

## Abdominal aortic aneurysms

See also the separate [Ruptured aortic aneurysm](#) and [Aortic dissection](#) articles.

### What is an abdominal aortic aneurysm?

An aneurysm is a permanent and irreversible dilatation of a blood vessel by at least 50% of the normal expected diameter.<sup>[1]</sup> Aortic aneurysms are classified as abdominal (the majority) or thoracic.

An aneurysm is caused by degradation of the elastic lamellae, a leukocytic infiltrate, enhanced proteolysis and smooth muscle cell loss. The dilatation affects all three layers of the arterial wall. A false aneurysm (pseudoaneurysm) is caused by blood leaking through the arterial wall but contained by the adventitia or surrounding perivascular tissue.

The 'normal' diameter of the abdominal aorta is approximately 2 cm; it increases with age. An abdominal aneurysm is usually defined as an aortic diameter of 3 cm or greater. Most abdominal aortic aneurysms (AAAs) arise from *below* the level of the renal arteries.<sup>[2]</sup>

Thoraco-abdominal aneurysms extend to a variable degree from the thoracic aorta into the abdominal aorta and may affect the origins of the visceral and renal arteries, which must be re-implanted into the graft during repair.

Aortic aneurysms may be associated with aneurysms elsewhere – eg, in an iliac artery or popliteal artery.<sup>[2]</sup> Large and life-threatening AAAs are preceded by a long period of subclinical growth in the diameter of the aneurysm (about 1–6 mm/year on average). The larger the AAA, the higher its growth rate and greater the risk of rupture. The risk of rupture is also greater for women.<sup>[2]</sup>

## How common is abdominal aortic aneurysm? (Epidemiology)<sup>[1]</sup>

- The UK national screening programme (which enrolls men at age 65) suggests a prevalence of about 1.3% in this population. The prevalence is falling.
- The prevalence of AAAs is approximately 6 times lower in women, but the rate of aneurysm rupture is significantly higher.

## Causes of abdominal aortic aneurysm (aetiology)<sup>[2] [3]</sup>

Most have no specific identifiable cause but risk factors include:

- Severe atherosclerotic damage of the aortic wall; however, new evidence suggests this is not the only factor, and aneurysmal disease is probably a distinct arterial pathology.
- Family history – there are probably strong genetic factors. One study reported a positive family history in 10% of patients.<sup>[4]</sup>
- Tobacco smoking is an important factor.
- Male sex.
- Increasing age.
- Hypertension is thought to have a weak link.
- Chronic obstructive pulmonary disease.
- Hyperlipidaemia.
- In population-based studies, people with diabetes have a lower incidence of aneurysms than people without diabetes.

For a minority, there may be a specific cause – for example:

- Trauma.
- Infection – brucellosis, salmonellosis, tuberculosis, HIV.
- Inflammatory diseases – eg, Behçet's disease, Takayasu's disease. Inflammatory aneurysms may have multifactorial pathology.<sup>[5]</sup>

- Connective tissue disorders – Marfan's syndrome, Ehlers-Danlos syndrome type IV.

## Symptoms of abdominal aortic aneurysm (presentation)<sup>[6]</sup>

### Unruptured AAA

- Most patients with unruptured AAA have no symptoms.
- AAA may be an incidental finding on clinical examination, or on scans – ultrasound, CT or MRI. It may sometimes be visible on a plain X-ray film.
- Possible symptoms and signs are:
  - Pain in the back, abdomen, loin or groin:
    - This may be due to pressure on nearby structures. Back pain may be due to erosion of the vertebral bodies.
    - **NB:** severe lumbar pain of recent onset may indicate impending rupture.
  - The patient or doctor may find a pulsatile abdominal swelling
  - Distal embolisation may produce features of limb ischaemia. The appearance of micro-embolic lower limb infarcts in a patient with easily palpable pedal pulses suggests a popliteal or abdominal aneurysm.
  - Ureterohydronephrosis can also occur with AAA.
  - Inflammation or retroperitoneal fibrosis can complicate AAA and may cause symptoms – eg, back pain, weight loss and symptoms related to entrapment of adjacent structures.<sup>[7]</sup>

### Ruptured AAA

- **NB:** the diagnosis may not be obvious. Ruptured AAA should be considered in any patient with hypotension and atypical abdominal symptoms. Similarly, abdominal pain in a patient with a known aneurysm or pulsatile mass must be considered as a possible ruptured or rapidly expanding aneurysm and treated accordingly.
- Ruptured AAA may present with:
  - Pain in the abdomen, back or loin - the pain may be sudden and severe.
  - Syncope, shock or collapse:
    - The degree of shock varies according to the site of rupture and whether it is contained - eg, rupture into the peritoneal cavity is usually dramatic, with death before reaching hospital; whereas rupture into the retroperitoneal space may be contained initially by a temporary seal forming.

