



ORIGINAL ARTICLE

Comparison of two maintenance electrolyte solutions in children in the postoperative appendectomy period: a randomized, controlled trial[☆]



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KEYWORDS

Hyponatremia;
Hypernatremia;
Fluid therapy;
Isotonic solutions;
Hypotonic solutions;
Postoperative period

Abstract

Objective: To compare two electrolyte maintenance solutions in the postoperative period in children undergoing appendectomy, in relation to the occurrence of hyponatremia and water retention.

Methods: A randomized clinical study involving 50 pediatric patients undergoing appendectomy, who were randomized to receive 2,000 mL/m²/day of isotonic (Na 150 mEq/L or 0.9% NaCl) or hypotonic (Na 30 mEq/L NaCl or 0.18%) solution. Electrolytes, glucose, urea, and creatinine were measured at baseline, 24 h, and 48 h after surgery. Volume infused, diuresis, weight, and water balance were analyzed.

Results: Twenty-four patients had initial hyponatremia; in this group, 13 received hypotonic solution. Seventeen patients remained hyponatremic 48 h after surgery, of whom ten had received hypotonic solution. In both groups, sodium levels increased at 24 h (137.4 ± 2.2 and 137.0 ± 2.7 mmol/L), with no significant difference between them ($p = 0.593$). Sodium levels

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48 h after surgery were 136.6 ± 2.7 and 136.2 ± 2.3 mmol/L in isotonic and hypotonic groups, respectively, with no significant difference. The infused volume and urine output did not differ between groups during the study. The water balance was higher in the period before surgery in patients who received hypotonic solution ($p = 0.021$).

Conclusions: In the post-appendectomy period, the use of hypotonic solution (30 mEq/L, 0.18%) did not increase the risk of hyponatremia when compared to isotonic saline. The use of isotonic solution (150 mEq/L, 0.9%) did not favor hypernatremia in these patients. Children who received hypotonic solution showed higher cumulative fluid balance in the preoperative period

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PALAVRAS-CHAVE

Hiponatremia;
Hipernatremia;
Hidratação;
Soluções isotônicas;
Soluções hipotônicas;
Pós-operatório

Comparação de duas soluções para manutenção hidroeletrólítica no pós-operatório de apendicectomia em crianças: um estudo controlado e randomizado

Resumo

Objetivo: Comparar duas soluções de manutenção hidroeletrólítica no período pós-operatório (PO) de crianças submetidas à apendicectomia, quanto à ocorrência de hiponatremia e retenção hídrica.

Métodos: Estudo clínico randomizado envolvendo 50 pacientes pediátricos submetidos à apendicectomia, randomizados a receber 2000 ml/m²/dia de solução isotônica (Na 150 mEq/L ou NaCl 0,9%) ou hipotônica (Na 30mEq/L ou NaCl 0,18%). Eletrólitos, glicose, ureia e creatinina foram mensurados no início do estudo, 24 e 48 horas após a cirurgia. Foram analisados volume infundido, diurese, peso e balanço hídrico.

Resultados: 24 pacientes apresentaram hiponatremia inicial, destes 13 receberam solução hipotônica. Dezesete pacientes permaneceram hiponatrêmicas 48 horas após a cirurgia, 10 haviam recebido solução hipotônica. Nos dois grupos os níveis de sódio aumentaram na 24^a hora PO ($137,4 \pm 2,2$ e $137,0 \pm 2,7$), não havendo diferença entre eles ($p = 0,593$). Níveis de sódio 48 h após a cirurgia foram $136,6 \pm 2,7$ e $136,2 \pm 2,3$ no grupo isotônico e hipotônico respectivamente sem diferença significativa. Os volumes infundidos e diurese não diferiram entre os grupos durante o estudo. O balanço hídrico foi maior no período anterior à cirurgia no grupo de pacientes que receberam solução hipotônica ($p = 0,021$).

Conclusões: No período pós-apendicectomia, o uso da solução hipotônica não aumentou o risco de hiponatremia, quando comparado a uma solução salina isotônica. O uso da solução isotônica não favoreceu a hipernatremia nestes pacientes. Crianças que receberam solução hipotônica apresentaram maior balanço hídrico cumulativo no período pré-operatório.

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Introduction

Hyponatremia is an electrolyte disorder commonly seen in hospitalized patients, defined as serum sodium levels < 136 mmol/L.¹⁻⁵ Its etiology has been related to fluid retention. If the infused fluid volume exceeds that of renal excretion capacity, dilution of extracellular solutes reduces osmolarity.¹ The presence of hypotonicity promotes cerebral edema due to imbalance between the intracellular and extracellular osmolarity in neuronal tissue. In the occurrence of acute decrease in serum sodium ($\text{Na}^+ < 130$ mmol/L), extracellular water penetrates the nerve cells, aiming to equalize the intra- and extra-cellular tonicities.^{2,6}

The maintenance solution proposed by Holliday & Segar in 1957, still widely used, was based on the metabolism of healthy children and calculated based on body weight (< 10 kg, 11-20 kg, > 20 kg; 3 mEq/L of Na^+ and 2 mEq/L of K^+), resulting in a hypotonic solution and excessive fluid

intake for critically-ill children, which may cause the onset of hyponatremia.^{7,8} The presence of stress (pain, fever, surgery), nausea, vomiting, anesthesia, intestinal manipulation, and hypovolemia are non-osmotic stimuli that increase the secretion and activity of the antidiuretic hormone (ADH) (arginine vasopressin).¹ High ADH action limits free water excretion and acute disease leads to the production of endogenous water, increasing the extracellular volume and resulting in or worsening the occurrence of hyponatremia.⁹ A recent review involving more than 500 children in six prospective studies showed that the use of isotonic solutions prevents hyponatremia in the postoperative (PO) period and that the use of hypotonic fluids results in decreased sodium.¹⁰

Children submitted to surgical procedures are at greater risk of hyponatremia and its neurological consequences, both due to ADH stimulation and the increased possibility of endogenous water production.^{4,11,12} All these circumstances increase the chances of hyponatremia

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