

Cardiovascular System – Blood Pressure

The importance of identifying and treating hypotension lies in its association with periventricular haemorrhage and adverse long-term neurodevelopmental outcome. [1,2] A clear association between hypotension and periventricular leukomalacia has not been established.[3] Continuous intra-arterial blood pressure (BP) monitoring is the ideal, especially in the sickest most immature babies. Intermittent, non-invasive BP monitoring may be a useful alternative in larger, relatively healthy babies when invasive monitoring is not available.

Hypotension is most commonly defined using various BP reference ranges derived from 'stable' preterm infants without evidence of neurological injury. Birth weight and postnatal age specific centile charts and tables have been published for preterm infants.[1,4] The 10th percentile for mean BP is approximately 25-30 mmHg in babies < 750 g.[1] The commonly cited 'rule of thumb' that defines hypotension as a mean BP below a baby's gestational age is only valid in the first 24 hours for very low birthweight infants.[4]

Although there is no evidence that treating hypotension improves short or long term neurological outcomes in preterm babies with RDS, it is considered good clinical practice to measure BP in infants with RDS and to treat hypotension when accompanied by clinical or laboratory evidence of poor tissue perfusion (**grade C recommendation**).

Blood pressure is the product of cardiac output and systemic vascular resistance. There is a weak correlation between BP and left ventricular output, and left ventricular output is either normal or high in three-quarters of hypotensive preterm infants.[5,6] Although some hypotensive babies may have evidence of myocardial dysfunction and low left ventricular output, hypotension is more frequently a result of low systemic vascular resistance (often associated with a haemodynamically significant ductal shunt).[5-7] Blood volume and BP are poorly related and hypovolaemia is a relatively rare cause of hypotension in preterm infants.[6,8]

Volume expansion should be the first line treatment for hypotension only if there is clear evidence of underlying hypovolaemia (**grade C recommendation**). The volume of fluid infused rather than its protein load is the important factor in BP response.[9] Normal saline is as effective as albumin and avoids the potential adverse effects of administering blood products.[10]

Dopamine is more effective than either volume expansion or dobutamine in increasing BP and should be considered as the first-line agent to treat hypotension.[11] (**grade A recommendation**). Most infants respond to dopamine at doses of 2 to 10 micrograms/kg/min; high dose dopamine > 20 micrograms/kg/min are usually avoided because of concerns regarding excessive peripheral vasoconstriction and reduced cardiac output.[11,12]

Dobutamine is an inotrope without the vasopressor actions of dopamine and may therefore increase cardiac output when hypotension is accompanied by myocardial dysfunction. It should be used as a second-line agent in addition to dopamine at a dose of 5-20 micrograms/kg/min. (**grade C recommendation**).

Adrenocortical insufficiency may be a cause of hypotension in some preterm infants.[13] Although hydrocortisone was as effective as dopamine in first line treatment of hypotension in one randomised controlled trial, steroid therapy should be reserved for babies with refractory hypotension.[14,15] (**grade C recommendation**). Hydrocortisone 2-6 mg/kg/d increases BP allowing a reduction in inotropic/vasopressor support.[15]

There are few data to support the use of other drugs in preterm hypotension. Adrenaline (epinephrine) has been used as a second line agent but there is little published work regarding efficacy and safety in the neonatal period.[16]

References

1. Cunningham S, Symon A G, Elton R A, Zhu C, McIntosh N. Intra-arterial blood pressure reference ranges, death and morbidity in very low birthweight infants during the first seven days of life. *Early Hum Dev* 1999; 56: 151-165.
2. Goldstein R F, Thompson R J, Oehler J M, Brazy J E. Influence of Acidosis, Hypoxaemia, and Hypotension on Neurodevelopmental outcome in Very Low Birth Weight Infants. *Pediatrics* 1995; 95: 238-243.
3. Dammann O, Allred EN, Kuban KC, Van Marter LJ, Pagano M, Sanocka U, Leviton A, Develop[mental Epidemiology Network. Systemic hypotension and white-matter damage in preterm infants. *Dev Med Child Neurol* 2002; 44: 82-90.
4. Lee J, Rajadurai V S, Tan K W. Blood pressure standards for very low birthweight infants during the first day of life. *Arch Dis Child Fetal Neonatal Ed* 1999; 81: F168-F170.
5. Kluckow M, Evans N. Relationship between blood pressure and cardiac output in preterm infants requiring mechanical ventilation. *J Pediatr* 1996; **129**: 506-512.
6. Pladys P, Wodey E, Beuchee A, Branger B, Betremieux P. Left ventricle output and mean arterial blood pressure in preterm infants during the 1st day of life. *Eur J Pediatr* 1999; **158**: 817-824.
7. Gill A B, Weindling A M. Echocardiographic assessment of cardiac function in shocked very low birthweight infants. *Arch Dis Child* 1993; **68**: 17-21.
8. Barr P A, Bailey P E, Sumners J, Cassady G. Relation between arterial blood pressure and blood volume and effect of infused albumin in sick preterm infants. *Pediatrics* 1977; **60**: 282-289.
9. Emery E F, Greenough A, Gamsu H R. Randomised controlled trial of colloid infusions in hypotensive preterm infants. *Arch Dis Child* 1992; **67**: 1185-1188.
10. So K W, Fok T F, Ng P C, Wong W W, Cheung K L. Randomised controlled trial of colloid or crystalloid in hypotensive preterm infants. *Arch Dis Child Fetal Neonatal Ed* 1997; **76**: F43-F46.

11. Subhedar NV, Shaw NJ. Dopamine versus dobutamine for hypotensive preterm neonates (Cochrane Review). In: The Cochrane Library, Issue 4, 2000. Oxford: Update Software. Cochrane Database Syst Rev. 2003;(3):CD001242.
12. Roze J C, Tohier C, Maingueneau C, Lefevre M, Mouzard A. Response to dobutamine and dopamine in the hypotensive very preterm infant. *Arch Dis Child* 1993; **69**: 59-63.
13. Scott S M, Watterberg K L. Effect of gestational age, postnatal age, and illness on plasma cortisol concentrations in premature infants. *Pediatr Res* 1995; **37**: 112-116.
14. Bouchier D, Weston P J. Randomised trial of dopamine compared with hydrocortisone for the treatment of hypotensive very low birthweight infants. *Arch Dis Child* 1997; **76**: F174-F178.
15. Seri I, Tan R, Evans J. Cardiovascular effects of hydrocortisone in preterm infants with pressor-resistant hypotension. *Pediatrics* 2001; **107**: 1070-1074.
16. Heckmann M, Trotter A, Pohlandt F, Lindner W. Epinephrine treatment of hypotension in very low birthweight infants. *Acta Paediatr* 2002; **91**: 566-570.