Available online at www.journalijmrr.com

INTERNATIONAL JOURNAL OF MODERN RESEARCH AND REVIEWS

ISSN: 2347-8314

Int. J. Modn. Res. Revs.

Volume 2, Issue 10, pp 325-332, October, 2014

ORIGINAL ARTICLE

HYPONATREMIA IN ELDERLY

***Dr. T. Prabhu**

*Post Graduate, Department of General Medicine, Rajah Muthiah Medical College, Annamalai University, Annamalainagar – 608 002, Tamilnadu, India

Article History: *Received 8th September,2014, Accepted 5th October, 2014, Published 7th October,2014*

ABSTRACT

AIM: The aim of the study is to determine the characteristics, causes and outcome of hyponatremia in hospitalized patients and to correlate with outcome following treatment.**OBJECTIVES;**To describe the etiological factors responsible for hyponatremia in hospitalized patients. To describe the clinical manifestations associated with hyponatremia. To correlate with outcome following treatment.

Keywords: : Hyponatremia, Patients

1.INTRODUCTION

Hyponatremia is defined as a serum sodium level less than 135meq/L. An abnormal sodium level does not necessarily imply abnormal sodium balance, but can be due to abnormal water balance as well. Hyponatremia, an excess of water in relation to the sodium in the extracellular fluid, is the most common electrolyte disorder in hospitalized patients and particularly so in the elderly.(1) Hyponatremia is important to recognize because of the potential morbidity and mortality.(2) The economic impact of hyponatremia on the patient and the health care facility is evident by longer duration of stay, higher risk of death and disability and increased cost of care.(3,4) Identifying the etiology and risk factors for hyponatremia will help in reducing its incidence in hospitalized patients and minimize the complications associated with hyponatremia and improve the overall cost of health care. There is a lack of Indian data on clinical spectrum of hyponatremia in hospital setting and treatment strategies to be adapted in various clinical studies, therefore, we planned to undertake this prospective follow up study in hospitalized patients at our tertiary care centre.

2.MATERIALS AND METHODS

Elderly patients (60 yrs and older) admitted in Medical unit, RMMC&H between January 2013 to April 2014 will be selected for the study. The period of study is 15 months. A minimum of 50 subjects with hyponatremia will be selected for the study.

**Corresponding author: Dr. T. Prabhu*, Post Graduate, Department of General Medicine, Rajah Muthiah Medical College, Annamalai University, Annamalainagar – 608 002, Tamilnadu,

INCLUSION CRITERIA:

1. Patients admitted in RMMC&H with Serum Sodium level less than 135mEq/l will be selected for the study.
2. Age >60 yrs.
3. Patient admitted in Medical unit.

EXCLUSION CRITERIA:

1. Patients admitted in the ward with Sodium level greater than 135mEq/l.
2. Age <60 yrs.
3. Post operative patients.
4. Recreational drug users.
5. Pregnancy.

Methodology

1. Clinical Assessment

(a) Detailed history - This included history of symptoms of hyponatremia, predisposing factors and pre- existing illnesses if present. The definition of symptomatic hyponatraemia was based on a clinical assessment of symptomatology including the presence of altered sensorium, postural dizziness, lethargy and seizures. Sensorium changes comprised acute confusional states, memory disturbances stupor, delirium and/or coma in the absence of dementia, psychiatric illness and substance abuse. Drugs that can increase the non-osmotic release of antidiuretic hormone (ADH) or potentiate its renal action (ADH-

Stimulating drugs) were recorded. History of illnesses causing hyponatremia such as congestive heart failure, chronic kidney disease, chronic liver disease, hypothyroidism and other

conditions which are associated with SIADH such as small cell lung carcinoma, CNS disease, pulmonary diseases were taken and recorded. History of fluid loss as in vomiting, diarrhea, diuretic use, excessive sweating was taken in all patients.

(b) Physical examination - Detailed clinical evaluation was done in every patient. Hydration status of the patient was determined by clinical examination. The signs of hypovolemia included tachycardia, orthostatic falls in blood pressure, decreased skin turgor, dry mucous membranes and decreased peripheral perfusion with a delayed capillary refill more than three seconds. Hypervolemic state was defined by the presence of anasarca, ascites, symmetrical and pitting pedal edema and raised jugular venous pressure (JVP). Accordingly patients were divided into hypervolemic, hypovolemic and euvolemic states.

At the time of diagnosis of hyponatremia detailed CNS examination was done to document the signs of raised ICP (bradycardia, hypertension and papilledema), mental status of the patient and other focal neurological deficit. CNS examination was repeated after the correction of hyponatremia and the presence of symptoms such as dizziness, lethargy, altered sensorium and seizures were attributed to hyponatremia unless there was a coexisting medical condition or medication effect to account for these symptoms.

