Late conversion of endovascular to open repair of abdominal aortic aneurysms

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Background: Failure of endovascular repair (EVAR) of an abdominal aortic aneurysm can result in significant risk of morbidity and mortality. We review our experience with late conversions to open repair.

Methods: We conducted a retrospective database review to identify all EVAR procedures performed between 1997 and 2010 and the number converted to open repair at our university-affiliated medical centre. Late conversion was defined as those occurring at least 30 days after initial EVAR.

Results: In all, 892 EVARs took place during the study period. Six patients (0.7%) required late conversion to open repair. Their mean age was 71 (range 58–83) years, and half were women. Half of the initial EVARs were for ruptured aneurysms. The median time to conversion was 15.6 (range 1.7–61.3) months. Indications for secondary conversion (50% urgent, 50% elective) included persistent type I endoleak (n = 3), combined type II and III endoleak (n = 1), graft thrombosis (n = 1) and aneurysm rupture (n = 1). Supraceliac clamping was required in most patients (67%), and the mean transfusion requirement was 2.6 units. Total endograft explantation occurred in 2 patients (33%), whereas partial or total endograft preservation occurred in 4 (67%). Median length of stay in hospital after conversion was 7 (range 6–73) days. There were no instances of early or in-hospital mortality following conversion.

Conclusion: Our EVAR experience includes a low rate of late conversion to open repair, with most conversions being a result of persistent aneurysm perfusion. Although technically challenging, late conversion can be safe. Our experience supports ongoing surveillance after EVAR.

Contexte : L'échec du traitement endovasculaire d'un anévrisme de l'aorte abdominale (AAA) peut entraîner un risque significatif de morbidité et de mortalité. Nous passons en revue notre expérience relative aux conversions tardives vers une réparation chirurgicale ouverte.

Méthodes : Nous avons analysé une base de données de manière rétrospective pour recenser tous les traitements endovasculaires de l'AAA effectués entre 1997 et 2010 et le nombre de conversions vers une chirurgie ouverte dans notre centre hospitalier universitaire. La conversion tardive se définissait par son exécution au moins 30 jours après la réparation initiale.

Résultats : En tout, 892 traitements endovasculaires de l'AAA ont eu lieu durant la période de l'étude. Six patients (0,7 %) ont eu besoin d'une conversion tardive vers une chirurgie ouverte. Leur âge moyen était de 71 ans (entre 58 et 83) et la moitié étaient des femmes. La moitié des traitements initiaux concernaient des cas de rupture d'anévrisme. Le temps médian avant la conversion était de 15,6 mois (de 1,7 à 61,3). Les indications de la conversion secondaire (50 % urgente, 50 % non urgente) incluaient une endofuite persistante de type I (n = 3), une endofuite mixte de type II et de type III (n = 1), une thrombose du greffon (n = 1) et une rupture d'anévrisme (n = 1). Le clampage supracœliaque a été nécessaire chez la plupart des patients (67 %) et les besoins transfusionnels moyens ont été de 2,6 unités. L'explantation totale de l'endogreffe a été nécessaire chez 2 patients (33 %), tandis qu'une préservation partielle ou totale de l'endogreffe a été possible chez 4 patients (67 %). La durée médiane de l'hospitalisation après la conversion a été de 7 jours (de 6 à 73). On n'a noté aucun cas de mortalité précoce ou perhospitalière après la conversion vers une chirurgie ouverte.

Conclusion : Notre expérience des traitements endovasculaires de l'AAA se caractérise par un taux faible de conversion tardive vers une chirurgie ouverte, la plupart des cas résultant d'une fuite anévrismale persistante. Bien que représentant un défi technique, la conversion tardive peut être sécuritaire. Notre expérience milite en faveur d'une surveillance continue des patients après un traitement endovasculaire de l'AAA.

Endovascular repair (EVAR) has been established as an excellent method of therapy for abdominal aortic aneurysms, with generally accepted improved short-term results and acceptable durability in appropriately selected individuals. However, there remains a small subset of patients who undergo conversion to open repair either at the time of initial EVAR or later during the course of postoperative surveillance.[1] The latter group is the subject of the present study.

Late conversion to open repair (beyond the first 30 postoperative days) has been reported to be required following up to 9% of EVARs.[2] Indications for late conversion include endoleaks not amenable to endovascular treatment, endograft thrombosis, endograft infection or migration and aneurysm rupture. There are also several specific technical aspects of endograft explantation or preservation that need to be considered.[3–5] Consequently, late conversion–related mortality can occur as frequently as 22% of the time.[5] The purpose of the present study was to review our centre's experience with late conversion to open repair of previously placed endografts.

