HYPERKALAEMIA
Supporting information

What is the evidence for the use of salbutamol, and is it superior to insulin as a treatment for hyperkalaemia? Has nebulised salbutamol been evaluated?

Intravenous administration of insulin (together with glucose) effectively manages hyperkalaemia in neonates (Ditzenberger, 1999), but the response is unpredictable, and carries the risk of hypoglycaemia, hyperosmolarity, and volume overload (Helfrich, 2001). No good, randomised trials for its use in neonates have been identified. Intravenous salbutamol is rapidly effective and side effects, including elevated heart rate, mild vasomotor flushing and mild tremor are all short-lasting (Helfrich, 2001; Kemper, 1996; Murdoch, 1991). One prospective, randomised, placebo-controlled double-blind trial of nebulised salbutamol, in 19 neonates <2000g, has been identified (Singh, 2002). Serum potassium levels fell rapidly (from 7.06 +/- 0.23 mmol/L to 6.34 +/- 0.24 mmol/L, P=.003) in the first 4 hours in the treatment group (n=8) in response to 400 mcg given by nebuliser. No significant change was seen in the placebo group (n=11) (6.88 +/- 0.18 mmol/L to 6.85 +/- 0.24 mmol/L).

Ditzenberger GR, Collins SD, Binder N. Continuous insulin intravenous infusion therapy for VLBW infants. J Perinat Neonat Nurs 1999;13:70-82

Helfrich E, de Vries TW, van Roon EN. Salbutamol for hyperkalaemia in children. Acta Paediatr 2001;90:1213-6

Kemper MJ, Harps E, Hellwege HH, et al. Effective treatment of acute hyperkalaemia in childhood by short-term infusion of salbutamol. Eur J Pediatr 1996;155:495-7

Murdoch IA, Dos Angos R, Haycock GB. Treatment of hyperkalaemia with intravenous salbutamol. Arch Dis Child 1991;66:527-8

Singh BS, Sadiq HF, Noguchi A, et al. Efficacy of albuterol inhalation in treatment of hyperkalemia in premature neonates. J Pediatr 2002;141:16-20

Evidence Level: II (for inhaled salbutamol)

Is rectal calcium resonium a safe treatment in neonates?

Intestinal perforation has been reported in infants treated with exchange resin enemas (Grammatikopoulos, 2003; Bennett, 1996), although these may have been spontaneous rather than as a result of the treatment.
Nausea and vomiting are common side effects of oral administration, but changing to the rectal route is “less effective” (Helfrich, 2001).
Only one randomised trial of resins in the treatment of hyperkalaemia in neonates has been identified (Hu, 1999). 40 VLBW infants were randomised to receive either glucose/insulin infusion (n=20) or kayexalate resin enema (n=20). Duration of hyperkalaemia was significantly shorter (26.4 +/- 14.9 vs 38.6 +/-13.3 hours) in the insulin group.

An appropriately-sized randomised trial is necessary to evaluate the risks and benefits of this treatment in premature infants (Grammatikopoulos, 2003).

Bennett LN, Myers TF, Lambert GH. Cecal perforation associated with sodium polystyrene sulfonate-sorbitol enemas in a 650 gram infant with hyperkalemia. Am J Perinatol 1996;13:167-70

Grammatikopoulos T, Greenough A, Pallidis C, et al. Benefits and risks of calcium resonium therapy in hyperkalaemic preterm infants. Acta Paediatr 2003;92:118-27

Helfrich E, de Vries TW, van Roon EN. Salbutamol for hyperkalaemia in children. Acta Paediatr 2001;90:1213-6

Hu PS, Su BH, Peng CT, et al. Glucose and insulin infusion versus kayexalate for the early treatment of non-oliguric hyperkalaemia in very-low-birth-weight infants. Acta Paediatr Taiwan 1999;40:314-8

Evidence Level: II (For no evidence of benefit of resins over glucose/insulin)
Evidence Level: V (For case report evidence of harm from resins)

Do some VLBW infants without renal failure suffer from hyperkalaemia?

Both renal and non-renal causes of neonatal hyperkalaemia have been suggested (Singh, 2002), and the cause of the condition is generally held to be multi-factorial (Ditzenberger, 1999). One study of 48 infants (Fukuda, 1989) implicated metabolic acidosis and catabolic state, but another, in 33 infants (Stefano, 1993), found no difference in muscle protein catabolism between 12 infants with hyperkalaemia and 21 without.
In a study of 18 VLBW infants (Gruskay, 1988) no differences in renal glomerular function were noted in 8 who developed hyperkalaemia and 10 who did not.
Inability to regulate potassium balance, as a result of immature distal tubule function, may result in hyperkalaemia in the absence of renal failure (Mildenberger, 2002; Lorenz, 1997; Matsuo, 1995; Sato, 1995).

Ditzenberger GR, Collins SD, Binder N. Continuous insulin intravenous infusion therapy for VLBW infants. J Perinat Neonat Nurs 1999;13:70-82

Fukuda Y, Kojima T, Ono, A, et al. Factors causing hyperkalemia in premature infants. Am J Perinatol 1989;6:76-9

Gruskay J, Costarino AT, Polin RA, et al. Nonoliguric hyperkalemia in the premature infant weighing less than 1000 grams. J Pediatr 1988;113:381-6

Lorenz JM, Kleinmann LI, Markarian K. Potassium metabolism in extremely low birth weight infants in the first week of life. J Pediatr 1997;131:81-6

Matsuo Y, Hasegawa K, Doi Y, et al. Erythrocyte sodium-potassium transport in hyperkalaemic and normokalaemic infants. Eur J Pediatr 1995;154:571-6

Mildenberger E, Versmold HT. Pathogenesis and therapy of non-oliguric hyperkalaemia of the premature infant. Eur J Pediatr 2002;161:415-22

Sato K, Kondo T, Iwao H, et al. Internal potassium shift in premature infants: cause of nonoliguric hyperkalemia. J Pediatr 1995;126:109-13

Singh BS, Sadiq HF, Noguchi A, et al. Efficacy of albuterol inhalation in treatment of hyperkalemia in premature neonates. J Pediatr 2002;141:16-20

Stefano JL, Norman ME. Nitrogen balance in extremely low birth weight infants with nonoliguric hyperkalemia. J Pediatr 1993;123:632-5

Evidence Level: IV

What level of hyperkalaemia should prompt treatment?

The criteria on which to treat hyperkalaemia have ranged from 6.8 to 7.5 mmol/L, but 6.5 mmol/L may be a better level at which to begin treatment, as rhythm disturbances are to be expected above 7.0 mmol/L (Grammatikopoulos, 2003). If treatment is not initiated until symptoms appear (or the serum level exceeds 7.0 mmol/L), the potential for success is reduced (Ditzenberger, 1999). Mortality rates may be as high as 80% once arrhythmias have appeared (Singh, 2002).

Ditzenberger GR, Collins SD, Binder N. Continuous insulin intravenous infusion therapy for VLBW infants. J Perinat Neonat Nurs 1999;13:70-82

Grammatikopoulos T, Greenough A, Pallidis C, et al. Benefits and risks of calcium resonium therapy in hyperkalaemic preterm infants. Acta Paediatr 2003;92:118-27

Singh BS, Sadiq HF, Noguchi A, et al. Efficacy of albuterol inhalation in treatment of hyperkalemia in premature neonates. J Pediatr 2002;141:16-20

Evidence Level: V

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