2. Investigations

a) Complete blood count – Hemoglobin (Hb), total leukocyte count (TLC), differential leukocyte count (DLC) and platelet count.

b) Urine routine examination (RE) and microscopic examination (ME) and specific gravity.

c) Serum sodium – serum sodium was done 6-8 hourly in patients with severe hyponatremia on 3% saline infusion. In symptomatic patients not on hypertonic saline serum sodium was done daily till the correction of hyponatremia. In asymptomatic patients it was done every alternate day.

d) Serum blood urea nitrogen (BUN) and glucose levels – for calculation of serum osmolality

e) Serum osmolality – was calculated by the formula:

Serum osmolality = 2([Na+] + [K+]) + RBS/18+BUN/2.8 mOsm/L

(RBS in mg/dL, BUN in mg/dL)

Patients were divided in following groups depending on their serum osmolarity-

(i) Normal osmolarity - 270 – 290 mOsm/L

(ii) Hyperosmolar - >290 mOsm/L

(iii) Hypo-osmolar - <270 mOsm/L

SIADH diagnostic criteria - The diagnostic criteria used were as described by Verbalis-(40)

Essential criteria

1) Extracellular fluid (ECF) effective osmolality below 270 mOsm/kg water.
2) Inappropriate urinary concentration (>100 mOsm/kg).
3) Clinical euvolemia (absence of signs of hypovolemia and hypervolemia)
4) Increased urinary [Na+] while on a normal salt and water intake.
5) Absence of adrenal, thyroid, pituitary or renal insufficiency or diuretic use.

Supplemental criteria

1) Abnormal water load test (inability to excrete at least 90% of 20 ml/kg water load in 4 h and/or failure to dilute urinary osmolality to below 100mOsm/kg).
2) Plasma AVP level inappropriately raised relative to plasma osmolality.
3) No significant correction of plasma [Na+] with volume expansion but improvement after fluid restriction.

3. Management and outcome assessment

Patients with hyponatremia were classified based on serum sodium levels into following categories:

	Category	Serum sodium concentration
(i)	Mild hyponatremia	131 - 134 meq/L
(ii)	Moderate hyponatremia -	120 - 130 meq/L
(iii)	Severe hyponatremia -	<120 meq/L

4. Treatment strategy - Decision on the treatment modality of hyponatremia was based on the cause and severity of hyponatremia and presence of neurological symptoms of hyponatremia.

i. Fluid restriction – defined as total fluid intake in 24 hrs equal to the volume of urine output of previous 24 hrs. Fluid restriction was advised in patients with hypervolemic hyponatremia as caused by CHF, renal disorders and chronic liver disease and patients with SIADH.

ii. Normal saline (0.9% NaCl) – normal saline was given to hypovolemic patients. Normal saline was also given as part fluid therapy as in cases of febrile illnesses, vomiting and diarrhoea.

iii. Loop diuretic- loop diuretic was given for excretion of free water in cases of SIADH and hypervolemic hyponatremia.

iv. Hypertonic (3%) saline- hypertonic saline was given in severe hyponatremia patients with neurological symptoms of hyponatremia and hypovolemic or euvolemic status with aim to increase serum sodium level by 8meq/L in 24 hrs.

5. Data collection - For all patient clinical and demographic detail, final diagnosis, investigations and management were recorded onto a standard data collection sheet as per the study proforma and later transferred to a

Microsoft Excel spreadsheet for analysis.

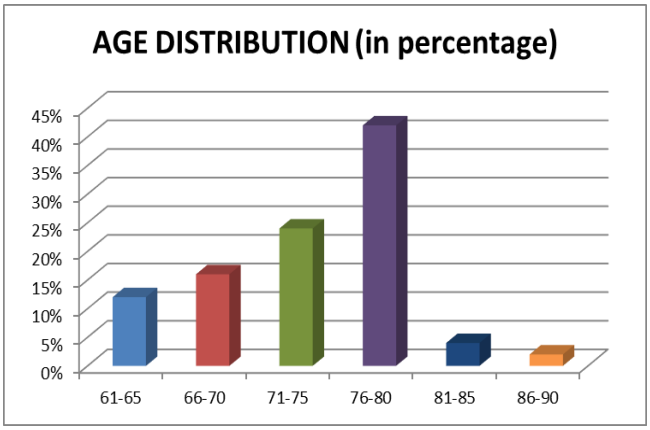
6. Statistical analysis - Data were recorded on a predesigned proforma and managed in a Microsoft Excel spreadsheet. All the entries were double-checked for any possible keyboard error. Data so collected was systematically analyzed. Data are presented as frequency distribution and simple percentages. Descriptive statistics i.e. mean and standard deviation has been calculated for the continuous variables. Categorical variables are expressed as percentages.