Methods

We reviewed the vascular surgery database at our university-affiliated medical centre to identify all patients who had undergone open aneurysm repair following an initial EVAR of the same infrarenal abdominal aortic aneurysm between 1997 and 2010. The time interval between the operations was noted, and patients who underwent open conversion during the initial 30 days following EVAR were excluded from further analysis. Demographic information, operative indications and details, and outcomes for this study cohort were identified. This study received approval of the University of Western Ontario's Ethics Review Board for research involving human participants.

Results

During the study period, 892 EVARs (both elective and emergent) were performed at our centre by 4 vascular surgeons. Six (0.7%) patients underwent late conversion to open repair at least 30 days following their initial EVAR. Both the initial and subsequent repairs were performed at our hospital for all 6 patients. We are not aware of any of our EVAR patients undergoing subsequent open repair at another institution, nor did we perform open conversion for a patient who had previously received an EVAR at another centre. The mean age of patients who underwent late open conversion was 71 (range 58–83) years, and half were women. The median time elapsed from the initial EVAR was 15.6 (range 1.7–61.3) months. This information is summarized in Table 1.

Table 1. Characteristics of patients who underwent late conversion of endovascular (EVAR) to open aneurysm repair

Characteristic	Value
Late conversion, no. (%)	6 (0.7)
Age, mean (range) yr	71 (58–83)
Sex, % male:female	50:50
Interval between EVAR and late conversion, median (range) mo	15.6 (1.7–61.3)

Half (3 of 6) of the initial EVARs were for ruptured aneurysms and the other half for elective repair. Initial stent grafts included Zenith (Cook Medical) in 2 patients and Talent (Medtronic) in 4. It is important to note that all stent grafts use an upper bare metal stent for suprarenal fixation. Indications for secondary conversion (50% urgent, 50% elective) were persistent proximal type I endoleak (loss of seal in infrarenal aorta, $n = 3$), combined type II and III endoleak (perfusion of aneurysm from back bleeding lumbar arteries and endograft limb disconnection respectively, $n = 1$), graft thrombosis ($n = 1$) and aneurysm rerupture ($n = 1$). In 2 patients, the type I endoleaks were caused by aortic neck dilatation and loss of the original proximal seal, whereas in 1 patient a proximal stent fracture (Fig. 1) led to disruption of the proximal bare stent from the endograft fracture and subsequent migration (Fig. 2). Supraceliac aortic clamping was used in 4 (67%) patients, and the mean transfusion requirement was 2.6 units. Total endograft explantation occurred in 2 (33%) patients, whereas partial or total endograft preservation occurred in 4 (67%; Fig. 3). Total endograft preservation was possible in the case of a reruptured aneurysm secondary to back

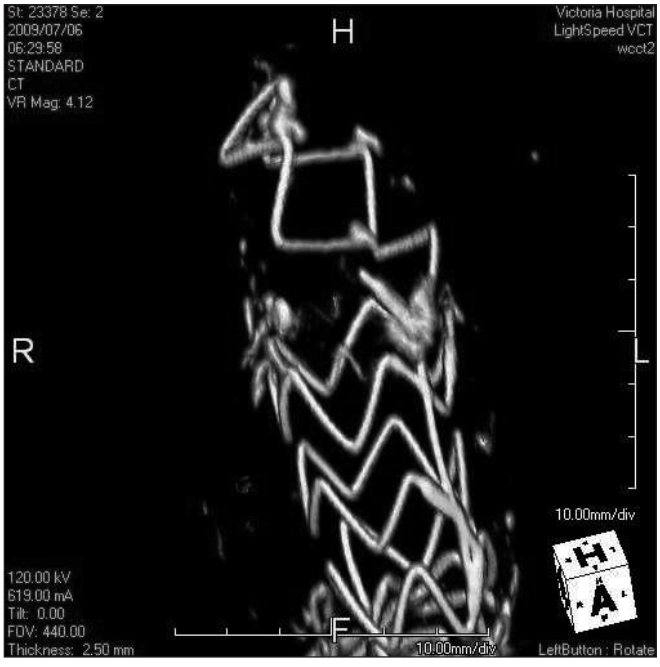

Fig. 1. Proximal bare metal stent fracture that resulted in device migration and type I endoleak.

bleeding lumbar arteries (type II endoleak). This allowed opening of the aneurysm sac and oversewing of the lumbar arteries. The median length of stay in hospital after late conversion was 7 (range 6–73) days. There were no instances of early or in-hospital death following late conversion to open surgery.

