Less Invasive (Common) Femoral Artery Aneurysm Repair Using Endografts and Limited Dissection

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WHAT THIS PAPER ADDS

A hybrid endovascular/open surgical technique, using an endograft connector to simplify anastomoses, is presented for the treatment of true and selected false aneurysms of the common femoral artery. This technique is especially useful when there is proximal extension to involve the external iliac artery. This procedure can be performed under local anaesthesia with sedation. It avoids extensive circumferential arterial dissection and cross-clamping as well as the need for retroperitoneal or transperitoneal exposure. Treatment is thereby simplified and complications reduced.

Objective: We report our experience with the treatment of femoral artery aneurysms (FAAs) under local anaesthesia with limited dissection, using endografts to facilitate the proximal anastomosis and some distal anastomoses.

Method: Between January 2006 and December 2010, six males, mean age 72 years (range, 65—80 years) with FAAs were treated at the University Hospital of Zurich. All operations were performed under local anaesthesia with analgosedation, except for one performed under spinal anaesthesia. After limited dissection and puncture of the anterior wall of the FAA, a sheath and a self-expanding endograft were introduced over a guide wire and with fluoroscopy they were guided intraluminally into the proximal normal neck of the FAA and deployed. Proximal arterial control was achieved with a balloon catheter introduced through the endograft. Then the FAAs were opened and distal arterial control is obtained with balloon catheters. The distal end of the stent graft was then sutured to the normal-sized distal arteries or to stent grafts placed within them.

Results: Of the six FAAs, four were true and two were false anastomotic aneurysms. Mean FAA diameter was 5.0 cm (range, 3.0—6.5 cm). Four patients also had aneurysmal involvement of the external iliac artery, one patient also had deep femoral aneurysms, but deep femoral circulation was always preserved. In three of the patients, the distal anastomosis was created to the femoral artery bifurcation, in two patients to the deep femoral artery when the superficial femoral artery (SFA) was chronically occluded and in one patient to the SFA. Immediate technical success was achieved in all six patients, and graft patency was observed from 9 to 48 months (mean 29 months). There were no amputations, complications or deaths.

Conclusion: This technique for repair of FAAs can be performed under local anaesthesia, minimises dissection and complications and simplifies exclusion of these lesions. It is of particular value in high-risk patients with large FAAs.

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Ilio-femoral artery aneurysms (FAAs) are the second most common peripheral aneurysms, with an incidence of 5/100,000.[1] They are bilateral in almost 50%;[2,3] every second patient has an abdominal aortic aneurysm (AAA) and every third a popliteal artery aneurysm.[2–6] FAAs are asymptomatic (in 15—40%) or with symptoms of compression of adjacent nerves, or veins (30%), with distal embolisation (25%), acute arterial thrombosis with limb ischaemia (15%) and rarely with signs of rupture (10%).[3,5,6] Asymptomatic common femoral artery aneurysm is considered to be significant when the minimum diameter reaches 3.0 cm[7] or even 2.5 cm.[8] Most reports encourage surgical repair for symptomatic FAA.[7] Open surgery is considered the 'gold standard' for treatment of FAAs.[9] With large FAAs, extensive groin and/or

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Table 1. Patients' co-morbidities, demographic and femoral artery aneurysms characteristics.

Variables	Number
Male sex	6/6 (100%)
Mean age (range) in years	72 (65—80)
Cigarette smoking	3/6 (50%)
Ischaemic heart disease	5/6 (83%)
Previous cerebrovascular insult	2/6 (33%)
Arterial hypertension	4/6 (67%)
Severe respiratory insufficiency (COPD)	5/6 (83%)
Chronic renal insufficiency	2/6 (33%)
Diabetes mellitus	3/6 (50%)
True aneurysm	4/6 (67%)
Symptomatic	4/6 (67%)
Isolated CFA aneurysm	1/6 (16%)
CFA aneurysm extended to EIA	4/6 (67%)
CFA aneurysm extended to CIA	1/6 (16%)
CFA aneurysm with DFA aneurysm	1/6 (16%)
CFA aneurysm associated with AAA	2/6 (33%)

COPD, chronic pulmonary obstructive disease; CFA, common femoral artery; EIA, external iliac artery; CIA, common iliac artery; DFA, deep femoral artery; AAA, abdominal aorta aneurysm.

abdominal dissections are necessary to obtain vascular control, resulting in lymphatic complications, skin necrosis and infection. The reports of complete endovascular treatment of FAAs are sparing.[10] We report our experience with the treatment of FAAs with limited dissection, using endografts and predominantly local anaesthesia.

