Cardiovascular disorders

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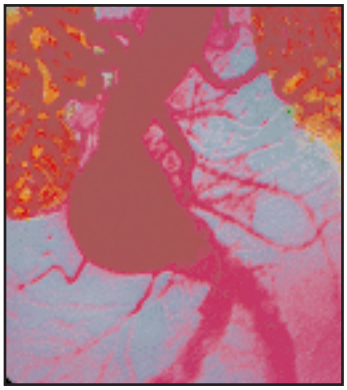
Abdominal aortic aneurysm repair



NS60 Bick C (2000) Abdominal aortic aneurysm repair. *Nursing Standard*. 15, 3, 47-52.
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Aims and intended learning outcomes

The aim of this article is to provide information about abdominal aortic aneurysm (AAA) and explain two different methods of surgical repair: first, the traditional open method and second, the new, less invasive endovascular stenting. After reading the article, you should be able to:

- Understand the meaning of the term AAA, including the different types.
- Recognise risk factors that would predispose an individual to AAA development.
- Understand the decisions made regarding choice of surgical repair method for individual patients.
- Explain the potential complications of both traditional repair and endovascular stenting.

Introduction

Although the Darke Report (1997) recommended that AAA surgery should only be undertaken by surgeons specialising in vascular techniques, in most hospitals, patients undergoing AAA repair are nursed in general surgical wards, or on a ward with 'vascular beds'. Therefore, it is important that nurses working on such a ward understand the condition and the surgical procedure that patients will be undergoing, to rationalise the nursing care they give.

What is an aneurysm?

An aneurysm can be defined as a local dilatation of a blood vessel (the Greek word *aneurysma* means a widening). The area of the vessel wall affected becomes progressively weaker as the aneurysm gradually enlarges, and the risk of spontaneous rupture increases.

The aorta is one of the large elastic arteries that carry blood from the heart to the rest of the body. It originates from the left ventricle of the heart as the thoracic aorta. The abdominal aorta arises at the diaphragm. It then passes inferiorly until it terminates at the bifurcation forming the two common iliac arteries, at around the level of the umbilicus.

Several arteries branch off the abdominal aorta, distributing blood to various organs (Box 1). Thus it can be seen that the aorta is a crucially important structure for normal circulatory function.

There are four types of aneurysm (Fig. 1):

- A fusiform aneurysm is the most common. It is a diffuse, circumferential dilation of an arterial segment, which forms a spindle shape.
- A saccular aneurysm is a localised outpouching of an artery, which results from an area of thinning and stretching of the arterial wall.
- The third type is a dissecting aneurysm. This occurs when a small tear of the inner arterial wall allows blood to form a pathway between the layers of the arterial wall.

in brief

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Summary
Rupture of an abdominal aortic aneurysm (AAA) is often a catastrophic event, while elective traditional repair involves major surgery. This article explains AAA development and traditional repair, and introduces a new, less invasive method of repair: endovascular stenting.

Keywords
- Cardiovascular disorders
- Surgery: operative

These key words are based on the subject headings from the British Nursing Index. This article has been subject to double-blind review.

