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Fenestrated and Branched Stent-grafting After Previous Surgery Provides a Good Alternative to Open Redo Surgery

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Objective. *To present our experience using fenestrated and branched endoluminal grafts for Para-anastomotic aneurysms (PAA) following prior open aneurysm surgery, and after previous endovascular aneurysm repair (EVAR) complicated by proximal type I endoleak.*

Methods. *Fenestrated and/or branched EVAR was performed on eleven patients. Indications included proximal type I endoleak after EVAR and short infrarenal neck (n = 4), suprarenal aneurysm after open AAA (n = 4), distal type I endoleak after endovascular TAA (n = 1), proximal anastomotic aneurysm after open AAA (n = 1), and an aborted open AAA repair due to bleeding around a short infrarenal neck.*

Results. *The operative target vessel success rate was 100% (28/28) with aneurysm exclusion in all patients. Mean hospital stay was 6.0 days (range 2–12 days, SD 3.5 days). Thirty day mortality was 0%. All cause mortality during 18 months mean follow-up (range 5–44 months, SD 16.7 months) was 18% (2/11) with no deaths from aneurysm rupture. Cumulative visceral branch patency was 96% (27/28) at 42 months. Average renal function remained unchanged during the follow-up period.*

Conclusions. *Our report highlights the potential of fenestrated and branched technology to improve re-operative aortic surgical outcomes. The unique difficulties of increased graft on graft friction hindering placement, short working distance, and increased patient co-morbidities should be recognized.*

Keywords: Fenestrated; Branched; Juxtarenal; Suprarenal; Fenestrated endograft; Branched endograft; EVAR; Aneurysm; Abdominal aortic aneurysm; Salvage surgery; Open aneurysm repair; Open surgery.

Introduction

Long-term proximal complications following endovascular aneurysm repair (EVAR) and open infrarenal abdominal aortic aneurysm (AAA) repair has been reported in the literature to range from 2.4 to 5.2%.[1–5] These complications include true juxta-anastomotic aneurysms and pseudo-aneurysms following open repair and type I endoleaks following EVAR.[3,5,6] Left untreated, these problems carry a significant risk of rupture and thereafter little opportunity for survival.[4]

Traditional open surgical repair, the historical mainstay of treatment, is difficult. In one large series reporting on open repair of proximal anastomotic failure following open infrarenal AAA repair, renal artery re-implantation or bypass was required in 45% with significant surgical morbidity in 27%.[1] In another series of patients with para-anastomotic aneurysms (PAA), emergency repair resulted in a 24% mortality, repair after rupture in 67% mortality, and elective repair carried an 11% mortality.[7]

Endovascular repair has been proposed as an alternative in properly selected patients with PAA as a means to reduce the relatively poor results following open repair.[8–11] In one series endovascular treatment reduced mortality to 3.6% and significant morbidity to 14.2%.[12] However, the long-term durability of endografts placed within a prior surgical prosthesis has been questioned.[11] In one series, tube grafts placed for the treatment of PAA required later revision in most of the cases.[11]

Endovascular repair of type I endoleaks are common, but often the anatomic limitation that resulted in failure of the initial endograft prevents successful

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standard treatment with the placement of an endovascular cuff or a new device. A juxta-renal aortic complications following EVAR or open surgery cannot be treated with standard endovascular grafts.

Fenestrated and branched techniques have been applied to this subset of patients who have not undergone prior surgery with good technical and short-term results.[13–16] Recently, there has been a technical report utilizing fenestrated and branched techniques to increase the percentage of patients with PAAs after open surgery who could be offered an endovascular treatment option.[17] This report presents our experience using fenestrated and branched endovascular stent-grafts both for the treatment of PAA following prior aneurysm repair by open surgery, and also after previous endovascular repair complicated by type I endoleaks.

Materials, Methods, and Patients

Eleven patients who had undergone previous aneurysm surgery were enrolled in a single institution investigational device protocol database between March 2002 and September 2005. Informed consent was obtained from all patients. Indications for fenestrated or branched EVAR included unfavorable anatomy for traditional endovascular repair, a PAA with maximum diameter of $\geq$5 or 5.5 cm in women and men respectively, or a persistent type I proximal endoleak. Traditional endovascular repair, including placement of a standard endovascular cuff or additional Palmaz stent, was deemed unlikely to result in a durable solution according to a multidisciplinary patient evaluation. Imaging evaluation included thin cut (<3 mm) spiral computerized tomography angiography (CTA) with axial and coronal reconstructions to evaluate anatomy and contrast angiography when deemed necessary for additional anatomic information.

Customized stent-grafts were either fenestrated or branched and based on the Zenith system (William A. Cook Australia., Ltd., Brisbane, Australia) as described previously.[16] Three types of customizable options were utilized: scallops, small fenestrations (6 mm in diameter), and branch sites (pre-made or a fenestration with a stent-graft inserted). Radio-opaque markers identified fenestrations and branch sites to enable accurate alignment. Anterior and posterior markers facilitated rotational orientation during insertion and deployment. Grafts were fitted with diameter reducing ties that allowed for only partial deployment (in terms of diameter) prior to catheterization of side vessels which allowed for small changes in orientation (and positioning) to facilitate proper placement.

Fenestrated and/or branched EVAR proceeded in the operating theatre under general, epidural, or local anesthesia based upon surgeon, anesthesiologist, and patient preference. Patients were pre-hydrated with intravenous solution prior to the procedure and urine output was monitored. Imaging was performed using a mobile C-arm (OEC 9800, General Electric Medical Systems, Salt Lake City, UT, USA). The technique for endograft deployment has been previously described.[13,15] Briefly, the stent-graft was positioned, then deployed but still constrained by the diameter reducing ties, catheterization of the visceral vessels performed, the reducing ties removed, the top cap opened followed by deployment of stents or grafts inside the target vessels. Completion angiography was then performed.

Post-operative evaluation consisted of clinical and laboratory assessment at discharge, 1 month, 6 months, 12 months, and annually thereafter. Helical CTA, duplex evaluation, and abdominal X-rays were performed at 1 month, 6 months, 12 months, and annually thereafter. Contrast angiography was performed for suspected type I endoleak and/or visceral vessel impairment with any required secondary intervention performed at the time of angiography.

Results

The patients included in the study all presented with co-morbidities which placed them at high risk for an open repair. Nine out of the eleven patients were classified as ASA Class III or IV. Indications for fenestrated or branched EVAR procedures included proximal type I endoleak after prior EVAR with a short infrarenal neck (fenestrated, $n=4$) (Fig. 1), suprarenal aneurysm extension after open infrarenal AAA repair (branched, $n=4$) (Fig. 2), a distal type I endoleak after prior endovascular TAA repair and less than 10 mm between the distal endograft and the coeliac axis (fenestrated, $n=1$) (Fig. 3), a proximal anastomotic aneurysm after previous open AAA repair (fenestrated, $n=1$), and finally one patient who had his open repair aborted due to inflammation and bleeding around a short infrarenal neck (fenestrated, $n=1$).

Eleven patients (9 men, 2 women) were treated from March 2002 until September 2005 at a single academic institution with expertise in fenestrated and branched procedures (Table 1).

Operative results

Endovascular access was obtained via the common femoral arteries. One patient underwent a planned