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Comparison of Sodium Imbalance in Diabetics and Non-Diabetics Presenting with Sepsis

Ali Ahmed Odho[1], Shaheen Bhatty[1]

[1]Department of Medicine, Dr. Ruth K.M. Pfau Civil Hospital, Karachi.

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Correspondence to: Ali Ahmed Odho, Department of Medicine, Dr. Ruth K.M. Pfau Civil Hospital, Karachi.
Email: aliaodho3@gmail.com

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ABSTRACT

Background: Patients with diabetes are more likely to get infection and, as a result, sepsis. Sepsis is the largest cause of intensive care unit (ICU) admissions, resulting in a huge healthcare burden. Despite extensive research on sepsis and electrolyte disturbances, in diabetic individuals there is a notable gap in studies comparing sodium imbalances in diabetic versus non-diabetic patients with sepsis. Therefore, the current study aims to explore these differences in sodium level in diagnosed patients of sepsis with and without diabetes. **Methodology:** It was a cross-sectional study conducted at Department of Medicine, Dr. Ruth K.M. Pfau Civil Hospital, Karachi from January to March 2025. The required sample size for this study after calculation was 113 patients however, the data was gathered for 120 patients 60 patients with diabetes and sepsis and other 60 without diabetes with sepsis. The study participants were recruited via non-probability consecutive sampling. The set inclusion criteria was patient of age between 18-70 years, either gender and patients presenting within 24–72 hours of sepsis onset. A 5 cc blood sample was drawn by a trained phlebotomist using aseptic techniques for serum sodium level assessment. Serum sodium levels were analyzed using flame spectrometry. All patients with sepsis were managed according to the hospital's standard treatment protocol. Data was recorded on a predesigned proforma, including the occurrence and type of sodium imbalance (hyponatremia or hypernatremia). **Results:** There was a significant difference (p-value <0.001) between the sodium level of diabetic and non-diabetic patients with sepsis. Most of the diabetic patients had hyponatremia (sodium level < 135 mEq/L). There was no significant difference (p-value = 0.221) in development of symptoms of sepsis among study participants of both the groups. **Conclusion:** Patients with sepsis and diabetes were presented with hyponatremia (sodium level < 135 mEq/L) in our study setting.

INTRODUCTION

Diabetes is a metabolic illness that is becoming increasingly common around the world. Diabetes is on the verge of becoming a pandemic due to changing lifestyles and widespread use of western diets that include processed foods[1]. Patients with diabetes are more likely to get infection and, as a result, sepsis. Sepsis is the largest cause of intensive care unit (ICU) admissions, resulting in a huge healthcare burden[2]. The death rate for patients admitted to the ICU with sepsis ranges between 18.9% and 52%. Several comorbidities, including advanced age, persistent alcoholism, and immunosuppressive status, have been demonstrated to have a deleterious impact on sepsis prognosis. However, the role of diabetes mellitus (DM) in sepsis-related outcomes is uncertain[3]. Diabetes mellitus (DM) affects 20.1% to 22.7% of all sepsis patients and is a significant comorbid illness in sepsis patients because it has the ability to modify essential aspects of sepsis pathogenesis. At baseline, diabetic patients have elevated levels of several endothelial pathways that are triggered during sepsis[4].

Sepsis, a severe systemic inflammatory response to infection, often leads to significant electrolyte disturbances, particularly sodium imbalances like hyponatremia and hypernatremia[5]. These imbalances are linked to worse outcomes, including increased morbidity and mortality, and are driven by mechanisms such as fluid shifts, renal dysfunction, and inappropriate antidiuretic hormone secretion (SIADH). Diabetic patients may be at higher risk for sodium imbalances due to factors like osmotic diuresis, pre-existing renal impairment, and altered hormonal regulation. Despite extensive research on sepsis and electrolyte disturbances, there is a notable gap in studies comparing sodium imbalances in diabetic versus non-diabetic patients with sepsis. In clinical practice, electrolyte imbalances are frequent. They mostly affect hospital

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populations, affecting a wide range of patients from those who are asymptomatic to those who are in critical condition, and they are linked to higher rates of morbidity and death. In community subjects, electrolyte homeostasis disruptions are also commonly seen. Even modest and persistent community-acquired electrolyte abnormalities are associated with a bad prognosis[5, 6].

Given that the aforementioned factors—particularly decreased renal function, malabsorption syndromes, acid-base disorders, and multidrug regimens—are frequently present in diabetics, diabetes mellitus (DM) is listed among the diseases with an increased prevalence of electrolyte abnormalities. It's noteworthy that around one-fifth of sepsis patients also have diabetes mellitus[7]. Despite extensive research on sepsis and electrolyte disturbances, in diabetic individuals there is a notable gap in studies comparing sodium imbalances in diabetic versus non-diabetic patients with sepsis. Addressing this gap is essential, as understanding the differences between these populations could aid in risk stratification and the development of targeted management strategies. Therefore, the current study aims to explore these differences and provide insights that could improve patient outcomes by preventing and managing sodium imbalances more effectively, particularly in diabetic patients, where such disturbances may be more severe or frequent.