3.RESULTS:

1. Age distribution:

- The maximum number of patients was in the age group 66 to 80 years. 65% of patients were between 70-80 years.
- The oldest patient was 86 years.
- Mean age was 60.46years.
- Less than 10% have been affected between 80-90 years.

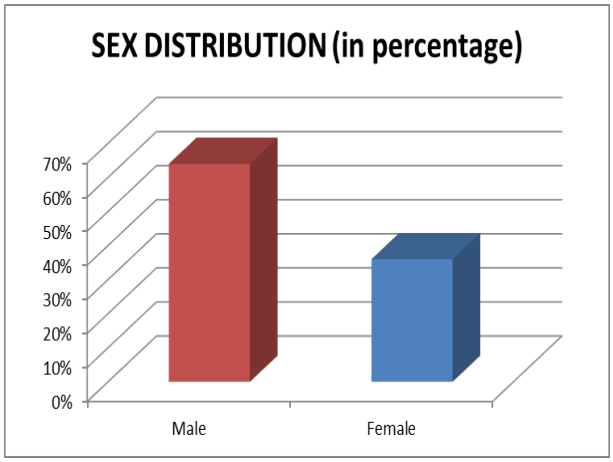
Fig 1. Age distribution of patients (in percentage)



2. Sex distribution:

- There were 32 males (64%) and 18 females (36%) out of 50 patients in this study.
- Male and female ratio of 1.8:1.
- Elderly males are more commonly affected.

Fig 2: Sex distribution (in percentage)



3. Symptoms of hyponatremia:

Fig 3: Symptoms of patients (in percentage)

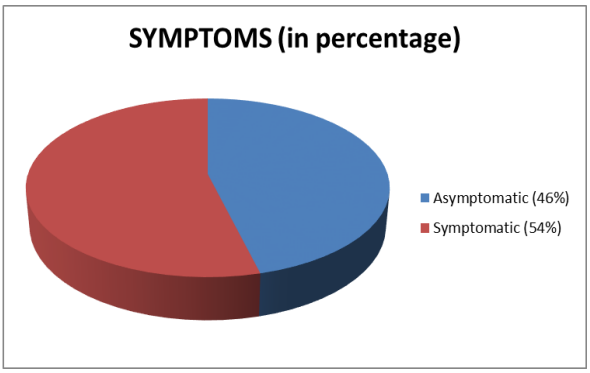
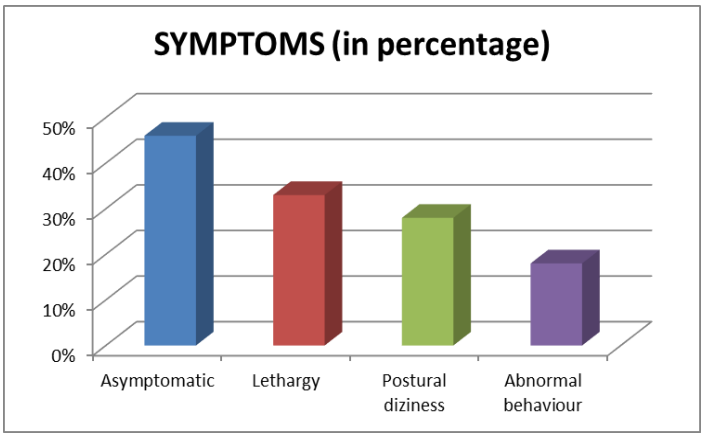


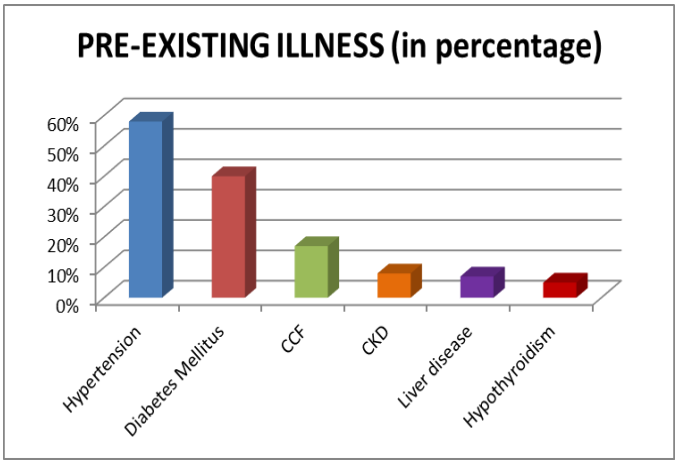
Fig 4: Distribution of symptoms of hyponatremia (in percentage). Several patients had more than one symptom.



