Indications for cardiac catheterisation

Left Heart
Right Heart
Dual
LHC – Ischaemic Heart disease

- Coronary angiography - definitive diagnostic tool that can assess the presence and severity of atheroma, thrombus and occlusion of coronary arteries
- Left ventricular angiography - assesses left ventricular function and can indicate areas of reduced function due to IHD/Myocardial Infarction
LHC – LV Function

- IHD, HOCM, Heart Failure
- The ejection fraction can be calculated by performing left ventricular angiography and areas of dyskinesia or akinesia identified
- The size of the left ventricle can also be assessed by LV angiography
- Measurement of systolic and diastolic pressures can indicate poor LV function
  - Low systolic pressures with high diastolic pressures indicate poor LV function
LHC – Aortic valve disease

Aortic Stenosis

- Pressure measurements - taken across the valve will indicate the presence and severity of Aortic valve stenosis
- Measurement of LV systolic pressure and aortic systolic pressure is taken whilst the valve leaflets should be fully open, in ventricular systole
- Commonly ‘pullback’ procedure - pressure is recorded continuously whilst the catheter is withdrawn across the aortic valve
- Aortic stenosis may also be seen as calcification (dark areas) on X-Ray screening
LHC – Aortic Valve Disease
Aortic Regurgitation

- Aortic root angiography
- Dye will be seen to travel retrogradely back into the ventricle during ventricular diastole when the valve leaflets should be fully closed
- Pressure measurement
  - low diastolic measurement due to the inability of the Aorta to maintain the diastolic pressure during ventricular diastole
  - This leads to a large pulse pressure seen on the aortic pressure trace
LHC – Mitral Valve Disease
Mitral Regurgitation

- LV angiography - Dye will be seen to pass retrogradely from left ventricle to left atrium through the regurgitant valve during ventricular systole when the mitral valve leaflets should be fully closed
- Mitral regurgitation can also be assessed by RHC pressure measurement
- Mitral stenosis cannot be assessed by LHC alone
LHC - Diseases of the Aorta

Aortic Dissection

- Aortic angiography
- Ascending or Descending, depending on the probable site of dissection
- The dissection is often seen as a ‘flap’ as dye penetrates the dissected lumen of the Aorta
- CT Scan may be used as the diagnostic tool of choice for assessment of this condition
LHC – Diseases of the Aorta

Co-arctation

- Aortic angiogram
- Coarctation is seen as a narrowed portion of the Aorta
- Pressure measurements - Continuous recording whilst the catheter is withdrawn from ascending to descending aorta across the coarctation
- A drop in aortic pressure (both systolic and diastolic) measurement is seen
LHC – Post CABG

- Coronary and graft angiograms are performed to assess presence and severity of atheroma, thrombus and occlusion.
- Left or right internal mammary arteries (LIMA or RIMA) may be used as grafts and angiography can be used to assess the patency of these arteries.
- Commonly the LIMA is used to graft the Left Anterior Descending artery (LAD).
- The RIMA is less common but on occasions is used to graft to the Right Coronary Artery.
- LV angiography can be performed to assess LV function post surgery.
LHC – Diseases of the myocardium

HOCM

- LV angiography - LV Function
- HOCM will lead to a hyperkinetic or vigorously contracting ventricle
- Intraventricular pressure measurements - used to assess the level of obstruction within the ventricle, caused by bulging of the interventricular septum
- Pressure is measured continuously whilst the catheter is ‘withdrawn’ from the apex of the left ventricle to the aorta
- A drop in systolic pressure can be seen at the level of the outflow tract where the obstruction is present
LHC Diseases of the myocardium
Dilated Cardiomyopathy

- LV angiography – to assess the extent of reduced LV function present in dilated cardiomyopathy
- Measurement of pressures - low systolic left ventricular and aortic pressure seen with poor LV function
- High LV End Diastolic pressure
LHC – Diseases of the myocardium

Restrictive Cardiomyopathy

- Increased LV & RV diastolic pressure measurements as relaxation of the ventricles is prohibited, maintaining a high pressure within the ventricular cavity during diastole
- Simultaneous LV & RV LVEDP measurements
- Echocardiography is the diagnostic tool of choice for all types of cardiomyopathy
LHC – Pre Cardiac Transplantation

- LV angiography is performed to assess LV function
- Coronary angiography is performed to assess the level of coronary artery disease (CAD)
- LV and aortic systolic and diastolic pressures are measured to assess LV function
- RHC & other procedures are also required
LHC – Post Cardiac Transplantation

