Clinical Standard Operating Procedure (SOP)

INTRA-AORTIC BALLOON PUMP MANAGEMENT

SETTING	Service-wide
FOR STAFF	All clinical staff
PATIENTS	All patients requiring Intra-Aortic Balloon Pump (IABP) management

Introduction

This document outlines the principles of safe transfer of a patient requiring Intra-Aortic Balloon Pump (IABP) management and is intended to support the training and education of Retrieve team members. The most commonly used IABP in the South West is the Maquet C300 Cardiosave.

The Retrieve team must be able to set up and safely secure an IABP device in the ambulance, monitor and document IABP observations and perform troubleshooting in the event of issues arising.

Background

The IABP is designed to increase coronary artery perfusion and decrease myocardial oxygen consumption when coronary artery supply is impaired. Indications for use include refractory unstable angina, impending myocardial infarction, acute myocardial infarction, refractory ventricular failure, cardiogenic shock and ischaemia-related intractable ventricular arrhythmias. The IABP is used as a bridge to support the patient prior to intervention, often at a specialist cardiac centre. Despite its name, it does not provide any additional pump support to directly replace the function of a failing left ventricle.

The IABP is composed of two principle parts:

- A flexible catheter with one lumen that allows for distal aspiration/flushing or pressure monitoring and a second that permits the periodic delivery and removal of helium gas to a closed balloon.
- A mobile console that contains the system for helium transfer as well as computer control of the inflation and deflation cycle.

The balloon catheter is inserted into the descending aorta percutaneously via the femoral artery, with the catheter tip sitting distal to the left subclavian artery and the base of the balloon above the renal arteries. The catheter is then connected to a console that shuttles helium in and out of the balloon to inflate and deflate in time with the cardiac cycle.

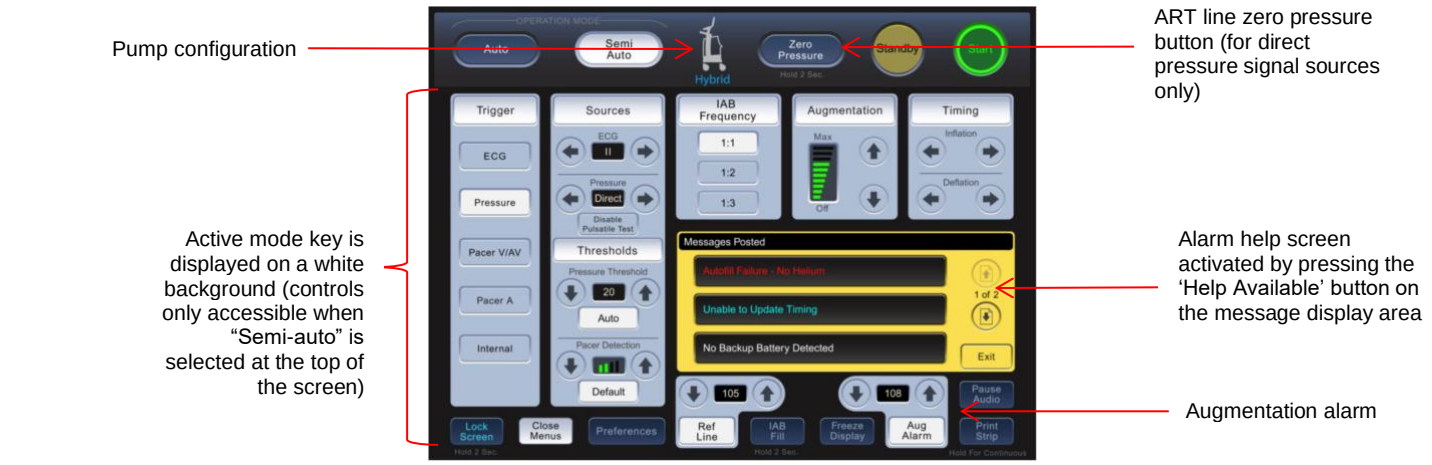
The IABP utilises counterpulsation, meaning the balloon is timed to inflate during diastole when the left ventricle is relaxed and the coronary arteries are filling with blood. This increases the perfusion pressure of the coronary circulation, increasing oxygen delivery to the myocardium. This is referred to as augmentation of aortic diastolic pressure or diastolic augmentation. It also causes some increased run-off into the distal arterial system below the balloon, which causes a reduction in aortic end-diastolic pressure just prior to the next systole. This reduction in pressure (i.e. afterload) makes it easier for the left ventricle to empty, allowing cardiac output to increase for the same myocardial oxygen demand or, a reduced oxygen demand (when supply is short due to coronary occlusion) to achieve the same cardiac output. Just before the left ventricle contracts, the balloon deflates, and the cycle repeats.

