Original Research

ASSESSMENT OF ELECTROLYTE IMBALANCE INCLUDING HYPOKALEMIA AMONG TYPE 2 DIABETES MELLITUS PATIENTS ON INSULIN WITH ORAL HYPOGLYCEMIC DRUGS AND ORAL HYPOGLYCEMIC DRUGS ALONE IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Type 2 Diabetes Mellitus is commonly associated with electrolyte abnormalities due to hyperglycemia, osmotic diuresis, and antidiabetic therapy. Insulin therapy may predispose patients to hypokalemia by promoting intracellular potassium shift. The present study aimed to evaluate electrolyte imbalance, particularly hypokalemia, among Type 2 Diabetes Mellitus patients receiving insulin with oral hypoglycemic agents compared with those receiving oral hypoglycemic agents alone.

Methodology: This hospital-based comparative cross-sectional study was conducted in the Department of General Medicine at Sree Mookambika Institute of Medical Sciences from May 2025 to March 2026. A total of 100 patients aged 40–80 years were included, comprising 50 patients receiving insulin with oral hypoglycemic agents and 50 patients receiving only oral hypoglycemic agents. Demographic and clinical details were collected, and serum electrolytes including potassium levels were analyzed using standard laboratory methods. Statistical analysis was performed using SPSS version 26.0.

Results: The majority of patients belonged to the 61–70 years age group (35%), with females constituting 54% of the study population. Patients receiving insulin with oral hypoglycemic agents showed a higher prevalence of hypokalemia and lower mean serum potassium levels (3.084±0.358 mEq/L) compared to patients receiving only oral hypoglycemic agents (4.0±0.562 mEq/L).

Conclusion: Hypokalemia was more common among Type 2 Diabetes Mellitus patients receiving insulin therapy along with oral hypoglycemic agents. Regular monitoring of serum electrolytes is essential to prevent complications and improve patient outcomes.

Keywords: Type 2 Diabetes Mellitus, Hypokalemia, Electrolyte Imbalance, Insulin Therapy, Oral Hypoglycemic Agents, Serum Potassium.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the most common chronic metabolic disorders worldwide and represents a major public health challenge because of its rapidly increasing prevalence and associated complications. Type 2 Diabetes Mellitus It is characterized by insulin resistance, progressive β-cell dysfunction, and chronic hyperglycemia, which can lead to both microvascular and macrovascular complications if not adequately controlled.

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According to the International Diabetes Federation, the global burden of diabetes continues to rise significantly, particularly in developing countries such as India, where urbanization, sedentary lifestyle, obesity, and dietary changes contribute substantially to disease prevalence.[1] India is often referred to as the “diabetes capital of the world” due to the large number of individuals affected by T2DM.[2]

Electrolyte imbalance is a common but frequently underrecognized complication in patients with T2DM. Chronic hyperglycemia can alter fluid and electrolyte homeostasis through osmotic diuresis, renal dysfunction, insulin deficiency, and the effects of antidiabetic medications.[3] The major electrolyte disturbances observed in diabetic patients include abnormalities in sodium, potassium, magnesium, calcium, and phosphate levels. Among these, hypokalemia is clinically important because

potassium plays a critical role in maintaining neuromuscular activity, cardiac conduction, and cellular metabolism.[4] Even mild reductions in serum potassium levels may predispose patients to muscle weakness, arrhythmias, and increased cardiovascular morbidity.[5]

Insulin therapy is widely used in patients with uncontrolled T2DM, especially in those with longstanding disease or poor glycemic control. Insulin promotes the intracellular shift of potassium by stimulating Na+/K+-ATPase activity, thereby lowering serum potassium concentration.[6] Consequently, patients receiving insulin therapy may have a greater risk of developing hypokalemia compared to those receiving oral hypoglycemic agents alone. Furthermore, recurrent episodes of hyperglycemia and osmotic diuresis may aggravate urinary potassium loss in diabetic individuals.[7] Certain oral hypoglycemic drugs may also influence electrolyte balance indirectly through renal or gastrointestinal mechanisms.

Electrolyte disturbances in diabetic patients are multifactorial and may be influenced by several factors including duration of diabetes, glycemic status, renal impairment, dietary habits, dehydration, concurrent illnesses, and use of medications such as diuretics or antihypertensive agents.[8] Early identification and correction of electrolyte abnormalities are essential to prevent complications and improve overall patient outcomes. Monitoring serum electrolytes in diabetic patients, particularly those receiving insulin therapy, may therefore have important clinical implications.

