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Current management of abdominal aortic aneurysms

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Abstract

The operative mortality following conventional open abdominal aortic aneurysm (AAA) repair has not fallen significantly over the past two decades. The introduction of EndoVascular Aneurysm Repair (EVAR) in 1991 has provided an alternative to open AAA repair, and an opportunity to improve operative mortality. Since then, the treatment of AAA has undergone a revolutionary change. However, a maximum transverse measurement of >5.5 cm is still a reasonable threshold with which to recommend repair in most patients with asymptomatic AAA; repair at smaller diameters may be recommended for women and some select cases. Open repair has proven durable, and should be considered in younger and lower-risk patients, and in some complicated cases it may be the only option. Open repair and EVAR are complementing each other in the current management of AAA. The decision as to which method is the best option for each individual should be made on the basis of the specific patient. Advances in endovascular technology have strengthened the armamentarium of vascular surgeons in dealing with AAA. The aim of this article is to provide an overview on the current management of AAA, with relevance to general practice.

Introduction

AAA is a fatal condition that primarily affects older patients. The incident in Hong Kong is not as rare as it was previously thought [1]. With a progressively ageing population, the incidence and prevalence of AAA is certain to rise. Most AAAs are asymptomatic, and physical examination lacks sensitivity for detecting an aneurysm [2]. It is important that family physicians understand which patients are at risk for the development of AAA, and the appropriate evaluation once a patient has been diagnosed, with knowledge on the current treatment options for AAA.

Definition and aetiology

An aneurysm is a permanent focal dilatation of an artery to 1.5 times its normal diameter. The normal infrarenal aortic diameters in patients older than 50 years are 1.5 cm in women, and 1.7 cm in men. By convention, an infrarenal aorta 3 cm in diameter or larger is considered aneurismal [3]. The primary event in the development of an AAA involves proteolytic degradation of the extracellular matrix proteins, elastin and collagen. Various proteolytic enzymes are involved during the degradation and remodelling of the aortic wall [4]. Cigarette smoking elicits an increased inflammatory response within the aortic wall [5]. Increased biomechanical wall stress also contributes to the formation and rupture of aneurysms, with increased wall tension and disordered flow in the infrarenal aorta. Approximately 20% of first-degree relatives, predominantly men, of a patient with an AAA will develop an aneurysm [6].

Screening

In Hong Kong, there is no screening programme for AAA. However, in the US, the US Preventive Services Task Force has released a statement summarizing recommendations for screening for AAA [7]. The guideline recommends one-time screening with ultrasound for AAA in men 65–75 years of age who have ever smoked. No recommendation was made for, or against, screening in men 65–75 years of age who have never smoked, and it recommended against screening women. Men with a strong family history of AAA should be counselled about the risks and benefits of screening as they approach 65 years of age.

Ultrasound is the standard imaging tool; if performed by trained personnel, it has a sensitivity and specificity approaching 100% and 96%, respectively, for the detection of infrarenal AAA [7].

Clinical evaluations for asymptomatic patients

Most patients with AAA are asymptomatic. Typically, aneurysms are noted on studies performed for other reasons, as opposed to during physical examination. AAAs in the 3- to 3.9-cm range are palpable 29% of the time, whereas those >5 cm are palpable 76% of the time [2]. Patients with asymptomatic AAA should be managed based on the size of the aneurysm. Studies have shown that surveillance in compliant male patients with aneurysms 4–5.5 cm wide is safe [8]; and surgery on AAAs <5.5 cm did not confer any survival advantages [9].

Patients with aneurysms ≥5.5 cm should be considered for elective AAA repair. However, each patient should be evaluated for the presence of risk factors for accelerated AAA growth, and for surgical risk and overall health.

All patients with AAAs should be educated on the signs of symptomatic and ruptured aneurysms. If they experience new or unusual pain in the back, groin, testicles, legs, or buttocks, emergency medical attention should be sought.

Open vs. endovascular repair

The two primary methods of AAA repair are open and endovascular. Before repair, a CT scan of the aorta and iliac arteries is required. Traditional open AAA repair involves direct access to the aorta, through an incision in the abdomen (Figure 1). This repair method is well established as definitive, requiring essentially no follow-up radiological studies. The majority of patients undergoing open AAA repair remain without significant graft-related complications during the rest of their lives (0.4–2.3% incidence of late graft-related complications in recent studies) [10]. However, the operative mortality following conventional open AAA repair has not fallen significantly over the past two decades. The introduction of EVAR in 1991 has provided an alternative to open AAA repair. Since then, the treatment of AAA has undergone a revolutionary change.