IABP features

Console and carriage

The IAPB console can be used in two different modes: either docked into the carriage (Hybrid) or undocked (Rescue). When in Rescue mode, the pump will run on battery power alone. The system will automatically recognise when you have disconnected from the carriage and notify you on screen when it is operating in rescue mode. The IABP contains two batteries each with an estimated running time of 90 mins. The battery status is indicated on the monitor display. The lit green circle indicates which battery is in use. The display will indicate when Battery 2 has less than 30 mins of charge remaining and then less than 5 minutes of charge remaining (see Appendix 1 for more information).

Display screens



Pressure monitoring

A transducer set is attached to the inner lumen on the IABP catheter. The pressure bag should be inflated to 300mmHg with a 500ml bag of 0.9% sodium chloride. Some hospitals may also add 1000i.u. of heparin to the 0.9% sodium chloride. Ensure the pressure bag fluid is labelled correctly and that it matches the hospital prescription.

Upon observing a dampened pressure trace, immediately investigate the cause and rectify in the same way you would approach any damped arterial line trace. If it cannot be rectified, contact the perfusionist/cardiac technician. Ensure the pressure transducer is at chest height and is zeroed appropriately using the 'Zero Pressure' button on the display screen. Do not under any circumstances take blood samples from the balloon catheter or on the 3-way tap on the transducer.

Note that if a fibre optic IAB catheter is in use, the above rules still apply. When a fibre optic IAB is connected the button on the display will be labelled 'Calibrate Pressure'

Transfer of a patient receiving IABP management

Referral

At the point of referral the following information should be sought:

- Recent issues and any significant issues at any stage
- Fully charged batteries – ask referrer to ensure that the batteries are fully charged when unplugged from mains power
- Helium tank – sufficient Helium in the tank, the dial must be in the green

Ideally, the bariatric trolley should be used when transferring a patient on an IABP as it has a specific securing bracket for the Maquet Cardiosave. However, the slim trolley can be used for this type of transfer if the team are already deployed or the bariatric trolley is unavailable. A different approach for securing the IABP is required in this situation (see Appendix 2).

At the referring hospital

Insertion site should be checked for any signs of bleeding, infection, or swelling and the date and time of insertion must be documented. Circulation distal to insertion site should also be assessed and posterior tibial and dorsalis pedis pulses recorded (and ideally marked to ease ongoing assessment). If pulses are not palpable, perfusion must be assessed using a hand-held Doppler. If no pulsatility is detected, this must be discussed with the referring team prior to departure.

To ensure that the catheter has not migrated since insertion, its length should be checked against the insertion procedure record.

The machine must be checked to ensure that:

- The battery is fully charged and works correctly when unplugged from mains power
- The helium cylinder is 'on' and it is sufficiently filled (check dial is in the green)
- Assess helium line for any signs of balloon rupture (rust coloured flakes in line)

Set the following alarm:

- Provided augmentation is clinically adequate, press 'Aug Alarm' button and set alarm limit to 10mmHg below current augmentation pressure.

