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F-EVAR does not Impair Renal Function more than Open Surgery for Juxtarenal Aortic Aneurysms: Single Centre Results

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WHAT THIS PAPER ADDS

This manuscript demonstrates single centre short and intermediate term results of comparison of open (OSR) versus fenestrated endovascular (F-EVAR) repair for juxtarenal aortic aneurysms, especially with regard to the renal function. For the first time the outcome after both procedures is compared using Cook Zenith and Vascutek Anaconda fenestrated stent grafts in the F-EVAR group.

Objective: To compare the results of elective open surgical repair (OSR) and total endovascular repair of juxtarenal aortic aneurysms (JAA), with either the Cook Zenith or the Vascutek Anaconda fenestrated stent grafts (F-EVAR) in a university hospital setting.

Patients and methods: Between April 1999 and July 2014, of 926 patients with an abdominal aortic aneurysm, 69 were juxtarenal, where 34 had an elective OSR and 35 had F-EVAR. A post-operative rise of baseline creatinine by >50% and/or deterioration of estimated glomerular filtration rate by 25% were defined as renal failure.

Results: The demographics of the patients were similar except for heart insufficiency, peripheral arterial disease, and pre-existing renal artery stenosis ($p < .05$). Median aneurysm diameters were 57 mm (range 50–80 mm) and 56 mm (range 36–64 mm) ($p = .194$), respectively, and the median pre-operative serum creatinine levels were 94 μmol/L (range 65–286 μmol/L) and 96 μmol/L (range 57–333 μmol/L) ($p = .871$) with median estimated glomerular filtration rate of 68 mL/min (range 21–117 mL/min) and 70 mL/min (range 18–114 mL/min) ($p = .308$) in the open and endovascular groups, respectively. The technical success (OSR versus F-EVAR) was 100% versus 94.3% with complete exclusion of the aneurysms in all cases. Median procedure time was 171 versus 188 min. During median in hospital stay of 11 versus 7 days ($p = .05$), mortality was 0 versus 2.9% and new onset of post-operative renal insufficiency was detected in 26.5% versus 8.5% patients ($p = .05$), although with 11.8% versus 5.7% being persistent ($p = .428$). During follow up, statistically similar new (late or persistent post-operative) renal insufficiency was detected in 14.7% versus 8.8% with dialysis in 3% of patients in each group with similar mortality within the 24 months.

Conclusions: This retrospective analysis demonstrates that OSR might be combined with more acute post-operative renal impairment than F-EVAR for JAA, but with similar intermediate term procedure related mortality and renal outcomes.

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INTRODUCTION

Open surgical repair (OSR) of juxtarenal aortic aneurysms (JAA) is challenging because of suprarenal, supra-superior mesenteric artery (SMA) and even supraceliac aortic cross clamping (CC), with temporary interruption of flow through the visceral arteries, which may cause hepatic and/or mesenteric ischemia as well as renal dysfunction leading to haemodialysis.

The cornerstone of standard endovascular aneurysm repair (EVAR) is the requirement of a sufficient proximal landing zone below the renals for adequate and durable sealing.[1] Therefore, a more proximal landing zone is required in cases of JAA. Thus, application of custom made fenestrated endografts (F-EVAR) is needed, to preserve essential visceral arteries. First introduced in 1996 by Park and colleagues,[2] F-EVAR demonstrated encouraging results with high technical success for thoraco-abdominal aortic aneurysms.[3] According to a recent literature review, the 30 day mortality rates after F-EVAR are about 2.1% after

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pararenal aortic aneurysm repair,[4] demonstrating similar results compared with open surgery with a mortality of about 2.9% during JAA repair.[5] On the other hand, Raux and colleagues reported in a recent retrospective study that F-EVAR was associated with a higher risk of 30 day perioperative mortality and morbidity compared with OSR for management of complex AAA.[6]

In addition to the FDA/CE-approved Zenith custom made fenestrated device (CMD) (ZFEN) (Cook Incorporated, Bloomington, IN, USA), another CMD has recently become available (Anaconda, Vascutek, Inchinnan, UK) with initially promising results.[7,8]

The objective of the current study is to present the single centre results of elective JAA treatment, comparing OSR with F-EVAR with either Zenith or Anaconda fenestrated stent grafts in a series of patients who were unsuitable for conventional EVAR.