- As with pre-transplant assessment, LV angiography and pressures are recorded to assess LV function.
- Coronary angiography is performed to assess presence and extent not only of developed CAD but also of ‘transplant vasculopathy’ disease.
- Does not involve the same processes as ischaemic heart disease.
- Presents as narrowing of the arteries from the myocardial bed proximally to the distal portion of the coronaries and is diffuse rather than presenting with isolated lesions.
RHC – RV Function

- Heart failure, IHD/Myocardial Infarction and RV dysplasia
- RV angiography, although uncommon can be performed to assess the right ventricular function and size
- RV pressure measurements, systolic and diastolic can be useful to assess poor RV function
RHC – Mitral Valve Disease

- Measurement of an indirect left atrial pressure, by positioning the catheter in the pulmonary capillary wedge position (PCW)
- The presence of mitral regurgitation can be diagnosed by the measurement of PCWP and will be elevated during ventricular systole, as blood leaks back into the left atrium when the mitral valve should be fully closed. This is seen as a high ‘v’ wave on the PCWP trace
- Mitral stenosis cannot be assessed by RHC alone – dual catheterisation
Ventricles in Systole
MR measurement
RHC – Pulmonary Valve Disease
Pulmonary Valve Stenosis

- Pressure difference between PA and RV during ventricular systole when the valve should be fully open
- Continuous recording of pressure measurement as the catheter is withdrawn from PA to RV is performed
- Calcification of the valve may also be seen as dark areas on the valve under X-Ray exposure
RHC – Pulmonary Valve Disease
Pulmonary Valve Regurgitation

- Pressure measurements will show a low diastolic pressure (as is seen with Aortic Regurgitation)

- Pulmonary artery angiography will show the back flow of dye from PA to RV during ventricular diastole when the pulmonary valvular leaflets should be fully closed
RHC - Tricuspid Valve Disease

Tricuspid Stenosis

- Assessed by the measurement of pressure between the right atrium and right ventricle during ventricular diastole when the valve leaflets should be fully open.

- Continuous pressure measurement is recorded as the catheter is withdrawn from RV to RA.
RHC – Tricuspid Valve Disease
Tricuspid Regurgitation

- Right ventricular angiography will show dye passing from RV to RA during ventricular systole when the valve leaflets should be fully closed
- Measurement of the RA pressure will show an elevated pressure during ventricular systole (a high ‘v’ wave on the RA pressure trace)
RHC – Pulmonary Diseases
Pulmonary Hypertension

- Primary or secondary
- Pulmonary hypertension will be seen as high pulmonary artery systolic and diastolic pressures
- Systemic hypertension is usually diagnosed non-invasively - take care to avoid anxiety states, which could be present during cardiac catheterisation
RHC - Pulmonary diseases
Oedema, obstruction, embolus

- Obstruction to flow or increased resistance to flow would be seen as elevated right sided pressures
- Calculation of Pulmonary Vascular Resistance may yield a high result
- Pulmonary artery angiography can be useful in the assessment of pulmonary embolus
- Reduced flow to areas of the pulmonary circulation will be seen as absence of dye in that part of the pulmonary tree
RHC – Intracardiac shunts

- The presence and severity of intracardiac shunts can be assessed using RHC
- ASD, VSD and PDA can be diagnosed by a step up in oxygen saturations seen between adjacent chambers or vessels of at least 10% at the level of the shunt
- What is a Normal Right sided saturation?
- Calculate quantification of shunt
- Angiography may also be used but would be performed by LHC assuming a Left to Right shunt is present
- Reversal of a shunt can occur if the shunt is severe
- Echocardiography is commonly used to diagnose Intracardiac shunt, however RHC can be useful to confirm its presence and assess severity
RHC - ASD

- Oxygen saturations are elevated in the right atrium compared to IVC and SVC measurements
- Right Atrial Pressure may be slightly elevated
- May see equalisation of la and RA pressures
- Withdrawl if possible across ASD should be recorded
RHC - VSD

- Oxygen saturations are elevated in the right ventricle compared to RA, IVC and SVC measurements.
- Right ventricular pressure may be elevated also.
- No attempt is made to cross VSD.
RHC - PDA

- Connection between Aorta and Pulmonary Artery
- Oxygen saturations are elevated in the Pulmonary artery (most commonly Left PA) compared to RV, RA, IVC and SVC measurements
- PA pressures may be elevated also
- Seen more commonly - Paediatric cardiology
- Perform procedure – closure/obstruction PDA
Congenital Abnormalities

