Common investigations in cardiovascular disease

Blood tests

- Full Blood Count (FBC)
- Cardiac troponins (cTn1, cTnT, high sensitivity troponins)
- Electrolytes, urea and creatinine
- Liver Function Tests (LFTs)
- Thyroid Function Tests (TFTs)
- Brain Natriuretic Peptides (BNP or N-terminal pro BNP)

Electrocardiography (ECG)

Chest X-Ray (CXR)

Coronary angiography

Echocardiography

Myocardial perfusion scan (MPS) (sestamibi scan/ thallium scan)

Cardiac computerised tomography (CT)

Cardiac Magnetic Resonance Imaging (MRI)

Blood tests

Full Blood Count (FBC)

A full blood count can identify presence of infection, anaemia and other blood disorders. Mild anaemia is common in heart failure and if left untreated may contribute to worsening of the condition and to a poorer prognosis. In cardiac disease, thrombocytopaenia (low platelet count) may be caused by medications such as diuretics or heparin.

Cardiac troponin (cTn1, cTnT, high sensitivity troponins)

Cardiac troponin is a serum biomarker used for the diagnosis of acute myocardial infarction (MI) and prognosis. Diagnosis of acute MI is dependent upon rise and fall of the biomarker, in addition to clinical findings or ECG changes. Serial troponins are frequently done to determine the peak troponin post MI, which has prognostic value. Cardiac troponins may be elevated in the presence of inflammatory conditions (e.g. acute myocarditis), structural heart disease, coronary vasospasm and non-cardiac conditions (e.g. sepsis, chronic kidney disease).

Electrolytes, urea and creatinine

Electrolytes, urea and creatinine tests identify electrolyte disturbances and define renal function.

Abnormal potassium (hyper- or hypo-kalaemia) may be secondary to renal impairment, potassium sparing medications and excessive diuresis and may contribute to cardiac arrhythmias.

Hyponatraemia (low blood sodium) is common in heart failure and is usually the result of fluid retention in excess of sodium stores.

Elevated serum creatinine suggests renal impairment and in cardiac disease may be secondary to medications; angiography (dye related), and progression of heart failure.

Liver Function Tests (LFTs)

Liver function tests identify abnormal liver function. Medications such as amiodorone and statins may provoke liver dysfunction. Chronic poor cardiac output may also disrupt liver function.

Congestive hepatomegaly may contribute to cardiac cirrhosis and subsequent hypoalbuminaemia, hypoglycaemia and increased prothrombin time in heart failure.

Thyroid Function Tests (TFTs)

TFTs identify hyper- or hypo-thyroidism. Although rare, thyroid dysfunction may cause or precipitate heart failure or precipitate atrial fibrillation. Amiodorone may cause hypo- or hyper-thyroidism.

Brain Natriuretic Peptides (BNP or N-terminal pro BNP)

BNP assists in the differentiation between cardiac and non-cardiac causes of dyspnoea especially when echocardiography is not available. A BNP or N-terminal proBNP level < 100pg/ml makes diagnosis of heart failure unlikely. Elevated (>600 pg/ml) BNP or N-terminal proBNP indicates heart failure decompensation is likely and is associated with severity of disease, risk of hospitalisation and survival.

The tests are more useful in detecting heart failure with reduced ejection fractions (HFREF) rather than heart failure with preserved ejection fraction (HFPEF).

Electrocardiography (ECG)

ECG records the electrical activity of the heart. It is a simple test that identifies heart rate, conduction disturbances, myocardial ischaemia and possible structural defects.

As changes may be transient, comparison with previous ECGs is always valuable. ECG aids in the diagnosis of underlying causes of heart disease such as coronary artery disease or arrhythmias.

ST segment elevation or depression may represent ischaemia or infarction. Large voltage QRS complexes, downward sloping ST segments and T wave inversion may represent chamber hypertrophy.

Rhythm disturbances such as atrial arrhythmias, heart block and intraventricular septal conduction delays are common in heart failure secondary to cardiac remodelling and may also exacerbate heart failure.

Exercise Stress Testing

The cardiac stress test is done with heart stimulation, either by exercise on a treadmill, cycle ergometry with the patient connected to an ECG. Exercise stress testing may identify myocardial ischaemia, haemodynamic/ electrical instability, or other exertion-related signs or symptoms. Note that cardiac "stress" may also be induced using medications, when an individual is unable to perform the exercise test as required.

