Intra-Aortic Balloon Pump (IABP)

IABPs are devices used to support cardiac and circulatory function in the critically ill. They achieve this by increasing myocardial oxygen delivery, decreasing myocardial oxygen consumption and improving left ventricular (LV) function.

Equipment and Insertion

The IABP consists of:

- **A catheter** with an outer lumen and inner lumen. The outer lumen delivers gas to the balloon for inflation, whilst the inner lumen monitors arterial pressure

- **A polyethylene balloon** at the distal end of the catheter. The balloon volume varies depending on patient size. When inflated the diameter should be no more than 90% of the patient's descending thoracic aorta diameter

- **Helium gas** used to inflate the balloon. Helium is used for its low density properties (permitting rapid gas transfer and fast inflation) and it ability to be absorbed quickly into the blood should the balloon burst

- **A pump** to drive the gas and inflate the balloon

The catheter is inserted into a large artery (commonly the femoral artery) using a modified Seldinger technique. It is then advanced up into the descending aorta until the tip is 2-3cm from the left subclavian artery. Ideally this is carried out under fluoroscopic guidance, TOE can be used in the acute setting to confirm placement.

Mechanism of Action

The IABP works by a counterpulsation mechanism. During diastole the balloon inflates, displacing aortic blood both proximally and distally. The augmented distal blood supply improves systemic blood flow, whilst the proximally displaced blood improves coronary artery flow. In early systole the balloon deflates, decreasing myocardial afterload (Figure 1).

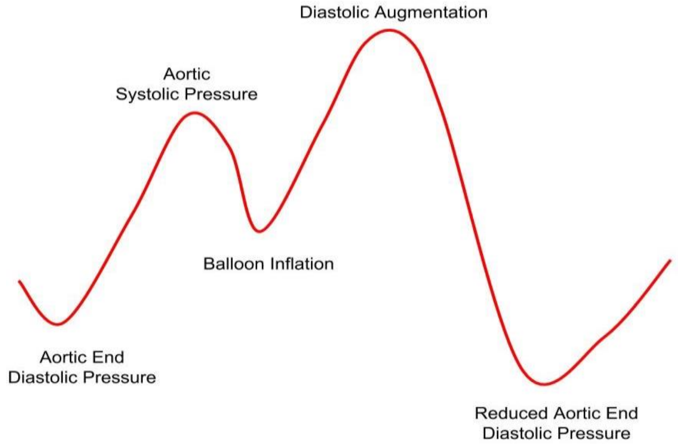

Figure 1 - An example of an arterial waveform with a correctly functioning IABP

The action of the IABP impacts the function of the heart, aorta and other organs (Figure 2). The extent of these effects depends on:

- **Balloon volume**. A higher balloon volume will result in displacement of more blood and thus improve diastolic augmentation
- **Heart rate**. Tachycardia will decrease diastolic time, and therefore balloon inflation time, lessening the effect of the IABP
- **Aortic compliance**. Diastolic augmentation by IABP is inversely related to aortic compliance

Heart Decreased LV systolic pressure Decreased LV diastolic pressure Decreased LV volume Decreased LV wall tension Decreased preload/ afterload Increased cardiac output	**Coronaries** Increased blood flow **Kidneys** Increased blood flow	**Aorta** Decreased systolic pressure Increased diastolic pressure **Haemoglobin** Decrease Hb and haematocrit due to haemolysis

Figure 2. Physiological effects of a correctly functioning IABP

Indications and Contraindications

Cardiac Indications	Absolute Contraindications
Myocardial infarction	Aortic regurgitation
Ventricular septal defect/rupture	Aortic dissection
Acute mitral regurgitation	Aortic stents
Cariogenic shock	End stage heart disease
Unstable angina	**Relative Contraindications**
Ventricular arrhythmias	Aortic aneurysm
LV failure	Coagulopathy
Procedural Indications	Severe Peripheral vascular disease
Catheterisation/angioplasty	Tachyarrythmias
Weaning from cardiopulmonary bypass	Major arterial reconstruction surgery
Cardiac surgery	

Figure 3 - Indications and contraindications for use of an IABP

<u>Complications</u>

The potential complications of an IABP are outlined in Figure 4. Suboptimal inflation or deflation refers to the balloon state during one cardiac cycle, and may be classed as early or late - see Figure 5. This can result in haemodynamic instability.

