GUIDELINES
These guidelines should be read in conjunction with the:

- Bayside Clinical Care Standards Policy
- Mutual Obligation for Patient Safety and Quality of Services at Bayside Health
- ICU Management of Ankle Brachial Index Measurement

PURPOSE
This document is intended for ICU residents, registrars and specialist nurses, and is to be used as a basic guide to managing an Intra–Aortic Balloon Pump (IABP) in ICU. This guideline should be used in conjunction with further educational resources found as hyperlinks throughout this document.

INTRODUCTION
An IABP is placed in the proximal descending aorta, just distal to the (L) Subclavian artery. The Balloon is automatically inflated during diastole and deflated just prior to, and during systole. Inflation and deflation is triggered by the ECG, (common) arterial pressure waveform or asynchronously.

An IABP improves myocardial function by:

- Increasing coronary artery perfusion pressure and myocardial oxygen supply
- Decreasing myocardial work load and myocardial oxygen demand/consumption
- Decreasing Left Ventricular (LV) afterload and increasing LV stroke volume

INDICATIONS
Left ventricular failure or cardiogenic shock
Mechanical complication post acute myocardial infarction (e.g. Ventricular Septal Defect)
Weaning from cardiopulmonary bypass or Extracorporeal Membrane Oxygenation (ECMO)
Bridge to heart transplant
Left ventricular compromise secondary to septic shock and/or severe myocardial contusion
Prophylactic support for high risk Percutaneous Coronary Intervention (e.g. Coronary Angioplasty)
CONTRAINDICATIONS
Severe Aortic Calcification/Stenosis
Valvular incompetence
Aortic Aneurysm
Severe Peripheral Vascular Disease
Severe Coagulopathy

COMPLICATIONS
Limb ischemia due to occlusion of the femoral artery, vascular injury or arterial embolisation
Aortic dissection during insertion or rupture during pumping
Haemorrhage from insertion site
Renal failure from incorrect IABP positioning causing arterial obstruction or arterial embolisation
Helium emboli from the balloon
Infection at site of insertion or catheter related

RESOURCES
Emergency IABP Trolley located in ICU at Cardiac Desk.
The IABP catheter size is determined by the patient’s height:
If height > 190 cm use 50cc balloon
If height 165 – 190 cm use 40cc balloon
If height < 165 cm use 30cc balloon

Arrow Cat II console (perfusion services in OT)
Insertion kit (introducer & sheath)
Slave cable, ECG Skin leads & Pressure cable
Arterial pressure transducer line and flush bag (0.9% saline) & pressure bag
Major Procedure tray, sterile drapes, sutures & local anaesthetic
Gown, gloves & mask
MANAGEMENT OF IABP

- IABP safety checklist to be completed at start of each shift.
  
  file:///\alfapps01\apps\ICUApps\icunet\Equipment Checklists_and_Stickers\ArrowAutoCATIABPChecklist.doc

- Hourly recording of systolic/diastolic/mean arterial pressures and diastolic augmentation on IABP 1/24 observation sticker.

- 1/24 Neurovascular observation performed, including L) radial pulse, and Dorsalis Pedis pulse of the limb that the IABP is in. A Doppler may be necessary to assess pulses.

- Assess position of IABP on CXR - ensure tip of IABP is between 2\textsuperscript{nd} – 3\textsuperscript{rd} Ant rib space (5-6 posterior rib space)

- Measure distance between catheter fixation hubs and record each shift to assess for catheter migration or position change

- Ensure SaO2 probe on left hand to monitor for left Subclavian occlusion caused by catheter migration

- Nursing staff to conduct IABP timing assessment at start of every shift or as clinically relevant (see correct timing of IABP below)

- Initial ABI at start of shift and then every 4/24 hyperlink to ABI protocol

- IABP transducer line is NOT to be used for blood sampling, as occlusion of the lumen may occur, nor is it to be used as an infusion port. It should be zeroed once per shift and re-levelled to mid chest point after position change

- The limb containing the catheter should always be held straight upon rolling and pressure area care. The head of the bed should be elevated no more than 30 degrees to prevent catheter migration and/or arterial puncture

