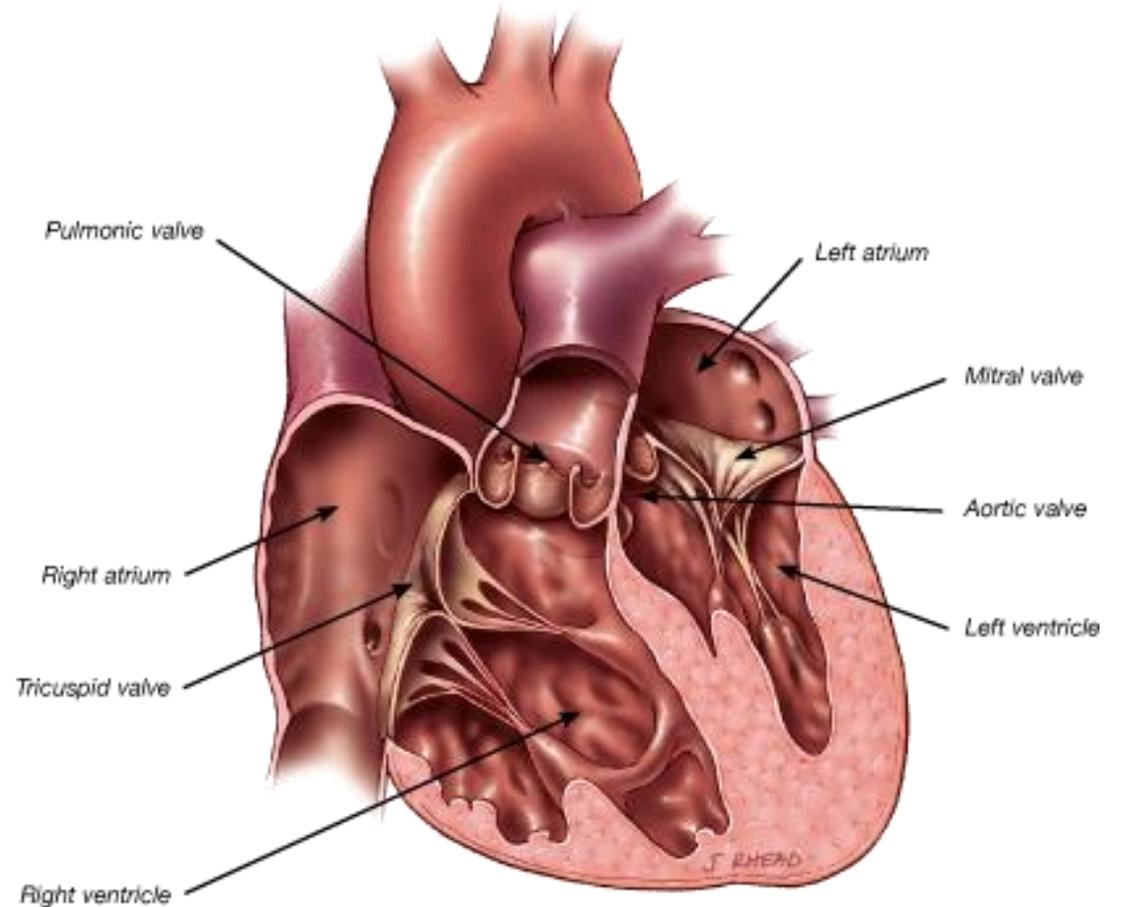


Aortic Valve Disease and TAVI

Educational material for Staff

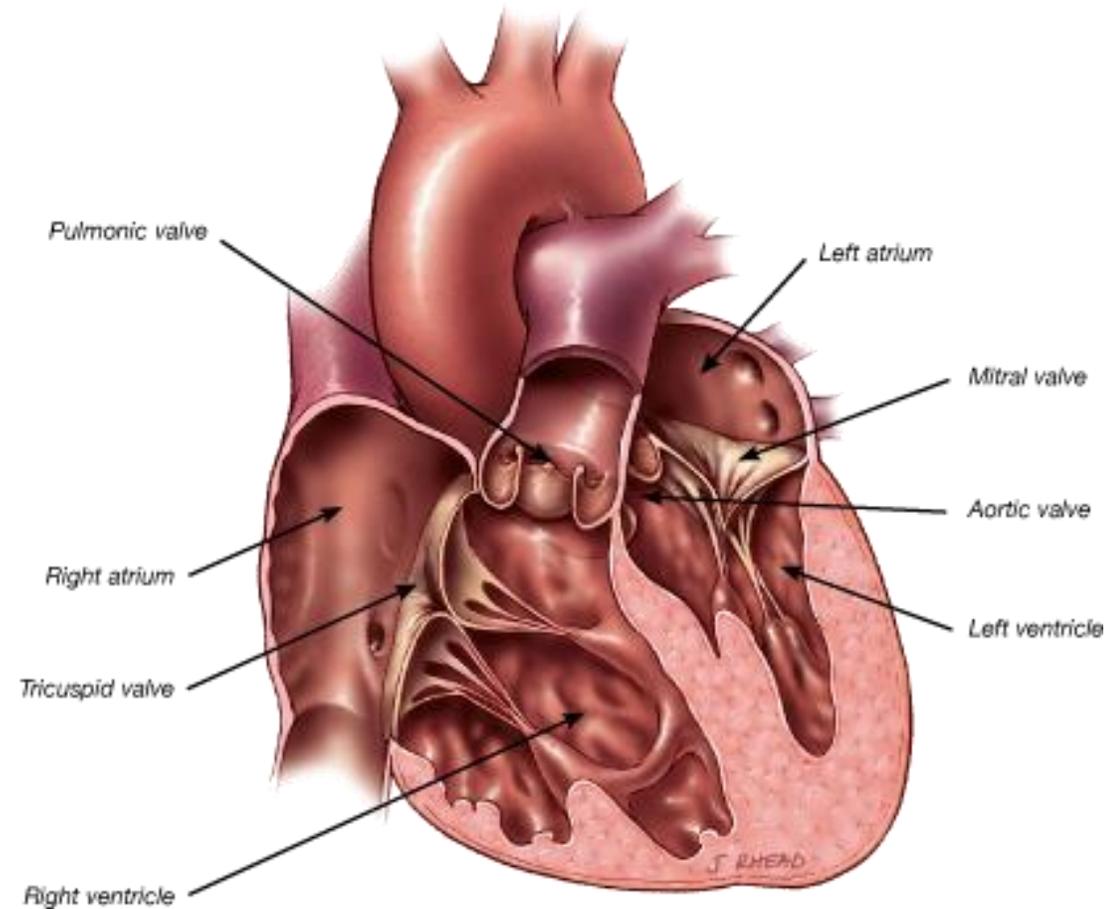
Normal Heart Anatomy

- The cardiovascular system is a closed system through which the heart pumps blood through blood vessels, allowing oxygenated blood to circulate to all parts of the body.
- The human heart is located within the thoracic cavity, medially between the lungs in the space known as the mediastinum.
- There are 4 heart valves within the heart, the aortic, mitral, tricuspid and pulmonary valves
- The valves allow forward flow of blood, then close to prevent back-flow of blood. The mitral and tricuspid valves control the flow of blood from the atria to the ventricles. The aortic and pulmonic valves control the flow of blood out of the ventricles. The image below shows the chambers and valves of the heart.



