

STUDY OF SODIUM PLASMA LEVEL IN ALTERED MENTAL STATUS ADULT  
PATIENTS

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## ABSTRACT

**Background:** Altered mental state is a frequent and clinically relevant presentation in the emergency department, including a wide range of neurological dysfunction, from confusion and disorientation to stupor and coma.

**Objectives:** To evaluate serum sodium levels in adult patients presenting with altered mental status to the emergency department of Al-Jamhory Teaching Hospital in Mosul.

**Methods:** The present study included prospective study of 45 adult patients who presented to emergency department in Al-Jamhory Teaching Hospital with altered mental status during the period from February 2025 to July 2025. The study excluded patients admitted with altered mental state secondary to trauma. the questionnaire included the demographic and clinical data (age, sex, occupation, address, chief complaint, with it is duration, medical history, drug history). In addition to full clinical examination of each patient (blood pressure, plus rate, body temperature) as well as complete neurological examination including (consciousness, orientation, Glasgow coma scale assessment).

**Results:** The study included 45 patients. Of them 26 (57.77%) males and 19 (42.23%) females with male: female ratio of 1.368:1. 21 (46.67%) patients had Na<sup>+</sup> level of more than 145 mmol/l (hypernatremia) while normal plasma Na<sup>+</sup> level was present in 16 (35.56%) and hyponatremia in 8 (17.77%) patients. the majority of patients with each of hypernatremia, normal sodium level and hyponatremia had Glasgow coma scale of 9-13. Moreover, the majority of patients of random blood sugar of more than 250 mg/dl with each of hypernatremia and hyponatremia had Glasgow coma scale of 9-13. While the majority of patients with random blood sugar of more than 250 mg/dl and normal sodium level had GCS of <9. Diuretic use was prevalent among 4 (19.05%) of hypernatremia patients, while it was used by 4 (25%) and 2 (25%) patients with normal sodium level and hyponatremia.

**Conclusion:** Both dysnatremia and changed serum osmolality contributed to lower Glasgow Coma Scale scores, emphasizing the importance of electrolyte imbalance as a reversible cause of altered mental status in emergency situations. Routine serum sodium and plasma osmolality testing should be emphasized in all adult patients presenting with altered mental status in the emergency department.

**KEYWORDS:** Awareness, Emergency, Hypernatremia, Hyponatremia.

## 1-INTRODUCTION

Altered mental state (AMS) is a frequent and clinically relevant presentation in the emergency department (ED), including a wide range of neurological dysfunction, from confusion and disorientation to stupor and coma.<sup>[1]</sup> It poses a diagnostic difficulty due to its numerous causes, which include metabolic abnormalities, infections, structural brain lesions, intoxications, and systemic disorders.<sup>[2]</sup> Prompt identification of reversible causes is critical, as delayed diagnosis and care can result in

higher morbidity, death, longer hospital stays and worse neurological outcomes.<sup>[3]</sup>

Among metabolic anomalies, serum sodium concentration disorders have a particularly essential role in altered mental status. Sodium is essential for regulating neuronal membrane potential and cerebral osmotic equilibrium.<sup>[4]</sup> Both hyponatremia and hypernatremia can impair neuronal function by causing cerebral edema or cellular dehydration, respectively,

resulting in neurological symptoms such as headache, disorientation, seizures, and coma.<sup>[5]</sup> The brain is especially sensitive to sudden variations in serum sodium levels, hence dysnatremia constitutes a medical emergency when combined with altered awareness.<sup>[6]</sup>

Abnormal serum sodium levels are common in emergency departments, particularly among adult patients with acute medical conditions, chronic comorbidities, dehydration, renal impairment, or who are taking diuretics or other medications that affect water and electrolyte balance.<sup>[7]</sup> The prevalence and severity of sodium imbalance may differ depending on geographic location, population characteristics, and healthcare access, emphasizing the need of local epidemiological data.<sup>[8]</sup>