Endovascular AAA repair

The first published cases of aortic stent graft placement in humans for the treatment of an AAA was in 1991 [11]. This minimally invasive procedure can be performed under regional anaesthesia and involves the deployment of a stent graft within the aneurysm sac, usually via the common femoral arteries (Figures 2 and 3). The stent graft is made of either polyester, or polytetrafluoroethylene attached to a metal stent, comprising either stainless steel or nitinol, which is a nickel–titanium alloy (Figure 4). The metal stent provides both radial and longitudinal support, with the aneurysm being excluded from the circulation by the graft material.

Figure 2. EVAR performed under X-ray control.

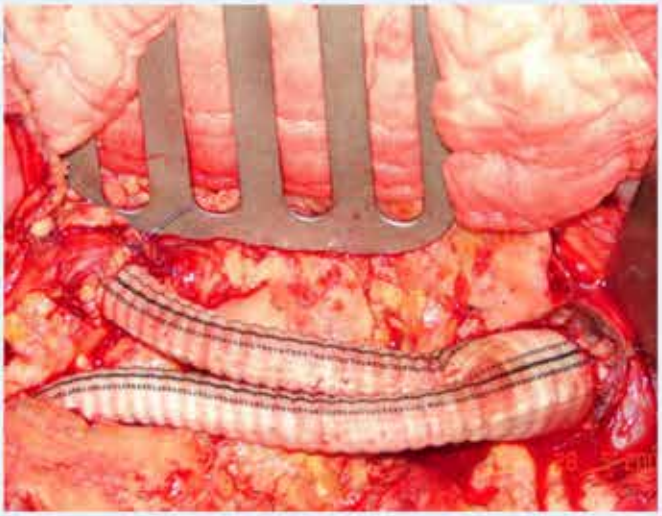

Figure 1. Open repair of AAA with a laparotomy wound.

Figure 3. Groin wounds after EVAR.

All endoluminal stent grafts rely on being oversized by 10–15%, relative to the normal diameter of the artery in which they are placed. One further variable is the proximal fixation method, which may be made from bare stents, hooks and barbs. These secure the device to the normal aortic wall at the proximal end, in order to minimize distal migration. Stent grafts of today are mostly either bifurcated aortoiliac devices, or aorto-uni-iliac devices, and are either one piece, or modular in design. If an aorto-uni-iliac device is deployed, the contralateral iliac artery has to be occluded, usually with a radiological plug, and a femoro-femoral crossover graft, performed to allow perfusion of the contralateral lower limb. Most infrarenal aortic aneurysms are now treated with bifurcated devices, either modular or single piece. The best results are achieved by covering the aorta from immediately below the renal arteries to the iliac bifurcations on each side (Figure 5).

Figure 4. An aortic stent graft.

Not all patients with an AAA are suitable for EVAR. Several studies have shown that about 50% of patients are suitable for EVAR [12,13]. However, with experience and improvements in stent graft technology, this figure is now increasing. In our practice, approximately 40% of elective AAA repairs are done with EVAR. In 2005 it was estimated that 36% of all AAA repairs in the US, and 12% in Europe were undertaken using this technique [14].

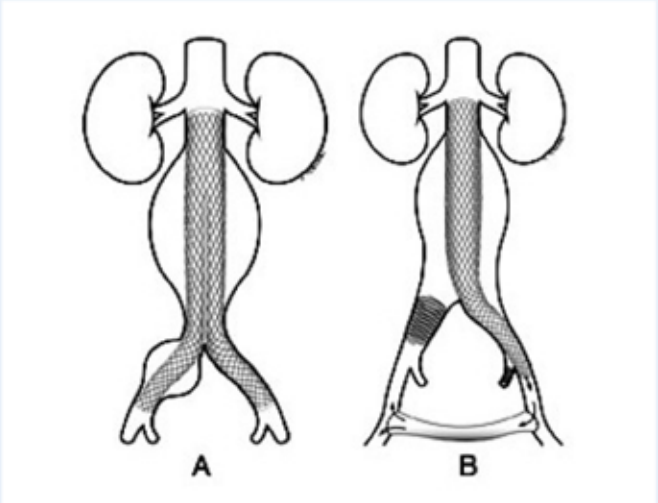

Figure 5. Types of stent graft - A; Bifurcated; B; Aorto-uni-iliac.

