Cardiovascular Status - Monitoring & Support - NICU - Paediatric Summary Clinical Guideline

Reference no.: NIC RC 06/ Feb 18/v002

Which babies need blood pressure monitoring and how?

All sick ventilated babies under intensive care should have **invasive continuous arterial blood pressure monitoring** via an umbilical arterial catheter (UAC) or peripheral arterial line (PAL) if possible. This is the most reliable and accurate way of recording blood pressure in sick or small neonates who have low blood pressures.

In stable and term babies ***Intermittent non-invasive oscillometric blood pressure monitoring*** (Dinamap) is acceptable. However, it has several well recognized disadvantages:

1. less accurate in small infants especially at low blood pressures
2. may overestimate mean blood pressure by 5-10 mmHg
3. may fail to identify transient hypotension or unstable blood pressure

Therefore, it is not clinically useful for identifying infants who are most at risk of hypotension and may delay response to hypotensive episodes. If used, intermittent non-invasive blood pressures should be interpreted with great caution.

How to assess and identify the need to support cardiovascular status in neonates?

Assessment for compromise in cardiovascular output is **not** based on MABP alone. Infants may have a MABP within the acceptable range but still have a low systemic output that requires cardiovascular support therapy.
In order to support cardiovascular status or treat hypotension promptly, accurate assessment of the following indicators of cardiovascular output is essential and should be documented.

1. **Hypotension**: There is no agreed definition of hypotension in newborn babies. Blood pressure level correlates positively with gestational and postnatal age. A commonly accepted **working definition of hypotension is that mean arterial blood pressure (MABP) in mmHg is below the value of the infant's gestational age in completed weeks**.
   Before intervening for a low blood pressure, it is paramount to reconfirm the low MABP after re-calibration by flushing, re-zero the arterial line and ensuring a contemporary good arterial waveform on the monitor.

2. **Urine output**: accurate recording of all urine output in all critically ill babies will provide valuable information on the systemic output over the previous few hours and hence the need for intervention. Urine output should generally be maintained above 1ml/kg/hour and subsequent recording of urine output will clarify the effectiveness of treatment.

3. **Blood lactate concentration**: if there is significant tissue hypoxia, lactate will be produced and its concentration will increase when production exceeds the rate of clearance. Normal level is below 2 mmol/l. The base excess is generally unhelpful as it does not correlate with the blood lactate concentration in this situation.

4. **Peripheral perfusion**: skin perfusion may be guided clinically with capillary refill time on the centre of the chest, although this measurement may be affected by ambient temperature and subject to inter-observer variation.

5. **Echocardiogram:** Functional echo when available will aid decision making in management of Hypotension. Do not delay treatment while awaiting an echocardiogram.

What is the treatment regimen for infants with a low systemic output?

Immediate management of a low systemic output or a confirmed low MABP should be directed at identifying and treating any underlying cause before volume expansion or inotropic support. Potential causes in preterm babies include cardiac dysfunction, ductal and intra-atrial shunts, poor venous return due to high ventilator pressures, a pneumothorax, adrenal insufficiency or rarely hypovolaemia.
First line treatment for hypotension – **VOLUME EXPANSION** should only be given cautiously and sparingly (10ml/kg to maximal 20ml/kg)

Indications: hypovolaemic conditions such as septic shock, haemorrhage and extensive or perforated Necrotising Enterocolitis.

- **0.9% saline**: current evidence suggests that 0.9% saline is as effective as 4.5% Human Albumin Solution [6].

- **Blood transfusion** (See also NIC HA02): if haemoglobin is <14g/dl, give a blood transfusion which will improve both venous return as well as tissue oxygenation.

- **Fresh Frozen Plasma/Cryoprecipitate**: in the presence of coagulopathy, then Fresh Frozen Plasma (FFP) or cryoprecipitate may be more appropriate than 0.9% saline.

- **Reassess cardiovascular status** following volume expansion, if still suboptimal commence on inotropic support. In addition, **correct any electrolyte imbalance** if present(hypocalcaemia,hypomagnesaemia hypophosphataemia, hypernatraemia, hyperkalaemia, hypoglycaemia)

Second line treatment – **INOTROPIC SUPPORT**

Indications: infants who remain hypotensive after cautious volume expansion and in the absence of specific hypovolaemic conditions as stated above.

Dopamine
- Indication: Dopamine is more effective than dobutamine in the short term treatment of systemic hypotension in preterm infants.
- Route: preferably via a central line (UVC/long line as it may cause significant local vasoconstriction).
- Dosage regimen: start at 5microgram/kg/minute, gradually increasing to maximum of 20 microgram/kg/minute.

Dobutamine
- Indications: if no central line access to deliver high doses of dopamine or failure to response at maximal Dopamine infusion dosage . Dobutamine is preferred to dopamine in preterm infants with significant PDA and in infants with cardiac dysfunction.

- Route: as it has no vasoconstrictive action, it can be infused via peripheral venous cannula., if central access is not available.

- Dosage regimen: start at 5microgram/kg/minute, gradually increasing to a maximum of 20 microgram/kg/minute.

Third line treatment - Hydrocortisone and Adrenaline

- Indications: if both Dopamine and Dobutamine fail to improve the MABP or systemic output.

- Pretreatment: Check a cortisol level before starting hydrocortisone but note wide normal reference range.

- Dosage regimen:

Hydrocortisone

First 48 hours: at a dose of 2.5mg/kg 6 hourly.
After 48 hours: stop if cardiovascular status stable. If continuing cardiovascular support is needed, reduce to the lowest effective dose.

Adrenaline: Infusion at a dose of 0.1-0.3 microgram/kg/minute. Doses above 0.5microgram/kg/minute should be used with caution, it may cause renal vaso-constriction.

N.B. Document response of treatment and reassessment of cardiovascular status following intervention.