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Association between Plasma Osmolarity and Mortality in Patients Admitted in ICU at IMCHRC, Indore

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Original Research Article

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Abstract: This research aims to explore the association between serum osmolarity and mortality in patients who are admitted in ICU with a specific category of Hyper Glycemia, Uremia & ACS in ICU of Index Medical College, Indore Total patient studied of 200. Both Genders age between 35-65 years. Patients were divided into three groups disease sub groups based on the diagnosis at admission: cardiac, hyperglycemic& uremia, the association between osmolarity & mortality was evaluated. Strengths and limitations of this study the small sample size. Subgroup analysis based on different admission diagnoses was performed to evaluate the osmolarity of mixed intensive care unit. Osmolarity was calculated in the current study which leads to certain bias despite an optimal equation were used. Using the formula 2x sodium + RBS/ 18+ Urea/2.8. Analysis of the 200 patients revealed relationship between osmolarity and mortality & ICU stay in patients with Hyperglycemic, Hyper Urecemia & Coronary Artery Disease. Both Hypo-osmolarity and hyper natraemia, leading to clinically adverse consequences such as increased in risk of mortality & increase no. of days in ICU cardiovascular, hyperglycemic and renal disorders 34 mortality were noted. 56 hypo osmolarity were associated with increased stay up to 72 hours in ICU. The values of serum osmolarity mortality & mortality were more in patients in Hypo & hyper Osmolarity, with the increasing in no. of days in ICU. Acute coronary syndrome 7–9 Despite the consistency of results hypo-osmolarity but hyper osmolarity was significantly showing is associated with associated with mortality except for extreme increased mortality, hyper osmolarity (=340mmoL/L). In all sub groups, vasopress if use was consistently associated with increased mortality. Hypo-osmolarity is associated with increased mortality in patients who are critically ill but Hper osmolarity as compare to Hypo-osmolarity.
Keywords: Osmolarity, Mortality, Sodium, Blood Nitrogen Urea & Random Blood Sugar.

INTRODUCTION

Serum osmolarity plays an important role in extrac ellular and intracellular water distribution and mainly depends on the concentrations of Na+, K+, Cl–, glucose and urea [1]. Perturbation of osmolarity is strongly associated with various body function in ICU & body compensatory mechanism come in to play patients admitted in ICUs, Forinstance, Rohla *et al*. [2] reported a significant correlation between mortality and hyperosmolarity in patients with acute coronary syndrome. However, this correlation became insignificant after excluding the patients who are critically ill, which further reflects the heterogeneity of disease severity [3]. Moreover, the impact of osmo-larity on different diseases is also inconsistent, especially for patients with Diabetes Miletus & Urenamia ACS.

Despite all of these efforts, the prognostic and therapeutic value of serum osmolarity for specifically critically ill populations still has not been well established. Holtfreter *et al*. [4] reported that serum osmolarity has moderate predictive value for mortality in unselected patients in ICU but two critical limitations should be noted. The mortality rate is high for patients with low serum osmolarity, which is consistent with clinical observations. Hyper osmolarity with more mortality stay in ICU patient because of complication of Co-morbidity.

Thus, it is of vital important to evaluate the association between osmolarity and mortality in patients in ICU. In the present study, patients were stratified based on their ICU admission diagnoses, and subgroup analysis was performed.

MATERIALS AND METHODS

The Multi parameter Intelligent Monitoring was used to monitor the consent was obtained for the original collection of obtained from the study.

Study population and stratification method

Patients who were pregnant or younger than 18 years old were excluded from this analysis. The following information was: age, gender, weight, comorbidity, type of patients admitted to ICU, hospital length of stay (LOS), hospital mortality, sequential organ failure assessment score, vasopressin use, urine output and serum levels of Na+, K+, glucose, urea, creatinine and albumin noted.

Serum osmolarity was calculated using the equation (2× Na+ + K+) + (glucose/18) + (urea/2.8). 16 Only values of plasma sodium, potassium, glucose and urea measured at the same time were used in the calculations. Patients without sufficient data to calculate serum osmolarity were excluded. Plasma protein levels were omitted as they only contribute~0.4% to serum osmolarity [6].