Normal Heart Anatomy

- Of the four cardiac valves, two are referred to as the atrioventricular (AV) valves. They control blood flow from the atria to the ventricles.
- The tricuspid valve sits between the right atrium and the right ventricle and has three leaflets.
- The mitral valve controls blood flow between the left atrium and left ventricle and has two leaflets.
- The aortic and pulmonic valves, each usually have three leaflets and are outflow valves, regulating the flow of blood as it leaves the ventricles and the heart.
- The aortic valve serves as the “door” between the heart and the rest of the body and is located between the left ventricle and the ascending aorta.
- The pulmonic valve is located between the right ventricle and the pulmonary artery.
- The mitral and tricuspid valves are substantially larger than the aortic and pulmonic valves.



Function of Heart Valves

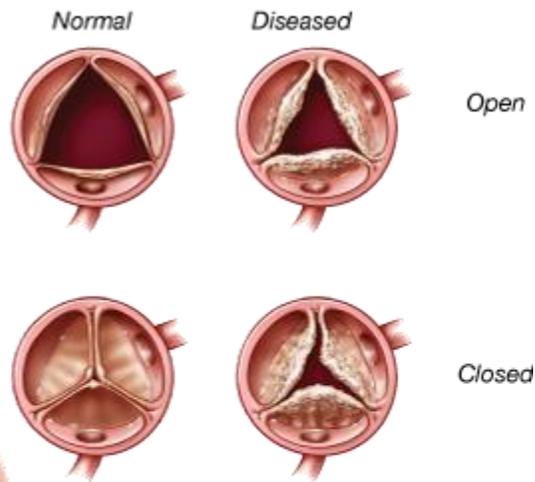
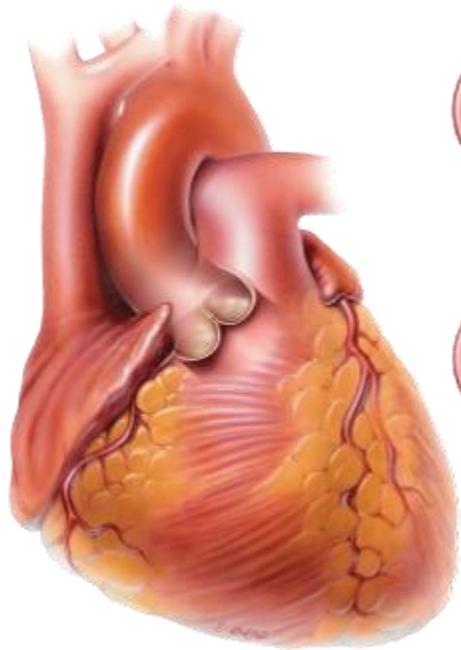
- A normal, healthy valve would be one which minimizes obstruction and allows blood to flow freely in only one direction. It would close completely and quickly, not allowing much blood to flow back through the valve (backward flow of blood across a heart valve is called “regurgitation”). While a small amount of regurgitation, or leak, may be present and is well tolerated, severe regurgitation is always abnormal.
- When a heart valve opens fully and evenly, blood flows through the valve in a smooth and even manner. When a valve is narrowed and does not open fully or evenly, blood flow through it becomes turbulent and is said to be “stenotic.”
- Both regurgitation (a leak) and stenosis (a narrowing) increase the heart’s workload.

Valve Defects and Diagnosis

Heart valves can fail by becoming narrowed (stenotic) so that they block the flow of blood or leaky (regurgitant) so that blood flows backward in the heart. Sometimes a valve is both stenotic and regurgitant. A variety of conditions can cause these heart valve abnormalities.....

- **Degenerative valve disease** – This is a common cause of valvular dysfunction. Most commonly affecting the mitral valve, it is a progressive process that represents slow degeneration from mitral valve prolapse (improper leaflet movement). Over time, the attachments of the valve thin out or rupture, and the leaflets become floppy and redundant. This leads to leakage through the valve.