The precise anatomical requirements for each stent graft may differ, but in general, there is a set of criteria to fulfil (Table 1). The anatomy of the proximal aorta and distal iliac vessels must be amenable to the fixation of the stent graft to the wall, and the iliac arteries must allow access to the aorta via the femoral arteries.

Therefore, all patients planning on undergoing EVAR must be properly assessed with a multi-slice CT scan, with contrast from the thoracic aorta to the common femoral arteries. Measurements can then be taken to further assess suitability for EVAR and to decide on the size of the stent graft.

Table 1. The suitable anatomical requirements for endovascular aneurysm repair.

Anatomical characteristics	Size
Proximal aortic neck length	>15 mm
Proximal aortic neck diameter	<32 mm
Proximal aortic neck angulation	<60 degrees
External iliac diameter	>7 mm
Iliac bifurcation angulation	<90 degrees

Evidence for EVAR

Endograft AAA repair is a relatively new technology; outcomes >5 years in patients with endografts are now available [15]. In-hospital mortality of AAA open repair is 3.8% vs. 1.2% for endovascular repair [16]. Thirty-day mortality has been reported as being 1.1–2.7% for open repair, and 0–1.7% for endovascular repair [17]; however, a 5-year comparison of open vs. endovascular repair did not show a significant difference in all-cause mortality during a recent nonrandomized prospective analysis. Post-procedural conversion to an open repair, from endovascular, was required in 2.8% of patients [11].

The best evidence is from the Endovascular Aneurysm Repair (EVAR) 1 trial [18]. It randomized 543 patients to endovascular repair, and 539 to traditional open repair; all of the patients were candidates for open repair. After 3 years, the all-cause mortality was identical in the two groups (28%) [18]. The EVAR 2 trial [19] compared endovascular repair with watchful waiting in unfit patients, who were not candidates for open repair. The results came as a surprise in that the mortality rates in both groups were similar after 4 years (62% for EVAR, and 66% for the no treatment group). In addition, the 30-day mortality rate after EVAR in this group was high at 9%. Although these multi-centre, randomized, controlled trials have provided level 1 evidence for endoluminal repair, the interpretation of the results remains controversial [18,20], and depends on one's perspective.

Health economists and purchasers of healthcare may believe that EVAR is more expensive and may not be better than open repair and the justification for the procedure can be questioned. In contrast, many vascular surgeons feel able to offer EVAR to patients in light of the results. EVAR remains a suitable option for patients who are unfit for open repair. As costs decrease and the technology improves, EVAR is likely to be performed in even more patients.

Disadvantages of EVAR

The initial enthusiasm for the technique was based on the fact that it was minimally invasive and avoided conventional open surgery. EVAR is an alternative treatment modality for AAA. The advantages of EVAR over open repair include the following: faster recovery time, and hence shorter time away from activities of daily living; a reduced need for general anaesthesia and intensive therapy beds; avoidance of a laparotomy; fewer disturbances to the patients' homoeostasis; less intra-operative blood loss; and decreased risk of erectile dysfunction.

However, in reality, EVAR is still far from perfect. Complications are not uncommon, such as failure with the stent graft components, including metal strut fractures, fabric flaws, loose ligatures and suture breakages.

A new term "endoleak" came into being; the definition of an endoleak is that there is contrast outside the device, but still contained within the aortic wall [21]. It means that blood is leaking out of the stent graft into the aneurysm sac. Some endoleaks can result in late rupture of the AAA. Table 2 provides a classification of endoleaks.

Table 2. Classification of endoleaks.

