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SNS Kalvi Nagar, Coimbatore - 35
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DEPARTMENT OF CARDIOPULMONARY PERFUSION CARE
TECHNOLOGY

COURSE NAME: CPB & PERFUSION TECHNOLOGY II

**TOPIC: INTRA AORTIC BALLOON PUMP – PRINCIPLE, PLACEMENT,
INDICATIONS, CONTRAINDICATIONS & COMPLICATIONS**



Cardiac Physiology

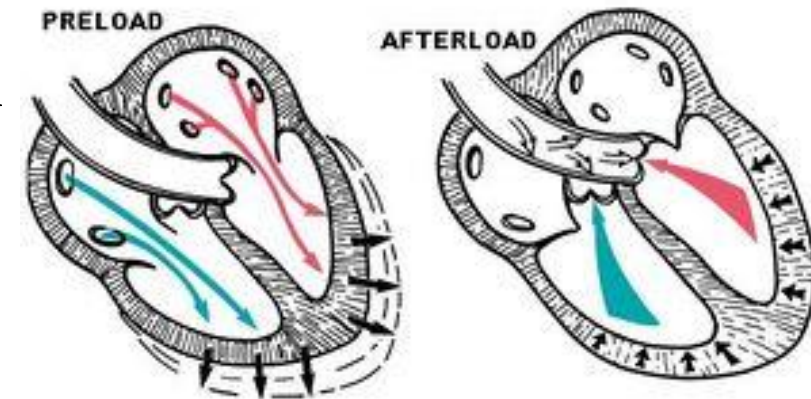


Preload

- Preload refers to the amount of stretch on the ventricular myocardium prior to contraction
- Preload is often referred to as "**filling pressure**".
- Factors affecting preload include: Aortic insufficiency Circulating blood volume Mitral valve disease Some medications (i.e. Vasoconstrictors, vasodilators)

Afterload

- Afterload is the resistance that the heart must overcome in order to eject the blood volume from the left ventricle
- Afterload can be affected by: Aortic stenosis, Arterial vasoconstrictors and vasodilators, Hypertension and Peripheral arterial constriction

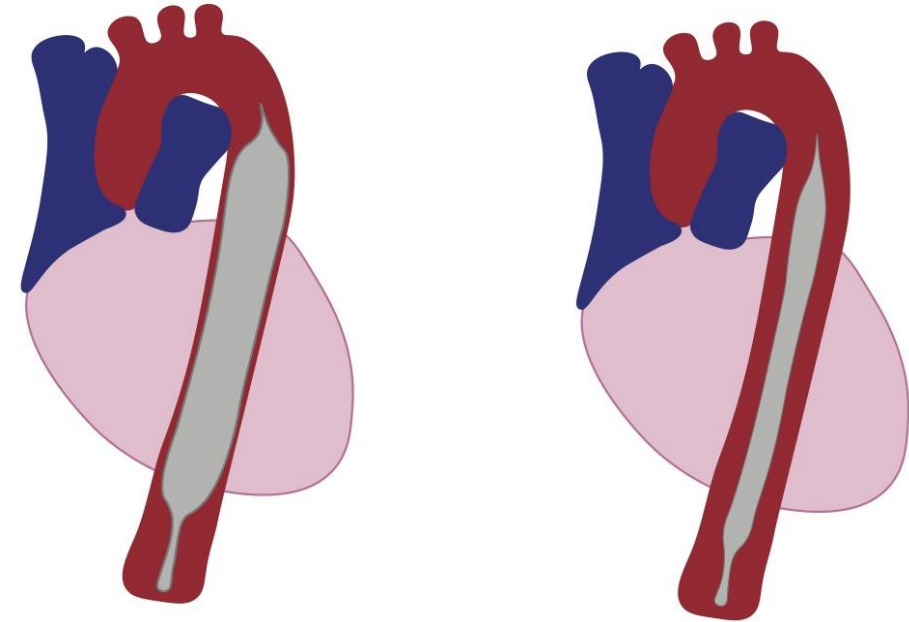




IABP



- Intra aortic balloon pump is a device that **increase myocardial oxygen delivery** by diversion of cardiac blood flow to the vital organs.
- **Decrease in myocardial oxygen demand** by decreasing the work load on the left ventricle by decreasing the aortic end diastolic pressure(**Afterload**).
- At present it is the simplest and most frequently used circulatory assist device



