



CRITICAL CARE WAIKATO HOSPITAL

WORKBOOK



NAME: _____



Section 6

Intra Aortic Balloon Pump

The Intra Aortic Balloon Pump (IABP)

The balloon is synthetic and is made for single use only. It is threaded into the aorta, usually via a femoral approach. The balloon is placed so that the tip lies just distal to the left subclavian artery and the distal end of the balloon lies in the descending aorta clear of the renal arteries. An x-ray is always taken after insertion to check the position. If the balloon is located too high, obstruction of the left subclavian or carotid artery could occur. If the balloon is placed too low, the renal arteries could be obstructed and it would be ineffective.

The balloon has a 40 ml capacity. The lumen is designed to be small enough to avoid occlusion of the femoral artery at the insertion site. The filling and emptying of the balloon is what causes displacement of the blood volume and the corresponding pressure changes. Inflation and deflation must occur at precise times within the cardiac cycle for optimal effects. Specifically, to reduce left ventricular workload and to increase coronary blood flow.

Helium is the gas of choice to fill the balloon because it has a low viscosity, hence is able to shuttle in and out of the balloon rapidly.

There is ALWAYS a perfusionist on call who is available for managing and troubleshooting the IABP.

Indications for Use

- Refractory LVF secondary to:
 - MI
 - Cardiogenic shock
 - MR
- PTCA – support and stabilisation eg failed procedure, prophylactic in high risk patients
- Weaning from cardiopulmonary bypass
- Post operative support:
 - Low cardiac output unresponsive to inotropes
 - Intra-operative MI
 - Multiple valve surgery / redo surgery
 - Low ejection fraction
- Stabilisation of patients while awaiting surgery

Contraindications

- Refractory LVF
- Severe aortic regurgitation
- Aortic dissection / aneurysm
- Severe aorto-iliac disease / extra-cardiac systemic disease
- Severe clotting disorders

Complications

- Aortic dissection / rupture (may occur on insertion)
- Balloon rupture / leak
- Bleeding (at insertion site or systemically secondary to anticoagulation)
- Thrombus formation
- Thrombocytopenia
- Infection
- Impaired limb circulation causing ischaemia
- Non-therapeutic effect resulting from improper timing

Trigger Modes

When in Auto mode, the Datascope is able to automatically determine the optimal trigger. Its first choice is ECG, and then secondly it will choose the arterial pressure waveform.

ECG – The most common mode - The IABP identifies the tallest peak as being the QRS wave and triggers accordingly. According to the ECG, inflation occurs at the peak of the T and deflation prior to the QRS.

Arterial pressure – Triggers from the arterial pressure sensor at the tip of the balloon. This mode may be used during CPR as the chest compressions might be detectable by the machine.

Haemodynamics

Inflation

Inflation occurs upon closure of the aortic valve and the balloon remains inflated throughout diastole. The closure of the aortic valve is identifiable on the arterial line waveform by the dicrotic notch. Augmentation increases aortic diastolic pressure.

The benefits are as follows:

- Increased coronary blood flow which improves myocardial oxygenation.
- Increased perfusion of distal organs and tissues
- Increased systemic perfusion pressure

If the balloon inflates early, i.e. before the dicrotic notch, the result will be detrimental to the patient:

- Forced premature closing of the aortic valve
- Incomplete ventricular emptying
- Increased myocardial oxygen demand
- Decreased cardiac output

This is an unsafe situation for the patient and should be reported immediately.

