Original Research Article

Evaluation of efficiency of various treatment modalities and outcome in patients with hyponatremia admitted to ICU

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Abstract

Background: Hyponatremia is the most common dyselectrolytemia in ICU patients and is an independent predictor of mortality. Its etiology, presentation and response to therapy and outcomes are highly unpredictable and rapid correction can lead to myelinolysis.**Objectives:** To Observe outcome of therapy in patients with hyponatremia and to compare efficacy of various treatment modalities.**Methods:**Observational study of patients admitted and managed by primary consultants. Sample of 50 consecutive adult patients admitted to Medical ICU from 01/10/2013 to 01/04/2014 with serum Sodium < 130 meq/L were prospectively studied after informed consent. Measures of Efficacy were taken as improvement in symptoms, adequate correction and length of ICU stay.Measures of safety were taken as mortality, rapid correction and over correction.**Result:**Hypertension was the most common comorbidity (48%). The commonest symptom was altered sensorium (52%). 14 % patients were receiving hydrochlorothiazide for HT. The mean sodium level was 116.96 ± 10.6 and the lowest value was 94 meq/l. 16% patients developed hyponatremia (Sodium level <130 meq/l) during ICU stay.Overcorrection of sodium level appears to be associated with increased mortality [3/5 vs 6/45] (Fishers exact test, p = 0.035). **Conclusion:**The volume of hypertonic saline calculated based on bodyweight and serum sodium levels consistently produces overcorrection of sodium levels in South Indian patients. The usage of hypertonic saline was restricted to the more severely hyponatremic patients and in general, less than 50% of the daily calculated volume of hypertonic saline only was administered.

Keywords: Hyponatremia,serum,sodium,nursing

Introduction

Hyponatremia is defined as a serum sodium concentration of less than 135 mEq per L (135 mMol per L). It is estimated that nearly 7 percent of healthy elderly persons have serum sodium concentrations of 135 mEq per L or less[1]. Cross-sectional studies suggest that hyponatremia may be present in 15 to 18 percent of patients in chronic care facilities[2].

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A 12-month longitudinal study showed that more than 50 percent of nursing home residents had at least one episode of hyponatremia Thus, it would be an unusual day in many family physicians' practices that at least one diagnostic or therapeutic issue related to water metabolism did not arise[3].The maintenance of a relatively constant volume and a stable composition of the body fluid are essential, for homeostasis. Some of the most important problems in clinical medicine arise because of abnormalities in the control systems that maintain this constancy of the body fluids. The total amount of body fluid volume and the total amounts of solutes as well as their concentrations are relatively constant during steady state conditions as required for homeostasis. Water is the most important solvent of the

fluid composition of living system. Next to oxygen, water is the most essential element of life. Total body water (TBW) as a percentage of body weight changes with age, decreasing rapidly at early life. Prenatally, TBW may be around 90% it decreases as the gestation advances. At birth TBW is 78% of the body weight. In the first few months of life, TBW drops dramatically to approximate the adult level of 55- 60% of body weight at 1 year of age. As osmotic pressure depends on concentration of osmotically active particles, it is directly proportional to the osmolarity of the solution. (As osmolarity is a measure of the concentration of solute particles)[4].If a cell is placed in a solution having a higher concentration of impermeant solutes[5]. When sodium intake is low, increase level of these hormones stimulates sodium reabsorption by the kidney, therefore preventing large sodium losses and reverse occurs when sodium intake is high[6]. The rationale behind the study was to observe outcome of therapy in patients with hyponatremia and to compare efficacy of various treatment modalities.

Material and Methods

Study Design- Prospective Observational Study
Study Settings-medical ICU'S of Medical Trust Hospital
Study Duration- 01/10/2013 to 01/04/2014
Consent type- Written Informed consent
Sample size- 50 consecutive patients admitted to ICU
Sampling Technique- Consecutive sampling technique
Inclusion Criteria- AGE> 18 yrs, Serum sodium <130 meq/l at admission or at any time during ICU stay.
Exclusion Criteria- AGE<18 yrs, Serum sodium level >130 meq/l, Serum sodium <130 meq/l but admitted in ward, Not giving consent, already on sodium correction measures at time of admission into ICU are excluded.

