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A Modified Approach to Maintenance Fluids of Hospitalized Pediatric Patients

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Abstract

There have been several articles regarding the development of hyponatremia using the Holliday and Segal formula for maintenance fluid therapy. This hyponatremia is caused by excessive antidiuretic hormone production. This article advocates a new formula for calculating maintenance fluids.

Keywords: Hyponatremia; Maintenance fluid therapy; Antidiuretic hormone; Basal metabolic rate

Introduction

There have been several articles written regarding the development of hyponatremia using the Holliday and Segal [1-20], formula for maintenance fluid therapy. Most of them have been observational studies. All authors agree that this hyponatremia is caused by excessive Antidiuretic Hormone production [2-5,12-15,17,19,21,22].

Excessive amounts of Antidiuretic Hormone can occur in many childhood medical conditions such as; the use of anesthesia agents, surgery, drugs (such as ecstasy, morphine, and chemotherapy drugs), asthma, bronchiolitis, chronic lung disease of prematurity, reduced atrial filling, quiet standing, gastroenteritis, meningitis, encephalitis, head injury, and going from a cool to warm environment [6].

It has been suggested that maintenance therapy be given as normal saline, [2-4] but that causes problems with sodium overload [7]. An infusion of normal saline solution in the presence of excessive ADH leads to hypertonic urine production with high urinary levels of sodium (>200 mg/L) which in turn can result in retention of free water and thus lowering the sodium farther [8-9]. Isotonic saline should be given only when there is a hemodynamic indication for that infusion [3]-such as dehydration, burns, infections shock, or traumatic shock.

Another factor in the production of hyponatremia is that some of the children that developed hyponatremia received significantly more fluids than recommended by Holliday and Segar [1]. This was verified by Hoorn [3], Finberg [7], verified the solid scientific evidence underlying the Holliday and Segar [1] article. When the child is hospitalized, he/she will be less active than normal. Thus the patient fluid requirement will be closer to the basal metabolic rate than the total expenditure with normal activity of an afebrile child [8].

All of the articles that suggest 0.9% saline as the maintenance fluid ignore the basic problem. This hyponatremia is due to excessive ADH. This is the first article that presents a method of preventing hyponatremia by treating the excessive ADH.

If excessive ADH is present the recommendations are to reduce maintenance fluids to ½ to ⅔ of the calculated maintenance [1,10]. Since this hyponatremia is due to excessive ADH, leading to the retention of water, and since most hospitalized children will have a condition that may cause excessive ADH [11], it is my suggestion that maintenance fluids be given closer to the basal metabolic rate curve. This can best be done by giving 75 mL/Kg for the first 10 Kg, 40 mL/Kg for the next 10 Kg (10-20Kg), and 20 mL/Kg for weight above 20 Kg.

When fluids are given to a hospitalized child electrolyte should be evaluated daily. One should observe for hyponatremia and if it develops reduce the fluids to ½ [9] to ⅔ [1] of the calculated fluid requirement. This should be given as 5 or 10% glucose, to decrease the breakdown of protein and fats, in ¼ normal saline and 20 mEq of potassium per litre (1000 mL).

The IV fluids that are given for maintenance should be individualized as the situation requires. Normal saline solution should only be used to treat deficits or on-going losses as dehydration, burns, and infectious or traumatic shock. Electrolytes must be monitored daily. The above reasoning and approach will permit children who require IV fluids to receive such without receiving excessive sodium or becoming Hyponatremic.

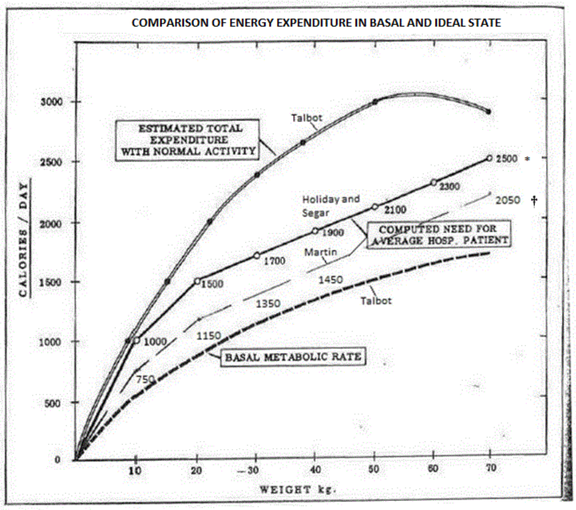

Figure 1: The upper and lower lines were plotted from data of Talbot [23]: 0-10 kg—75 mL/kg, 10-20 kg—1000 cal + 40 mL/kg for each kg between 10 + 20 kg, 20 kg and up—1500 cal + 20 mL/kg for each kg over 20 kg.

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