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Abdominal aortic aneurysms

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Abstract

Vascular surgery is a relatively new surgical sub-speciality in the UK, with treatment of abdominal aortic aneurysms forming a substantial proportion of the emergency and elective caseload. This article summarises the guidance from the National Institute of Health and Care Excellence and the European Society for Vascular Surgery that outlines the epidemiology, diagnosis and management of abdominal aortic aneurysms. This is important for both vascular and non-vascular trainees to understand because of the critical nature of the disease, which can cause catastrophic haemorrhage, limb loss and mortality. However, if discovered in time, abdominal aortic aneurysms are a very treatable condition.

Key words: Abdominal; Aneurysm; Aortic; Surgery; Vascular

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Definition

Abdominal aortic aneurysms are segmental, full thickness dilatations of the abdominal aorta by more than 50% of its normal diameter. Aortic diameter varies with age, sex, ethnicity and body weight. With a maximum normal aortic diameter of 2.1 cm, abdominal aortas are considered aneurysmal once the diameter is more than 3 cm (Erbel and Eggebrecht, 2006).

Epidemiology

Since most abdominal aortic aneurysms are asymptomatic, calculation of prevalence is problematic. Prevalence is negligible before the age of 50 years and steadily increases with age thereafter (Sampson et al, 2014), with UK population screening studies suggesting a prevalence of 1.3% in men who are 65 years of age (National Institute of Health and Care Excellence, 2020). The prevalence is six times greater in men than women (Vardulaki et al, 2000). Ruptured abdominal aortic aneurysms are a major cause of morbidity and mortality and account for 2.1% of all deaths in men over the age of 65 years in the UK (Vardulaki et al, 2000). Meta-analysis of the deaths attributed to ruptured abdominal aortic aneurysms show a pooled total mortality of 82% with roughly 32% occurring before the patient reaches hospital, and in patients that do reach hospital, perioperative mortality is approximately 53% (Reimerink et al, 2013). The risk of aneurysm rupture is proportional to aneurysm diameter; as the diameter increases, the stress on the aortic wall increases (Table 1).

Table 1. Abdominal aortic aneurysm size and annual risk of rupture

Abdominal aortic aneurysm diameter (cm)	Risk of rupture (%)
<4.0	0
4.0–4.9	0.5–5
5.0–5.9	3–15
6.0–6.9	10–20
7.0–7.9	20–40
≥8.0	30–50

From Ullery et al (2018)

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Pathophysiology

Classically, aneurysm formation was thought to be the result of atherosclerosis, but present understanding reveals a degenerative disease with genetic and environmental influences. Histologically, there is destruction of the elastin, collagen and smooth muscle within the tunica media and adventitia and infiltration by macrophages and phagocytes (López-Candales et al, 1997). Smoking is the single largest modifiable risk factor for abdominal aortic aneurysms, with a four-fold greater prevalence in smokers than non-smokers and a greater rate of aneurysm growth (Svensjö et al, 2011). Other established independent risk factors include male sex, age, hypertension (1.6x prevalence) and hyperlipidaemia (1.4x prevalence) (Svensjö et al, 2011). Having a family history of abdominal aortic aneurysms is associated with a more than four-fold increased risk of developing an abdominal aortic aneurysm (Blanchard et al, 2000) whereas, paradoxically, people with diabetes, especially those with type 2 diabetes, have consistently been shown to be at a reduced risk of developing an abdominal aortic aneurysm compared to people who do not have diabetes. The mechanisms behind this relationship are still being investigated but research has shown that the aortic walls of people with diabetes are thicker and more resistant to degradation (Lederle, 2012). Additionally, metformin, used as a treatment for type 2 diabetes, reduces the rate of growth of aortic aneurysms. The mechanism is thought to be via reduced aortic inflammation and extracellular matrix remodelling (Golledge et al, 2017). Rarer causes of abdominal aortic aneurysms are trauma, infections, inflammation and vasculitis.

