Hypotension

The gestational age can be a useful guide to a “normal mean BP” in the first 24 hours, after which BP normally rises. After this time there is no clear agreement (2), but in general the BP should ideally be over 28-30 mmHg. Gestational age remains a useful benchmark.

1. The primary function of blood pressure is to enable efficient nutrient perfusion of organs and removal of waste products of tissue metabolism. Therefore assess perfusion of

- lungs (oxygenation)
- heart (rate)
- kidneys (urine output >1ml/kg/hr)
- tissues (lactate < 2.5 mmol/l)
- skin (capillary refill < 2 seconds)
- toe-core temperature gap (<2 degrees Celsius)

If they are normal, then the BP is probably sufficient.

2. We should only treat low BP (less than GA) with evidence of poor perfusion (1).

3. Blood pressure spontaneously increases in ELBW infants during the first 24 – 48 hours (2). There is currently no clear evidence that “low” blood pressure affects developmental outcome (3)

4. Are there other factors to prioritise? - some inotropes (dobutamine) can cause BP to fall if the circulating volume is low or calcium or magnesium are critically low

5. Is the baby in transitional circulation? If a duct is patent, this may affect the decision making, as the blood pressure (mean) may appear lower.

6. How mature is the baby? Contractility, regulation improve with gestational age

Causes of hypotension

Try to understand the cause before you treat! Causes of hypotension include

- Extreme immaturity
- Hypoxia
- Pneumothorax
- Non-therapeutic hypothermia
- Intravenous opiates
- Use of paralytic agents
- Blood loss (Feto-maternal, brain, lungs, gut, external e.g. from arterial line)
- Hypovolaemia 2 to polyuria caused by glucosuria / hyperglycaemia or large insensible water loss
- NEC
- Sepsis
- Cardiac tamponade (UVC / long line malposition)
- Low mean BP due to wide pulse pressure (e.g. PDA)
- High positive intrathoracic pressure (due to mechanical ventilation)
- Heart failure
Treatment of Hypotension

1. Volume

Volume should be given only if the baby is hypovolaemic and routine use of volume is to be discouraged. Assess clinically by perfusion and by applying gentle pressure over the liver to transiently increase venous return to the heart – if this results in a transient but significant improvement in BP then volume may be indicated.

What to use:
- Normal 0.9% saline 10ml/kg iv. Saline can lead to a hyperchloraemic acidosis and reduction in serum bicarbonate, so it is not without side effects!
- Blood if indicated – see transfusion thresholds in guideline (10-15ml/kg)
- FFP if abnormal clotting – see guideline
- Platelets – see guideline

2. Inotropes – which one to choose?

First line usually:

**Dopamine** (D1, D2, B1,B2 agonist) – increases contractility and vascular resistance, must be given centrally. It has more effect on BP than dobutamine. Dose 5-20 micrograms/kg/min

Second line usually:

**Dobutamine** (B1 agonist) – increases contractility, produces vasodilation, tachycardia. Useful if concerned about vasoconstrictive effects of dopamine. Dose 5-20 micrograms/kg/min

Other inotropes – consultant decision

**Hydrocortisone**
Its use as a first line inotrope is uncertain, but it can be a useful rescue treatment for vasopressor resistant hypotension. It increases release of myocardial cytosolic calcium and also upregulates adrenoceptors thus allowing weaning of inotropes. Onset of action is from 2-6 hours. Dose 2.5mg/kg 6 hourly, wean over 2-4 days.

**Epinephrine** – A1, A2, B1, B2 agonist
Greater peak effect than dopamine, increases contractility and vascular resistance. Higher doses can cause receptor desensitisation and acidosis. **Must be given centrally.**
Dose 100-300 nanograms/kg/min

**Norepinephrine** – A1, A2,B1 agonist
Mainly alpha-agonist therefore mainly increases BP by vasoconstriction. Dose (as base)20-100nanograms/kg/min, can go higher

**Vasopressin**
ADH agonist in arterioles. Rescue medicine in severe cases
Dose 0.018-0.12 units/kg/hour

**Milrinone**
PDE III inhibitor
Dose 0.5 – 0.75 micrograms/kg/min
Sample Clinical scenarios

1. Extremely preterm newborn baby
   Is unlikely to be hypovolaemic and blood pressure may be gestationally appropriate. First line treatment might be dopamine, used cautiously (e.g. start at 10 micrograms/kg/min)

2. Sepsis / NEC
   Intravascular depletion is common, so fluid resuscitation usually needed – see above. Systemic vasodilation likely to be present so use dopamine first line.

3. Sudden fall in blood pressure
   Might be pneumothorax or acute haemorrhage (lung/brain) or high intrathoracic pressure. Check for cause before treating, as treatments might be very different

4. PPHN
   First choice inotrope might be dobutamine to minimise vasoconstrictive effects on pulmonary arterioles. In practice however these babies often require multiple inotropes to maintain systemic BP. Focus on correction of acidosis, hypoglycaemia and non-therapeutic hypothermia. Use nitric oxide, consider sildenafil, see guideline

5. “Renal” dopamine
   A meta-analysis of 61 RCTs, or which 5 were neonatal, showed improved urine output after low dose (<5 micrograms/kg/min) dopamine. No effect on survival noted. Consultant decision.

Remember that these are potent drugs with side effects – e.g. dopamine has immune and endocrine effects.

Do not start the highest dose immediately. Assess the haemodynamics, intervene early with appropriate treatment, titrate carefully and pay attention to the volume / electrolyte / ventilation / environmental factors affecting the baby.

Ensure that ionised calcium levels are maintained within normal ranges as this also impacts on myocardial function and ability to respond to inotropes

Monitoring
   Invasive blood pressure monitoring is normal for babies requiring inotropic support.

Weaning
   Wean dopamine / dobutamine in decrements of 3-5 micrograms/kg/min

References
1. Which inotrope and when in neonatal and paediatric intensive care. Mark Turner and Paul Baines, ADCEducation and Practice, December 2011: 96(6);216

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