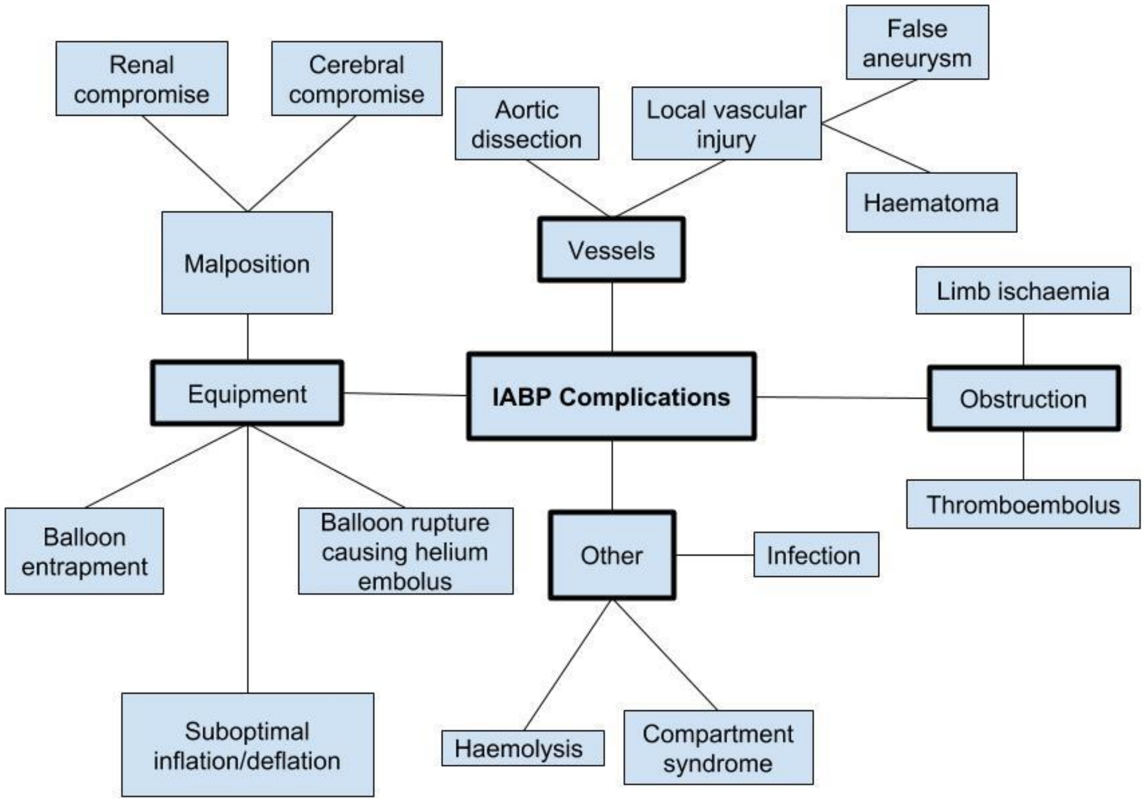

Figure 4. Potential complications resulting from IABP use

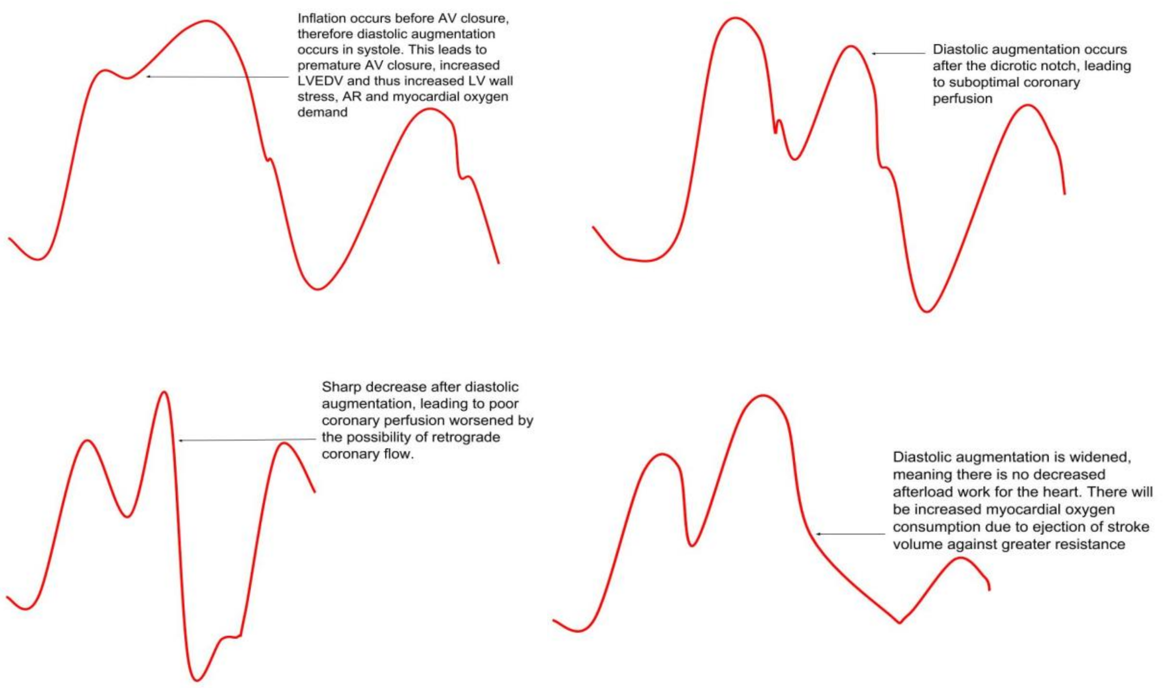

Figure 5 - Clockwise from top left; early inflation, late inflation, late deflation, early deflation

<u>References</u>

Murli K, Kai Z (2009); Principles of intra-aortic balloon pump counterpulsation, *Continuing Education in Anaesthesia Critical Care & Pain*, Volume 9 (Issue 1) Pages 24–28

Author: Francesca Millinchamp
Editor: Matt Bell
Date: April 2018