PATIENTS AND TECHNIQUE

Patients

Over the 5 years, between January 2006 and December 2010, six patients with FAAs were treated at the University Hospital of Zurich. Mean age was 72 years (range, 65—80 years). All patients were male. Patient demographic characteristic are summarised in Table 1. There were four patients with true FAAs and two with anastomotic aneurysms after aortobifemoral arterial reconstruction for arterial occlusive disease. In all but two patients, FAA was symptomatic: groin tenderness and pain in three patients and distal embolisation in one patient.

Technique

Under local anaesthesia, limited dissection of the anterior wall of the common femoral artery (CFA) is performed. This is punctured with an 18-G needle (Fig. 1-a) and a soft 0.035-inch guiding wire is introduced in the artery for several centimetres (Fig. 1-b). A sheath is advanced over the guide wire into the artery and an endograft (6—13 mm in diameter; 10—15 cm long) is then introduced into the proximal normal neck of the FAA under angiographic control. To prevent the endograft slipping out of the artery, it is advanced into the artery approximately 1.5—2 cm. After retracting the sheath, the endograft is deployed partially inside the artery and partially outside (Fig. 1-c). Finally, balloon dilatation achieves full endograft expansion, and the balloon catheter is used to achieve proximal arterial control (Fig. 1-d). In that way the endograft is telescoped partially up to the normal artery creating the proximal anastomosis in a sutureless manner. The FAA is opened and distal control of the superficial femoral artery (SFA) and deep femoral artery (DFA) is obtained with balloon catheters. The distal anastomosis or anastomoses are constructed in one of three ways (Fig. 2). First, the distal end of the endograft is sutured to a native femoral artery bifurcation (Fig. 2-a) or to a normal-sized patent SFA or DFA distal artery in case of an occluded DFA or SFA. Second, the distal end of the endograft is sutured to the endograft already deployed in the SFA or DFA (Fig. 2-b). Third, the distal end of the endograft is sutured to, or landed in a, standard vascular graft, already anastomosed either to the CFA bifurcation (Fig. 2-c), or to a patent SFA (Fig. 2-d) or DFA (Fig. 2-e). Two stitches are always placed to penetrate the arterial wall and endograft to prevent slippage of the endograft. The overlying aneurysm sac is then partially excised and the remnant closed to cover the grafts. In case of concomitant AAA and FAAs, endovascular abdominal aorta aneurysm repair (EVAR) precedes the FAA treatment.

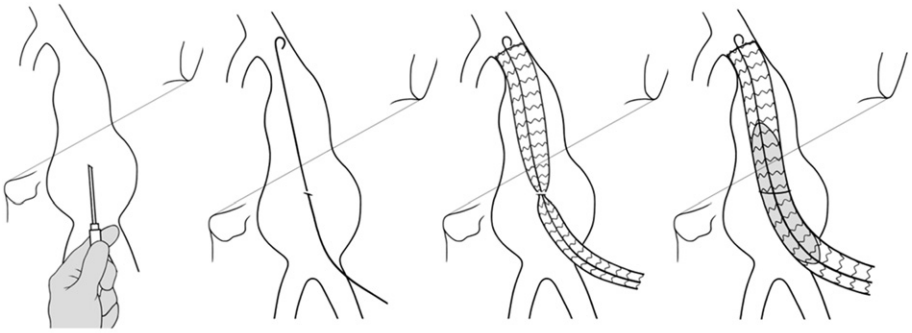

Figure 1-a Figure 1-b Figure 1-c Figure 1-d

Figure 1. General principle of technique using endograft for proximal sutureless anastomosis in treatment of FA aneurysm. **1-a**: CF artery is punctured with 18G needle; **1-b**: soft 0.035 inches guide wire is introduced in the artery; **1-c**: after the sheath is removed the endografts deployed under angiographic control partially inside and partially outside the artery; **1-d**: balloon dilatation achieves full endograft expansion and is used to achieve proximal arterial control.

