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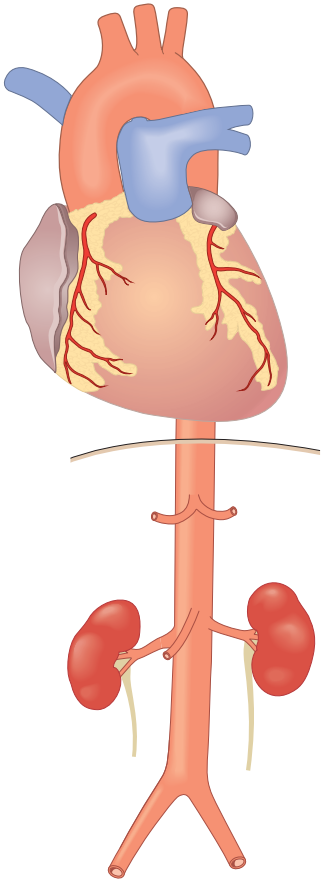
Cardio-Aortovascular Surgery



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Contents

Patient endorsement

AORTIC DISSECTION AWARENESS

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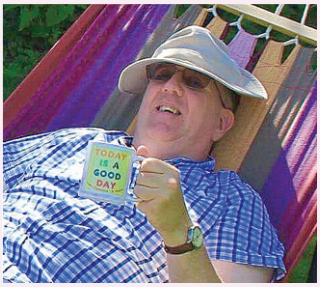
TODAY IS A GOOD DAY



Your aorta is vitally important. An operation to repair it is a big deal. It's quite normal to feel apprehensive and to have questions. This booklet helps you to understand, prepare and recover. It was reviewed by patients just like you.

As Chair of the National Patient Association for Aortic Dissection, I am living proof of how well it is possible to do after major aortic surgery. I got involved in helping other patients after recovering from two 10-hour operations to repair a life-threatening aortic dissection. Today, I'm doing great.

You will be looked after by an expert multidisciplinary surgical team at a specialist aortic centre. The best advice I can give you is to consider yourself a part of that team. The quality of your outcome and eventual recovery depends upon you, as well as on the efforts of your healthcare professionals.

This booklet will help you to inform yourself and know what to do, so you can play your part in achieving the best possible outcome from your aortic surgery. It is full of easy-to-understand information that you can trust. Read it thoroughly. Discuss it with those close to you. Ask questions about anything you don't understand. After all, you are a part of the team for this operation! Good luck!

I wish you all the very best on your aortic journey.

Gareth Owens
www.aorticdissectionawareness.org

Introduction

To help you and your family to understand more about your planned operation, we have developed this booklet to guide you through the process. It will give you general information about what to expect before and during your admission to hospital.

Many patients are **anxious** when the recommendation is made to undergo **aortic surgery**. We hope this booklet:

- Explains the most **important facts** about aortic diseases
- **Answers** frequently asked questions
- **Reduces** your anxiety
- **Improves** your individual treatment

The incidence of thoracic aortic aneurysms sits around 6 per 100,000, and 6 per 100,000 for aortic dissections. Studies have shown that this number has significantly increased over the past two decades and continues to grow steadily, largely due to improved rates of diagnosis (i, ii).

Conditions associated with the thoracic aorta are:

- Aortic aneurysm
- Aortic dissection
- Intra-mural haematoma
- Penetrating aortic ulcer
- Anomalous aortic arch
- Complications in adulthood of congenital abnormalities of the great vessels
- Transection – trauma, usually blunt and caused by road traffic accidents

Often, aortic disease is unfortunately only recognised when serious complications arise. In particular, this includes aortic dissection whereby the layers of the aortic wall tear. In the worst case, this may lead to a rupture of the aorta. In these cases it is necessary to undergo emergency surgery.

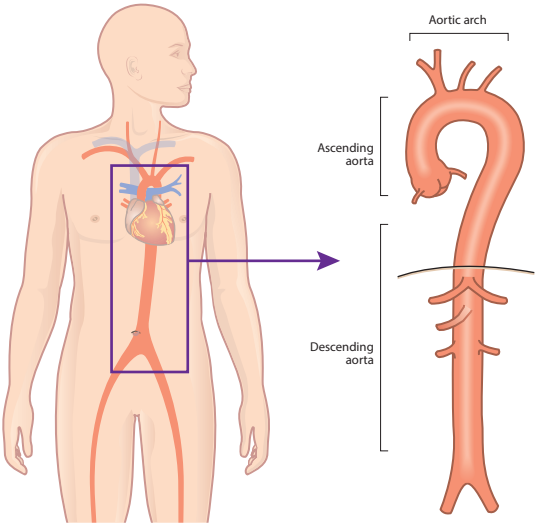
Acute aortic disorders are associated with a high death rate, therefore their prevention is of great importance. Regular review via **MDT meetings** and clinics play a large role in the surveillance of patients with aortic diseases.

In the event that it is necessary to replace the thoracic aorta, you will be invited to a face-to-face clinic appointment where your options will be discussed with you.

New aortic prostheses and hybrid approaches enable surgeons today to work on longer, or hard to reach, segments of the aorta during a single procedure.

1. Gouveia a Melo E et al (2022) Incidence and Prevalence of Thoracic Aortic Aneurysms: A Systematic Review and Meta-analysis of Population-Based Studies. Seminars in Thoracic and Cardiovascular Surgery. Volume 34, 1.
2. Howard DP et al (2013) Population-based study of incidence and outcome of acute aortic dissection and premorbid risk factor control: 10-year results from the Oxford Vascular Study. Circulation, 127, pp. 2031-2037.

Your aorta and what it does



The aorta is the largest artery of the body and carries oxygenated blood from the heart to the rest of the body via the circulatory system.

You will hear your aorta discussed in sections:

- **Aortic root**; where blood first exits the heart. The aortic root contains the aortic valve, the origins of both coronary arteries, and a segment called the sinuses of Valsalva
- **Ascending aorta**; is the portion of the aorta between the aortic root and the aortic arch. The point where the aortic root and the ascending aorta meet is called the sino-tubular junction. At this junction, the aorta becomes less elastic and more rigid. Diseases in this area are rarely genetic
- **Aortic arch**; is where the aorta transitions from the centre of the chest to the back. Branches of blood vessels from the aortic arch supply blood to the head, arms and then becomes the descending aorta
- **Descending aorta**; runs through the chest into the abdomen, starting after the aortic arch. Atherosclerosis, the weakening of the vessel wall, plays a large role in heart disease in the descending aorta
- **Thoracoabdominal aorta**; is what we call the aorta once it transitions to the back of the body and refers to a long segment extending from the chest into the abdomen. Diseases here may involve genetic origins but are far more likely to be due to a history of smoking, high blood pressure, or atherosclerosis
- **The abdominal aorta** is largest artery in the abdomen. It runs from the descending aorta down to branches that supply the pelvis and legs, just below the navel. High blood pressure is the most common cause of disease in the abdominal aorta

The aorta is widest as it leaves the heart and narrows gradually until it divides at the pelvis. The size of the aorta is relevant to the patient's height and weight and is typically larger in men than women. A normal aortic diameter is less than 40mm.

Overview of aortic diseases

Aortic diseases can be divided into **chronic** aortic diseases and **acute** aortic syndromes. Although chronic aortic diseases can be considered 'stable', chronic aortic diseases can trigger an acute event.

