

# Advances in management of abdominal aortic aneurysms

## Key points

- Abdominal aortic aneurysms (AAAs) predominantly affect men aged over 65 years, with a prevalence of 10% in men aged over 80 years.
- AAA is the third most common cause of sudden death in older men, after myocardial infarction and stroke.
- Most AAAs are asymptomatic and are incidentally diagnosed.
- Medical management of cardiovascular risk factors, including use of antiplatelet agents and statins, is an important part of care.
- Endovascular aneurysm repair (EVAR) has become the modality of choice for repair of AAAs above a threshold diameter.
- EVAR has lower perioperative mortality and morbidity than open repair, but there is no difference in mid- and long-term mortality; EVAR is associated with more re-interventions and requires lifelong surveillance.

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Management of abdominal aortic aneurysms is guided by aneurysm diameter and symptoms. Patients with small asymptomatic aneurysms require regular surveillance for aneurysm enlargement and risk factor control. Endovascular repair has become the treatment modality of choice for most patients with aneurysms above a threshold diameter.

**A**bdominal aortic aneurysms (AAAs) are a common incidental finding in older men. This article outlines the modern management of AAA, which has expanded the potential of repair to include patients with significant comorbidities. The medical management of patients with an AAA is also discussed, as it comprises an important component of their care.

## EPIDEMIOLOGY AND AETIOLOGY

AAAs are defined as focal dilatations of the abdominal aorta resulting in an increase in diameter of at least 50% compared with the expected normal diameter. In practice, this equates to a 3 cm-diameter aorta being defined as aneurysmal. AAAs are more common with increasing age, male sex (male to female ratio of 5:1), the presence of chronic obstructive pulmonary disease (COPD), smoking,

hypertension, family history of aortic aneurysm, genetic predisposition and white race. There is an inverse correlation between AAA and the presence of diabetes. The prevalence of aneurysms increases with age, with AAAs being found in 5% of 65-year-old and 10% of 80-year-old men.<sup>1</sup>

The main risk of an AAA is rupture; however, the incidence of ruptured AAA is falling. Proposed reasons include increased diagnosis of small aneurysms, improved medical management of cardiovascular risk factors and the decline in smoking rates. It may also be related to a possible reduction in the incidence of aneurysms in developed countries.

## PATHOPHYSIOLOGY

Traditionally, aneurysms were thought to result predominantly from atherosclerosis of the infrarenal aorta. However, recent advances in

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vascular biology have demonstrated that chronic inflammation and proteolysis are the key processes leading to the development of AAA. Additional factors, such as depletion of vascular wall smooth muscle cells, haemodynamic factors, molecular genetics and angiogenesis are also thought to contribute.<sup>2</sup>

### CLINICAL FEATURES

Most AAAs are asymptomatic and diagnosed on ultrasound or CT examination as an incidental finding during the investigation of another condition. Occasionally, large aneurysms can cause abdominal tenderness, abdominal, back, flank or groin pain or lower limb emboli. They may also be discovered as a midline pulsatile mass on abdominal examination.

