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ORIGINAL ARTICLE

Maintenance fluid therapy in a tertiary hospital: A prevalence study☆

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KEYWORDS
Intravenous fluids;
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Abstract
Objective: To assess the types of maintenance fluids used in our hospital, comparing their volume and composition to the standards recommended by the guidelines.
Material and methods: Observational, cross-sectional study. Volume and type of fluid therapy administered during 24 h to patients admitted to various hospital departments were recorded. Patients receiving fluid therapy because of water-electrolyte imbalance were excluded.
Results: Out of 198 patients registered, 74 (37.4%) were excluded because they did not meet the criteria for inclusion. Mean administered volume was 2500 cc/day. Mean daily glucose dose was 36 g per 24 h (SD: 31.4). The most frequent combination included normal saline solution (NSS) and glucose 5% (64.4%). Mean daily dose of sodium and chlorine was, respectively, 173 mEq (SD: 74.8) and 168 mEq (SD: 75), representing a surplus daily dose of +87.4 mEq and +85 mEq. Potassium, magnesium and calcium daily deficit was, respectively, −50 mEq, −22 mEq and −21 mEq per day. Buffer administration was exceptional, bicarbonate (2.29%), acetate (1.29%), lactate (1.15%) and gluconate (1.10%) being the buffering agents most frequently used.
Conclusion: NNS is the most frequently used solution. In contrast to excess doses of sodium and chlorine, there is a great deficit of other ions, buffering agents and caloric intake in the fluid therapy regimens that are usually prescribed.

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PALABRAS CLAVE
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Hipercloremia

Fluidoterapia de mantenimiento administrada en un hospital terciario: estudio de prevalencia

Resumen
Objetivos: Evaluar el tipo de «fluidos/sueros» de mantenimiento administrados en nuestro hospital, y comparar como se ajustan a las recomendaciones actuales, tanto en volumen como en composición.
Material y métodos: Estudio observacional y transversal. Se registró el volumen y tipo de fluidoterapia de mantenimiento que se pautaba durante 24 h a pacientes ingresados en diferentes servicios del hospital. Se excluyeron aquellos en los que la administración de líquidos estuviese condicionada por un exceso o déficit de líquidos y electrólitos.
Resultados: Se recogieron los datos de 198 pacientes, de los cuales 74 (37,4%) fueron excluidos por no cumplir los criterios de inclusión. El volumen medio administrado fue de 2.500 cc/día. La dosis media de glucosa fue de 36 g cada 24 h (DE: 31,4). La combinación más frecuente incluyó suero salino fisiológico (SSF) con glucosado 5% (64,4% de los casos). La cantidad media de sodio administrada en 24 h fue de 173 mEq (DE: 74,8) y la de cloro de 168 mEq (DE: 75), lo que supone superávit de +87,4 mEq y +85 mEq, respectivamente. En relación con el potasio, magnesio y calcio, el déficit fue de −50 mEq, −22 mEq y −21 mEq día, respectivamente. La administración de sustancias *buffer* fue excepcional, siendo las más frecuentemente utilizadas el bicarbonato (2,29%), acetato (1,29%), lactato (1,15%) y gluconato (1,10%).
Conclusión: El SSF es la solución más frecuentemente utilizada. En contraste con el exceso de sodio y cloro habitualmente pautado, la cantidad de otros iones, como potasio, magnesio, sustancias *buffer* y aporte calórico, es muy deficitaria.

Introduction

Intravenous fluid therapy is one of the most important and common therapeutic measures used by anaesthesiologists, intensivists, surgeons, etc. Its objective is the replacement of body water and the correction of electrolyte alterations and the acid–base balance, which are often required in surgical patients.[1]

In the body, water and electrolytes are distributed in different compartments and maintain a constant balance. The largest volume is found in the intracellular fluid (ICF), which accounts for 60% of total body water (TBW), while extracellular fluid volume (EFV) accounts for the remaining 40%. Around 32% of EFV is made up of interstitial fluid, and only 8% represents blood volume (BV), with plasma volume estimated at around 35–40 mL/kg.[2]

The movement of fluid between the different compartments is determined by the Starling equation,[3] which determines the filtration force: *(Filtration force:* $K_f\ [P_c - P_i] - \sigma\ [\pi_c - \pi_g]$); where K_f = filtration coefficient derived from hydraulic conductance, P_c = capillary hydrostatic pressure, P_i = interstitial hydrostatic pressure, σ = reflection coefficient derived from osmotic conductance, π_c = interstitial oncotic pressure, and π_g = interstitial pressure. In short, it represents the difference between the forces tending to draw water from the vascular compartment into the interstitial space versus those that try to retain it inside the vessel.

However, this traditional approach has varied since the introduction of electron microscopy, which revealed the presence of another structure above the endothelial cell wall[4]: the ''glycocalyx''. The glycocalyx[5] is a gel composed of glycoproteins and proteoglycans located on the endoluminal aspect of endothelial cells. It repels negatively charged molecules, macromolecules >70 kDa, sodium, erythrocytes and platelets. Overlying endothelial cells and the glycocalyx form the double membrane.

The type of solution to be used will depend on the compartment to be replenished. Isotonic crystalloids should be used to correct hydration and replace electrolytes in interstitial fluid[6–8]; the volume administered will depend on insensible losses due to surgical exposure (0.5–1 mL/kg/h)[9] and urine output.[7] Preoperative fasting does not need replacement, and the third space is a myth.[10]

On a practical level, the Holliday–Segar formula, also known as the 4-2-1 rule, is widely used. According to this formula, blood volume replacement is performed as follows:

- Weight less than 10 kg: 40 mL/kg/h.
- Weight >10–20 kg: 40 mL/h for the first 10 kg body weight, plus 2 mL/kg/h for each kg over 10 kg.
- Weight >20 kg to 80 kg: 60 mL/h for the first 20 kg body weight, plus 1 mL/kg/h for each kg over 20 kg, up to a maximum of 2400 mL per day.

Table 1 shows some of the different solutions on the market.

In patients with decreased effective circulating volume, i.e. intravascular losses, hypovolaemia and hypoperfusion, vascular replacement is performed with fluid to increase