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Short reports

Transfemoral endoluminal repair of abdominal aortic aneurysm with bifurcated graft

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Traditional open repair of abdominal aortic aneurysm has disadvantages. We present our experience of transfemoral endoluminal repair with a bifurcated graft system. 29 patients with aortic aneurysm over 5·5 cm in diameter and 1 with a 3·2 cm aneurysm and bilateral iliac stenosis were assessed; 5 were suitable for the procedure. The operation was successful in all the patients, without haemodynamic compromise or major complications. This technique has the potential to reduce morbidity and mortality from abdominal aortic aneurysm. Further modifications are required to make it applicable to most aneurysms.

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Endoluminal repair of abdominal aortic aneurysm is a new technique for transfemoral graft placement and aneurysm exclusion. This minimally invasive approach avoids laparotomy, retroperitoneal dissection, and clamping of the aorta required for open repair. Instead of being sutured to the aorta, the graft is secured by self-expanding metal stents deployed under angiographic control. We report use of a bifurcated endoluminal graft for abdominal aortic aneurysm.

29 consecutive patients with abdominal aortic aneurysm greater than 5·5 cm in diameter and 1 with a 3·2 cm aneurysm and bilateral iliac stenosis were assessed with ultrasound, contrast-enhanced computed tomography, and transfemoral aortogram. Measurements included the distance from the lowest renal artery to the neck of aneurysm and to the aortic bifurcation, distance from aortic to iliac bifurcation, diameter of aneurysm neck, and system we used is suitable for an aneurysm neck up to 2·5 cm in diameter with a minimum neck length of 1·5 cm. The right iliac artery has to be straight and open to allow passage of the delivery system and the maximum diameter of the iliac limb of the graft cannot exceed 1·5 cm. None of our patients had a non-aneurysmal segment of aorta between the aneurysm and aortic bifurcation to allow deployment of a straight graft and only 5 (17%) patents were found suitable for the bifurcated system. The major reasons for unsuitability were short neck (8), wide neck (7), iliac aneurysms (6), and wide (2) and too tortuous (2) an iliac artery.

Modified Gianturco-z-stents (Cook) were used to secure the top end of the soft-dacron bifurcated graft (Meadox) in the non-aneurysmal infrarenal aorta and the bottom end of the two limbs into the common iliac artery. Siremobil 2000 (Siemens) C-arm was used for angiographic imaging. The procedure was under general anaesthesia in the operating theatre. Both the common femoral arteries were exposed and 10 000 U heparin was administered in an intravenous bolus before arteriotomy. A transfemoral catheter was introduced from the left femoral artery and passed over the aortic bifurcation and pulled out of the right common femoral arteriotomy with a stone-retrieval basket. The delivery system (an inner shaft and an outer sheath containing the graft and stent) was introduced through the right common femoral arteriotomy. Care was required in deployment of the top stent between the renal artery and the aneurysm, by withdrawing the outer sheath with the inner shaft stabilised in the correct position by angiographic screening. Complete withdrawal of the outer sheath exposed the catheter between the left limb of the graft and the inner shaft at the right femoral arteriotomy. This catheter was disconnected from the inner shaft and sutured to the transfemoral catheter. The left graft limb was guided into the left iliac artery as the transfemoral catheter was withdrawn from the left femoral arteriotomy. After the deployment of both limbs of the grafts, Wallstents (Schneider) were used for additional support.

Bifurcated aorto-iliac grafts were successfully inserted in all patients (table). All remained haemodynamically stable during operation. 2 patients required extraperitoneal exposure of the common iliac on one side to assist accurate deployment of the bottom stent. All resumed normal diet within 24 hours of the procedure and were mobile within 48 hours. All remained well at 1–4 months' follow-up. In 1 patient the left limb of the graft occluded at 3 months and was successfully treated by a femoro-femoral bypass graft.

