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SERUM ELECTROLYTE PROFILES IN PATIENTS OF MYOCARDIAL INFRACTION WITH TYPE 2 DIABETES MELLITUS

Anurag Mishra[1], Dr Ajay Kumar Gupta[2], Shailendri Kushwaha[3], Sagar Tiwari[4], Jyoti[5], Sneh Lata[6], Dr Praveen Katiyar[7*]

[1]School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India, 208024.
[2]Associate Professor, School of Pharmaceutical Sciences (Formerly University Institute of Pharmacy), Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India, 208024.
[3]Ph.D Scholar, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India, 208024.
[4,5,6]MSc - MLT in Clinical Biochemistry, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India, 208024
[7]Associate Professor, School of Health Sciences, Chhatrapati Shahu Ji Maharaj University, Kanpur, Uttar Pradesh, India, 208024.*

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Corresponding author: Dr Praveen Katiyar
(drpraveenkatiyar@gmail.com)

ABSTRACT

This study aims to assess serum concentrations of serum electrolytes such as sodium, potassium, and chloride in myocardial infarction patients with Type 2 Diabetes. This randomized prospective study was conducted at the LPS Institute of Cardiology, Kanpur Nagar, U.P., India. 300 subjects were participated and evenly divided into two groups: control and case group (MI patients with T2DM). Patient selection was based on inclusion and exclusion criteria. Blood samples were collected via venipuncture; serum was separated into aliquots and analyzed. Our study observed that the mean sodium levels were (136.21 ± 3.71 mEq/L) in the control group and (128.78 ± 4.85 mEq/L) in the case group. The mean potassium levels were (3.6 ± 0.2 mEq/L) in the control group and significantly higher at (5.6 ± 0.3 mEq/L) in the case group. Conversely, the mean chloride levels were (108.1 ± 0.86 mEq/L) in the control group and significantly lower at (98.8 ± 0.78 mEq/L) in the case group. These findings indicate significant alterations in serum electrolyte levels in myocardial infarction patients with T2DM. These findings emphasize the importance of individualized electrolyte management, particularly for patients with elevated potassium or altered chloride levels, as even minor imbalances can significantly impact health. Future research should further explore the mechanisms underlying these electrolyte variations to guide more precise and effective clinical interventions.

KEYWORDS: Na++, Chloride, Heart failure, Type 2 Diabetic Mellitus

1. INTRODUCTION

Electrolytes are vital elements in the human body, contributing significantly to essential physiological functions. They assist in regulating fluid balance, maintaining pH stability, enabling nerve signaling, supporting blood clotting, and facilitating muscle contractions[1]. Essential electrolytes include potassium, sodium, and calcium, vital for maintaining proper electrolyte balance. An electrolyte disturbance can occur due to various factors such as kidney diseases, fever, dehydration, and vomiting[2] and these factors has been identified as a potential causative factor to difficulties observed in diabetes and other endocrine disorders[3]. Diabetes mellitus is not a simple condition but rather comprises a diverse range of metabolic disorders characterized by persistent hyperglycemia[4]. This complexity arises from dysregulation in lipid, carbohydrate, and protein metabolism, which is typically due to defects in insulin production and/or insulin action at the cellular level[5]. Diabetes mellitus is characterized by a range of clinical manifestations, notably polyuria, polydipsia, fatigue, unintended weight loss, blurred vision, hyperphagia, and the presence of diabetic dermatomes[6]. Current estimates suggest that approximately 100 million individuals globally are living with diabetes mellitus, and the prevalence of this metabolic disorder is escalating[7]. Hyperglycemia induces osmotic diuresis, creating a physiological environment that alters electrolyte concentrations. Elevated glucose levels exert an osmotic effect, reducing effective circulating blood volume and causing fluid shifts from intracellular compartments, which can lead to cellular dehydration[8]. This study aims to assess serum electrolyte imbalances and their clinical significance in patients of MI with T2DM.

2. MATERIALS AND METHODOLOGY

This randomized prospective study was conducted at the LPS Institute of Cardiology, Kanpur Nagar, Uttar Pradesh, India. The study population consisted of 300 subjects, including 150 cases (patients with myocardial infarction and Type 2 Diabetes Mellitus) and 150 controls. The study was approved by the Human Ethical Committee of CSJM University, Kanpur (Ref. No. CSJMU/R&D/1486/2023). Patients were selected according to predefined inclusion and exclusion criteria. Blood specimen were collected by venipuncture in plain vials, and the serum was separated into aliquots and analyzed.