Correlation of symptoms and level of serum sodium: Totally 23 (46%) patients were asymptomatic with documented hyponatremia. Among them 3 patients were mild hyponatremia (131-13mEq/L) and 20 patients were moderate hyponatremia (121-130mEq/L). The lowest serum sodium level among asymptomatic patients was 126 meq/L. (Mean-127.4meq/L ; SD-2.5meq/L).

4. Pre-existing illness:

Fig 5: Distribution of pre-existing illness (in percentage)



58% of patient had hypertension, 40% of patients had diabetes, 17% of patient had Congestive Cardiac Failure (CCF), 8% of patient had Chronic Kidney Disease (CKD), 7% of patient had Liver disease and 5% of patient had Hypothyroidism as shown in Fig 5.

5. Hydration status:

Fig 6: Hydration status of patients (in percentage)

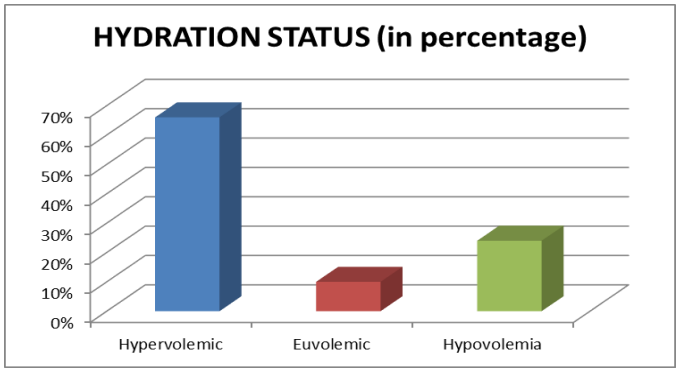


Table 1: Hydration status (in number and percentage)

Diagnosis	No. of patients	Percentage
Hypervolemic	33	66%
Euvolemic	5	10%
Hypovolemic	12	24%
Total	50	100%

More than half of the patients in our study belong to hypervolemic status (33 patients; 66%) are presented with symptoms of volume overload.

6. ETIOLOGY OF HYPONATREMIA

In our study most of the patients had multi-factorial etiology.

Most common etiology for hyponatremia

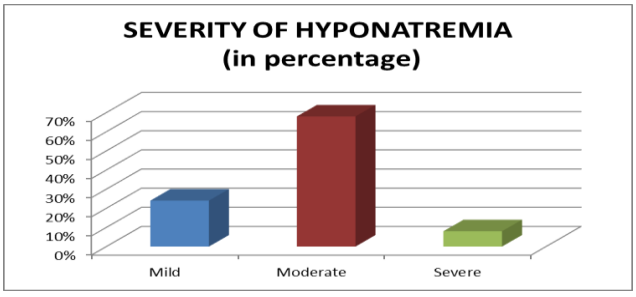
- 22 (44%) due to congestive cardiac failure
- 8 (16%) due to cirrhosis of liver
- 6 (12%) due to renal disorder
- 5 (10%) due to hypothyroidism
- 5 (10%) due to drugs
- 2 (4%) due to diabetic ketoacidosis
- 1 (2%) due to meningitis

7. Severity of hyponatremia:

Table 2: Severity of hyponatremia (in numbers & percentage)

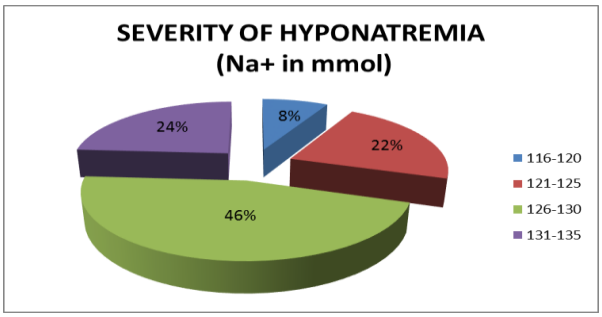
Na+ in mmol	No. of patients	Percentage
116-120	4	8%
121-125	11	22%
126-130	23	46%
131-135	12	24%
Total	50	100%

Fig 7: Severity of hyponatremia (in percentage)



In our study majority of the patients had moderate hyponatremia (68%).

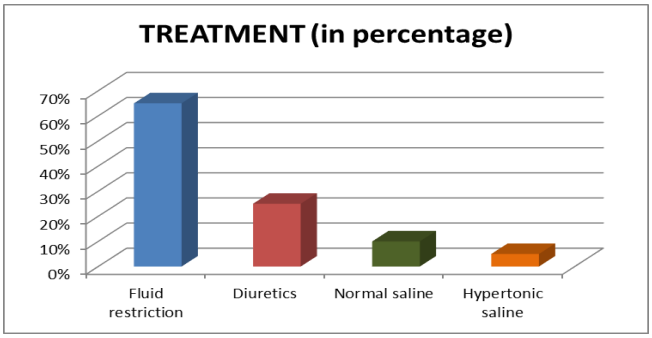
Fig 8 Severity of hyponatremia (Na+ in mmol) (in percentage)



- Mild hyponatremia (131-135mmol/l) was seen in 12 (24%) patients.
- Moderate hyponatremia (121-130mmol/l) was seen in 34 (68%) patients.
- Severe hyponatremia (116-120mmol/l) was seen in 4 (8%) patients.

