

CASE ONE

Short case number: 3_27_1

Category: Cardiovascular

Discipline: Surgery

Setting: General Practice

Topic: Abdominal aortic aneurysm

Case

John El Alam is a 65 year old long term patient of the practice. His medical history includes hypertension which has been reasonably well controlled and a myocardial infarction at age 50. Unfortunately despite your best efforts he continues to smoke 15-20 cigarettes a day. He presents today with a history of central abdominal pain through to his back. He has had no other associated symptoms and vital signs are within normal range.

With his history of cardiovascular disease and hypertension you are considering the possibility of an aortic aneurysm.

Questions

1. What clinical examination findings would suggest an abdominal aortic aneurysm?
2. What is an aneurysm and what is the difference between a true and a false aneurysm?
3. Describe pictorially a saccular and fusiform aneurysm and describe the possible aetiology of an aneurysm.
4. John's physical examination is unremarkable; however in light of his risk factors you request an abdominal ultrasound. The results demonstrate a 4 cm abdominal aortic aneurysm [AAA]. What are the treatment recommendations based on the size of the aneurysm?
5. John is referred to a vascular surgeon, who recommends elective surgery, what are the indications for elective repair of an abdominal aortic aneurysm?
6. What is the risk of rupture of an abdominal aneurysm based on size? What advice may have been given to John regarding the risks of Vs the risks of rupture?
7. It is possible that John also has an aneurysm of his popliteal arteries. What percentage of patients with AAA have popliteal artery aneurysms and what are the risks associated with popliteal artery aneurysm.



Suggested reading:

- Garden OJ, Bradbury AW, Forsythe JLR, Parks RW, editors. Davidson's Principles and Practice of Surgery. 6th edition. Philadelphia: Churchill Livingstone Elsevier; 2012.
- Henry MM, Thompson JN, editors. Clinical Surgery. 3rd edition. Edinburgh: Saunders; 2012.

ANSWERS

1. What clinical examination findings would suggest an abdominal aortic aneurysm?

In thin patients:

- pulsation may be visible on inspection
- pulsatile, expansile swelling in the midline of the abdomen, usually extending towards the left-hand side
- bruit on auscultation in association with origin stenoses of the branches of the abdominal aorta (coeliac axis, superior mesenteric, renal arteries)
- There is an association between AAA and aneurysms elsewhere, so the examiner should specifically exclude the presence of femoral and popliteal aneurysms
- The surface marking of the aortic bifurcation is at the level of the umbilicus, so any pulsation felt below this level is likely to denote the presence of iliac aneurysmal disease.

However, it is important to appreciate that clinical examination alone, even when performed by an experienced vascular surgeon, may be unreliable for confirming the presence or absence of aneurysmal disease and for estimating the size of the aorta.

An AAA may present in the following ways:

- *Asymptomatic* (30%). The AAA may be detected incidentally on routine physical examination, or most commonly, abdominal ultrasound scan conducted for another reason.
 - *Symptomatic* (20%). AAA may cause pain in the central abdomen, back, loin, iliac fossa or groin. Thrombus within the aneurysm sac may be a source of emboli to the lower limbs. Less commonly, the aneurysm may undergo thrombotic occlusion. AAA may also become inflamed and then compress surrounding structures such as the duodenum, ureter and the inferior vena cava.
 - *Rupture* (50%). AAA may rupture, usually into the retroperitoneum, but sometimes into the peritoneal cavity or rarely into surrounding structures Eg duodenum.
2. What is an aneurysm and what is the difference between a true and a false aneurysm?

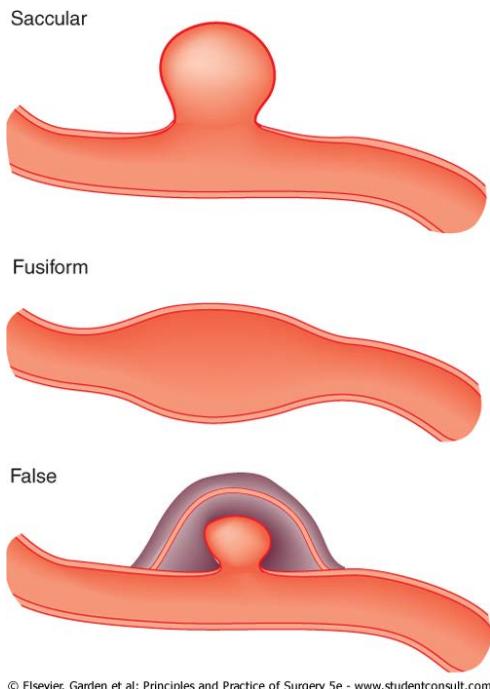
True aneurysms

All three layers of the arterial wall enclose a true aneurysm

False aneurysms (see image in Q3)