Methodology- After taking an informed consent, the serum sodium of patients who are found to have hyponatremia. Serum sodium level will be recorded daily, and in case any correction is being undertaken, then serum sodium will be monitored accordingly. For patients with no obvious cause is found to cause hyponatremia, further investigations

a. serum osmolarity
b. urine osmolarity,
c. urine spot sodium,
d. fasting lipid profile,
e. thyroid function test
f. Serum cortisol level -where it indicated

The rate of sodium correction will be monitored and comparison of the ideal sodium correction to the achieved sodium correction will be done. So also, the amount of 3% saline, used for correction will be compared to the ideal amount that was calculated as per formula.Outcome following treatment.

Based on the type of hyponatremia and severity of symptoms patients are started on correction of hyponatremia by considering the following guidelines and formula. Patients' outcome to treatment is recorded.

Hyponatremia

Na^+ requirement (mmol) = total body water x (desired Na^+ - serum Na^+)

$$\text{Rate of infusion (cc/hr)} = \frac{Na^+ \text{ requirement (mmol)} \times 1000}{\text{infusate } Na^+ \text{ (mmol/L)} \times \text{time (hours)}}$$

Statistical Analysis- Data were expressed in terms of percentages. Epi-info 7 software was used for analysis. Fisher exact test and Pearson's correlation was used for analysis. P value <0.05 is considered statistically significant.

Results

Table 1: Distribution of participants according to Sex and Age

Sex	**Percentage**	**Number**
Male	48%	24
Female	52%	26
Age	**Male**	**Female**
<40	2	0
<50	2	2
<60	8	2
<70	8	3
<80	3	12
>80	1	7
Total	24	26

As per table 1 out of 50 patients enrolled in the study, 52% were males and 48% were females. Most of the patients admitted were belonged to age group between 70-<80 years. Females were more in <80 years while males were equal in 60-70 years.

Table 2: Volume status at the time of Admission

Vol.status	Number	%
Hypovolumeic	19	38%
Euvolumeic	20	40%
Hypervolumeic	11	22%
Total	50	100

As per table 2 at the time of admission 38% of patients were hypovolumeic while 22% were hypervolumeic. Nearly 40% patients were euvolumeic.

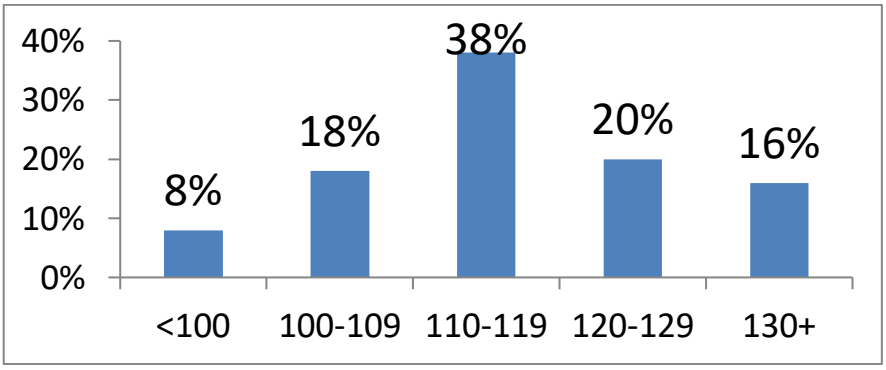

Fig 1: Sodium levels at the time of admission

The mean sodium level was 116.96 ± 10.6 and the lowest value was 94 meq/l as per figure 1. Nearly 38% of patients belonged to range between 110-119 meq/l.