Discussion

Since its original report nearly 2 decades ago,[6] technological advances have allowed EVAR to become the most common method of treating abdominal aortic aneurysms in many centres worldwide. Although initially introduced in higher risk individuals, it is now being used in average risk patients with good short-term and acceptable longer-term outcomes in randomized trials.[7] Regardless of these technological advances, however, there likely will always remain a small subset of patients who will require aortic reinterventions following EVAR. As a result, mandatory, lifelong radiographic surveillance remains an essential component after EVAR. Many of these reinterventions will be possible via percutaneous interventional routes, but some will require conversion to open repair. Open conversions can occur early and are usually the result of a technical difficulty or surgical misadventure during the initial EVAR. Although a few authors have described late conversions as those that require a second anesthetic following the initial EVAR,[5] most define it as conversions occurring more than 30 days beyond the initial endovascular repair.[1–4,8–10] This more common definition of late conversion was used in the present study.

In a recent review, late open conversion was reported to occur in 0.4%–22% of patients following EVAR, with an overall rate of 1.9%.[1] In the randomized EVAR-1 Trial, the rate of late conversion to open repair was 2.6% at a mean of 3.3 years after initial repair.[7] The 0.7% rate of late conversion in the present study compares favourably with this published information. As with our experience, the most common causes of late conversion are aneurysm expansion, with or without a documented endoleak, endograft migration or disconnection, thrombosis, infection and aneurysm rupture.[1] Although rare, aneurysm rupture, as occurred in 1 of our patients, was reported to occur in 1.4% of patients in the EUROSTAR database during the first year and in 0.6% in the second year.[11]

Conversion to open repair following EVAR involves some unique technical challenges that are quite different from those with open repair alone. As reflected in the present series, conversions more commonly involve suprarenal or supraceliac aortic clamping with corresponding visceral and renal ischemia and increased transfusion requirements compared with initial open repair. Although there were no perioperative deaths in our series, postoperative mortality rates of l0% have been reported following late conversion.[1]

Several specific technical features of open conversions are worth noting. First, either a transperitoneal, as in this series, or a retroperitoneal approach can be used, with the retroperitoneal approach having the possible advantage of avoiding the occasional post-EVAR aortic inflammatory

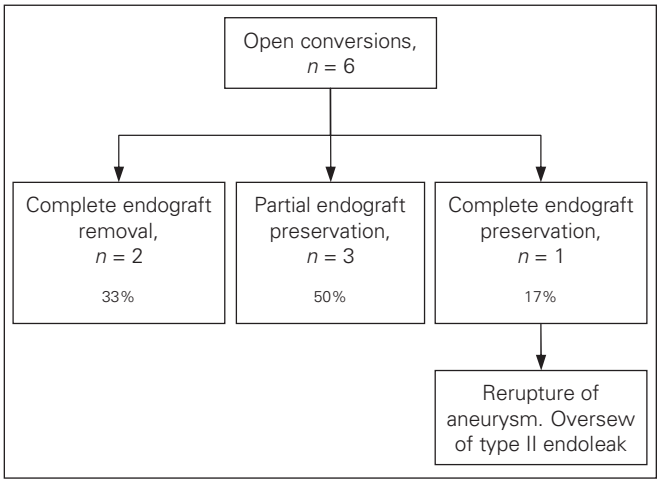

Fig. 3. Extent of endograft preservation with open conversion.

