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SHORT REPORT

Physician Modified Low Profile Endograft for Endovascular Repair of Juxtarenal Abdominal Aortic Aneurysms in Patients with Small Access Vessels

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WHAT THIS PAPER ADDS

Branched or fenestrated aortic stent grafts allow endovascular repair of juxtarenal abdominal aortic aneurysm in patients at high risk for open repair; however, they are expensive, 18—20 F in diameter depending on endograft diameter, not widely available in most countries, and require three to four weeks in urgent cases and up to six to eight weeks for graft customisation. Physician modification and implantation of a standard 14F stent graft with a 16F sheath is described for endovascular repair of juxtarenal aneurysms in patients with small access vessels.

Introduction: Urgent or emergency treatment of patients with abdominal aortic aneurysms that are anatomically unsuitable for conventional repair because of short proximal necks, small diameters and access vessel calcification, and high risk for open repair can be performed with commercially available branched or fenestrated aortic endografts or physician modified stent grafts.
Report: A technique is described for modification and successful implantation of a commercially available standard aortic stent graft with a low profile main body in two patients at high risk for open repair, with small access vessels and requiring uni- or bilateral renal artery fenestration for juxtarenal aneurysm repair.
Discussion: Based on two case experiences, the use of physician modified off the shelf endografts appears to be a feasible and effective alternative to fenestrated endovascular repair in patients with juxtarenal abdominal aortic aneurysms at high risk for open surgical repair. Studies comparing effectiveness of the different options, including chimney/snorkel technique and debranching, are warranted.

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INTRODUCTION

If fenestrated endovascular repair (FEVAR) and open surgical repair are not feasible as first choice treatments for juxtarenal abdominal aortic aneurysm (AAA) because of procedural or clinical outcome considerations,[1,2] options include debranching of the visceral aorta with subsequent aortic stent grafting and "snorkel" or "chimney" techniques that have been associated with lower morbidity and mortality.[3] However, broader use of branched or fenestrated aortic endografts is limited by cost, availability, endograft diameter, and time required for graft customisation. Another option is physician modification of commercially available standard stent grafts and reconstrained stent graft after deployment and repositionable platform.[4,5] Two cases are described in which physician modified endovascular aneurysm repair using low profile (14F), a 16F sheath, and partial deployment of a commercially available stent graft allowed treatment of patients with a small access and juxtarenal AAA.

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REPORT

Two patients were treated. First, a 71 year old man who had a 6.7 cm juxtarenal AAA arising 4 mm below the lower edge of the left renal artery (LRA). He had severe chronic obstructive pulmonary disease and coronary artery disease with myocardial revascularisation 10 years ago without follow up. The echocardiogram showed an ejection fraction of 30%, dilated cardiomyopathy, and atrial fibrillation using an oral anticoagulant which rendered open repair high risk. The patient had persistent and important bleeding from a prostatic lesion with haemodynamic symptoms needing transfusion, despite best medical treatment and continuous irrigation using a triple lumen urinary catheter. He needed radical prostatectomy surgery to remove the cancer and stop the persistent bleeding. The aortic diameter was 25 mm at the level of the upper renal artery (right) and 28 mm at the level of lower renal artery (left). The distance from the bottom of the right renal artery (RRA) to the top of the AAA was about 2 cm. The distance from the LRA to top of the AAA was 4 mm. There is no thrombus or calcification between the RRA and the beginning of the AAA. The second patient was a 71 year old woman who had contained rupture and a symptomatic 7.9 cm juxtarenal AAA and was high risk for open repair because of her age, diabetes, and coronary artery disease, with two coronary angioplasties in the last two years and severe aortic valve stenosis with an area of 0.9 mm^3 and a gradient of 49 mmHg. Both renal arteries had their origins at same level, very close to the beginning of the AAA. The diameter of the aorta was 20 mm at level of the renal arteries. The distance from the lower edge of the superior mesenteric artery (SMA) to the top of the AAA was about 17 mm without thrombus or calcification.

Both patients had a <6 mm diameter access of both external iliac arteries. Because of the non-availability of a commercial fenestrated endograft at the institution, the risks and benefits of open and endovascular aneurysm repair with a physician modified stent graft were discussed with the patients, who consented to the latter on a compassionate use basis[6] (Table 1).

Endograft modification

A 30 mm diameter Incraft was chosen for the first patient, oversized about 5%—15%, 20 mm long, and 25—28.2 mm neck diameter. For the second patient a 26 mm diameter Incraft oversized about 20% to 30%, 17 mm long, and 20 mm neck diameter was chosen.

