Abdominal Aortic Aneurysms

See also the separate Ruptured Aortic Aneurysm and Aortic Dissection articles.

Definition

An aneurysm is a permanent and irreversible dilatation of a blood vessel by at least 50% of the normal expected diameter. 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. 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-planted into the graft during repair.

Aortic aneurysms may be associated with aneurysms elsewhere - eg, in an iliac artery or popliteal artery.

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.

Epidemiology

- The prevalence of AAAs is estimated at 1.3-12.7% in the UK.
- Symptomatic AAA in men has an incidence of 25 per 100,000 at age 50, which increases markedly to 78 per 100,000 in those over the age of 70.
- The incidence of AAA rose from the 1970s to 2000 but now appears to be declining.

Aetiology

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. About 15% of first-degree relatives of a patient with an AAA, mainly men, will develop an aneurysm.
- Tobacco smoking is an important factor.
- Male sex.
- Increasing age.
- Hypertension.
- 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. [7]
- Connective tissue disorders - Marfan's syndrome, Ehlers-Danlos syndrome type IV.

**Presentation** [5]

**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. [7, 8]

**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 the 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.
Investigations\[5\]

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:**[2]
  - **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. CT with contrast can show rupture of the aneurysm.
  - **MRI angiography** may be used. This is safer than conventional angiography, as it does not use nephrotoxic contrast medium.

Management of uncomplicated abdominal aortic aneurysm

Treatment is discussed in the separate Ruptured Aortic Aneurysm and Aortic Dissection articles.

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.\[9\]

**Medical management**

- Regular ultrasound monitoring - the frequency dictated by the diameter of the aneurysm at the time of detection - for example:
  - 3.0-4.4 cm: annual ultrasound.
  - 4.5-5.4 cm: three-monthly ultrasound.
  - 5.5 cm or bigger - consider surgery (see below): three-monthly ultrasound.

- Treat underlying causes where feasible - eg, infection. Some cases of peri-aortitis or retroperitoneal fibrosis may merit treatment with prednisolone or immunosuppressants.\[8\]
- 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:
  - There is some evidence that the following may reduce the rate of expansion of small aneurysms but their role is not yet clear:
    - Doxycycline or roxithromycin.\[10\]
    - Angiotensin-converting enzyme (ACE) inhibitors or losartan.\[10\]
    - Statins.\[10\]
    - Low-dose aspirin.\[11\]

**Driving**\[12\]

See the DVLA guide for patients with cardiovascular disorders.
Surgery

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 [3]**
  - 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.
  - Currently, about 65% of patients with AAA are suitable for endovascular repair.

- **Pros and cons of endovascular repair:**
  - **Advantages:**
    - Avoids open abdominal surgery.
    - Avoids aortic cross clamping.
    - Reduced mortality in the first four years of follow-up; longer-term results are unknown.[3]
  - **Disadvantages:**
    - Follow-up with ultrasound or CT scans is essential to monitor the endograft.
    - Failure of the endograft can occur - this was a common problem with early grafts but the newer designs are more durable.
    - Randomised controlled trials (RCTs) suggest reduced mortality in the first four years of follow-up. However, rates of death from any cause appear to equalise over the years, due to stent graft-related complications.[13, 14]
    - A systemic review found no long-term survival benefit for patients who have endovascular repair compared with open repair for AAA. There was also a significantly higher risks of reintervention and aneurysm rupture after endovascular repair.[15]

Prognosis

Natural history
- The risk of rupture is mainly determined by aneurysm diameter.
- The natural history of small AAA is gradual expansion at an annual rate of approximately 10% of the initial arterial diameter.
- People with aortic aneurysms are at increased risk of cardiovascular events, mostly unrelated to the aneurysm. [6]
Elective repair

- Overall mortality in the UK is 2.4% for elective AAA repair. There is an inverse relationship between operative mortality and the number of cases performed in individual hospitals, with many specialist centres reporting mortality rates well below 52%.
- The mortality rate of aneurysm repair depends on the patient’s fitness for surgery and the morphology of the aneurysm.
- 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

- Risk of rupture increases with aneurysm size and aneurysms over 6 cm have a 25% annual risk of rupture.
- 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

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. See the reference link at the end of the heading for this section for more information on UK screening programmes.

Further reading & references

- Laparoscopic repair of abdominal aortic aneurysm; NICE Interventional Procedure Guidance, August 2007
- ESC Guidelines on the diagnosis and treatment of aortic diseases (covering acute and chronic aortic diseases of the thoracic and abdominal aorta of the adult); The Task Force for the Diagnosis and Treatment of Aortic Diseases of the European Society of Cardiology (Aug 2014)
- Endovascular stent-grafts for the treatment of abdominal aortic aneurysms; NICE Technology Appraisal Guidance, February 2009
- Assessing fitness to drive: guide for medical professionals; Driver and Vehicle Licensing Agency

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