Heli-FX Endoanchors during TEVAR:

Indications and Outcomes

P M Kasprzak, R. Kopp, K. Pfister
Department of Vascular Surgery
Endovascular Surgery
University Hospital Regensburg, Germany

Disclosures Dr. Kasprzak (grants, speaker fee, development)
Cook, Gore, Vascutek, Bard, Medtronic, Maquet, UCB, Bentley
Complications after TEVAR

- Aneurysm expansion, - rupture
- Endoleak Type Ia/b, II, III
- Migration
- Stent graft protrusion = coarctatio, infolding, collapse
- Side branch occlusion / organ dysfunction, ischemia
- Intraluminal thrombosis
- Spinal ischemia
- Aortic dissection
- Stent graft infection
- Complications of the groin / iliacs
Proximal Migration / Dislocation after 1 Year
Partial debranching for descendens aneurysm

Endoleak Ia after 6 months

Arch stent graft with scalop

Cook ®
EndoAnchoring for TEVAR

Problems at the Sealing Zone:
- Short neck / kinking
- Stent graft nonalignment
- Proximal ‘convex´ Descendens Aneurysm
- Type I a/b Endoleak
- Migration
- Stent graf protrusion / Infolding

Possible solution: EndoAnchoring?

First EndoAnchors in TEVAR worldwide on 23.03.2011
How to get a secure and permanent fixation?

Surgical suture

Gold standard: open surgery

Alternative?

4,5 mm

Staples, EndoAnchors
Figure 2.—The Heli-Fx Thoracic Guide (courtesy of Medtronic, Inc.): A) the Heli-FX Guide is available in 3 different tip sizes to allow for better device stability based on aortic diameters; B) recommended Guide selection based on aortic inner diameter.
Endoanchors would then be placed

INNER CURVE & OUTER CURVE

OF THE THORACIC ARCH
Add 10 to 15 degrees cranial tilt and repeat

Add an additional 10 to 15 degrees cranial tilt and repeat if required
Cranial tilt
Add 10 to 15 degrees Caudal tilt and repeat

Add an additional 10 to 15 degrees Caudal tilt and repeat if required
Subtotal stent graft collapse at the level of the distal aortic arch after unsuccessful proximal stent graft extension and primary treatment for traumatic aortic rupture (A). Successful secondary attachment of the proximal aortic extension stent graft to the inner curvature of the distal aortic arch using 7 endostaples (insert with black arrows, B).
Endoleak I b after TEVAR

Distal Extension
Fixation with 3 helical endostaples (arrow) and thoracic stent graft extension for secondary treatment of a thoracic aortic aneurysm with a distal type Ib endoleak (insert with white arrows showing 2 endostaples).
Proximal EndoAnchor of the TEVAR with Scalop for Brachiocephalic Trunk and Fenestration for the left CCA in Patient with Multibranched Stentgraft for Type II TAAA
Fenestrated TEVAR / BEVAR
Migration of Fenestrated (LSA) TEVAR in BEVAR for TAAA
EndoAnchors – De Novo Indication takes Over

EndoAnchors in 142 Patients with EVAR, TEVAR, FEVAR and BEVAR

- TAA (n=305) 10%
- BEVAR/FEVAR (n=283) 5%
- EVAR (n=289) 33%

Primary 80%, Secondary 20%
EndoAnchors and thoracic or thoracoabdominal EVAR
(n = 30)

Indications for endovascular repair
• TAA n = 12
• suprarenal AAA n = 8
• TAAA n = 4
• PAU thoracic aorta/aortic arch n = 2
• rupt TAA + aortobronchial fistula n = 1
• Post-traumatic n = 3

Endovascular and hybrid procedures
• TEVAR n = 17
• TEVAR + FEVAR n = 8
• TEVAR + BEVAR n = 3
• TEVAR + B/FEVAR n = 1
• chim/TEVAR n = 1
Indications for EndoAnchors

- short/curved landing zone \( n = 13 \)
- endoleak type Ia/b \( n = 5 \)
  - with aneurysm progression \( n = 2 \)
- migration \( n = 2 \)
- migration + risk of side branch malperfusion \( n = 3 \)
- non alignment \( n = 3 \)
- ruptured aneurysm + short landing zone \( n = 3 \)
- aortic dissection type B (fixation at CT) \( n = 1 \)

EndoAnchors implanted: \( 7.2 \pm 3.4 \) (range: 2 – 15)
EndoAnchors and thoracic or thoracoabdominal EVAR

$n = 30$
age: $69.5 \pm 12\text{ y}$
follow-up: 3-60 months

- persistent endoleak type I-III: 4 (13%)
aortic expansion/aneurysm progression: 5 (17%)  

Re-interventions in 4 patients
- 1 prox endoleak, TEVAR with early mortality (pneumonia)
- 1 stent graft dislocation in overlapping zone -> TEVAR
- 1 proximal stent graft extension (aortic arch) + prox. chimney graft
- 1 secondary FEVAR
The use of EndoAnchors to rescue complicated TEVAR procedures

Sarah B. ONGSTAD 1, Daniel F. MILLER 1, Jean M. PANNETON 1, 2 *

1Vascular Surgery Department, Eastern Virginia Medical School, Norfolk, VA, USA. 2Division of Vascular Surgery, Sentara Heart Hospital, Norfolk, VA, USA

Figure 10.—Freedom from endoleak.
*Kaplan-Meier curve demonstrating 92% freedom from post-operative endoleak requiring reintervention at up to 12 months following the index procedure. Number of patients at risk is indicated in the x-axis.
Figure 11.—Freedom from aortic-related reintervention. *Kaplan-Meier curve demonstrating 81% freedom from aortic-related reintervention at up to 12 months following the index procedure. Number of patients at risk is indicated in the x-axis.