Despite the clinical significance of serum sodium abnormalities in patients with altered mental status, there is minimal local data on their occurrence and pattern in Iraqi emergency departments. Understanding the association between blood sodium levels and altered mental status might help emergency physicians make an early diagnosis, prioritize investigations, and initiate appropriate care on time. As a result, the aim of this study is to evaluate serum sodium levels in adult patients presenting with altered mental status to the emergency department of Al-Jamhory Teaching Hospital in Mosul. The study's findings may help to improve clinical assessment procedures and patient outcomes in Iraqi emergency care settings.

**2-PATIENTS AND METHODS**

The present study included prospective study of 45 adult patients who presented to emergency department in Al-

Jamhory Teaching Hospital with altered mental status during the period from February 2025 to July 2025. The study excluded patients with altered mental state secondary to trauma.

Data on these patients who admitted to emergency department are prospectively studied and entered demographic and clinical data, including (age, sex, occupation, chief complaint, with it is duration, medical history, drug history).

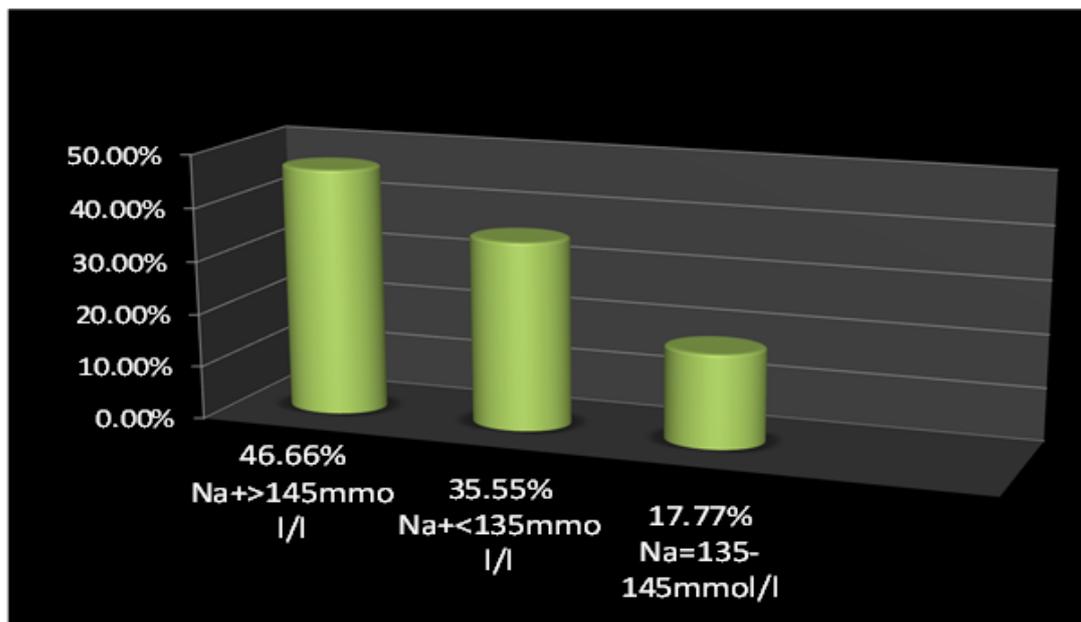
Full clinical examination of each patient was performed (blood pressure, plus rate, body temperature) as well as complete neurological examination including (consciousness, orientation, Glasgow coma scale assessment).

Investigations were done by OPTI CCA-TS machine for blood test which included (Na<sup>+</sup> serum level, blood urea) and random blood sugar. Descriptive analysis was conducted to study and analyzed the results.

**3- RESULTS**

The study included 45 patients. Of them 26 (57.77%) males and 19 (42.23%) females with male: female ratio of 1.368:1.