Valve Defects and Diagnosis



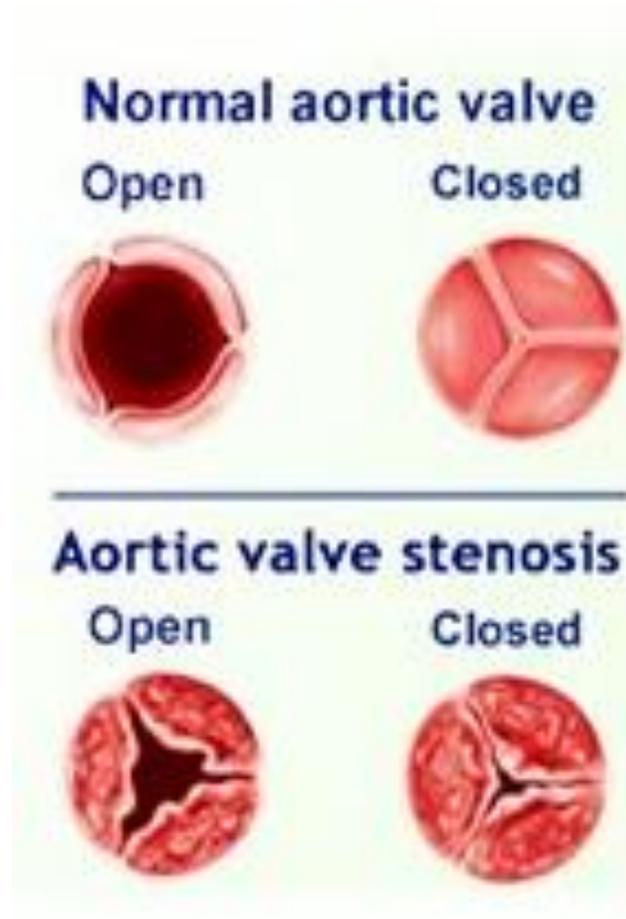
- **Calcification due to aging** – Calcification refers to the accumulation of calcium on the heart’s valves. The aortic valve is the most frequently affected. This build-up hardens and thickens the valve and can cause aortic stenosis, or narrowing of the aortic valve. As a result, the valve does not open completely, and blood flow is hindered. This blockage forces the heart to work harder and causes symptoms that include chest pain, reduced exercise capacity, shortness of breath and fainting spells. Calcification comes with age as calcium is deposited on the heart valve leaflets over the course of a lifetime.

Valve Defects and Diagnosis

Other causes can include:

- **Coronary artery disease** – Damage to the heart muscle as a result of a heart attack can affect function of the mitral valve. The mitral valve is attached to the left ventricle. If the left ventricle becomes enlarged after a heart attack, it can stretch the mitral valve and cause the valve to leak.
- **Rheumatic fever** – Once a common cause of heart valve disease, rheumatic fever is now relatively rare in most developed countries. Rheumatic fever is caused by an infection of the Group A Streptococcus bacteria and can detrimentally affect the heart and cardiovascular system, especially the leaflet tissue of the valves. When rheumatic fever affects a heart valve, the valve may become stenotic, regurgitant or both. It is common for the heart valve abnormality to become apparent decades after the bout of rheumatic fever.
- **Congenital abnormalities** – Congenital heart defects (present at birth) can affect the flow of blood through the cardiovascular system. Blood can flow in the wrong direction, in abnormal patterns, and can even be blocked, partially or completely, depending on the type of heart defect present. Ranging from mild defects such as a malformed valve to more severe problems like an entirely absent heart valve, congenital heart abnormalities often require specialized treatments.
- **Bacterial endocarditis** – Bacterial endocarditis is a bacterial infection that can affect the valves of the heart causing deformity and damage to the leaflets of the valve(s). This usually causes the valve to become regurgitant, or leaky, and is most commonly seen in the mitral valve.

Aortic stenosis



- Aortic stenosis is one of the most common and most serious valve disease problems.
- Although some people have AS as a result of a congenital heart defect called a *bicuspid aortic valve*, this condition more commonly develops during aging as calcium or scarring damages the valve and restricts the amount of blood flowing through the valve.
- Age-related aortic stenosis usually begins after age 60, but often does not show symptoms until ages 70 or 80.