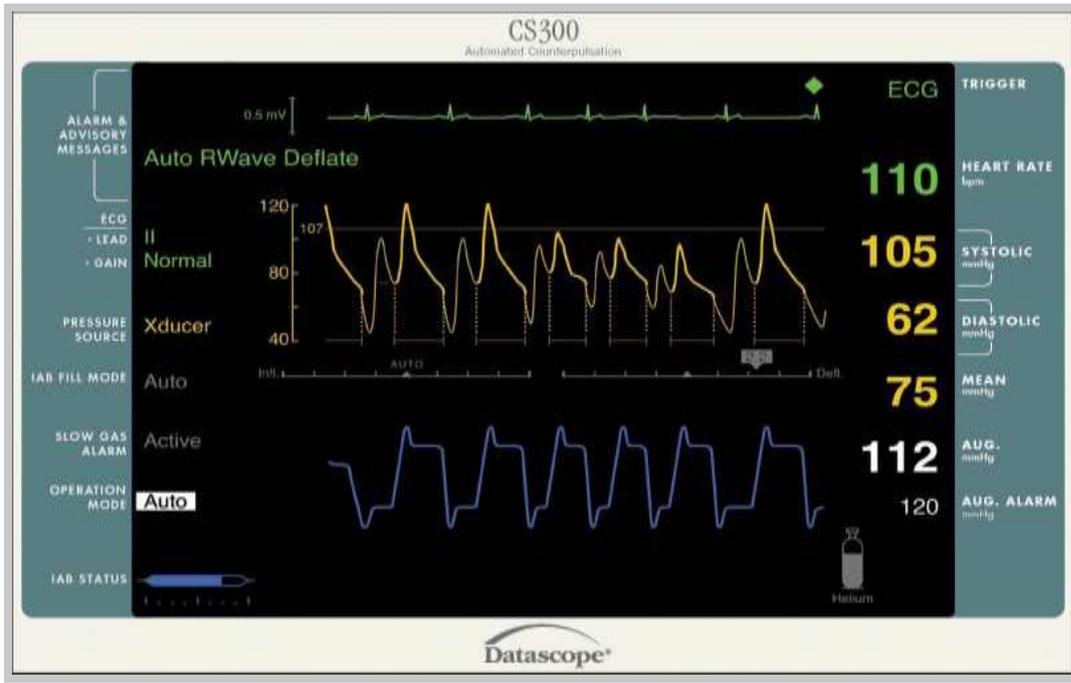
Deflation

Rapid deflation occurs immediately prior to systole. The sudden evacuation of the balloon causes a drop in pressure in the aorta, which results in the left ventricle having to generate a lesser pressure in order to open the aortic valve. The result is:

- Decreased left ventricular workload
- Decreased myocardial oxygen demand

If the balloon deflates late, there is resistance to ejection. *This is an unsafe situation for the patient and must be reported immediately.* The significance of late deflation is:

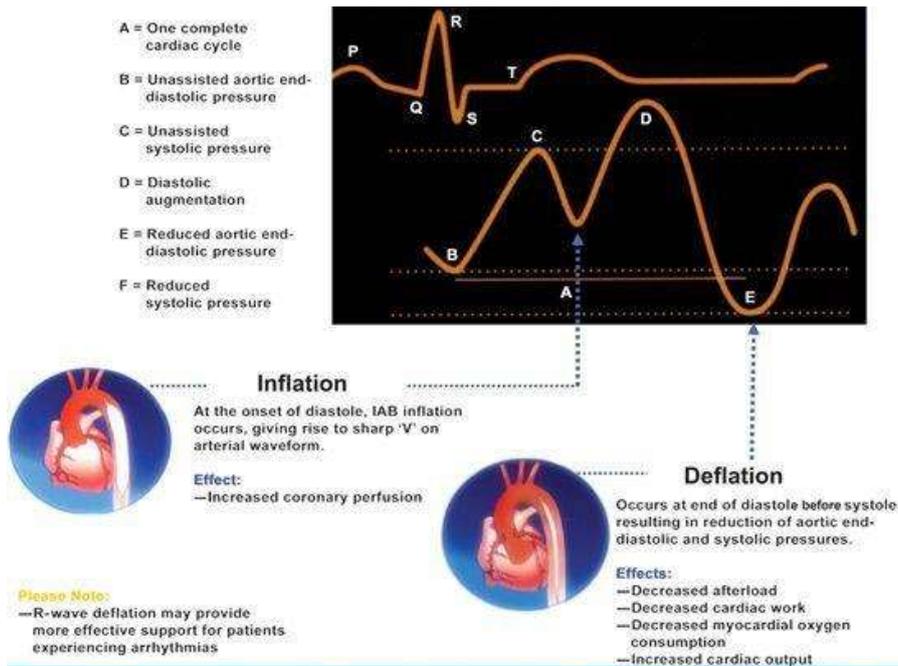
- Increased afterload, therefore increased LV workload
- Increased myocardial oxygen demand
- Decreased stroke volume
- Decreased cardiac output
- Potential for serious consequences in the presence of mechanical defects such as ventricular aneurysm, mitral regurgitation, septal defects



