Endothermal Ablation for Venous Insufficiency

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Medical Director
The Vein Institute of Toronto
Objective: remove the GSV from the circulation

1. Surgical - HL & stripping
2. Chemical – sclerotherapy
3. Thermal – RF & Laser

Thermal ablation has emerged. Surgical stripping is no longer the gold-standard
Invagination stripping of GSV
Prospective randomized studies of recurrent varicose veins after high ligation & stripping

<table>
<thead>
<tr>
<th>First author</th>
<th>Followup (mo)</th>
<th>Saphenectomy limbs (patients*)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Recurrent reflux</td>
</tr>
<tr>
<td>Dwerryhouse(^5)</td>
<td>60</td>
<td>15/52(^\d)</td>
</tr>
<tr>
<td>Sarin(^8)</td>
<td>21</td>
<td>21/43(^\d)</td>
</tr>
<tr>
<td>Rutgers(^13)</td>
<td>36</td>
<td>10/69(^\d)</td>
</tr>
<tr>
<td>Neglén(^16)</td>
<td>60</td>
<td>—</td>
</tr>
<tr>
<td>Jakobsen(^39)</td>
<td>36</td>
<td>—</td>
</tr>
<tr>
<td>Munn(^40)</td>
<td>30–42</td>
<td>—</td>
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</table>

(2 – 5 yrs) 28% 26%
Neovascularization at SFJ causes recurrence

Chaotic nest of new veins at SFJ reconstitute axial vein remnants downstream in the thigh

Van Rij, JVS 2004
Treatment Goals

- Ablate vein
- Avoid complications
  - DVT
  - Nerve injuries
  - Skin burns
- Minimize recurrence
Treatment Plan

- Understanding anatomy is key to successful outcomes
- Preprocedure US evaluation is critical in determining treatment plan
Common patterns of VV

GSV  Pudendal  Dodd  Giacomini
Origin ?
Major Veins of the Leg (Anterior view)
Great saphenous vein anatomy

- Superficial Circumflex Iliac Vein
- Femoral Vein
- Anterior Lateral Tributary
- Posterior Medial Tributary
- Greater Saphenous Vein
- Anterior Tributary Vein
- Posterior Arch Vein
- Superficial Epigastric Vein
- Superficial External Pudendal Vein
- Superficial circumflex iliac vein
- External pudendal vein
- Anterior accessory great saphenous vein
- Posterior accessory great saphenous vein
- Femoral/popliteal vein
- Posterior tibial vein
- Great saphenous vein
- Proximal paratibial perforating veins
- Posterior arch (Leonardo’s vein)
- Lateral
- Medial
Origin?

- Incompetent perforator reflux
- Thermal ablation is not the treatment of choice
- Treatment of GSV, SSV, etc is not indicated
Compartments of the Thigh

SC, Superficial compartment;
DC, deep compartment.
Saphenous Canal

GSV

SSV
Vein Entry
Vein Entry

- Site of GSV entry is somewhat controversial
  - Knee level entry has lead to higher recurrence rates
  - Below knee entry may lead to parathesias

- Site of SSV entry is typically mid calf
Saphenous nerve & GSV

Sural nerve & SSV
Vein Entry
Vein Entry

- Is it just like a PICC line?
  - Beware of spasm
  - Calming environment
  - Warm environment
  - Reverse trendelenburg position
Vein Entry: Micropuncture Kit
Catheter Tip Position

- **Start distal to SEV**
  - Allows abdominal wall drainage into SFJ
    - No propagation of thrombus
    - No neovascularization

Eliminate scenario of “frustrated venous drainage”
Catheter Tip Position - ultrasound image
Vascular Sheath
Tumescent Anesthesia
Tumescent Anesthesia

- Key to procedural success
  - Heat sink
  - Analgesia
  - Compression of vein
  - Displace adjacent structures
- .05-.1% (.5-1gm/liter)
  - 6-7mg/kg has been listed as max dose
  - However liposuction studies have shown dosages of 35mg/kg have been safe
Tumescent Anesthesia
Tumescent Anesthesia
Tumescent Anesthesia
Radiofrequency Ablation
Closure® Procedure
(Radiofrequency)

- Catheter inserted in refluxing vein
- Catheter positioned, electrodes deployed
- RF Energy heats and contracts vein wall
- Catheter slowly withdrawn, closing vein
- Denuded vein is physically narrowed
Resistive Heating – direct contact with vein wall

Impedance high >200
Heating = Temp 85 C
Animal Research: Acute histologic effects of RF heating.