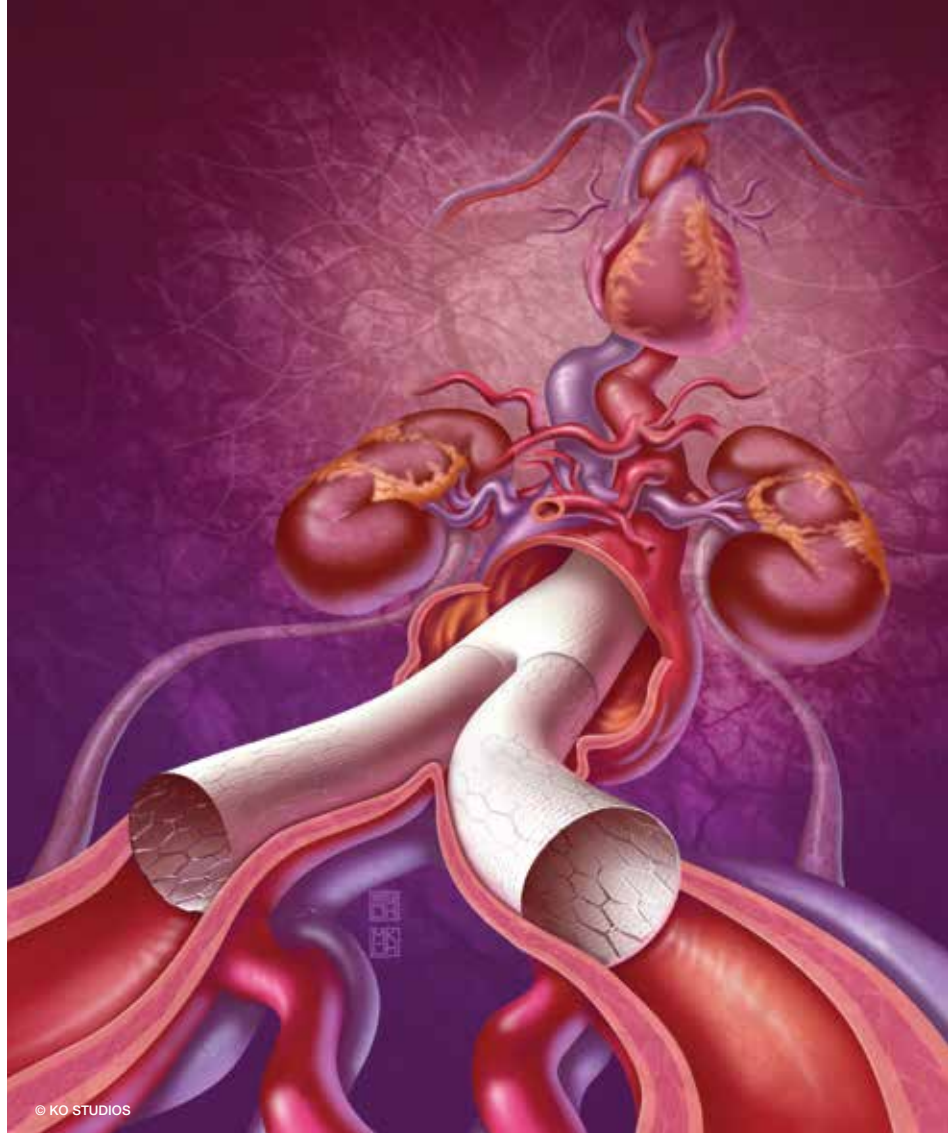
A ruptured AAA classically presents with abdominal or back pain, hypotension, syncope and a pulsatile abdominal mass.

### REFERRAL GUIDELINES

Any patient with a new diagnosis of AAA should be referred to a vascular surgeon for advice and assessment, with the urgency of the referral guided by the symptoms and diameter of the aneurysm. In the absence of any imaging results, the first-line investigation is an arterial duplex ultrasound examination to confirm the diagnosis and axial diameter (Figure 1).

Management depends predominantly on the diameter of the AAA, as follows.

- Patients with a small AAA thought to be suitable for future repair will be entered into a surveillance program, undergoing ultrasound surveillance at regular intervals until the threshold for repair is reached (5.5 cm, or 5.0 cm in certain patient groups).
- Patients with a large AAA will undergo assessment with cross-sectional imaging, usually in the form of CT, to assess AAA morphology and plan treatment by endovascular or open means (Figures 2 and 3).
- Contraindications to repair include significant comorbidities or a life expectancy of less than three years. An opinion on patient suitability for repair should be sought from a vascular surgeon in all cases.



After the patient has been diagnosed and referred to a vascular surgeon then primary care management should focus on commencement and maintenance of medical therapy.

### MANAGEMENT

#### Medical management

In terms of cardiovascular risk, patients with AAA should be considered equivalent to those with coronary heart disease, and all cardiovascular risk factors should be addressed (i.e. secondary prevention strategies). This includes smoking cessation and treatment of dyslipidaemia, hypertension and diabetes. There is good evidence to support the use of antiplatelet agents and statins in all patients with an aneurysm, as these drugs are associated with a significant reduction in major cardiovascular events (stroke and myocardial infarction).

#### Surveillance of small AAAs

Following referral to a vascular surgeon and instigation of medical management, patients with small aneurysms (less than 5.5 cm

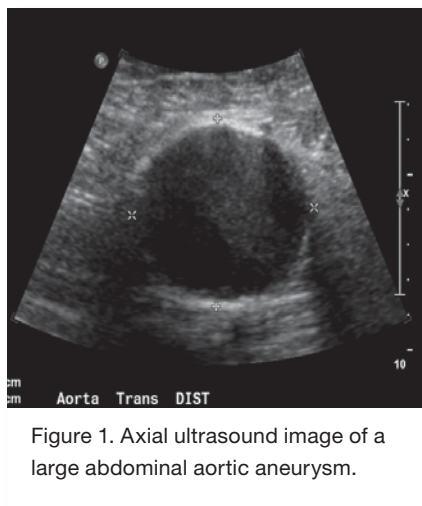


Figure 1. Axial ultrasound image of a large abdominal aortic aneurysm.