Chronic aortic diseases:	Acute aortic syndromes:	Possible causes:
• Aneurysm • Chronic dissection	• Aortic rupture • Aortic ulcer • Aortic dissection (Type A or B) • Intramural haematoma (IMH)	• Atherosclerosis • Genetic connective tissue disorders (explained more later in the book) • Inflammation of the aorta (infection or autoimmune diseases) • Bicuspid aortic valve • Previous aortic dissection or surgery

What is an aortic aneurysm?

An aortic aneurysm is a **swelling** or bulge to more than 1.5 times its normal size, which is caused by a **weakening** of the aortic wall. An aneurysm in the ascending aorta can also lead to **aortic regurgitation** (leaking of the aortic valve) causing symptoms such as; shortness of breath, lethargy and swelling of your ankles. These are often the first **symptoms** for some patients with aortic disease.

Aortic aneurysms can develop in the **chest** and **abdominal** areas. Patients who have already been treated for an aneurysm have an **increased risk** of developing aneurysms in other, untreated areas. Therefore, **regular check-ups** are essential.

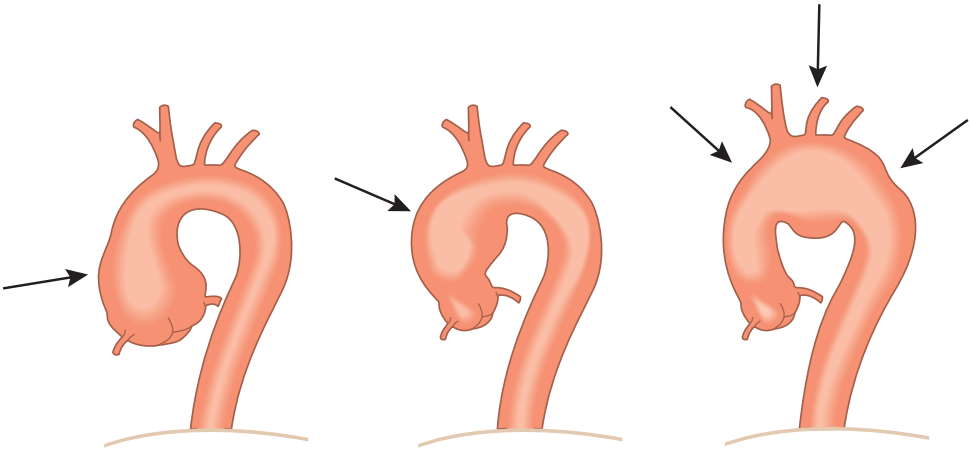
Sometimes, aortic aneurysms **do not cause symptoms**. Often aortic aneurysms are detected by chance during routine tests like chest X-rays, computerised tomography (CT) scans and echocardiograms (echo).

A thoracic aortic aneurysm is commonly found among patients who have **'atherosclerosis'** (hardening of the arteries) and general 'wear and tear' of the aorta.

The type and location of your aneurysm will be discussed by your consultant in clinic, who will describe which part of your aorta will need operating upon or **surveillance** (watching).

Sometimes the aneurysm can affect more than one section of the aorta, leading to treatment of multiple sections, either by surgery or stenting or a mixture of both.

Examples of aortic aneurysms:

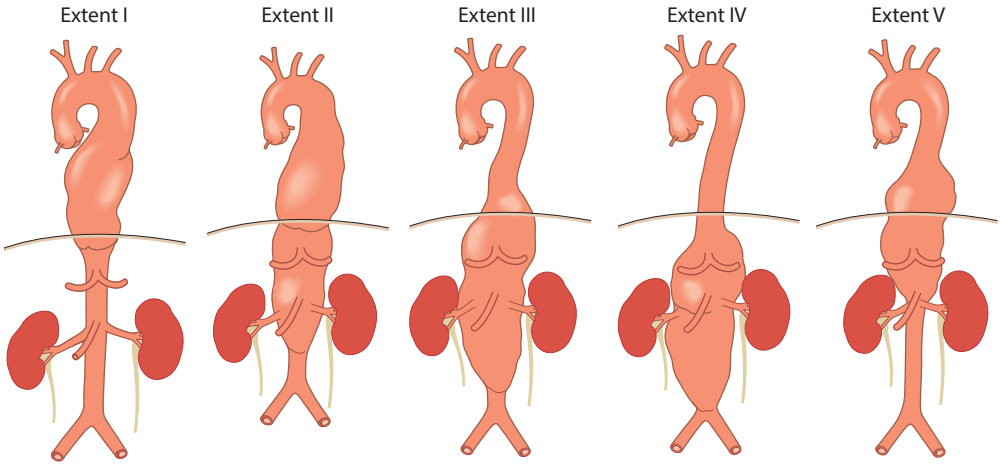


Aortic root aneurysm

Ascending aortic aneurysm

Aortic arch aneurysm

Thoracoabdominal aortic aneurysms **(aneurysms in the chest and abdomen)** can be classified from one to five using the **Crawford classification** as shown below:



Extent I – arises from above the sixth intercostal space, usually near the left subclavian artery, and extends to sometimes include the origins of the celiac axis and superior mesenteric arteries

Extent II – also arises above the sixth intercostal space and extends down to include the infrarenal aortic segment, often to the level of the aortic bifurcation

Extent III – rises in the lower half of the descending thoracic aorta, below the sixth intercostal space, and extends into the abdominal aorta to the level of the aortic bifurcation

Extent IV – generally involves the entire abdominal aorta from the level of the diaphragm to the aortic bifurcation

Extent V – arises in the lower half of the descending thoracic aorta, below the sixth intercostal space, and extends into the abdominal aorta, but is limited to the visceral segment, not extending beyond the kidneys

Genetics

Approximately **20%** of individuals presenting with these thoracic aortic conditions exhibit an autosomal dominant pattern of **inheritance** of the condition in the family.

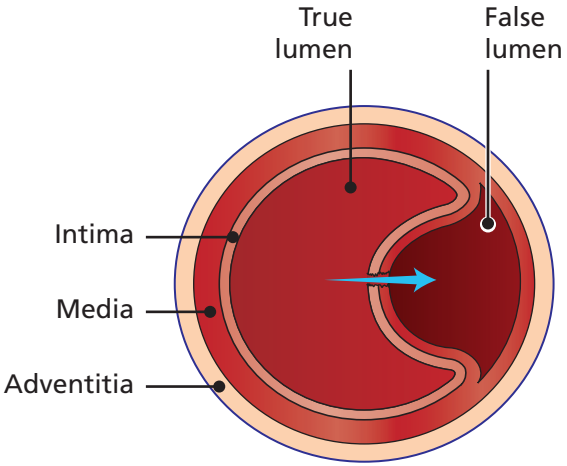
Examples of syndromic disorders that we know can lead to aortic conditions are: Marfan's Syndrome, Ehlers-Danlos Syndrome, Loeys-Dietz Syndrome and Turners Syndrome.

Here at the Queen Elizabeth Hospital Birmingham, we run a service looking specifically at the genetic causation of aortic disease. If we feel there may be a **genetic cause** for your aortic disease, we will refer you to our **consultant cardiologist** who specialises in this area. In this instance, you will be invited to meet the genetic team in clinic; complete a blood test, which will be tested for genetic mutations, and undergo closer surveillance for **you and your family**.