Prior to moving the patient onto the transfer trolley, document the following settings:

- Trigger setting currently in use (ECG, BP or pacing)
- Current ratio setting (1:1, 1:2, 1:3)
- Current augmentation pressure

Once the patient has been transferred onto the transfer trolley, complete the following:

- Re-zero ART line transducer
- Verify accurate arterial waveform / readings

If there are any concerns with the IABP, consult the referring consultant or perfusionist before packaging the patient.

Before leaving the referring hospital, you must contact the receiving unit to request a Perfusionist/Cardiac Technician to be available to meet you at the receiving unit. Ensure that you provide them with an estimated time of arrival.

The referring unit must be made aware that it is their responsibility to organise the return of their IABP as per the Referring to Retrieve SOP and it should be discussed whether they would like to arrange collection from the receiving hospital or Retrieve base.

Transfer of patient onto transfer trolley and ambulance

During lateral movement of the patient onto the trolley, one person must be responsible for the IABP at all times to ensure that the catheter line is appropriately secure and not pulled. The patient can be sat up by 30 degrees if required.

During ambulance transfer, the IABP must be secured within its carriage to enable it to be plugged into mains power and reduce the risk of running out of battery mid-transfer. However, the machine can be difficult to manoeuvre whilst in its carriage, so for loading/unloading, the following is recommended:

- Place IABP in Rescue mode
- Secure to trolley via IABP bracket on Ferno bariatric trolley whilst moving around hospital
- Secure display screen to the round bracket on side of trolley
- Load trolley into ambulance and secure as usual
- Place IABP back in it's carriage, plug in and check it is charging
- Place display screen on top of the carriage and secure to mount. It can be rotated to ensure when team members are seated in the seats
- Secure IABP machine as per Appendix 1. This **must** be completed prior to the ambulance moving to ensure it is not a missile in the event of an accident

When offloading the patient, the reverse should be followed. A Retrieve team member must take full responsibility of the IABP when being moved around and loaded/unloaded from the trolley.

Documentation

In addition to standard Retrieve documentation (as per Documentation SOP), patients receiving IABP management should have the following documentation included in the ARC-EMS record.

Retrieve Survey should include documentation of the following:

- IABP trigger
- IABP frequency
- Systolic/diastolic pressures
- Augmented diastolic pressure
- Catheter size, balloon volume, insertion depth, and insertion site
- Any recent changes to the settings
- The quality the dorsalis pedis and posterior tibial pulses, the colour, temperature and CRT in the lower limbs pre-transfer and on arrival at the receiving hospital

Every 15 minutes during transfer, in addition to BP, record:

- Augmented diastolic pressure.

Troubleshooting

Alarms

Alarms will be displayed at the bottom of the monitor screen. Alarms faults can be referenced in the embedded 'Help Available' menu on the control panel of the IABP. If unable to troubleshoot the alarm and resume pump operation, follow the "IABP failure" procedure (below) and contact the receiving hospital consultant immediately.

IAB disconnection

If the IAB catheter tubing is disconnected:

- Reattach the IAB catheter and extension tubing
- Press the START key to refill the IAB and resume support

IABP failure

Not all patients will immediately deteriorate, depending upon the degree of support the IABP has been giving.

The following actions should be taken while actively monitoring the patient's physiological response to loss of support:

- Disconnect catheter from pump
- Quickly inflate and deflate balloon with air (10mls of air less than total balloon volume - 30ml for a 40ml IAB) into the balloon connector and aspirate immediately
- Manual inflation/deflation should be done every 5-10 minutes
- Contact receiving hospital consultant immediately and request for replacement IABP to be prepared

Do not let IABP catheter sit more than 20 minutes with no movement or shuttling of air.

Gas loss in circuit / autofill failure - blood suspected

If blood is noted inside balloon lumen/catheter tubing (may be the colour and consistency of brown/copper/rust fleck of dirt), immediately disconnect from IABP to allow any residual gas to be released. Once this has been completed clamp off the helium line using the endotracheal tube clamps found in the primary bag.

Contact receiving hospital consultant immediately and request for replacement IABP to be prepared. The team should anticipate deterioration of the patient physiology as a result of a lack of IABP support.

