according to their location above or below the knee, medial, anterior, lateral or posterior in reference to the inguinal skin crease, popliteal skin crease or floor level.

Incompetence is defined as a perforator that allows outward flow of >0.5 s during calf relaxation or release after distal compression.

Recurrent perforator incompetence after surgery is far more common than previously recognized. (FIG.23)

6. **Tributaries and of non-saphenous veins**

Assessment of the main incompetent tributaries, the intersaphenous veins and the non-saphenous veins.

These veins are superficial to the fascia and are localized in reference to the popliteal skin crease or floor level.

By carefully tracing these veins while eliciting reflux with a distal compression/release manoeuvres, it is possible to detect the related refluxive vein. (FIG.24)
Images for this section:

**Fig. 1:** CFV without connection to the residual segment of GSV. The GSV terminal valve is no longer visible.

**Fig. 2:** GSV Residual stump
Fig. 3: SFJ reflux associated to residual refluxive tributaries after SFJ disconnection

Fig. 4: SFJ reflux associated to residual reflux in AASV after SFJ disconnection
Fig. 5: Multiple newly developed tortuous veins in the site of the previous SFJ ligation

Fig. 6: The saphenous compartment is empty.
Fig. 7: A venous trunk is partially present within the saphenous compartment.

Fig. 8: Revascularization with multiple venous channels in the saphenous compartment.
Fig. 9: Persistent reflux in varicose veins after GSV stripping.
Fig. 10: Residual refluxive AASV after stripping of the above-knee GSV.
Fig. 11: Multiple examples of reflux in LNVN in the groin (escape point in connection with AASV).
Fig. 12: Incompetent abdominal-pelvic veins connect directly with residual GSV segment that is dilated and refluxive.
Fig. 13: Persistent reflux in JSF and GSV trunk depicted after calf compression/release manoeuvre in a patient with selective perforator ligation.
**Fig. 14:** Persistent reflux in below-knee GSV.

**Fig. 15:** Refluxive GSV in the leg connecting to a incompetent tributary (the anterior arch vein).
Fig. 16: Ligation at the level of the popliteal vein (PV): PV without connection to the residual segment of SSV.
Fig. 17: Ligation at the confluence with gastrocnemius veins - residual stump.
Fig. 18: Incompetent residual stump.

Fig. 19: Neovascularization of popliteal fossa varicose network.
**Fig. 20:** Incompetent popliteal fossa perforator in its typical location in front of the lateral condyle of the femur.

**Fig. 21:** Incompetence of the gastrocnemius vein.
**Fig. 22:** Reflux in residual SSV segment connecting with varices in the thigh that drains pelvic varices.

**Fig. 23:** Recurrent perforator incompetence connecting to superficial varices.
Fig. 24: Incompetent tributary draining a refluxive residual venous trunk in GSV compartment and connecting to superficial varices.
Conclusion

Duplex venous imaging is a precise and detailed method of evaluating recurrent varicose veins, recommended as a safe non-invasive technique.

References


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