Figure 1 shows distribution of the study patients according to their plasma Na<sup>+</sup> level. 21 (46.67%) patients had Na<sup>+</sup> level of more than 145 mmol/l (hypernatremia) followed normal plasma Na<sup>+</sup> level in 16 (35.56%) and hyponatremia in 8 (17.77%) patients.



**Figure 1: Distribution of the study patients according to their Na<sup>+</sup> level.**

Table 1 shows that the majority of patients with each of hypernatremia, normal sodium level and hyponatremia had Glasgow coma scale of 9-13.

**Table 1: Distribution of patients with hypernatremia and hyponatremia according to their Glasgow coma scale.**

Sodium level	GCS 14-15	GCS 9-13	GCS <9
Hypernatremia	2 (9.52%)	15 (71.42%)	4 (19.04%)
Normal sodium level	5 (31.25%)	6 (37.5%)	5 (31.25%)
Hyponatremia	0 (0%)	8 (100%)	0 (0%)

Table 2 shows that the majority of patients with both more and less than 300 mmol/ l osmolality had Glasgow coma scale of 9-13.

**Table 2: Distribution of patients with more and less than 300 mmol/ l osmolality according to their Glasgow coma scale.**

Sodium level	GCS 14-15	GCS 9-13	GCS <9
More than 300 mmol/l	4 (15.38%)	18 (69.24%)	4 (15.38%)
Less than 300 mmol/l	3 (15.79%)	11 (57.90%)	5 (26.31%)

Table 3 shows that the majority of patients with both more and less than 40 years had Glasgow coma scale of 9-13.

**Table 3: Distribution of patients with more and less than 300 mmol/ l osmolality according to their Glasgow coma scale.**

Sodium level	GCS 14-15	GCS 9-13	GCS <9
More than 40 years	3 (8.82%)	26 (76.47%)	5 (14.71%)
Less than 40 years	2 (18.19%)	5 (45.45%)	4 (36.36%)

Table 4 shows that the majority of patients of random blood sugar of more than 250 mg/dl with each of hypernatremia and hyponatremia had Glasgow coma

scale of 9-13. While the majority of patients with random blood sugar of more than 250 mg/dl and normal sodium level had GCS of <9.

**Table 4: Distribution of patients with of random blood sugar of more than 250 mg/dl with each of hypernatremia, normal sodium level and hyponatremia according to their Glasgow coma scale.**

Sodium level	GCS 14-15	GCS 9-13	GCS <9
Hypernatremia + random blood sugar more than 250 mg/dl.	1 (16.67%)	4 (66.66%)	1(16.67%)
Normal sodium level + random blood sugar more than 250 mg/dl.	1 (33.33%)	0 (0%)	2 (66.67%)
Hyponatremia + random blood sugar more than 250 mg/dl.	0 (0%)	3 (100%)	0 (0%)

Diuretic use was prevalent among 4 (19.05%) of hypernatremia patients, while it was used by 4 (25%) and

2 (25%) patients with normal sodium level and hyponatremia.

**Table 5: Distribution of patients according to diuretic use.**

Diuretic use	Hypernatremia	Normal sodium level	Hyponatremia
Yes, number (%)	4 (19.05%)	4 (25%)	2 (25%)
No, number (%)	17 (80.95%)	12 (25%)	6 (25%)

**4. DISCUSSION**

This study assessed serum sodium levels in adult patients presenting with altered mental state to emergency department and found a significant prevalence of sodium abnormalities, particularly hypernatremia. Nearly half of the patients developed hypernatremia, with hyponatremia appearing in a lower proportion. These findings highlight the significance of dysnatremia as a reversible metabolic etiology of AMS in emergency situations. Similar findings have been reported in recent emergency-based studies, where electrolyte imbalance, particularly sodium derangement, was identified as a frequent cause of acute neurological impairment in critically ill patients.<sup>[9-10]</sup> Hypernatremia was more prevalent than hyponatremia in this study, which differs from general hospitalized populations but is consistent with emergency department-based studies of severely unwell or

dehydrated individuals. Hypernatremia in AMS is frequently accompanied with diminished thirst, limited access to free water, sepsis, or hyperglycemia, all of which are typical in emergency cases. According to recent studies, hypernatremia in adults is strongly associated with greater illness severity and poor neurological outcomes, especially when serum sodium levels rise rapidly.<sup>[11-12]</sup>