METHODOLOGY

It was a cross-sectional study conducted at Department of Medicine, Dr. Ruth K.M. Pfau Civil Hospital, Karachi from January to March 2025, after getting approval from CPSP (CPSP/REU/MED-2019-183-14861). The sample size was calculated by using the WHO sample size calculator using frequency of sodium imbalance in patients with sepsis 75% (pilot), margin of error 8% and confidence level 95%. The required sample size for this study after calculation was 113 patients however, the data was gathered for 120 patients to balance the groups. The 120 participants were recruited as 60 patients with diabetes and sepsis and other 60 without diabetes with sepsis. The study participants were recruited via non-probability consecutive sampling.

The set inclusion criteria was patient of age between 18-70 years, either gender and patients presenting within 24–72 hours of sepsis onset. The exclusion criteria were patients with a history of hypothyroidism or hyperthyroidism, patients with a history of taking NSAIDs or thiazide diuretics, patients with a history of gout, patients with a history of stroke, chronic renal failure, chronic obstructive pulmonary disease (COPD), asthma, congestive heart failure (CHF), or myocardial infarction, patients with a history of malignancy and/or currently undergoing chemotherapy, patients with a history of adrenal insufficiency (Addison's disease), patients with active liver disease or cirrhosis, patients currently on chronic corticosteroid therapy, patients with a history of syndrome of inappropriate antidiuretic hormone secretion (SIADH), patients presenting with severe dehydration or overhydration, patients currently taking medications that affect sodium balance (e.g., SSRIs, antiepileptics like carbamazepine) Pregnant or lactating women.

Patients presenting with sepsis meeting the inclusion criteria, were enrolled from the Department of Medicine at Civil Hospital, Karachi after taking written informed consent. At the time of admission, all patients were screened for sepsis. A 5 cc blood sample was drawn by a trained phlebotomist using aseptic techniques for serum sodium level assessment. Serum sodium levels were analyzed using flame spectrometry. All patients with sepsis were managed according to the hospital's standard treatment protocol. Data was recorded on a predesigned proforma, including the occurrence and type of sodium imbalance (hyponatremia or hypernatremia). Data was analyzed by SPSS version 26. The data was normally distributed according to Shapiro-Wilk test. Therefore, Mean and standard deviation were reported for age, duration of sepsis and sodium level. Frequency and percentage were reported for gender, residential status, diabetes mellitus, hypertension, smoking status, and sodium imbalance. Pooled-t test was applied to check the statistical significance at 95% confidence interval and p-value less than 0.05 was considered as significant.

RESULTS

As per sample size calculation 120 diagnosed patients of sepsis 60 with diabetes and 60 without diabetes were approached. The mean age of study participants was 51.19 ± 9.86 years (Diabetic = 52.4 ± 10.06 years, non-diabetic = 49.9 ± 9.5 years). Out of them 62 (51.7%) were male and 58 (48.3%) were female, gender distribution of study participants (diabetic and non-diabetic) is shown in figure 1. Out of 120, 48 (40%) had history of hypertension and 32 (26.7%) were smokers (Figure 2). Figure 3 demonstrates the hypertension and smoking status of patients with diabetes. There was a significant difference (p-value <0.001) between the sodium level of diabetic and non-diabetic patients with sepsis. Most of the diabetic patients had hyponatremia (sodium level < 135 mEq/L). There was no significant difference (p-value = 0.221) in development of symptoms of sepsis among study participants of both the groups.

Figure 1

Gender Distribution of Study Participants

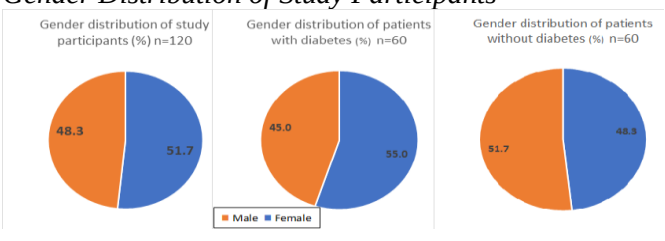

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Figure 2
Hypertension and Smoking Status of Study Participants (n=120)