Symptoms of Aortic Stenosis

It's important to note that many people with AS do not experience noticeable symptoms until the amount of restricted blood flow becomes significantly reduced.

Sometimes the person suffering from AS may not complain of symptoms. However, family members may report they have noticed a decline in routine physical activities or developed significant fatigue.

Symptoms of aortic stenosis may include:

- Heart murmur
- Breathlessness
- Chest pain (angina), pressure or tightness
- Fainting, also called syncope
- Palpitations or a feeling of heavy, pounding, or noticeable heartbeats
- Decline in activity level or reduced ability to do normal activities requiring mild exertion

Diagnosis

- Heart valve issues can often be identified by use of a stethoscope on routine physical examination and is the most important diagnostic tool.
- Heart valve abnormalities, whether stenosis or regurgitation, often produce an audible heart murmur. If a heart murmur is new or loud, it should prompt further investigation.
- Echocardiography allows for the formal diagnosis of aortic stenosis. It can often be challenging to interpret the results of echo, for example in patients with reduced left ventricular function, sometimes further testing in the form of a trans oesophageal echo (TOE) or a stress echo is needed to establish a diagnosis.
- Treatment for aortic stenosis is recommended when the valve is considered severely stenosed and the patient has associated symptoms. If either of these two things are not present, patients should be monitored regularly to check the progression of their valve disease and symptoms.



Treatment for Aortic Stenosis

- When untreated severe symptomatic aortic stenosis is associated with a very poor prognosis and treatment in the form of surgical AVR or TAVI is the only way to improve survival.
- Recently published trials have shown TAVI to be an appropriate treatment choice for high risk and intermediate risk patients. The decision between which treatment is most appropriate for each patient is often made during a “heart team meeting” or MDT. This MDT has cardiologists, surgeons, imaging specialists and nurses present.
- The joint society has issued some recommendations to help guide the choice of intervention

Aspects to be considered by the Heart Team for the decision between SAVR and TAVI in patients at increased surgical risk

	Favours TAVI	Favours SAVR
Clinical characteristics		
STS/EuroSCORE II <4% (logistic EuroSCORE I <10%)		+
STS/EuroSCORE II ≥4% (logistic EuroSCORE I ≥10%)	+	
Presence of severe comorbidity (not adequately reflected by scores)	+	
Age <75 years		+
Age ≥75 years	+	
Previous cardiac surgery	+	

Favors
TAVI

Favors
SAVR

Anatomical and technical aspects		
Favourable access for transfemoral TAVI	+	
Unfavourable access (any) for TAVI		+
Sequelae of chest radiation	+	
Porcelain aorta	+	
Presence of intact coronary bypass grafts at risk when sternotomy is performed	+	
Expected patient–prosthesis mismatch	+	
Severe chest deformation or scoliosis	+	
Short distance between coronary ostia and aortic valve annulus		+
Size of aortic valve annulus out of range for TAVI		+
Aortic root morphology unfavourable for TAVI		+
Valve morphology (bicuspid, degree of calcification, calcification pattern) unfavourable for TAVI		+
Presence of thrombi in aorta or LV		+

Favors
TAVI

Favors
SAVR

Cardiac conditions in addition to aortic stenosis that require consideration for concomitant intervention		
Severe CAD requiring revascularization by CABG		+
Severe primary mitral valve disease, which could be treated surgically		+
Severe tricuspid valve disease		+
Aneurysm of the ascending aorta		+
Septal hypertrophy requiring myectomy		+