Figure 12.—Freedom from aortic-related death. *Kaplan-Meier curve demonstrating 90% freedom from aortic-related death at up to 12 months following the index operation. Number of patients at risk is indicated in the x-axis.
### TABLE I. Description of index operations performed.

<table>
<thead>
<tr>
<th>Indication</th>
<th>Operation performed</th>
<th>N.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic aortic aneurysms</td>
<td>TEVAR</td>
<td>9</td>
</tr>
<tr>
<td>(N=23)</td>
<td>TEVAR with hemi-arch debranching (including 2 cases with innominate chimney)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TEVAR with LSA laser fenestration</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>TEVAR with LSA revascularization</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TEVAR with LSA laser fenestration, carotid-carotid bypass</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with LCA laser fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with LCA chimney</td>
<td>1</td>
</tr>
<tr>
<td>Thoracoabdominal aneurysms</td>
<td>TEVAR</td>
<td>1</td>
</tr>
<tr>
<td>(N=4)</td>
<td>TEVAR with 4-vessel fenestration</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TEVAR with SMA, bilateral renal chimneys</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with SMA chimney</td>
<td>1</td>
</tr>
</tbody>
</table>

LSA: left subclavian artery; LCA: left common carotid artery; SMA: superior mesenteric artery.

### TABLE II. Description of redo operations performed.

<table>
<thead>
<tr>
<th>Indication</th>
<th>Operation performed</th>
<th>N.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thoracic aortic aneurysms</td>
<td>TEVAR</td>
<td>8</td>
</tr>
<tr>
<td>(N=16)</td>
<td>TEVAR with LSA plug</td>
<td>2</td>
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<tr>
<td></td>
<td>TEVAR with innominate laser fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with LCA laser fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with total arch debranching</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with hemi-arch debranching, innominate chimney</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with celiac chimney</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with celiac coil embolization</td>
<td>1</td>
</tr>
<tr>
<td>Thoracoabdominal aneurysms</td>
<td>TEVAR</td>
<td>5</td>
</tr>
<tr>
<td>(N=11)</td>
<td>TEVAR with 3-vessel fenestration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TEVAR with SMA chimney</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>TEVAR with 2-vessel fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with 4-vessel fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with 1-vessel fenestration</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>TEVAR with visceral debranching</td>
<td>1</td>
</tr>
</tbody>
</table>

LSA: left subclavian artery; LCA: left common carotid artery; SMA: superior mesenteric artery.

CONCLUSIONS: EndoAnchors can be safely utilized in TEVAR with high rates of technical success. These results demonstrate the potential to enhance thoracic endograft efficacy and durability with the use of therapeutic and prophylactic EndoAnchors. Long-term data is needed to further define the use of this technology in the thoracic aorta.
Limitations of EndoAnchors in TEVAR

- Lack of appostion between stentgraft and aortic wall
- Endoleak I a/b (distance to the aortic wall > 3mm)
- Thick thrombus formation
- Stentgraft underseized

Possible solution: Extension Stent Graft... and Endoanchors or planned Debranching, Scalops, Fenestrations, Branches in emergency CHIMPS
Proximal Cuff-Extension with no oversizing and Fixation with EndoAnchors in Patient with Migration and Type I a Endoleak after multibranched BEVAR
BACKGROUND:
The aim of this study was to report the occurrence of a type IIIb endoleak after endovascular repair of a thoracic aortic aneurysm caused by endoanchor dislocation.

CASE REPORT:
An 84-year-old female patient underwent thoracic endovascular repair for aneurysmal disease of her thoracic aorta. The procedure included primary left subclavian artery revascularization and the placement of endoanchors to enhance fixation of the endograft within the aortic arch. Dislocation of one of the endoanchors resulted in a graft defect leading to a type IIIb endoleak and aortic diameter expansion.

CONCLUSIONS:
Endoanchors represent a promising adjunct in endovascular repair settings. However, their use requires careful procedure planning and special attention during follow-up.
Conclusions:

We consider EndoAnchors for treatment in:

- Nonalignment
- Short neck / kinking
- Prevention of migration / side-branch malperfusion
- Stent graft protrusion
- Partial stent graft collaps
- Typ I endoleak (ev. with Extension-Cuff / Stentgraft) as therapy option with promising results
How (and where) to get a secure and permanent fixation in TEVAR?

Fixation in:
- hostile neck ✔
- distal kink ✔
- fenestrated arch devices ✔
- nonaligment ✔
- graft prolaps ±
- gutter in chimps ?
- lack of oversizing —
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