Major parts of IABP

- Intra-aortic balloon catheter
- Machine

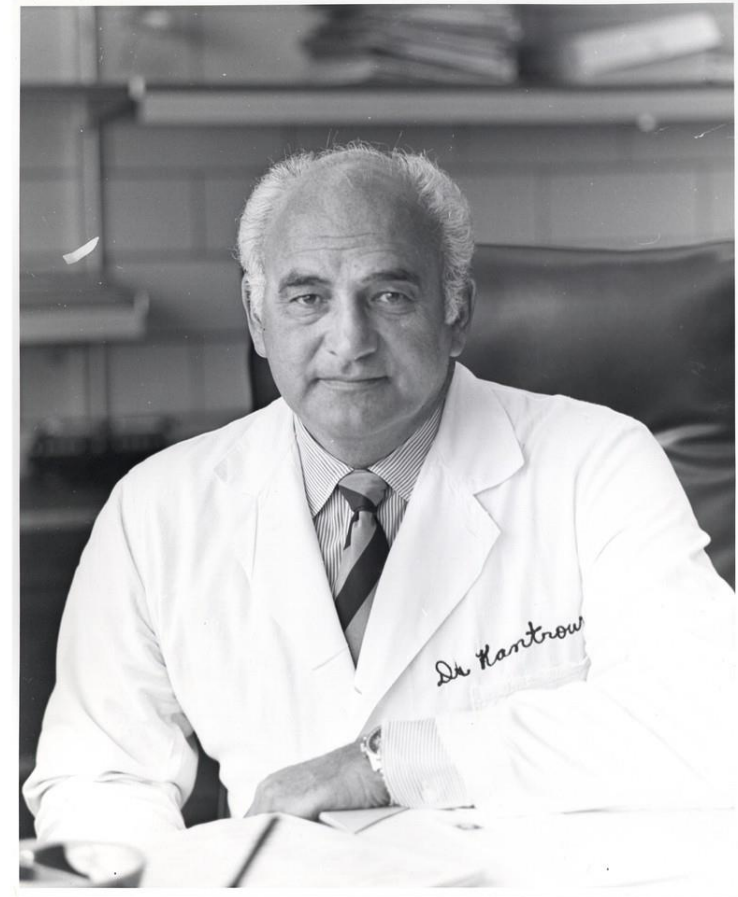




History

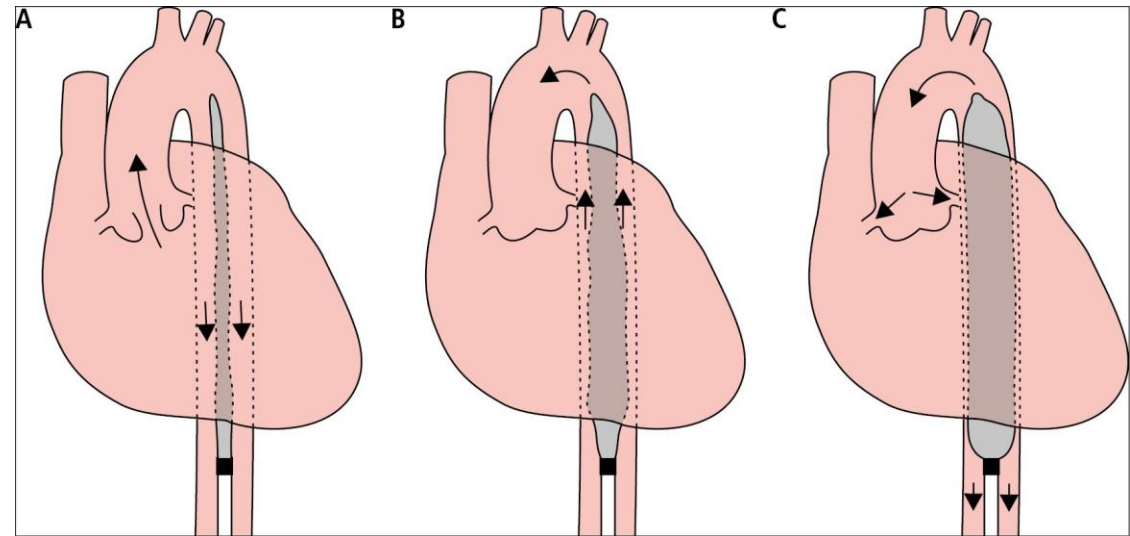


- **KANTROWITZ** described augmentation of coronary blood flow by retardation of the arterial pressure pulse in animal model in 1952
- In 1958 **HARKEN** suggested the removal of some of the blood volume via the femoral artery during systole and replacing it rapidly in diastole as the treatment for left ventricular failure.
- Four years later **MOULOPOULOS** and colleagues from Cleveland Clinic developed an experimental prototype of an IABP whose inflation and deflation were timed to the cardiac cycle