If you feel there may be any family history of aortic disease or sudden death, or you feel this may be applicable to you, please do not hesitate to discuss with your advanced clinical practitioner, surgeon or cardiologist.

What is an aortic dissection?

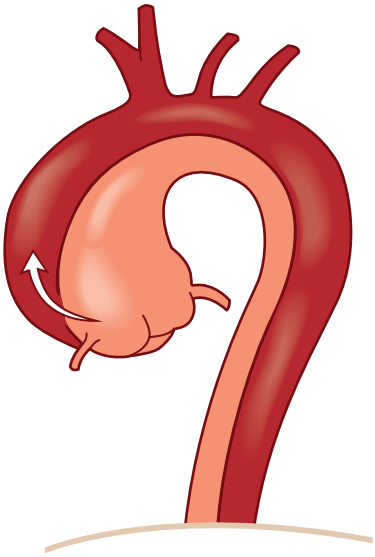
An aortic dissection is a life-threatening condition caused by a tear in the innermost layer of the aorta. Blood surges through the tear, causing the inner and middle layers of the aorta to separate (dissect). If the blood-filled channel ruptures through the outside aortic wall, aortic dissection is often fatal. Symptoms of aortic dissection include **extreme pain**, collapse, shock or **unconsciousness**. Acute aortic dissections often result from aortic aneurysms; the larger the aorta and the greater the tension on the aortic wall, the greater the risk for an aortic dissection.



An aortic dissection can block the vessels/branches leading out of the aorta, causing a heart attack, stroke, paraplegia and malperfusion of the arms or legs, or insufficient blood supply to the abdominal organs.

Aortic dissection is **relatively uncommon**. The condition most frequently occurs in men in their 60s and 70s. Symptoms of aortic dissection may mimic those of other diseases, often leading to delays in diagnosis. However, when an aortic dissection is detected early and treated promptly, the chance of survival greatly improves.

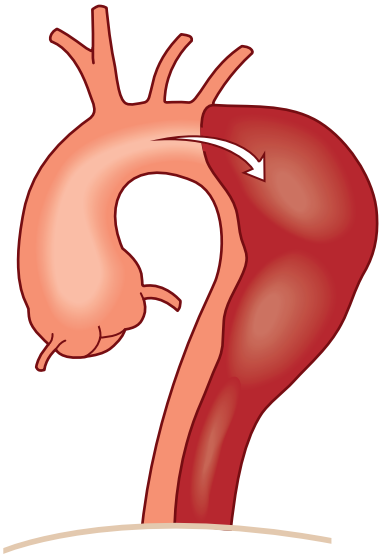
Aortic dissections are classified as per the **Stanford classification**, Type A and Type B dissections. '**Type A**' when describing an aortic dissection, affects the aortic root and/or the ascending aorta and this is a serious surgical emergency. A specific risk of a 'Type A dissection' is that it can extend to include **the aortic valve, coronary arteries, the head and neck vessels** and **the descending aorta**.



'Type A Dissection'

This can lead to **sudden death** through rupture and bleeding into the pericardium (the sack enclosing the heart), known as a cardiac **tamponade**. Blood trapped inside the pericardium compresses the beating heart from the outside, leading to heart failure. An untreated "Type A dissection" has a high **mortality** rate of about 40–60% in the first 48 hours, increasing around 1% every hour.

In contrast, a "**Type B dissection**" arises from beyond the aortic arch and extends to the descending aortic segment and beyond. This accounts for about 25% of patients with an aortic dissection. There is a lower risk for serious complications in comparison to a Type A dissection because the heart and vessels to the head aren't affected. However, the abdominal and leg vessels can become obstructed or the aorta can rupture causing bleeding which could be fatal.



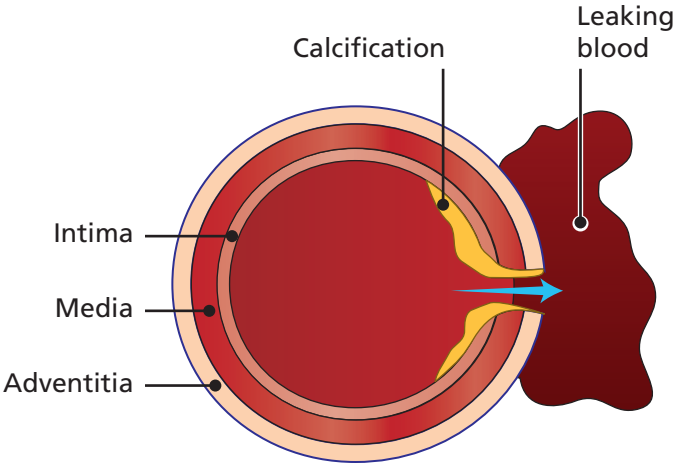
'Type B Dissection'

"Malperfusion syndrome" occurs when an aortic dissection obstructs a vessel, preventing adequate blood supply from reaching the respective organ. Malperfusion syndrome is a common cause of death from an aortic dissection. Even after successful emergency surgery,

organ damage caused by malperfusion syndrome can be irreversible. Therefore, despite treatment, there may still be long-term end organ damage such as chronic kidney failure or the lasting effects of a stroke.

What is an aortic rupture?

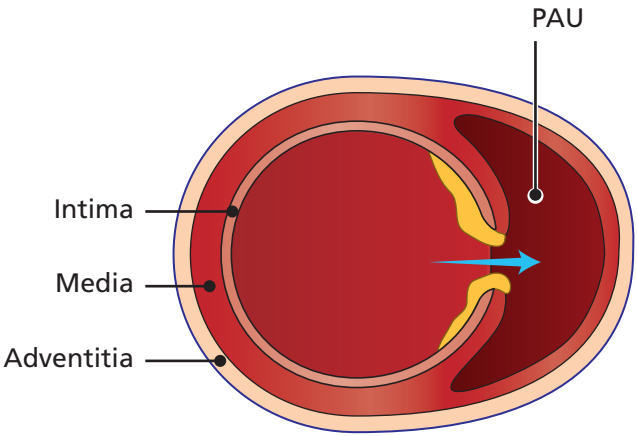
The term aortic rupture describes the **bursting of the aortic wall**. This results in the leakage of blood into the surrounding tissue. If large amounts of blood penetrates a cavity in the body, such as the pericardium or the chest cavity, this can lead to immediate death. A "**contained rupture**" is when the layers of tissue are able to stem the leakage, the blood loss is slowed and those affected can sometimes reach the hospital in time.



An aortic rupture is an **acute, life threatening emergency**, which must be treated immediately. The risk of death from an aortic rupture is extremely high. It is assumed that only **40%** of those affected reach the hospital alive. Of these, 20–30 % will not make it despite emergency treatment.

What is a penetrating aortic ulcer (PAU)?

An aortic ulcer is caused by atherosclerosis (plaque) and causes localised **damage to the inner aortic wall**, allowing blood to escape into the outer layers of the aortic wall. An ulcer is usually smaller than 2cm and looks like a bulge in imaging investigations. An untreated aortic ulcer can lead to an aneurysm, aortic dissection or rupture and should, therefore, be **treated urgently**.



What is aortitis?

Aortitis describes the **inflammation** of the aorta due to an **infection** or an **autoimmune disease** (non-infectious aortitis). Aortitis causes a thickening of the aortic wall, which can be detected through several tests (e.g. CT or MRI).