- Denude endothelial lining
- Contraction & thickening of vein wall
- Necrosis of smooth muscle and vein wall components
- Shrinkage of collagen fibrils
Animal Research: Post Treatment Effects

- Extensive growth of fibroblasts
- New collagen synthesis
- Further thickening of vein wall
- Fibrous plug
Sonographic Vein Disappearance (RF)

Trunk status:

- Segmental trunk reflux
- Segmental trunk recanalization signs
- No flow - hypoechogenic
- No flow - hyperechogenic, shrunk
- Complete sonographic disappearance

94% of RF-treated limbs were sonographically undetectable at 24 months \(^2,3\)

N=18 Limbs
5-year registry data: RF ablation

<table>
<thead>
<tr>
<th>Absence of reflux</th>
<th>1 Year</th>
<th>2 Years</th>
<th>3 Years</th>
<th>4 Years</th>
<th>5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>407/458</td>
<td>211/240</td>
<td>103/119</td>
<td>93/107</td>
<td>31/37</td>
</tr>
<tr>
<td></td>
<td>89%</td>
<td>88%</td>
<td>87%</td>
<td>87%</td>
<td>84%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Absence of varicose veins</th>
<th>1 Year</th>
<th>2 Years</th>
<th>3 Years</th>
<th>4 Years</th>
<th>5 Years</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>360/458</td>
<td>191/240</td>
<td>99/119</td>
<td>81/107</td>
<td>29/37</td>
</tr>
<tr>
<td></td>
<td>79%</td>
<td>79%</td>
<td>83%</td>
<td>76%</td>
<td>78%</td>
</tr>
</tbody>
</table>

92% of limbs that are reflux-free at 1 year continue to be reflux free at subsequent follow-up (to 5 years)

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<tr>
<th>Reference</th>
<th>Follow-Up</th>
<th>Efficacy Rate</th>
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<tbody>
<tr>
<td>Weiss(^4)</td>
<td>2 years</td>
<td>90%</td>
</tr>
<tr>
<td>Rosenblatt(^5)</td>
<td>2 years</td>
<td>95.7%</td>
</tr>
<tr>
<td><strong>Whiteley(^6)</strong></td>
<td>1 year</td>
<td>99.2%</td>
</tr>
<tr>
<td><strong>Kistner(^7)</strong></td>
<td>1 year</td>
<td>97%</td>
</tr>
<tr>
<td>Stripping</td>
<td>2 years(^8)</td>
<td>87%</td>
</tr>
<tr>
<td></td>
<td>3 years(^9)</td>
<td>85%</td>
</tr>
<tr>
<td>Ligation</td>
<td>2 years(^8)</td>
<td>58%</td>
</tr>
<tr>
<td></td>
<td>3 years(^9)</td>
<td>54%</td>
</tr>
</tbody>
</table>

** Adjuncts performed on perforators & tributaries
Endovenous laser
Endovenous Laser Treatment

There are 4 FDA approved devices 810 nm, 940 nm, 980nm & 1320nm.
Endovenous Laser Position
Steam bubbles

Absorption of laser energy by hemoglobin & water results in the formation of steam bubbles.
Fiber pull-back (50 J/cm-70J/cm)
Endovenous Laser: mid-

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<tr>
<th>Follow-Up (Yrs)</th>
<th>Closed / No. Treated</th>
<th>Continued Occlusion</th>
</tr>
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<tbody>
<tr>
<td>&lt; 1 Year</td>
<td>218 / 231</td>
<td>94 %</td>
</tr>
<tr>
<td>1 – 2 Years</td>
<td>245 / 247</td>
<td>99 %</td>
</tr>
<tr>
<td>2 – 3 Years</td>
<td>151 / 151</td>
<td>100 %</td>
</tr>
<tr>
<td>&gt; 3 Years</td>
<td>72 / 72</td>
<td>100 %</td>
</tr>
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- Followed 3 – 42 months (mean of 20 months)

Several single center reports with vein closure rates 93 - 99%

Robert J. Min, MD
Conclusions

- Proper treatment plan and evaluation is critical
- Adequate tumescent anesthetic is key
- Attention to procedural details (avoid spasm) is important
- Both RF and Laser have excellent results and have supplanted stripping as the primary treatment of incompetent veins