Duplex Ultrasound in Lower Limb Varicose vein

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Deep veins
- account for approx 90-95% of venous blood return to the heart
- CFV, PFV, FV, POP, V & major calf veins

Superficial veins
- account for approx 5-10% of venous blood return to the heart

Perforating vein

Deep veins (Variants)
- Duplicated Femoral vein 25-30%
- Duplicated Popliteal 40%

Superficial veins
- Greater Saphenous v. ➔ Great Saphenous v. (GSV)
- Smaller/Short Saphenous v. ➔ Small Saphenous v. (SSV)
- Accessory Saphenous v. ➔ Anterior & Posterior Great Saphenous v.
GSV

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Lower Limb Venous System

- Saphenofemoral complex

SCI - Superficial circumflex iliac
SE - Superficial epigastric
SEP - Superficial external pudendal
PM - Posteromedial accessory
AL - Anterolateral accessory


Tributary

Deep fascia

Superficial fascia

Saphenous compartment (Egyptian eye)


**Average Superficial veins Ø:**
- GSV: 4 - 6 mm (thigh)
- SSV: 4 - 7 mm

**Average deep veins Ø:**
- CFV: 1.2 – 1.9 cm
- SFV: 0.9 – 1.0 cm
- Pop. V: 0.9 – 1.5 cm
- Calf V: 0.5 cm

**Perforating vein (Perforator):**
- Bicuspid semilunar
- Smooth muscle & connective tissue
- covered with endothelium
- Pointing towards the heart
- No. varies, ↑ in no. down to the leg
- Axial valves - along the major venous trunk
- Ostial valves - at junction of primary venous trunk
- Juxta-axial valves - near the junction of major veins

**Two normal venous flow direction:**
- Superficial to deep
- Perforator – superficial to deep
- Valvular function - unidirectional flow
- Peripheral to central - towards heart

**Dependent on integrity of:**
- Residual force from contraction of heart
- Muscle pumps - second pump for blood circulation
- Valvular function - unidirectional flow
- Abdominal venous pump
Venous Hamodynamics

Musculo-venous pump (Peripheral heart):
- Lower calf pump
- Upper calf pump
- Thigh pump

Basic Venous Hamodynamics

Respiratory effect:
- "Expiration"
  - P ↓
- "Inspiration"
  - P ↑

Partial vacumm in right atrium:
- Right Atrium during ventricular filling phase

Lower limb venous

Deep v ➔ Perforator ➔ Superficial v ➔ Venous insufficiency

Lower Limb Varicose Veins

- Caused by ineffective or defective valves - reflux
- Dilated, tortuous, or lengthened superficial veins
- Greek term – “grapelike”
- Primary / Secondary cause
**Lower Limb Varicose Veins**

**Primary:**
- No deep veins involved
- Incompetence arises from non-obstructive causes, e.g. hereditary, hormonal, pregnancies

**Secondary:**
- Deep veins involved
- Most common caused by obstruction, e.g. DVT

**Post-phlebitic Syndrome:**
- Partial venous obstruction
- Damage to venous valves
- Valvular fibrosis
- Increasing incompetence
- Pressure transmission from: right atrium, deep, communicating, superficial veins

**Symptoms:**
- Heaviness of legs
- Aching / pain
- Itching
- Night Cramps
- Cosmetic
- Bleeding
- Phlebitis

**Signs:**
- Spider veins / varicosities
- Pigmentation
- Eczema
- Ankle swelling
- Ulceration
Reflux:
- **Proximal reflux**
  - CFV, Femoral vein, Popliteal vein (up to tibial confluence)
  - GSV above popliteal skin crease
- **Distal reflux**
  - TP trunk, ATV, PTV
  - Gastrocnemius
  - GSV below popliteal skin crease, SSV

Connections to GSV territory with primary varicose veins:
- SPJ
- GSV tributaries
- TE
- Popliteal perforators

Connections to SSV with primary varicose veins (sources for reflux):
- SPJ
- GSV tributaries
- TE
- Popliteal perforators
Treatment of Varicose Veins

- Sclerotherapy
- Sx – ligation / stripping

Post Sx Recurrent Varicose Veins

About 20% of V.V. Sx:
- Inaccurate clinical assessment
- Inadequate primary Sx
- Neovascularisation
- SFJ not correctly identified
- Tributaries distribution in GSV (?) or SSV (?)

Common sites:
(sources of reflux)
- Groin - SFJ / tributaries to CFV
- Pelvic veins
- Perforator regions - thigh & calf
- Unknown

Myers et al
"Making sense of vascular ultrasound, a hand-on guide"
Arnold, London 2004: 204-205

Purposes:
- Assessment of patency of superficial & deep veins
- Evidence of superficial +/- deep venous incompetency
- Precise location of incompetence & segment involved
- Identification of any perforator disease
- Identification of source(s) of recurrent varicose veins

Duplex Ultrasound Assessment of Varicose Veins

Limitations:
- Obesity
- Severe leg oedema
- Open draining ulcers
- Inability to stand for an extended length of time
**Practical Protocol:**

- **Patient Preparation**
- **Transducer & machine settings**
- **Technique**

**Patient Prep:**

- Explanation & reassurance of patient
- Clinical Hx
- Physical assessment

**Patient Clinical Hx:**

- PHx of venous thrombosis?
- FHx of leg varicosity & occupation?
- Hx of venous Ulceration?
- Signs & Symptoms?
- PHx of V.V. sclerotherapy / Sx?