If the wall of an artery is pierced, the resulting haematoma sometimes remains in continuity with the lumen via the puncture site. A pulsatile swelling then forms, the wall of which consists of compacted thrombus and surrounding connective tissue. Small aneurysms (2-3 cm in diameter) often thrombose spontaneously. Larger aneurysms tend to expand, especially if the patient is on aspirin, heparin or warfarin, and compress surrounding tissues. The most common site is the groin after common femoral artery instrumentation, and this may cause femoral vein compression and deep venous thrombosis (DVT).

1. Describe pictorially a saccular and fusiform aneurysm and describe the possible aetiology of an aneurysm.



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Atherosclerosis

There is continuing controversy over whether aneurysmal disease is just another manifestation of atherosclerosis. However, many believe it to be a separate condition-medial degenerative disease. Nevertheless, there is no doubt that aneurysmal disease shares the same risk factors as atheromatous occlusive disease (although hypertension appears a more important factor) and that aneurysmal and occlusive arterial disease often coexist. In addition, there is a strong familial element in aneurysmal but not in occlusive disease. Furthermore, there are patients, some of whom have never smoked, who exhibit widespread aneurysmal dilatation (arterial ectasia or arteriomegaly) without any evidence of peripheral, cerebral or coronary occlusive disease.

Inflammation

In some patients, atherosclerosis, whether associated with aneurysmal dilatation or not, can lead to an intense periadventitial inflammatory and fibrotic response. The reasons are unclear, but clinical problems can occur in consequence.

Dissection

Weakness of the aortic wall may result in an intimomedial tear and allow blood to track under pressure through and/or out with the various layers of the wall. Such a dissecting aneurysm usually affects the thoraco-abdominal aorta. Rupture may occur outwards (usually fatal) or inwards into the aortic lumen with the subsequent formation of a large saccular aneurysm in the weakened section. Causes of the defect include:

- atherosclerosis, usually with hypertension
- Marfan's syndrome in which there is a structural defect in the biochemical nature of the media.

Infection

The arterial wall is normally highly resistant to bacterial and other infections. However, certain organisms (*Salmonella* and *Treponema pallidum*) have a particular ability to infect, and thus to weaken, the aortic wall, leading to the formation of a mycotic aneurysm and its rupture.

2. John's physical examination is unremarkable, however in light of his risk factors you request an abdominal ultrasound. The results demonstrate a 4 cm abdominal aortic aneurysm [AAA]. What are the treatment recommendations based on the size of the aneurysm?

Criteria	Treatment
Symptomatic aneurysms regardless of size	Urgent surgery
Asymptomatic aneurysms of diameter < 5.5 cm	Surveillance if increasing by < 1 cm/year Elective surgery if increasing by > 1 cm/year
Asymptomatic aneurysms of diameter > 5.5 cm	Elective surgery

The UK Small Aneurysm Trial and the similar US-based ADAM trials have shown that the risks of open surgery generally outweigh the risks of rupture until an asymptomatic AAA has reached 5.5 cm in antero-posterior maximum diameter.

Once a small AAA has been detected, the best way of following up the affected patient is by repeated ultrasound scans at 3-6-monthly intervals and best medical therapy (smoking cessation, control BP, aspirin or other anti-platelet agent, lipid lowering therapy), which affords the same benefits as it does in patients with occlusive disease (which often coexists).

Ultrasound is only accurate to about 0.5 cm and tends to underestimate AAA size. Thus, most surgeons will arrange for a CT scan to be performed when the AAA reaches 5.0 cm, along with other tests designed to assess fitness for surgery. Once the AAA reaches 5.5 cm and assuming the clinical assessment and investigations indicate that the patient is fit for surgery, the surgeon will normally begin discussions with the patient with a view to operative repair (open or endovascular).

3. John is referred to a vascular surgeon, who recommends elective surgery, what are the indications for elective repair of an abdominal aortic aneurysm?

Indications for elective repair:

The decision to operate involves weighing the known risk of leaving the AAA in place against that of operation. The first depends upon:

- size
- presence of symptoms
- age and physiological state

The risk of operation depends primarily upon cardiorespiratory status. Anaesthetists and cardiologists can help the surgeon assess this, and also life expectancy, more precisely. There is no advantage to be gained in repairing a small aneurysm at low risk of rupture in an elderly person with severe myocardial disease whose cardiac prognosis is poor.