3. RESULT

The study involved 300 participants, evenly split into two groups: 150 MI patients with T2DM in the case group and 150 healthy individuals in the control group in which control group had 45 females and 105 males, while case group had 52 females and 98 males (refer to Table 1, Figure 1). The average age in the control group was 46 years for males and 40 years for females, whereas in the case group, it was 48 years for males and 42 years for females (see Table 2, Figure 2). Serum electrolyte analysis (Table 3) showed a significantly higher sodium level in the control group (136.21 ± 3.71) compared to the case group (128.78 ± 4.85) ($p = 0.00^{**}$). Potassium levels were significantly elevated

in cases (5.6 ± 0.3) compared to controls (3.6 ± 0.2) ($p = 0.00^{**}$). Chloride levels were significantly lower in cases (98.8 ± 0.78) than in controls (108.1 ± 0.86) ($p = 0.00^{**}$), indicating statistically significant differences across all measured parameters (Figure 3).

Table 1: Gender Distribution of Subjects in the Study Population

Participants	Case Group	Control Group
Male	98	105
Female	52	45
Total	150	150

All values are frequency of Subjects in study population.

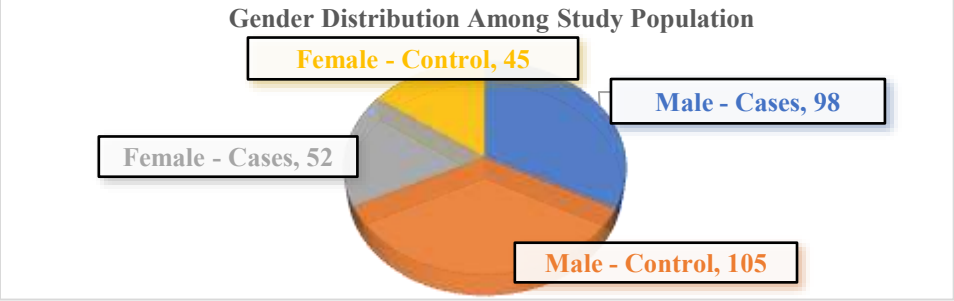

Figure 1: Illustrates the gender distribution within the study population.

Table2: Mean Age of Subjects in the Study Population

Gender	Case Group (Mean age)	Control Group (Mean age)
Male	48	46
Female	42	40

All values represent the mean age of study populations

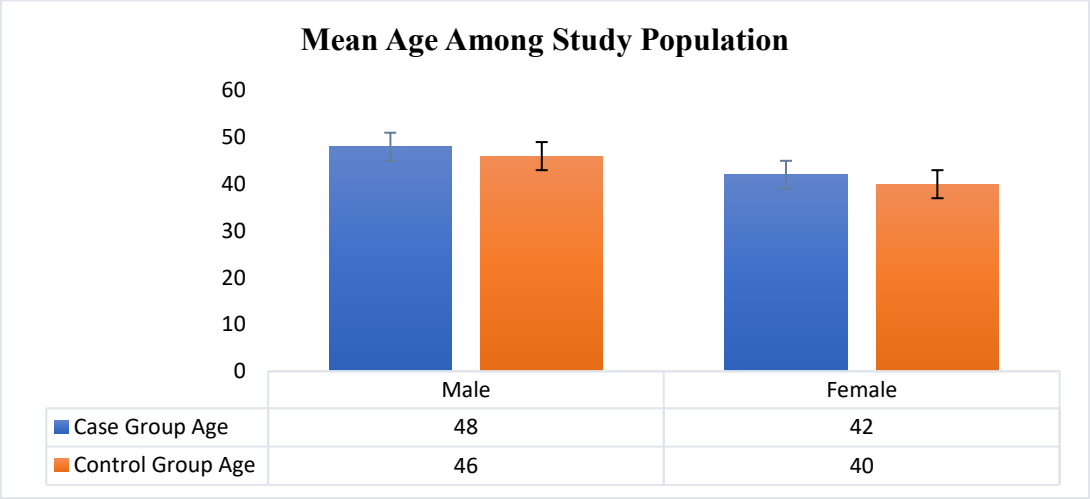

Figure 2: llustrates the Mean age of study population.

Table 3: Serum Electrolytes in Study Population

Parameters	Case (Mean & SD)	Control (Mean & SD)	T-vale	P-value
Sodium (mEq/L)	128.78 ± 4.85	136.21 ± 3.71	7.14	<0.001**
Potassium (mEq/L)	5.6 ± 0.3	3.6 ± 0.2	-32.87	<0.001**
Chloride (mEq/L)	98.8 ± 0.78	108.1 ± 0.86	42.03	<0.001**

All value were mean & SD. T-value: Student's t-test statistic; P-value: significance value; ** indicates highly significant results (P < 0.001).