Diagnostics

The diagnostic pathway begins with a **consultation** and a **physical examination** by one of our surgeons, surgical care practitioners (SCP) or advanced clinical practitioners (ACP). If an aortic disease is suspected, you will undergo some, or all, of the following diagnostic tests and be discussed in our multidisciplinary team meeting which specialises in aortic diseases.

Transthoracic echocardiography (ECHO)

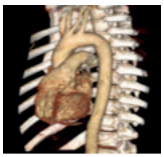
This is an **ultrasound of the heart** and its surrounding blood vessels. The test delivers valuable information on the heart valves, the pumping action of the heart, the aortic root and the ascending aorta. The advantages of an ECHO are; its wide availability, ease of use and low risk to patients. However, it cannot offer information on the aortic arch or the descending aorta.

Transoesophageal echocardiography (TOE)

This is also an **ultrasound of the heart** but from a different angle (behind the heart). Here, an ultrasound probe is guided down the oesophagus (food pipe) to give closer and more accurate images from behind the heart. TOE allows a more precise examination of the heart. However, the aortic arch cannot be viewed and some patients can find this procedure uncomfortable, therefore it requires sedation.

Computed tomography (CT)

CT is the most sensitive imaging choice for clarifying aortic diseases, both in elective and emergency situations. For this test, you will be asked to lie on a table which will pass through an X-ray tube. As it does this, a multitude of cross-sectional X-ray images will be produced. In order to gain clear images of the aorta, a **contrast** agent is administered through a cannula in your arm. CT gives us high-resolution images for every part of the body with extremely **precise** conclusions about the aorta. 3D reconstructions of the aorta can be made to improve visibility of the aortic disease.



Due to high levels of radiation exposure, this test should only be used when the indication justifies it. Before a contrast agent is used, your kidney function will need to be tested by blood test.

In general, CT examination is a **low-risk procedure** and in examinations of aortic diseases, the benefits greatly outweigh the risks. Because of the high information value of the images of aortic

diseases and its immediate accessibility, CT is the **most important** test to assess the aorta before an operation as well as during follow-up.

However, if frequent follow-up examinations are expected, particularly with younger patients, it is preferable to use MRI as the routine imaging technique, in order to avoid the risks of radiation.

Magnetic resonance imaging (MRI)

MRI, like CT scans, produce numerous cross-sectional images of the examined body part, but use **magnetic fields** instead of X-rays. MRIs are increasingly used during surveillance, as you can visualise the whole aorta and there is no risk of radiation exposure for patients. However, it must be noted that MRIs cannot be used with patients with **metal implants**, including some pacemakers, due to the use of magnetic fields. MRI also takes much longer than CT scans and therefore is **not used in emergency** situations.

Additional tests

If surgical treatment of an aortic aneurysm is indicated, pre-operative examinations will be planned. Among other things, important risk factors such as lung or kidney disorders are screened. Associated heart diseases, which would need to be treated during surgery, are also excluded.

Cardiac catheterisation

A coronary angiogram procedure is usually performed **prior to surgery** to study your coronary arteries to exclude **coronary heart disease**. It is a specialised procedure that allows a doctor to examine the arteries that supply blood to the heart. The procedure is usually carried out through blood vessels in the **groin or wrist**. You will be awake during the procedure but will be given a local anaesthetic to numb the skin. A small cut is made and a thin tube (called a **catheter**) and fine wires are inserted into the artery and passed up through the blood vessel to the heart. A special type of **dye** that can be seen on X-ray is injected through the tube to enable the doctor to examine the coronary arteries and the heart. Narrowing of blood vessels or

anatomical anomalies can be detected. If any major abnormalities are identified, the best form of treatment will be discussed with you.

Further tests you may require include, **electrocardiogram (ECG)** which is a heart tracing that looks at the rhythm of your heart, a **lung function test**, which looks at your lung capacity, and potentially various other blood tests.

Some aortic diseases develop gradually over a longer period of time and can be conservatively monitored (**surveillance**). It is only if the condition changes or deteriorates, or meets an indication for an operation, that surgery will be recommended. However, other aortic diseases need to be treated either **immediately or urgently** with the majority treated with surgery in an elective, planned manner.

Surgery

Surgery on the aorta can be performed either through a vertical incision on the front of your chest (a sternotomy) or through a horizontal incision on the left-hand side of your chest (a thoracotomy). The two main reasons for operating include worsening **symptoms** or an increase in **size of the aneurysm**.

The diseased part of the aorta is removed and replaced with a synthetic graft made from dacron. All branches that affect that segment of the aorta are re-attached. If the aneurysm is near to your aortic valve and you are displaying symptoms from your valve not working well, then this may need to be replaced at the same time. This is called an aortic valve replacement.

You will have a general anaesthetic and the surgery is performed using the aid of a **cardiopulmonary bypass machine**, which supports your heart and lungs during the operation, allowing oxygenated blood to continue to flow to your other vital organs. You will spend approximately two nights on the Critical Care Unit following your surgery; you will then be transferred to the ward area to continue your recovery. The ward stay

is usually an additional four to seven days, however this may be longer depending on which operation you require.

Rarely, the treatment you need requires a two-stage approach. In these circumstances, you will be admitted for one stage then brought back for the second operation when you are fit at a later date. Your consultant will explain this to you in full if this is applicable to you.

Aortic valve replacement

The aortic valve allows blood to flow from the left ventricle of the heart, up into the aorta against gravity, and prevents backflow into the heart. The normal aortic valve has three leaflets; it is therefore called **tricuspid**, 'tri' meaning three. If the valve leaflets do not meet sufficiently, blood can flow back into the heart from the aorta, reducing the amount of oxygenated blood to the body; this is known as **aortic regurgitation**. The valve can also become narrowed or stiff and this is known as **aortic stenosis**, preventing an adequate amount of blood from leaving the heart, which can also cause symptoms.

Aortic valve disease can be congenital (from birth), develop as part of the ageing process, stem from rheumatic disease as a child, or occur as a result of endocarditis, which is an infection affecting the valve and preventing it from working properly. Symptoms associated with aortic stenosis and aortic regurgitation include; shortness of breath on exertion or at rest, swollen ankles, angina (chest pain), tiredness or syncope (fainting). If aortic regurgitation or stenosis is identified in any of the above examinations, you will be offered aortic valve surgery to either repair or replace the valve and restore its function.

The procedure

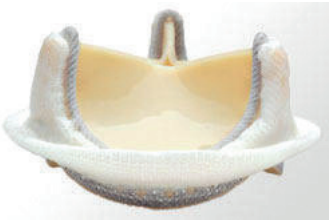
During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone.

The patient's diseased aortic valve is cut out, leaving the aortic valve

annulus (a fibrous ring). Any calcified material in the aortic valve annulus is removed. The annulus is then measured and an appropriate prosthetic valve is chosen. Following this, the chosen prosthetic valve is stitched to the aortic annulus and secured in place.