The Datascope IABP Display
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The Datascope IABP Console
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Inflation/Deflation Timing and the Cardiac Cycle
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Timing

Normal Timing

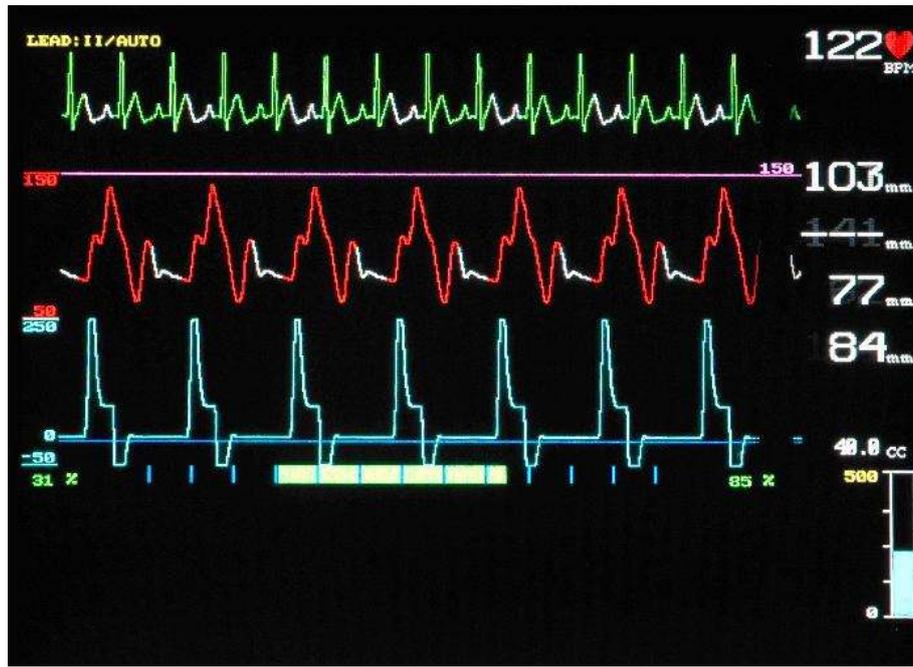


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The image above shows a 1:2 ratio. The highlighted areas illustrate when the balloon would be inflated i.e. inflation at the diastolic notch and deflation occurs immediately prior to systole. In order to accurately assess timing, the assist ratio

must be changed to 1:2 or less for a screen, the image frozen, then the ration put back to 1:1. The frozen screen allows for time to make an assessment.

