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Prevalence and Correlates of At Admission Hyponatremia in Critically Ill Elderly patients and its impact on clinical course of ICU: Experience from a specialized geriatric facility in North India

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ABSTRACT

Aim: To assess the prevalence of at admission hyponatremia in critically ill elderly patients; and to describe its clinicodemographic correlates and impact on clinical course and outcome.

Method: A retrospective record review of 267 non-COVID ICU admissions at a specialized geriatric facility over a period of one year was done. At admission serum sodium levels <135 mEq/L were considered as hyponatremia. Demographic profile and comorbidity profile of the patients was noted. Severity of hyponatremia was assessed as mild (130-134.9 mEq/L), moderate (125-129.9 mEq/L) and severe (<125 mEq/L) respectively. Total duration of ICU stay was noted as clinical course of illness and in-ICU mortality was noted as the final outcome. Data was analysed using SPSS 21.0 software. Chi-square, independent samples t-test and ANOVA were used to analyze the data.

Results: Mean age of patients was 72.65±7.82 years (Range 60-93 years), majority of them were males (56.2%). At admission prevalence of hyponatremia was 36.3% (n=97). Among hyponatremia cases majority (n=50; 51.5%) had mild, followed by moderate (n=31; 32.0%) and severe (n=16; 16.5%) hyponatremia. Mean duration of ICU stay was 8.65±5.51 days (range 1-45 days). There were 10 (3.7%) mortalities. History of cardiovascular disease and higher mean number of comorbidities showed a significant association with at-admission hyponatremia. Mortality rate was significantly higher in hyponatremic (8.2%) as compared to non-hyponatremic cases (1.2%). Severity of hyponatremia showed a significant association with hypertension, cardiovascular disease, number of comorbidities, type of hyponatremia, but did not show a significant association with duration of ICU stay and mortality.

Conclusion: Critically ill elderly patients had a high prevalence of at-admission hyponatremia which also tend to affect the outcome.

Key words: Critically ill, Elderly patients, ICU, Hyponatremia, Mortality.

INTRODUCTION

Critical illness affects the normal body metabolism and affects different physiological activities. It has a detrimental effect on the fluid and electrolyte balance of the body, thus affecting normal body homeostasis. Imbalance in volume distribution of both intracellular and extracellular fluid volume along with electrolyte levels takes place during critical illness. The sodium balance in the body is affected by a disturbance in water

homeostasis and sodium content[1-5]. During the critical illness dietary intake of sodium is phenomenally low and the sodium balance is affected adversely[6]. Elderly patients, particularly those admitted to intensive care units with a critical illness are at an increased risk of hyponatremia owing to presence of factors that stimulate the increase in levels of antidiuretic hormones and medications that induce reduction in sodium levels apart from age in itself being an independent risk factor associated with hyponatremia. An additional risk of hyponatremia in elderly is often introduced by intake of a diet poor in salt and protein along with high intake of water, a phenomenon termed as "tea and toast"[7].

Our facility is a fully dedicated geriatric care facility with a high turnover of elderly ICU patients. In this article, we describe our experience of hyponatremia in elderly critically ill patients and its impact on their clinical course and outcome.

MATERIAL AND METHOD

This study was a retrospective record review of 267 elderly (aged ≥60 years) non-COVID ICU admissions at a specialized geriatric care facility over a period of one year. Being retrospective in nature, waiver of informed consent and permission for use of data was obtained from the appropriate institutional authority.

Details such as age and sex were noted. Presence of comorbidities such as diabetes, hypertension, cardiovascular disease, renal disease, respiratory illness, liver, other gastrointestinal and neurological diseases was noted. Total number of comorbid conditions was calculated.

At-admission serum sodium levels were noted. Hyponatremia was defined as serum sodium level <135 mEq/L. Grading of hyponatremia was done as follows:

Mild	130-134.9 mEq/L
Moderate	125-129.9 mEq/L
Severe	<125 mEq/L

In cases with hyponatremia, the type of hyponatremia (hypovolemic, euvolemic or hypervolemic) was also recorded on the basis of following criteria:

Euvolemic	270 – 290 mOsm/L

Hypervolemic	>290 mOsm/L
Hypovolemic	<270 mOsm/L

Duration of ICU stay was noted. Outcome was noted in terms of mortality.

