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Reference Article: Friedman, Jeremy N. et al. Comparison of isotonic and hypotonic intravenous maintenance fluids. *Pediatric Emergency Care* February 2015, Vol 31, No.2, 83-160.

Question: Do hospitalized pediatric patients receiving hypotonic maintenance fluids have higher rates of hyponatremia compared to those receiving isotonic maintenance fluids?

Introduction: Maintenance fluids in pediatric patients have traditionally been hypotonic fluids- with 0.45% NS with 5% dextrose being the most common. However, this recommendation came from a 1957 study that looked at electrolyte requirements and milk composition. Since that time, more recent literature has refuted the dogma of hypotonic maintenance fluids in children. Furthermore, this newer literature has suggested that patients receiving hypotonic fluids have increased rates of hyponatremia which has been associated with increased mortality in pediatric patients. The purpose of this study was to evaluate rates of hyponatremia in pediatric patients receiving hypotonic fluids vs those receiving isotonic fluids.

Methods: This study was a double blinded randomized clinical trial consisting of 110 patients from 2 hospitals on Canada from 2008-2012. These were pediatric patients aged 1 month to 18 yrs that were admitted to general pediatric unit. Patients were included if they had normal serum sodium levels at admission and were expected to require IV fluids. Exclusion criteria included: conditions that required specific fluids, patients that were edematous, using diuretics, or had hyperglycemia > 270. Patients were divided equally into treatment groups of either 0.9 % NS with 5% dextrose or 0.45% NS with 5% dextrose. Primary outcome measured was serum sodium level at 48 hrs. Secondary outcomes measured were serum sodium levels at 24 hrs, hyponatremia >135, hypernatremia > 145, hypertension, weight gain, and edema. Study was stopped if patient developed hyponatremia >135, hypernatremia > 145, hypertension of > 20% increase in systolic or diastolic pressure from baseline, weight gain > 10% from baseline, or ICU admission.

Results: With respect to primary outcome of serum sodium level at 48 hrs was not significantly different with mean serum sodium level of 139.9 in isotonic group and 139.6 in hypotonic group. Authors had determined cutoff of 2.5 mEq difference to be significant. For secondary outcomes there was no significant difference in serum sodium levels at 24 hrs (140.5 in isotonic group vs 139.6 in isotonic group). Two patients in hypotonic treatment group developed hyponatremia. One patient in each group developed hypernatremia. Two patients in each group developed hypertension. Two patients in isotonic group developed edema. There was no significant weight gain from baseline in either group.

Discussion: In pediatric medicine it has become dogma that patients being admitted that will require IV fluid therapy be provided with hypotonic (0.45% NS with 5% dextrose) and not isotonic fluids. As is common across medicinal practices, much of what we do as physicians is founded upon old literature or poorly done studies. Although this study failed to demonstrate significant differences in serum sodium levels at 48 hrs in isotonic vs hypotonic groups, there have been two previous meta-analyses from 2014 that compared isotonic fluids vs hypotonic fluids and did find increased risk of hyponatremia in the hypotonic fluid groups. These studies were conducted on postoperative and ICU patients however. Overall, there have been few high

quality studies to assess appropriate IV fluid selection in pediatric patients. This study was designed well with respect to being double blinded and randomized but did lack in sample size with only 110 total patients. There have been previous studies since 2006 that show hypotonic fluids lead to hyponatremia and increased complications in pediatric populations, suggesting that isotonic solutions could be a better selection for maintenance fluids. This concept is interesting given that the current standard is isotonic fluid therapy. Better designed studies are needed to further investigate this topic as it may result in a large paradigm shift in the practice of emergency and inpatient management of pediatric patients that require IV fluids.