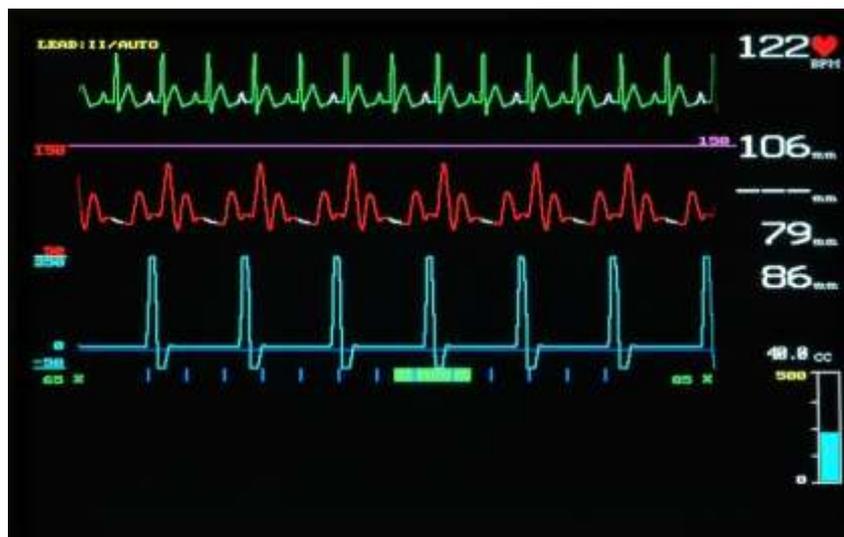
Early Inflation



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Early inflation is illustrated by the highlighted areas, i.e. prior to the aortic valve closure notch. The aortic valve is still open at this point in the cardiac cycle, therefore this situation is unsafe to the patient.

Late Inflation



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As highlighted, inflation occurs well after the aortic valve closure notch. This is sub-therapeutic for the patient.

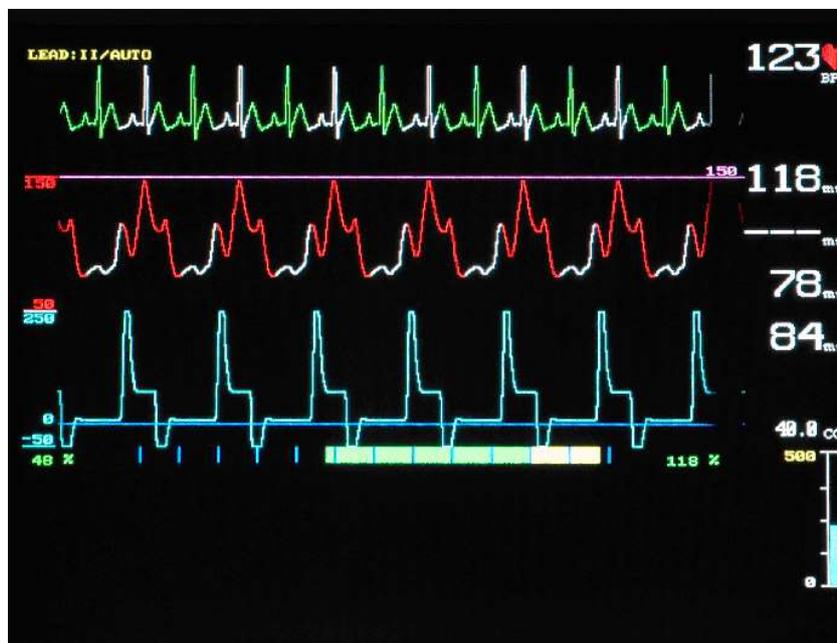
Early Deflation



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The image above illustrates early deflation, which is a sub-therapeutic situation for the patient.

Late Deflation



Medical Illustration © 2002 Arrow International, Inc., <http://www.arrowintl.com/>

The image above illustrates a long inflation time, extending into systole. This is unsafe for the patient.