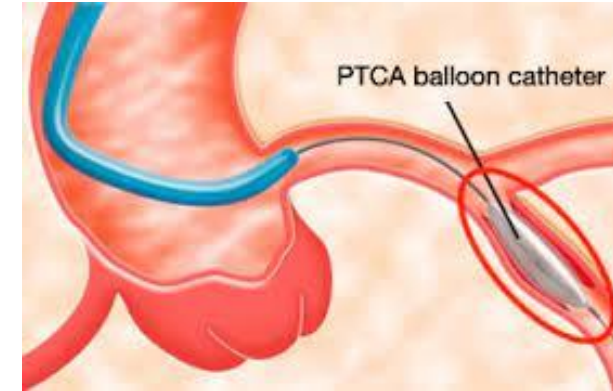


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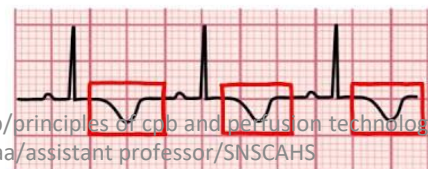
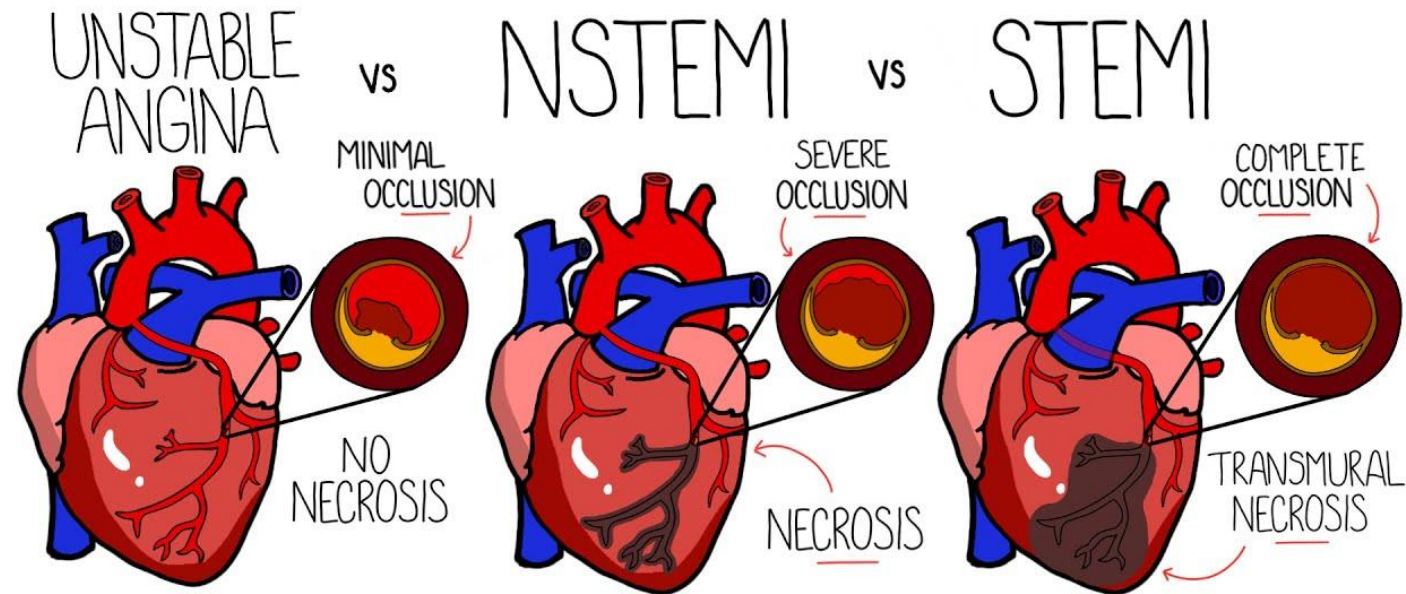
- In **1958 KANTROWITZ** imported improved systemic arterial pressure and urine output with use of IABP in 2 subjects with cardiogenic shock, one of who survived to hospital discharge.
- Percutaneous IAB's in sizes 8.5 to 9.5 French were introduced in 1979 and shortly after this **BERGMAN** and Colleagues described the first percutaneous insertion of IABP
- The first pre-folded IAB was developed in 1986.



Indications



- Unstable angina
- Acute MI
- Mechanical complication following MI
- Cardiogenic shock
- Adjacent to PTCA
- Adjacent to cardiac catheterization
- Operative(pre post intra)
- Acute MR and VSD
- Weaning from CPB
- Refractory LV failure
- Ventricular arrhythmias
- Sepsis



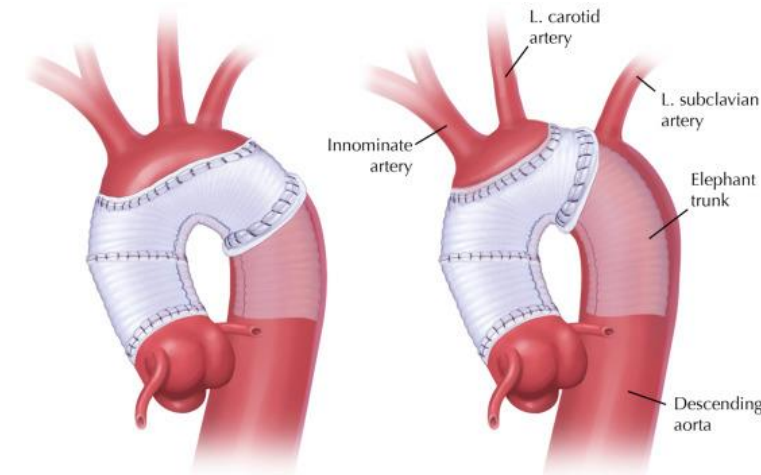
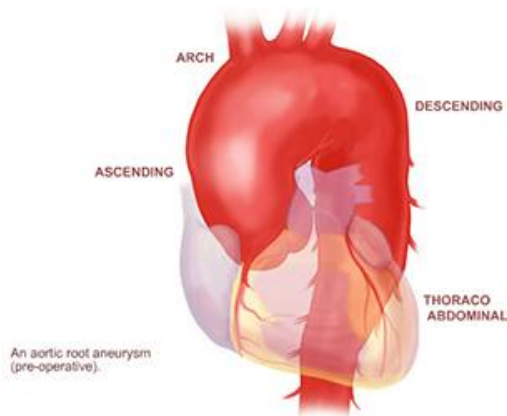
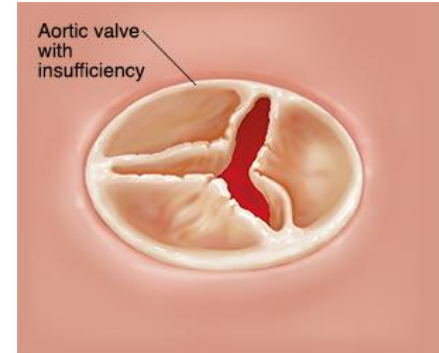
Contraindications