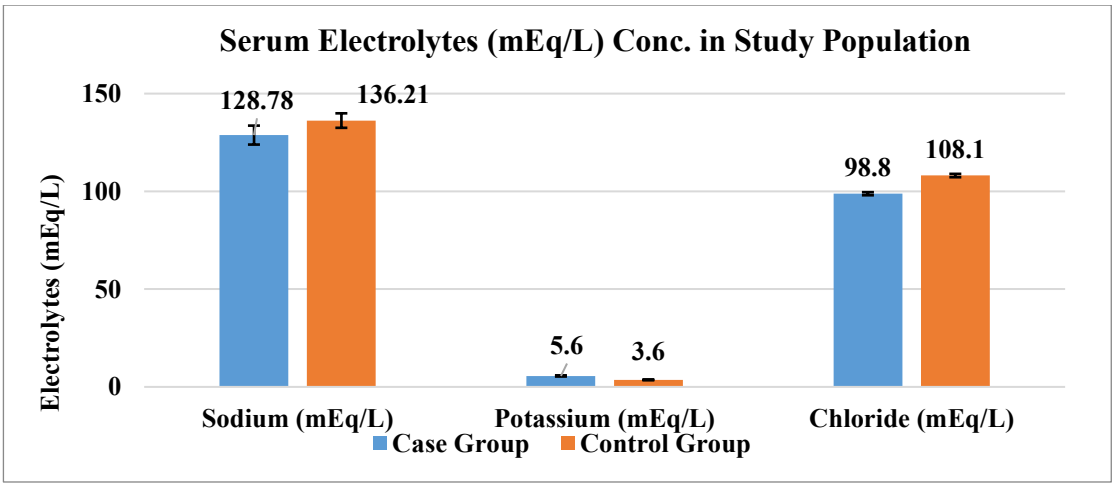

Figure 3: Displays serum Sodium, Potassium and Chloride levels in study population.

4. DISCUSSION

This study thoroughly examined the electrolyte profiles of patients in the case and control groups, specifically focusing on sodium, potassium, and chloride concentrations. Our findings indicated that serum sodium levels are higher in control group compared to case group, and serum potassium high in case group compared to control group, in contrast serum chloride is higher in control group compared to case group, suggesting possible physiological disruptions in the case group. These results agree with previous studies, which have emphasized the importance of potassium and chloride levels in patient outcomes. For instance, Javaid et al. (2023) observed similar electrolyte variations, including fasting blood sugar, serum sodium, potassium, and chloride, in patients with

diabetes, which could be relevant to our own findings in the case group9. Collins et al. (2017) identified a U-curved association between serum potassium conc. and mortality. Their study found that individuals with potassium levels ranging from 4.0 to <5.0 mEq/L had the lowest mortality rates, whereas those with levels below 4.0 or above 5.0 mEq/L faced a significantly higher risk[10]. Elevated potassium levels in our case group suggest a potential impact on cardiac function, aligning with the cardiovascular risks identified in other studies, such as Ter Maaten et al. (2016)[11]. The role of chloride is also critical, as highlighted by Ter Maaten et al. (2016) and Wu et al. (2023). These studies noted that low chloride levels can signal poor diuretic response, worsening heart failure, and increased mortality risks[11,12]. Similarly, in our study, the case group demonstrated reduced chloride concentrations, which may indicate underlying issues such as acid-base disturbances or renal dysfunction. The findings from Kondo et al. (2018) and Wu et al. (2023) further support the observation that persistent or progressive hypochloremia is associated with a heightened risk of mortality, which underscores the need for careful monitoring of this electrolyte[12,13]. Collectively, our findings reinforce the critical role of potassium and chloride imbalances in determining clinical outcomes. Elevated potassium and reduced chloride levels in the case group reflect trends seen in other studies, suggesting that these imbalances may contribute to poor prognosis, especially in patients with pre-existing conditions like heart failure, kidney disease, or diabetes. These results highlight the importance of early identification and management of electrolyte disturbances to optimize patient care and mitigate potential complications.

5. CONCLUSION

This study highlights significant electrolyte imbalances in MI patients with T2DM, with notably lower sodium and chloride levels and elevated potassium levels in the case group compared to controls. Statistical analysis exposed significant differences ($p < 0.001$**) for all parameters. These findings suggest that electrolytes imbalances may play a critical role in the pathophysiology of myocardial infarction in diabetic patients, underscoring the importance of regular electrolyte monitoring and management. The results highlight the necessity for early detection and intervention to manage electrolyte disturbances, which can significantly improve patient care. Ongoing research into the connections between electrolyte imbalances and various clinical conditions is essential for advancing treatment approaches and optimizing patient outcomes.

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Ethical Approval: Approved by the Human Ethical Committee, CSJM University, Kanpur (Ref. No. CSJMU/R&D/1486/2023).

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