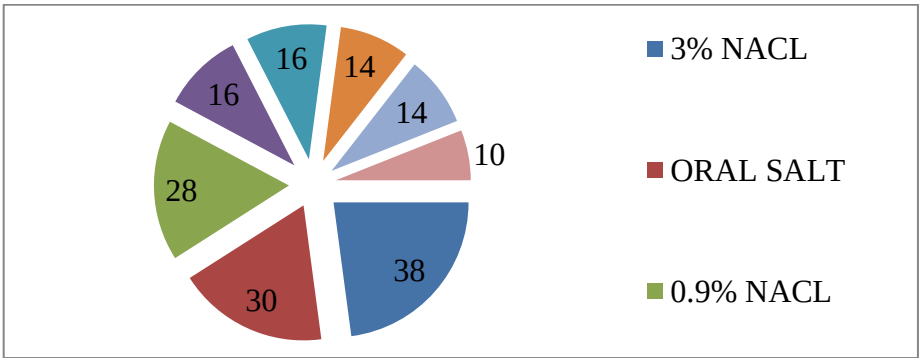

Fig 2:Modes of Treatment

Figure 2 determines the modes of treatment in the patients. The most common mode of treatment was 3% NACL in 76% of patient, followed by 0.9% NACL in 56% of patients. Oral salt was given in 60% of patients. While 32% patients also received Vaptans and fluid restoration.

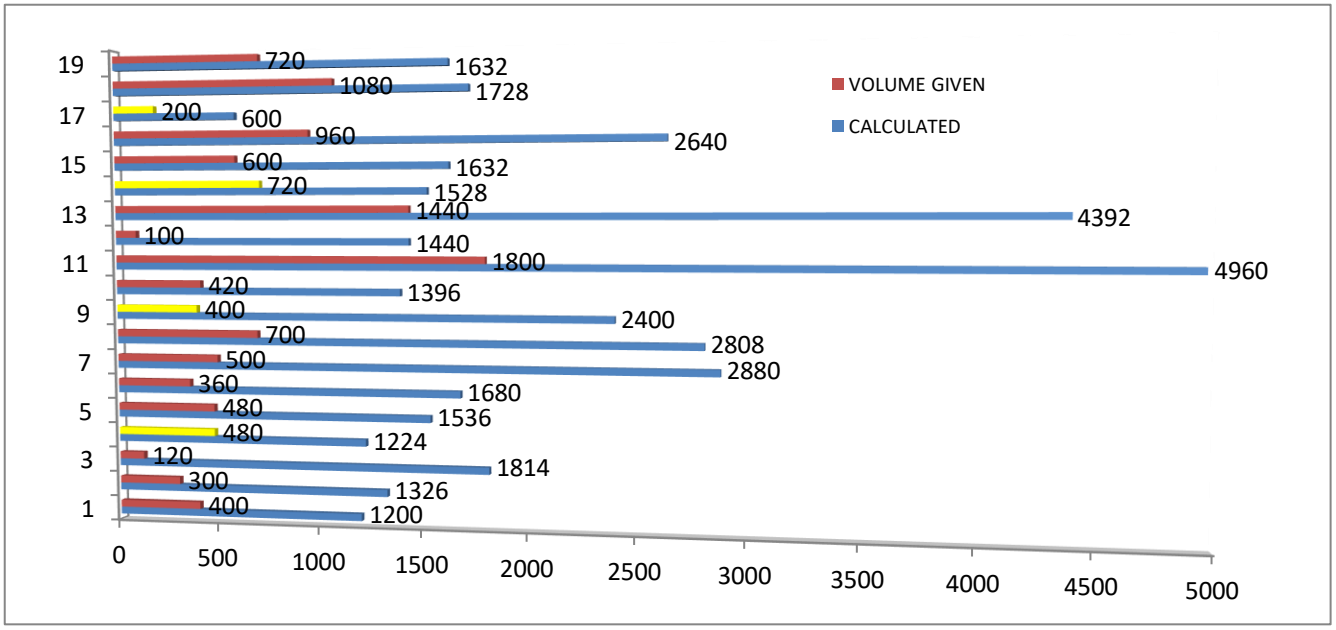

Fig 3: 3% NaCl Calculated vs Actually Administered (in ml)