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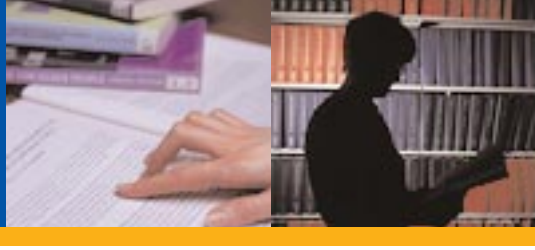
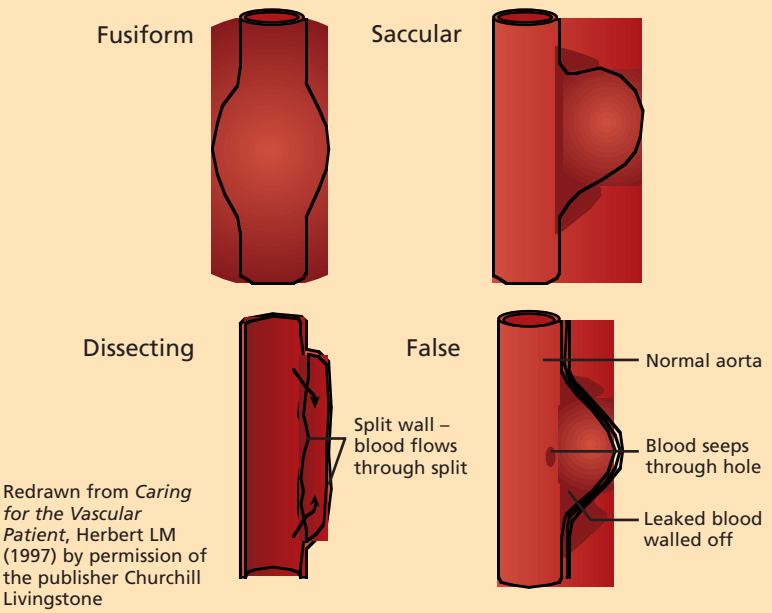


Box 1. Branches of the abdominal aorta

Branch of abdominal aorta	Organ supplied
Inferior phrenic arteries	Inferior surface of diaphragm
Coeliac arteries:	
Common hepatic	Liver
Left gastric	Stomach and oesophagus
Splenic	Spleen, pancreas and stomach
Superior mesenteric artery	Small intestine, caecum, ascending and transverse colon
Suprarenal arteries	Adrenal glands
Renal arteries	Kidneys
Gonadal arteries	Testes or ovaries
Inferior mesenteric artery	Transverse, descending and sigmoid colon and rectum

(Source: Tortora and Anagnostakos 1990)

Fig. 1. The four types of aneurysm



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- Fusiform, saccular and dissecting aneurysms are known as 'true aneurysms'. The fourth type, a false aneurysm, results from a wound to all three layers of the arterial wall, such as that which occurs during angioplasty. Blood leaks from the artery, forms a clot outside the artery wall and connective tissue is laid down around it.

Aetiology of AAA

Historically, it has been accepted that the cause of most AAAs is atherosclerotic degeneration of the vessel wall. However, according to Anderson (1994): 'Atherosclerosis implies hardening of the arterial wall, whereas aneurysms are like balloons.'

It has also been shown that there is a familial tendency to AAA development (Salo *et al* 1999). For this reason, screening projects have been implemented to diagnose the presence of asymptomatic AAA, so that elective repair can be undertaken before the vessel ruptures (Scott *et al* 1995, Shaw 1992, Wilmink *et al* 1999). Other inheritable causes of AAA are connective tissue disorders, such as Ehlers-Danlos's syndrome and Marfan's syndrome.

Infection might lead to the development of a mycotic aneurysm (Fahey 1994). Bacteria can enter the arterial wall through the vaso vasorum – the network of tiny vessels that provide the blood supply to the artery wall.

Lifestyle factors commonly believed to increase the risk of AAA development are the same as those believed to increase the risk of other forms of arterial disease, such as coronary artery disease and peripheral vascular disease. 'Smoking is probably the most reported factor associated with an increased risk of AAA' (Anderson 1994). A study by Franks *et al* (1996) found the relative risk of developing an aneurysm increased with the number of cigarettes currently smoked. Smoking has also been shown to affect the growth rate of aneurysms (MacSweeney *et al* 1994).

Other risk factors include high blood cholesterol levels and uncontrolled hypertension (Franks *et al* 1996).

Prevalence of AAA

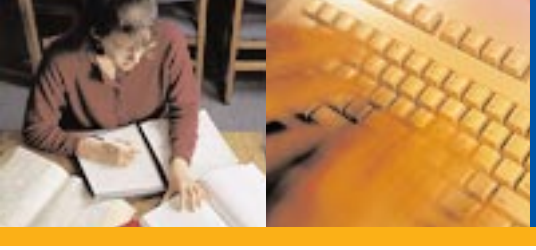
It is estimated that AAAs account for 10,000 deaths each year in the UK (Greenhalgh 1990). Males present more frequently than females (Fowkes 1990), having an incidence five to seven times higher (Hatswell 1994a). This is due to protection afforded females by the hormone oestrogen, which inhibits atherosclerosis (Sarrel *et al* 1994).