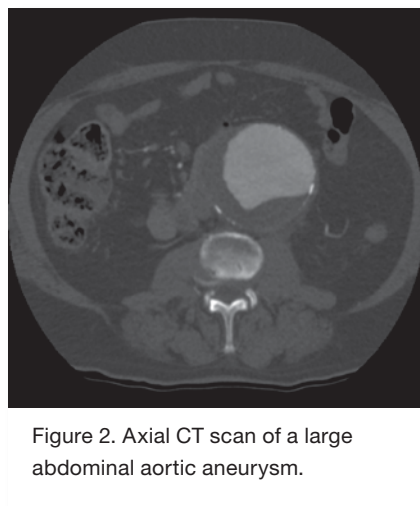


Figure 2. Axial CT scan of a large abdominal aortic aneurysm.



Figure 3. CT three-dimensional reconstruction of a large abdominal aortic aneurysm.

diameter in most patients) should be entered into a regular ultrasound surveillance program. These programs are usually run by hospital vascular units. In some circumstances, screening could be performed in primary care if a robust system is in place that triggers a referral when the aneurysm approaches the threshold diameter.

A recent meta-analysis suggests that the following surveillance intervals are safe in the management of small AAAs:

- 3.0 to 3.9 cm diameter, several-year intervals
- 4.0 to 4.9 cm diameter, one-year intervals
- 5.0 to 5.4 cm diameter, six-month intervals.<sup>3</sup>

However, these intervals are longer than those currently used in the UK AAA screening program, and in clinical practice the surveillance intervals are usually half those quoted.

### Aneurysm repair

AAA repair is considered when the AAA reaches a threshold diameter or exhibits concerning features. Indications for AAA repair include:

- AAA diameter of 5.5 cm or more in men with average perioperative risk
- AAA diameter of 5.0 cm or more in men with low perioperative risk and in women

- rapid expansion of a small AAA (0.5 cm or more over six months)
- the development of symptoms.

The primary goal of AAA repair is to prevent aneurysm rupture with the lowest associated morbidity and mortality possible. Two treatment options are currently available: open surgical repair and endovascular aneurysm repair (EVAR). Treatment is highly individualised and utilises a multidisciplinary approach.

#### Open surgical repair

Traditional open surgery using an inlay graft has been the ‘gold standard’ treatment for AAAs for over 50 years. Although the technical success of this operation has been fully optimised, it has been associated with mortality rates of up to 10%. Recent improvements in the delivery of vascular surgery have driven mortality rates below 5%, and in low-risk patients, open repair may be as safe as EVAR with the advantage of greater durability.<sup>4</sup>

Typically, open repair is offered to:

- young patients
- patients who are anatomically unsuitable for EVAR
- patients who are unable to comply with the lifelong postoperative surveillance necessary following EVAR.

Open repair involves a laparotomy, cross-clamping of the aorta and graft placement, possible blood transfusion and

postoperative intensive care unit admission. Transverse and retroperitoneal approaches are used in some centres. Hospital stay is typically seven to 10 days, and the return to preoperative levels of activity can take several months.

#### Endovascular aneurysm repair

EVAR involves accessing the aneurysm from a peripheral vessel (usually the femoral artery), and placing an endograft inside the aneurysm to exclude it from the circulation. The principal advantage of EVAR centres on its significantly lower perioperative mortality and morbidity, as demonstrated in three randomised controlled trials, the EVAR 1 trial, the Dutch Randomised Endovascular Aneurysm Management (DREAM) trial and the US OVER trial.<sup>5-7</sup> In addition, there is no cross-clamping of the aorta; blood transfusion and intensive care admission are rarely needed; and hospital admission is of shorter duration, with a quicker return to activities.

