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Comparison of outcomes for double fenestrated endovascular aneurysm repair versus triple or quadruple fenestrated endovascular aneurysm repair in the treatment of complex abdominal aortic aneurysms

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ABSTRACT

Objective: This study compared outcomes of standard fenestrated endovascular aneurysm repair (St-FEVAR) with renal artery fenestrations only with more complex FEVAR (Co-FEVAR) with additional fenestrations for the superior mesenteric artery or the celiac trunk, or both.

Methods: All consecutive patients treated with FEVAR for short-necked, juxtarenal, or suprarenal aortic aneurysms between January 2010 and July 2016 were included. Patients with stent grafts with a combination of fenestrations and branches were excluded. Data were collected prospectively. All stent grafts used were customized based on the Zenith system (William A. Cook Australia, Ltd, Brisbane, Queensland, Australia).

Results: A total of 384 patients (345 men; mean age, 72.7 ± 7.8 years) were treated. St-FEVAR was used in 199 patients (51.8%) and Co-FEVAR in 185 (48.2%), including 30 patients with a quadruple FEVAR. Overall technical success was 373 of 384 (97.1%), and the difference between the St-FEVAR group (195 of 199 [98%]) and the Co-FEVAR group (178 of 185 [96.2%]) was not statistically significant ($P = .37$). Mean operative time was 135 ± 46 minutes for St-FEVAR and 176 ± 53 minutes for Co-FEVAR ($P < .001$). Mean fluoroscopy time was 45 ± 17 minutes for St-FEVAR and 57 ± 21 minutes for Co-FEVAR ($P < .001$). Overall 30-day mortality was two of 384 (0.5%), and the difference between the two groups was not statistically significant (St-FEVAR: 1 of 199 [0.5%] vs Co-FEVAR: 1 of 185 [0.5%]; $P = 1.0$). Major perioperative complications between St-FEVAR group (22 of 199 [11.1%]) and Co-FEVAR group (24 of 185 [13%]) were similar ($P = .64$). Mean follow-up was 20 ± 17.1 months. Estimated survival at 1 and 3 years was 95% ± 1.7% and 83.4% ± 3.6% for St-FEVAR vs 94% ± 2.4% and 89.4% ± 3.5%, respectively, for Co-FEVAR ($P = .96$). Estimated freedom from reintervention at 1 and 3 years was 97.9% ± 1.2% and 90.5% ± 3.1% for St-FEVAR vs 95.4% ± 2.0% and 89.1% ± 4.2%, respectively, for Co-FEVAR ($P = .5$). Estimated target vessel patency at 1 and 3 years was 99.2% ± 0.4% and 98.6.0% ± 0.6% for St-FEVAR vs 98.6% ± 0.6% and 97.9% ± 0.9%, respectively, for Co-FEVAR ($P = .48$).

Conclusions: Co-FEVAR is not associated with an increase in perioperative mortality and morbidity compared with St-FEVAR. Co-FEVAR requires longer procedure and fluoroscopy duration, but technical success rates are as high as in St-FEVAR. A liberal use of Co-FEVAR is therefore justified whenever a longer and higher proximal sealing zone is needed. (J Vasc Surg 2017;■:1-8.)

Fenestrated endovascular abdominal aortic aneurysm (AAA) repair (FEVAR) is being increasingly applied for the treatment of anatomically suitable short-necked, juxtarenal, and suprarenal aortic aneurysms. High-volume centers have reported excellent perioperative and midterm outcomes.[1-4]

Stent graft configuration with regard to the number of fenestrations depends on the desired proximal landing zone. Standard FEVAR (St-FEVAR), usually fitting two fenestrations for the renal arteries and a scallop for the superior mesenteric artery (SMA), was the configuration first used in the treatment of short-necked and some juxtarenal AAAs. FEVAR for more complex anatomy (Co-FEVAR), with extension of disease at the level of renal arteries or higher and a stent graft design fitting three or four fenestrations for the renal arteries, the SMA, and the celiac trunk, became later available to achieve adequate proximal sealing.

Co-FEVAR could have potential advantages for the durability of the repair because it lands higher in the aorta and lengthens the proximal sealing zone. Obviously, Co-FEVAR requires more complex stent graft planning

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and represents a more complex procedure. It also adds to the imaging requirements, because lateral viewing is needed for catheterization and stenting of the visceral arteries. The complexity may result in higher perioperative mortality and morbidity as a result of the longer operative time, prolonged catheter and wire manipulations, increased blood loss, increased contrast use, and increased coverage of segmental arteries and associated spinal cord ischemia (SCI).[5]

The present study investigated whether stent graft design complexity affects perioperative outcomes of FEVAR in a high-volume endovascular center.