ABSOLUTE

- Thoracic or abdomen arch aneurysm
- Occluded aorta
- Aortic regurgitation
- Aortic dissection
- Aortic stents

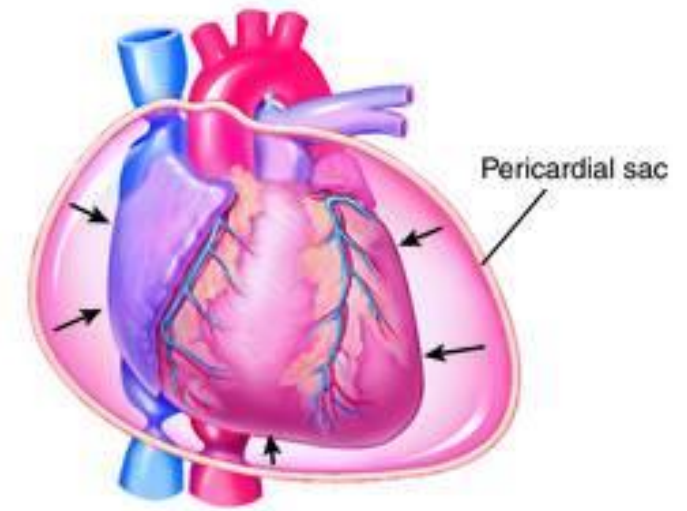
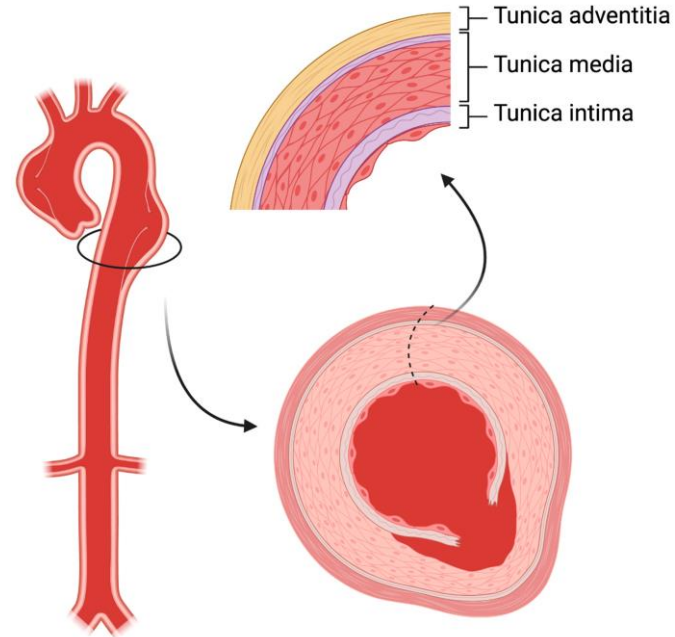
RELATIVE

- Aortic insufficiency
- Severe peripheral valvular disease
- Uncontrolled sepsis
- Tachyarrhythmias
- Major arterial reconstruction surgery



Complications

- Limb ischemia
- Thromboembolism
- Vascular injury
- Infection
- Aortic dissection
- Balloon rupture
- Transient loss of peripheral pulse
- Hematological changes (hemolysis, thrombocytopenia)
- Cardiac tamponade





Preventive measures for Complications



- Limb ischemia - monitor distal pulses
- Juxta-renal positioning - monitor urine output, CXR
- Bleeding, hematoma - monitor sheath site, check coagulation status
- Decreased augmentation - consider low SVR (sepsis), decreased cardiac output
- Worsening cardiac ischemia - adjust timing/trigger





Assessment 1



- What is the full form of IABP?
- What is Limb Ischemia and how it is caused?
- What are the relative contraindication?





How does it works???



- The balloon is connected to a console that regulates the inflation and deflation of the balloon with the passage of helium.
- **Helium** gas is used for inflation and deflation
- The word Counter-pulsation stands for balloon inflation in diastole and deflation in systole.





Why Helium?