AAAs are most common in males over 60 years of age, and the incidence is increasing (Stevens 1993). This trend has been observed in the UK, Australia and Sweden. Possible explanations for this are (Stevens 1993):

- Enhanced awareness of the condition.
- Improved diagnostic techniques, leading to earlier detection.
- Rising numbers of older people in the population.

TIME OUT 1

Reflect on a patient you have cared for following AAA repair. Which factors do you think played a part in the development of his or her AAA?



Symptoms

Symptoms suggestive of a leaking AAA are abdominal and back pain, and a tender, pulsating mass felt on abdominal examination. However, even large aneurysms can be difficult to palpate in overweight individuals, and clinical examination has been found to be unreliable (Hatswell 1994b).

Many asymptomatic AAAs are discovered when patients undergo radiological investigations for other conditions, such as ultrasound examination for urological problems.

Rupture

The majority of AAAs are asymptomatic, and present only when they begin to leak or rupture (Bell 1996). Rupture causes massive haemorrhage into the abdominal cavity, which is usually fatal. 'Mortality following rupture of an AAA is more than 90 per cent, with many people dying before reaching hospital' (Galland 1998). In comparison, mortality rates following emergency repair are approximately 50 per cent, and following elective AAA repair are between 5 and 10 per cent.

Patients admitted to A&E departments with ruptured AAA are in a collapsed state, hypotensive and tachycardic. They need urgent intravenous access and fluid replacement, pain control and blood sampling, for baseline measurements and cross-matching for massive blood transfusion. Transfer to theatre for immediate surgical repair is required.

'As a rule, the larger the aneurysm, the greater the chance of rupture' (Fahey 1994). The diameter of the aorta is about 2cm. AAAs usually expand at a rate of about 0.5cm a year (Wolfe 1992) and those above 5cm have a higher risk of rupture (Jones and Ludwa 1997). Therefore, most surgeons keep patients with a known AAA under regular review until it reaches a diameter of 5.5cm, when it is electively repaired.

TIME OUT 2

It is probable that many older people have an asymptomatic, undiagnosed AAA. Consider the possible reasons for the fact that screening programmes are not more common.

History of AAA repair

Although endovascular repair of AAA is generally thought of as the new method, the basic idea actually predates open surgical repair. In 1864, an English surgeon placed 75 feet of wire into an AAA to stimulate thrombosis. In 1879, Corradi, an Italian physician, attempted to achieve coagulation by passing an electric current through wire inserted into an AAA (Lazarus 1992).

Dubost performed the first open surgical repair in 1951, and in 1954 Robin used the first synthetic graft. The introduction of the current 'traditional' method of AAA repair became widespread during the 1960s (Lazarus 1992).

Traditional AAA repair

With traditional surgery, the patient is given a general anaesthetic and intubated. The surgeon gains access to the aorta via a long midline incision, from the xiphoid process to the symphysis pubis, and by moving the bowel to one side. The aorta is clamped above and below the aneurysm to prevent excessive bleeding when the aneurysm is opened. If the AAA is leaking or ruptured, it is not until the clamps are placed that any control of blood loss can be achieved.

The aneurysm is opened and any thrombus present removed, before the surgeon stitches a synthetic graft in place. The graft may be made of either woven or knitted Dacron, according to the surgeon's preference. If the aneurysm is limited to the aorta itself, a straight tube graft will be used; if the aneurysm extends into the iliac arteries, a bifurcated 'trouser graft' is needed.

In elective surgery, anticoagulation is achieved with intravenous heparin, to prevent thrombus formation within the graft. Any such blood clots could later pass emboli on to the smaller arteries in the legs, and cause a blockage.

When both ends of the graft have been sutured in place, the clamps are removed, anastomoses are checked to ensure there is no leakage and the aorta is closed around the graft.

