

What is the value of bicarbonate in correcting acidosis during newborn resuscitation?

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The World Health Organization has produced guidelines for the management of common illnesses in hospitals with limited resources. This series reviews the scientific evidence behind WHO's recommendations. The WHO guidelines, and more reviews are available at:
http://www.who.int/child-adolescent-health/publications/CHILD_HEALTH/PB.htm

This review addresses the question: *What is the value of bicarbonate in correcting acidosis during newborn resuscitation?*

The WHO Pocketbook of Hospital Care for Children currently makes no recommendation regarding the use of bicarbonate in neonatal resuscitation.

INTRODUCTION

Drugs have traditionally been used in newborns who do not respond to adequate ventilation and chest compressions. However, in newborn resuscitation, the emphasis is on adequate ventilation and compressions as drugs will be useless unless the primary problems of hypoxaemia/ischaemia are overcome and there is some degree of circulation. There is still no firm evidence for or against sodium bicarbonate in neonatal resuscitation.

METHODS

Articles were identified through Medline searches by use of Pubmed clinical queries.

Using the terms acidosis AND (sodium bicarbonate OR bicarbonate) AND (newborn OR infant OR neonat*) and searching under the clinical filter for systematic reviews, 6 articles were found, 2 of which were relevant. Using the terms (bicarbonate OR acidosis) AND newborn resuscitation under therapy, broad, sensitive (Limits: Publication Date from 1980 to 2005), 85 articles were retrieved, 2 of which were relevant.

The title and abstract of each retrieved study was read by two independent reviewers to assess eligibility; those on the use of bicarbonate in correcting newborn acidosis were selected. The methodological quality of the selected articles were assessed using the Oxford Centre for Evidence Based Medicine Levels of Evidence (CEBM LOE) [1].

Overall, 2 systematic reviews (SRs), 2 randomised control trials (RCTs) and 1 Guideline were identified; 2 were level 1a evidence while two had a LOE of 1b (Table1).

RESULTS

Mortality as an outcome was reported by one SR [2] and one study [3]; the SR did not find evidence of an effect on mortality (RR 1.39, 95% CI 0.72 to 2.67), RD 0.12, 95% CI -0.12 to 0.36), although only one small RCT measured this effect. Similarly, the composite primary outcome of death or abnormal neurological examination at discharge was similar in both groups (52% vs 54%, p=0.88)[3].

The incidence of intra/peri-ventricular haemorrhage was reported by 2 studies [2][3] one SR [2] did not find evidence of an effect in this outcome (RR 1.24 95% CI 0.47 to 3.28; RD 0.05, 95% CI -0.16 to 0.25). The same SR noted that sodium bicarbonate may cause hypernatraemia and has been associated with intra-ventricular haemorrhage when given rapidly and in large quantities. In one study [3] the incidence of intraventricular haemorrhage (IVH) was similar between groups, 11% vs 10.7%. All the intraventricular bleeds were seen in the preterm neonates.

Arterial blood pH/ excess was reported by one SR [2] and two studies [3][4]. The SR did not find any statistically significant difference in the rate at which pH was corrected or in the mean arterial blood pH levels after commencing the intervention. The same SR reported failure to improve pH >7.25 and base excess to <-6mmol/litre within 4 hours of treatment. However, this difference was of borderline statistical significance: RR 0.28, 95% CI 0.07-1.11). In the two studies[3][4] the mean pH was between the groups.

There were no significant differences in the other outcomes; encephalopathy, cerebral edema, need for ventilation, duration of respiratory distress, seizures [4] and need for inotropic support, multiple-organ dysfunction [3].

One SR [5] found no studies meeting the criteria for inclusion and concluded that there is no evidence available from RCTs to support or refute the rapid correction of metabolic acidaemia in low birth weight infants as compared with slow or no correction.

DISCUSSION

The findings of this review demonstrate that bicarbonate administration in preterm infants with metabolic acidosis is of no value; mortality was similar between the groups. Similarly, there were no significant differences in abnormal neurological examination, arterial blood pH/base excess, encephalopathy, cerebral edema and need for ventilation.

The use of bicarbonate has potential risks; rapid administration of large quantities of sodium bicarbonate may cause hypernatremia and intra-ventricular haemorrhage. Furthermore, the hyperosmolarity and CO₂ generating properties of sodium bicarbonate may be detrimental to myocardial or cerebral function.

The small number of studies found may, however, limit the strengths of the above findings.

SUMMARY

Based on the available evidence (from the current review), bicarbonate administration does not help to improve survival or immediate neurological outcome. Bicarbonate infusion has potential risks. Thus, consideration should be given to revision of current recommendations. The above notwithstanding, there is need for larger studies to confirm the above findings.

REFERENCES

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Table 1: Included studies

Author Design	Country Setting	Sample Size	Inclusion Criteria	Intervention	Results	LOE
Lokesh <i>et al</i> 2004 RCT	India Hospital Intensive Care Unit	55	Asphyxiated neonates continuing to need positive pressure ventilation at 5 min of life No congenital malformations	Bicarbonate Group (n=27) Given 4ml/kg(1.8 meq./kg sodium bicarbonate over 3-5 minutes Dextrose Group (n=28) Given 4ml/kg of undiluted 5% dextrose over 3-5 minutes Outcomes Death or abnormal neurological examination at discharge. Encephalopathy, multi-organ dysfunction, intraventricular haemorrhage (IVH) and arterial pH at 6 h	Death or Abnormal Neurological Examination at discharge Bicarb group =52%, Dextrose group =54% (P =0.88) Incidence of Encephalopathy Bicarb group =74%, Dextrose group =63% Incidence of Cerebral Oedema Bicarb group =52%, Dextrose group =30% Need for Inotropic Support Bicarb group = 44%, Dextrose group =29% Mean arterial pH at 6 hrs were similar between the two groups. Survival to Discharge Bicarb group=18/27(66.7%) Dextrose group=19/28(68%) (P=0.84) Neurologically Abnormal at Discharge Bicarb group=28% of the survivors Dextrose group=32% of the survivors (P=0.10).	1b
Murki <i>et al</i> 2004 RCT	India Neonatal Intensive Care Unit	55	Asphyxiated neonates continuing to need positive pressure ventilation at 5 min of life No congenital malformations	Base Group (n=27) Given 4ml/kg(1.8 meq./kg sodium bicarbonate over 3-5 minutes Dextrose Group (n=28) Given 4ml/kg of undiluted 5% dextrose over 3-5 minutes Outcomes Acid-base status at 1,6,12, and 24 hours of life, need for ventilation, duration of respiratory distress, need for inotropes, duration of inotropes, seizures, cerebral edema and encephalopathy	The mean pH, base deficit and PaCO ₂ were similar at 24 hours of life Mean pH Base group =7.38 ± 0.15, Control group =7.38 ± 0.07 Base Deficit Base group =4.26 ± 4.60 Control group=5.02 ± 5.76 PaCO₂ Base group =34.67 ± 15 Control group =32.67 ± 7.83 Acidosis at 24 Hours Base group =3[12%], Control group =7[28%] All p-values>0.05	1b