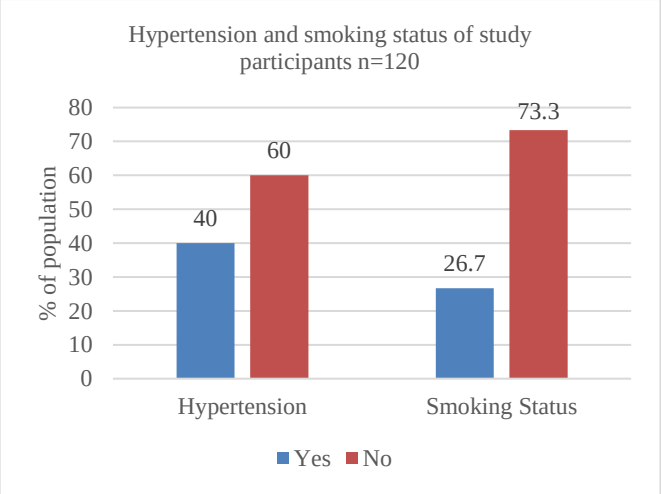

Figure 3
Hypertension and Smoking Status of Diabetic Participants n=60

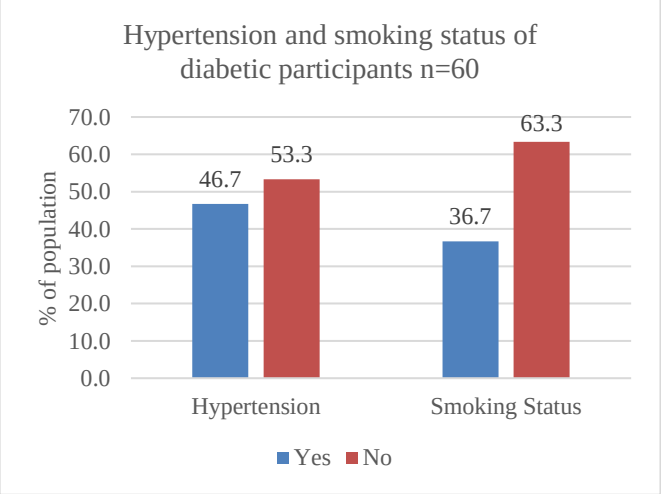

Table 1
Mean Sodium (Na) Level in Diabetic and Non-Diabetic Patients with Sepsis

Group		N	Mean	Std. Deviation	p-value
Sodium level	Diabetic	60	129.75	4.045	<0.001
	Non diabetic	60	138.72	2.415	

Table 2
Mean Time for Duration of Symptoms (Days)

Group		N	Mean	Std. Deviation	p-value
Duration of symptoms	Diabetic	60	1.75	.654	0.221
	Non diabetic	60	1.90	.681	

DISCUSSION

The primary function of sodium is to regulate fluid balance, ensuring that the appropriate quantity of water is retained in and around cells. This function is essential for maintaining blood pressure and blood volume, which are critical for cardiovascular health[8]. Sodium also promotes the healthy function of neurons and muscles. It facilitates nerve impulse transmission and muscle fiber contraction and relaxation, resulting in smooth physiological movements and responses[9]. The kidneys manage salt levels by excreting excess quantities through urine or storing them when necessary, ensuring a delicate balance required for biological processes. While sodium is required, excessive consumption can raise health concerns such as high blood pressure, heart disease, stroke, and kidney difficulties[10]. Most adults take more sodium than is recommended, primarily from processed meals. To avoid these hazards, health recommendations suggest that most adults limit their sodium consumption to less than 2,300 mg per day[11].

Recent study has thrown light on sodium's complex involvement in sepsis, demonstrating its importance in both the progression and therapy of this life-threatening illness[12]. Serum sodium levels have been found to be strongly linked with sepsis-induced coagulopathy (SIC) and patient outcomes[13]. A retrospective study of sepsis patients hospitalized to the ICU discovered that greater blood sodium levels were strongly associated with an increased risk of SIC and a poorer prognosis[14]. Patients with SIC had considerably greater serum sodium levels than those without SIC, and serum sodium levels correlated positively with SIC scores[15]. Multiple studies have found a link between serum sodium levels and mortality in sepsis patients, with higher sodium levels associated with higher death rates. These findings highlight the significance of careful sodium management in sepsis treatment, as well as the potential of blood sodium levels as a prognostic biomarker in septic patients[16, 17, 18]. Considering complexity of sodium imbalance and associated complications the current study compared the sodium level in diagnosed patients of sepsis with and without diabetes.

In the current study patients with diabetes were found to be hyponatraemic (sodium level < 135 mEq/L) when compared to patients without diabetes. Diabetes mellitus can lead to the development of hyponatremia; however, the relationship is complicated and diverse. Hyponatremia in diabetes individuals is frequently caused by osmotic diuresis-induced hypovolemia, in which excess glucose in the urine causes greater water loss, potentially leading to hypovolemic hyponatremia[19]. Furthermore, diabetic nephropathy and chronic renal failure can decrease water excretion, making diabetic individuals more susceptible to hyponatremia[20]. Diabetes has been associated to hyponatremia independent of hyperglycaemia, which could be owing to altered vasopressin regulation and insulin-induced effects on renal water channels[21]. Diabetic patients are more prone to have hyponatremia than non-diabetics, underlining the inherent link between diabetes and electrolyte disorders[22]. However, it is crucial to

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remember that diabetes can cause both hyponatremia and hypernatremia, depending on the severity of hyperglycaemia and the existence of associated complications such as diabetic ketoacidosis or hyperosmolar hyperglycaemic condition. As a result, while diabetes can cause hyponatremia, electrolyte changes in diabetic patients vary greatly and are context-dependent. Therefore, when admitted due to sepsis and diabetes the sodium levels must be considered as important factor for good prognosis of patients[23].

CONCLUSION

Patients with sepsis and diabetes were presented with hyponatremia (sodium level < 135 mEq/L) in our study setting. There was no difference in duration of development of symptoms of sepsis. To explore the further role of sodium in same scenario a prospective study is suggested that can follow the management of patients with sepsis and diabetes and identify the treatment outcome.

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