Post-operative nursing care

Patients who have undergone emergency AAA repair are transferred to an intensive care unit for continuing ventilation, until their condition is stable enough for them to undertake breathing for themselves. Those whose AAA has been repaired electively are usually also nursed in an intensive care unit, or a high dependency unit, where invasive monitoring enables early detection of any complications.

Continuous evaluation of the patient's respiratory and cardiovascular status, hydration and renal function, pain control, signs of haemorrhage

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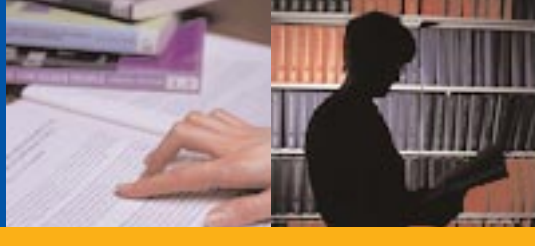


Box 2. Potential problems following traditional AAA repair

- Myocardial infarction
- Bleeding
- Renal failure
- Respiratory failure
- Lower limb ischaemia
- Graft infection
- Paralytic ileus
- Bowel infarction
- Impotence
- Spinal cord ischaemia

or infection, and lower limb perfusion is initially necessary, along with attention to hygiene needs, prevention of skin breakdown and provision of a comfortable, environment.

Potential complications of traditional repair

Unfortunately, there are a number of complications that can occur following traditional AAA repair (Box 2). Myocardial infarction, bleeding and renal failure are the three most common (Warbinek 1990). Many patients needing aortic surgery also have coronary artery disease (Galland 1998) and are, therefore, at greater risk of peri-operative myocardial infarction. In addition, the heart is put under considerable strain during surgery, with significant pressure changes due to the clamping and unclamping of the aorta. Pharmacological cardiac support is often needed in the form of intravenous inotrope infusions, such as epinephrine or norepinephrine.

Peri-operative bleeding can occur due to a leaking anastomosis, a bleeding vessel or coagulopathy (failure of the blood to clot normally – a complication of a large blood transfusion). It is necessary to check blood clotting times frequently in the initial post-operative phase to enable correction, if necessary, with fresh-frozen plasma, platelets or protamine sulphate.

Renal failure is more likely in patients who have a degree of renal impairment pre-operatively, or when it has been necessary to clamp the aorta above the renal arteries (Galland 1998). This causes a period of kidney ischaemia. A low-dose intravenous dopamine infusion is given to ensure maximum renal perfusion. Dialysis might be necessary to support the patient through an acute episode of renal failure.

Respiratory problems also present a significant post-operative risk, due to the large abdominal incision, particularly in patients who smoke or have chronic pulmonary disease. Abdominal inflammation and pain can cause 'splinting' of the diaphragm, thus reducing the depth of respiration and preventing the patient coughing effectively, to expectorate secretions. Epidural analgesia can reduce this problem by providing better pain relief, less sedation, less respiratory depression and enabling earlier mobility than other methods of pain control (Matula 1993).

Acute ischaemia of the lower limbs is a possibility following AAA repair. This is due to emboli or atheromatous debris passing down the leg arteries from the site of the AAA repair. Occlusion of the larger iliac or femoral arteries can be treated by embolectomy, but more frequently it is the tiny blood capillaries that are affected, leading to reduced tissue perfusion, sometimes despite maintenance of palpable foot pulses. This is commonly known as 'trash foot'. The ensuing necrosis might necessitate amputation.

Other less common potential complications include paralytic ileus, bowel infarction, spinal cord ischaemia, impotence and graft infection.

Most patients undergoing elective AAA repair make a good post-operative recovery, returning to a general ward area within about 48 hours and being discharged home around ten days later. A study by Magee *et al* (1992) found these patients generally retain a good quality of life.

TIME OUT 3

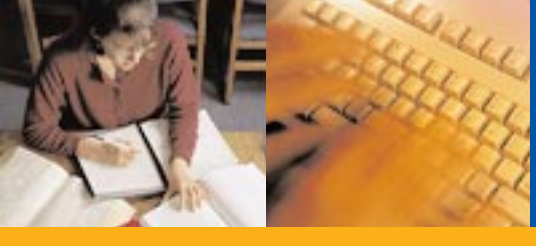
In older patients undergoing major surgery, it is not always possible to prevent complications such as myocardial infarction. Reflecting on patients you have cared for following AAA repair, list the aspects of nursing care given that either prevented, detected or treated complications.