Data was analyzed using IBM Stats 25.0 software. Independent samples 't'-test, chi-square and Fisher exact tests were used for comparison of data.

RESULTS

Age of patients ranged from 60 to 93 years. Mean age of patients was 72.65±7.82 years. Majority of patients were males (56.2%). The sex ratio of study population was 1.28:1. All the patients had one or more comorbid condition(s). Hypertension (50.9%), diabetes (39.7%) and renal disease (36%) were the most common comorbid conditions. Mean number of comorbid condition was 2.32±1.17. A total of 97/267 (36.3%) patients had serum sodium levels <135 mEq/l at the time of admission. Duration of ICU stay ranged from 1 to 45 days with a mean of 8.56±5.51 days. There were 10 (3.7%) mortalities. At-admission hyponatremia did not show a significant association with age, sex, history of diabetes, hypertension, renal disease, respiratory illness, liver disease, other gastrointestinal diseases and neurological illness, however, history of cardiovascular disease had a significant association with hyponatremia (p=0.008). Patients with hyponatremia had significantly higher frequency of comorbid conditions as compared to those not having hyponatremia (p=0.015). Though duration of ICU stay was longer in hyponatremic as compared to normonatremic elderly patients yet this difference was not significant statistically (p=0.081). In-ICU mortality rate was also higher in hyponatremic (8.2%) as compared to normonatremic (1.2%) elderly and this difference was significant statistically too (p=0.003). In the present study, euvolemia (40.2%) was the most common type, followed by hypovolemia (34%) and hypervolemia (25.8%) respectively (Table 1; Figs. 1 and 2).

Within hyponatremic group (n=97), mild, moderate and severe hyponatremia was seen in 50 (51.5%), 31 (32.0%) and 16 (16.5%) patients respectively. There was no significant association of severity of hyponatremia with age and sex of patients. However, comorbidities like hypertension and cardiovascular disease showed a significant association with increasing severity of hyponatremia (p<0.05). With increasing severity of hyponatremia, there was a significant incremental trend in mean number of comorbid conditions too (p=0.003). Euvolemic hyponatremia was significantly more common in mild and moderate hyponatremia

as compared to that in severe hyponatremia (p=0.038). There was no significant association between ICU stay and severity grade of hyponatremia (p=0.887). Though mortality rate was higher in moderate (16.1%) and severe (12.5%) hyponatremia as compared to that in mild hyponatremia (2%) yet this difference was not significant statistically (p=0.064) (Table 2).

DISCUSSION

In the present study, at-admission hyponatremia was seen in 36.3% of elderly critically ill patients. It is to be noted that hyponatremia in elderly hospitalized patients is a common problem. Nearly15-30% of hospitalized patients or institutionalized elderly are known to have mild hyponatremia[8]. At-admission hyponatremia prevalence in the present study is in close proximity with that reported by Rao *et al.*[9], who in a large series of 1440 elderly ICU patients reported it to be 36%. In a recent study, Dash *et al.*[10] found as many as 47.9% of elderly hospitalized patients to be hyponatremic. Compared to their study, relatively lower prevalence of hyponatremia in the present study could be owing to the fact that in the present study, we calculated this prevalence on the basis of at-admission status only and did not include the patients admitted with normonatremic status and developing hyponatremia during hospitalization. As such a relatively lower at-admission hyponatremic prevalence in elderly hospitalized patients was reported by Zhang *et al.*[11], who reported it to be 24.7%, it must be interpreted that a high prevalence of at-admission hyponatremia in elderly ICU patients indicates the significance of hyponatremia as a possible contributory factor forcing the ICU admission. In the previous studies too, hyponatremia in elderly has often been reported to be associated with a predominance of symptomatic manifestations like lethargy, drowsiness, abnormal behaviour, confusion, seizures and coma that lead to need for ICU care[9,11-14].

