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Buffered solutions versus 0.9% saline for resuscitation in critically ill adults and children: a Cochrane Review

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Background

Fluid therapy is one of the main interventions provided for critically ill patients, although there is no general consensus regarding the type of solution. Among crystalloid solutions, 0.9% saline is the most commonly administered. Buffered solutions may offer some theoretical advantages (less metabolic acidosis, less electrolyte disturbance), but the clinical relevance of these remains unknown.

Objectives

To assess the effects of buffered solutions versus 0.9% saline for resuscitation in critically ill adults and children.

Search methods

We searched the following databases to July 2018: CENTRAL, MEDLINE, Embase, CINAHL, and four trials registers. We checked references, conducted backward and forward citation searching of relevant articles, and contacted study authors to identify additional studies. We imposed no language restrictions.

Selection criteria

We included randomized controlled trials (RCTs) with parallel or cross-over design examining buffered solutions versus intravenous 0.9% saline in a critical care setting (resuscitation or maintenance). We included studies on participants with critical illness (including trauma and burns) or undergoing emergency surgery during critical illness who required intravenous fluid therapy. We included studies of adults and children. We included studies with more than two arms if they fulfilled all of our inclusion criteria. We excluded studies performed in persons undergoing elective surgery and studies with multiple interventions in the same arm.

Data collection and analysis

We used Cochrane's standard methodological procedures. We assessed our intervention effects using random-effects models, but when one or two trials contributed to 75% of randomized participants, we used fixed-effect models. We reported outcomes with 95% confidence intervals (CIs).

Main results

We included 21 RCTs (20,213 participants) and identified three ongoing studies. Three RCTs contributed 19,054 participants (94.2%). Four RCTs (402 participants) were conducted among children with severe dehydration and dengue shock syndrome. Fourteen trials reported results on mortality, and nine reported on acute renal injury. Sixteen included trials were conducted in adults, four in the paediatric population, and one trial limited neither minimum or

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maximum age as an inclusion criterion. Eight studies involving 19,218 participants were rated as high methodological quality (trials with overall low risk of bias according to the domains: allocation concealment, blinding of participants/assessors, incomplete outcome data, and selective reporting), and in the remaining trials, some form of bias was introduced or could not be ruled out.

We found no evidence of an effect of buffered solutions on in-hospital mortality (odds ratio (OR) 0.91, 95% CI 0.83 to 1.01; 19,664 participants; 14 studies; high-certainty evidence). Based on a mortality rate of 119 per 1000, buffered solutions could reduce mortality by 21 per 1000 or could increase mortality by 1 per 1000. Similarly, we found no evidence of an effect of buffered solutions on acute renal injury (OR 0.92, 95% CI 0.84 to 1.00; 18,701 participants; 9 studies; low-certainty evidence). Based on a rate of 121 per 1000, buffered solutions could reduce the rate of acute renal injury by 19 per 1000, or result in no difference in the rate of acute renal injury. Buffered solutions did not show an effect on organ system dysfunction (OR 0.80, 95% CI 0.40 to 1.61; 266 participants; 5 studies; very low-certainty evidence). Evidence on the effects of buffered solutions on electrolyte disturbances varied: potassium (mean difference (MD) 0.09, 95% CI -0.10 to 0.27; 158 participants; 4 studies; very low-certainty evidence); chloride (MD -3.02, 95% CI -5.24 to -0.80; 351 participants; 7 studies; very low-certainty evidence); pH (MD 0.04, 95% CI 0.02 to 0.06; 200 participants; 3 studies; very low-certainty evidence); and bicarbonate (MD 2.26, 95% CI 1.25 to 3.27; 344 participants; 6 studies; very low-certainty evidence).

Authors' conclusions

We found no effect of buffered solutions on preventing in-hospital mortality compared to 0.9% saline solutions in critically ill patients. The certainty of evidence for this finding was high, indicating that further research would detect little or no difference in mortality. The effects of buffered solutions and 0.9% saline solutions on preventing acute kidney injury were similar in this setting. The certainty of evidence for this finding was low, and further research could change this conclusion. Patients treated with buffered solutions showed lower chloride levels, higher levels of bicarbonate, and higher pH. The certainty of evidence for these findings was very low. Future research should further examine patient-centred outcomes such as quality of life. The three ongoing studies once published and assessed may alter the conclusions of the review.

Section Info

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