The CERAB technique—procedural tips and clinical outcome

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Disclosure

Speaker name:
Michel Reijnen

I have the following potential conflicts of interest to report:

✓ Consulting
☐ Employment in industry
☐ Stockholder of a healthcare company
☐ Owner of a healthcare company
☐ Other(s)

☐ I do not have any potential conflict of interest
Kissing stent configuration

• Meta-analysis on 605 patients
  • 81% primary patency at 2-year
  • 84% intermittent claudication
  • 53% TASC A & B

• Patency affected by:
  • Radial mismatch
  • Differences in stent conformation
  • The protrusion length of the stents in the distal aorta
    ➢ Re-circulation, turbulence and stasis
    ➢ Mesenchymal tissue, thrombus and intimal hyperplasia

Covered Endovascular Reconstruction of the Aortic Bifurcation - CERAB

Goal: to provide a more anatomical and physiological endovascular reconstruction of the aortic bifurcation
Covered Endovascular Reconstruction of the Aortic Bifurcation - CERAB

- In vitro study and comparison of CERAB patients with matched KS patients
- No difference in preoperative anatomy or indication for intervention
- Significantly more mismatch in KS configuration

<table>
<thead>
<tr>
<th>Method</th>
<th>Area (mm²)/Volume (mm³)</th>
<th>CERAB mean (SD)</th>
<th>KS mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ellipse</td>
<td>Radial mismatch area</td>
<td>14.1 (4.2)</td>
<td>172.7 (70.0)*</td>
</tr>
<tr>
<td></td>
<td>Radial mismatch volume</td>
<td>307.7 (131.2)</td>
<td>7268 (3810.9)*</td>
</tr>
<tr>
<td>ROI</td>
<td>Radial mismatch area</td>
<td>11.0 (4.8)</td>
<td>165.8 (71.5)*</td>
</tr>
<tr>
<td></td>
<td>Radial mismatch volume</td>
<td>240 (127.3)</td>
<td>7047.0 (3239.0)*</td>
</tr>
</tbody>
</table>

*denotes P <0.05

CERAB

Laser Particle Image Velocimetry

CERAB and BM kissing stents; Mostly laminar flow throughout the cardiac cycle

BM Kissing stents; turbulence and recirculation at phases B and C

Suboptimal placed limbs:

- Inferior stent-to-wall apposition (Double-D configuration)
- 4-fold increase in mismatch area

Clinical results of CERAB

Midterm outcome

- February 2009 – July 2016
- 130 elective patients, two centers
- Age 61 (36-81) years, 69 male
- Chimney procedures excluded
- Previous aorto-iliac intervention in 41%

Rutherford classification:

<table>
<thead>
<tr>
<th>Grade</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>0.8%</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>3</td>
<td>84</td>
<td>66.1%</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>17.3%</td>
</tr>
<tr>
<td>5</td>
<td>18</td>
<td>14.2%</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1.6%</td>
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TASC -II classification:

<table>
<thead>
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<th>Grade</th>
<th>n</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>7</td>
<td>(5.4%)</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>(5.4%)</td>
</tr>
<tr>
<td>D</td>
<td>116</td>
<td>(89.2%)</td>
</tr>
</tbody>
</table>
Clinical results of CERAB

Complications

- **Procedural**
  - Unintended dissection, n=6
  - Bleeding, n=4
  - Stent dislocation, n=1
  - Stent deformation, n=1
  - Thrombus formation, n=2

- **Post Procedural**
  - Pneumonia, n=3
  - Stent deformation, n=3
  - Thrombosis, n=2
  - CFA occlusion, n=1
  - MODS, n=1
  - Renal insufficiency, n=1

- No 30-day mortality
Clinical results of CERAB

Complications

• Procedural
  • Unintended dissection n=6
  • Bleeding n=4
  • Stent dislocation n=1
  • Stent deformation n=1
  • Thrombus formation n=2

• Post Procedural
  • Pneumonia n=3
  • Stent deformation n=3
  • Thrombosis n=2
  • CFA occlusion n=1
  • MODS n=1
  • Renal insufficiency n=1

• No 30-day mortality

Taeymans K et al. J Vasc Surg May;67(5):1438-1447
XperCT
Cone beam CT tool
Clinical results of CERAB

Complications

• **Procedural**
  - Unintended dissection \( n=6 \)
  - **Bleeding** \( n=4 \)
  - Stent dislocation \( n=1 \)
  - Stent deformation \( n=1 \)
  - Thrombus formation \( n=2 \)

• **Post Procedural**
  - Pneumonia \( n=3 \)
  - Stent deformation \( n=3 \)
  - Thrombosis \( n=2 \)
  - CFA occlusion \( n=1 \)
  - **MODS** \( n=1 \)
  - Renal insufficiency \( n=1 \)

• **No 30-day mortality**
Closure devices
Closure devices
Clinical results of CERAB

Midterm outcome

- Median follow-up 24 months
- Total primary patency
  - 12 months 91%
  - 24 months 89%
  - 36 months 87%
- Secondary patency
  - 12 months 97%
  - 24 months 97%
  - 36 months 97%
- Clinical improvement at 36 months 96%
- Limb salvage rate at 36 months 97%
Clinical results of CERAB

Midterm outcome

Previous treatment of AIOD

- Surgical reconstruction of the aortoiliac segment (n=7)
- Endovascular intervention (N=46, 35%)
  - 46% PBA of the common iliac artery
    (17% kissing balloons)
  - 37% Stenting of the common iliac artery
    (31% kissing stents)

<table>
<thead>
<tr>
<th>One-year follow-up</th>
<th>Yes (n = 46), %</th>
<th>No (n = 80), %</th>
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<tbody>
<tr>
<td>Primary patency</td>
<td>80</td>
<td>88</td>
</tr>
<tr>
<td>Primary assisted patency</td>
<td>91</td>
<td>97</td>
</tr>
<tr>
<td>Secondary patency</td>
<td>98</td>
<td>98</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Three-year follow-up</th>
<th>Yes (n = 46), %</th>
<th>No (n = 80), %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary patency</td>
<td>76</td>
<td>85</td>
</tr>
<tr>
<td>Primary assisted patency</td>
<td>83</td>
<td>88</td>
</tr>
<tr>
<td>Secondary patency</td>
<td>94</td>
<td>98</td>
</tr>
</tbody>
</table>

Taeymans K et al. J Vasc Surg 2018 May;67(5):1438-1447
Clinical results of CERAB

Debulking
Clinical results of CERAB

Debulking

After debulking with 8Fr Rotarex
Clinical results of CERAB

Role of outflow stenosis

HD significant outflow stenosis causes;
• 2-fold decrease in peak outflow velocity
• 3-fold decrease in TA-WSS in both CERAB and control

In CERAB the TA-WSS was 2-fold lower compared to the control model, independent of the lesion severity

Outflow stenosis after CERAB will have a higher tendency to progress in time and may require early treatment

Summary

• CERAB is related to the most optimal geometry and flow patterns for extensive AIOD and good clinical outcome is good up to 3-year follow-up

• Proper placement and optimal deployment of the limbs and early treatment of outflow stenosis are important to improve outcome

• Cone beam CT and debulking may improve outcomes, particularly in re-do cases

• Endovascular options seem unlimited, but the preferred treatment remains tailor-made, particularly in complex cases
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