The Snorkel Technique for Juxtarenal Aneurysms

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IMAD
Liege, Belgium
October 5, 2012

*NO DISCLOSURES
**OFF LABEL USE OF DEVICES
Basic Definitions

- Parallel graft alongside the main aortic endoprosthesis to maintain flow in a covered branch vessel.
Self-expanding bare metal stents
Effectively raise renal orifice a few mm
Ensure graft material in region of renals without compromising renal flow
6 juxtarenal cases (2 ruptured, 3 urgent)

Covered stents

Valid alternative to fenestrated during emergency setting or unsuitable for FBE

Rescue procedure to salvage side branch
Early experience with the snorkel technique for juxtarenal aneurysms

Jason T. Lee, MD, Joshua I. Greenberg, MD, and Ronald L. Dalman, MD, *Stan*  

**Objective:** The lack of readily available branched and fenestrated endovascular aneurysm created an opportunity for creative deployment of endograft components to treat juxtarenal early experience with “snorkel” or “chimney” techniques in the endovascular management. **Methods:** We retrospectively reviewed planned snorkel procedures for juxtarenal aneurysm 2009 to August 2011. Our standardized technique included axillary or brachial cutdown stents and mostly percutaneous femoral access for the main body endograft. **Results:** Fifty-six snorkel grafts were successfully placed in 28 consecutive patients (mean aneurysms). Mean aneurysm size was 64.8 mm (range, 53-87 mm). The snorkel configuration zone from an unsuitable infrarenal neck for standard EVAR (mean diameter, 33.5 mm; neck diameter of 24.5 mm and length of 18.0 mm. Five patients had unilateral renal sn snorkels, and six had celiac/superior mesenteric artery/renal combinations. Technical success 98.2%, with loss of wire access leading to one renal stent deployment failure. Thirty-day mortality was readmitted 1 week postoperatively with pneumonia and died of sepsis; one patient hemispheric stroke. Other major complications included perinephric hematomas, 7.1%; p iliac artery injury requiring endoconduit placement, 3.6%; and brachial plexus nerve injury included self-limited arrhythmias (14.3%) and one non-Q-wave myocardial infarction (3.6%), with all recovering without coronary intervention. Mean follow-up was 10.7 months (range, 3-25 months). Mortality related causes at 3 months (89.3% survival). Postoperative imaging revealed one renal stent 3 months (98.2% overall primary patency). Seven (25%) early endoleaks were not confirmed by computed tomography angiography: two type I, three type II, and two type III (25%), leading bridging stents (type III). The small type 1a endoleaks and other type endoleaks and re scan. Mean sac regression at the latest follow-up was 7.3 mm. No aneurysm has been detected. **Conclusions:** Early success with the snorkel technique for juxtarenal aneurysms has complex short-neck to no-neck EVAR. Although long-term follow-up is needed, this and lack of requirement for custom-built devices may make this approach more available stent grafts. (J Vasc Surg 2012;55:935-46.)

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28 consecutive elective patients (2009-2011)

IRB approved protocol

98% technical success

7.1% 30-day mortality

98% primary patency

Survival 89% at one year
TECHNIQUE
Hybrid Suite
Recommended Access

LOW BRACHIAL

HIGH BRACHIAL

AXILLARY
Single high brachial incision for double renal 7F 90cm Terumo sheaths
125 cm JB1 slip cath
260mm glide wire
260mm Rosen wire
7F 90cm Terumo sheaths into target branch origin
125 cm JB1 slip cath
260mm Rosen wire
Line up iCAST stents
6x59 or 7x59 on AP view
Check SMA position on lateral view.
Deploy fabric below SMA
Cannulate gate and position molding balloon
Deploy iCAST stents
Begin inflating molding balloon
“Triple Kissing” Balloons
Always deflate aortic balloon prior to deflating snorkel balloons
Results 2009-2012

- 70% male
- Age 75 years (60-88)
- AAA size 65.1mm (51-95)
- Most not suitable for open repair
  - Severe CAD (79%), COPD (46%), CHF (32%)
  - 100% ASA Class 3 or worse
- All elective cases
  - 79% juxtarenal AAAs
  - 12% previous Type I endoleaks
  - 9% with previous open repair
Results