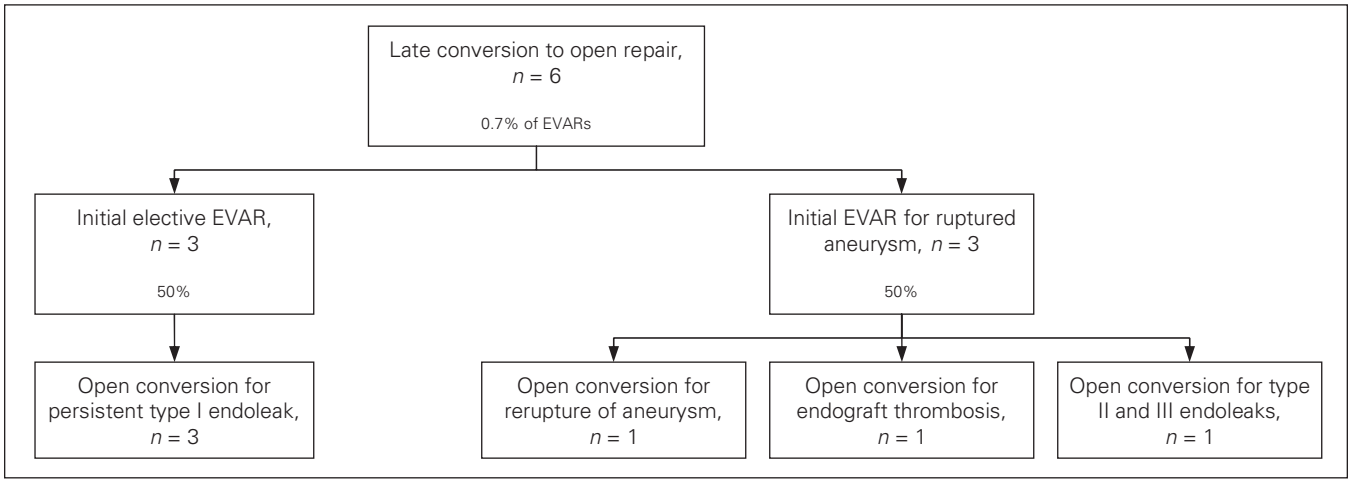

Fig. 2. Indications for endovascular aneurysm repair (EVAR) procedure and subsequent late conversion.

reaction.[10] The site of proximal clamp placement is often suprarenal or supraceliac, as the bare metal stent of the most commonly used endografts are placed in a transrenal position and can extend to the superior mesenteric artery. Direct clamping of these relatively stiff endografts risks insufficient aortic control and damage to the aorta if the bare metal stent or fixation barbs tear the aorta. As a result, direct clamping of the proximal aorta across the endograft is not recommended and can be dangerous.

The important strategic decision regarding complete or incomplete endograft preservation is tailored to the individual clinical situation. A "clamp and pull" complete endograft extraction approach has been advocated by some surgeons;[2] however, this is a dangerous approach with transrenal fixated endografts, as the bare metal stent becomes incorporated into the juxtarenal aortic lining with a layer of neointima.[12] Endograft extraction with this technique can lead to clinically important tears in the pararenal aorta with hemorrhage and renal artery injury requiring revascularization.[5] Others have reported successful complete extraction by collapsing the upper bare metal stent into a large syringe[13] or by constricting it with a circumferential nylon tape or heavy suture.[8] We have been less than enthused with the practical application of these techniques.

Currently we recommend partial endograft preservation in most cases of late conversion. In instances where conversion is performed for aneurysm perfusion via a proximal type I endoleak, we recommend extraction of the covered portion of the endograft with preservation of the upper bare metal stent with wire cutters.[2] This avoids undue trauma to the renal artery ostia and allows an upper anastomosis directly to the aorta. In cases of graft thrombosis, the upper bare metal stent and the proximal part of the covered stent graft can be preserved while a graft is sewn full-thickness to the endograft and the aortic wall.[3,4] In our opinion, complete endograft extraction is necessary only when late conversion is performed for an infected endograft. Classically in these cases the infrarenal aorta is oversewn and the lower extremities are revascularized with an axillobifemoral bypass.[8] This is an infrequent indication for open conversion,[1] and we have not experienced such a case. Although these principles are described regarding the proximal component of the endografts, they can be similarly applied to the distal iliac limbs.[4]

Most late conversions occur following postoperative radiologic surveillance and allow for a planned approach.[1] This reinforces the need for postoperative surveillance as late failures, although rare, can occur. The latest conversion in the present series occurred because of device failure 5 years after the initial implant (Fig. 1). The long-term durability of the latest generation of devices is still relatively unknown, further reinforcing the need for surveillance. We currently employ contrast-enhanced computed tomography (CT) during the first postoperative year, followed by yearly CT or ultrasonography, according to surgeon preference.

Limitations

Our study has the same shortcomings as any retrospective review. In addition, although we are unaware of any of our patients undergoing late conversion at another centre, this may have been the case; as such, our results may underestimate the risk of late conversion.

Conclusion

Lifelong radiographic surveillance is a mandatory component following EVAR of abdominal aortic aneurysms. Unfortunately, however, it is likely that a small proportion of EVAR patients will continue to require open conversion during this surveillance period. The technique of open conversion can be safely applied as long as attention is paid to some specific technical features, as outlined in our small series.

Competing interests: T.L. Forbes has received consulting fees from Cook Medical and Medtronic, who manufacture the stent grafts described in this study. None declared for D.M. Harrington, J.R. Harris and G. DeRose.

Contributors: T.L. Forbes designed the study, acquired the data and wrote the article. All authors analyzed the data, reviewed the article and approved its publication.

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