8. TREATMENT:

Fig 9: Treatment strategy for correction of hyponatremia (in percentage)



- Fluid restriction was the major treatment given in our study (65%).
- Diuretics were used in 25% of our patients.
- Normal saline was given in 10% of our patients.
- Hypertonic saline was given in 5% of our patients.

9. Mortality:

Table 3: Outcome in different levels of hyponatremia.

Hyponatremia	No. of patients (n=50)	Outcome	
		Death (n=5)	Discharge (n=45)
Mild	12	1	11
Moderate	34	3	31
Severe	4	1	3

- The mortality was 10% in this study.
- Among these, 1(2%) patient belong to mild hyponatremia, 3 (6%) patient belong to moderate hyponatremia and 1 (2%) patient belong to severe hyponatremia.
- Death of the patient corresponds with the co-morbid conditions.

Outcome in different co-morbid condition:

Table 3: Outcome of different Co-morbid condition

Co- morbid condition	No. of patients (n=50)	Outcome	
		Death (n=5)	Discharge (n=45)
CCF	22	3	19
Cirrhosis of liver	8	2	6

The co-morbid conditions associated with hyponatremia in our study were hypertension, diabetes, congestive cardiac failure, cirrhosis of liver, chronic renal disorder, hypothyroidism, drugs, diabetic ketoacidosis, anemia in failure and meningitis. Among the study group, 22 patients had CCF, 8 patients had cirrhosis of liver, 6 patients had chronic kidney disease, 5 patients had hypothyroidism, 5 patients had drugs, 2 patients had DKA, 1 patient had anemia in failure and 1 patient had meningitis. The outcome of the patients was related with the different comorbid conditions. It was observed that the mortality was more with associated CCF (6%) and cirrhosis of liver (4%). The overall mortality was 5 (10%) patients.

4.DISCUSSION

Hyponatremia is the most common electrolyte disturbance seen in hospital practice. It is more common in the elderly patients with multiple medical comorbidities[5]. Hyponatremia has been associated with considerable morbidity and mortality in many chronic diseases, most notably in patients with congestive heart failure[6] and cirrhosis of liver[7]. Hyponatremia also leads to increased health care cost and the majority of these costs are attributable to the incremental resource utilization for patients who were not admitted specifically for hyponatremia, but whose hospitalization was prolonged due to hyponatremia.

In previous studies, incidence of hyponatremia in hospitalized patients was found to be about 1% to 6%[8,9,10]. 5-year retrospective study of 2,188 patients, Bennani et al[11] found the incidence of hyponatremia to be 14% at the time of admission to the intensive care unit while DeVita et al[12] found the incidence of hyponatremia in ICU to be 29.6%. In this study incidence of hyponatremia in ICU patients was 22.4%. Incidence of hyponatremia has been shown to have direct correlation with age[5]. In our study 65% of the patients were 70 to 80 yrs old. Multiple comorbidities like Hypertension and Diabetes Mellitus are present in this age group treatment of which predisposes a patient to hyponatremia. Use of diuretics is also more common among the elderly patients, which has been a major cause of hyponatremia in hospitalized patients. Hawkins et al noted that increasing age, after adjusting for sex, was independently associated with both hyponatremia at presentation and hospital-acquired hyponatremia[5].

In the present study prevalence of hyponatremia was more in male patients with male: female ratio of 1.8:1 (32 males and 18 females). This is due to the fact that the number of patients admitted in the male medical wards outnumbered the patients admitted in the corresponding female wards.

There was difficulty in assessing the exact duration of hyponatremia as the data of serum sodium prior to the detection of hyponatremia was not available for most patients in this study. In this study 54% of the patients had manifestations of hyponatremia at presentation. A major proportion (46%) of the patients in the study did not have evident clinical manifestations of hyponatremia. This can be possibly due to the reason that acute hyponatremia (hyponatremia of <48 hr duration) is less frequent than chronic hyponatremia (>48 hr duration) in which symptoms are ameliorated by the phenomenon of cerebral adaptation to hyponatremic state[13]. Major clinical manifestations of hyponatremia were lethargy (33%) and postural dizziness (28%) which occurred with equal frequency in both severe and moderate hyponatremia. Altered sensorium (19%) as manifestation of hyponatremia was less common and was also equally frequent in patients with severe and moderate hyponatremia. 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[14]. In another study by Nzerue et al on outcome of hyponatremia in hospitalized patients 52.9% patients had neurological manifestations[2]. These included seizures, reduced consciousness level, confusion unsteadiness and falls. In our study 19% patients had varied neurological manifestations of hyponatremia however none of the patient had seizures.