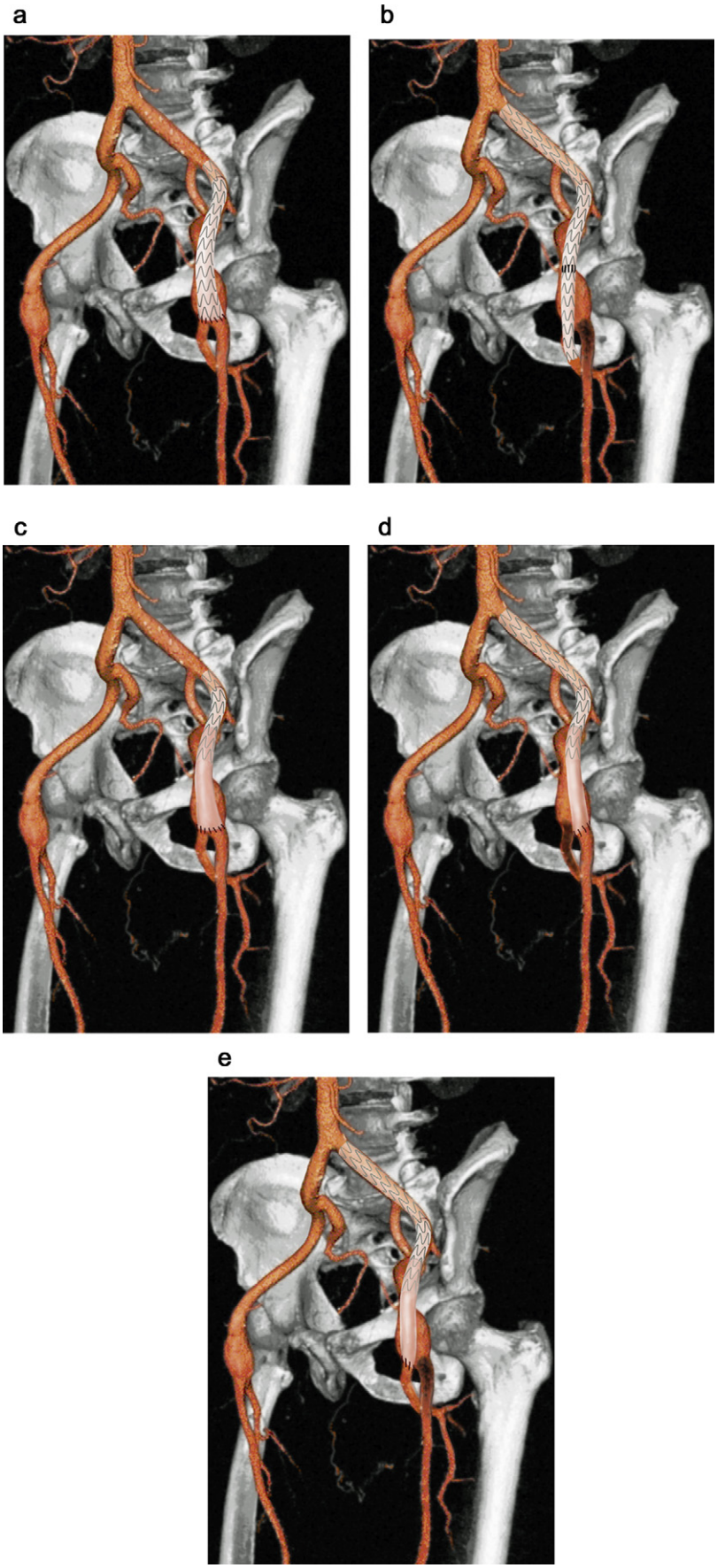

Figure 2. The distal anastomosis or anastomoses are constructed in different ways. **2-a**: distal end of the endograft is sutured to a native femoral artery bifurcation; **2-b**: distal end of the endograft is sutured to the endograft already deployed in deep femoral artery (when the SFA is chronically occluded) or in SFA (when the DFA is chronically occluded). **2-c**: distal end of the VB endograft landed in a standard vascular graft, and anastomosed either to CFA bifurcation, patent SFA (**2-d**), or patent DFA (**2-e**).

Table 2. Preoperative characteristics in patients with FAAs (femoral artery aneurysms).

Patient	Age	Sex	Previous operations (years ago)	Symptoms of FAAs	Aneurysm type	CFA aneurysm diameter	SFA	DFA	EIA aneurysm diameter	AAA diameter
1	69	M	AFF (9)	Yes	Anastomotic	6 cm	Patent	Patent	—	No
2	79	M	No	No	True	6.5 cm	Dilated	Patent	3.2 cm	6.5 cm
3	67	M	AFF (20)	Yes	Anastomotic	3.5 cm	Occluded chronic	Patent	Occluded chronic	No
4	70	M	AII (12)	Yes	True	6.1 cm	Patent	Patent	2.6 cm	No
5	80	M	EVAR (4)	Yes	True	4.5 cm	Occluded chronic	4.0 cm	2.5 cm	No
6	65	M	No	No	True	3.7 cm	Patent	Patent	2.0 cm	6.0 cm

CFA, common femoral artery; SFA, superficial femoral artery; DFA, deep femoral artery; EIA, external iliac artery; AAA, abdominal aortic aneurysm; AFF aorto bi-femoral open surgical repair; AII, aorto-bi-iliac open surgical repair; EVAR, endovascular abdominal aorta aneurysm repair.

