Venous stent-related complications

Prof. Cees H.A. Wittens, MD PhD
Head of Venous Surgery
Maastricht University Medical Center
Uniklinik Aachen
Requirements for stents per segment

- The vein geometry should dictate the shape of the stent and not VV!!
  - Flexibility
- The stent must be able to treat the underlying pathology
  - Radial Force
- Location dependent:
  - IVC: High radial force, low flexibility, large diameter.
  - CIV, EIV and CFV: High radial force, high flexibility, large diameters
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

Visible after weeks due to **straightening!!**
Obstruction due to stent sticking out into the lumen $\rightarrow$ alignment!!
Good alignment $\rightarrow$ better long term patency $\pm$ anticoagulation
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- **Straightening**
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- **Straightening**
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Shortcomings of stents

- Compression of stent (radial force to low)
- Straightening
  - Kinking of stent (high rigidity)
  - Stent rigidity
  - Bamboo stick effect
- Tapering
Movements in pelvis/groin:

supine

sitting
New venous Stents

Flexibility ++

Radial force ++
New Sinus-Venous stent
New Sinus-Venous stent \((N=31)\) vs Old design stents \((n=66)\): In PTS procedures

**Arterial stents vs Sinus Venous for PTS**

- **New secondary**
- **Old secondary**
- **New Assisted primary**
- **New primary**
- **Old assisted primary**
- **Old primary**

**P\(<0.05**

\(\approx + 10\% \)!!
New Sinus-Venous stent vs Old design stents:
In PTS procedures

Complications first year

<table>
<thead>
<tr>
<th></th>
<th>Old design stent</th>
<th>%</th>
<th>Sinus Venous</th>
<th>%</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patiënts</td>
<td>66</td>
<td>100</td>
<td>31</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Reocclusion</td>
<td>16</td>
<td>24</td>
<td>3</td>
<td>10</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Kinking</td>
<td>7</td>
<td>11</td>
<td>1</td>
<td>3</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Fracture</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Tapering</td>
<td>19</td>
<td>29</td>
<td>4</td>
<td>13</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>Residual compression</td>
<td>7</td>
<td>11</td>
<td>3</td>
<td>10</td>
<td>NS</td>
</tr>
<tr>
<td>Mild stenosis</td>
<td>17</td>
<td>26</td>
<td>9</td>
<td>29</td>
<td>NS</td>
</tr>
</tbody>
</table>

Higher flexibility
Higher radial force
Less reinterventions
# New venous Stents

<table>
<thead>
<tr>
<th>Type</th>
<th>Radial force</th>
<th>flexibility</th>
<th>placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zilver Vena</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>Veniti</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>Sinus Venous</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Sinus XL flex</td>
<td>++</td>
<td>+</td>
<td>++</td>
</tr>
</tbody>
</table>

**Zilver Vena**

**Veniti**

**Sinus Venous**

**Sinus XL flex**

![Zilver Vena](image1.png)

![Veniti](image2.png)

![Sinus Venous](image3.png)
Other new venous Stents

- Optimed
  - Oblique closed cell (6 cm length)
  - Flair it
  - Reposition it
  - Deploy
  - Extention with Sinus Venous for the iliofemoral tract

- Bard (no new features)

- Medtronic (no new features)

- ?? (improvements)
Conclusion:

- Preventing stent related problems:
  - Improve flexibility
    - Optimize alignment
    - Prevent need for anticoagulation
  - Improve radial force
    - Prevent compression
  - Prevent straightening
    - Prevent kinking
    - Prevent fractures
    - Prevent stentmaterial sticking into the lumen
    - Prevent “curtaining”
    - Prevent “Bamboo effect”
  - Optimize delivery
    - Prevent shortening
    - Allow repositioning
Venous stent-related complications

Prof. Cees H.A. Wittens, MD PhD
Head of Venous Surgery
Maastricht University Medical Center
Uniklinik Aachen