The majority of patients in all sodium categories had a Glasgow Coma Scale (GCS) score of 9–13, suggesting substantial impairment of consciousness. Patients with hypernatremia had lower GCS scores than those with normal sodium levels, indicating the previously recognized neurotoxic effect of high serum sodium related to neuronal dehydration and cerebral atrophy. According to recent studies, both hyponatremia and

hypernatremia are independently related with lower GCS and altered sensorium in emergency and intensive care patients.<sup>[13-14]</sup>

In the context of serum osmolality, the majority of patients in both hyperosmolar and normo-/hypoosmolar states had considerable impairment of consciousness. This discovery demonstrates that changed mental status is impacted not just by absolute sodium levels, but also by total plasma osmolality and the rate of osmotic fluctuations. Recent research reveals that acute changes in effective serum osmolality are more predictive of neurological symptoms than isolated electrolyte values, especially in critically ill individuals.<sup>[15]</sup>

Age-related analysis revealed that patients over the age of 40 were more likely to present with mild AMS. This could be explained by age-related physiological fragility, an increased prevalence of comorbidities, poorer renal concentrating ability, and weakened adaptive mechanisms to electrolyte imbalances. Similar age-related tendencies have been observed in recent emergency medicine study, with older patients being more vulnerable to dysnatremia-associated neurological impairment.<sup>[16]</sup>

This study found a significant interaction between hyperglycemia and sodium imbalance. Patients with elevated random blood sugar levels and dysnatremia had mostly moderate AMS, but those with hyperglycemia and normal sodium levels had more severe impairment. Hyperglycemia causes osmotic diuresis and relative hyperosmolar states, which can worsen brain dysfunction even in the absence of overt sodium abnormalities. This finding is consistent with recent studies that highlight the combined effect of glucose and sodium abnormalities on mental status in emergency patients.<sup>[17]</sup>

Diuretic usage was seen in all sodium categories, with slightly higher rates among individuals with normal sodium levels and hyponatremia. Diuretics, particularly thiazides, are widely known contributors to hyponatremia, but loop diuretics may cause volume depletion and hypernatremia. Recent systematic review demonstrate that medication-related electrolyte imbalance is still a significant and often overlooked cause of AMS in people presenting to emergency rooms.<sup>[18]</sup>

The small sample size and single-center design at Al-Jamhory Teaching Hospital limit the study's generalizability. Serum sodium and osmolality were only assessed at the time of presentation, making it unfit for evaluating dynamic changes and their neurological consequences. Potential confounders such as concomitant illnesses, infections, and drugs other than diuretics were not properly controlled, and the cross-sectional design made it impossible to demonstrate causation between sodium imbalances and changed mental status.

## 5- CONCLUSION

This study demonstrates that serum sodium disorders are widespread among adult patients presenting with altered mental status to AL-Jhumhory Teaching Hospital's emergency department. Hypernatremia was the most common sodium disturbance, and it was mostly linked with significant impairment of consciousness. Both dysnatremia and changed serum osmolality contributed to lower Glasgow Coma Scale scores, emphasizing the importance of electrolyte imbalance as a reversible cause of altered mental status in emergency situations. Routine serum sodium and plasma osmolality testing should be emphasized in all adult patients presenting with altered mental status in the emergency department. More multicenter studies with bigger sample sizes and longer follow-up are needed to better understand the prognostic implications of dysnatremia and to inform uniform management approaches in emergency care.

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## Conflict of interest

About this study, the authors disclose no conflicts of interest.

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