WHAT IS THE IDEAL VENOUS STENT

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Disclosures
- Love steak
- Veneti - consultant

Venous Stenting is Not New...

- Significant body of clinical work
- Existing stents (off label)...Wallstent
- Good success treating venous outflow obstruction (peer review publications)
- Current generation of stents in USA IDE trials IDE and available OUS
  - VIVITrial – Zilver Vena (Cook Medical)
  - VIRTUS Trial – VICI VENOUS STENT (VENITI, Inc.)
  - ?? – Venovo (Bard)
  - Sinus Venous (Optimed) – No trial
  - Wallstent (BSC) – No trial

Safety and efficacy of current designs

The “Perfect Venous Stent”

- Necessary “chronic outward force”
- Sufficient “radial resistive force” across length of stent
- Self-expandable
- Minimal foreshortening on deployment and balloon dilatation
- Competing Design Attributes ...
  - Trade-offs are inevitable...
    - Sufficient flexibility not to kink at physiological angles
    - Allow repeated shortening, twisting, and/or bending at the groin
    - Longer stents to avoid overlapping of multiple stents

Stent Strength

- Chronic Outward Force: How much the stent pushes outward. Changes w diameter expansion.
- Crush Resistance: How much the stent can resist a single load (Point load)
- Radial Resistive Force: How much circumferential load a stent can resist intrinsically

Radial Resistive Force

- Radial strength was measured during loading/compression (radial resistive force-hoop strength) and inflation/deflation (outward force-self expanding)
- Stents were compressed radially
Radial Resistive Force

Radial Resistive Force: How much circumferential load the stent can take

Braided stent elongates

Crush resistance

Each stent was crushed 50% of its diameter between a plate and silicone tube (simulated vein).

The force exerted by the stent was measured at the stent midpoint and endpoint.

Crush Resistance

Coverage

Coverage evaluated by measuring the maximum circular unsupported surface area (MCUSA) - relates to scaffolding and vessel coverage.

Gap size (mm)

<table>
<thead>
<tr>
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<th>Closed Cell</th>
<th>Open Cell</th>
<th>Hybrid</th>
<th>Braided</th>
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</thead>
<tbody>
<tr>
<td>Closed Cell MCUSA (sq mm)</td>
<td>0.8</td>
<td>4.5</td>
<td>5.1</td>
<td>2.8</td>
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</tbody>
</table>

*Low MCUSA = better coverage

Uniform Strength and Shape

Consistent coverage, strength, and deployment

4 struts hybrid
6 struts open cell hook
12 struts veniti
34 struts braided wall

Sufficient Flexibility for Physiology

Braided stainless steel stent

Hybrid design

Closed cell structure
**Tip - Length/Extent of Stenting**

- Never “land” a stent at the junction of the internal and external iliac vein
  - to avoid “straightening” of the CIV
  - to prevent a “denovo” stenosis in the external iliac vein below the stent

**Deployment**

- Want...
  + Accuracy
  + Control
  + Ease of Use
- Don’t want...
  - “Jumping”
  - Gapping
  - Wrapping
  - Excessive Foreshortening

**Stent Attributes by Design**

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<tbody>
<tr>
<td>Crush Resistance</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>++</td>
</tr>
<tr>
<td>Flexibility</td>
<td>++</td>
<td>++</td>
<td>++</td>
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<tr>
<td>Deployment</td>
<td>++</td>
<td>++</td>
<td>-</td>
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<tr>
<td>Radial Resistant Force</td>
<td>+</td>
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<td>-</td>
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<tr>
<td>Coverage</td>
<td>++</td>
<td>-</td>
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**Conclusion**

- Arterial stents are not venous stents
- Venous anatomy and disease = trade-offs in stent design
- Need to look at stent attributes holistically, not individually

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