- Monitor renal function: Creatinine & Urea levels and Urine output

- Assess insertion site each shift for redness, ooze, Change dressing prn

- The IABP should not remain immobile (off) for > 20min due to risk of thrombus formation.
**INSERTION & INITIATION OF IABP AUTOCAT II**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Rationale</th>
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</thead>
<tbody>
<tr>
<td>Pre-insertion assessment:</td>
<td>Provides baseline for evaluation of treatment efficacy.</td>
</tr>
<tr>
<td>Full haemodynamic &amp; physical assessment.</td>
<td>To determine best side for insertion of catheter.</td>
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<tr>
<td>Circulation observations/ultrasound of both legs.</td>
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<tr>
<td>Obtain consent</td>
<td>Legal requirement</td>
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<tr>
<td>Preparation of pump console:</td>
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<tr>
<td>Ensure console is plugged in to AC power</td>
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<tr>
<td>Turn console on and select auto mode</td>
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<tr>
<td>Place pump in standby</td>
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<tr>
<td>Check helium supply on</td>
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<tr>
<td>Ensure all appropriate cables are attached to the machine –</td>
<td></td>
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<tr>
<td>the ECG skin leads attached to the patient, the arterial</td>
<td></td>
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<tr>
<td>pressure cable attached to the transducer and slave cable</td>
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<tr>
<td>attached to monitor in lead II (optional)</td>
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<tr>
<td>Prepare the patient by shaving both groins.</td>
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<tr>
<td>Prepare equipment.</td>
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<td>Lie patient flat.</td>
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<tr>
<td>Medical officer and assistant perform 2-minute surgical</td>
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<tr>
<td>scrub and don gown and gloves.</td>
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<tr>
<td>Following cleaning and draping, the femoral artery is</td>
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<tr>
<td>accessed and the guide wire inserted through the access needle</td>
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<tr>
<td>The assistant helps maintain the sterility of the guide wire.</td>
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<tr>
<td>Prepare the balloon catheter for insertion by attaching the</td>
<td>Minimises the risk of accidental damage to the balloon during insertion.</td>
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<tr>
<td>one-way valve to the end. Using the 60ml syringe, ensure that</td>
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<tr>
<td>the balloon is completely deflated by pulling the plunger of</td>
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<tr>
<td>the syringe all the way out.</td>
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<tr>
<td>Remove the stylet from the central lumen of the catheter.</td>
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<tr>
<td>This can be used to judge the insertion distance needed for</td>
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<tr>
<td>the catheter – measure from the puncture site to the patient's</td>
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<tr>
<td>Manubriosternal angle.</td>
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<tr>
<td>Insert the catheter over the guide-wire.</td>
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<tr>
<td>Once in place, aspirate blood from the central lumen and</td>
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<tr>
<td>flush with 5 ml 0.9% saline.</td>
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<td>Connect the end of the repositioning sleeve to the sheath</td>
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<tr>
<td>and stitch in place.</td>
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<tr>
<td>Connect the primed pressure transducer and line to the</td>
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<tr>
<td>catheter. Zero Transducer at this stage and assess for</td>
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<tr>
<td>appropriate arterial waveform.</td>
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<tr>
<td>Ensure arterial pressure waveform and ECG trace are present</td>
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<tr>
<td>on Autocat II monitor prior to commencement of pumping.</td>
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<tr>
<td>Press on and initiate pumping</td>
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<tr>
<td>Ensure timing ratio 1:2 selected and Autocat II in Auto mode</td>
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<tr>
<td>SEE CORRECT TIMING OF IABP BELOW. Once timing assessed</td>
<td></td>
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<tr>
<td>initiate 1:1 ratio for full support</td>
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<tr>
<td>Perform Chest Xray – ensure tip of IABP is between 2nd – 3rd</td>
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<tr>
<td>Ant intercostal (5-6 posterior rib space)</td>
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<tr>
<td>Suture the distal end of the catheter after adjusting the</td>
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**Suture the distal end of the catheter after adjusting the position if necessary.**

**Secures IABP catheter to inhibit migration**

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**Suture the distal end of the catheter after adjusting the position if necessary.**

**Secures IABP catheter to inhibit migration**
CORRECT TIMING OF IABP AUTOCAT II:

BALLOON PUMP WAVEFORM CHARACTERISTICS

Timing should always be conducted in a ratio of 1:2

Corresponding reference: [Link](file:///alfapps01/apps/ICUApps/icunet/Equipment/IABP-Part 2 AutoCAT 2 WAVE IABP_2006.ppt)

- **Diastolic Augmentation** (Highest peak – represents balloon inflation, should occur just after dicrotic notch)
- **Unassisted Systole** (should be higher than Assisted systole)
- **Assisted Systole** (should be lower than Unassisted systole)
- **There must be a sharp ‘V’ on the waveform at the dicrotic notch. The Dicrotic notch should not be visible.**

Balloon pressure waveform characteristics:

- **C** = peak inflation (static)
- **B** = IAB inflation (dynamic)
- **A** = fill pressure baseline (10-15 MM Hg)
- **D** = plateau pressure
- **E** = IAB deflation
- **F** = negative undershoot

**PAEDP** = Patient Aortic End Diastolic Pressure (should always be higher than BAEDP)

**BAEDP** = Balloon Aortic End Diastolic Pressure (systolic afterload reduction caused by balloon deflation, should always be lower than PAEDP if afterload reduction effective.)

For further waveform troubleshooting refer to following link.
[Link](file:///alfapps01/apps/ICUApps/icunet/Equipment/IABP-Part 2 AutoCAT 2 WAVE IABP_2006.ppt)
Anticoagulation and IABP Management

Introduction
Published IABP registry reviews demonstrate that therapeutic anti-coagulation with un-fractionated heparin is commonly used in the management of the patient with an IABP. The rationale is to minimize the risk of peripheral arterial thrombotic occlusion and ischaemic injury. However, this possible benefit has not been proven to occur; nor has the optimal method of therapeutic coagulation been established.