The incidence of abdominal aortic aneurysm has increased over the past three decades.[1] Nearly 2·3% of men

Patient	Maximum aneurysm diameter (cm)	Neck length (cm)	Neck diameter (cm)	Duration of procedure (min)
1 (67/M)	6 0	3 0	2 5	120
2 (55/M)	6 2	2 0	2 3	105
3 (78/M)	5 7	5 0	2 2	190
4 (63/M)*	3 2	4 5	1 8	300
5 (67/M)	7 0	2 0	2 3	100

*Symptomatic bilateral ostial iliac stenotic disease with coexisting small aneurysm.

Table: **Patients' details**

aneurysm greater than 4 cm in diameter.[2] The overall mortality rate of patients in the community with rupture of an aortic aneurysm is 85–95%.[3] Although screening is being used to detect symptom-less aneurysms before they rupture, most surgeons operate only on aneurysms over 5·5 cm in diameter; the management of smaller aneurysms remains controversial.[4] The reluctance to operate on smaller aneurysm is mainly due to the high risk of postoperative morbidity and mortality. Patients with aortic aneurysm often have generalised arterial disease and angiography shows a 47–65% frequency of coronary artery disease.[5] During open repair, infrarenal abdominal aortic cross-clamping increases systemic vascular resistance by about 40% and decreases stroke volume and cardiac output by 15–35%, with renal hypoperfusion and subsequent hypotension during declamping.[6] Less invasive techniques with lower morbidity and mortality would therefore be of value; transfemoral endovascular aneurysm repair is thus an important development.

Parodi et al[7] reported the successful use of endoluminal transfemoral repair with non-bifurcated grafts in patients with abdominal aortic aneurysm. A limitation of their technique is that deployment of a straight aorto-aortic graft requires a segment of non-aneurysmal aorta above and below the aneurysm. Most substantial aneurysms do not have such a segment because the aneurysm usually extends to the aortic bifurcation. None of our patients was suitable for a straight graft. A bifurcated graft can be used in such a situation because the limbs of the graft are deployed in the unaffected common iliac arteries. The endoluminal placement of bifurcated graft used in this study has been developed by Chuter[8] and its successful clinical use has been reported.[9]

Endoluminal aortic aneurysm repair takes no longer than traditional open repair and experience may shorten the procedure. Patients do not require postoperative management in the intensive-care unit. Shorter hospital stay and early resumption of normal activities add to the potential economic benefit. Transfemoral endoluminal aneurysm repair with a bifurcated graft could reduce morbidity and mortality from surgery for abdominal aortic aneurysm and allow treatment of patients who would not tolerate the open procedure.

However, only limited follow-up is available on our patients and it remains to be seen whether this technique can prevent rupture of the aneurysm. Further refinement involving development of thinner grafts is in progress to allow packing of wider grafts into the sheath, to enable inclusion of patients with aneurysm neck over 2·5 cm in diameter. Also, with further experience, it may be possible to deploy the top stent in necks under 1·5 cm in length. With these two improvements, it would be possible to treat most patients.

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Smoking and growth rate of small abdominal aortic aneurysms

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Smoking is an important risk factor for abdominal aortic aneurysm. Limiting the growth rate of small aneurysms has the potential to prevent them reaching a size at which surgical repair is considered. In 43 patients, with small aneurysms, growth rates were studied by serial ultrasound over 3 years. The median expansion rate of these small aneurysms was 0·13 cm per year. Growth rates were higher in those who continued to smoke (0·16 *vs* 0·09 cm per year in those who no longer smoked, p=0·038). Higher growth rates were significantly correlated with the concentration of serum cotinine. Stopping smoking could reduce the growth rate of small abdominal aortic aneurysms.

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Abdominal aortic aneurysm is common in the elderly. Rupture may be the first sign, and that disaster carries a fatality rate of over 90%.[1] Many die before admission and of those who undergo emergency repair, mortality is over 40%.[2] Ultrasound screening has been advocated to allow elective repair before rupture.[3] It would be better to prevent small aneurysms enlarging to a dangerous size. Most aneurysms detected by screening are small,[4] which provides the opportunity to modify risk factors to reduce aneurysm growth.

We have reported the high yield of aneurysms detected by ultrasound in patients with peripheral arterial disease.[5] 43 of these patients (median age 72, range 68–78; 33 men) were available for serial follow-up of aneurysm size. The median follow-up was 2