Type	Endoleak explanation
Type 1	Graft attachment leaks
1A	Proximal end of endograft
1B	Distal end of endograft
1C	Iliac occluder
Type 2	Retrograde blood flow arising from patient arteries
2A	Inferior mesenteric artery
2B	Lumbar artery
Type 3	Graft defect
3A	Junctional leak or modular graft separation
3B	Fabric disruption
Type 4	Graft wall porosity resulting in flow through fabric of graft
Type 5	Endotension: Sac pressurisation without evidence of an endoleak

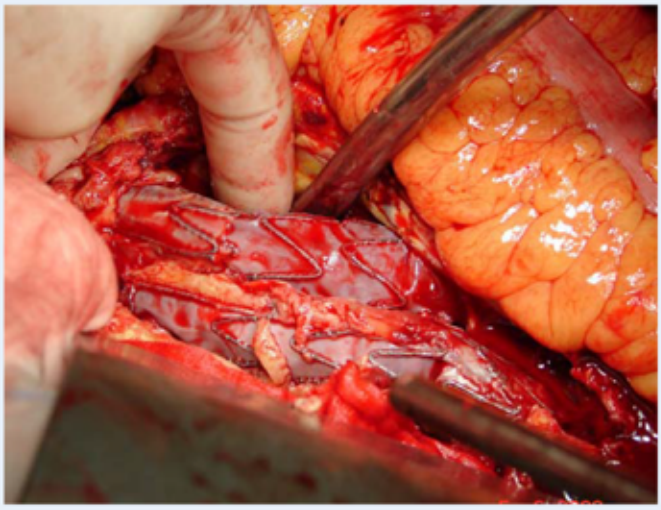

Figure 6. Conversion to open repair after failure of EVAR treatment.

Surveillance and reinterventions

The long-term outcome of EVAR is difficult to predict; therefore vigilant surveillance is indicated in all patients who undergo EVAR, with the aim of detecting endoleaks and preventing late ruptures.

Surveillance modalities include CT, magnetic resonance imaging (MRI), plain radiography and ultrasound. CT is the standard modality used in most centres, although plain radiography with ultrasound is a satisfactory alternative.

Endoleaks are a phenomenon unique to EVAR, and are sometimes associated with aneurysm enlargement and eventual rupture; reintervention is not uncommon in these patients [22]. Continued improvements in stent graft design may reduce the need for secondary interventions, and thereby further reduce aneurysm-related mortality [23].

Open repair

In the presence of EVAR, the role of open surgery in the management of AAA has evolved. Its proven durability has made it a good option in some physically fit patients, and sometimes the only option in AAA with morphology not suitable for EVAR (Figure 6). Moreover, hybrid procedures (combined open and endovascular surgeries) are not uncommon today; it is mainly applied in complicated cases that are difficult to manage with pure open or endovascular techniques. The introduction of endovascular technology has actually broadened the treatment options that vascular surgeons can provide to their patients [24,25].

Conclusion

EVAR is a major advance in the treatment of AAA, and confers a number of advantages, including the use of only

local or regional anaesthesia, with less postoperative pain, and a shorter hospital stay. The benefits have been proven in a number of studies with level 1 evidence.

However, EVAR is still far from perfect. Not all AAA patients are suitable for EVAR. Complications like endoleaks, graft migration, and the need for secondary interventions are very common. Durability of the stent graft is still a concern. Therefore life-long surveillance is always necessary. In some cases, open repair is necessary, and is sometimes the only option.

EVAR is actually complementing open surgery in the overall management of AAA. Vascular surgeons now have a full range of treatment options available, including open repair, EVAR, or a hybrid procedure. It is a tailor-made approach based on an individual patient's age, fitness, preference, and AAA morphology. Advances in endovascular technology have strengthened the armamentarium of surgeons in dealing with vascular disease.