Treatment for Aortic Stenosis - MDT

- The aortic MDT will review all the tests, history and description of the patient's general condition before making a recommendation.
- Sometimes the MDT may decide whether the patient is best served with surgical AVR or TAVI.
- Occasionally the MDT may not recommend any treatment. This may be because:
 - The valve is not severely stenosed enough to warrant treatment and the patient should continue ongoing valve surveillance.
 - The patient is either not symptomatic or the symptoms could be attributable to other causes (such as lung disease) which may need further investigation.
 - The patient is considered too frail for any treatment. This may be due to other co-morbidities, especially those that would be life limiting within 2 years , i.e. cancer.
 - Valve treatment is also not recommended for patients who have dementia. Careful assessment and discussions with the patient/family need to take place in this setting and some patients with mild dementia may still be offered treatment.
- Recently published trials have shown TAVI to be an appropriate treatment choice

TAVI – Work up

- Before patients can be accepted for TAVI a number of tests need to be performed to ensure treatment is possible and appropriate. These are:
 - **Transthoracic echo**
to confirm the diagnosis of severe aortic stenosis
 - **Coronary angiography**
to investigate the coronary anatomy and potential significant CAD
 - **CT TAVI**
Vital piece of information in the decision making tree and case planning.
Gated cardiac scan and non-gated peripheral vascular scan allow for detailed images in order to establish access route (femoral TAVI or non trans-femoral) and size/type of valve.
In cases where the AS severity is borderline a calcium score can be calculated on the CT scan and is useful
CTs can be performed at JCUH for in-house or local out patients or at North Tees for out of area patients or those requiring a more detailed scan.

TAVI – Work up

- Some patients will have multifactorial dyspnoea/ symptoms
- Not an uncommon scenario – they may have airway disease, pulmonary fibrosis, pulmonary hypertension, anaemia, physical deconditioning, multi- valve pathologies that can all contribute to their symptoms.
- It is not always possible to tease out the contribution of different aetiologies towards the patient's symptoms.
- Symptom trajectory can offer some clues as can some additional tests such as spirometry and ABGs for patients with airways disease.

TAVI – Work up

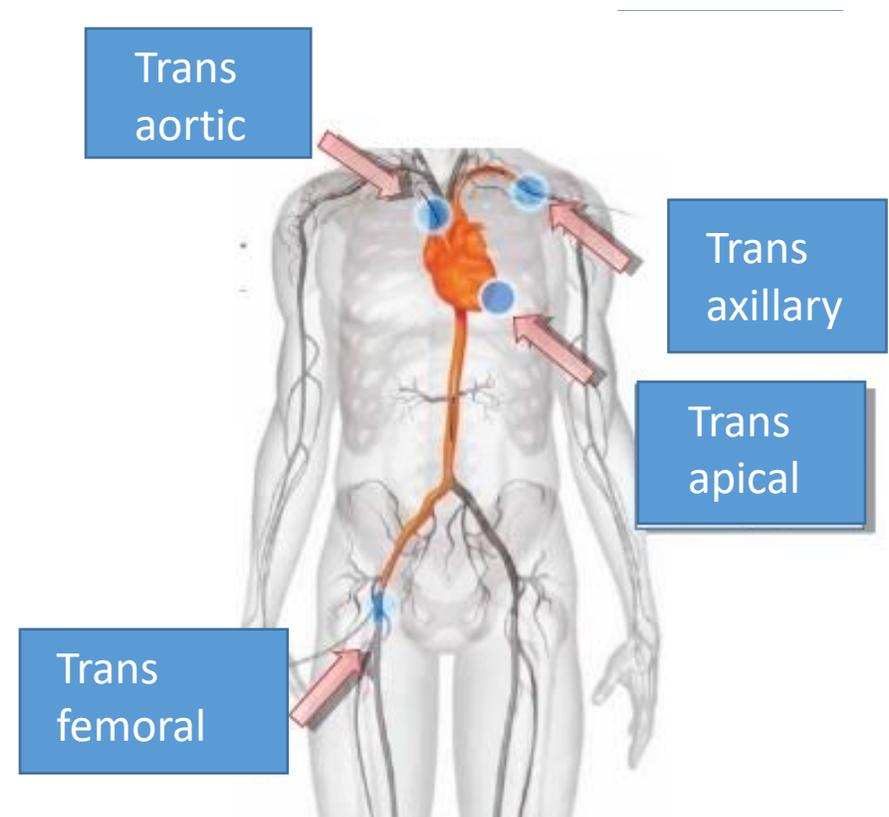
- Incidental findings can be identified on the CT scan, examples include lung nodules, hepatic, renal, GI tract masses.
- For any concerning extra-cardiac pathology further evaluation/investigation should be done locally before TAVI is performed/considered.
- Sometimes non urgent incidentals are identified which don't affect the plan for TAVI but would need follow up or dedicated imaging after valve intervention.