See the separate [Ruptured aortic aneurysm](#) article for further details.

## Examination

- Bimanual palpation of the supra-umbilical region can detect 61% of aneurysms >3 cm and 82% of those >5 cm.
- Sensitivity is reduced with increasing waist size.
- There may be an abdominal bruit.
- Clinical signs vary according to whether the aneurysm compresses other structures or ruptures - and, if ruptured, the site and extent of bleeding.
- Retroperitoneal haemorrhage may cause Grey Turner's sign, ie flank bruising.

## Diagnosing abdominal aortic aneurysm (investigations)<sup>[8]</sup> <sup>[9]</sup>

This covers the non-urgent scenario. Investigations aim to evaluate the detailed anatomy of the aneurysm, any treatable causes and the patient's fitness for surgery:

- Blood tests:
  - FBC, clotting screen, renal function and liver function.
  - Cross-match if surgery is planned.
  - ESR and/or CRP if an inflammatory cause is suspected.
- ECG, CXR and possibly lung function tests.
- Scans:<sup>[10]</sup>
  - **Ultrasound** is simple and cheap; it can assess the aorta to an accuracy of 3 mm. It is used for initial assessment and follow-up
  - **CT** provides more anatomical details - eg, it can show the visceral arteries, mural thrombus, the 'crescent sign' (blood within the thrombus, which may predict imminent rupture) and para-aortic inflammation. The National Institute for Health and Care Excellence (NICE) recommends thin-slice contrast-enhanced arterial-phase CT angiography for elective patients or patients with suspected rupture being considered for repair.

## Management of uncomplicated abdominal aortic aneurysm<sup>[10]</sup>

Treatment is discussed in the separate [Ruptured aortic aneurysm](#) and [Aortic dissection](#) articles.

NICE recommends considering repair for unruptured abdominal aortic aneurysm if it is:

- Symptomatic.

- Asymptomatic, larger than 4.0 cm and has grown by more than 1 cm in one year (measured inner-to-inner maximum anterior-posterior aortic diameter on ultrasound).
- Asymptomatic and 5.5 cm or larger (measured inner-to-inner maximum anterior-posterior aortic diameter on ultrasound).

For uncomplicated AAA, small aneurysms (<5.5 cm) are generally monitored and larger ones (5.5 cm or greater) should be considered for surgery. There is no strong evidence to demonstrate any advantage of immediate repair for small AAAs.<sup>[11]</sup>

## Medical management

- Regular ultrasound monitoring – the frequency dictated by the diameter of the aneurysm at the time of detection as per the standard operating procedures of the NHS AAA Screening Programme:<sup>[12]</sup>
  - 3.0-4.4 cm: annual ultrasound.
  - 4.5-5.4 cm: three-monthly ultrasound.
  - 5.5 cm or bigger – consider surgery (see below): or three-monthly ultrasound.
- Treat underlying causes where feasible – eg, infection. Some cases of [periaortitis](#) or retroperitoneal fibrosis may merit treatment with prednisolone or immunosuppressants.<sup>[13]</sup>
- Attention to risk factors:
  - Smoking cessation.
  - Rigorous blood pressure control.
  - Statins – the role of statin therapy in AAA is unproven but statins are advised because AAA patients have increased cardiovascular disease risk.
  - Antiplatelet therapy where appropriate.

- Other medical treatment:
  - NICE recommends that further research should be conducted on the possible effectiveness of macrolides (eg, azithromycin) and metformin in reducing the rate of growth and risk of rupture of small aneurysms.
  - It also recommends further research on the use of tranexamic acid in reducing blood loss and improving survival of patients undergoing the repair of a ruptured AAA.

## **Driving**<sup>[14]</sup>

See the DVLA guide for patients with cardiovascular disorders.

## **Surgery**<sup>[10]</sup>

Indications:

- For all patients with aneurysms of 5.5 cm diameter or greater, consider elective surgical repair (if fit enough for surgery).
- The decision about surgical intervention is based on the risk of surgery versus rupture for each patient. In general, the risk of rupture is mainly determined by the aneurysm diameter but rupture rates are higher in patients who smoke, in females, in those with hypertension and in those with a strong family history.
- Other indications for surgery are rupture, rapid expansion, or onset of sinister symptoms/signs such as back or abdominal pain or tenderness.

## **Types of repair for AAA**

- **Surgical (open) repair:**
  - This is the traditional operation. It involves exposure of the abdominal aorta, aortic and iliac clamping and replacement of the aneurysmal segment with a prosthetic graft. The graft is effective and durable.