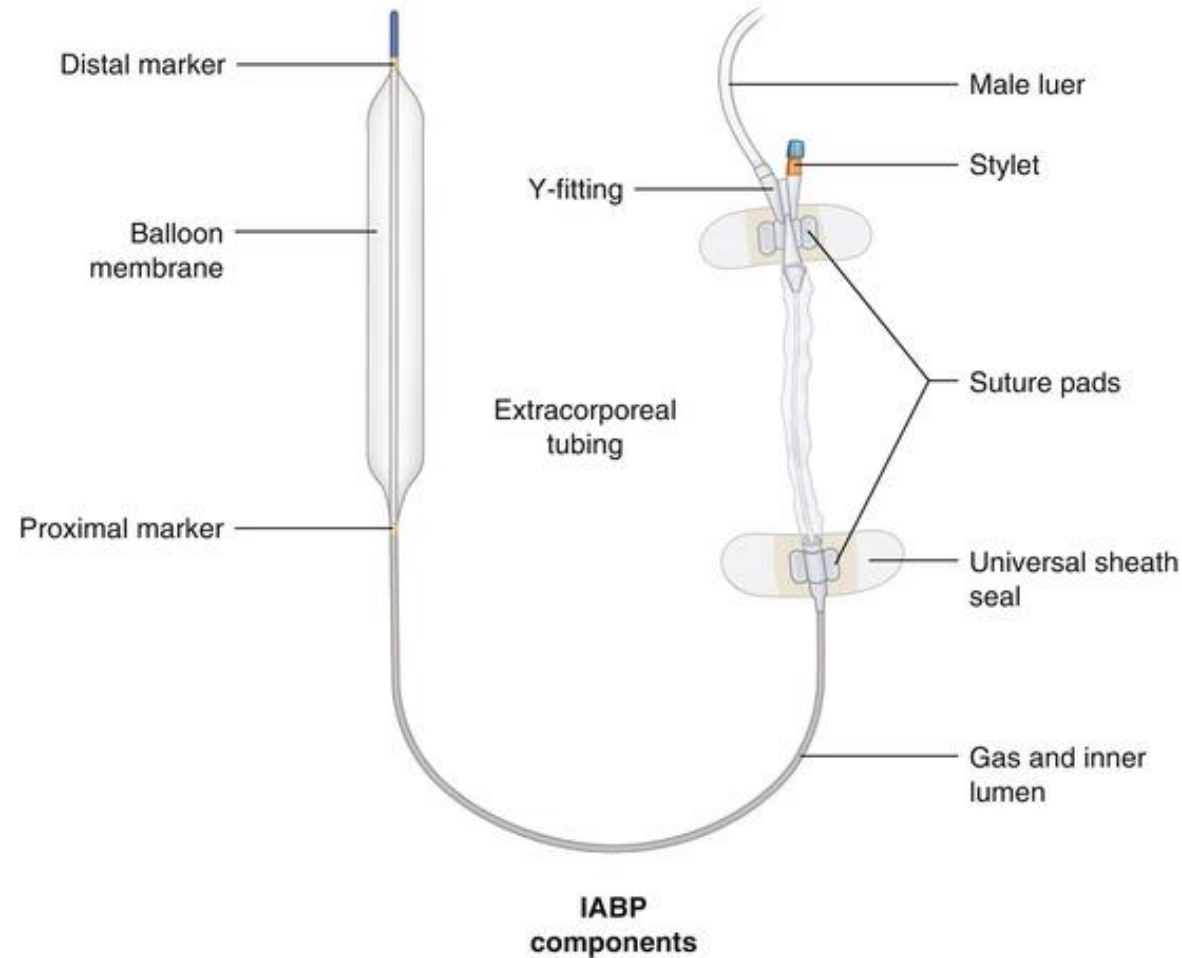


- Helium is used because it has **lower airflow resistance**, which enables faster balloon inflation & deflation.
- Helium is also highly soluble in blood, so it is less likely to cause air embolism if the balloon ruptures