Presentation

The majority of abdominal aortic aneurysms are asymptomatic but symptomatic aneurysms can present with tenderness over the aneurysm or obstructive symptoms and signs of duodenal, ureteric or inferior vena cava obstruction. Abdominal palpation of a pulsatile mass has a less than 50% sensitivity for detection of abdominal aortic aneurysms (Wanhainen et al, 2019). In emergency cases, patients present with abdominal pain and haemorrhagic shock of rupture or acute limb ischaemia from distal embolisation. In the UK, since 2009 there has been a well-established abdominal aortic aneurysm ultrasound screening programme that men aged 65 years are invited to attend. Screening has been shown to be cost effective and reduce aneurysm-related mortality (Scott, 2002). The safe surveillance frequencies for patients with diagnosed sub-threshold abdominal aortic aneurysms are shown in Table 2.

Asymptomatic aneurysms are detected incidentally in 1% of abdominal imaging (computed tomography, ultrasound or magnetic resonance imaging scan) with alternative pathological indications (van Walraven et al, 2010). If the aneurysm is subthreshold (<5.5 cm) then the patient should be referred to the vascular service as an outpatient. If ≥5.5 cm, the patient should be referred as an urgent outpatient. If larger than 7 cm, it would be prudent to discuss the patient with the inpatient vascular service, to expedite preoperative assessment and potential surgery (Wanhainen et al, 2019). An aneurysm undergoing rapid growth (>1 cm/year) is at higher risk of rupture and, in the first instance, should be rescanned within 2 weeks to mitigate against measurement errors. Aneurysm screening in women is currently not recommended because of the low prevalence of disease in the female population. However, women are four times more likely to rupture a small abdominal aortic aneurysm, which is thought to be a result of their larger relative aortic size compared to their body size. In women, aneurysm size relative to body surface area is more predictive of rupture than aneurysm size alone (Lo et al, 2014). Given the lack of clear evidence,

Table 2. Surveillance frequencies for sub-threshold abdominal aortic aneurysm

Diameter (cm)	Surveillance frequency
3.0–3.9	3 years
4.0–4.9	1 year
>5.0	3–6 months

From Bown et al (2013)

and that women have a higher operative mortality rate than men, the European Society for Vascular Surgery advises considering elective abdominal aortic aneurysm repair in women with aneurysms ≥5.0 cm in diameter (Wanhainen et al, 2019). Any patient with a symptomatic aneurysm should be referred to the vascular service urgently as an inpatient for further investigation, which might warrant urgent repair.

Management

Conservative and medical management of all abdominal aortic aneurysms involves reducing cardiovascular risk with exercise, healthy diet, smoking cessation and antiplatelet, lipid lowering and antihypertensive therapy (Wanhainen et al, 2019). Surgical management of small, asymptomatic aneurysms measuring <5.5 cm in diameter is guided by two large multicentre randomised control trials of open surgery against surveillance (American Aneurysm Detection and Management study (Lederle et al, 2002) and the UK Small Aneurysm Trial (Powell et al, 1998)), along with two smaller studies of endovascular repair against surveillance (Positive Impact of endoVascular Options for Treating Aneurysms earLy (Ouriel, 2009) and the Comparison of surveillance vs. Aortic Endografting for Small Aneurysm Repair (Cao et al, 2011)). A 2015 Cochrane review of all four studies showed that there was no significant difference in long-term survival between the repair and surveillance groups with conservative management both safe and cost effective (Filardo et al, 2015). Surveillance is therefore recommended for the majority of patients with abdominal aortic aneurysms 3–5.5 cm in diameter.

Patients with abdominal aortic aneurysms measuring >5.5 cm in diameter are therefore considered for elective open surgical repair (Figure 1) or endovascular aneurysm repair (Figures 2 and 3) depending on the patient's fitness for surgery and aortic anatomy. The EVAR-1 trial showed a two-thirds reduction in 30-day operative mortality when comparing elective endovascular aneurysm repair to open surgical repair for abdominal aortic aneurysms larger than the 5.5 cm threshold (Greenhalgh, 2004). This initial early mortality benefit was