The major pre-existing illnesses present among the patients in our study were hypertension (58%), diabetes mellitus (40%), chronic kidney disease (8%), heart failure (17%) and chronic liver diseases (7%) and hypothyroidism (5%). In our study hypertension was a major risk factor for hyponatremia due to diuretic use in elderly patients. The studies on hyponatremia have not demonstrated direct correlation between hyponatremia and hypertension, although correlation of hyponatremia with age[5] and diuretic use is evident[15].

In our study 6 (12%) of the patients had hyponatremia due to renal disorders out of which 4 patients had pre-existing renal disease, 2 patient had acute renal failure. Total 8 (16%) patients had liver disorder (6 patients with pre-existing liver disease and 2 had acute viral hepatitis) and another 22 (44%) patients had hyponatremia due to heart failure. Thus 36 patients in our study had renal disorder, heart failure or chronic liver disease. Thus majority of these patients were admitted to the hospital due to non-complaince with treatment and inappropriate fluid intake leading to volume expansion and dilutional hyponatremia.

In majority of these patients loop diuretics and fluid restriction was sufficient to correct hyponatremia. In study by Saeed et al, 37 % of the patients had hyponatremia due to these disorders (renal disorders 21%, liver disorders 7% and CHF (9%)[19]. Ten percent patients in our study had pre-existing hypothyroidism. In study by Clayton et al hypothyroidism induced hyponatremia occurred in 3.7%[14].Diuretic use were also the common cause for hyponatremia in our study. Thiazide diuretics are a common cause of severe hyponatraemia[16]. Up to a third of elderly patients taking a thiazide at hospital admission are hyponatremic and 14% of patients prescribed a thiazide diuretic in primary care have a sodium below the normal range[15,17]. Severe hyponatremia occurs almost exclusively with thiazide rather than loop diuretics[18].

Saeed et al, studied hyponatremia in hospitalized patients and in 19 out of 57 patients (33.3%) it was associated with diuretic use[19]. In a study by Huda et al, 14 out of 22 (63.6%) patients of hyponatremia on diuretics were taking thiazide diuretics[20]. Our hyponatremic patients who were taking a loop diuretic had at least one other cause for the hyponatremia in the form of liver disease and heart failure. Loop diuretics are frequently

used to treat conditions such as congestive cardiac failure and cirrhosis in which hyponatremia occurs due to hypervolemia, while thiazide diuretics are being prescribed routinely for management of primary hypertension especially in the elderly age group.

Clayton et al had concluded in their study that selective serotonin reuptake inhibitors (SSRIs) were a frequent cause of drug induced hyponatremia[14]. They had 12 (11.1%) patients out of 108 who were taking SSRI. Van Amelsvoort et al had found that carbamazepine led to hyponatremia in patients with epilepsy, neuralgia, mental retardation and psychiatric disorders with a frequency varying from 4.8 to 40%[21]. However in our study, none of the patients were taking SSRIs.

In our study 5% patients had severe hyponatremia. Diuretic use was the most common etiology associated with severe hyponatremia. In study by Clayton et al on severe hyponaremia in a hospitalized patients 25 out of 105 patients had single etiology for severe hyponatremia which included thiazide diuretics in 11 patients, liver disease in 4 patients, CNS lesion/stroke in 2 patients, hypopituitarism/Addison's disease in 2 patients, lower respiratory tract infection in 1 patient, carbamazepine in 1 patient and unknown cause in another 4 patients[14].

In our study 43% of the patient had multiple etiological factors for hyponatremia. In recent studies varying proportions of the patient have been associated with multiple etiologies of hyponatremia. In study by Clayton et al 75% of the patients of hyponatremia had multiple etiologies while in study by Nzerue et al only 10.9% of the patients had multiple etiological factors[14,2]. These studies emphasize the importance of establishing the various factors responsible for hyponatremia in the patient so that relevant corrective measures are taken during the treatment.

Treatment of hyponatremia in our study was decided by the severity of hyponatremia, presence of symptoms and the underlying disorders. Patients with clinical evidence of dehydration as in patients with vomiting, diarrhea and febrile illnesses and no neurological symptoms of hyponatremia were treated with normal saline infusion. Patients with dilutional hyponatremia were treated with fluid restriction (intake equal to the urine output in previous 24 h) and/or loop diuretics for promoting excretion of free water.

In our study 10% of the patients received normal saline, 65% of the patients were on fluid restriction and 25% patients received loop diuretics. None of the patients were given oral sodium supplementation due to non-availability. There are considerable differences in the treatment strategies for hyponatremia in recent studies on hyponatremia in hospitalized patients. 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[22,2].