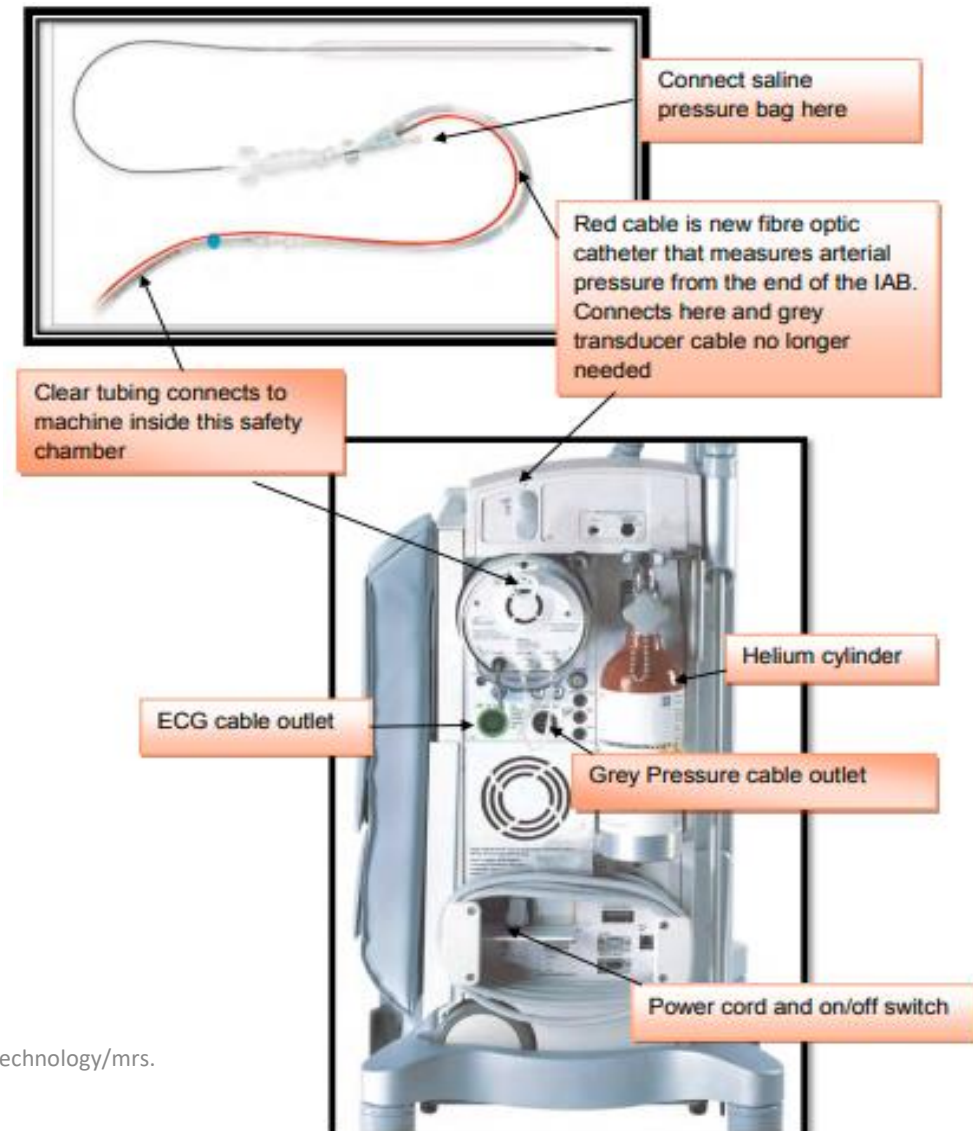
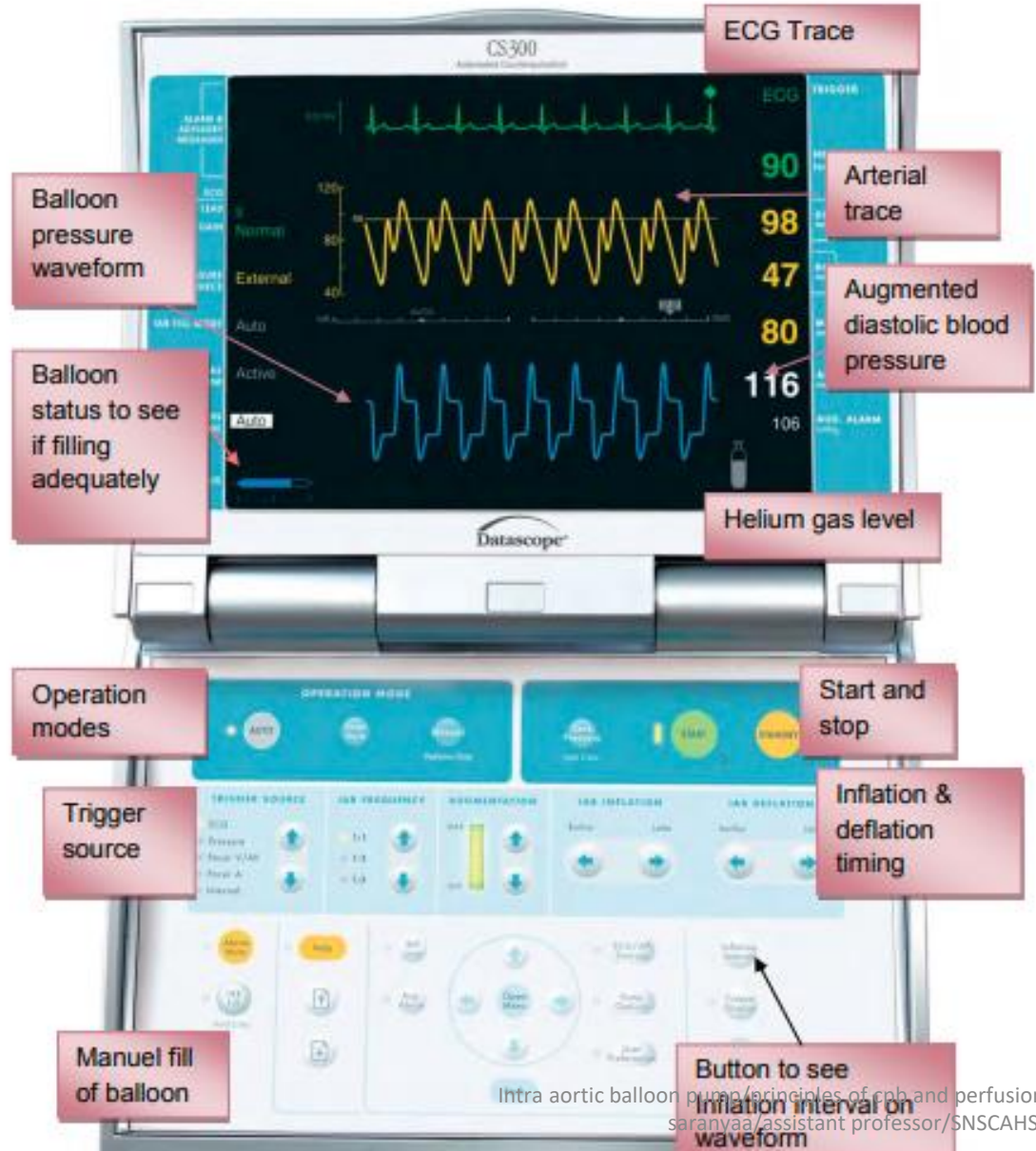