RESULTS

In one patient, the aneurysm involved only the CFA; in four patients, the CFA aneurysm extended to the external iliac artery (EIA), in one to the common iliac artery and in one patient the CFA aneurysm was associated with a DFA aneurysm. In two patients, the FAAs were also associated with AAAs, and both required treatment by EVAR (Table 2). Two FAAs were postoperative anastomotic false aneurysms (both after aorto-bi-femoral reconstruction for aortoiliac occlusive disease), without clinical, laboratory, computed tomography (CT) or local intra-operative signs of infection. Four were true atherosclerotic aneurysms. The mean aneurysm diameter was 5.0 cm (range, 3.5—6.5).

All operations were performed under local anaesthesia with analgosedation, except for one performed under spinal anaesthesia (Table 3). In all cases sizing of the endograft was based on preoperative CT arteriography measurements. In three of the patients, the distal anastomosis was created to the CFA bifurcation, in two patients to the DFA when the SFA was chronically occluded. In one patient (patient No. 4, tables) with a 6.1-cm aneurysm at the CFA bifurcation level, the arterial reconstruction was performed with an end-to-end anastomosis between the endograft in the external iliac artery and a second endograft deployed in the SFA. Then a third endograft deployed in the DFA was sutured in an end-to-side fashion to the endograft deployed in the SFA. The mean operative time was 120 min (range, 90—180 min).

The immediate technical success of our sutureless telescoping anastomotic technique for FAA treatment was 100%. There was no 30-day mortality or morbidity. In patient No. 4, the inguinal wound was closed in a delayed fashion after 5 days of negative pressure wound therapy on the exposed grafts using the VAC system with a V.A.C. GranuFoam (KCI, San Antonio, TX, USA).[11]

Mean follow-up was 29 months (range, 9—48 months) and the patency rate was 100%, with no stent-graft migration, and no stent-graft occlusion (Fig. 3). Three patients died during follow-up of unrelated causes (metastatic prostatic cancer, intestinal ischaemia and acute myocardial infarction).

DISCUSSION

The small series of six patients treated over 5 years demonstrates that a less invasive technique under local anaesthesia can be used effectively to treat even complex FAAs: in four patients, the CFA aneurysm extended to the external iliac artery (EIA), in one to the common iliac artery and in one patient the CFA aneurysm was associated with a DFA aneurysm. In all but two patients FAA was symptomatic: groin tenderness and pain in three patients and distal embolisation in one patient. In all patients, the proximal anastomosis was created using endograft telescoped partially up to the normal artery. The distal anastomosis was created in three patients to the femoral artery bifurcation, in two patients to the deep femoral artery and

Table 3. Intraoperative data, postoperative medical treatment and follow-up.

Patient	Anaesthesia	Type of stent-graft (mm)	Distal anastomosis	SFA type of endograft	DFA type of endograft	EVAR	Technical success	Postoperative medical treatment	Follow-up (months)
1	LA	10 HB	CFA bifurcation	—	—	No	Yes	ASS 100 mg	41
2	Spinal	10 HB	CFA bifurcation	—	—	Yes	Yes	ASS 100 mg	14
3	LA	10 VB	DFA	—	—	No	Yes	OAC	48
4	LA	9 VB	SFA + VB bypass to DFA	7 mm VB	5 mm VB	No	Yes	ASS 100 mg	9
5	LA	8 VB	DFA	—	6 mm VB	No	Yes	ASS 100 mg, OAC	40
6	LA	6 VB	CFA bifurcation	—	—	Yes	Yes	ASS 100 mg	24

LA, local anaesthesia; SFA, superficial femoral artery; DFA, deep femoral artery; CFA, common femoral artery; EVAR, endovascular abdominal aorta aneurysm repair; VB, Viabahn; HB, Hemobahn; ASS, acetylsalicylic acid; E-S, end-to-side anastomosis; OAC, oral anticoagulants.