- **Pre-snorkel Neck**
  - 32.6 mm diameter (18-45)
  - 1.5 mm length (0-5)

- **“Post-snorkel” Neck**
  - 25.1 mm diameter (18-32)
  - 19.4 mm length (10-30)
### Configuration (n=43)
- 28 (65%) bilateral renal
- 6 (14%) unilateral renal
- 9 (21%) combination with visceral

### Main body endograft
- 26 (60%) Zenith
- 5 Renu, 5 Endurant, 2 TX2, 2 Excluder, 1 TAG, 1 Talent, 1 Valiant

### 85/87 branches preserved in the 43 patients
- 97.7% technical success
# Outcomes

<table>
<thead>
<tr>
<th>PERIOPERATIVE (n=43)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluoroscopy time (min)</td>
<td>72.9</td>
<td>35-155</td>
</tr>
<tr>
<td>Contrast dose (mL)</td>
<td>180.0</td>
<td>66-400</td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>236.9</td>
<td>110-515</td>
</tr>
<tr>
<td>Estimated blood loss (mL)</td>
<td>413</td>
<td>100-2000</td>
</tr>
<tr>
<td>Baseline creatinine (mg/dL)</td>
<td>1.1</td>
<td>0.8-1.6</td>
</tr>
<tr>
<td>Highest postop creatinine</td>
<td>1.4</td>
<td>0.9-5.8</td>
</tr>
<tr>
<td>Long-term followup creatinine</td>
<td>1.2</td>
<td>0.8-4.4</td>
</tr>
<tr>
<td>ICU length of stay (days)</td>
<td>0.8</td>
<td>0-6</td>
</tr>
<tr>
<td>Total length of stay (days)</td>
<td>3.4</td>
<td>2-10</td>
</tr>
</tbody>
</table>
Short-term Results (n=43)

- Complications
  - 2 peri-nephric hematomas (4.6%)
    - Transfusion post-op
    - No renal failure issues or need for HD
  - 4 acute renal failure with 1 requiring permanent HD (2.3%)
    - In double renal/visceral combination snorkels
  - 1 brachial plexus injury (2.3%), 1 iliac artery injury (2.3%)
  - 5 post-op arrhythmias (11.6%), 1 post op MI (resolved)

- 7.0% 30-d mortality (post-op pneumonia/ sepsis, CVA, paraplegia)

- 1 additional death at 3 months (unrelated MI)

- Follow-up time 16.5 months (1-36)
  - Survival 88.4%
Imaging Follow-Up (n=43)

- 96.5% overall primary patency
  - 3 occluded renals
    - 1 at 3 month CT-A
    - 1 during unrelated abdominal operation 3m post-op
    - 1 at 1 month f/u
  - 98.8% secondary patency
Occluded L renal after abdominal operation with rising creatinine to 7.0
Re-angioplasty
Re-stented
AAA Follow-Up

- 8 early endoleaks (18.6%)
  - 3 type I (2 resolved, 1 required additional snorkel and cuff)
  - 3 type II (no sac enlargement, all have resolved at 6 months)
  - 2 type III (cuff placement at 6 mo, resolved on 1 year followup)
- 5 secondary interventions (11.6%)
  - 2 patients with occluded renals
  - 1 type I endoleak
  - 1 type III endoleak
  - 1 kinked renal

<table>
<thead>
<tr>
<th>Preop Aneurysm size (mm)</th>
<th>65.1</th>
<th>51-95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop Sac Size (mm)</td>
<td>58.0</td>
<td>32-93</td>
</tr>
<tr>
<td>Sac regression at latest f/u (mm)</td>
<td>7.3</td>
<td>-1- -23</td>
</tr>
<tr>
<td>F/U time</td>
<td>16.5</td>
<td>1-36</td>
</tr>
</tbody>
</table>
8/22/2012
Pre-intervention
8/22/2012
Left Renal Snorkel Angioplasty
8/22/2012
Left Renal
Snorkel
Post-Angioplasty
SOLICITATION: BAA-NHLBI-CSB-HV-2013-02-JS

AMENDMENT: Three (3)