In our study hypertonic 3% saline was used for the treatment of severe symptomatic hyponatremia. 5% patients were given hypertonic saline infusion. The aim was gradual correction of hyponatremia with increase of serum sodium by 8meq/L in 24 hrs. The level of correction was usually within the recommended level in most patients. In study by Nzerue et al 3% patients received hypertonic saline while in study by Hoorn et al 5% of the patients received hypertonic saline[2,22].Therefore the use of hypertonic saline in the present study has been limited to 3% saline and it comensurates with the available literature.

The mortality in patients with severe hyponatremia has been found to be between 20 to 27% in literature[2,20]. The overall mortality among patients of hyponatremia in our study was 10% and 20% among patients with severe hyponatremia.

Mortality was not directly related to hyponatremia but to the severity of the underlying medical condition in the patients. In 2005, Huda et al in their study found that there was 27% mortality among patients of severe hyponatremia[20], however mortality among these patients was not directly related to hyponatremia but to other concomitant severe comorbidity. In study by Nzerue et al mortality among patients with severe hyponatremia was 20.2%[2]. In our study, congestive cardiac failure and cirrhosis of liver was the most common cause of death Papadakis et al had found that hyponatremia is an independent risk factor for mortality in patients with cirrhosis[7].

Hyponatremia is a common electrolyte abnormality found in hospitalized patients in general medical and surgical wards.It is more common in elderly patients and critically ill patients admitted to the ICU.

Hypertension and Diabetes Mellitus as pre-existing comorbidity was present in majority of patients and it predisposed the patients to hyponatremia.

The major causes of hyponatremia were renal disorders, CHF, and chronic liver disease. Hyponatremia was found to be related to multiple etiological factors in a large number of patients.

Treatment of hyponatremia with hypertonic saline should be restricted to the patients with severe hyponatremia and those with neurological symptoms of hyponatremia. Treatment with hypertonic saline is safe provided gradual correction of hyponatremia is followed.

Osmotic demyelination syndrome is a rare complication related to the treatment of hyponatremia and should be suspected in a case of hyponatremia who develop fresh neurological deficits while on treatment or after treatment with hypertonic saline.

Severe hyponatremia is associated with considerable mortality in patients with underlying medical diseases as advanced cirrhosis.

A systematic approach to the diagnosis of hyponatremia with the application of simple diagnostic algorithms, using history, clinical examination and laboratory findings to establish mechanism of hyponatremia can significantly improve the assessment and management of hyponatremia.

5.SUMMARY

Hyponatremia is the most common electrolyte disorder in hospitalized patients particularly in elderly. Hyponatremia is important to recognize because of the potential morbidity, mortality and the economic impact on the patient and the

health care. Studying the etiology, risk factors and management of hyponatremia in hospitalized patients will help in reducing its incidence and minimize the complications associated with hyponatremia.

The study was conducted at a tertiary care centre. These patients were evaluated for the underlying cause of hyponatremia which included detailed history and physical examination followed by appropriate laboratory investigations based on the serum osmolality.

50 patients of hyponatremia were included in the study. 46% of the patients were asymptomatic and 19% had abnormal behavior. There was a wide range of etiologies, most common being congestive heart failure (44%),liver disorder (16%) and renal disorder (12%). 43% patients had multiple causes. 5% patients of symptomatic severe hyponatremia were treated with hypertonic saline infusion, 25% patients were given loop diuretics with hypervolemic hyponatremia, fluid restriction was advised to 65% patients and 10% patients received normal saline. Five patients included in the study died, 3 of which had congestive cardiac failue and 2 had advanced cirrhosis of liver as underlying cause.

Hyponatremia is a common problem in hospital in patients more so in critically ill ICU patients. The possible cause of hyponatraemia should always be sought as outcome in severe hyponatraemia is governed by etiology, and not by the serum sodium level. Treatment of severe symptomatic hyponatremia with hypertonic saline is safe if recommendation for the rate of correction of hyponatremia is strictly followed. Osmotic demyelination syndrome is a rare complication related to the treatment of hyponatremia and should be suspected in a case of hyponatremia who develop fresh neurological deficits while on treatment or after correction of hyponatremia.

