The definition of critical iliac vein stenosis needing an invasive treatment

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Disclosure

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I do not have any potential conflicts of interest
The definition of critical iliac vein stenosis needing an invasive treatment

• Concept of “critical stenosis”
• Concept of optimal diameter
• Concept of optimal adaptive limits
“Critical stenosis” concept


No change in ICA flow in <50% stenosis, 50% reduction in 90% stenosis

Collateral flow!
Hemodynamics of stenosis: Physiological effects of stenosis

Flow rate

Poiseuille’s law

Flow $\mathbf{Q} = \frac{\Delta P}{R}$ (resistance)

Chemoregulation

Vasodilation

$P_{\text{const}}$

$\Delta P$

$\Delta P$

Flow $\mathbf{Q}$

Percent stenosis

Flow cm$^3$/s

$\Delta P$ mm Hg

Flow cm$^3$/s

Percent stenosis

Inside radius of stenosis (cm)

Percent of maximum flow

Percent of maximum pressure drop

1.0-cm-long stenosis in 10-cm-long artery with radius of 0.5 cm (flow=5.0 cm$^3$/s)
Hemodynamics of stenosis: Physiological effects of stenosis

Flow rate

Poiseuille’s law

\[ Q = \frac{\Delta P}{R \text{ (resistance)}} \]

Chemoregulation

Vasodilation

\[ R = R_s + R_p \]

\[ Q = \frac{\Delta P}{R_s \text{ (const)}} \]
Intravascular ultrasound scan evaluation of the obstructed vein

Peter Neglén, MD, PhD, and Seshadri Raju, MD, Jackson, Miss


Conclusion: Venous IVUS appears to be superior to single-plane venography for the morphologic diagnosis of iliac venous outflow obstruction and is an invaluable assistance in the accurate placement of venous stents after venoplasty. No preoperative or intraoperative pressure test appears to adequately measure the hemodynamic significance of the stenosis. In lieu of adequate hemodynamic tests, IVUS determination of morphologically significant stenosis appears to be presently the best available method for the diagnosis of clinically important chronic iliac vein obstruction. Collateral formation should perhaps be looked on as an indicator of a more severe stenosis, although significant obstruction may exist with no collateral formation. (J Vasc Surg 2002;35:694-700.)
Hemodynamics of stenosis: Physiological effects of stenosis

Flow rate

Flow \( Q = \frac{\Delta P}{R \text{(resistance)}} \)

Venous

\[ Q = \frac{\Delta P}{R} \]

\( P_{\text{const}} \quad R_{s\text{ const}} \)

\( \uparrow P \quad \uparrow R \)
Hemodynamics of stenosis: Physiological effects of stenosis

Flow rate

\[
Q = \frac{\Delta P}{R (\text{resistance})}
\]

Venous

1.0-cm-long stenosis in 10-cm-long artery with radius of 0.5 cm (flow ~ 5.0 cm³/s)

Percent stenosis

Flow cm³/s

\[\Delta P \text{ mm Hg} \]

Percent of maximum flow

Inside radius of stenosis (cm)

\[P \text{ const} \]

Rs const

Collaterals

\[\uparrow P\]
Optimal Caliber of Iliac-Femoral Vein Segments

IVUS is key, venogram has no measurement scale

<table>
<thead>
<tr>
<th></th>
<th>Diameter (mm)</th>
<th>Area (mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFV</td>
<td>12</td>
<td>125</td>
</tr>
<tr>
<td>EIV</td>
<td>14</td>
<td>150</td>
</tr>
<tr>
<td>CIV</td>
<td>16</td>
<td>200</td>
</tr>
<tr>
<td>IVC</td>
<td>18-24</td>
<td>300-450</td>
</tr>
</tbody>
</table>
“optimal venous caliber” concept
Standing 281 mm²  
Lying on the left side 400 mm²  
Supine 61 mm²
Conductance

**Normal vein**

**Extra-venous fibrosis**

**Intra-venous synechia**
Venous function

1. Conduction
2. Adaptation
Blood volumes distribution

Exercise intensity

[Diagram showing blood flow distribution during exercise]

Cardiac output

Both legs

Head and trunk

Both arms

Exercise intensity

ΔP Obstruction ≈ ΔP Controls

IF Obstruction: 24 mm Hg → 60 mm Hg
Controls: 21 Mm Hg → 45 Mm Hg
Intravenous pressure changes in patients with postthrombotic deep venous obstruction: results using a treadmill stress test

“optimal venous caliber” concept

Physiologic Capacitance

Normal adaptive limits
“optimal venous caliber” concept

Physiologic Capacitance

Adaptive limits
"optimal venous caliber" concept

Adaptive limits

Physiologic Capacitance

Reflux

Inflow

Depth

C.  c. Big Outflow
Flow is 2% of normal value.
81- time decrease is adaptation.
Outflow Fraction vs. Resistance

Resistance (R): $R \approx \Delta P/F = 80\text{ mm Hg} / F_1$
During the intervention, pressure in the CFV was $18.0 \pm 7.8$ mmHg in affected and $11.7 \pm 5.9$ mmHg in non-affected limbs.
Digital APG

R at 80 mm Hg

R at 30 mm Hg
Resistance at lower pressures is higher in IFO

**Resistance**
(wood’s units)

**No obstruction**

**Iliac-Femoral obstruction**

Pressure (mm Hg)

Pressure (mm Hg)
CONCLUSIONS

• Concept of “critical stenosis” is not applicable to veins

• Clinically useful physiological test assessing Iliac vein stenosis does not exist

• Measuring venous resistance at low pressures is promising

• Clinical indications > anatomical criteria