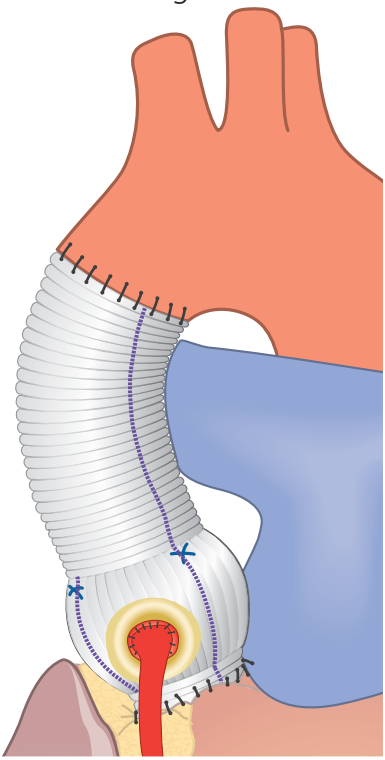
Patients requiring this surgery will make an informed decision with their surgeon about the type of valve prosthesis they will have. This decision is made depending on your age, occupation, co-morbidities and lifestyle. The differences are shown in the table below:

Mechanical prosthesis	Bioprosthesis 'Tissue'
Made of a combination of carbon, titanium and graphite	Made of bovine or porcine tissue
The foreign surface activates blood clotting and so requires life-long Warfarin to prevent clots forming and reduce the risk of stroke or valve failure	Do not activate blood clotting and so does not require Warfarin to thin the blood
Often a 'click' can be heard by the patient or people around the patient during valve closure	No click is heard
Likely to last a life-time	Lifespan of around 10-15 years due to calcification and degeneration (age and activity dependent)



Aortic root replacement:

During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone.

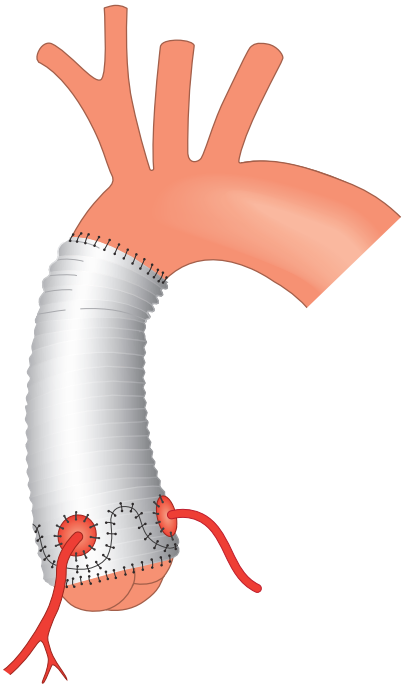


During an aortic root replacement, the aortic valve and the section of the aorta which is closest to the valve, known as the 'aortic root', is replaced with an artificial Dacron graft, and the aortic valve is replaced with a mechanical or biological valve. Valved conduits may be sewn together at the factory or constructed by the surgeon during the operation.

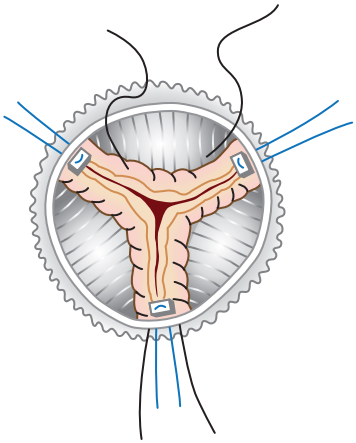
An example is shown here:

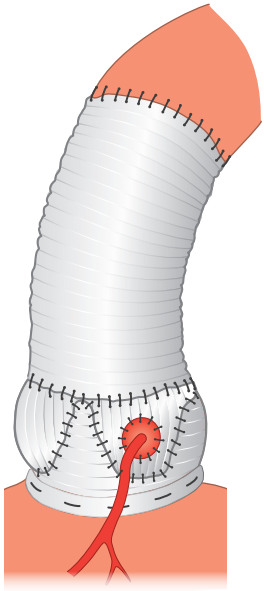
Valve sparing aortic root replacement:

During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone.



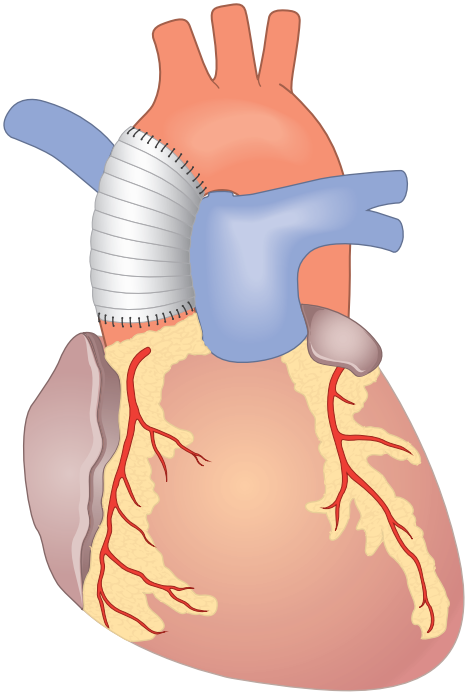
A ‘valve sparing’ aortic root replacement is chosen if your aortic root needs to be replaced but your aortic valve does not. In this case, the aortic root will be replaced but your own valve will be preserved. This can prevent long-term use of anticoagulants and may reduce the risks of stroke and infection associated with valve replacement.





Ascending aorta replacement:

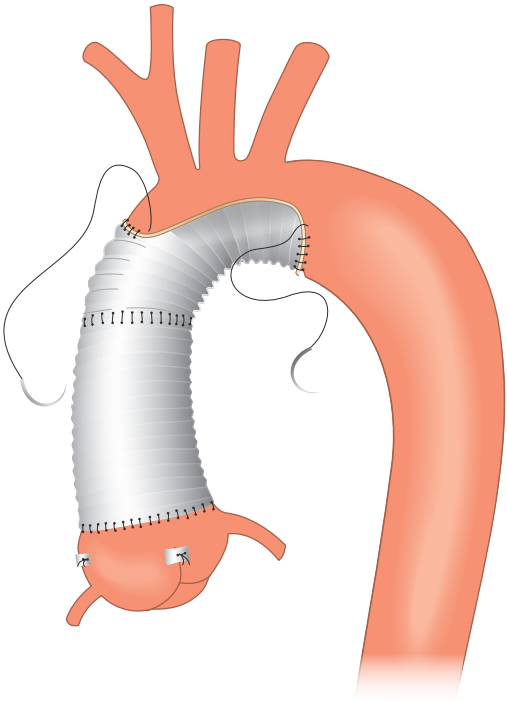
During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone.



If only the ascending aorta is affected by aneurysm, this can be replaced with a straight aortic prosthesis (known as a "**tube graft**"). For this, the ascending aorta is clamped before the aortic arch and subsequently replaced with a straight synthetic Dacron graft that spans just above the openings of the coronary arteries (sinotubular junction) to the aortic clamp, as seen above.

Partial aortic arch replacement

During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone.