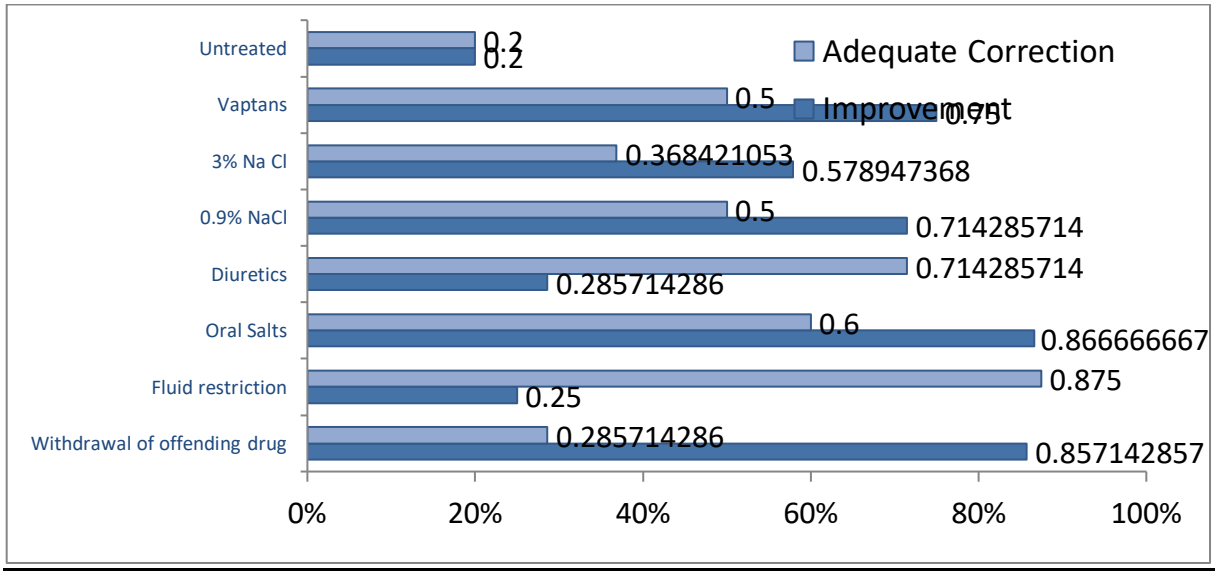

Fig 4:Adequate Correction and Improvement

Figure 4 shows adequate correction which was done in the ICU patients and the mean value of the improvement through different mode of treatment. As seen, there is no correlation between adequate treatment and improvement. It signifies that improvement in ICU patients is not directly related to adequate correction. There are other factors helping in the improvement of patients. ($p>0.05$).

Discussion

In the present study Hypertension was the most common comorbidity (48%). The commonest symptom was altered sensorium (52%).14 % patients were receiving hydrochlorothiazide for HT. The mean sodium level was 116.96 ± 10.6 and the lowest value was 94 meq/l.16% patients developed hyponatremia (Sodium level <130 meq/l) during ICU stay.The amount of actual hypertonic saline used was much lesser (30% of calculated) than the formula estimated volume required for appropriate correction. Rapid correction (more than 10 meq/l/d) was seen in 42% of patients receiving hypertonic saline even with this rate of administration. 9/50 (18%) patients died, of which 4 were receiving hypertonic saline (N=19). Hawkins et al noted that increasing age, after adjusting for sex, was independently associated with both hyponatremia at presentation and hospital-acquired hyponatremia[7]. In study of severe hyponatremia in Queen's Medical Centre, UK, by Clayton et al, 36.2% patients had neurological symptoms attributable to the hyponatremia at presentation[8]. In another study by Nzerue et al on outcome of hyponatremia in hospitalized patients 52.9% patients had neurological manifestations[9]. In study by Hoorn et al on severe hyponatremia in hospitalized patients, 29% patients were given normal saline, 9% patients were advised fluid restriction, 10% patients received oral sodium chloride supplementation and 19% patients received no therapy for hyponatremia whereas in study by Nzerue et al 82% of the patients received normal saline, 9% patient were given fluid restriction while 6% patients were treated with other treatment modalities such as withdrawal of drug causing hyponatremia[9,10]. Many studies in the past indicate a higher mortality in the elderly patients with severe hyponatremia, with a mortality ranging from 33% to 86%[11-13].

Conclusion

The volume of hypertonic saline calculated based on bodyweight and serum sodium levels consistently produces overcorrection of sodium levels in patients. The usage of hypertonic saline was restricted to the more severely hyponatremic patients and in general, less than 50% of the daily calculated volume of hypertonic saline only was administered. In contrast to the commonly reported rate of infusion of 3% saline at 2ml/kg/hr, the actual rates used varied from 0.1 to 0.5ml/kg/hr (Mean calculated volume 2042ml±251vs actual volume given 598ml±105).

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