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CORRESPONDENCE

Should we use hypotonic or isotonic maintenance intravenous fluids in sick patients? Why a study in healthy volunteers will not provide the answer

Response to: Effect of isotonic versus hypotonic maintenance fluid therapy on urine output, fluid balance, and electrolyte homeostasis: a crossover study in fasting adult volunteers

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Editor—Sick patients who are unable to ingest oral fluids usually receive i.v. maintenance fluid therapy (IVMFT). The main goal of IVMFT is to temporarily meet water, electrolyte and glucose needs pending a more sustainable (par)enteral solution for feeding and hydration. Despite routine application, IVMFT is often based on dogmatic principles rather than high quality empirical research.[1] Furthermore, macro- and micronutrient deficiencies, fluid overload, hyperchloraemic acidosis and hyponatraemia have all been reported as potentially detrimental complications. Fortunately, well-designed high quality studies performed over the last decade have substantially improved our insights into safe and effective IVMFT. Recently, Van Regenmortel and colleagues[2] contributed additional data to this growing body of evidence by comparing the effects of isotonic and hypotonic IVMFT in healthy adult volunteers. They conclude that a hypotonic IVMFT (NaCl 0.32%) increased diuresis and resulted in significantly less intravascular fluid retention compared with isotonic IVMFT (NaCl 0.9%). In line with a previous report by this group, the authors argue that IVMFT should be hypotonic in order to avoid fluid overload.[3]

We fully concur that fluid overload can negatively impact on outcomes and should be avoided. The study findings are, however, in strong contradiction with the rapidly growing evidence that favours the use of isotonic balanced solutions for IVMFT in sick patients.[4] A closer look at the study by Van Regenmortel and colleagues illustrates why its external validity to draw meaningful conclusions on IVMFT in sick patients is limited.

The study findings are not a surprise. Basic physiological principles explain that the distribution volume of isotonic fluids is limited to the extracellular fluid compartment (ECF) (which includes the intravascular space), whereas hypotonic solutions will diffuse into both extracellular and intracellular compartments.[5] In addition, hypotonic infusions in healthy humans lead to a minimal decrease of plasma osmolality. This change, sensed by hypothalamic osmoreceptors, inhibits antidiuretic hormone (ADH) release and hence decreases water reabsorption in the renal collecting tubules. As a consequence free water excretion increases and osmotic homeostasis is maintained. This explains the absence of hyponatraemia, as this would only occur if maximal free water excretion capacity is

overwhelmed or in the presence of so-called non-osmotic stimuli for ADH release. The fact that the authors still detected ADH does not exclude the above mechanism, because ADH assays are not very sensitive for low concentrations.[6]

In sick patients, however, free water excretion is frequently impaired as a result of non-osmotic stimuli for ADH secretion. Decreased circulating volume (even subclinical), pain, nausea, anxiety, stress, certain drugs and inflammation all trigger ADH release and overrule 'normal' osmoregulation.[7 8] Such non-osmotic ADH release is a common response to sickness and is highly prevalent in hospitalized patients. In this setting hypotonic infusions can cause hyponatraemia because of retention of water in the ECF. This acute decrease in ECF osmolality can cause potentially life-threatening cerebral oedema, mainly in sick children.[9–11] Furthermore, hyponatraemia is increasingly recognized as an independent risk factor for adverse outcomes.[12]

An additional issue with the study by Van Regenmortel and colleagues is the use of NaCl 0.9% as the isotonic infusion. The high chloride load predictably caused a hyperchloraemic acidosis. Hyperchloraemic acidosis is increasingly recognized as a factor that impairs microcirculation and kidney function.[13 14] Therefore it cannot be excluded that a decrease in microvascular renal circulation partially explains the lower urine production in the group that received NaCl 0.9%. Time has come to agree that NaCl 0.9% is not 'a physiological solution' or 'normal saline', but rather 'an abnormal acidogenic solution' that in no way deserves the description as 'physiological'. Fortunately hyperchloraemic acidosis can be prevented by the use of more balanced isotonic solutions.[15]

In conclusion, we believe that this study compared two inferior solutions in a nonrepresentative (i.e. healthy) group of study participants lacking non-osmotic ADH triggers that many of our sick patients have. This study provides no evidence to favour the use of hypotonic solutions for IVFMT in sick patients. In our opinion, the evidence-lacking part of this debate is no longer about the optimal fluid composition but rather the amount of fluid that we calculate as normal daily intake. The latter is, unfortunately, still mainly based on dogma and traditions.[1]

Declaration of interest

None declared.

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Cardiopulmonary exercise testing in preoperative risk assessment and patient management

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Editor—The article by Swart and colleagues[1] aroused our interest. In 1999 our group published a paper in which we used cardiopulmonary exercise testing (CPX) to stratify surgical risk in 548 consecutive patients >60 years of age (or younger with known cardiopulmonary disease).[2] We found that, to quote, 'In elderly patients undergoing major intra-abdominal surgery, the AT (anaerobic threshold), as determined by CPX testing, is an excellent predictor of mortality from cardiopulmonary causes in the