Update on the Value and Limitations of Multilayered Uncovered with Covered Stents for Treating Aortic Aneurysms: Indications and Results

Lu Qingsheng
Division of Vascular Surgery, Shanghai Hospital, SMMU
Military Institute of Vascular Diseases
Clinical Centre of Vascular Surgery
Shanghai, P. R. China

Flow-modulating Strategy in Aorta
Experiences and Lessons

Advantage

Clinic outcome of Multilayer Flow Modulating (MLFM) Bare Stents was good but not good enough. Aneurysms expansion and rupture were reported and the indication was limited.

Disclosures
No

Backgrounds: Flow-diverting Strategy in Aorta
The concept of sac entrance and its influence on the sac thrombosis

<table>
<thead>
<tr>
<th>Variable/Variable</th>
<th>Fast-thrombosis group</th>
<th>Delayed-thrombosis group</th>
<th>P</th>
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</thead>
<tbody>
<tr>
<td>Aneurysm diameter</td>
<td>57.20 ± 4.81</td>
<td>54.85 ± 5.76</td>
<td>.279</td>
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<tr>
<td>Proximal aortic neck</td>
<td>20.65 ± 2.83</td>
<td>22.25 ± 2.12</td>
<td>.162</td>
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<tr>
<td>Sac entrance (SE)</td>
<td>14.95 ± 12.57</td>
<td>27.50 ± 17.94</td>
<td>.045</td>
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Short-SE aneurysms manifested quicker thrombosis compared to wide-SE ones

Inspiration from Previous Clinical Observation
How to shorten the sac entrance (SE): The joint procedure

The joint procedure: concept and design
The length of the aneurysm sac entrance could be artificially shortened by a stent-graft covering part of it, followed by multiple layers of uncovered stents to cover the residual SE.

Stent-grafts: used to cover non-branch zone of the aneurysm, shortening the sac entrance
Uncovered stents: used to cover the reno-visceral segment of aorta, preserving the visceral branches

Validation of This Theory in Clinical Practice
Variation of the joint procedure

Standard joint procedure
Extended joint procedure
Extended and Reversed joint procedure

Type Y TAAA
A stent-graft covering proximal aneurysm sac, MLUS covering reno-visceral segment

Type I TAAA
Two stent-grafts covering proximal aneurysm sac, MLUS covering reno-visceral segment

Type II TAAA
Two stent-grafts covering proximal aneurysm sac, A stent-graft covering distal aneurysm sac, MLUS covering reno-visceral segment
Validation of This Theory in Clinical Practice

Variation of the joint procedure

Extended and Reversed joint procedure

Reversed joint procedure

Type III TAAA
One or Two stent-grafts covering proximal aneurysm sac, A stent-graft covering distal aneurysm sac, MLUS covering reno-visceral segment

Type IV TAAA
A stent-graft covering distal aneurysm sac, MLUS covering reno-visceral segment

Type V TAAA: 83-year-old female, pararenal saccular aneurysm

Pre-operative CTA: Side-wall saccular aneurysm involving the celiac trunk, and adjacent to the superior mesenteric artery and renal arteries

Validation of This Theory in Clinical Practice

STEP 1:
Pre-stenting angiogram to confirm the size and location of the aneurysm

STEP 2:
The first uncovered stents was deployed to cover the entire aneurysm zone, providing circumferential bearing support for the subsequent stents

STEP 3:
A stent-graft was placed within the first bare stent to cover the most part of the sac entrance(SE), leaving a residual SE in the reno-visceral segment.

STEP 4:
The second uncovered stents was deployed overlappingly to cover the residual sac entrance at the reno-visceral zone.
Validation of This Theory in Clinical Practice

Follow-up findings

- Complete thrombosis and shrinkage of the aneurysm sac
- Patent collaterals

Type I TAAA: 62-year-old male
Stent-grafts covering proximal aneurysm sac, MLUS covering reno-visceral segment.
Follow-up CTA revealed complete thrombosis of the aneurysm sac and patent side branches.

Type II TAAA with dissection: 46-year-old male
Stent-grafts covering proximal and distal aneurysm sac, MLUS covering reno-visceral segment.
Follow-up CTA revealed complete thrombosis of the aneurysm sac and patent side branches.

Type III TAAA: 80-year-old male
Stent-grafts covering proximal and distal aneurysm sac, MLUS covering reno-visceral segment.
Follow-up CTA revealed complete thrombosis of the aneurysm sac and patent side branches.

Type IV TAAA: 72-year-old male
A stent-grafts covering distal aneurysm sac, MLUS covering reno-visceral segment.
Follow-up CTA revealed complete thrombosis of the aneurysm sac and patent side branches.
Mid-term Outcome of the Joint Procedure
Single-centre Retrospective Analysis of the Pilot Patient Cohort

From Feb 2012 to Oct 2017
- 34 selective TAAA patients (22 men, mean age: 67.8 years)
- Type I: 19 cases; Type II 2 cases; Type III 2 cases;
- Type IV: 4 cases; Type V: 7 cases
- TAAA diameter: 50mm-112mm Mean 63.5 ±14.1 mm
- Average follow-up length: 39 months
- Aneurysm shrinkage was demonstrated in 19 patients; aneurysm stabilization was observed in 14 patients. 1 aneurysm expansion.
- Mean aneurysm diameter decreased from 59.5 ± 14.1 mm to 53.3 ± 16.8 mm (p=0.001)
- Significant increase in sac thrombus deposition volume from 18.8 ± 10.2% to 93.6 ± 5.5% (p < 0.001)
- The majority of side branches (131/132) were successfully preserved

Discussion: Changing in Flow Pattern
Flow pattern could change greatly after the joint procedure

Discussion: Quicker thrombosis and More diameter decrease ratio

Discussion: Indications for TAAA
- TAAA diameter: 50mm-112mm

Limitation: Type 3 Endoleak with Expansion

Limitation: Type 3 Endoleak with Expansion
- Add one stent-graft and one bare stent
- 6 Months
Initial Conclusion of the Joint Procedure

- The joint procedure could be a feasible alternative in complex aortic aneurysms where side branches need to be preserved;
- Short-term outcome seems acceptable, yet long-term follow-up is required;
- Might be a modified concept for the flow-modulating with better outcome;
- Need New Designed Joint Stents to overcome the limitation.

Qingsheng Lu, MD
Tel: +86 13917292504
E-mail: luqs@xueguan.net