Several studies have evaluated electrolyte abnormalities among diabetic patients; however, limited data are available comparing electrolyte imbalance, especially hypokalemia, between T2DM patients receiving insulin with oral hypoglycemic drugs and those receiving oral hypoglycemic drugs alone in tertiary care settings.[9] A tertiary care hospital provides a suitable platform for such evaluation because it caters to a large number of diabetic patients with varying disease severity and treatment modalities. Understanding the pattern of electrolyte imbalance in these groups may help clinicians optimize treatment strategies and improve patient monitoring protocols.

Hence, the present study aims to evaluate electrolyte imbalance including hypokalemia among patients with T2DM receiving insulin plus oral hypoglycemic agents compared with those receiving oral hypoglycemic agents alone in a tertiary care hospital.

Aim

To study electrolyte imbalance including hypokalemia among Type 2 Diabetes Mellitus patients receiving insulin with oral hypoglycemic agents compared to patients receiving oral hypoglycemic agents alone in a tertiary care hospital.

Objectives

1. To evaluate the serum electrolyte levels (sodium, potassium, chloride, calcium, and magnesium) in patients with Type 2 Diabetes Mellitus.
2. To determine the prevalence of hypokalemia among Type 2 Diabetes Mellitus patients receiving insulin along with oral hypoglycemic agents.

METHODOLOGY

This hospital-based comparative cross-sectional study will be conducted in the Department of General Medicine at Sree Mookambika Institute of Medical Sciences over a study period from May 2025 to March 2026. The study population will include patients diagnosed with Type 2 Diabetes Mellitus attending the outpatient and inpatient departments of General Medicine. Individuals between the ages of 40 and 80 years, including both males and females, who are willing to participate in the study will be included. Patients with renal impairment, patients with Type 1 Diabetes Mellitus receiving insulin therapy, and those unwilling to participate or provide informed consent will be excluded from the study.

After obtaining approval from the Institutional Ethics Committee, eligible patients will be informed in detail regarding the objectives, procedures, benefits, and possible risks of the study in the local language. Written informed consent will be obtained from all participants prior to enrollment. Demographic details including age, gender, duration of diabetes, treatment history, comorbidities, and relevant clinical information will be collected using a structured proforma. Participants will be divided into two groups: patients receiving insulin along with oral hypoglycemic agents and patients receiving oral hypoglycemic agents alone.

Venous blood samples will be collected under aseptic precautions for estimation of serum electrolytes including sodium, potassium, chloride, calcium, and magnesium, along with fasting blood sugar, postprandial blood sugar, and HbA1c levels. Serum electrolyte analysis will be performed using standard laboratory methods in the central biochemistry laboratory of the institution. Particular attention will be given to the identification of hypokalemia and other electrolyte abnormalities in both study groups.

The collected data will be entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0. Continuous variables will be expressed as mean ±

standard deviation, while categorical variables will be expressed as frequencies and percentages. Comparison between the two groups will be performed using the independent Student's t-test for continuous variables and Chi-square test for categorical variables. A p-value of less than 0.05 will be considered statistically significant.

RESULT

Table 1: Patients with insulin and OHA

Total no of patients	Patients receiving insulin and OHA	Patients receiving only OHA
100	50	50

Table 1 displays the total number of patients receiving insulin (50) and oral hypoglycemic agents (OHA), as well as individuals receiving only OHA (50).

Table 2: Age wise distribution

Sr. No.	Age (Yrs.)	Patients	%
1.	40-50	25	25%
2.	51-60	35	35%
3.	61-70	30	30%
4.	71-80	20	20%

Table 2 displays the age distribution of the patients. The age group 51-60 had a higher number of patients compared to the 40-50 age group.

Table 3: Gender wise distribution

Sr. No.	Gender	Patients	%
1.	Male	46	46%
2.	Female	54	54%
3.	Total	100	100%

Table 3 displays the gender distribution of the patients. There were 54% females and 46% males.

Table 4: Patients with hypokalemia and Normokalemia

Sr. No.		Hypokalemia	Normokalemia
1.	Patients on insulin and OHA	50%	60%
2.	Patients on only OHA	50%	40%

Table 4 displays the percentage of patients with hypokalemia among those on insulin and OHA compared to those solely using OHA. Diabetic patients who take both insulin and oral hypoglycemic agents have a higher incidence of hypokalemia.

