Haemodynamics of the development of varicose vein disease: do we really have new knowledge?

S. Onida, AH. Davies
Department of Surgery and Cancer
Imperial College London
Disclosures

• None
Measuring venous disease

- Anatomical
  - Doppler
    - Colour duplex
  - Haemodynamic
    - Plethysmography
      - Ambulatory Venous pressures
  - Clinical
    - CEAP
    - VCSS
- Functional
  - Generic
  - Disease specific
Use duplex ultrasound to confirm the diagnosis of varicose veins and the extent of truncal reflux, and to plan treatment for people with suspected primary or recurrent varicose veins.

Varicose veins: diagnosis and management

Clinical guideline
Published: 24 July 2013
nice.org.uk/guidance/cg168

Eur J Vasc Endovasc Surg (2015) 49, 678–737

Editor’s Choice — Management of Chronic Venous Disease

Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)

Recommendation 11

Duplex ultrasound is recommended as the primary diagnostic test of choice in suspected chronic venous disease, to reliably evaluate the specific venous anatomy and to identify the source and pattern of reflux.

The care of patients with varicose veins and associated chronic venous diseases: Clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum

2.1 We recommend that in patients with chronic venous disease, a complete history and detailed physical examination are complemented by duplex scanning of the deep and superficial veins. The test is safe, noninvasive, cost-effective, and reliable.
Clinical Parameters?

Clinical classification:
- $C_0$: no visible or palpable signs of venous disease
- $C_1$: telangiectasies or reticular veins
- $C_2$: varicose veins
- $C_3$: edema
- $C_{4a}$: pigmentation or eczema
- $C_{4b}$: lipodermatosclerosis or atrophic blanche
- $C_5$: healed venous ulcer
- $C_6$: active venous ulcer

Etiologic classification:
- $E_c$: congenital
- $E_p$: primary
- $E_s$: secondary (postthrombotic)
- $E_n$: no venous cause identified

Anatomic classification:
- $A_s$: superficial veins
- $A_p$: perforator veins
- $A_d$: deep veins
- $A_n$: no venous location identified

Pathophysiologic classification:
- Basic CEAP
  - $P_r$: reflux
  - $P_o$: obstruction
  - $P_{r,o}$: reflux and obstruction
  - $P_n$: no venous pathophysiology identifiable

- Static
- Not designed to respond to treatment
- Single measure of disease status
- Supplemented by VCSS for severity
• Haemodynamic disturbance

• Inability of venous conduits to maintain a normal pressure and flow to the heart

• Reflux and obstruction

• Reflux Time (RT) > 0.5 s
Higher CEAP Class associated with larger vein diameters.
Ache and swelling incidence was not related to the extent of reflux.

Incidence of skin changes went from 44% when the below-knee segment of the LSV was involved to 73% when reflux occurred throughout the LSV and SSV. Ulceration (14%) was found only in the latter situation.
Saphenous pulsation on duplex may be a marker of severe chronic superficial venous insufficiency

Christopher R. Lattimer, MBBS, FRCS, MS, FDI, Mustapha Azzam, MD, DIC, MSc, PGD, Evi Kalodiki, MD, DIC, PhD, FRCS, Gregory C. Makris, MD, and George Geroulakos, MD, FRCS, DIC, PhD, London, United Kingdom

Conclusions: The high prevalence of saphenous pulsation in patients with severe superficial chronic venous insufficiency and significantly increases with clinical severity and saphenous pulsation on duplex evaluation supplement duplex evaluation in terms of disease progression, recurrence after treatment, and as a hemodynamic marker of severity. (J Vasc Surg 2012;56: 1338-43.)

Fig 1. Duplex tracing of a typical saphenous pulse (SP) waveform. Each major tick represents 1 second. The background SP (4 cm/s) is basic, irregular, and of varying amplitude. Inspiration, is seen at the end of the trace.

Fig 2. The prevalence of reflux (A) and saphenous pulse (SP) (B) across three levels of clinical severity. There was a significant stepwise increase in the prevalence of SP according to clinical severity with no detectable SP in approximately half of the subjects’ legs with intermediate clinical severity (C2-3).
...no correlation in changes in VRT with either generic or disease-specific quality of life following intervention, suggesting that hemodynamic measurement is a poor outcome assessment tool in patients with uncomplicated venous disease.
Conclusions: Saphenous size alone cannot be used as an indicator of significant reflux. More than two thirds of the limbs with isolated saphenous reflux have calf pump abnormalities, which also occurred without reflux in the opposite limb—a novel finding. This means that in addition to quantification of reflux volume, calf pump assessment such as with air plethysmography and AMVP is desirable in clinical classes 3 and higher for proper assessment. (J Vasc Surg: Venous and Lym Dis 2015;3:8-17.)
Correlation between the hemodynamic gain obtained in the veins and chronic venous disease.

Correlação entre o ganho hemodinâmico obtido nas veias e a doença venosa crônica.