Endovascular stenting

Increasingly, patients needing AAA repair have other chronic disease (Lombardo 1997), which renders them 'high risk' for lengthy general anaesthetic and major surgery. Endovascular stenting is a less invasive technique for AAA repair and involves less risk than traditional repair (Ransom 1996). It, therefore, represents an important alternative for treatment of aortic disease in these patients.

A small incision is made in the groin and a direct arterial puncture is performed. A guidewire is passed via the iliac artery into the aorta and the stent is passed over it into position, creating a new channel for blood flow and excluding the AAA from the circulation. The stent graft is a composite structure consisting of a Dacron tube (similar to that used in traditional repair), within which there is an expandable metal framework, to support and secure the device in position within the aorta. Accurate positioning of the stent is achieved under radiological control. Once in place, the stent is expanded and anchors to the aortic wall with small metal hooks.

If the aneurysm involves the iliac arteries as well as the aorta, the 'trouser' stent is introduced in two pieces (Fig. 2). The aortic part and one 'trouser leg' are placed via one femoral incision and the other 'leg' through a second femoral puncture, in the other leg. The component parts



fit together *in situ*, under X-ray control. Thus this patient has bilateral groin incisions to be observed post-operatively.

This technique requires a skilled multi-disciplinary team, including nurses, an anaesthetist, a vascular surgeon and an interventional radiologist. The surgeon and radiologist work together closely, from initial patient assessment and preparation, through the stenting procedure, to patient follow up, to ensure the continuing success of the repair. The usual pre-operative patient preparation for AAA repair is undertaken, in case the need arises to perform a traditional open repair. In addition, accurate measurements of the aorta, the aneurysm and the iliac arteries are needed (Woodburn *et al* 1998). The iliac artery must be large enough to allow passage of the stent, and there must be sufficient healthy aorta below the renal arteries and above the iliac bifurcation to which the stent can be anchored. These measurements are obtained pre-operatively from angiography and a spiral CT (computerised tomography) scan.

Stent grafts are produced in various forms by different companies. Those currently being used at Walsgrave Hospitals NHS Trust are made-to-measure for each patient and cost approximately £4,500 each. Although this renders the procedure significantly more expensive than traditional repair, it provides the opportunity for AAA repair in patients who might otherwise not have been offered surgery. In addition, recovery is much easier for the patient and usually involves a reduced post-operative hospital stay (Woodburn *et al* 1998).

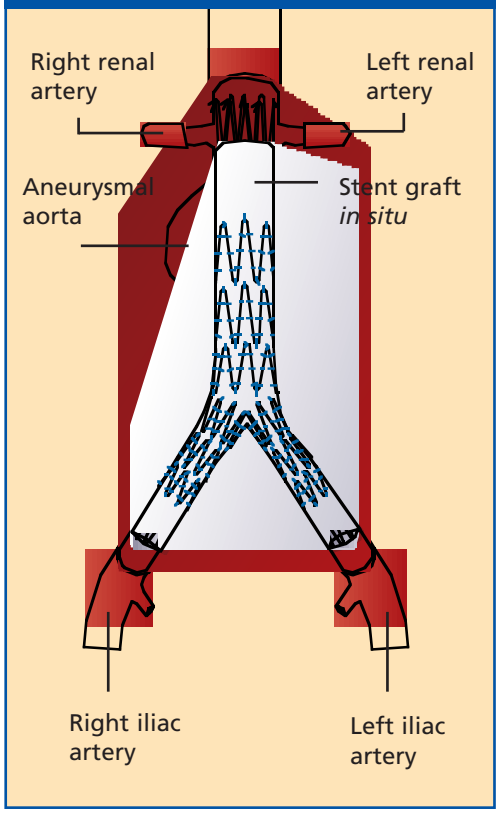
TIME OUT 4

Before reading further, write down what you think the other advantages or disadvantages of AAA repair by endovascular stenting might be. Compare your answer with the following information.