References

1. Cheng SW, et al. Abdominal aortic aneurysm in Hong Kong: audit from a teaching hospital (1975–1995). *Chinese Medical Journal* 1998;111(5):457–9.
2. Lederle FA, Simel DL. The rational clinical examination. Does this patient have abdominal aortic aneurysm? *J Am Med Assoc* 1999;281:77–82.
3. Lederle FA, et al. Relationship of age, gender, race, and body size to infrarenal aortic diameter. *J Vasc Surg* 1997;26:595–601.
4. Wassef M, et al. Pathogenesis of abdominal aortic aneurysms. *J Vasc Surg* 2001;34:730–8.
5. Rasmussen TE, et al. Human leukocyte antigen class II immune response genes, female gender, and cigarette smoking as risk and modulating factors in abdominal aortic aneurysms. *J Vasc Surg* 2002;35:988–93.
6. van Vlijmen CJ, et al. Familial abdominal aortic aneurysm. *Eur J Vasc Endovasc Surg* 2002;24:105–16.
7. US Preventive Services Task Force. Screening for abdominal aortic aneurysm: recommendation statement. *Ann Intern Med* 2005;142:198–202.
8. The United Kingdom Small Aneurysm Trial Participants. Long-term outcomes of immediate repair compared with surveillance of small abdominal aortic aneurysms. *N Engl J Med* 2002;346:1445–52.
9. Lederle FA, et al. Immediate repair compared with surveillance of small abdominal aortic aneurysms. *N Engl J Med* 2002;346:1437–44.
10. Hertzer NR, et al. Open infrarenal abdominal aortic aneurysm repair. *J Vasc Surg* 2002;35:1145–54.
11. Parodi JC, et al. Transfemoral intraluminal graft implantation for abdominal aortic aneurysms. *Ann Vasc Surg* 1991;5:491–9.
12. Brewster DC, et al. Initial experience with endovascular aneurysm repair: comparison of early results with outcome of conventional open repair. *J Vasc Surg* 1998;27:992–1003.
13. Armon MP, et al. Anatomical suitability of abdominal aortic aneurysms for endovascular repair. *Br J Surg* 1997;84:178–80.
14. Katzen BT, et al. Endovascular repair of abdominal and thoracic aortic aneurysms. *Circulation* 2005;112:1663–75.
15. Moore WS, et al. Five-year interim comparison of the Guidant bifurcated endograft with open repair of abdominal aortic aneurysm. *J Vasc Surg* 2003;38:46–55.
16. Lee WA, et al. Perioperative outcomes after open and endovascular repair of intact abdominal aortic aneurysms in the United States during 2001. *J Vasc Surg* 2004;39:491–6.
17. Elkouri S, et al. Perioperative complications and early outcome after endovascular and open surgical repair of abdominal aortic aneurysms. *J Vasc Surg* 2004;39:497–505.
18. The EVAR Trial Participants. Endovascular aneurysm repair versus open repair in patients with abdominal aortic aneurysm (EVAR trial 1). *Lancet* 2005;365:2179–86.
19. The EVAR Trial Participants. Endovascular aneurysm repair and outcome in patients unfit for open repair of abdominal aortic aneurysm (EVAR trial 2). *Lancet* 2005;365:2187–92.
20. Blankensteijn JD, et al. Two-year outcomes after conventional or endovascular repair of abdominal aortic aneurysms. *N Engl J Med* 2005;352:2398–405.
21. White GH, et al. Endoleak—a proposed new terminology to describe incomplete aneurysm exclusion by an endoluminal graft. *J Endovasc Surg* 1996;3:124–5.
22. Fransen GA, et al. Rupture of infra-renal aortic aneurysm after endovascular repair: a series from EUROSTAR registry. *Eur J Vasc Endovasc Surg* 2003;26:487–93.
23. Torella F. Effect of improved endograft design on outcome of endovascular aneurysm repair. *J Vasc Surg* 2004;40:216–21.
24. Gilbert U, Schaub TA. Abdominal aortic aneurysm. *Am Fam Physician* 2006;73:1198–204,1205–6.
25. Davis M, Taylor PR. Endovascular infrarenal abdominal aortic aneurysm repair. *Heart* 2008;94:222–8.

Q&A

Answer these on page 17 or make an online submission at: www.hkmacme.org

Please indicate whether the following questions are true or false

1. AAA is rarely seen in Hong Kong.
2. Cigarette smoking elicits an increased inflammatory response within the aortic wall.
3. The US guidelines recommend one-time screening with ultrasound for AAA in men 65–75 years of age who have ever smoked.
4. Ultrasound has a sensitivity and specificity approaching 100% and 96%, respectively, for the detection of infrarenal AAA.
5. Surgery on AAAs <5.5 cm did not confer any survival advantages
6. Only around 50% of AAAs can be treated with EVAR; open repair is still necessary in many cases.
7. Traditional open AAA repair and EVAR are both associated with high reintervention rates, and life-long surveillance is necessary.
8. In endovascular AAA repair, the stent graft is made of either polyester, or polytetrafluoroethylene attached to a metal stent.
9. In endovascular AAA repair, the best results are achieved by covering the aorta from immediately below the renal arteries to the iliac bifurcations on each side.
10. The definition of an endoleak is that there is contrast outside the device, and outside the aortic wall.

ANSWERS TO DECEMBER 2009

Practical approach to the management of cough in adults

1. True	2. False	3. True	4. False	5. True
6. True	7. False	8. False	9. False	10. False