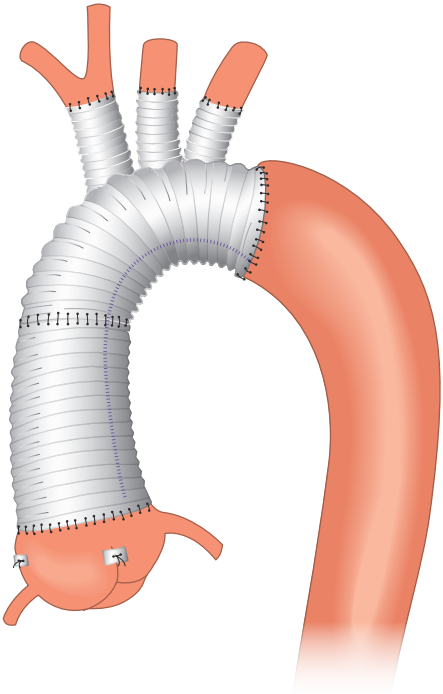


For many patients who undergo surgery due to an aneurysm of the ascending aorta, a portion of the aortic arch is also replaced. For these patients the replacement of the entire aortic arch is not necessary. You may hear it called '**hemiarch** replacement' or a '**partial** aortic arch replacement'. This involves assessment of the aortic arch from within, and for this, the aortic arch must be briefly opened under a period of circulatory arrest (where the circulation to the body is stopped).

Following assessment, the extent of arch replacement that is required is made. This can involve replacement of just the under surface of the aortic arch or include up to a two vessel re-implantation. This requires the implementation of various surgical techniques and can be discussed with you in further detail if required.

Total aortic arch replacement

During this operation, the surgeon will make an incision, called a median sternotomy, in your chest and through the breastbone. Because of its anatomical characteristics, replacing the entire aortic arch is one of the most complex interventions within aortic surgery.

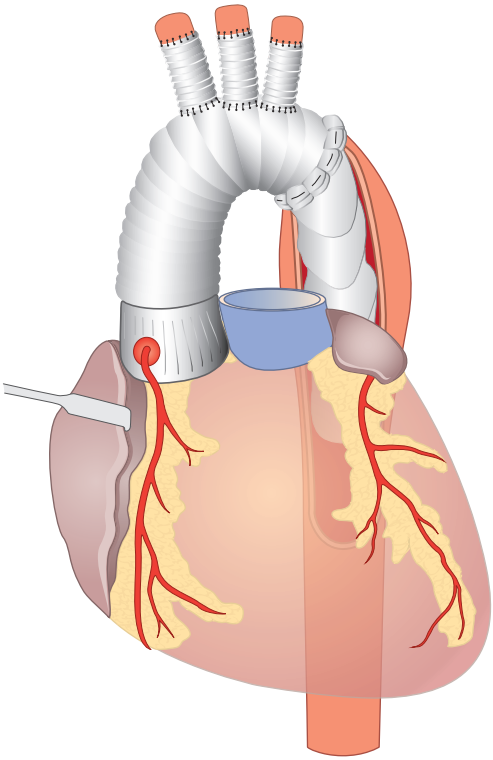


The three arteries that supply the arms and head with blood begin at the **aortic arch**. After the aortic arch, the aorta transitions into the descending aorta, supplying blood to the lower part of the body. To complete the operation, the blood flow to the body and head is temporarily stopped. To protect the brain and other organs, the entire body is cooled down to 22 degrees. Circulation is re-started at the earliest opportunity once that stage of the operation is complete.

The head and neck arteries that begin at the aortic arch are re-implanted **individually** or grouped as a combined '**island**' onto the synthetic graft, that is used to replace the aortic arch.

Aortic arch replacement with frozen elephant trunk

If the aneurysm extends from the aortic arch into the descending part of the aorta, it can be treated with a total arch replacement (TAR) and deployment of a stent into the descending portion of the aorta – at the same sitting. This stent is called a '**frozen elephant trunk**' and aims to exclude the aneurysmal portion and achieve a seal below the aneurysm.

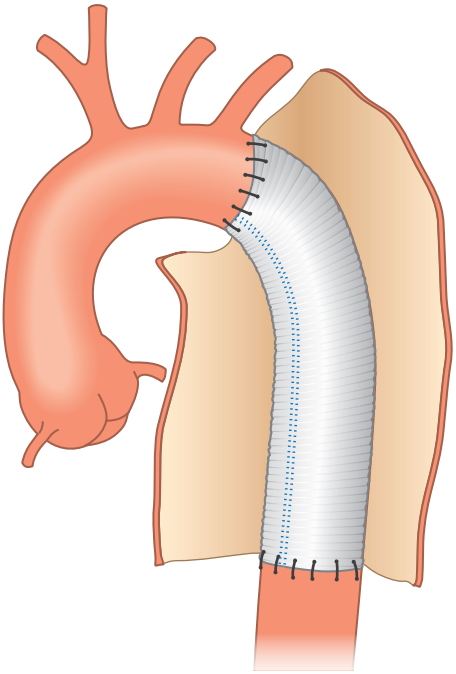


The extent of the descending thoracic aneurysm dictates if a FET alone would suffice, or a further second stage procedure may be required at a later date to treat the whole of the aneurysm. Your surgical team will discuss this with you. If a second stage procedure is required, this can be either an 'open' procedure through the left side of your chest, or an endovascular procedure (with stent deployments) through the groin. These options will also be discussed with you, if required.

Occasionally a '**floating elephant trunk**' is left in your descending aorta, when we anticipate that a stent will not be suitable and a second stage procedure may be required at a later stage, through an 'open' technique through the left chest.

Descending thoracic aorta replacement

During this operation, the surgeon will make an incision called a left thoracotomy, along the left side of your chest. Your surgeon may opt for this procedure if you have an isolated descending thoracic aneurysm, or penetrating aortic ulcer confined to the descending segments.

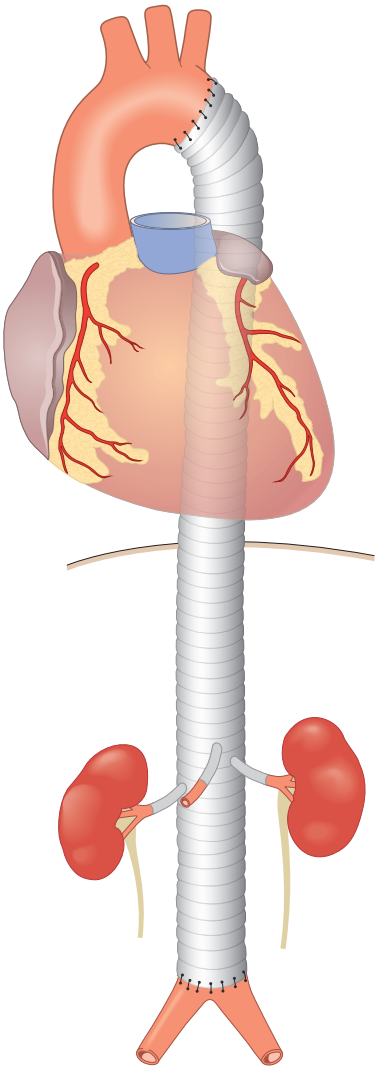


Descending thoracic aneurysms are located in the left chest adjacent to the spine. Access to this segment of the aorta requires open surgery through a large incision in the back and side of the left chest, via the space between your ribs; your ribs are spread apart. A section of one or more ribs may need to be removed to allow access to the entire aorta from the arch to the diaphragm. The aneurysmal part of the aorta is replaced with a Dacron graft.

Additional to the usual risks of aortic surgery, operating on the descending thoracic aorta involves a risk of **paralysis of the legs (paraplegia)**. One of the main branches that supply blood to the spinal cord arises off the thoracic aorta, which is being excluded in this type of surgery and as such caries a risk of paraplegia due to a reduction of blood supply to the spinal cord. Various **surgical adjuncts** are used to minimize and reduce the risks of paralysis and stroke. This will be explained to you in full during your **consent** process.