In the present study, mild and moderate severity of hypernatremia comprised 83.5% of affected elderly patients, while only 16.5% had severe hyponatremia. Moreover, euvolemic (40.2%) and hypovolemic (34%) types were more common as compared to hypervolemic (25.8%) type. Zhang *et al.*[11] too in their study reported a dominance of mild and moderate hyponatremia (90.8%) as compared to severe hyponatremia (10.2%) respectively, though proportion of those with severe hyponatremia was lower in their study as compared to that in the present study. It might be attributed to the fact that they carried out their study in a general

hospitalized elderly population as compared to the present study that was carried out in critically ill elderly patients.

Maloo and Jain[13] in their study among ICU admitted elderly patients too found severe hyponatremia in only 8% of hyponatremic patients, however, they used a relatively lower cut-off (<120 mEq/L) for determination of severe/profound hyponatremia. Jain and Nandy[12] on the other hand, reported a dominance of severe/profound hyponatremia (51%) using the same criteria as used in the present study. As far as dominance of euvolemia and hypovolemia is concerned, Rao *et al.*[9] also reported euvolemic type as the most dominant type; however, in their study hypervolemia patients outnumbered the hypovolemia patients. Contrary to this, in the study by Maloo and Jain[13], hypervolemic type was the most common type (64%) whereas euvolemic type was the least common type (10%). As such, the severity and type of hyponatremia might show a variation under different situations, probably owing to definition/criteria used, pre-existing conditions and types of interventions made prior to ICU admission.

In the present study, we did not find a significant association of at-admission hyponatremia with age and sex of the patients. Similarly, comorbid conditions except for history of cardiovascular disease were found to be significantly associated with hyponatremia, though mean number of comorbid conditions was significantly higher in those with hyponatremia as compared to those with hypernatremia. As such, association of cardiovascular disease and increased number of comorbid conditions with hyponatremia could be explained owing to lower dietary intake of sodium and a possible role of medications used for treatment of multiple conditions, particularly in cases having multiple comorbid conditions like hypertension and cardiovascular disease. An association with higher number of comorbid conditions with hyponatremia in elderly patients, as observed in the present study has been reported by Dash *et al.*[10] in their study too. In the present study we did not find a significant association of hyponatremia with duration of hospital stay but found it to be significantly associated with mortality. Contrary to our study, Dash *et al.*[10] found hyponatremia to be associated with significantly longer duration of ICU stay but did not find a significant association between mortality and hyponatremia. The reason for this difference might be owing to the fact that in the present study, we noted at-admission hyponatremia, while in their study hyponatremia during any time of hospitalization was recorded. In the present study, the mortalities took place in the early clinical course itself, and hence, though hyponatremia did not affect the average duration of ICU stay, it had a significant association with mortality.

In the present study, we found that increasing severity grade of hyponatremia was significantly associated with an increased frequency of comorbid conditions and hypervolemic type. We also witnessed that mortality rate was higher in moderate and severe hyponatremia patients as compared to mild hyponatremia, yet neither mortality nor duration of ICU stay had a significant association with severity of hyponatremia. Compared to the present study Zhang *et al.*[11] found both mortality as well as hospital stay to be significantly associated with higher severity grade of hyponatremia in elderly. There could be two reasons for this difference, first, the present study had an elderly critically ill population and secondly a relatively lower overall mortality rate (3.7%) as compared to their study (11.7%). Moreover, factors like a much older age profile of patients in their study (Mean age 84.6 years) as compared to the present study (mean age 72.65 years) and difference in nature of patients (hospitalized vs critically ill) also contribute to these differences. Chandregowda *et al.*[15] in their study also reported a significant association between severity of hyponatremia and mortality. However, in their study the cut-off value used for severe hyponatremia was <120 mEq/L as compared to <125 mEq/L in the present study. The findings in the present study are in agreement with that reported by Maloo and Jain[13] who also did not find a significant association between mortality and severity of hyponatremia. Owing to a dominance of mild and moderate grades, the fewer number of patients in severe grade also contribute to absence of a statistically significant association despite a higher proportional difference in mortality.