TITLE: Vascular Interventions/Innovations and Therapeutic Advances (VITA) Stage-A (Concept to Proof of Principle) & Stage B (Proof of Principle to IND or IDE)

EFFECTIVE DATE: July 5, 2012

ISSUED BY:

National Heart, Lung, and Blood Institute, NIH
Office of Acquisitions, CSB, DERA
6701 Rockledge Drive, Suite 6042, MSC 7902
Bethesda, Maryland 20892-7902
SS8. Chimney and Periscope Grafts: Mid-term Results in 77 Consecutive Patients with Complex Aortic Aneurysms

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¹Clinic for Cardiovascular Surgery, University Hospital Zurich, Zurich, Switzerland; ²University of Palermo, Palermo, Italy; ³New York University Medical Center, New York, NY.

OBJECTIVE: The chimney and periscope techniques require coverage of visceral orifices in aorta with complex thoraco-abdominal aneurysms. Our objective was to describe our endovascular approach to treat these challenging aneurysms.

METHODS: Between 2002-2011, 77 consecutive patients were treated with complex thoracic, abdominal, and juxtarenal aneurysms. Patients were divided into 3 categories: mixed arch, thoraco, and juxtarenal; mixed hybrid and all endovascular.

RESULTS: 77 patients were treated, 61 with Ch-EVAR for juxtarenal, 149 renovisceral ch-grafts. Technical success was 99.4%, 30 d mortality was 7%, F/u time was 12 months with only 3 occlusions (98%). 25% type II endoleaks, 8% type I all repaired.

- 77 patients treated from 2002-2011
  - Mixed arch, thoraco, and juxtarenal
  - Mixed hybrid and all endovascular
- 61 patients with Ch-EVAR for juxtarenal
- 149 renovisceral ch-grafts
  - Technical success 99.4%
  - 30 d mortality 7%
  - F/u time 12 months only 3 occlusions (98%)
  - 25% type II endoleaks, 8% type I all repaired
### Table IV. Reported literature of snorkel/chimney endovascular aortic aneurysm repair for juxtarenal abdominal aortic aneurysms (AAAs)