Nel Rodrigues Alves Dezotti¹, Edwaldo Edner Joviliano³, Takachi Mawa³

---

### TABLE 1 - Mean, median and quartile (P25, P50 and P75%) values of the pre- and postoperative hemodynamic difference of the venous filling index (VFI) of groups C₂ + C₃, C₄ and C₅ + C₆

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>1st Quartile(P25)</th>
<th>Median (P50)</th>
<th>3rd Quartile(P75)</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₂ + C₃</td>
<td>38</td>
<td>0.07</td>
<td>0.72</td>
<td>2.36</td>
<td>1.34</td>
<td>1.80</td>
</tr>
<tr>
<td>C₄</td>
<td>15</td>
<td>0.73</td>
<td>1.87</td>
<td>4.24</td>
<td>2.60</td>
<td>2.09</td>
</tr>
<tr>
<td>C₅ + C₆</td>
<td>10</td>
<td>1.21</td>
<td>2.75</td>
<td>6.33</td>
<td>3.29</td>
<td>3.13</td>
</tr>
</tbody>
</table>

---

### TABLE 2 - Mean, median and quartile (P25, P50 and P75%) values of the pre- and postoperative hemodynamic difference of the ejection fraction (EF) of groups C₂ + C₃, C₄ and C₅ + C₆

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>1st Quartile(P25)</th>
<th>Median (P50)</th>
<th>3rd Quartile(P75)</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₂ + C₃</td>
<td>38</td>
<td>-24.83</td>
<td>-4.25</td>
<td>2.98</td>
<td>-9.84</td>
<td>22.05</td>
</tr>
<tr>
<td>C₄</td>
<td>15</td>
<td>-38.60</td>
<td>-18.30</td>
<td>-7.90</td>
<td>-22.91</td>
<td>17.35</td>
</tr>
<tr>
<td>C₅ + C₆</td>
<td>10</td>
<td>-29.03</td>
<td>-14.75</td>
<td>16.95</td>
<td>-9.71</td>
<td>30.63</td>
</tr>
</tbody>
</table>

---

### TABLE 3 - Mean, median and quartile (P25, P50 and P75%) values of the pre- and postoperative hemodynamic difference of the residual volume fraction (RVF) of groups C₂+C₃, C₄ and C₅+C₆

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>1st Quartile(P25)</th>
<th>Median (P50)</th>
<th>3rd Quartile(P75)</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₂ + C₃</td>
<td>38</td>
<td>-8.10</td>
<td>4.25</td>
<td>19.10</td>
<td>9.14</td>
<td>25.84</td>
</tr>
<tr>
<td>C₄</td>
<td>15</td>
<td>-5.10</td>
<td>7.50</td>
<td>35.40</td>
<td>12.41</td>
<td>19.21</td>
</tr>
<tr>
<td>C₅ + C₆</td>
<td>10</td>
<td>-12.56</td>
<td>8.65</td>
<td>32.60</td>
<td>5.32</td>
<td>32.44</td>
</tr>
</tbody>
</table>
Reflux time estimation on air-plethysmography may stratify patients with early superficial venous insufficiency

C R Lattimer, E Kalodiki, M Azzam and G Geroulakos
Ealing Hospital & Imperial College, London SW7 2AZ, UK

Table 2 Proposed stratification of patients with SVI based on clinical and haemodynamic assessments using CEAP and VFT90

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
<th>Clinical VFT90 (second)</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>Mild</td>
<td>C2 – 4a</td>
<td>&gt;25</td>
</tr>
<tr>
<td>S2</td>
<td>Moderate</td>
<td>C2 – 4a</td>
<td>&lt;25</td>
</tr>
<tr>
<td>S3</td>
<td>Severe</td>
<td>C4b – 6</td>
<td>&lt;25</td>
</tr>
</tbody>
</table>

VFT90 – time to reach 90% of total venous volume

Figure 3 The VFT90 and the VFI benchmarked against two groups of severity of CVI. Although the median VFI is statistically higher in the more severe groups there was no discrimination (b, d). However, all 17 patients in the severe groups had a VFT90 < 25 seconds as demonstrated by the horizontal dashed line (a, c)

Conclusion
Patients with early clinical disease could be divided into two groups based on the severity of haemodynamic impairment. The use of the VFT90 in the stratification of patients for longitudinal natural history studies, treatment provision and response to treatment have yet to be determined.
The PRV and PRF are better parameters than the RT for discrimination of clinical severity in both superficial and deep venous insufficiency, and should be used to quantify venous valvular insufficiency.
Guideline 3. Plethysmography

<table>
<thead>
<tr>
<th>Guideline No.</th>
<th>3. Plethysmography</th>
<th>GRADE of recommendation</th>
<th>Level of evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>We suggest that venous plethysmography be used selectively for the noninvasive evaluation of the venous system in patients with simple varicose veins (CEAP class C₂).</td>
<td>2</td>
<td>C</td>
</tr>
<tr>
<td>3.2</td>
<td>We recommend that venous plethysmography be used for the noninvasive evaluation of the venous system in patients with advanced chronic venous disease if duplex scanning does not provide definitive information on pathophysiology (CEAP class C₃-C₆).</td>
<td>1</td>
<td>B</td>
</tr>
</tbody>
</table>

The care of patients with varicose veins and associated chronic venous diseases: Clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum

---

Management of Chronic Venous Disease

*_Clinical Practice Guidelines of the European Society for Vascular Surgery (ESVS)*_

<table>
<thead>
<tr>
<th>Recommendation 14</th>
<th>Class</th>
<th>Level</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plethysmography may be considered for the assessment of quantitative parameters related to venous function.</td>
<td>IIb</td>
<td>C</td>
<td>85, 180, 181</td>
</tr>
</tbody>
</table>
Thank you