The present study was carried out in a specialized geriatric care referral facility where specialized care for geriatric patients is available. Assessment of serum sodium levels at admission itself is a routine clinical practice followed in our set-up and consequently, the interventions and management are planned accordingly. Owing to holistic approach and specialized caregiving the facility is able to attain more favourable results. The findings of the present study also endorse that despite critical illness and hyponatremic status, in-ICU mortality rate was low and duration of ICU stay was minimal. The findings of the present study show the need to develop geriatric care further and to develop specific interventions and protocols to deal with the physiological situations like hyponatremia more effectively.

CONCLUSION

At admission hyponatremia was seen in 36.3% of elderly critically ill patients admitted to our facility. It was seen to be mild in majority (51.5%). Although, hyponatremia was associated with an increased risk of ICU mortality yet it did not affect the duration of ICU stay.

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Table 1: Comparison of Demographic and Clinical Profile between Critically ill Elderly patients with and without Hyponatremia

SN	Characteristic	Hypo-natremia (n=97)	No hypo-natremia (n=170)	Total (n=267)	Statistical significance 'p'-value
1.	Mean age±SD (Range) years	72.75±7.90 (60-93)	72.59±7.79 (60-90)	72.65±7.82 (60-93)	0.869
2.	Male:Female	51 (52.6%): 46 (47.4%)	99 (58.2%): 71 (41.8%)	150 (56.2%): 117 (43.8%)	0.370
3.	Comorbid conditions				
	Diabetes	43 (44.3%)	63 (37.1%)	106 (39.7%)	0.243
	Hypertension	54 (55.7%)	82 (48.2%)	136 (50.9%)	0.242
	Cardiovascular disease	37 (38.1%)	39 (22.9%)	76 (28.5%)	0.008
	Renal disease	42 (43.3%)	54 (31.8%)	96 (36.0%)	0.059
	Resp. illness	17 (17.5%)	43 (25.3%)	60 (22.5%)	0.144
	Liver Disease	16 (16.5%)	26 (15.3%)	42 (15.7%)	0.795
	Other gastrointestinal diseases	16 (16.5%)	18 (10.6%)	34 (12.7%)	0.164
	Neurological illness	21 (21.6%)	47 (27.6%)	68 (25.5%)	0.279
4.	Mean No. of comorbidities±SD	2.55±1.17	2.19±1.14	2.32±1.17	0.015
5.	Mean duration of ICU stay±SD (Range) days	9.34±5.90 (2-45)	8.12±5.24 (1-36)	8.56±5.51 (1-45)	0.081
6.	Mortality	8 (8.2%)	2 (1.2%)	10 (3.7%)	0.003

Table 2: Profile of Hyponatremia cases according to severity of hyponatremia (n=97)

SN	Characteristic	Mild (n=50)	Moderate (n=31)	Severe (n=16)	Statistical significance 'p'-value
1.	Mean age±SD (Range) years	71.68±7.73 (60-90)	74.10±7.77 (61-86)	73.50±8.70 (63-93)	0.379
2.	Male:Female	25 (50.0%): 25 (50.0%)	16 (51.6%): 15 (48.4%)	10 (62.5%): 6 (37.5%)	0.678
3.	Comorbid conditions				
	Diabetes	24 (48.0%)	10 (32.3%)	9 (56.3%)	0.220
	Hypertension	20 (40.0%)	20 (64.5%)	14 (87.5%)	0.002
	Cardiovascular disease	13 (26.0%)	15 (48.5%)	9 (56.3%)	0.035
	Renal disease	19 (38.0%)	13 (41.9%)	10 (62.5%)	0.223
	Resp. illness	10 (20.0%)	4 (12.9%)	3 (18.8%)	0.709
	Liver Disease	9 (18.0%)	7 (22.6%)	0	0.130
	Other gastrointestinal diseases	8 (16.0%)	6 (19.4%)	2 (12.5%)	0.828
	Neurological illness	8 (16.0%)	7 (22.6%)	6 (37.5%)	0.190
4.	Mean No. of comorbidities±SD	2.21±1.18	2.68±1.05	3.31±1.01	0.003
5.	Type Euvolemic Hypovolemic Hypervolemic	 25 (50.0%) 18 (36.0%) 7 (14.0%)	 11 (35.5%) 10 (32.3%) 10 (32.3%)	 3 (18.8%) 5 (31.3%) 8 (50.0%)	0.038
6.	Mean duration of ICU stay±SD (Range) days	9.46±5.14 (2-33)	8.94±7.63 (1-45)	9.75±4.37 (2-16)	0.887
7.	Mortality	1 (2.0%)	5 (16.1%)	2 (12.5%)	0.064