Values of serum Na+, K+, glucose and urea measured at the same time during the ICU stay. Although 285–300mmoL/L is typically considered the normal range of serum osmolarity, was used as the normal range and reference group in the present study. Crude outcomes were compared among three groups: hypo-osmolarity(<285mmoL/L), normal osmolarity (290–300 mmoL/L) and hyper osmolarity (>=310 mmoL/L). The data were also analyzed in terms of subgroups based on diagnosis at admission: cardiac vascular, Hyper Glycemia & Urecemia

OUTCOMES

The primary endpoint was hospital mortality defined as death during hospitalisation. Secondary endpoints included hospital stay, in ICU, development of acute kidney injury and maximum sequential organ failure assessment score detoriating for patient with more than 01 during ICU stay. For patients with more than one ICU stay, only the first ICU stay was considered. An increase in serum creatinine level of more than 1.5 times above base line was considered to reflect acute kidney injury according to the Kidney Disease Improving Global Outcome criteria[7] Vasopress in use was definetly was one of the most important medication was used during ICU stay for any reason.

STATISTICAL ANALYSIS

Continuous variables are presented in the tables as the mean with SD or median with inter quartile ranges. A logistic regression model was built for each of the three subgroups using osmolarity as a design variable, with the normal range (285–310mmoL/L) as the reference group.

RESULTS

Hyper osmolarity max was associated with increased hospital and ICU mortality compared with normal osmolarity levels for patients with or without respiratory disease. In addition, hyper osmolarity max was also associated with higher acute kidney injury rates in these two subgroups ($p<0.001$, both).

Vasopressin was used less often by survivors but use of vasopressin was in non-survivors for more than 24 hours. (2.50% vs19.6%, $p<0.001$).

Figure 01 shows the relationship between osmolarity and hospital mortality for patients in ICU Four models yielded non-linear relationships, with the lowest mortality rate at osmolarity between 290 to 300. In our study where all variable were very high very low had poor outcome as compare to were two or one parameter was deranged.

In Hypo Osmalality most important factor was Hyponatremia patient were high dose of diuretic to reduce edema & especially renal origin. It was managed by following formula for correction. Hypertonic Salin 1.6% was used with caution as it has its own complication. Patient who had on high level of BNU & Serum cretinine had to undergo dialysis use soda bicarb to combat acidosis, also in decay diabetic keto acidosis.

Hypoglycemic responded better completely & earlier as compare to Hyperglycemic Patients. To further explore the effect of hyper osmolarity, Osmolarity was categorized into three groups (as described above),

Hyperosmol hyposmolarity & hyper osmolarity max was significantly associated with higher mortality (levels 1 to 2), but extreme hyper osmolarity max (=340mmoL/L) was related to increased mortality. In both models, vasopressin use was positively associated with mortality, Level 5 and above.

The results showed that the diagnostic performance was moderately good for the cardiac and vascular groups and the lowest AUC (0.651) was found for the Renal Group, as expected.

Table-01: Osmolarity (%)

S. No.	Model Variable	Na(%)	RBS(%)	Urea(%)
1.	Osmalility Below 240	5.5%	6%	6.5%
2.	Osmalility 241-260	13%	13%	12.5%
3.	Osmalility 261-280	21.5%	22.5%	23..5%
4.	Osmalility 281-300	34.5%	33.5%	32%
5.	Osmalility 301 Above	25.5%	25%	25.5%

Male % - 58 Female % - 42

Serum Sodium Levels

Sodium	No.	Percentage
Below 100	6	3
101-120	40	20
121-140	119	59.5
141-160	31	15.5
Above 161	4	2

Range of RBS

RBS	No.	Percentage
Below 100	49	24.5
101-200	102	51
201-300	26	13
301-400	19	9.5
401-500	3	1.5
Above 501	1	0.5

Range of Urea

Urea	No.	Percentage
Below 50	147	73.5
51-100	31	15.5
101-200	19	9.5
Above 201	3	1.5

DISCUSSION

Our results reveal that hyper osmolarity is associated with increased hospital mortality of patients who are critically ill, presenting as a ‘U’-shaped association. However, this pattern was not observed for patients with respiratory admission disease, and only extreme hyper osmolarity was related to increased risk of death in this subgroup. In addition, vasopressin is strongly associated with a higher mortality rate in all six subgroups. Link between osmolarity imbalance and mortality in patients in mixed ICU.

