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Original research article

To study electrolyte imbalance including hypokalemia, in type 2 diabetes mellitus patients taking insulin and oral hypoglycemic medicines versus oral hypoglycemic drugs alone

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Abstract

Introduction and Background: Diabetes mellitus is a serious disorder that is widespread globally. It is a significant health issue and one of the fastest-growing metabolic diseases. The aim of this study was to examine electrolyte imbalance, namely Hypokalemia caused by exogenous Insulin in individuals with Type 2 Diabetes Mellitus.

Materials and Methods: A total of 100 patients were included in this investigation. This study was conducted at the Department of Pharmacology, Madha Medical College and Research Institute, Chennai, Tamil Nadu, India. The study was conducted from February 2016 to February 2017. This study is an observational, comparative, cross-sectional study comparing Type 2 Diabetes Mellitus patients on long-term insulin therapy and oral hypoglycemic medications with patients solely on oral hypoglycemic agents.

Results: This study analysed electrolyte imbalance, namely hypokalemia, in individuals with type 2 diabetes mellitus who were treated with insulin and oral hypoglycemic agents. 100 patients were placed into two groups for the trial. One group consisted of 50 patients with type 2 diabetes mellitus who were taking insulin plus oral hypoglycemic agents, whereas the other group included 50 patients with type 2 diabetes mellitus who were only taking oral hypoglycemic agents. The age bracket mentioned spans from 40 to 80 years. There were more patients aged 51-60 years in the age distribution, while female patients slightly outnumbered male patients in the sex distribution.

Conclusion: In order to prevent problems and improve quality of life, the use of exogenous insulin should be restricted to acceptable indications, doses, and frequent monitoring of serum potassium.

Keywords: Electrolyte imbalance, hypokalemia, type 2 diabetes mellitus, insulin

Introduction

Worldwide, diabetes mellitus is rather common and poses a significant health risk. It is the fastest-growing metabolic disorder and a big health concern. This disease, which ranks third globally, impacts 7.1% of the Indian population and 1.5% of the global population. Hyperglycemia that does not go away, regardless of how much insulin the body produces or how well it works, is a hallmark of diabetes mellitus [1, 2]. Sushruta initially characterised diabetes as a condition characterised by the production of an excessive amount of sweet-tasting urine. The acinar cells emit digesting enzymes, while the islet cells secrete hormones; this was discovered in 1869 by a German medical student named Paul Langerhans [3, 4].

A state similar to diabetes mellitus in humans can be observed in pancreatectomy dogs. In the early 20th century, a Berlin doctor named Gurg Zeuler attempted to use pancreatic extract to cure a diabetic patient who was almost about to die. Physiologist Nicolas Paulesco of Rome discovered that diabetic dogs injected with pancreatic extract had lower urine sugar and ketones levels between 1916 and 1920. A pancreatic extract that lowered blood glucose content in diabetic dogs was obtained by Banting and Best in 1921. Banting and Best's active extract was initially administered to 14-year-old Leonard Thompson, whose blood sugar level was 500 mg/dl. After treating patients in North America with a stable extract developed by Macleod and J.B. Collip, they moved on to using insulins from pigs and cows. Human insulin is now being prepared for therapy through recombinant DNA technology [5, 7].

The majority of people with type 1 and type 2 diabetes mellitus are treated with exogenous insulin. To exert its effects, insulin stimulates the GLUT4 transporter, which carries glucose into cells. As a result of its effect on Na + K + ATPase activity, insulin facilitates potassium entry into skeletal muscle and

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hepatic cells [8, 10].

Potassium, an important cation of cells, is mainly contained within cells themselves (98 percent). Twenty percent of potassium is found in the brain and big viscera, ten percent in the skin and subcutaneous tissues, and seventy percent in the muscles. A serum potassium level between 3.5 and 5 mMol/L is considered normal. Hypokalemia is characterised by a blood potassium level below 3.5 mMol/L. Decreased consumption, gastrointestinal loss, renal loss, and medications such as exogenous insulin, salbutamol, theophylline, diuretics, laxatives, amphotericin B, and others can lead to hypokalemia [9, 11].

By bringing potassium into the cells, insulin treatment reduces potassium concentration. Hypokalemia can be a serious side effect of insulin therapy administered externally. Hypokalemia causes conduction abnormalities in the heart as well as myalgia, exhaustion, muscular cramps, and paralytic ileus. Hyperglycemia and carbohydrate intolerance are the outcomes of hypokalemia, which inhibits insulin secretion and reduces peripheral glucose utilisation. The purpose of this research is to compare the prevalence of hypokalemia and other electrolyte imbalances in type 2 diabetic patients taking insulin in addition to oral hypoglycemic medicines versus those taking oral hypoglycemic drugs alone. Hypokalemia and other electrolyte imbalances, as well as other side effects of exogenous insulin therapy, will be monitored in this study [10, 12].

The researchers set out to examine potential insulin-related side effects, with a focus on electrolyte imbalances caused by exogenous insulin, particularly hypokalemia, in people with type 2 diabetes mellitus.

Materials and Methods

A total of 100 patients were included in this investigation. This study was conducted at the Department of Pharmacology, Madha Medical College and Research Institute, Chennai, Tamil Nadu, India. The study was conducted from February 2016 to February 2017. This study is an observational, comparative, cross-sectional study comparing Type 2 Diabetes Mellitus patients on long-term insulin therapy and oral hypoglycemic medications with patients solely on oral hypoglycemic agents.

Inclusion Criteria

- Individuals between the ages of 40 and 80.
- Both men and women.
- Tose who are open to taking part in the study.

