Intra-aortic balloon pump

An intra-aortic balloon pump is a mechanical device inserted via femoral artery and into the descending thoracic aorta. The balloon should sit 1-2cm below the origin of subclavian artery and above the renal artery.

The main goals of treatment are to increase coronary artery perfusion, decrease pre and after load and decrease myocardial oxygen consumption.

Cardiac physiology	Contraction of ventricles propels blood into pulmonary and systemic circulation. Principles of blood flow are that fluid (blood) flows from an area of high pressure to an area of low pressure. When two chambers of differing pressure suddenly join the pressures in both chambers will attempt to equalise.	
Electrical and Mechanical activity	There are two events that make up the cardiac cycle an electrical one (represented by the ECG waveform) and a mechanical one (represented by the arterial pressure waveform).	
Cardiac output	As a mechanical pump the performance of the heart is expressed as cardiac output (CO). There are two main influences on CO. Stroke volume which in turn is determine by preload, afterload and contractility and heart rate which is affected by endocrine, CNS and baroreceptors. **Preload** refers to the amount of stretch on the myocardium prior to contraction (Starlings law) and is estimated by left ventricular end diastolic volume. **Afterload** clinically measured using systemic vascular resistance and is related to the impedance to ventricular election and related to mass of blood, aortic end diastolic pressure and resistance of arterioles. **Contractility** refers to the intrinsic ability to contract independently of the effects of pre and after load. **Heart rate** The length of diastolic time is determined by heart rate therefore increased HR reduced time for filling of coronary arteries.	
Cardiac Cycle		**How the balloon pump helps**
Diastole	**Diastolic Phase** **Isovolumetric relaxation** Diastole is generally accepted as starting immediately after dicrotic notch on A-line trace which represents closure of aortic and pulmonary valves. At this time the pressure in ventricles remains higher than in atria so no volume changes occur as ventricles relax. **Ventricular filling** When ventricular pressure falls below atrial pressure tricuspid and mitral valves open and fill will blood that has accumulated in atria. **Atrial contraction** As ventricles fill atrial pressure falls and the last phase of diastole is when atria contract emptying final 15-25% volume into ventricles.	○ **90% of coronary artery perfusion takes place during diastole.** ○ The IABP works by inflating at the start of diastole. By inflating at this time it should: • Increase coronary blood flow • Increase diastolic pressure • Potentially open up collateral vessels thereby increasing oxygen supply to the ischaemic heart muscle • Improve systemic perfusion (reducing preload at next cycle)

Cardiac Cycle		How the balloon pump helps
Systole	**Systolic Phase** **Isovolumetric phase (pre-ejection) phase** Initially ventricles are full and all valves are closed. Enough pressure needs to build up to exceed the pressure in the aorta and pulmonary arteries. This time period utilizes much energy. 90% of myocardial oxygen consumption occurs during pre-ejection (IVC) phase. **Rapid ventricular ejection** The aortic valve opens at the exact moment the left ventricular pressure exceeds aortic end-diastolic pressure (approx.. 75% stroke vol. ejected). Ejection continues until the point of maximum ventricular pressure (peak systolic pressure) **Reduced ventricular ejection** After which the remaining 25% is ejected.	• The balloon deflating just before ventricular contraction causes a fall in aortic pressure which means ventricles do not require as much energy/pressure to eject blood (reducing afterload) which decreases myocardial oxygen demand. • Shorten IVC (pre-ejection phase) • Increased stroke volume • Enhanced cardiac output

Indications for use	3 main indications:	
	1. Acute Coronary Syndrome (ACS) – a blockage or restriction of the coronary arteries causing myocardial ischaemia or acute myocardial infarction (AMI) leading to.	Goal in IABP is to balance oxygen supply and demand until or during interventional procedures to address or correct the issue.
	2. Complications of Heart Failure (HF) – cardiogenic shock and other complications of HF result in depression of myocardial function. Cardiac Output (CO) is markedly depressed and usual compensatory mechanisms no longer sufficient to cope.	IABP may be considered when other first line medical therapies do not improve the patient's clinical state.
	3. Cardiac and non-cardiac surgery. The IABP may be used in haemodynamically unstable patients through various cardiac and non-cardiac surgical procedures e.g. value surgery / pre – bypass or anaesthetic induction.	The main objective of IABP in this circumstance is to maintain margin of safety in the balance of myocardial oxygen supply and demand in certain patients before, during or in the immediate post-operative period.
Contraindications: haemodynamically significant aortic valve insufficiency, aortic aneurysm or aortic wall disease, atherosclerosis or severe peripheral vascular disease, severe coagulopathy, end-stage disease or sepsis.		
Complications: **IABP related:** cardiac arrhythmias, ineffective cardiac assist e.g incorrect or missed triggering , incorrect timing (synchronisity), incorrect volume delivery. **IAB related:** Obstruction or occlusion of artery at IABP catheter placement, thromboembolic complications, infection, failure of IAB, failure of IAB membrane, improper sizing of balloon, bleeding.		

Care of patient and device

Task	Frequency	Rationale
Examine insertion site for signs of bleeding/haematoma **including external buttock	Hourly **2-4hrly	There is risk of bleeding from exertion site and may happen.
Check balloon sheath has no blood visible.	Hourly	There should be no blood visible and any seen indicates damage to balloon inside. This should be treated as an emergency.
Nurse patient at no more than 40 degree in bed with leg straight.	Hourly	Risk of balloon migration into carotid artery occluding blood flow.
Glasgow coma scale and mentation	Hourly	Risk of balloon migration into carotid artery occluding blood flow.
Pedal and post tibial pulses	Hourly	Using doppler to ensure adequate blood supply to peripheries and that IABP was not causing reduction in blood supply.
Brachial pulse, colour, sensation and movement in hand	Hourly	Risk of migration of balloon into subclavian artery occluding and reducing blood supply to arm/hand. If awake and able ask about pins and needles to hand.
Urine output and **renal function	Hourly **Daily	Risk of balloon descending and occluding renal artery.
CXR	Daily ?	Assess placement of balloon – the tip should sit between 2nd and 3rd intercostal space.
Check volume remaining in helium cylinder and spare cylinder available	Per shift	The balloon using the same volume of gas repeatedly therefore the volume shouldn't empty quickly.