6.CONCLUSION

- 65% patients were between 70-80 yrs.
- Elderly males are more commonly affected with male & female ratio of 1.8:1.
- Symptoms of hyponatremia were present in 54% of patients. 46% patients had no symptoms of hyponatremia.
- 58% of patients had hypertension & 40% of patients had diabetes as co-morbid condition.
- 66% of patient in our study belong to hypervolemic status.
- Most common etiology of hyponatremia in our study was due to congestive cardiac failure (44%).
- The second most common cause was cirrhosis of liver (16%).
- In this study 24% of patient had mild hyponatremia, 68% patient had moderate hyponatremia and 8% of patient had severe hyponatremia.
- Fluid restriction was the major treatment given in our study (65%).
- Diuretics were used in 25% of our patients.
- Normal saline was given in 10% of our patients.
- Hypertonic saline was given in 5% of our patients.
- The mortality was 10% in this study.
- Among these, 1 (2%) patient belongs to mild hyponatremia, 3 (6%) patients belong to moderate hyponatremia and 1 (2%) patient belongs to severe hyponatremia. Death of the patient corresponds with the co-morbid conditions.

7.REFERENCES

1. Ellison DH, Berl T. The syndrome of inappropriate antidiuresis. N Engl J Med 2007; 356:2064.
2. Nzerue Chike M., Baffoe-Bonnie Henry, You Wei, Falana Babajide, and Dai Shifan. Predictors of Outcome in Hospitalized Patients with Severe Hyponatremia. Journal of the National Medical Association Vol. 95, No. 5, May 2003 335-343.
3. Drummond M. Cost-of-illness studies: a major headache? Pharmacoeconomics. 1992;2:1–4.
4. Drummond, MF.;O'Brien, BJ.;Stoddart, GL.; Torrance, GW. Methods for the economic evaluation of health care programmes. 2nd Oxford Medical Publications; 1997.
5. Hawkins RC. Age and gender as risk factors for hyponatremia and hypernatremia. Clin Chim Acta. 2003;337:169 –172.
6. WH Lee, M Packer. Prognostic importance of serum sodium concentration and its modification by converting-enzyme inhibition in patients with severe chronic heart failure. Circulation. 1986;73:257–267
7. Papadakis MA, Fraser CL, Arieff AI. Hyponatraemia in patients with cirrhosis. Q J Med 1990; 76:675–88.
8. Baran D, Hutchinson TA. The outcome of hyponatremia in a general hospital population. Clin Nephrol 1984; 22:72–6.
9. Gill G, Leese G. Hyponatraemia: biochemical and clinical perspectives. Postgrad Med J 1998; 74:516–23.
10. Janicic N, Verbalis JG. Evaluation and management of hypo-osmolality in hospitalized patients. Endocrinol Metab Clin North Am. 2003;32:459–81.
11. Bennani SL, Abouqal R, Zeggwagh AA, et al. Incidence, causes and prognostic factors of hyponatremia in intensive care. RevMed Interne. 2003;24:224 –229.
12. DeVita MV, Gardenswartz MH, Konecky A, Zabetakis PM Incidence and etiology of hyponatremia in an intensive care unit. Clin Nephrol. 1990 Oct;34(4):163-6.
13. Singer G Gary, Brenner M Barry. Fluid and Electrolyte Disturbances. In Harrison's Principles of Internal Medicine, Kasper L Dennis, Fauci S Anthony, Longo L Dan, Braunwald E, Hause L Stephen, Jameson J Larry (eds). 2006; 16th edition, volume –1, 252-255.McGraw Hill publication.
14. Clayton J.A., le Jeune I.R. and Hall I.P. Severe hyponatraemia in medical in- patients:aetiology, assessment and outcome. Q J Med 2006; 99:505–511
15. Clayton JA, Rodgers S, Blakey J, et al. Thiazide diuretic prescription and electrolyte abnormalities in primary care. Br J Clin Pharmacol 2006; 61:87.
16. Adrogue HJ, Madias NE. Hyponatremia. N Engl J Med. 2000;342:1581–1589.

17. Byatt CM, Millard PH, Levin GE. Diuretics and electrolyte disturbances in 1000 consecutive geriatric admissions. J R Soc Med 1990; 83:704–8.

18. Berl T, Robertson GL. Pathophysiology of water metabolism. In: Brenner BM, ed. The kidney. WB Saunders, 2000.

19. Saeed B O, Beaumont D, Handley G H, Weaver J U. Severe hyponatraemia: investigation and management in a district general hospital.J Clin Pathol 2002;55:893–896

20. Huda M S B, Boyd A, Skagen K, Wile D, Heyningen C van, Watson I, Wong S, Gill G Investigation and management of severe hyponatraemia in a hospital setting Postgrad Med J 2006;82:216–219.

21. Van Amelsvoort T; Bakshi R; Devaux CB; Schwabe S. Hyponatremia associated with carbamazepine and oxcarbazepine therapy: a review. Epilepsia 1994 Jan-Feb;35(1):181-8.

22. Ewout J. Hoorn, Jan Lindemans and Robert Zietse. Development of severe hyponatraemia in hospitalized patients: treatment-related risk factors and inadequate management. Nephrol Dial Transplant (2006) 21: 70–76

*****