Under strict sterile conditions on a back table, the Incraft (Cordis Corporation, FL) aortic endograft was partially unsheathed, and the first and second covered rings were partially opened, leaving the main body partially closed. The “free flow stent” was constrained by the release wire. The locations for the fenestrations were pre-marked on the body of the stent graft using the measurements obtained from centreline analysis on computed tomography angiography (CTA), in which the distance to the visceral branches from the superior extent of the landing zone and size of the branch orifices were identified using axial images and clockface orientation. These modifications allowed a proximal landing zone of 20 mm for the first patient and 17 mm for second patient.

The fenestrations were made with a no. 11 blade; enlarged with a 6 mm diameter balloon (which helps make them perfectly round); sutured circumferentially with 0.014″ PT[2] wire (Boston Scientific, MA) using 6-0 Prolene for reinforcement and to make them visible under fluoroscopy; and pre-cannulated with 0.018″ hydrophilic wires (one and two, respectively, for male and female cases) to the main body and pulled out from the proximal stent of the main body separately. The stent graft was partially reloaded retrogradely into the sheath (Table 2).

Endograft implantation

The main body was introduced by the largest femoral access, and the contralateral limb was placed by the contralateral femoral access. A 16F DrySeal (W.L. Gore and Associates, AZ) sheath was introduced. No pre-dilation was needed probably because the largest diameters of the external iliac arteries in the patients were 5.95 and 5.93 mm, very close to the 6.1 mm diameter of the DrysealFlex. The reconstrained main body was then introduced through the femoral sheath.

The top of the covered part of main body was positioned right below the RRA in the first patient, and just inferior to

Table 2. Steps for physician modification of Cordis Incraft low profile endograft system

1. Pre-operative planning using 3D CTA reconstruction and centreline analysis
2. Endograft is partially deployed
3. Fenestrations are made by blade incising the fabric, ballooned and reinforced by circumferentially suturing a cut 0.014″ wire
4. Fenestrations are pre-cannulated with 0.035″ wires through the fenestrations
5. Endograft is partially reloaded and slid inside 16F sheath into the aortic lumen as fr as the renal arteries

CTA = computed tomographic angiography.

Table 1. Measurements of aneurysms

	AAA diameter — cm	Aortic diameter at level of renal artery — mm	Distance from lower edge right renal artery to beginning of AAA — mm	Distance from lower edge of left renal artery to beginning of AAA — mm	Distance lowest renal to aortic bifurcation — cm	Diameter of right external iliac artery — mm	Diameter of left external iliac artery — mm
Patient 1	6.7	28.2	21.6	4	10.66	5.93	5.22
Patient 2	7.9	20.3	0.0	1	10.98	5.39	5.95

AAA = abdominal aortic aneurysm.

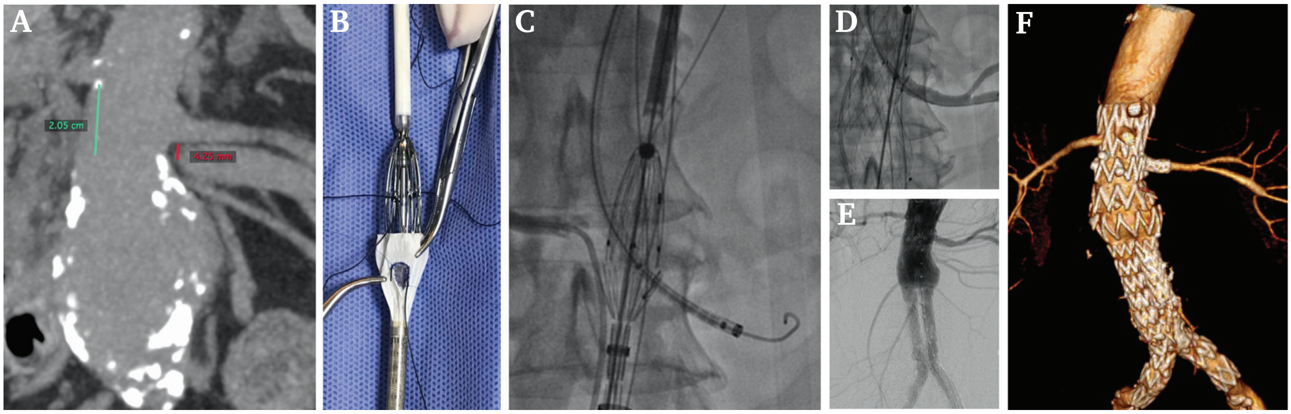

Figure 1. Patient 1. (A) Angiotomography showing morphology and anatomical characteristics of juxtarenal abdominal aortic aneurysm. (B) Modified Incraft making a fenestration to the left renal artery, reinforced mark suture, using the tip of a 0.014″ wire and 6-0 Prolene. (C) Modified Incraft partially deployed, bridge stent graft positioned into the left renal artery through the fenestration, CB1 catheter at right renal artery. (D) Selective renal angiography after Incraft/stent graft deployment. (E) Final angiogram. (F) Angiotomography/3D reconstruction: detail of fenestration to left renal artery.

