Clinical Guideline Template
Royal Children's Hospital

Title: Invasive Haemodynamic Monitoring

Introduction

Invasive haemodynamic monitoring is used to monitor cardiovascular physiology, to modify interventions and to evaluate the response to the therapies provided. This monitoring is inclusive of intra-arterial lines, central venous lines and direct cardiac monitoring lines.

Definition of Terms

- **Intra-arterial pressure (IA):** Measurement providing moment-to-moment picture and a visual display of systolic, diastolic and mean arterial pressure
- **Mean Arterial Pressure (MAP):** Measurement of the mean perfusion pressure throughout the cardiac cycle. MAP is the product of Systemic Vascular Resistance (SVR) and Cardiac Output (CO)
- **Central Venous Pressure (CVP)**: Estimates venous blood volume which reflects right ventricular function and intravascular volume status (preload). It is an indirect measure of the pressure in the right atrium (RA).
- **Right atrial pressure (RAP):** Direct measure of RA pressure. Enables continuous direct assessment of right ventricular filling pressure (preload).
- **Left atrial pressure (LAP):** Direct measure of left atrial pressure. Enables continuous assessment of left ventricular filling pressure (preload).
- **Pulmonary Artery pressure (PA):** direct measurement of the pressure in the pulmonary artery, which reflects right ventricular ejection and is primarily influenced by the pulmonary vascular resistance.
- **Swan Ganz Catheter:** is an invasive haemodynamic monitoring device used for measuring pulmonary artery pressure, pulmonary artery wedge pressure and cardiac output. **(Link to Swan Ganz Policy)**

- Refer to Central Venous Access Device policy for central line management

RCH CVAD Policy (www.rch.org.au/policy_rch/index.cfm?doc_id=7845)

Aim

The aim of the guideline is to outline the principles in management of invasive pressure lines for clinicians caring for patients in the Paediatric Intensive Care Unit (PICU) and Paediatric Emergency Transport Service (PETS) at the Royal Children's Hospital.

- Transducers convert physical energy from the pressure in blood vessels to an electrical signal that is amplified and displayed on the monitor.
- The tubing connecting the cannula to the transducer should be non-compliant and under 1 metre in length
- The tubing should not be extended or have added stopcocks
- All connections must be tightly secured
- The tubing should be free of kinks, clots, and air bubbles to ensure accurate pressure measurement
- Transducers should be zeroed when commencing measurements, and at least once every shift
- Levelling is done initially and relevelling should occur with each patient position change
- Important to detect technical errors especially when measured parameters are not expected

Priming

- Obtain 50ml of priming solution from pre-prepared stock bags (Hep Saline 5u/ml >2kg for IA, Hep saline 1unit/ml <2kg for IA, Hep Dextrose 1 unit/ml for CVP, direct RA, LA, PA).
- Using a clean technique, prime a micro-bore luer lock extension set (flush line) and transducer. Ensure all air is removed by flushing into the transducer and out all 3 way taps and the full length of the line.

Line Patency

- Lines require infusion of a Heparinised solution at 1ml per hour minimum.
- Attach to infusion pump if required and run at 1ml/hr (CVP flush may not be required if other infusions running through lumen)
- Observe the waveform for blunting (or decreased amplitude), indicating over dampening which maybe due to clots in the line, or air bubbles in the line.

Line Filters

- Direct monitoring lines require a 0.22 micron air filter attached proximally to the patient catheter via a 3 way tap.
- In order to obtain an accurate pressure reading when the filter is in the line it is necessary exclude the flush line from the reading by turning the tap off to the line and filter.

Pressure reading

Levelling

- To eliminate hydrostatic pressure, transducers should be levelled at an external zero-pressure landmark which represents mid point of the right atrium. This is the phlebostatic axis, which is at the 4th intercostal space and halfway between the anterior and posterior chest wall
- The phlebostatic axis reference point is most accurate when the patient is positioned supine
- Once the external reference point is identified it should be marked for easy identification and consistency
- The transducer should be re-levelled when the patients position in the bed is changed
- Alignment for levelling is best achieved with a laser level fixed to the transducer mount. Alternatively a carpenters spirit level can be used
    - Place one end of spirit level against the cross bar on the top 3-way tap of transducer. This point represents the top of the fluid column. Align other end of spirit level against levelling reference point (Refer to Figure 1).