IABP Balloon

- Introducer Needle
- Guide Wire
- Vessel Dilator
- Sheath
- Intra-aortic Balloon
- Gas Tubing
- 60ml in Syringe
- Three way stopcock
- Arterial Pressure Tubing



IABP Machine





Effects of IABP

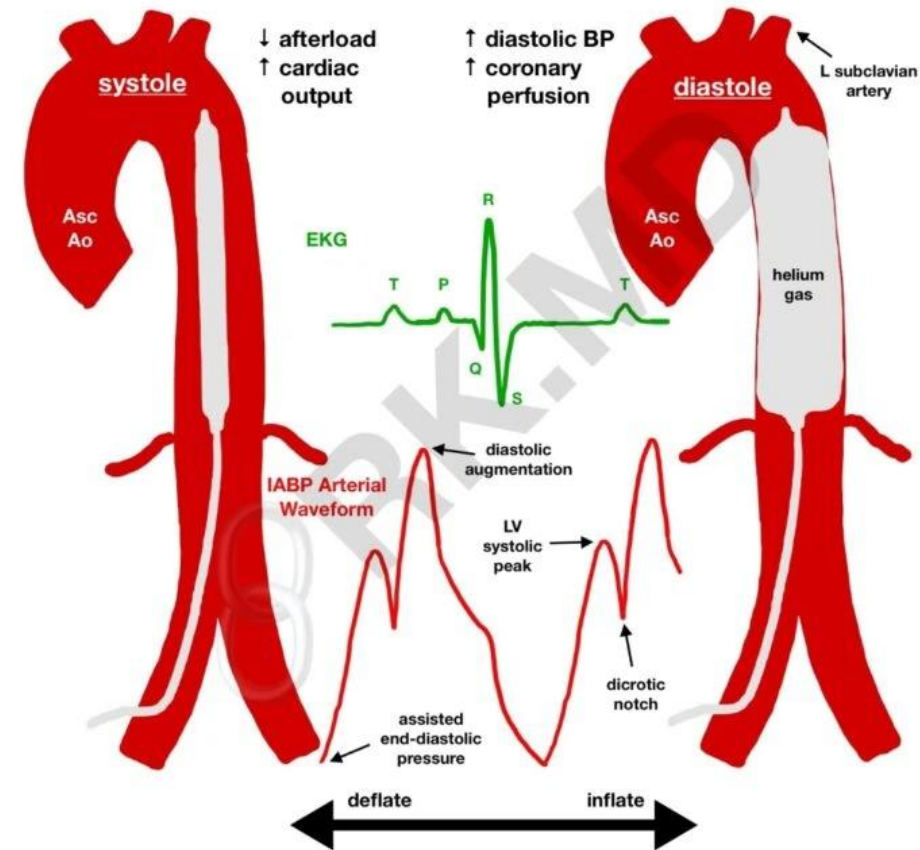


- Increase in diastolic pressure
- ↓
- Increase in coronary perfusion
- ↓
- oxygen supply to the heart tissue
- ↓
- Decreasing systolic pressure & Decreased the end diastolic pressure (Afterload)
- ↓
- (Sudden deflation forming a space in the aorta that helps shifting the volume from the left ventricle)
- ↓
- Decrease myocardial oxygen demand

Effects of IABP

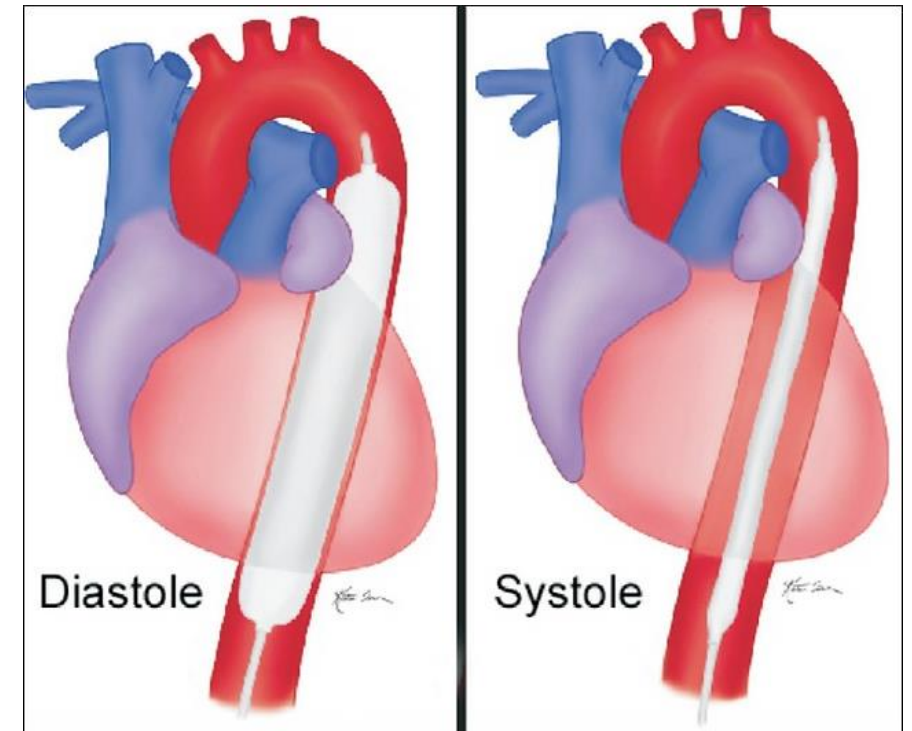
- Decrease heart rate.
- Increase in cardiac output.
- Decreasing systemic vascular resistant
- Decreasing the left ventricle end diastolic pressure.
- Increasing mean arterial pressure, that will lead to an improvement of the perfusion to all organ.
- Reduces mitral valve regurgitation.
- Increases LV ejection