Water balance inside the body is of vital importance for patients who are critically ill, and serum osmolarity plays an important role in extracellular and intracellular water distribution. Perturbation of osmolarity is common in patients admitted to ICU, which is related to intracellular dehydration or oedema, potentially leading to adverse outcomes [6]. Holtfreteretal recently examined the ability of osmolarity to predict mortality of patients admitted to the Most importantly, the hetero-geneity of patients in mixed ICU was ignored.

In the present study, between osmolarity and mortality was found, which emergency, those admitted to ICU were more likely to be unconscious, intubatedor sedated [9, 10] and insufficient as in Uremia. ‘Water intake’commonly happened which lead to higher incidence of hyper volaemichypernatraemia[9,11] thus, the peak of serum osmolarity may be more important for patients in ICU.

For ICU patients with cardiac diseases, the impact of osmolarity on mortality has not been reported. Hyperosmolarity was associated with increased mortality and readmission, but the impact of hypo-osmolarity wasinsignificant[12].

However, the osmolarity categories were not evenly distributed in this study, which lead to the inadequately evaluation of hypo-omolarity. In the present study, the association between hyperosmolarity and increased mortality was also observed, with moderately. In addition, association between hypo-osmo was similar to Trevor Nicholson'sfinding[8] that both calcularity max and mortality was also confirmed in the current hypo-osmolarity on admission were associated with increased mortality in emergency patients. However, several differences should be noticed. First, the stratification method was different from ours and more importantly, unlike with patients admitted to study, which is consistent with the findings of DeLuca *et al*. [13] Moreover, Rohla *et al.* [2] reported that the significant correlation between hyperosmolarity and mortality for patients with acute coronary syndrome.

Two aspects should be considered when interpreting the underlying mechanism. First, hyperosmolarity is always accompanied by the increase of its main components, such as hypernatremia [14] and hyperglycaemia[15] which have separately been reported as risk factors for patients with increased mortality. Second, hyper osmolarity itself could cause redistribution of body fluids, such as mobilization of fluid from the venous capacitance vessels to the effective circulatory volume, thereby increasing cardiac preload volume and leading to worse outcomes.

In clinical practice, hyper osmolarityis common in patients with cerebral diseases[1] partly owing to dehydration. Nag *et al*. [3] reported that higher serum osmolarity at admission (=310mmoL/L) was associated with early death and worse outcomes, and this was also confirmed by Bhalla *et al*.[1]. In our study we also has similar outcome.

Correlation between hypo-osmolarity and mortality was found. However, whether treatment to increase serum osmolarity would benefit these patients was unclear. Therapies such as haemodilution, related to low osmolarity, further studies are needed to investigate the interactions among serum osmolarity, osmo therapy and mortality in this subgroups.

A vasopressin receptor agonist, vasopressin was used more often in the hyperosmolarity group, as expected, and a strong link between vasopressin use and mortality was detected for all six subgroups. Currently, the merit of using vasopressin in patients who are critically ill is still debatable. Vasopressin in has been recommended to be added to no epinephrine[16] for the treatment of septic shock because it has been found to decrease the levels of circulating cytokines, chemokines and growth factors[17] even though it has been reported to be associated with increased adverse events during septic shock[18] Owing to the nature of our observational study, whether vasopressin causes increased mortality or its use is simply a marker of sicker patients with higher risk of death needs to be further investigated.

Short Coming of the present study is the small sample size, which allowed for subgroup analysis and adjustment for confounding factors, but it also has limitations. First, the osmolarity was calculated in the present study rather than being measured directly, which could cause deviation from actual osmolarity values despite careful consideration of the optimal equation[16] second, because osmolarity was used as the independent variable, only 200 patients were included in hypo-osmolarity & hyper-osmolarity both are associated with high mortality rate[19]. Third, the grouping method was based on diagnosis at admission, and thus overlap within subgroups was unavoidable. Finally, owing to the nature of retrospective research, the association between osmolarity and mortality could only be directly inferred, but it also provided compelling evidence for further research to establish a definitive causal link. Whether treat mentor correction of the hypo-osmolarity or hyper osmolarity could reduce mortality among these patients needs further investigation.

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