Way Outside the IFU: Snorkel/chimneys in combination with ZFEN

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Early experience with the snorkel technique for juxtarenal aneurysms

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Objective: The lack of readily available branched and fenestrated endovascular aneurysm repair (EVAR) offered an opportunity for creative deployment of endograft components to treat juxtarenal aneurysms. We report early experience with “snorkel” or “chimney” techniques in the endovascular management of complex aortic aneurysms.

Methods: We retrospectively reviewed planned snorkel procedures for juxtarenal aneurysms performed from May 2009 to August 2011. Our standardized technique included auxiliary or brachial cutdown for delivery of covered stents and mostly percutaneous femoral access for the main body endograft.

Results: Fifty-six snorkel grafts were successfully placed in 28 consecutive patients (mean age, 75 years) with juxtarenal aneurysms. Mean aneurysm size was 64.8 mm (range, 53–87 mm). The snorkel configuration extended the proximal neck from an unsuitable infrarenal neck for standard EVAR (median diameter, 38.8 mm; length, 0.0 mm) to neck diameter of 24.5 mm and length of 18.0 mm. Five patients had unilateral renal snorkels, 17 had bilateral snorkels, and six had celiac/superior mesenteric artery/renal combinations. Technical success of snorkel placement was 98.2%, with loss of wire access leading to one renal stent deployment failure. Thirty-day mortality was 7.1%; one patient died 1 week postoperatively with pneumonia and died of sepsis; one patient died at 1 week of a hemispheric stroke. Other major complications included perinephric hematoma, 7.1%; permanent hemodialysis, 3.6%; and brachial plexus nerve injury, 3.6%. Cardiac complications included self-limited arrhythmias (14.5%) and one non-Q-wave myocardial infarction (3.6%), with all recovering.

Conclusions: Early experience with snorkel techniques is promising. The approach is particularly beneficial when an unsuitable infrarenal neck precludes standard EVAR. Further long-term follow-up is needed to fully assess the clinical benefits of this technique.

79 consecutive patients (2009-current)

IRB approved protocol

98% technical success

2.5% 30-day mortality

96% primary patency (mean 31 months, 3-72)

Survival 89% at one year, 83% at two years
517 patients with 898 parallel grafts
- 692 renal arteries, 156 SMAs, 50 celiacs
- 94% patency
- 5.7% type I endoleak
- 2 year survival 79%
Fenestrated/Branched EVAR

Approved July 2012

Chuter TAM. J Vasc Surg 2006;43:111A
Vascular Surgery
Complex Juxtarenal AAA 2009-current
79 snorkel, 74 ZFEN

32 Snorkel
74 ZFEN

VFEN approval
Early experience and lessons learned with fenestrated endografts compared with the snorkel/chimney technique

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Objective: Recent approval by the Food and Drug Administration of custom fenestrated endografts has increased endovascular options for patients with short-neck or juxtarenal abdominal aortic aneurysms (AAAs). We sought to compare the early learning curve at a single institution of fenestrated repair vs the snorkel technique.

Methods: From 2009 to 2013, we performed 57 consecutive snorkel procedures for juxtarenal AAAs in an Institutional Review Board-approved prospective cohort, and since the summer of 2012, we gained access to the Food and Drug Administration-approved custom fenestrated device. Patient demographics, imaging, and operative techniques were compared between the first 15 cases for each of the snorkel (sn-EVAR) and fenestrated (f-EVAR) endovascular aneurysm repair (EVAR) techniques.

Results: Patient demographics and AAA morphology on preoperative imaging were similar between the groups. Operative time tended to be similar in the 3- to 4-hour range, with more fluoroscopy time and less contrast material used in f-EVAR than in sn-EVAR (P < .05) because of differing strategies of renal premarking. Larger delivery systems for f-EVAR required a higher rate of iliac conduits (40% vs 0%). Perioperative complications, short-term renal patency rates, and evidence of acute kidney injury were similar.

Conclusions: The early experience of f-EVAR was similar to that of sn-EVAR in terms of patient demographics, case selection, and procedural characteristics. A significant portion of the learning curve for both procedures, particularly for f-EVAR, lies in the preoperative planning of fenestrations and the cannulation of branch vessels. Similar short-term postoperative outcomes between these two particular techniques indicate that both will have utility in the treatment of high-risk patients with complex anatomy. (J Vasc Surg 2014;□:1-9.)
Renal Cannulation Angles

The rate limiting step
- Time to complete the procedure
- Overall procedural success

In contrast to Sn-EVAR
Downward angulation - most challenging
Renal Cannulation Angles

**Impact of Renal Artery Angulation on Procedural Efficiency During Fenestrated and Snorkel/Chimney Endovascular Aneurysm Repair**

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**Abstract**

Purpose: To determine the impact of renal artery angulation on time to success and procedural efficiency during fenestrated and snorkel/chimney endovascular aneurysm repair. A total of 77 patients (mean age 74.2 years; 63 men) who underwent fenestrated or chimney technique from 2009 to 2013 were reviewed. Renal artery angulation was measured from the axis of the renal artery to the axis of the aortic segment at the point of cannulation. The degrees of renal artery angulation were classified as positive or negative. Aneurysm necks were divided into three groups based on the presence of fenestration: no fenestration, single fenestration, and multiple fenestration. The mean procedure time was 230 ± 91 mins. The mean time to success was 123 ± 57 mins. Positive renal artery angulation was associated with longer times to success (152 ± 67 mins) compared with negative renal artery angulation (107 ± 47 mins) (p = 0.008). Positive renal artery angulation was also associated with longer total procedures (243 ± 94 mins) compared with negative renal artery angulation (217 ± 87 mins) (p = 0.036). These results suggest that renal artery angulation may be a significant factor in the efficiency and success of endovascular aneurysm repair.
71 yo male
9.3 cm AAA

Double angle with downgoing renal

SMA at same level as R renal and very close to L renal
71 yo male
9.3 cm AAA

Double angle with downgoing renal

SMA at same level as R renal and very close to L renal
“The Kitchen Sink” for type 4 TAAA

R Renal Snorkel

Scallop for Celiac

SMA Fenestration

L Renal Periscope
ZFEN vs. SNORKEL/CHIMNEY
WHAT WOULD YOU DO?
Conclusions

• Snorkel, chimney, periscope, sandwich techniques are all here to stay
• Techniques have demonstrated acceptable outcomes and patency for juxtarenal AAAs in multiple studies
• ZFEN is on-label treatment for short-neck AAA
  – Anatomic considerations
  – Downward going renals
  – Proximity of SMA to renals
  – Limited to 3 holes in current design
• Future studies to determine snorkel/chimney in combination with ZFEN
Thank you!