Air Plethysmography for Beginners

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Disclosures: None

Clinical value of Venous Filling Index (VFI)

Prevalence of skin changes, edema and ulceration

<table>
<thead>
<tr>
<th>VFI (ml/sec)</th>
<th>Edema (%)</th>
<th>Ulceration (%)</th>
<th>Skin changes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3-5</td>
<td>12</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>5-10</td>
<td>46</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>&gt; 10</td>
<td>76</td>
<td>58</td>
<td>76</td>
</tr>
</tbody>
</table>

N = Normal, P = Primary VVs, S = Skin changes, P = Popliteal reflux

From Nicolaides A and Sumner D 1991

VFI in Relation to Number of Incompetent Perforating Veins


Ibegbuna V et al, Europ J Vasc Endovasc Surg 2006;31:535-41
Ejection Fraction (EF) and Residual Volume Fraction (RVF)

N = Normal limbs, PVV = limbs with primary varicose veins, DVI = deep venous incompetence, DVO = deep venous obstruction

Relationship between RVF and Ambulatory Venous Pressure (AVP)

Prevalence of ulceration in relation to RVF in 175 limbs with CVI

<table>
<thead>
<tr>
<th>N</th>
<th>RVF (%)</th>
<th>Ulceration (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>&lt; 30</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>31-40</td>
<td>8</td>
</tr>
<tr>
<td>48</td>
<td>41-50</td>
<td>18</td>
</tr>
<tr>
<td>43</td>
<td>51-60</td>
<td>42</td>
</tr>
<tr>
<td>32</td>
<td>61-80</td>
<td>72</td>
</tr>
<tr>
<td>8</td>
<td>&gt; 80</td>
<td>88</td>
</tr>
</tbody>
</table>

Ope circle = Superficial venous reflux
Closed circles = Deep venous reflux
From Nicolaides A and Sumner D 1991

Combination of Duplex and VFI

Clinical severity class | N  | VFI         | P     |
------------------------|----|-------------|-------|
0 Asymptomatic          | 34 | 1.6 ± 1.6   | ------|
1 Mild CVI (ache & swelling) | 42 | 2.3 ± 1.7   | < 0.05|
2 Moderate CVI (skin changes) | 11 | 8.0 ± 5.6   | < 0.05|
3 Severe CVI (Ulceraion) | 31 | 8.5 ± 5.2   | < 0.001|

“The combination of VFI and duplex scanning (multisegment score) not only localized the reflux, but also separated severe clinical disease from mild with high sensitivity (83%) and high specificity (86%)”

Neglen and Raju 1993:17:590-5

Venous hemodynamics across CEAP classes (median and interquartile range)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control (n=27)</th>
<th>CEAP 1 (n=26)</th>
<th>CEAP 2-3 (n=24)</th>
<th>CEAP 4-6 (n=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VV ml</td>
<td>78 (63.2-93.5)</td>
<td>109 (82-130)</td>
<td>132 (115-140)</td>
<td>149 (125-182)</td>
</tr>
<tr>
<td>VFI ml/sec</td>
<td>0.5 (0.3-0.8)</td>
<td>1.3 (0.7-1.8)</td>
<td>3.1 (2.8-4.5)</td>
<td>6.5 (4.0-10.1)</td>
</tr>
<tr>
<td>RVF %</td>
<td>15.8 (11.2-23.5)</td>
<td>19.7 (11.7-28.3)</td>
<td>23.5 (20.2-32.3)</td>
<td>40.0 (33.8-46.2)</td>
</tr>
</tbody>
</table>

All values increased significantly (P < 0.001, Kruskal-Wallis test)


Effect of HSL, Stripping and Phlebectomy in limbs with VVs, ICPVs and normal deep veins

24 limbs at 3 months after surgery

71% IVPVs became competent
VFI decreased from 6.0±2.9 to 2.2±1.3 ml/sec
EF increased from 56% to 62%
RVF decreased from 40% to 28%


Effect of Valvuloplasty in Limbs with Axial Reflux in Deep Veins

140 limbs after surgery
VFI decreased from 4.1±2.8 to 3.1±2.8 ml/sec
VRT normalized in all patients

Patients with a VFI > 4.0 ml/sec have a risk of ulcer recurrence of 43% at 1 year and 60% at 2 years. Therefore deep valve reconstruction is indicated.
No benefit if VFI < 4.0 ml/sec
Conclusions

1. Duplex provides information on presence or absence and anatomic extent of reflux

2. If quantitative information is needed (how much reflux) for clinical decisions, duplex should be complimented by plethysmography