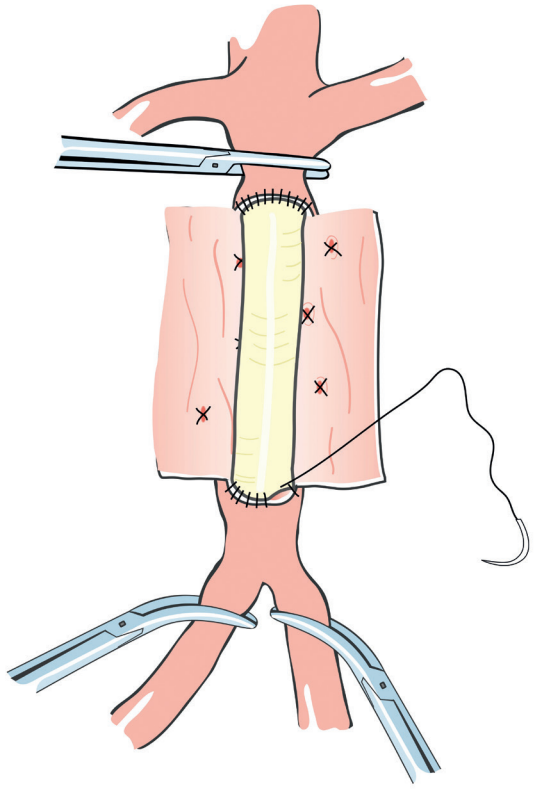

Figure 1. Open abdominal aortic aneurysm repair.

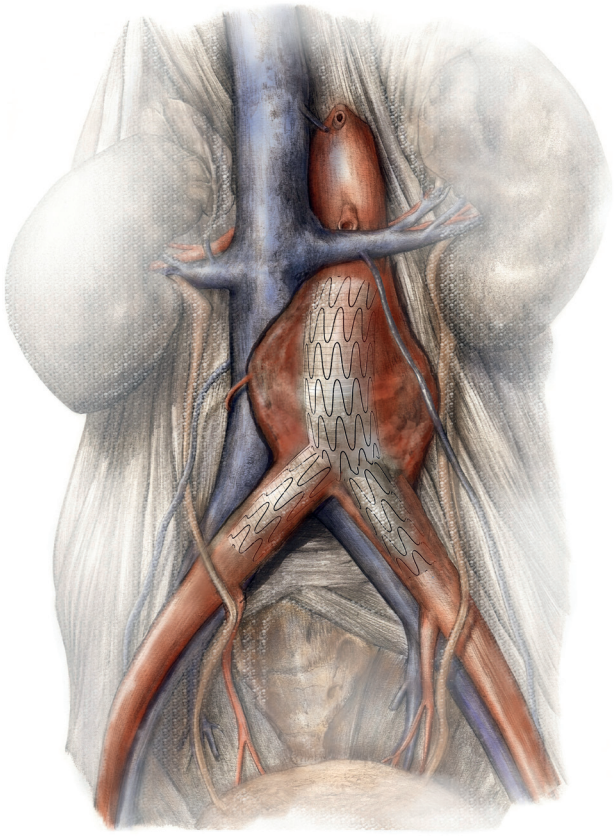

Figure 2. Endovascular aneurysm repair.