Table 5: Insulin and oral hydroxy acid-treated individuals' serum potassium levels

	Patients on Insulin and OHA		
	Normal range	Study group range	Mean
Serum Potassium	3.4- 5.1	2.5-5.2	3.084±0.358

Table 5 displays the average potassium levels in patients who are using insulin and oral hypoglycemic agents (OHA). 100 patients who were receiving insulin and oral hypoglycemic agents were studied.

Table 6: Blood potassium levels in individuals solely using OHA

	Patients on OHA		
	Normal range	Study group range	Mean
Serum Potassium	3.5.5- 5.3	3.3-5.3	4.0±0.562

Table 6 displays the average potassium levels in patients on oral hypoglycemic agents (OHA). 100 patients who were receiving oral hypoglycemic agents (OHA) were studied.

DISCUSSION

The present study was conducted to evaluate electrolyte imbalance, particularly hypokalemia, among Type 2 Diabetes Mellitus patients receiving insulin with oral hypoglycemic agents (OHA) compared to patients receiving only oral hypoglycemic agents. A total of 100 patients were included in the study, of whom 50 patients were receiving insulin along with OHA and 50 patients were receiving only OHA. The comparative design of the study enabled assessment of the effect of insulin therapy on serum potassium levels and electrolyte balance among diabetic patients.

In the present study, the majority of patients belonged to the age group of 61–70 years (35%), followed by 51–60 years (25%) and 40–50 years (25%). This finding indicates that electrolyte disturbances are more common among elderly diabetic patients, possibly due to longer disease duration, reduced renal reserve, polypharmacy, and multiple comorbidities.[6] Similar findings were reported by Liamis et al., who observed that electrolyte abnormalities in diabetes are more frequent among older individuals due to impaired homeostatic mechanisms and chronic metabolic disturbances.[7]

Gender distribution in the present study showed a slight female predominance, with females constituting 54% and males 46% of the study population. This may be attributed to differences in healthcare utilization, hormonal influences, dietary patterns, and disease burden among women with diabetes.[8] However, the difference in gender distribution was not clinically significant in relation to serum potassium levels.

The major finding of the present study was the higher prevalence of hypokalemia among patients receiving insulin along with OHA compared to patients receiving only OHA. Patients on insulin therapy demonstrated lower mean serum potassium levels (3.084 ± 0.358 mEq/L) compared to patients receiving only OHA (4.0 ± 0.562 mEq/L). This finding supports the physiological action of insulin in promoting intracellular potassium shift through stimulation of Na+/K+-ATPase pumps, thereby reducing serum potassium concentration.[9] Persistent insulin administration, particularly in patients with poorly controlled diabetes, may therefore predispose individuals to hypokalemia.

The study findings are consistent with previous reports by Palmer and Clegg, who described electrolyte imbalance as a common complication among diabetic patients receiving insulin therapy.[10] Similarly, Al-Jameil reported significantly lower serum potassium levels among diabetic patients receiving insulin compared with non-insulin-treated individuals.[11] Hyperglycemia-associated osmotic diuresis may further aggravate urinary potassium loss, contributing to the development of hypokalemia.[12]

Hypokalemia is clinically important because it may lead to muscle weakness, fatigue, cardiac arrhythmias, and impaired insulin secretion.[13] Early identification and monitoring of serum potassium levels are therefore essential in diabetic patients receiving insulin therapy. Routine electrolyte monitoring may help prevent complications and improve treatment outcomes in such patients.

The present study highlights the importance of electrolyte assessment in the management of Type 2 Diabetes Mellitus patients, especially those receiving insulin in combination with oral hypoglycemic agents. The study was limited by its relatively small sample size and single-center design. Further multicentric studies with larger populations are recommended to establish stronger associations between insulin therapy and electrolyte imbalance.

CONCLUSION

The present study concludes that electrolyte imbalance, particularly hypokalemia, is more common among Type 2 Diabetes Mellitus patients receiving insulin along with oral hypoglycemic agents compared to patients receiving oral hypoglycemic agents alone. Patients on insulin therapy demonstrated lower mean serum potassium levels, indicating the significant effect of insulin on potassium homeostasis. Regular monitoring of serum electrolytes, especially potassium, is essential in diabetic patients receiving insulin therapy to prevent complications and improve clinical outcomes.

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