An Pediatr (Barc). 2018;89(2):98–103

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ORIGINAL ARTICLE

A comparison of post-surgical plasma glucose levels in patients on fluids with different glucose concentrations☆,☆☆

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Received 30 May 2017; accepted 2 October 2017
Available online 30 June 2018

KEYWORDS
Hyperglycaemia;
Post-operative;
Maintenance intravenous fluid therapy

Abstract
Objective: To compare plasma glucose levels and incidence of hyperglycaemia in the post-operative period after general surgery using fluids with different glucose.
Methodology: A randomised, open-label, non-blind, clinical trial was conducted on patients admitted to Paediatric Intensive Care Unit after elective surgery. The inclusion criteria were from 6 months to 14 years of age, with a weight greater than 6 kg, onset glucose level > 60 mg/dL, and a signed informed consent, with no oral intake and maintenance intravenous fluid therapy using fluids with 3.3% or 5% glucose. Plasma glucose levels were measured before surgery, on admission, and 8, 24, and 48 h, with the mean glucose levels and incidence of hyperglycaemia (glucose level > 150 mg/dL) in both groups being compared.
Results: A total of 60 patients received glucose/saline 1/3 (51 mEq/L sodium and 33 g/L glucose), and 70 glucose/saline 5/0.9% (154 mEq/L sodium and 50 g/L glucose). Mean glucose levels were higher in the group receiving glucose 5%, with no statistical difference. There was no significant difference in the incidence of hyperglycaemia; 8 h: 26% in the 3.3% group vs. 21.3% in the 5% group ($P = .63$); 24 h: 20% vs. 22.7% ($P = .8$); and 48 h: 19% vs. 23.1% ($P = .78$).
Conclusions: The use of fluids with 3.3% glucose in the post-operative period of general surgery maintains mean glucose levels in a similar range to that of patients receiving fluids with 5% glucose, with no difference in the incidence of hyperglycaemia.

☆ Please cite this article as: Martínez Carapeto I, López Castilla JD, Fresneda Gutiérrez R. Comparación de niveles de glucemia postoperatoria usando sueros con diferente concentración de glucosa. An Pediatr (Barc). 2018;89:98–103.

☆☆ Previous presentation: This study was presented as an oral communication and received the First Prize for the best oral communication at the XXXII Congress of the Sociedad Española de Cuidados Intensivos Pediátricos; May 4–6, 2017; Granada, Spain.

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PALABRAS CLAVE
Hiperglucemia;
Postoperatorio;
Fluidoterapia intravenosa de mantenimiento

Comparación de niveles de glucemia postoperatoria usando sueros con diferente concentración de glucosa

Resumen
Objetivo: Comparar los niveles de glucemia e incidencia de hiperglucemia en el postoperatorio de cirugía general usando sueros con diferente concentración de glucosa.
Metodología: Ensayo clínico aleatorizado, abierto, no ciego, en pacientes no diabéticos, que ingresan en Cuidados Intensivos Pediátricos tras cirugía electiva, de 6 meses a 14 años, peso superior a 6 kg, glucemia >60 mg/dl y firma de consentimiento informado, manteniéndose a dieta con sueroterapia de mantenimiento intravenosa mediante suero con glucosa al 3,3 o 5%. Se determinan niveles de glucemia preoperatoria, al ingreso, y a las 8, 24 y 48 h, comparando los valores medios y la incidencia de hiperglucemia (glucemia > 150 mg/dl) en ambos grupos.
Resultados: Un total de 60 pacientes recibieron suero glucosalino 1/3 (51 mEq/l de sodio y 33 g/l de glucosa) y 70 pacientes suero glucosalino 5/0,9% (154 mEq/l de sodio y 50 g/l de glucosa). La glucemia media fue mayor en el grupo al 5%, sin diferencia estadística. No hubo diferencia en la incidencia de hiperglucemia; 8 h: 26% del grupo 3,3% vs. 21,3% del grupo 5% (p = 0,63); 24 h: 20% vs. 22,7% (p = 0,8); 48 h: 19% vs. 23,1% (p = 0,78).
Conclusiones: En el postoperatorio de cirugía general, el uso de soluciones glucosadas al 3,3% consigue niveles de glucemia similares a los detectados en pacientes que reciben suero con glucosa 5%, con una incidencia de hiperglucemia similar.

Introduction

Intravenous (IV) fluid therapy is necessary to meet the water, electrolyte and energy requirements of hospitalised patients when oral intake is not possible or indicated. Although there is nearly universal consensus on the use of isotonic fluids for maintenance fluid therapy,[1–7] the optimal dextrose concentration for fluid therapy in the immediate postoperative period has yet to be established. Although the recommended dextrose concentration for maintenance fluid therapy has traditionally been 5% (10% in newborns),[8,9] there is growing debate that it may be preferable to use lower dextrose concentrations to prevent the development of hyperglycaemia and its potential harmful effects in critical patients. There is evidence in the paediatric literature of an association between hypoglycaemia or hyperglycaemia and increased morbidity and mortality in critical patients, which has also been described in adults. Several possible mechanisms have been proposed to explain this association, such as increased release of proinflammatory cytokines, acute dyslipidaemia, endothelial dysfunction, hypercoagulability or increased glucose toxicity leading to apoptosis and cell death.[10,11]

Patients and methods

We performed a single-centre, prospective, open-label phase IV randomised controlled trial (EudraCT 2010-023280-17) in the Paediatric Intensive Care Unit (PICU) of the Hospital Infantil Virgen del Rocío (Seville, Spain) between June 2011 and May 2013. We included patients aged 6 months to 14 years weighing 6 or more kg that had undergone elective surgery and in whom postoperative oral and/or enteral fasting with maintenance IV fluid therapy was prescribed for a minimum of 6 h. We obtained written informed consent from the parents or legal guardians. The exclusion criteria were diabetes and refusal of consent. Patients that required changes in treatment, treatment for acute hypoglycaemia (glycaemia < 60 mg/dL) or whose consent for participation was withdrawn during the study were excluded from the final analysis. We used the Epidat 3 software to allocate patients randomly to one of two treatment groups, on a 1:1 ratio: the hypotonic (HT) group, which received 2/3 dextrose in 1/3 saline (51 mEq of chloride, 51 mEq of sodium and 33 g of dextrose per litre of solution), and the isotonic (IT) group, which received 5% dextrose in 0.9% saline (154 mEq of chloride, 154 mEq of sodium and 50 g of dextrose per litre of solution). We calculated fluid requirements by the Holliday-Segar method[12] and did not add any other components to the administered solutions. Patient followup extended from the time of PICU admission to the development of oral/enteral tolerance and/or discontinuation of IV fluid therapy or discharge from PICU, for a maximum of 48 h, with recording of plasma glucose levels at admission and at 8, 24 and 48 h. We collected data on demographic characteristics and the duration and type of surgical intervention. During surgery, patients received isotonic fluids without dextrose.

The primary outcome was the plasma glucose level (in mg/dL). The secondary outcome was the incidence of hyperglycaemia. We defined hyperglycaemia as a plasma glucose level of more than 150 mg/dL based on the findings of studies in adults and children that analysed the association of elevated glucose levels with morbidity and mortality