Removal of balloon

Retrieve will not remove balloons unless directed to do so by the receiving hospital consultant. This has been agreed with the Perfusionists at UHP and UHBW as the risk of removal and subsequent requirement for direct groin pressure outweighs the potential benefit within an ambulance.

Cardiac arrest

If counterpulsation is to be continued and synchronised to CPR, then arterial/pressure trigger should be selected. To do this, select “Semi-Auto” from the top of the console, then open the “Trigger” menu, and select “Pressure”. If CPR generates sufficient blood pressure, then in most cases, the IABP will detect this and may improve perfusion to the coronary and carotid arteries.

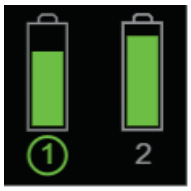
In the event that the CPR does not generate a consistent and reliable trigger, then the following additional steps should be taken:

- Change the assist interval to 1:1

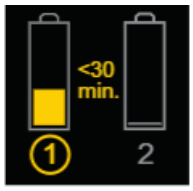
If the trigger remains unreliable and the IABP is not effective, the IABP should be turned off. The IAB should now be manually inflated as described above.

Appendix 1

Battery Icons



When both batteries are installed in the battery bay, the circled battery bay indicates the one in use. Once depleted the pump will automatically transition to the next battery.



When the second battery reaches less than 30 mins remaining, an approximate time will be displayed in 5-minute intervals.

An AC plug icon will be displayed over the greyed-out battery icon to indicate that the pump is using AC power

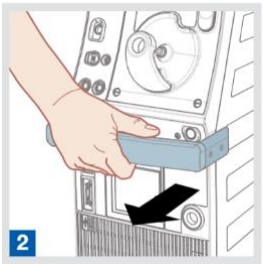
Pump Modes

Hybrid mode

Rescue mode (transport mode). Runs on battery power only

Appendix 2

Removal of the pump console from the carriage

		
Release latch located below the pump console (ensure wheels and locked)	Grab handle and slowly slide console out	Grab the handles located on top and front of the console, then remove from carriage

Securing console and display monitor to bariatric trolley

		
Unscrew the grey cap and lift support arm	Pull out the red lever	Drop down the flap
		
Place the pump console sideways onto the bracket with the front of the console facing the right hand side of the patient	Lift the flap back into place ensuring both the red leaver and grey cap are secure	Secure both the pump and the flap with the seatbelt straps

		
Place the display monitor onto the round mount on the side of the trolley. once mounted the screen can be opened	Once the trolley has been moved into the ambulance and secured, the pump console needs to be placed back into the carriage and the display monitor placed back onto the carriage mount	Using the ratchet strap ensure the IABP is safely secured
		
The strap must pass through the black oyygen holder as this is bolted to the ambulance chassis	Bring the strap up through the handle. DO NOT wrap the strap around the handle	Pass the strap through the black D-ring seen in bottom left of photo. Ensure the strap is around the base the of unit and not around the wheels.

Securing console and display monitor to slim trolley

The slim trolley does not contain an IABP bracket and therefore must be loaded in the ambulance whilst remaining in the carriage.

A member of staff must take responsibility of the pump while transferring the patient from the hospital to the ambulance; this should be wheeled along next to the patient. The pump should be moved to the foot end of the trolley whilst loading the trolley into the ambulance ensuring that there is enough slack on the line to avoid migration of the catheter.

Once the trolley is secured into the ambulance the IABP pump can be secured to the ambulance as shown above.

Document Governance

REFERENCES	Maquet Cardiosave instruction manual https://getinge.showpad.biz/s/intra-aortic-balloon-counter-pulsation-infopack
RELATED DOCUMENTS AND PAGES	Packaging SOP Documentation SOP
AUTHORISING BODY	
SAFETY	The IABP must be adequately secured according to this SOP prior to movement of the ambulance.
QUERIES AND CONTACT	Retrieve Leadership Team