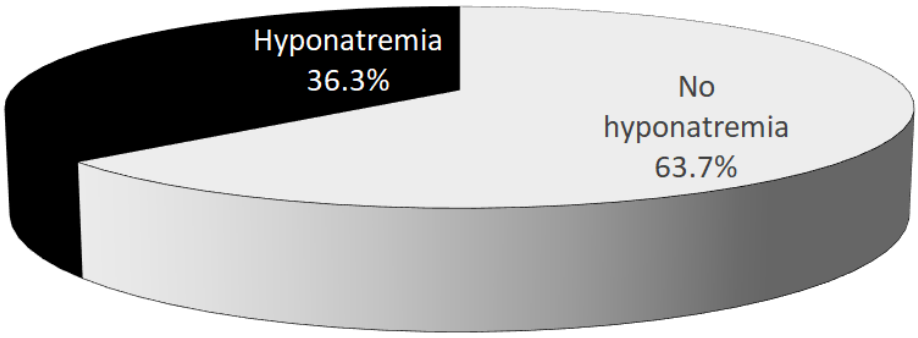

Fig. 1: Distribution of cases according to on admission hyponatremia status

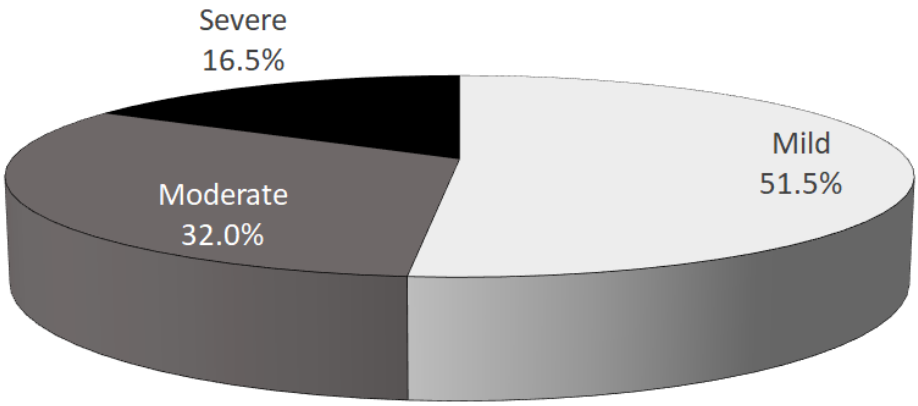

Fig. 2: Distribution of hyponatremia cases according to severity status

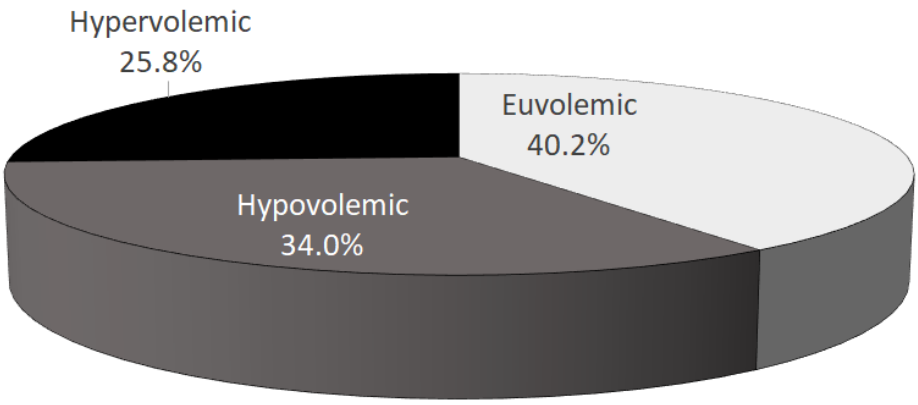

Fig. 3: Distribution of cases according to type of hyponatremia