In the light of paucity of evidence, the commencement of the heparin infusion and the therapeutic APTT target range is always at the discretion of the treating ICU Consultant and dependent upon specific clinical circumstances such as:

- Coagulopathy
- Bleeding
- Heparin Induced Thrombosis – Thrombocytopenia (HITTS)
- Low Platelet Count
- Removal of IABP

Anti-Coagulation Guidelines

1. Non-Surgical Patients
   a. All patients, unless contra-indicated, should receive therapeutic anti-coagulation with heparin.

2. Surgical Patients
   a. No systemic therapeutic anticoagulation is necessary within the first 24 hour post operation, unless specifically indicated (e.g. Pulmonary Thrombo-embolism).
   b. Unless contra-indicated all patients should receive therapeutic anti-coagulation with a heparin infusion after 24 hours post insertion of IABP or at such a time when any existing post operative coagulopathy and/or bleeding has normalized or ceased.

3. Suggested initial Heparin regime
   a. 5000 units Heparin Subcutaneously TDS
   b. In otherwise uncomplicated surgical patients where systemic Heparinisation is deemed necessary, a suggested starting dose of 500 units per hour is recommended with an APTT range of 40 – 50
Anticoagulation (cont)

4. IABP Removal

   a. Therapeutic anticoagulation should be ceased at least 4 hours prior to removal of the IABP.

   **NOTE:**
   In particular circumstances some patients may require alternative anti-coagulation regimens. For example, LMWH if at risk of HITTS; or direct thrombin inhibitors with suspected/proven HITTS.

   Coagulation tests should be performed to measure APTT every six hours whilst on a continuous heparin infusion, until therapeutic range met and twice daily (bd) thereafter.

WEANING

Counter pulsation may be reduced from 1:1 to 1:2 and finally 1:3 depending on the patient’s hemodynamic status.

Do not set the pump at 1:3 unless for weaning and prior to removal. There is an increased risk of thrombus formation at an IABP frequency of 1:3

CARDIAC ARREST

In the event of cardiac arrest, switch to AP trigger due to loss of ECG rhythm. During CPR, an arterial pressure tracing is generated therefore the pressure trigger may be used. If the console does not recognize the arterial pressure tracing, the compressions may not be adequate.

The balloon pump does not need to be disconnected during defibrillation.
TRANSPORT

Ensure the battery is fully charged prior to transport.

When the green indicator LED below the power switch is lit, this denotes AC power is being received by the pump. The amber indicator LED denotes that the battery is at least 80% charged. An audio alarm and display message will appear if the available battery power is <20mins, <10mins and <5mins.

If a “battery inoperative” message appears or the pump fails upon AC disconnection, check the circuit breaker in the helium tank compartment it may be off.

Ensure skin leads are secured adequately to patient. If unable to use ECG as trigger, you can change to AP waveform.

- A fully charged battery will last approximately 90 mins
- Ensure adequate helium supply and spare tank is available
- Ensure IABP plugged into AC power and check the LED light indicator is on and that the battery is charging when patient is not being transported or is at destination.

Personnel required for transport
- Senior ICU registrar or consultant
- Critical Care RN
- **Perfusionists** are NOT required for routine transports.

REMOVAL OF IABP

Prior to removal check patient FBE/COAGS within acceptable range.
If anticoagulated, consider ceasing 4 hours prior to removal.
Determine if surgically or peripherally inserted. **If insertion was surgical, patient must have IABP removed in theatre.**

Peripherally inserted balloon catheters are to be removed by medical officers only.
When the catheter is removed, allow a very small volume of arterial bleed to occur to expel any small clots. **Medical staff to apply pressure to site for at least 20 minutes.** Then cover site with a sandbag or pressure dressing for 2-4 hours (with frequent checks for signs of bleeding). The patient must remain stationary during this time to reduce risk of bleeding.
RELATED DOCUMENTATION

Ankle Brachial Index guideline in ICU
ICU Equipment – IABP powerpoint presentations
Central Venous Catheter (CVC) Management Guideline
Bayside Health Infection Control Requirements Policy
Bayside Health Standard Precautions Guideline

REFERENCES

Charter of Human Rights and Responsibilities Act 2006 (Vic)¹
Western Sydney Health 2004 Intensive Care Evidence Based Practice Guidelines
Wentworth Area Health Service 2002, Insertion of Intra-Aortic Balloon Catheter
Tips for successful intra-aortic balloon pumping vol 2 issue 1
Arrow AutoCAT 2 wave IABP check list for start up or handover www.mayohealthcare.com.au

Contact person: Mat Reid Position: Clinical Educator
Andrew Hilton Position: ICU Intensivist
Email: m.reid2@alfred.org.au Phone: 03 9076 2000
a.hilton@alfred.org.au

¹ REMINDER: Charter of Human Rights and Responsibilities Act 2006 – All those involved in decisions based on this guideline have an obligation to ensure that all decisions and actions are compatible with relevant human rights.