Thoracoabdominal aneurysmal repair or replacement

This operation involves access to the entire descending and abdominal aorta. This requires the surgeon to make an incision called a thoracotomy and extend this into the abdomen via a laparotomy.



There are two ways to treat a thoracoabdominal aneurysm: open repair and replacement or endovascular repair with stents. In the **open**

procedure, an incision is made on the back, around to the chest and extending to the abdomen, to expose the entire descending and abdominal aorta. The endovascular procedure requires access through the vessels in the groin and deploys stent inside the aorta to exclude the aneurysmal components.

The procedure that best suits an individual is discussed in a multidisciplinary meeting that includes a team of experts (cardiac/aortovascular surgeons, vascular surgeons, cardiologists, radiologists and advanced care practitioners). The best approach for each case is discussed, including the options, risks and benefits of each, and both short and long-term outcomes.

An **open procedure** includes resection and replacement of the diseased segment with a graft. All the main branches that supply the abdominal organs are re-implanted individually. This procedure is often used in the younger patients who are felt fit enough for an open operation, and those with a connective tissue disorders.

The endovascular procedure requires **stenting** and is a minimally invasive technique known as **EVAR** (endovascular aneurysm/aortic repair) or **TEVAR** (thoracic endovascular aneurysm/aortic repair). These procedures are usually carried out by a vascular surgeon.

As with the descending thoracic aortic replacement described above, the extensive open operation comes with additional risks including the risk of paraplegia. Various adjuncts are used to reduce the risks of paraplegia including the placement of spinal fluid drain and using motor evoked potentials (technique used to assess lower leg nerve conduction).

You will remain in the Intensive Care Unit for 4–8 days on average before transferring to the ward for a further 10–14 days. Thoracoabdominal procedures can be very long and your body undertakes a high level of physiological stress; this can impact the

length of time you take to recover. We anticipate your length of stay in hospital to be around 14 days, depending on complications.

You should plan to be away from work, getting your full strength back, for around 12 weeks (patient dependant). Your surgeon will advise you on specific post-operative restrictions, however most are explained in this booklet.

Pre-admission clinic

As part of your preparation for surgery, you will be reviewed by a pre-admission nurse and a member of the Cardiac Anaesthetic Team.

This assessment can take up to **two hours** and involves:

- Taking a full history and a clinical examination
- Assessment of your social situation and whether you require any extra support or have any disabilities
- Explanation about the procedure and your hospital stay
- Explanation about the recovery period following surgery
- Discussion around cardiac rehabilitation (the availability of this currently depends on where you live)
- Repetition of any investigations if necessary
- Advice on your medication including which tablets you should stop prior to coming into hospital
- Discussion of any concerns and answering of any questions you may have
- Advice around dental visits prior to valve surgery; this will reduce the risk of infection on your new valve
- Discussion on your expected length of hospital stay
- Advice on arrangement of any additional help you may need such as a social referral, dietician referral, or smoking cessation.

Some of this information may have already been discussed with you during your first clinic consultations with your surgical team.

Smoking advice

If you are currently smoking, it would be best if you could **give up** at least three months prior to your operation. Giving up smoking may not be easy and you will need **support** and **encouragement** from family and friends, however stopping smoking will reduce your risk of complications post-operatively. These **complications** may include chest infections (that will prong your need for ventilation), sternal wound break down, wound infections and withdrawal. Your **GP** can offer you support regarding this.

Day of admission

You will be informed about your planned surgical date and date of admission by post or telephone. It is at this time that you will be reminded of any medications that need to be stopped for a period of time prior to surgery. A telephone number will also be included on your letter that you can call to enquire about your admission time and bed availability.

Please bring the following items in to hospital with you:

- All your tablets in their original bottles or packets
- Your admission letter and this booklet
- Nightwear, dressing gown, underwear
- A soft, non-underwired bra or sports bra for ladies
- Flat comfortable full shoes or full slippers
- A wash bag containing: toothbrush, toothpaste, denture box, brush, comb, glasses in their case, shaving equipment, soap, and a flannel or small sponge. It would be helpful if you could label your denture box and glasses case with your name and date of birth before you come into hospital.

We do have the facility to store a small overnight bag containing your property but would suggest you leave valuables at home. Your property will be given back to you once you return from critical care to a ward.

Follow up

Following discharge from hospital, you will be invited to a **surgical follow-up** clinic approximately six weeks post-surgery. Here the surgical team will assess your recovery by:

- Taking a history of your progress from discharge
- Physical examination
- Completing and reviewing any required tests such as ECG, X-ray, ECHO, bloods etc
- Reviewing your surgical wounds
- Reviewing and altering medication to control your blood pressure

If progress is satisfactory and further clinic follow-up is not required, you will be discharged to our **aortic surveillance** programme where you will be monitored closely until we are confident you are not at risk of further surgical concerns following this operation. This will involve a mix of face-to-face clinics, telephone consultations in our **ACP-led virtual surveillance clinic and regular CT, Echo or MRI scans** to observe any post-operative changes and also to monitor the remaining non-operated aortic segments.

Please ensure you have had bloods within six months prior to any CT scan. Please contact your GP directly to arrange this. Without this, your scan will be cancelled.

Surveillance imaging and progress will be discussed in the MDT meetings and your plan moving forward will be explained by way of a letter of correspondence following each MDT. This may result in further surveillance with imaging, a face-to-face clinic consultation, or you may be discharged from surveillance to the care of your cardiologist/GP. The interval of imaging that is required and frequency of follow-up will be outlined in the MDT outcome letter and will depend on the imaging that has been reviewed in the meeting.

Your recovery

Lifestyle

Your six week surgical follow-up will prompt a formal **cardiac rehabilitation** plan (if available in your area), which is specially formed to safely facilitate your return to normal daily life, exercise and work as usual. The length of time this takes varies from person to person but is likely to be around 12 weeks. If your operation means that you need to take blood thinners such as Warfarin, some **professions or hobbies should be stopped**. Please discuss this with your ACP or surgeon in hospital, or with your GP. We advise against any activity involving submerging the body in water such as swimming, hot tubs or taking a bath, for at least six weeks or until the wound is completely healed. Again, this can be discussed with your ACP or surgeon.

Dental hygiene

Moving forward, it is extremely important to practice **good dental hygiene** and inform your **dentist** of your recent surgery, including any medication you are taking. This is particularly important if we have operated on your aortic valve. It is likely that you will require prophylactic antibiotics during invasive dental procedures.

Sex/Intimacy

After surgery, patients are often apprehensive to ask about sex. They're either embarrassed or they're so stressed they forget to ask the question so here is some advice:

- Do not do anything that you do not feel ready for or causes pain
- If you had your operation via sternotomy, you must take care **not to put any weight** through your arms or chest for a minimum of 6–8 weeks
- Using **pillows** to position may help take strain off the body
- Try to introduce sex back into your life slowly and **keep exertion low** throughout
- Please note: increased fatigue is normal following surgery

- It is possible that your medications can have negative side-effects on your libido – please **do not be afraid** to discuss this with your GP or cardiologist as changes may be able to be made

Driving

Updated information states that you **do not need to inform the DVLA** following cardiac or aortic surgery, however you must not drive until you can safely control your vehicle and have been cleared by your surgeon or GP. We advise that you should refrain from driving a car for the first **six weeks** following surgery or until cleared to do so at your follow-up appointment. This is because the movements required to safely drive a car, such as looking over your shoulder, turning the steering wheel and performing emergency stops, can put pressure on the chest, undo any sternal healing and cause pain. As a passenger, **take time** getting in and out of the car to protect your chest. Using a seatbelt is still a legal requirement following surgery.