METHODS

The study included all consecutive patients treated with FEVAR for short-necked, juxtarenal, or suprarenal aortic aneurysm under the guidance of the senior author (E.L.G.V.) between January 2010 and July 2016. FEVAR as a technique was approved by the Paracelsus Medical University Ethical Committee. Patient informed consent was not required for this study.

Patient data were analysed in two groups by the complexity of the stent graft configuration. The St-FEVAR group consisted of patients who had renal artery fenestrations only, with a most common configuration of two fenestrations for the renal arteries and a scallop for the SMA. The Co-FEVAR group consisted of patients with more complex stent graft design with additional fenestrations for the SMA or the celiac trunk, or both.

The analysis did not exclude patients with previous failed EVAR or open abdominal aortic surgery. Patients with type IV thoracic AAAs treated with fenestrated and branched techniques have been reported elsewhere and were excluded from the present report.[6] Data were collected in a prospectively maintained database.

Aneurysm morphology was assessed by thin-cut (≤1.5 mm) spiral computed tomography angiography (CTA) with axial and coronal/sagittal reconstructions. The main indication for FEVAR included absent or too short proximal neck for standard EVAR in an AAA of ≥50 mm in diameter. AAAs <50 mm with a coexistent iliac aneurysm ≥35 mm were also treated. The physical status of patients was assessed preoperatively with the American Society of Anesthesiologists (ASA) Physical Status Classification score.

Stent grafts. Stent grafts were customized based on the Zenith system (William A. Cook Australia, Ltd, Brisbane, Queensland, Australia) fitting fenestrations and scallops for the visceral vessels according to preoperative CTA measurements.[7,8] Most commonly a composite three-part system was used, consisting of a proximal fenestrated tube, a distal bifurcated component, and a contralateral limb. In selected cases of limited working length distally (eg, previous bifurcated surgical graft or EVAR), a fenestrated cuff only was used.

Procedure. All procedures were performed in an angiography suite or a hybrid operating room with a fixed imaging system. All stent grafts were implanted under general anesthesia.

Patients were usually admitted one day before the procedure, unless prehydration or cardiac evaluation was considered necessary.

Surgical access was performed with a bilateral femoral cutdown. Double purse string sutures of 4-0 Prolene (Ethicon, Somerville, NJ) fitted with a snugger were used to allow removal of the delivery system of the proximal body completely while the target vessels were stented from the contralateral side. This helped restore blood flow to the ipsilateral limb as early as possible. Only a stiff guidewire was kept in position to secure safe introduction of the bifurcated graft later. The stent graft deployment technique for fenestrated stent grafts has been previously described in detail.[8,9]

Postoperative management. Patients were monitored postoperatively with clinical and laboratory examinations, including abdominal X-ray imaging in four standardized anteroposterior and oblique views, as reference before discharge. CTA controls were performed at 1 month, 1 year, and thereafter, depending on each patient's characteristics after discussion in the group aiming to reduce the burden of CTAs. Upon suspicion of endoleak or branch vessel malperfusion, additional duplex subtraction angiography for further evaluation and possible reintervention was performed.

Definitions and data analysis. Technical success was defined as successful deployment of the planned stent grafts with patent target vessels and absence of type I or III endoleak at the first postoperative CTA. Initial clinical success was defined as successful deployment of the stent grafts at the intended location without death as a result of aneurysm-related treatment, type I or III endoleak, graft infection or thrombosis, aneurysm rupture, or conversion to open repair ≤30 days.[10]

SCI was defined as any new neurologic deficit at the lower limbs not attributable to another pathologic change. Paraplegia was defined as complete inability to move the lower limbs.[11] Perioperative renal function deterioration was defined as a rise of serum creatinine of >30% from preoperative levels.

Data were analyzed using SPSS 22 software (IBM Corp, Armonk, NY). Variables are presented as mean ± standard deviation. The χ^2 test was applied for categoric variables. One-way analysis of variance was used for continuous data. Statistical significance was set at $P < .05$. Outcomes compared between the St-FEVAR and Co-FEVAR groups included technical success, operative time, estimated blood loss, fluoroscopy time,