PATIENTS AND METHODS

Prospectively collected data of patients undergoing elective OSR or F-EVAR of JAA between April 1999 and July 2014 were analysed retrospectively. All symptomatic, mycotic, inflammatory, and ruptured aneurysms were excluded. The definition of JAA was based on the short necked AAA, if the CC was needed above one or both renal arteries in the OSR group. The choice for F-EVAR was based on a short infrarenal aneurysm neck of $\leq$10 mm.

Pre-operative imaging was performed using contrast enhanced computed tomography (CTA) with $\leq$1.5 mm slices from the neck to the groins. All patients underwent echocardiography, lung function spirometry, or coronary angiogram when necessary. Individual risk factors and comorbidities included arterial hypertension (patients taking one or more antihypertensive medications), history of myocardial infarction, coronary heart disease (current angina and/or history of previous coronary interventions such as angioplasty or coronary artery bypass graft), chronic obstructive pulmonary disease, peripheral arterial disease (history of previous interventions such as angioplasty or bypass-surgery; current Fontaine stages I-IV and/or reduction of ankle brachial index $<$0.8), diabetes mellitus, heart insufficiency (limitations of activity according to New York Heart Association (NYHA) functional classification and/or reduction of ejection fraction $<$30%), and renal insufficiency (current creatinine level $>$141 µmol/L with or without the need of dialysis).

The patients were offered either OSR or F-EVAR and made their choice after they were informed about the risks and had completed a written consent form for the selected procedure. Early in the series, renal artery stenosis was an exclusion criterion for patients in the F-EVAR group because of expected difficulties with cannulation; however, this is no longer considered to be a contraindication. Each patient was pre-operatively classified according to American Society of Anesthesiologists (ASA) classification,[9] and underwent risk evaluation according to European System for Cardiac Operative Risk Evaluation (EuroSCORE) guidelines.[10] Risk factors and comorbidities, and their distributions in the two groups are given in Table 1.

Stent grafts

The Cook Zenith CMD (Fig. 1) consists of a polyester graft and a Gianturco Z-stent support skeleton. The graft is partially constrained by diameter reducing ties, which provide the option of partial repositioning of the stent graft. The Vascutek Anaconda CMD (Fig. 2) has a nitinol ring-stent design. The main body is fully repositionable even after complete unsheathing of the device and the magnet assisted system provides cannulation of the contralateral gate of the body. Prior to the procedures, an anatomical model of the aorta was used for prototype implantation of grafts.

Procedures

OSR. All operations were performed under general anaesthesia with the patient in a supine position by either J.B. or M.G. Either a transperitoneal midline or retroperitoneal incision was selected. To mobilize the left renal vein, ligation of the lumbar-renal, adrenal, and gonadal veins was performed. When indicated, renal and visceral arteries were isolated individually and clamped followed by aortic CC.

The distal clamps were placed either on the iliacs or the common femoral arteries (CFA). Depending on the anatomy, either a tube or bifurcated Dacron graft was chosen. The proximal anastomosis was made using an end to end technique. The distal anastomosis was sutured either end to end intra-abdominally or end to side to the femorals.

Mannitol (12.5 25 g) and 10 mg furosemide as well as 70—100 U/kg of heparin were given prior to CC. Renal ischemia was defined as the time from aortic CC until the last renal artery was re-perfused.

F-EVAR. All procedures were performed under general anaesthesia in the hybrid operating room with a ceiling mounted angiographic C-arm system by the same surgeons (J.B./M.G.). Initially, the Zenith stent graft was implanted because it was the only commercially available product. When the Anaconda stent graft became available it was also used, with good results and offering the possibility of repositioning and good clarity of the orifices of the fenestrations. After that, the decision on which stent graft was implanted was made by the main surgeon (J.B./M.G.). After 70—100 U/kg of heparin were administered, the CFAs were punctured and cannulated either percutaneously or by open femoral access, depending on the surgeon's preference and patient's habitus. After the main body was inserted and the fenestrations were cannulated and stented through a 20F sheath from below, the Advanta V12 stent grafts (Atrium, Hudson, NH, USA) were flared in the proximal third by a 10 mm balloon to give a safe seal. The iliac extensions were placed in a standard fashion. For patients with aorto-iliac aneurysm (AIAA) and a distal landing zone in the external iliac artery (EIA), the body of the Cook Zenith iliac side-branched graft (ISBG) (Cook Inc., Bloomington, IN, USA) was placed in the CIA and EIA prior to the bridging and contralateral iliac leg as previously described.[11] A