- Angiography, pressure measurement and oxygen are commonly used to assess congenital abnormalities.
- Left Heart Catheterisation should be performed simultaneously.
RHC - Pre Cardiac Transplantation

- Pressure measurements and angiography can be useful to assess RV function
- Calculation of Pulmonary Vascular Resistance (PVR) can be useful to assess suitability for heart/heart lung/lung transplantation
- Calculation of PVR requires pressure measurements as well as measurement of Cardiac Output
- This is measured by the thermodilution method, which requires placement of a thermodilution Swann Ganz catheter
- Cardiac output measurement is also useful to assess left and right ventricular function
RHC – Post Cardiac Transplantation

- RHC is useful to assess RV function and PVR post transplantation
- Pressure measurements, Cardiac output measurements and angiography can be performed
- LHC should be performed for pre & post transplantation also
Cardiac Output & Hemodynamic Monitoring

- CO measurement can be useful for assessment of heart function in any disease state or medical condition.
- Using the thermodilution method, placement of the Swann Ganz catheter is performed.
- Short term and long term measurements are commonly undertaken.
- CO measurements can also be calculated using oxygen saturations taken from the right side of the heart, thus requiring right heart catheterisation.
Cardiac Output & Heamodynamic monitoring

- Right-sided pressures give important information regarding the haemodynamic state of the patient.
- Pulmonary Capillary Wedge Pressure will give an indirect assessment of left ventricular function and therefore Swann Ganz, RHC catheter placement is often performed on Intensive Care Units where cardiac function and haemodynamic status are required.
Right Sided Angiography - note

- Angiography on the right side of the heart is less commonly undertaken.
- Pressures on the right side are less than those on the left due to the reduced distance and resistance to flow offered by the pulmonary versus the circulatory system.
- The walls of the right sided chambers and vessels are thinner and therefore careful use of angiography with reduced pressure flow of dye is chosen.
Dual catheterisation – Mitral Valve Disease, Stenosis

- The diagnosis and assessment of Mitral Valve stenosis requires catheterisation of both the right and left heart.
- Pressure measurements are required to be taken across the mitral valve in LV and LA.
- Left atrial catheter placement is difficult with left heart catheterisation alone as the mitral valve apparatus often prevents retrograde placement into the left atrium.
Dual catheterisation – Mitral Valve Disease, Stenosis

- Pressures are recorded from the LV and indirect LA (i.e. PCWP) simultaneously during ventricular diastole when the valve leaflets should be fully open.
- Calcification of the mitral valve may be seen on X-Ray screening.
Ventricles in Diastole
Mitral Stenosis
Dual Catheterisation – Pericardial Effusion

- The effusion can result in RV and LV diastolic restriction, prohibiting full relaxation of both ventricles.
- Pressure measurement of LV and RV end diastolic pressures recorded simultaneously will reveal overlapping of pressure recordings.
- The same EDP (End Diastolic Pressure) will be recorded from both the RV and LV coincidentally.
- The Pericardial Effusion causes equalisation of pressures during diastole in both ventricular chambers.
Dual Catheterisation – Pericardial Effusion

- Echocardiography is more commonly used to identify the presence of pericardial effusion.
- Pericarditis (inflammation of the pericardium) can often lead to pericardial effusion. However, pericarditis is diagnosed from Electrocardiography and Echocardiography.
- Severe pericarditis may lead to restriction.
- Treatment – pericardial tap, pericardial window.
- Echocardiography is occasionally used during tap procedures.
Dual Catheterisation
Congenital abnormalities & transplantation

- As previously mentioned, it is beneficial to perform both right and left cardiac catheterisation for the diagnosis and assessment of congenital abnormalities as well as pre & post cardiac transplantation.
Summary
Left Heart Catheterisation

- IHD
- LV Function
- Mitral Valve Disease
- Aortic Valve Disease
- Diseases of the Aorta
- Post CABG
- Cardiac Transplantation
- Cardiomyopathy
Summary

Right Heart Catheterisation

- RV function
- Mitral Valve Disease
- Tricuspid Valve Disease
- Pulmonary Valve Disease
- Pulmonary Diseases
- Intracardiac Shunts
- Congenital Abnormalities
- Cardiac Transplantation
- CO measurement & Haemodynamic monitoring
Summary
Dual Cardiac Catheterisation

- Mitral Valve Disease
- Pericardial Effusion
- Congenital Abnormalities
- Cardiac Transplantation