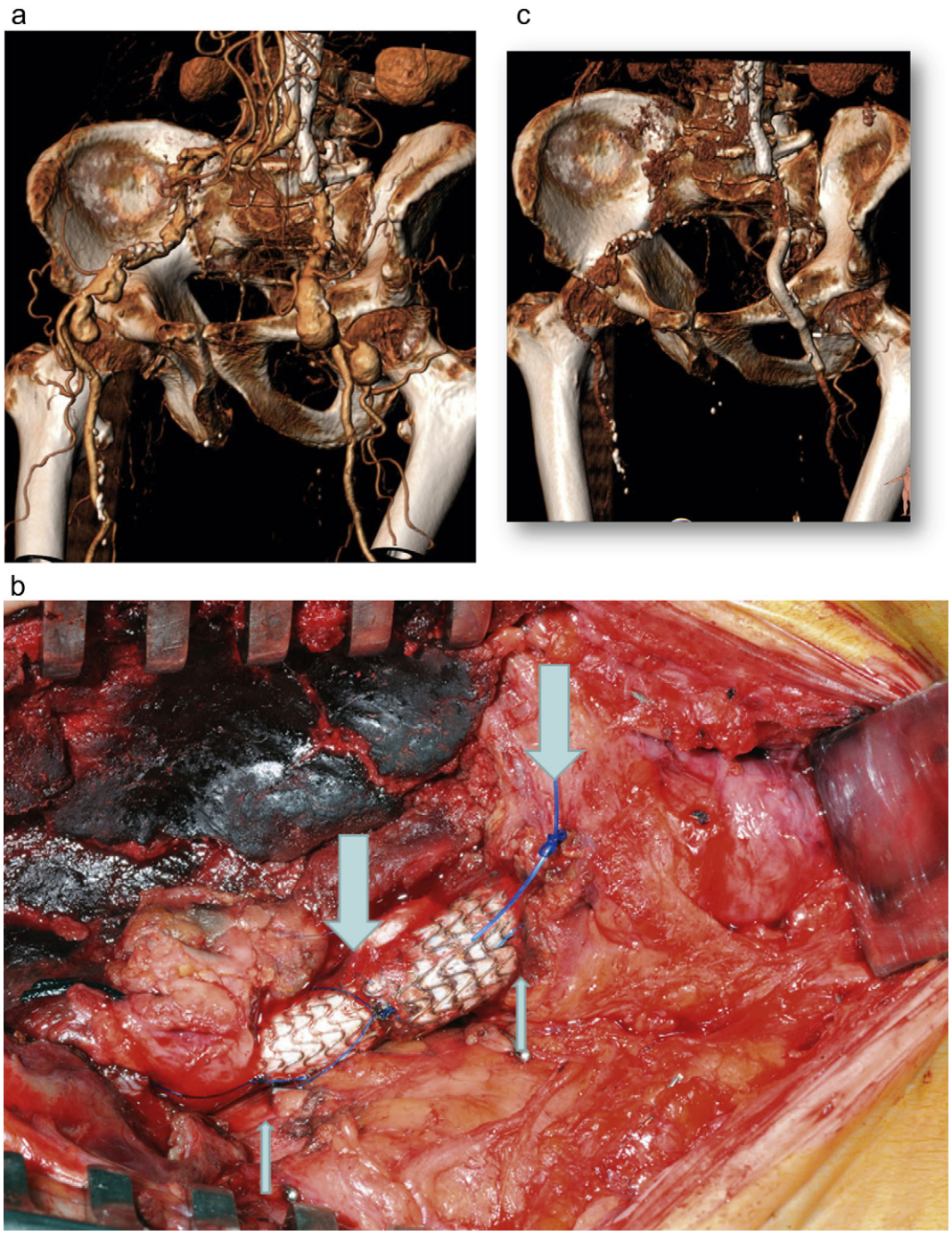

Figure 3. Eighty years old gentleman four years after EVAR for infrarenal abdominal aorta aneurysm. **3-a**: three-dimensional computed tomographic (CT) reconstruction shows bilateral common femoral artery (CFA) aneurysm. On the left side CFA aneurysm (4.5 cm diameter) is extended to external iliac artery (EIA) aneurysm (2.5 cm), with aneurysm of the first branch of deep femoral artery (DFA) (4.0 cm). **3-b**:Iintraoperative view 8 mm Viabahn® (deployed proximally in external iliac artery) sutured with a running suture (block down arrow left) to 5 mm Viabahn® deployed in DFA (SFA is chronically occluded). Block up arrows depict the use of secured stitches (6-0 polypropylene) on the profunda femoral artery (left), and proximal common femoral artery (right) to fix the Viabahn endograft to the artery wall. Block down arrow right: with horizontal mattress suture (4-0 propylene) additional tightening of Viabahn® in the external iliac artery, **3-c**: three-dimensional CT reconstruction 4 years after operation shows patent Viabahn-to-Viabahn graft with normal DFA perfusion.

in one patient to the SFA. Immediate technical success was achieved in all six patients, and graft patency was observed from 9 to 48 months (mean 29 months). There were no amputations, complications or deaths.