<table>
<thead>
<tr>
<th>Chimney/snorkel series for AAAs (first author)</th>
<th>No.</th>
<th>Urgent (%)</th>
<th>Snorkels per patient (mean)</th>
<th>Covered stents (%)</th>
<th>Type I endoleak (%)</th>
<th>6-month patency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohrlander(^{17})</td>
<td>6</td>
<td>84</td>
<td>1.8</td>
<td>100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Hiramoto(^{18})</td>
<td>8</td>
<td>NA</td>
<td>1.0</td>
<td>12.5</td>
<td>12.5</td>
<td>100</td>
</tr>
<tr>
<td>Allaqaband(^{19})</td>
<td>2</td>
<td>0</td>
<td>1.0</td>
<td>50</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Donas(^{20})</td>
<td>15</td>
<td>33</td>
<td>1.0</td>
<td>100</td>
<td>6.7</td>
<td>94</td>
</tr>
<tr>
<td>Bruen(^{21})</td>
<td>21</td>
<td>5</td>
<td>1.7</td>
<td>100</td>
<td>4.8</td>
<td>94</td>
</tr>
<tr>
<td>Coscas(^{22})</td>
<td>16</td>
<td>25</td>
<td>1.6</td>
<td>100</td>
<td>12.5</td>
<td>96</td>
</tr>
<tr>
<td>Current series</td>
<td>28</td>
<td>0</td>
<td>2.0</td>
<td>100</td>
<td>7.1</td>
<td>98</td>
</tr>
<tr>
<td>Author</td>
<td>CG n/direction</td>
<td>CG patency</td>
<td>Endoleak type I</td>
<td>Morbidity</td>
<td>30-day mortality</td>
<td>30-day follow-up (months)</td>
</tr>
<tr>
<td>--------</td>
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<td>--------------------------</td>
</tr>
<tr>
<td>Our series (2011)</td>
<td>3 proximal, 1 caudal</td>
<td>100% (4/4)</td>
<td>1 type Ia endoleak; coil and biological glue infusion via microcatheter</td>
<td>None</td>
<td>0</td>
<td>8.6</td>
</tr>
<tr>
<td>Coscas et al (2011)</td>
<td>26 proximal</td>
<td>96.1% (25/26)</td>
<td>2 type Ia; 1 sealing, 1 spontaneously resolved</td>
<td>3 renal failure, 1 stroke</td>
<td>12.5% (2/16)</td>
<td>10.7</td>
</tr>
<tr>
<td>Richardson et al (2011)</td>
<td>1 proximal</td>
<td>100% (1/1)</td>
<td>—</td>
<td>None</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Ilici et al (2011)</td>
<td>2 proximal</td>
<td>100% (2/2)</td>
<td>1 type Ia, spontaneously resolved</td>
<td>None</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bruni et al (2011)</td>
<td>37 proximal</td>
<td>97.8% (36/37)</td>
<td>—</td>
<td>5 renal function impairment, 4 access arterial thrombosis, 3 access site pseudoaneurysms, 3 ileus &gt;4 days, 2 stroke</td>
<td>4.8% (1/21)</td>
<td>6</td>
</tr>
<tr>
<td>Schlosser et al (2011)</td>
<td>2 proximal</td>
<td>100% (2/2)</td>
<td>Type Ia, the whole chimney procedure was repeated</td>
<td>None</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Kettelken et al (2011)</td>
<td>1 caudal</td>
<td>100% (1/1)</td>
<td>—</td>
<td>None</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Donas et al (2010)</td>
<td>15 proximal</td>
<td>93.3% (14/15)</td>
<td>—</td>
<td>1 myocardial infarction</td>
<td>0</td>
<td>6.7</td>
</tr>
<tr>
<td>Lachat et al (2010)</td>
<td>2 proximal</td>
<td>100% (4/4)</td>
<td>Low flow type Ib; spontaneously resolved</td>
<td>None</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>D’Ura et al (2010)</td>
<td>1 caudal</td>
<td>100% (1/1)</td>
<td>1 type Ia</td>
<td>None</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Banic et al (2010)</td>
<td>4 caudal</td>
<td>100% (4/4)</td>
<td>Low flow type Ib; spontaneously resolved</td>
<td>ND</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Alagaband et al (2010)</td>
<td>3 proximal</td>
<td>100% (3/3)</td>
<td>—</td>
<td>None</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Hiramoto et al (2009)</td>
<td>1</td>
<td>100% (8/8)</td>
<td>3 type I; 1 Palmaz, 2 spontaneously resolved</td>
<td>ND</td>
<td>0</td>
<td>6.5</td>
</tr>
<tr>
<td>Oehlinger et al (2008)</td>
<td>11 proximal</td>
<td>100% (11/11)</td>
<td>—</td>
<td>1 renal failure, 1 asymptomatic compression of a renal CG</td>
<td>12.5% (1/8)</td>
<td>12.5</td>
</tr>
<tr>
<td>Larzon et al (2008)</td>
<td>15 proximal</td>
<td>100% (15/15)</td>
<td>1 type Ia; embolization of IIA stenosing EIA</td>
<td>1 myocardial infarction, 2 renal failure, 1 AP, 1 access fem. thrombosis</td>
<td>4.1% (4/93)</td>
<td>9.0 ± 1.0</td>
</tr>
</tbody>
</table>

Vascular Surgery
Summary

• Sn-EVAR technique provides acceptable short-term results for elective juxtarenal AAA repair in high risk patients as well as bailout or emergent circumstances
  – 97.7% technical success in branch preservation
  – 96.5% primary patency in follow-up
  – Acceptable morbidity and mortality at 1 year follow-up
  – Protection from aneurysm rupture
  – Secondary interventions are feasible
The $1,000,000 Question
Vascular Surgery
Conclusions

- Sn-EVAR is an excellent alternative to branched/fenestrated systems until more readily available or we move towards off-the-shelf designs
  - Relies on skills/techniques/devices we are comfortable with
  - Patency and freedom from endoleak comparable to f-EVAR
  - Does not require customization or modification of devices
  - Potentially more flexible in configurations
  - Can be used in urgent cases and bailout scenarios
Thank you!