INTRA-AORTIC BALLOON PUMP (IABP)



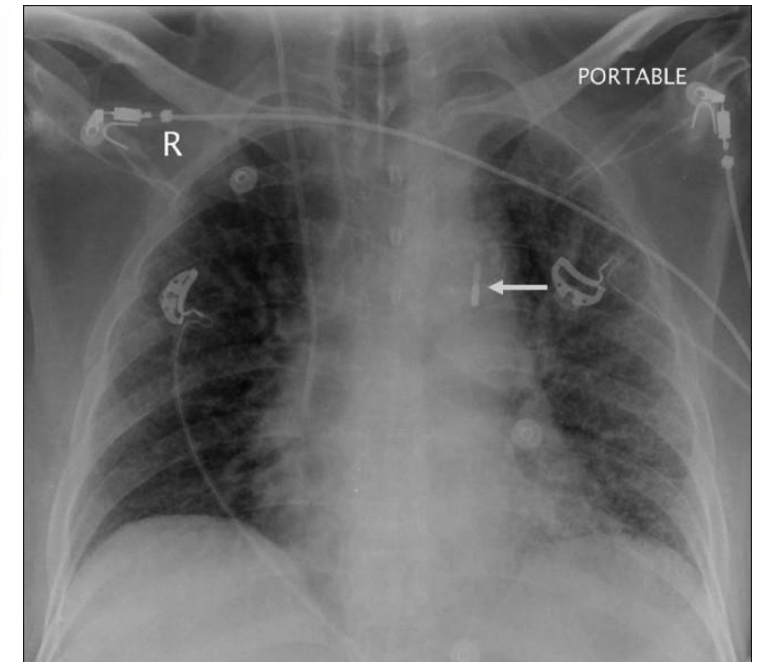
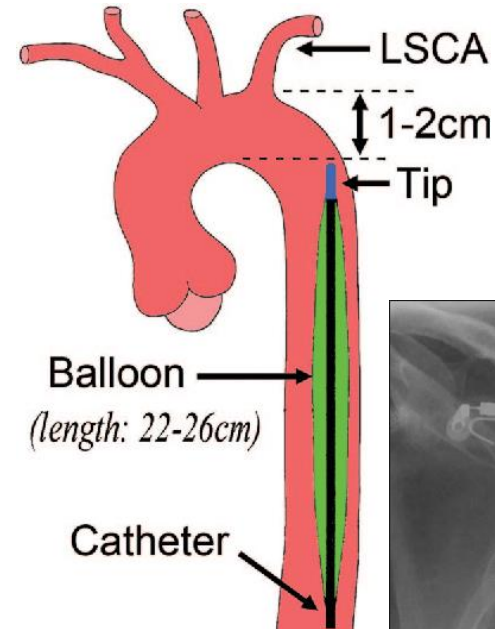
Effects on other systems

- Increasing renal perfusion and urine output
- Increasing cerebral perfusion
- Increasing respiratory function by decreasing the pulmonary capillary wedge pressure
- Decreasing the systemic vascular resistance



IABP Position

- The position of the IABP is important and can be assured first from the timing using the pressure wave and then by a chest X-Ray.
- **2 centimeters below the take-off of the left subclavian artery to prevent occlusion of the subclavian artery, 2cm above the renal artery.**
- On chest Xrays, **the tip** should be **visible between the 2nd and 3rd intercostal space.**





Intra - Aortic Balloon Size



BALLOON MEMBRANE VOLUME (cc)		PATIENT HEIGHT (cm)
MAQUET	25	<152
	34	152-162
	40	162-183
ARROW	30	147 - 162
	40	162 - 182
	50	>182



Assessment 2



- Why Helium is used?
- What is the exact placement of IAB?
- Balloon inflation occurs during?
- Balloon deflation occurs during?





Thank you



Reference:

- Manual of Cardiopulmonary Bypass Medtronic
- Cardio Pulmonary Bypass , Sunit Ghosh Florian Falter Albert C. Perrino
- <https://rk.md/2017/intra-aortic-balloon-pump-arterial-line-ekg-waveforms/>