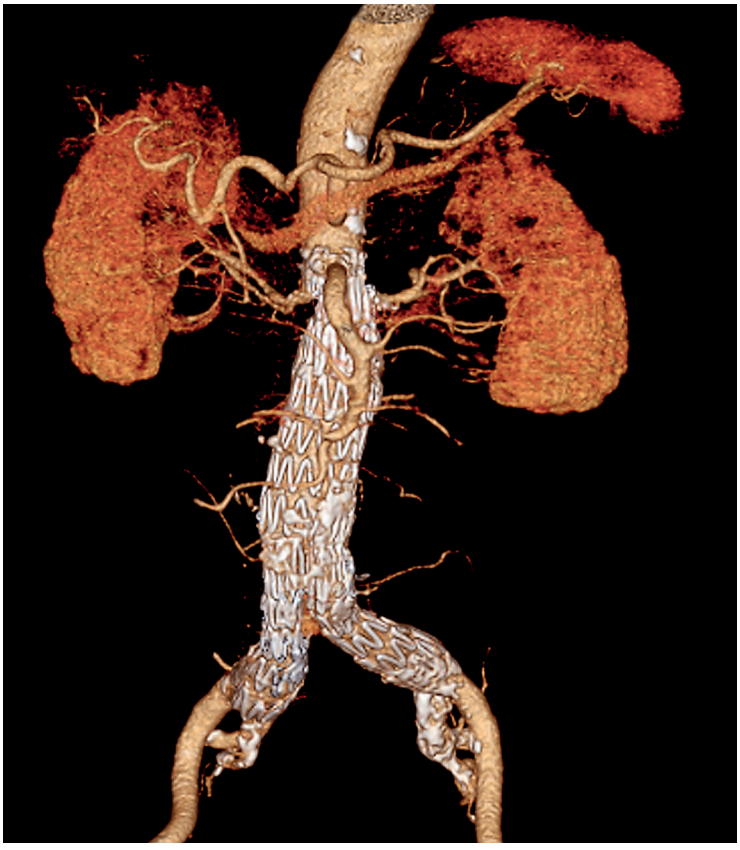

Figure 3. Three-dimensional computed tomography reconstruction of an endovascular aneurysm repair.

lost by 2 years, with elective endovascular aneurysm repairs associated with an increased risk of re-intervention as a result of endoleaks. These occurred in up to one-third of cases, and 32% of these endoleaks required re-intervention (Lal et al, 2015).

Additionally, the EVAR-2 trial showed that endovascular aneurysm repair had a considerable 30-day mortality in patients who were unfit for open surgical repair and although endovascular aneurysm repair reduced aneurysm-related mortality, it did not improve overall mortality over no intervention (Greenhalgh, 2005). Owing to the poor long-term outcomes for endovascular aneurysm repair and associated expenses of reintervention, the National Institute of Health and Care Excellence published new guidelines on the management of abdominal aortic aneurysm in March 2020, advising that elective open surgical repair should be offered to most patients unless contraindicated by abdominal copathology such as hostile abdomens from previous surgery, stomas, horseshoe kidneys, or anaesthetic or medical comorbidities. Elective endovascular aneurysm repair should then be considered in these contraindicated or high-risk cases (National Institute of Health and Care Excellence, 2020). For emergency ruptures, either endovascular aneurysm repair or open surgical repair can be attempted but endovascular aneurysm repair has some benefit over open surgical repair in all women and in men aged over 70 years (Ulug et al, 2018). Overall 5-year survival following elective abdominal aortic aneurysm repair is 69%, with the most common causes of late death following abdominal aortic aneurysm repair being ischaemic heart disease, pulmonary disease and lung cancer (Bahia et al, 2015).

Conclusions

With the improvement of vascular technologies, the management of abdominal aortic aneurysms will continually evolve and this will be represented in updated published guidelines. Long-term research is needed to create a predictive objective risk stratification tool to assess and determine patient suitability to undergo open surgical repair vs endovascular aneurysm repair vs turn down from surgery to optimise the benefits of each treatment modality. With a greater understanding of the genetic and cellular basis for aneurysm development, targeted pharmaceutical therapies can be developed to slow aneurysm growth. Uncertainty regarding thresholds for treatment in women and specific ethnic groups warrants further investigation, showing there is plenty of scope for further discovery in the specialty.

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Key points

- The risk of abdominal aortic aneurysm rupture is proportional to the diameter of the aneurysm.
- Patients with abdominal aortic aneurysms measuring 3–5.4 cm in diameter should be kept under surveillance.
- Patients with abdominal aortic aneurysms growing >1 cm/year need to be rescanned within 2 weeks.
- Patients with abdominal aortic aneurysms measuring >5.5 cm in diameter should be considered for elective open surgical repair.
- If open surgical repair is contraindicated, or the patient has a high anaesthetic or medical risk, then endovascular aneurysm repair should be considered.
- Patients with symptomatic abdominal aortic aneurysms need urgent vascular review for assessment for urgent or semi-urgent surgery.
- Ruptured aneurysms can be treated with open surgical repair or endovascular aneurysm repair.

Curriculum checklist

This article addresses the following requirements from the general internal medicine training curriculum:

- Managing an acute unselected take
- Managing patients in an outpatient clinic, ambulatory or community setting, including management of long-term conditions
- Managing medical problems in patients in other specialties and special cases

Conflicts of interest
The authors declare that there are no conflicts of interest.

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