How to measure iliac vein stenosis

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Disclosure
• Stock & royalty in Veniti, Inc.
• US Patent: IVUS Dx of CVD
• US Patent: Iliac vein stent design
• Stent usage in iliac-femoral veins is currently off label.

Control Of Peripheral Venous Pressure
• Central Mechanisms
  – arterial inflow (eg. A-V fistula)
  – right atrial pressure (eg. Congestive failure)
  – intra-abdominal pressure (Obesity)
  – iliac vein caliber/stenosis
• Peripheral Mechanisms:
  (all affect caliber of flow-channel)
  --Compliance of venous bed
  -- Efficiency of debranching/upscaling
  -- Caliber of Colarterals

What is the “normal” size of the common iliac vein?

Distribution curve of CIV IVUS area in CVD patients n=371
The Area Method: % stenosis calculated based on anatomic minimums, not relative to adjacent segment

- CIV: 16 mm Diameter; 200 sq mm Area
- EIV: 14 mm Diameter; 150 sq mm Area
- CFV: 12 mm Diameter; 125 sq mm Area

The basis of symptoms in CVD is elevation of peripheral venous pressure. Peripheral venous pressure begins to rise with as little as 20% stenosis and becomes significant at 50% stenosis.

Rokitanski stenosis

*Cannot use adjacent 'normal' segment as reference for calculating percentage stenosis or velocity comparison.*

Venous obstruction = Overflow dam
Supine CFV Flow Velocity increases after Iliac Stenting because of area reduction (Decompression) implying pressure reduction. No change in quantitative flow.

<table>
<thead>
<tr>
<th>Supine duplex: n = 61</th>
<th>Supine Pre-stent</th>
<th>Supine Post-stent</th>
<th>% Change (±)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Averaged Velocity (TAV, cm/sec)</td>
<td>0.08 (0.02-0.18)</td>
<td>0.11 (0.05-0.25)</td>
<td>38 (±)</td>
<td>0.0009*</td>
</tr>
<tr>
<td>Area (mm²)</td>
<td>111.22 (25.52-257.30)</td>
<td>100.29 (22.06-292.55)</td>
<td>-10 (±)</td>
<td>0.045*</td>
</tr>
<tr>
<td>Phasic Duration (T, sec)</td>
<td>2.70 (0.15-5.10)</td>
<td>3.10 (0.60-5.10)</td>
<td>15 (±)</td>
<td>0.1</td>
</tr>
<tr>
<td>Flow Volume Rate (mL/min)</td>
<td>9.29 (1.79-94.77)</td>
<td>9.29 (2.64-35.11)</td>
<td>0 (±)</td>
<td>0.1</td>
</tr>
<tr>
<td>Phasic Flow Volume (mL)</td>
<td>23.17 (1.19-94.77)</td>
<td>26.47 (6.04-137.62)</td>
<td>14 (±)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Central Mechanisms: Starling Resistor (abdomen)
Pressure gradient (ΔP) & external pressure influence flow.

VENOUS PRESSURE: CENTRAL MECHANISMS
Upstream venous pressure (back pressure) is related to:
- Mechanical Model
- Arterial Inflow
- Starling (abd.) pressure
- Outflow size/stenosis
- Outflow (atrial) pr.
- The above four are not additive; the one with highest venous back pressure dominates like tandem stenoses.

VENOUS PRESSURE: PERIPHERAL MECHANISMS
Control of Peripheral Venous Pressure
- Central mechanisms
- Peripheral mechanisms
- Venous hypertension is the basis of CVD