The EVAR 1 trial randomly allocated patients to EVAR or open repair and found a 30-day mortality rate of 1.7% in the endovascular group compared with 4.7% in the open repair group.<sup>5</sup> This benefit in



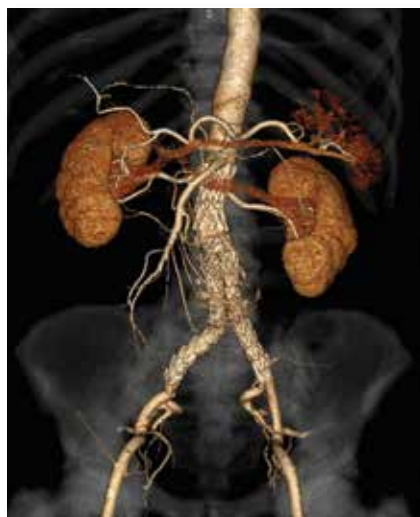


Figure 4. CT scan after endovascular aneurysm repair showing a stent graft. Uncovered stents extend across the renal arteries.

AAA-related mortality was sustained in the initial few years of the study, but was lost by six years, primarily because of fatal endograft ruptures. This highlights the necessity of ongoing surveillance even many years after repair.

The most recent Cochrane meta-analysis comparing all EVAR trials similarly reported significant short-term benefits in mortality that were not maintained over intermediate and long-term follow-up periods.<sup>8</sup> Most deaths were due to cardiac and other unrelated causes, highlighting the age and comorbidity profile in these patients, irrespective of the repair modality chosen.

### Follow up

Following open repair most patients are discharged from follow up after one or two outpatient reviews. Sexual dysfunction is common after open (and endovascular repair) and is probably underreported. Late complications of open surgery may include incisional hernias. The rare complication of an aorto-enteric fistula should be considered in any patient with a history of AAA presenting with an upper gastrointestinal bleed.

**TABLE 1. ABDOMINAL AORTIC ANEURYSM DIAMETER AND RISK OF RUPTURE**

Diameter (cm)	Annual risk of rupture (%)
< 4	<0.5
4 to <5	0.5 to 3
5 to <6	3 to 15
6 to <7	10 to 20
7 to <8	20 to 40
≥8	30 to 50

Following EVAR, patients undergo life-long surveillance either by ultrasound or CT (Figure 4). This is to monitor the structural integrity of the graft, anatomical position and leaks that can occur around the stent (endoleak). Several scans are performed in the first year and then annually thereafter.

### COMMON PATIENT QUESTIONS

#### Are AAAs dangerous?

Most AAAs are asymptomatic. In rare instances, they can cause distal emboli, but the principal risk is rupture. Three-quarters of patients who have a ruptured AAA die before reaching hospital, and the overall in-hospital mortality is 50%. Aneurysm diameter is the best predictor of rupture, with rupture rare in small AAAs (<5.5 cm). As mentioned above, patients with AAA are also at risk of major cardiovascular events, such as myocardial infarction and stroke, and need optimal medical management of cardiovascular risk factors irrespective of aneurysm diameter.

#### What is the risk of rupture?

Although the diameter of an AAA is the best predictor of rupture risk, rupture is influenced by many additional factors. Risk of rupture has been estimated from population-based epidemiological studies as well as trials looking at interventions for small aneurysms and is not entirely predictable (Table 1). However, most trials involving patients with small AAAs (<5.5 cm) found that the annual risk of rupture was no

greater than 1%. For example, the UK Small Aneurysm Trial (UKSAT) found the annual risk of rupture to be 0.3% for AAAs <3.9 cm, 1.5% for those measuring 4 cm to 4.9 cm and 6.5% for those measuring 5 cm to 5.9 cm.<sup>9</sup>

Aneurysm expansion appears to be exponential, with more rapid expansion in aneurysms larger than 5.5 cm in diameter.<sup>10</sup> A small aneurysm that expands 0.5 cm or more over a six-month period is considered to be at higher risk of rupture.

#### Why not repair small aneurysms rather than waiting until they reach 5.5 cm?

The only intervention proven to prevent death from AAA rupture is repair by surgical or endovascular techniques. To balance operative mortality, elective surgical repair is not offered until the risk of rupture exceeds the risk of operative mortality. Traditionally this occurred when the AAA diameter exceeded approximately 5.5 cm. This rationale has been formalised by two large randomised controlled trials, UKSAT and the Aneurysm Detection and Management (ADAM) study.<sup>9,11</sup> As well as confirming the low rupture risk in small AAAs, these trials failed to show any advantage of early open surgery in small (<5.5 cm) AAAs compared with ultrasound surveillance.

