Neonatal Hypotension

Introduction:

Blood pressure (BP) is the product of blood flow and vascular resistance. Normal BP is difficult to define in preterm babies, a group who, by definition, are not normal. Watkins et al \(^1\) defined the 10th centile for mean BP within the first 24 hours according to birth weight.

<table>
<thead>
<tr>
<th>Birth Weight</th>
<th>10th centile for mean BP</th>
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<tbody>
<tr>
<td>500-750 grams</td>
<td>26 mmHg</td>
</tr>
<tr>
<td>750-1000 grams</td>
<td>28 mmHg</td>
</tr>
<tr>
<td>1000-1250 grams</td>
<td>29 mmHg</td>
</tr>
<tr>
<td>1250-1500 grams</td>
<td>30 mmHg</td>
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From this a useful "rule of thumb" can be derived that mean BP should be maintained above the gestation in weeks.

Incidence and risk factors:

Need for treatment of low BP increases with lower gestation. This figure shows the proportion at each gestation which were given treatment for low BP in 126 babies (<30 weeks) born at KGV Hospital in 1995 and 1996.

Other factors which increase the risk of hypotension include lack of antenatal steroids, \(^2\) large patent ductus arteriosus, higher pressure ventilation. \(^3\) Risk of hypotension reduces with increasing postnatal age.

Consequences:

Hypotension has been associated with poor outcomes, particularly intraventricular haemorrhage and periventricular leukomalacia. \(^1\), \(^4\), \(^5\)

**Diagnosis:** BP is used in neonatology as a marker of systemic perfusion. However BP correlates only weakly with cardiac output and babies can have low BP and normal cardiac output and normal BP and low cardiac output. \(^3\) Therefore BP should not be the only criteria by which systemic perfusion is assessed (see
when to intervene).

- The first priority is to confirm the BP reading is accurate and that the transducer has been calibrated and positioned correctly.
- The second priority is to establish whether hypotension is symptomatic of another problem. Conditions to consider include:
  - Patent ductus arteriosus, 3, 6, 7
  - Hypovolaemia or blood loss.
  - Pneumothorax.
  - Sepsis (particularly in persistent or late hypotension).
  - Adrenocortical insufficiency in extreme prematurity, 8, 9
  - High mean airway pressure on mechanical ventilation.

- Echocardiography is very useful and should be performed if expertise is available.

*When to intervene:*

1. In any baby with clinical or laboratory evidence of poor perfusion including pallor, metabolic acidosis, rising potassium and urine output <0.5 ml/kg/hr together with echocardiographic evidence of low systemic blood flow.
2. And/or Mean BP persistently below gestation in weeks.

**Interventions:**

The aim of supporting BP is to improve pressure by improving flow. Unfortunately the available outcome data concentrates on change in BP. There is very little data on the effect of circulatory support on systemic or organ flows or long term neurological outcomes. Available interventions include:

- **Volume replacement.** As a group, hypotensive babies are not hypovolemic 10 and volume replacement improves BP in slightly less than half of preterm babies. 11 However, since hypovolemia does occur, and is difficult to diagnose clinically, small amounts of volume replacement are unlikely to be harmful and inotropes will not help if a baby is hypovolemic. We would therefore commence circulatory support with 10 mls/kg of 5% albumin over 20-30 minutes.

- **Inotropes:** Dopamine and dobutamine are the most widely used inotropes in neonatology. Dopamine is better than dobutamine at improving blood pressure, 12, 13, 14 however while the central actions of these drugs is similar, peripherally dopamine vasoconstricts while dobutamine vasodilates. 15, 16 This effect is dose dependent, Roze et al 14 in the only study to date which has looked at flow, demonstrated that dopamine, at doses above 10 mcg/kg/min. increased vascular resistance and reduced cardiac output while dobutamine reduced vascular resistance and increased cardiac output. Seri et al 16 showed improvements in renal blood flow with dopamine at 4 mcg.kg.min. Therefore:
  1. **First line inotrope:** Dobutamine starting at 10 micrograms/kg/min increasing to 20 micrograms/kg/min depending on response.
  2. **Second line inotrope:** Dopamine starting at 5 micrograms/kg/min increasing to 10 micrograms/kg/min depending on response. Doses above 10 mcg/kg/min should be avoided.
  3. **Third line inotrope:** Adrenaline starting at 0.05 micrograms/kg/min increasing to 1 micrograms/kg/min depending on response. Adrenaline markedly increases vascular resistance and should only be given after echocardiographic assessment and consultation at a senior level.
- **Indomethacin:** Low blood pressure is associated with early clinically silent significant ductal shunting. 5, 7 If this is demonstrated on echocardiography, it would be reasonable to commence Indomethacin 0.1 mg/kg as described in the PDA guideline.
- **Hydrocortisone:** Some very preterm babies have an immature corticosteroid stress response. 8, 9 Bouchier et al 17 showed hydrocortisone 2.5 mg/kg in two doses 4 hours apart increased blood pressure in 81% of babies. However we do not know whether this effect is mediated by increased flow or resistance and we do not know effects on long term outcomes.
Key Points

<table>
<thead>
<tr>
<th>Key Points</th>
<th>Level of evidence</th>
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<tbody>
<tr>
<td>* Do not use BP as the only marker of systemic perfusion.</td>
<td>3</td>
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<tr>
<td>* Aim to keep MBP above gestation in weeks.</td>
<td>1</td>
</tr>
<tr>
<td>* Echocardiography may diagnose cause of hypotension</td>
<td>3</td>
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<td>* Initially give 10 mls/kg volume replacement then dobutamine 10 mcg/kg/min depending on response.</td>
<td>14</td>
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<tr>
<td>* There is little data on the effects of circulatory support on systemic blood flow or long term outcomes.</td>
<td>N/A</td>
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References


the hypotensive very preterm infant. *Arch Dis Child* 1993;**69**:59-63.