4. What is the risk of rupture of an abdominal aortic aneurysm based on size? What advice may have been given to John regarding the risks of surgery Vs the risks of rupture?

The reported annual risk of rupture varies quite widely but is probably in the region of:

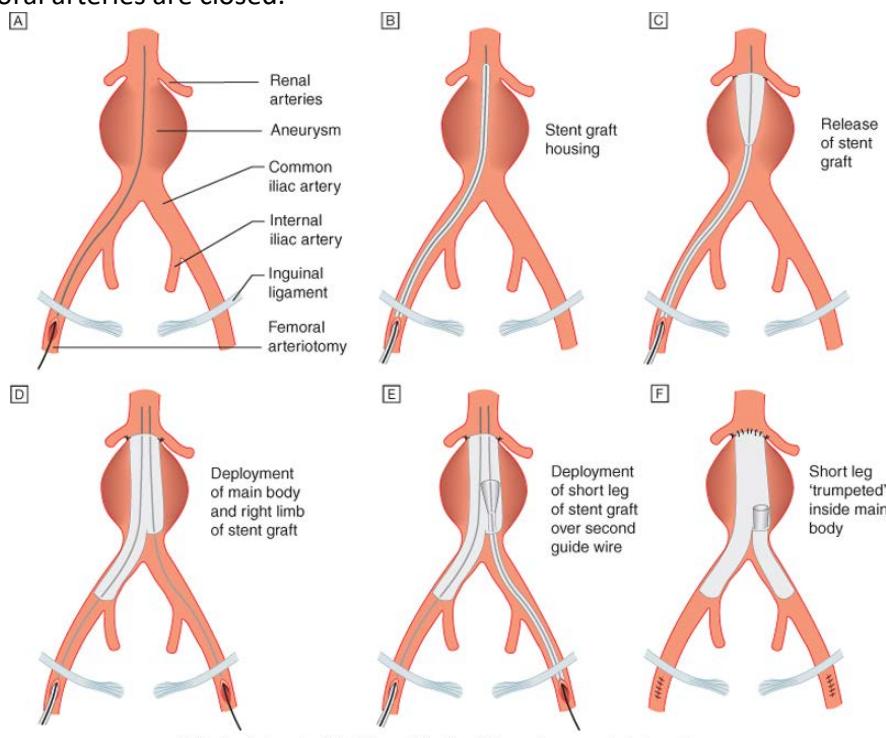
- 6cm: 5-10%
- 7cm: >20%

Balancing the risks of surgery against those of rupture can be difficult in smaller aneurysms. The UK Small Aneurysm Trial found that for stable AAAs of 4-5 cm diameter, surveillance was safer than surgery, as the rupture risk was about 1% per annum. This does not apply to saccular or mycotic aneurysms, rapidly expanding or symptomatic aneurysms and perhaps equivalent-sized AAAs in small females. Such patients should all be treated surgically.

The 30-day major morbidity and mortality for open AAA repair is approximately 10% for elective asymptomatic AAA, 20% for emergency symptomatic AAA and over 50% for ruptured AAA.

Endovascular aneurysm repair (EVAR)

- A guidewire is passed through the aneurysm via an incision in the right common femoral artery.
- A catheter containing the main body of the stent graft is passed over the guide wire and into position within the aneurysm.
- The outer cover of the catheter is removed, allowing the upper part of the stent graft to spring open and become attached by hooks to the wall of the aorta just below the renal arteries.
- The rest of the catheter is removed, allowing deployment of the main body of the graft and the right (long) limb within the common iliac artery.
- Via an incision in the left common femoral artery a second guide wire is passed up through the short limb of the stent graft.
- A second catheter containing the rest of the stent graft is passed over the guide wire and into the main body of the stent graft. As before, retraction of the outer cover allows the top of the second limb of the stent graft to open within the short limb of the main body.
- Deployment is complete and the aneurysm sac completely excluded from the circulation.
- The femoral arteries are closed.



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5. It is possible that John also has an aneurysm of his popliteal arteries, what percentage of patients with AAA have popliteal artery aneurysms and what are the risks associated with popliteal artery aneurysm.

Popliteal aneurysms

These are present in 10 - 20% of patients with AAA and their presence must be sought, if necessary with ultrasound, in all such patients. Around 50% are bilateral. If a patient presents with a popliteal aneurysm, there is a 50% chance that he or she also has an AAA, which again must be sought.

The main complications of popliteal aneurysm are distal embolization and acute thrombosis; the latter is associated with limb loss in up to 50% of cases because the calf vessels are often chronically occluded, which makes surgical bypass difficult.