Nursing Considerations

CONSIDERATION	RATIONALE
Continuous monitoring	To maintain patient safety
Clear ECG tracing with prominent 'R' wave.	To promote correct timing
Alarms set on the IABP console. Hourly timing assessment	For early alert of malfunction
Consider Heparin infusion, APTT checks as per protocol.	To reduce risk of thrombus
Potential for renal impairment <ul style="list-style-type: none">• Daily CXR• Daily U & Es	Low cardiac output state. Possible malposition of balloon catheter causing obstruction to renal artery
Potential for impaired limb circulation. Check CWMS, pulses blood supply of feet.	Risk of IABP catheter (partially) occluding the femoral artery
Balloon should not remain deflated (should be removed soon after deflation)	Risk of Thrombus formation
Check left radial pulse	Possible malposition of catheter causing obstruction of left subclavian artery
Log roll to keep cannulated limb extended. Careful pressure area cares. Maintain flat to 45° sitting position	Prevent kinking of catheter and damage to femoral artery
Careful neuro assessment. Observe tubing for the presence of blood and record hourly	Risk of Helium embolus. Indicates balloon rupture. Catheter will require change. Report immediately and turn console off, will require changing.
Potential for Aortic dissection. Observe abdomen for swelling / discolouration. Assess pain and Hb	Greatest risk during insertion, ongoing risk relating to counterspulsation.

Troubleshooting

The perfusionist is the person responsible for the IABP. He/she is available on call at all times.

The perfusionist generally sets the console appropriate to the patient's requirements. IT IS NOT THE RESPONSIBILITY OF THE NURSE TO ALTER ANY SETTINGS. Rather, it is the responsibility of the nurse to be able to accurately assess the patient and the console (considering timing) and to report appropriately. The nurse must be familiar with functions of the IABP and so as to be able to make accurate assessment.

Timing is critical. As a guide, the augmented wave form should be greater than the native wave form. Timing can be accurately assessed by comparing the native wave form with the augmented wave form. This is most easily achieved by switching the assist ratio to 1:2, freezing the screen, then reverting back to a 1:1. Remember that by altering the ratio in this way, support is halved which may impact significantly on patients with critical impairment, so this should only be done by a practitioner with an appropriate level of knowledge/skill/experience relating to the IABP.

Weaning from the IABP

The decision to wean the patient from the IABP is made by the ICU medical team.

Criteria for weaning:

- Improved cardiac output
- Haemodynamically stable.
- Significantly reduced (or no) inotropes.

Weaning is possible in two ways:

Method 1

Decrease the balloon assisted ratio, e.g. from 1:1 to 1:2. This results in a very sudden reduction in assistance, effectively 50% as the patient will go from having balloon assistance with every cardiac cycle to having assistance with every second cardiac cycle.

Method 2

Gradually reduce the augmentation. This is a more gentle process as the ratio of assistance to cardiac cycle is not affected; rather the amount of assistance is reduced. The volume of the balloon should not be reduced by more than a third.

At Waikato Hospital ICU, *Method 1* is the standard method of weaning. The instruction to wean the IABP should be documented by the medical staff in the patient's medical record.

Procedure for Removal

1. Prior to removal, any heparin infusion should be stopped for 3 hours. An APTT of < 50 is desirable to reduce the risk of bleeding.

2. During this period, the balloon assist ratio should remain no less frequent than 1:4 to reduce the risk of thrombus formation. The assist frequency should be returned to 1:1 for 5 minutes every hour if the ratio is less than 1:3.
3. The patient is positioned flat and the balloon catheter is removed, after which pressure is applied for at least 40 minutes (until bleeding stops).
4. Once the bleeding has ceased a sandbag is applied to the site for one hour and the patient is to remain flat.
5. After one hour, if the patient is stable and desires a position change, his/her head may be elevated up to 40 degrees. The insertion site should be treated carefully and not stressed for a further 12 hours.
6. Recordings post removal:
 - ½ hourly BP, pulse for four hours
 - ½ hourly inspection of site for bleeding / haematoma for 4 hours, then 2 hourly for a further 8 hours or until the patient mobilises
7. If bleeding recurs, position the patient flat and apply firm pressure to the site.

Remember this is a guide only, and medical staff may have specific requests according to individual patient needs.

References

Arrow International, Inc. (2002). Counterpulsation Applied – An Introduction to Intra-Aortic Balloon Pumping.

Oh, T.E. (1997). *Intensive Care Manual (4th Edition)*. Oxford: Butterworth-Heinemann.

Acknowledgements

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