Exclusion Criteria

- Patients with renal impairment.
- Patients with Type 1 Diabetes Mellitus on Insuline.
- Patients unwilling to participate and provide consent

Study procedure

Patients will receive detailed explanations regarding the study's objectives and protocols. Patients who wish to participate in the study will be required to provide informed consent in the specified manner in the local language. We will collect the demographic information of the patients. Patients who meet the specified criteria will be included in the trial.

Results

This study aimed to evaluate electrolyte imbalance, particularly hypokalemia, resulting from exogenous insulin therapy and the adverse effects of insulin in patients with type 2 diabetes mellitus who are taking both insulin and oral hypoglycemic agents, compared to patients with type 2 diabetes mellitus who are only taking oral hypoglycemic agents.

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%

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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

When treating diabetes mellitus type 1, type 2, hyperkalemia, and gestational diabetes mellitus, exogenous insulin is among the most popular drugs used. Insulin regulates the metabolic processes of numerous tissues, affects cell proliferation, and encourages glucose and adipose storage within specialised target cells. Treatment of diabetic ketoacidosis and hyperglycemic hyperosmolar coma also involves the administration of insulin. Insulin comes in a variety of modalities for administration, including subcutaneous injection, inhaled insulin, and continuous subcutaneous infusion devices. Some of the side effects of using exogenous insulin include hypoglycemia, lipodystrophy, allergies, and edema. Serious consequences such as paralytic ileus, arrhythmias, and muscle cramps can develop from hypokalemia, which is prevalent in people using exogenous insulin for an extended period of time [13, 15].

This study examined the effects of insulin and oral hypokalemia on electrolyte imbalances in patients with type 2 diabetes mellitus. One hundred patients were split evenly between the two groups. In one group, 50 patients with type 2 diabetes mellitus who were using insulin in addition to OHA were included, and in the other group, 50 patients who were taking OHA alone were included. Participants' ages vary from forty to eighty. According to the age distribution, there are more patients between the ages of 51 and 60, and when looking at the sex distribution, there are somewhat more female patients than male patients [16, 18].

In a study involving 100 individuals with type 2 diabetes mellitus, serum electrolytes were taken. Among those patients, 63% had hypokalemia while taking insulin and OHA together, while 12% had it while taking OHA alone for over 5 years. When people use insulin for an extended period of time, their serum potassium levels drop significantly [19, 20]. The average serum potassium level in individuals receiving both exogenous insulin and oral hydroxyacetone is 3.083 mMol/L, while the average serum potassium level in patients receiving OHA alone is 3.997 mMol/L. There is a statistically significant difference between patients taking insulin and OHA and those taking OHA alone. In individuals receiving insulin

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and OHA, 36 experience mild hypokalemia, 25 moderate hypokalemia, and 2 severe cases; in those taking only OHA, 12 cases of mild hypokalemia occur [20, 22].

When administered exogenously, insulin increases the activity of the Na + -K + -ATPase pump, which in turn promotes the entrance of K+ into hepatic cells and skeletal muscles, leading to hypokalemia. Hypoglycemia caused by insulin may also contribute by increasing adrenaline secretion. When treating extreme hyperglycemia, insulin injection is the most common cause of hypokalemia. Potassium deficiency is a common complication of diabetic ketoacidosis and HHS. Hyperglycemia and carbohydrate intolerance result from impaired insulin production and reduced peripheral glucose utilisation, which is caused by hypokalemia. Hypokalemia causes poorly controlled diabetes mellitus, which in turn causes hypokalemia, creating a vicious cycle in diabetic individuals [23, 25].

Among the type 2 diabetes mellitus patients enrolled in this trial, 63% had hypokalemia while taking insulin and OHA together, while 12% shown hypokalemia while taking OHA alone. This lends credence to the idea that long-term use of exogenous insulin therapy, which is associated with a host of side effects including weakness, constipation, exhaustion, and muscle cramps, can induce severe hypokalemia in patients with type 2 diabetes mellitus. Due to long-term insulin treatment, most people with type 2 diabetes mellitus experience myalgia, muscular cramps, and exhaustion [26, 28].

To avoid hypokalemia, it is vital to utilise insulin appropriately and deliver the optimum doses during long-term therapy while testing serum potassium often. Patients with type 2 diabetes mellitus who use insulin and oral hydroxyanisole have mean serum sodium levels of 135.67 and 136.15, respectively; however, these changes are not statistically significant. Patients with type 2 diabetes mellitus who are taking insulin and oral hydroxyantrol have mean random blood sugar levels of 134.47, while those who are on OHA alone had levels of 143.81. The difference between the two groups is statistically significant [27, 29].

Everyone who takes part in this study is asked to fill out a questionnaire about the side effects of insulin. Almost every single patient out of one hundred experienced some sort of unpleasant impact. Fatigue was the adverse impact experienced by the majority of patients. Leg cramps are the second most common sign. Many patients also had palpitations, tremors, and profuse perspiration [30, 31]. The majority of the adverse drug reactions fell into the "possible" or "probable" categories according to the World Health Organization's causation assessment scale. The majority of side effects are classified as mild on the modified Hartwig Siegel scale. Patients will experience a decline in quality of life due to the aforementioned negative effects, which include lethargy, palpitations, muscle cramps, and weariness. Patients on long-term exogenous insulin therapy are at increased risk for these complications. To prevent hypokalemia and its consequences and to improve the quality of life for patients, it is vital to administer exogenous insulin cautiously and at the proper doses while also monitoring serum potassium often [32, 37].

Conclusion

Administering exogenous insulin to patients with type 2 diabetes mellitus leads to hypokalemia by facilitating the influx of potassium into skeletal muscles and hepatic cells. This can result from prolonged usage of external insulin. Exogenous insulin should be used judiciously with clear reasons, precise dosing, and regular monitoring of serum potassium levels to prevent problems and enhance quality of life.

Funding

None.

Conflict of Interest

None.

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