Chest X-Ray (CXR)

A chest x-ray aides in the differentiation between respiratory and cardiac causes of dyspnoea. In those with heart failure, common findings include cardiomegaly, interstitial oedema, pulmonary oedema and pleural effusions. Evidence of surgery (eg CABG, valve repair, ICD implantation) is also detected on CXR.

Coronary angiography

Coronary angiography investigates integrity of coronary arteries by insertion of a catheter into the coronary vasculature and the use of dye to produce the image. The presence, location and extent of vessel narrowing is identified on the image and likely sources of symptoms ("culprit lesions") may be identified. The results guide treatment such as revascularisation (PCI, CABG) or medical management.

Echocardiography (echo)

An echocardiogram provides an ultrasound image of the cardiac anatomy . Echocardiography may be conducted using a transducer (probe) external to the chest wall as is the case with transthoracic echo (TTE). A transoesophageal echo (TOE) is more invasive but provides more detailed information and involves the (ultrasound transducer being passed into the patient's oesophagus.

Echocardiography can provide information about chamber size and shape, blood flow velocities, systolic and diastolic function, contractility, wall motion abnormalities and ejection fraction, valve function, and presence of chamber thrombus.

NB. Echocardiography is the gold standard investigation for diagnosis of heart failure and should be re-assessed on completion of medication titration and at least every 2 years thereafter. Echo can identify:

- Type of heart failure. Ejection fraction can determine whether the type of heart failure, i.e. Heart Failure with Reduced Ejection Fraction – HFREF (EF < 45%)

Heart Failure with Preserved Ejection Fraction – HFPEF (normal EF however impaired diastolic function).

- Regional wall motion abnormalities (RWMA) and wall dyssynchrony (HF patients with wall dyssynchrony may be eligible for biventricular pacing).

- Valve sclerosis, stenosis or regurgitation. (Valve dysfunction may cause or exacerbate HF and may be amenable to repair or replacement).

Stress echocardiography

Stress echo assesses patients with suspected or known myocardial ischaemia. Exercise or medication is used to stress the heart. Cardiac function is then evaluated using echocardiography pre and immediately post stress. Myocardial response may be described as hypokinetic (decreased), dyskinetic (impaired) or akinetic (absent).

This test is valuable in assessment of viable/ischaemic myocardium in known CVD being considered for revascularisation.

Myocardial perfusion scan (MPS) (sestamibi scan/ thallium scan)

MPS is a non invasive nuclear medicine scan that examines myocardial perfusion both at rest and under stress using a small amount of a radioactive substance, called a radionuclide (radiopharmaceutical or radioactive tracer). Stress scanning may be conducted after exercise (treadmill or stationary bicycle) or using medication (adenosine, dipyridamole, dobutamine) to increase the blood flow to the heart. The study identifies severity of coronary artery disease as well as providing information regarding management such as the need for angiography or coronary artery revascularisation. MPS may also be used to identify patients with recurrent ischaemia following revascularisation with either percutaneous coronary intervention (PCI) or coronary artery bypass graft (CABG).

Cardiac Computerised Tomography (CT)

Cardiac CT uses CT technology to provide detailed images of the heart. This may include identification of anatomical abnormalities such as aneurysms or valve dysfunction, as well as providing information about pulmonary vein anatomy which may be implicated in AF. Cardiac CT also provides information about patency of grafts following CABG.

CT angiography uses the addition of a contrast dye to prove more detailed information about CAD.

Calcium scoring may be undertaken with CT to investigate the presence, location and extent of calcified plaque in the coronary vasculature. The test has prognostic value and may guide further investigations and management.

Cardiac Magnetic Resonance Imaging (MRI)

Cardiac MRI uses high intensity magnetic fields and radiofrequency to produce 3D images with high resolution. The image provides accurate information about cardiac volumes, muscle mass, contractility, tissue scarring and ejection fraction. Location and size of myocardial infarction can be described with precision and may provide useful information regarding patency of bypass grafts.

The image can identify regional wall motion abnormalities (RWMA) and wall dyssynchrony, valve sclerosis, stenosis or regurgitation and provide information regarding myocardial fibrosis and assists in the diagnosis of amyloid cardiomyopathy, myocarditis and cardiac sarcoid.

Stress MRI

A stress myocardial MRI is a MRI scan that uses an intravenous infusion of a drug (adenosine, dipyridamole or dobutamine) to increase the work load of the heart. A gadolinium dye or contrast agent is injected and provides images as it passes through the myocardium. The stress MRI identifies myocardial scarring or defects and myocardial perfusion and is valuable in assessment of ischaemic myocardium for possible revascularisation or treatment.