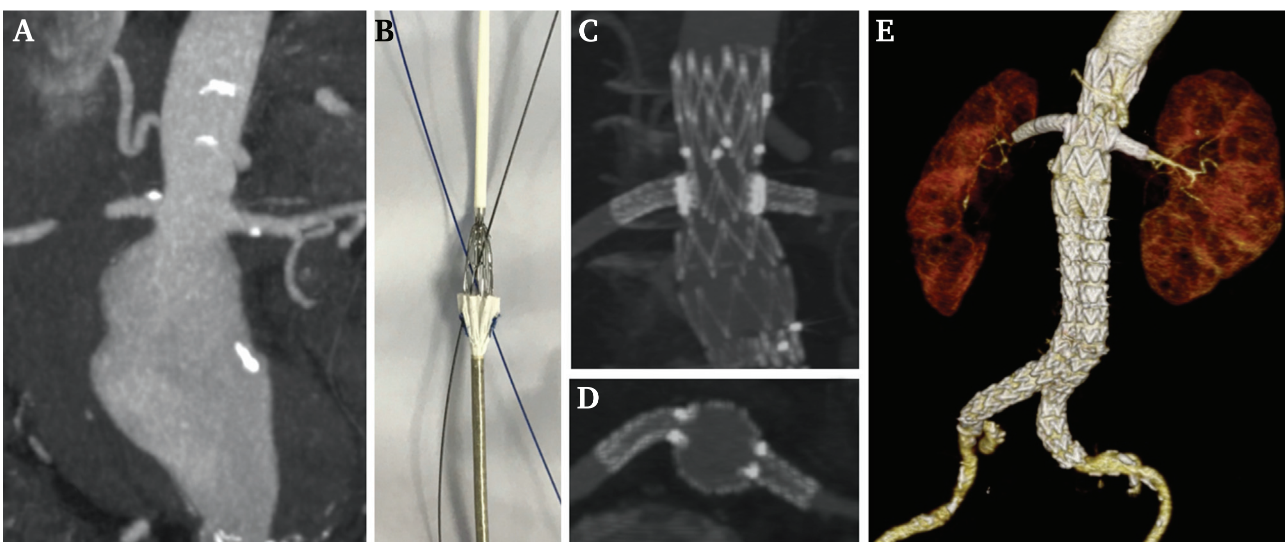

Figure 2. Patient 2. (A) Angiotomography showing morphology and anatomical characteristics of juxtarenal abdominal aortic aneurysm. (B) Steps of Incraft modification. Two pre-loaded wires through to two fenestrations. (C, D, E) Angiotomography/3D reconstruction: follow up after 12 months.

the SMA according to the lateral aortogram. Via brachial access (single on first and bilateral on second case), the pre-cannulated wires were captured separately using a snare at the thoracic aorta. A 7F Ansel Flexor (Cook Medical Inc., Bloomington, IN) slide on a through and through system was used for crossing inside the top edge of the partially released proximal stent without any trouble and selectively cannulating one/both renal arteries. After angiographic confirmation, the wires were exchanged for Rosen wires (Cook Medical Inc., IN). After accessing both renal arteries, the aortic endograft was deployed and the proximal seal zone fully expanded with a Coda balloon (Cook - W. L. Gore & Associates, Inc). The iCast covered stents (Atrium Medical, NH) were deployed into left renal (male case)/both renal arteries (female case) and flared proximally with a 12 mm angioplasty balloon. The contralateral gate was then cannulated, and the contralateral limb was deployed in the standard fashion.

Procedural outcomes

The completion angiogram and intra-operative 3D computed tomography and follow up CTA 12 months after the procedure (Figs. 1 and 2) demonstrated SMA patency, both renal arteries, and no evidence of endoleak. No re-interventions, occlusions, or ischaemia were detected. Follow up of two subsequent cases performed without the use of pre-cannulated wires is near completion.

DISCUSSION

Because customised endografts are not suitable for patients who need urgent or emergency juxtarenal aneurysm repair, different techniques can be applied, including parallel grafts, and branched[7,8] or physician modified endografts.[9,10] An off label use of a physician fenestrated Incraft stent graft appears to be a viable alternative for patients with small access vessels, at high risk for open repair, and in urgent or emergency cases. The technique (summarised in Table 2) might allow the limitations of branched or fenestrated aortic endografts, such as cost, availability, endograft diameter, and time required for graft customisation to be overcome. Larger studies the comparing use of physician modified off the shelf endografts with chimney/Storkey techniques and debranching for repair of juxtarenal aneurysms in patients with small access vessels is warranted.

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