- **Endovascular repair of AAA:**
  - Endovascular aneurysm repair (EVAR) involves introducing a stent-graft system through the femoral arteries, which relines the aneurysm, diverts blood flow through the endograft and allows the aneurysm to thrombose. This requires that the aneurysm should have an adequate (1.2 cm) 'neck' below the renal arteries for stent fixation.
  - EVARs may be standard or complex. Complex EVARs involve some variation from standard technique, such as surgeon-modified grafts or the instrumentation of aortic branch vessels.

### **Open surgery or EVAR?**

- For unruptured AAAs which meet the criteria for surgery, offer open repair unless the patient has abdominal co-pathology (eg, stoma, adhesions, horseshoe kidney), anaesthetic risks, and/or medical comorbidities.
- Consider EVAR for patients with unruptured AAAs who have abdominal co-pathology, anaesthetic risks, comorbidities or other issues arising from discussion with the patient which make EVAR the preferred option.
- Complex EVAR is currently being evaluated as part of audit and research trials. It should only be undertaken after detailed discussion with the patient about the pros and cons of the procedure compared to the other options.
- For ruptured AAAs the risk:benefit ratio favours open surgery in men under 70. For men over 70, women of any age, or patients with anaesthetic risks, medical comorbidities or abdominal co-pathology, standard EVAR may be the preferred option. Complex EVAR should only be offered as part of a research trial.

### **Monitoring**

After EVAR, patients should be offered enrolment into a surveillance programme. Consider contrast-enhanced CT angiography or colour duplex ultrasound for assessing AAA diameter and EVAR device limb kinking.



## Prognosis<sup>[9]</sup>

### Natural history<sup>[15]</sup>

- The risk of rupture is mainly determined by aneurysm diameter.
- The average growth rate of AAAs of sizes 30 mm to 55 mm ranges 0.2–0.3 cm/year. Larger AAAs are associated with higher AAA growth rates.
- People with aortic aneurysms are at increased risk of cardiovascular events, mostly unrelated to the aneurysm.

### Elective repair<sup>[16]</sup>

- Long-term survival patterns after elective open repair and EVAR for unruptured AAA vary markedly across patients with different age and comorbidity profiles. Overall, 70% of patients after repair will survive five years.
- Patients with severe cardiorespiratory or renal disease may have high peri-operative mortality rates, and for them the threshold for elective repair may be set at a larger aneurysm diameter.

### Without surgery

The annual survival rate is only 20% for aneurysms larger than 5 cm.

### Ruptured AAA

- The outcome is poor, with approximately 80% overall mortality from ruptured AAA.
- Most patients die before reaching hospital. Surgical repair of ruptured AAA has a mortality of around 50%.

# Screening for abdominal aortic aneurysm<sup>[17]</sup>

Screening by ultrasound is feasible to allow early diagnosis. The idea is to offer a single scan to men aged 65. If negative, this effectively rules out AAA for life. The roll-out of the NHS AAA Screening Programme in England began in 2009. The reference link for this section is for NHS England. Information for AAA screening programmes for Scotland, Wales and Northern Ireland is available on the NHS inform, Public Health Wales and nidirect websites respectively.

The screening programme in England is as follows:

Men aged 65 and over are most at risk of AAAs. Men who are resident in England receive an invitation in the post for screening when they are aged 64 or 65. Men over 65 who have not received an invitation can contact their local AAA screening service to make an appointment.

Any women, or men under 65 who think they are at higher risk (eg, family history of the condition) have the possibility of having a scan outside the screening programme.

- No aneurysm found: aorta is less than 3 cm wide; no further screening or monitoring required.
- Small AAA: aorta measures 3 cm to 4.4 cm; no treatment required apart from healthy lifestyle but follow up scans every year to check its size. Healthy lifestyle advice, such as stopping smoking, eating healthily and exercising regularly, is very important in reducing the risk of increasing the size of the AAA.
- Medium AAA: aorta measures 4.5 cm to 5.4 cm across; no treatment required apart from healthy lifestyle but follow up scans every 3 months. Further treatment only required if it becomes a large AAA.
- Large AAA: aorta measures 5.5 cm or more; referral to Vascular Surgeon within 2 weeks to discuss treatment options. Most men with a large AAA are advised to have surgery.

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## Further reading

- [Keisler B, Carter C](#); Abdominal aortic aneurysm. Am Fam Physician. 2015 Apr 15;91(8):538-43.
- [Sakalihan N, Michel JB, Katsargyris A, et al](#); Abdominal aortic aneurysms. Nat Rev Dis Primers. 2018 Oct 18;4(1):34. doi: 10.1038/s41572-018-0030-7.
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- [Kim HO, Yim NY, Kim JK, et al](#); Endovascular Aneurysm Repair for Abdominal Aortic Aneurysm: A Comprehensive Review. Korean J Radiol. 2019 Aug;20(8):1247-1265. doi: 10.3348/kjr.2018.0927.

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