In general, asymptomatic common femoral artery aneurysm is considered to be significant when the minimum diameter reaches 3.0 cm[7] or even 2.5 cm.[8] Most reports encourage surgical repair for symptomatic FAA.[7] Conventional treatment includes partial resection of the aneurysm and arterial reconstruction with a prosthetic graft sewn distally to/above femoral bifurcation, or to the SFA or DFA if patent. If the FAA involves the femoral bifurcation, it is

necessary to reconstruct a patent DFA and SFA. If large FAAs extend to the external iliac artery, SFA or DFA, it may be necessary to perform extensive lower abdominal, groin or thigh dissections to obtain healthy arterial necks and arterial control. This often requires general anaesthesia and results in a substantial incidence of lymphatic complications, wound healing and skin necrosis up to 19%, and a higher risk for postoperative bleeding and other complications.[12]

In contrast to popliteal artery aneurysms,[13,14] the reports of complete endovascular treatment of FAAs are sparse.[10] There are several reasons why CFA seems not to be suitable: the CFA begins close to the inguinal ligament and repetitive hip flexion during ambulation might result in stent compression,[15] leading to poor blood flow to DFA. Contralateral approach for antegrade endograft deployment may result in false aneurysm formation at the puncture site (almost one-third of FAAs are bilateral), and aneurysm exclusion does not solve the compressive symptoms. The advantages of complete endovascular treatment are reported for popliteal aneurysm repair: avoidance of general anaesthesia, less blood loss, shorter hospitalisation, lower morbidity and mortality and faster functional recovery.[13]

The present hybrid technique is a reasonable alternative to open surgery when complete endovascular treatment is not feasible, or possible. It includes the best of both techniques. First, the procedure can be performed under local anaesthesia with sedation, and is well tolerated and safe. Mitchell showed that the duration of anaesthesia is an independent predictor of pulmonary complications after elective surgery, and non-abdominal vascular surgery.[16] Second, limited anterior wall dissection is associated with less local complications compared to extensive aneurysms dissection, and a vascular anastomosis in the groin has known rate of lymphatic complications/wound/graft infection, delayed wound healing and skin necrosis up to 19%.[12] There is also a higher risk for early postoperative bleeding (3.4–7%).[17,18] Third, vessel cross-clamping is avoided. Traditionally, in large aneurysms extending to EIA, SFA or DFA, proximal aneurysm control is obtained through extensive lower abdominal or retroperitoneal dissection requiring general anaesthesia. Moreover, using our endograft telescoping anastomotic technique we were able to create non-sutured proximal anastomosis. After classically sutured femoral artery anastomoses false anastomotic aneurysms occur in almost 7% of cases.[19] The excellent mid-term results of endograft connector sutureless anastomoses in other settings have been confirmed by our group.[20–22]

In all anastomoses we used Viabahn endografts (Viabahn, Gore Inc., Flagstaff, AZ, USA). The self-expanding nitinol exoskeleton with longitudinal flexibility and shape memory makes this graft more resistant to deformation by mechanical forces.[23] The ultrathin expanded polytetrafluoroethylene (PTFE) with heparin-bonded bioactive inner surface is responsible for a reduced risk of thrombosis.[24] The commercially available Viabahn is tailored individually based on FAA's anatomical characteristics and involvement of CFA bifurcation, SFA, DFA and the EIA. Nitinol stents may be safely cut to desired length using cutting scissors. There is a report on the use of other endografts (Fluency, Bard, Murray Hill, NJ, USA) to treat FAA extended above the inguinal ligament with combined open and endovascular approach.[25]

CONCLUSION

This small series of patients demonstrates that a less invasive technique under local anaesthesia can be used effectively to treat even complex FAAs with less dissection using endografts to facilitate arterial reconstructions with sutureless telescoping anastomoses. Complications can be minimised and mid-term results are excellent.

CONFLICT OF INTEREST/FUNDING

None.

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