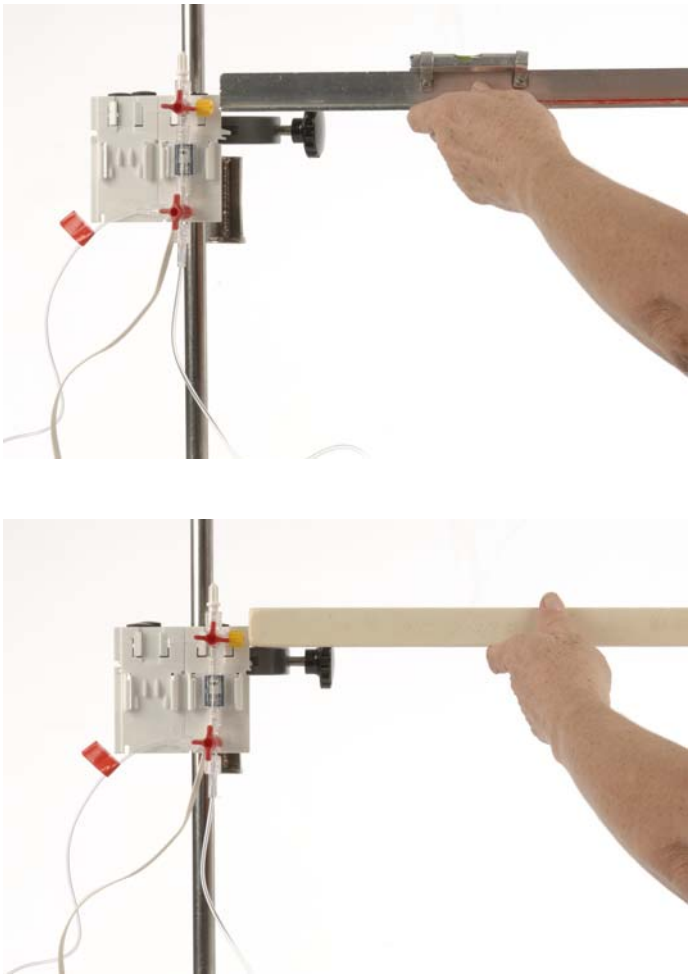

Figure 1: Levelling reference point with various spirit levels

Zeroing

- So that the pressure measured is above atmospheric pressure, intravascular pressures are referenced against ambient atmospheric pressure by exposing the pressure transducer to air
- Transducers require zeroing at the beginning of each shift and after major position changes
    - Identify required waveform on monitor
    - Turn 3 way tap on flush line off to transducer, ensuring flush continues to patient.
    - Open top 3 way tap of transducer to air and remove cap
    - Press zero on the monitor
    - Ensure ‘0’ is displayed when ’zero complete’ message appears.
    - Replace cap and turn top 3 way tap so it is closed to air
    - Rotate 3 way tap on flush line so that it is open to transducer and patient and flush (if required)

Figure 2: Tap closed prior to zeroing

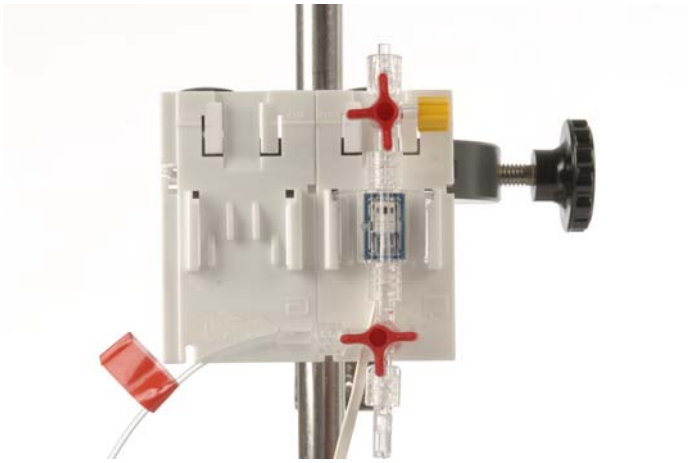

Figure 3: Tap open to air for zeroing

Line Changes

- Transducers and flush lines are changed every 72 hours.

  (www.rch.org.au/policy_rch/index.cfm?doc_id=7845)

Safety

Monitoring Scale

- Set pressure reading to a scale which provides the best trace reflecting the measured pressure
- Beware of setting the scale to 'optimum' as this provides only a narrow range. If the patient's pressure changes out of the range the trace will be flat, and needs therefore to be distinguished from haemodynamic compromise and low pressure readings.

Alarms

Patient specific alarm limits should be set for each parameter. Alarms should be turned on, set within a narrow range, and audible.

Labelling

Ensure all lines and transducers are correctly labelled when the line is established. The label is placed on the short viggo connecting directly to the insertion catheter.

All monitoring and flush lines are labelled "Monitoring Line Only".

Monitoring and flush lines are not used for drug infusions.

Lines are colour coded.

- Red tape for IA
- Blue tape for CVP/RA
- Green tape for LA
- Yellow for PA

Connections

- All connections must be securely luer locked
- The tubing should be free of kinks, clots, and air bubbles

Special Considerations

Infection control. Refer to CVAD Guideline
(www.rch.org.au/policy_rch/index.cfm?doc_id=7845)