Medication

Taking medication is essential to recovery following aortic surgery and to prevent further complications. Blood pressure medication is key to keep pressure and tension on the aortic wall low.

Close control of blood sugars using diabetic medication is essential as high blood sugar can **delay healing**. Statins are crucial to lower cholesterol and prevent formation of atherosclerotic plaques, which can result in rupture.

Both foreign material in the aorta and atherosclerotic plaques increase the risk of blood clots, causing further damage. Anti-platelets, such as aspirin, reduce the formation of these clots, acting as secondary prevention.

Travel and wellness

Short trips can be taken following a successful six week follow-up appointment. We do not advise travelling away from your local centre prior to this point in case you require unanticipated follow-up treatment. We advise long haul trips should be put off until **three months post-surgery, and until after your first clinic follow-up review**. When travelling, ensure you take an **adequate supply** of medicine, a copy of your **discharge letter** from the hospital, and any recent correspondence from your surgical team. Take care when carrying heavy luggage and avoid sauna visits for at least three months post-surgery.

Exercise

Pre-op you are allowed to perform **light cardiovascular exercise**, however any exercise or movement that involves '**bearing down**' or causes you to '**strain**' is strongly **advised against**, as this creates changes in your blood pressure and increases your risk of an aortic dissection or rupture. Again, cardiovascular activity, such as walking, post-op is **essential for recovery** but anything more than this is not advised prior to your six-week follow-up. Your exercise tolerance can be gradually built up within your own comfort zones.

Mental health

In some patients, **anxiety and depression** following aortic surgery, elective and emergency, is unfortunate but **very real**. Maintaining a balance between doing enough but not over doing it, alongside control of blood pressure and **knowledge** of possible complications and further operation, can be overwhelming. Although increased **fatigue**, difficulty holding **concentration** and **low libido** can be normal post aortic surgery, feelings of **low mood**, increased **stress**, **post-traumatic stress disorder**, **anxiety** and recurrent **dreams** should be explored by your GP or practitioner. There are also self-help tools available via mobile applications, websites such as 'Mind', and self-referral options to local services such as 'Healthy Minds', as well as other government initiatives, that may help.

Quality of life is not a luxury, it is essential. Please seek help and do not suffer in silence.

Ongoing symptoms

It is important to understand that these are major operations and you must inform your cardiac surgical team if you experience any of the following symptoms:

- Ongoing dizziness despite drinking well
- Fainting episodes
- Chest pain
- Acute onset of back pain
- New onset of poor blood flow to your hands and feet (pale, cold to touch)
- New altered sensation to your hands and feet (tingling or numbness)
- New change in bowel habits (acute diarrhoea or constipation)
- Any new onset of weakness or symptoms of stroke

Know your Aorta

Know your Diagnosis	Know your numbers	Know your options	Know your treatments
My aortic diagnosis is:	**My aorta measurements are:**	**My treatment options offered are:**	**The medications I am taking for my heart and aorta are:**

My Aorta

Frequently asked questions

If I am put on surveillance, what does this mean?

When you are put on surveillance, this means that your aneurysm does not require an operation at this moment in time, usually because a strong surgical indication has not been met. This can mean in some cases that you might never need surgery and you will continue to have repeat scans and virtual clinic consultations to check on your progress. If you have had an operation, you may be under surveillance to monitor progress since the operation.

If I have an aortic aneurysm, how big should it be before I am offered surgery?

Your aneurysm usually needs to measure a specific size relative to your own height and weight and/or for you to have symptoms before you will be considered for surgery. This will be explained to you by your surgical team.

How long would I be in hospital for if I had surgery?

Length of stay depends on the type of surgery you require. We estimate that a usual hospital stay is 5–7 days for conventional surgery on the heart. Aortic surgery is more complex and if you require a complex 'all day operation' then this can increase to a longer period in hospital, depending on your recovery time.

How much pain will I have following surgery?

You are likely to have some discomfort and pain following surgery, but this is normal. We will however aim to manage the pain as much as possible post-op so that you can get back to a normal lifestyle. The ACPs or doctors on the ward will prescribe you regular pain medication.

If I don't have surgery, what other options do I have?

During your consultation, the consultant will discuss in detail with you the 'risks and benefits' of having an operation and what options are available to you, and you will have time to think about them with your

family. The consultant will make sure you are on the correct medication and will continue to monitor your aneurysm and your symptoms, even if you are unsure about having an operation.

How does having an aneurysm affect my life?

If you have an aortic aneurysm, your lifestyle should not have to change dramatically. We advise maintaining a normal blood pressure and no heavy lifting or exercise, otherwise you should continue to live and work as normal. If you do have a manual job involving heavy work, please discuss with your consultant any concerns you might have.

What symptoms should I expect to get with my aneurysm?

Most people do not experience any symptoms after having an aortic aneurysm. If your heart valve function has started to deteriorate, you may start to experience shortness of breath on exertion, walking uphill or stairs, chest pain, and peripheral oedema, which is swelling around your ankles and lower legs. If you develop a hoarse voice and/or difficulty in swallowing, you should speak to your GP or consultant ASAP.

Will I need further operations?

With aortic disease there is the possibility you might need further surgery in the future, particularly if you have a known or suspected genetic mutation. This risk will differ from patient to patient depending on the underlying causation of the aneurysm or dissection, and this will be explained to you during your consultation.

Do I need to be worried about my immediate family?

If there is a genetic causation to your aortic disease or we believe there is a risk that your blood family (children, siblings, parents) may have a similar condition requiring investigation, we may invite them for a consultation. Please do not hesitate to highlight this to your GP if you are worried or concerned.

If you have any severe chest or back pain then you should call 999 and be taken to your nearest Accident & Emergency Department (A&E) for assessment

Abbreviations and Acronyms

AAA Abdominal Aortic Aneurysm
AAS Acute Aortic Syndrome
ACE Angiotensin-Converting Enzyme
AD Aortic Dissection
AO Aorta
AOS Aneurysm-Osteoarthritis Syndrome
BAV Bicuspid Aortic Valve
BSA Body Surface Area
CoA Coarctation of the Aorta
CSF Cerebrospinal Fluid
CXR Chest X –Ray
CT Computed Tomography
ECG Electrocardiogram
EDS Ehlers-Danlos Syndrome
EVAR Endovascular Aortic Repair
FL False Lumen
GCA Giant Cell Arteritis
IAD Iatrogenic Aortic Dissection
IMH Intramural Haematoma
LCC Left Coronary Cusp
MRA Magnetic Resonance Angiography
MRI Magnetic Resonance Imaging
PAU Penetrating Aortic Ulcer
PET Positron Emission Tomography
RCCA Right Common Carotid Artery
RCC Right Coronary Cusp
SoV Sinus of Valsalva
TAA Thoracic Aortic Aneurysm
TAAD Type A Aortic Dissection
TAI Traumatic Aortic Injury
TEVAR Thoracic Endovascular Aortic Repair
TL True Lumen
TOE Transoesophageal Echocardiography
TS Turner Syndrome
TTE Transthoracic

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