TAVI - Procedure

TAVI can be performed via a number of access routes:

- Transfemoral (TF) through an incision in the groin allowing the passage of a 14-19f sheath and is usually performed under local anaesthetic with only very light sedation.
- Trans axillary (TAX) through an incision near the collarbone into the axillary vessel. Can be performed under local anaesthetic with sedation.
- Trans aortic (TAo) upper partial sternotomy performed under general anaesthesia and requires recovery in CICU.
- Trans apical (TA) Left anterior thoracotomy performed under general anaesthesia and requires recovery in CICU.

The transfemoral approach is favoured with over 90% of cases being performed this way. If CT scanning shows that the femoral vessels are not suitable (e.g. too small, too calcified, too torturous) then the other alternative access routes will be explored.



TAVI - Procedure

- There are many TAVI valves on the market, they fall into two types – self expanding and balloon expandable.
- At JCUH we use two valves the Edwards Sapien 3 balloon expandable valve and the St Jude Portico self expandable valve.

Sapien 3



Portico



TAVI - Procedure

- Each valve comes in a range of sizes which are selected according to the annular measurements made on CT.
- The choice between a balloon expandable valve and a self expanding valve will be made by the TAVI team and can depend on a number of clinical features which may affect deployment or potential risk of the procedure.
- Please [take time to watch the 2 procedural videos](#) filmed at JCUH which show the implantation of both valves with commentary to explain the various stages involved in the procedure. Further information can also be found on the Edwards Lifesciences or St Jude websites.

TAVI - Recovery

- Following TAVI patients will largely recover in CCU. This allows for post procedural cardiac monitoring.
 - Close attention needs to be paid to the heart rhythm post TAVI – due to the effect of valve deployment on the his bundle. Pre-existing RBBB and low valve deployment increases the risk of conduction issues and subsequent PPM implant post TAVI.
 - The site used for valve implantation should also be carefully monitored, especially at the femoral site, ensuring adequate haemostasis and perfusion of the limb.
- There is very little requirement for patients to recover in CICU, except in trans aortic/apical cases when general anaesthesia is used and the patient will commonly require a chest drain.

TAVI - Recovery

- Following an uncomplicated trans femoral or trans axillary TAVI patients will be discharged the following day. Before discharge from hospital we will ensure adequate mobilisation, stable ECG/Hb/renal function as well as reviewing a routine post procedural TTE.
- Patients are encouraged to return steadily to their usual activity within the next few days. They are advised not to drive for 1 month post TAVI in line with DVLA guidelines.
- All patients will be followed up at JCUH with a repeat echo, 6-8 weeks after TAVI. If they are well at this stage annual follow/echo monitoring up will continue at their local hospital.

Questions?

If you have any questions following on from this self directed presentation please do not hesitate to ask any member of the TAVI team.

Please also take the time to access the procedural videos and visit the Edwards and St Jude websites.

<https://www.edwards.com/gb/devices/heart-valves/transcatheter>

<https://www.sjmglobal.com/en-int/professionals/featured-products/structural-heart/tissue-heart-valves/aortic-and-mitral-valves/portico-aortic-valve>