**Physical assessment:**

- Swelling, pain, tenderness?
- Discolouration?
- Varicosities distribution
- Healed or open ulceration distribution / location
- Sx incision?

**Signs:**

- [Image of varicose veins on leg]
- [Image of varicose veins on leg]
**Duplex Ultrasound Assessment of Varicose Veins**

**Signs:**

1. **Vascular Laboratory Concord Hospital, Sydney**
2. **Duplex Ultrasound Assessment of Varicose Veins**

**Patient position:**

- specially designed stool
Patient position:
- Tilted table

Transducer & u/s machine settings:

Technique:
Methodological approach to assess:
- Deep venous system
- Superficial venous system
- Perforators
- Other incidental finding if any

Deep & superficial veins assessment:
- Patency?
- Competency?
- Level?

Perforators assessment:
- Location?
- Size?
- Competency?
Diagnostic criteria for patency:
- **B-MODE**
  - Incompressibility of superficial and deep veins
- **SPECTRAL DOPPLER**
  - Loss of respiratory phasicity
- **COLOUR DOPPLER**
  - Absence of flow / filling defect

Assessment of competency by induced reflux:
- Distal augmentation
- Proximal compression
- Vigorous dorsal & plantar flexion
- Valsalva manoeuvre
- Automatic rapid inflator
  (* let the vein refill often in between!!)

Diagnostic criteria for incompetency:
- Normal < 0.5 sec
- Minor reflux 0.5 – 1.0 sec
- Significant 1.0 – 2.0 sec
- Gross >2 sec

Diagnostic criteria for incompetency:
- Spectral Doppler Vs Colour Doppler
**Duplex Ultrasound Assessment of Varicose Veins**

**Colour Doppler**
- Roadmap for small 
  & complex vessels
- Quick assessment
- Qualitative only

**Spectral Doppler**
- Steady hand
- Quantitative

**Deep veins assessment:**
- CFV, FV, Pop. V, major calf veins

**Technique:** CFV

Non-occlusive thrombus

**Technique:** CFV

Incompetent

**Technique:** CFV

Valsalva Manoeuvre

**Technique:** FV

Incompetent
Duplex Ultrasound Assessment of Varicose Veins

Technique: Pop. V

Superficial veins assessment:
- SFJ
- GSV & its tributaries
- Associated perforator
- SPJ
- SSV & its tributaries
- Associated perforator

Competent

Incompetent

Technique: SFJ

Second terminal valve

No recommination to CFV
**Duplex Ultrasound Assessment of Varicose Veins**

**Technique:** Thigh GSV

- Recommunication to CFV
- Old thrombus
- Competent
- Incompetent
- Atrophic GSV

**Technique:** Calf GSV

- Dilated
- Incompetent
**Technique:** Thigh Trib.

**Vascular Laboratory:** Concord Hospital, Sydney

**Duplex Ultrasound Assessment of Varicose Veins**

- Varicose trib.
- Incompetent perf. underneath ulcer region

**Technique:** Calf Trib.

**Vascular Laboratory:** Concord Hospital, Sydney

**Perforator assessment:**
- Location?
- Size?
- Competency?
Technique:

Location
- From KC?
- From MM / Floor?

Size?
- Measure at the point perforating the deep fascia
- > 3mm, likelihood of reflux

*(Location & size – pre subfascial endoscopic perforator Rx planning)*

Competency?
Normal < 0.5 sec

Dilated & Incompetent (>0.5 sec)
Technique:

- Relevance ??

Identify all perforators associated with varicosity regardless of the diameter.
Technique: SSV with associated perf.

Incompetent trib.

Incompetent perf.

Technique: SSV thigh extension / Giocnemius v.

Worksheet:

- Patient’s clinical profile
- Patency?
- Evidence of venous insufficiency?
  - source of varicosity
  - refluxing pattern
  - sites of recurrence
- Perforator disease
  - location, size, competency
- Other abnormal findings, if any

Other abnormal findings:

- Lymphadenopathy
- Soft tissue oedema
- Baker’s cyst etc

Worksheet:

- source of varicosity
- refluxing pattern
- sites of recurrence
- location, size, competency
- Other abnormal findings, if any

Pre-op perforators marking:
Duplex Ultrasound Assessment of Varicose Veins

Technique:

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Duplex Ultrasound Assessment of Varicose Veins
Duplex Ultrasound is a non-invasive modality for accurately diagnosing Lower limb varicose vein. It provides both anatomical & physiological detail about the pathogenesis & the recurrence of the disease.

Sonographers require thorough knowledge of the anatomy & the pathogenesis of the disease.