Endovascular repair, with its lower peri-operative mortality compared with open surgery, has prompted the re-evaluation of the threshold diameter of 5.5 cm for

intervention in average-risk patients. Once again two randomised controlled trials, CAESAR and PIVOTAL, failed to demonstrate any survival benefit of endovascular repair of small AAA, and the threshold remains 5.5 cm.<sup>12-14</sup>

Patients whose AAA is causing symptoms (abdominal tenderness or otherwise unexplained abdominal pain) or is rapidly expanding and in some cases women may be offered repair below this threshold. In Australia, men at low perioperative risk are also frequently offered intervention for AAAs at 5.0 cm diameter.

### Can anything else be done to prevent aneurysm rupture?

Several additional factors have been identified as being associated with increased rupture risk, including smoking, hypertension, COPD, family history and rapid expansion of the AAA. Although a biomechanical and haemodynamic element contributes to aneurysm rupture, there is no evidence to recommend avoiding moderate exercise. The dominant processes that determine aneurysm rupture are biochemical, inflammatory and proteolytic. There is some indirect evidence that in addition to smoking cessation and blood pressure control, statin use may retard AAA expansion, again highlighting the importance of medical management in patients with an AAA.

### Is AAA hereditary?

A strong familial relationship exists with AAA, with a 30% incidence in siblings of patients with an AAA, but no single mode of inheritance has been identified. As such, it is recommended that all first-degree relatives undergo ultrasound screening for AAA at around the age of 50 years.

### What are the implications of an AAA for driving?

Patients with an untreated AAA cannot hold an unconditional driving licence. However, a conditional licence may be considered for those with aneurysms less than 5 cm pending periodic (private

licence) or annual (commercial licence) review. Following aneurysm repair, a conditional licence may be considered depending on recovery after four weeks (private) or three months (commercial).<sup>15</sup>

### AAA SCREENING

The role of ultrasound screening in reducing aneurysm-related mortality was investigated by the Multicentre Aneurysm Screening Study (MASS).<sup>16</sup> This randomised controlled trial found that screening was associated with an increase in elective AAA repair, a 50% reduction in ruptured aneurysm surgery and a 53% reduction in aneurysm-related mortality. Certain countries, such as the UK and Sweden, have subsequently introduced screening programs involving a single ultrasound examination in men aged over 65 years. There is no proven benefit in screening women or in re-screening men at a later date who have a normal aortic diameter on initial screening.

The benefit and logistics of screening depend on population density and geographical location, which may explain in part why there is currently no screening program in Australia. Recently the apparent decline in AAA prevalence has raised doubts regarding the economic benefits of screening. However, the latest study to address these concerns in England suggests that the National Health Service screening program remains cost-effective.<sup>17</sup>

### THE FUTURE

The scope for EVAR continues to expand with technological advancements and incorporation of new technology resulting in endovascular treatment of aneurysms with more complex morphology. Fenestrated and branched stent grafts are being used for aneurysms involving the renal and visceral vessels. EVAR can also be successfully used in the treatment of ruptured AAAs. Current interest surrounds new technology based on sealing the aneurysm sac with polymer, which may expand the number of patients suitable for endovascular treatment even further.

Since the 1960s, the quest has continued for a pharmacological agent that retards aneurysm growth. Current research focuses on the role of statins and ACE inhibitors in inhibiting aneurysm expansion.

### CONCLUSIONS

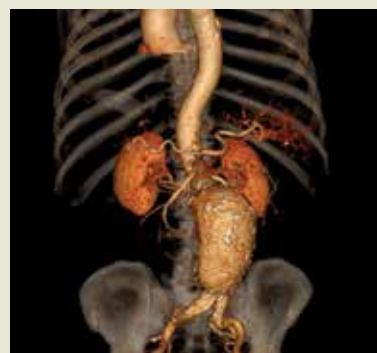
AAAs are a common and treatable cause of sudden death in older men. In addition to managing the aneurysm, medical management of cardiovascular risk factors plays an important role. Significant advances in endovascular technology have expanded the scope of repair to include patients who would previously have been precluded from open surgery. Despite these advances, EVAR remains an evolving technology, and long-term data suggest that rupture is still possible, highlighting the importance of long-term surveillance. **MT**

### REFERENCES

A list of references is included in the website version ([www.medicinetoday.com.au](http://www.medicinetoday.com.au)) and the iPad app version of this article.

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