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Reference:

“Effect of volume of fluid resuscitation on metabolic normalization in children presenting in diabetic ketoacidosis: a randomized controlled trial” The Journal of Emerg Med. Vol 50 No 4 pp 551-559 2016

Clinical Question:

Will high volume or low volume fluid resuscitation lead to metabolic normalization sooner in 0-18 yo puts with type I DM and DKA?

Introduction:

The authors hypothesized that lower fluid volumes would lead to sooner normalization of metabolic abnormalities in 0-18 yo puts with type I DM and DKA. DKA was defined as glucose > 250 mg/dL, presence of ketone bodies in blood, and metabolic acidosis (pH < 7.30 or bicarbonate < 15 mmol/L). The authors had thought that higher volumes of fluid resuscitation would deplete the keto-anions by increased urination. The thought being that the keto-anions serve as substrates for bicarbonate regeneration. The depletions of the keto-anions would be replaced by chloride anions leading to a non-anion gap metabolic acidosis which would increase the length of treatment time (hospital stay).

Methods:

This was a randomized control trial conducted in a pediatric emergency department and inpatient units of an academic freestanding children’s hospital in the US. The treating physician selected patients for the study which were then randomly assigned. Due to concerns over possible patient harm the study was required to stay within the accepted treatment regimen for DKA of 10-20 ml/kg of 0.9% saline in the first hour followed by >0.45% saline at 1-2x maintenance rates. Patients were assigned to either 20 mL/kg bolus followed by 0.675% at 1.5x maintenance (high volume group) or 10 mL/kg at 1.25x maintenance (low volume group).

For obvious reasons the medical staff were not blinded to the treatment arm. Also of note the patient was blinded but the family was told what arm they were in. This is less significant since the results of concern laboratory results to include VBG, BMP, magnesium, phosphate and beta- hydroxybutyrate. These were sent hourly for the first 4 hours. Primary outcome was time to metabolic normalization defined as bicarbonate > 15 mmol/L and pH > 7.30. Secondary outcomes included normalization of bicarbonate and pH along with length of hospital treatment (duration of stay once IV fluids were started), and development of adverse outcomes. Early termination was allowed for worsening status. Sample size was calculated based on an 8 hour difference between groups.

Results:

Fifty patients were randomized from Dec 2007-June 2010. The high volume group had more females (72% vs 48%) and also had lower baseline bicarbonate (7.0 mmol/L vs 10.0 mmol/L). No deviations were recorded in the boluses and 1 deviation in the maintenance fluid protocol.

Recovery times as defined above were 8.0 h in the high volume group and 7.7 h in the low volume group. When adjusted for baseline serum bicarbonate, high volume fluid resuscitation was associated with metabolic normalization (hazard ratio 2.0, 95% CI 1.0-3.9; p = 0.04) and hastened normalization of pH (hazard ration 2.5, 95% CI 1.2-5.0; p = 0.01). Time to normalization of bicarbonate, pH, length of treatment or time to discharge was not statistically significant between the groups. Time to discharge was not significantly different between groups. Of note there were no adverse events, although the study was not powered to look at concerns over cerebral edema.

Conclusion:

This paper did not provide definitive answers related to IV fluid resuscitation and DKA in the pediatric population. The differences observed were not statistically significant. The study was limited due to the need to stay within the established treatment protocols for treatment of DKA. The paper did show a difference between the high and low volume treatment arms without any adverse events. The study

population was not powered to look for cerebral edema. This paper is significant for being a prospective study to assess the effect of fluid volume on metabolic normalization in pediatric patients with DM 1 in DKA (possibly the first). This paper will hopefully allow further study of high vs low volume fluid resuscitation in pediatric DKA patients.