Advantages of endovascular stenting

The potential complications of traditional repair are minimised or negated by the use of an endovascular stent. The procedure involves far less stress for the heart than traditional repair, as the pressure changes involved with clamping and unclamping the aorta do not occur. The risk of ischaemia, which aortic clamping might cause in the kidneys, heart, spinal cord and bowel, is negated, as the blood supply is not interrupted during the procedure. There is less chance of haemorrhage, although the groin incision needs the usual frequent post-operative observation. Post-operative intra-abdominal bleeding should still be suspected if the patient is tachycardic with a falling blood pressure.

Fig. 2. Bifurcated endovascular stent graft



The lack of a large abdominal incision means there is no risk of causing peritoneal adhesions. Also, the risk of respiratory complications is reduced as the patient is able to breathe deeply and cough effectively, enabling him or her to expectorate the increased secretions caused by the anaesthetic. Analgesic requirements are reduced and the need for a blood transfusion usually negated. In most cases, the patient is able to take light meals and mobilise the following day.

These advantages were confirmed in a study by Kozon *et al* (1998): 'Patients are independent earlier, do not experience as much pain, and therefore can leave hospital earlier. The patients are usually able to meet their needs themselves and, therefore, are more independent.'

However, Kozon *et al* (1998) observed that patients having repair by endovascular stenting were extremely anxious that their aneurysm would 'fit with the new procedure'. Indeed, anxiety is common with both methods of repair, and usually begins when the patient is diagnosed as having an AAA, and is warned that if

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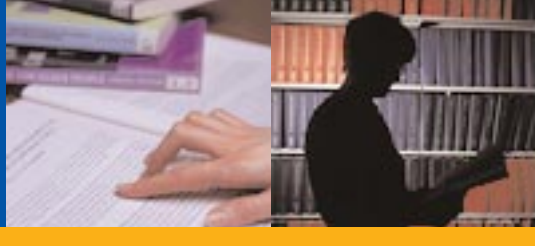

it grows to more than about 5.5cm, the risk of rupture increases significantly. Pre-operative nursing care must address this issue by providing reassurance and as much information as the patient wishes.

TIME OUT 5

Imagine that you are 61 years old and are looking forward to a happy, healthy retirement. However, you have been told that the intermittent abdominal pain you have been experiencing is due to an AAA, presently measuring 4.5cm. Write down how you think you would feel and how you imagine it might affect your quality of life.

Potential complications of endovascular stenting

There are some disadvantages of endovascular stenting. There is a risk of damaging the iliac arteries during stent insertion, and it is possible that the stent could migrate within the aorta. Undersizing of the stent or slight misplacement could result in blood leakage around the stent into the aneurysmal sac; an oversized stent might induce aneurysmal rupture (Ransom 1996). Renal failure following endovascular repair can occur if the graft occludes the entrance to a renal artery, or as a result of administration of large quantities of intravenous X-ray contrast (Woodburn *et al* 1998). The long-term success of stent grafts has not been determined, whereas it is recognised that a traditional graft usually 'outlives' the patient.

In view of the controlled situation necessary for stent placement and the need for the stents to be individually prepared, this method is not suitable for emergency repair at present. However, this could change in the future, if stents are used 'off the shelf' and the procedure becomes more rapid with team experience.

Conclusion

Endovascular stenting represents very important progress in AAA repair. Surgeons at Walsgrave Hospitals NHS Trust have been offering this method of AAA repair to selected patients over the past two years, with encouraging success.

However, as with any new procedure, it is imperative that the team who will care for the patient is educated to a level that ensures members are competent to do so. In addition, thorough pre-operative planning by the surgeon and radiologist is critical to ensure a successful outcome.

Ironically, it would appear that 19th century ideas of repairing AAAs endovascularly are being used successfully in the 21st century

TIME OUT 6

Now that you have completed the article, you might like to think about writing a practice profile. Guidelines to help you write and submit a profile are outlined on page 55.

Acknowledgement

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