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A Study to Determine the Status of Serum Electrolyte in Hyperglycemia Patient in Tertiary Care Hospital Kanpur

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Abstract
Background: A multi-factorial illness, diabetes mellitus has a significant impact on many bodily functions. Due to the direct impact of hyperglycemia on these electrolytes in diabetic patients, electrolyte imbalance is a significant issue. **Material and Methods:** It was a prospective study carried out at the Rama Medical College Hospital and Research Centre in Mandhana, Kanpur, in the biochemistry department. In this study, 50 patients with known diabetes and 50 healthy controls were both participants. Patients with known cases of diabetes mellitus, ranging in age from 35 to 60, were included in this study. **Results:** With a p value of 0.01, the mean FBS level in type 2 diabetics (156.52 ± 29.26mg/dl) was substantially greater than that in healthy controls (92.21±14.65mg/dl). Similar to this, type 2 diabetics' serum potassium levels (4.27± 1.72mmol/L) were considerably higher than those of the healthy control group (4.08 ±1.25mmol/L) (p=0.01). Additionally, a p value of 0.05 was used to determine statistical significance for the mean difference in serum chloride levels between type 2 diabetic patients (108.73± 12.24) and healthy controls (105.54± 11.2). On the other hand, type 2 diabetics' mean blood sodium levels, which have a p value of 0.001, are considerably lower than healthy controls' (141.21 ±16.32mmol/L) (138.28 ±15.25mmol/L). **Conclusion:** The effects of diabetes mellitus on key cellular processes and events are quite diverse. Electrolyte imbalance is a serious issue for diabetes individuals because it affects how cells are distributed throughout cellular compartments.
Keywords: Electrolytes, sodium, potassium, chloride, fasting blood glucose and diabetes mellitus.

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INTRODUCTION

The impact of diabetes mellitus to worldwide public health is significant and growing. Chronic hyperglycemia, caused by faulty insulin action, secretion, or both, characterises it.[1] People with diabetes are more likely to develop chronic complications, which can have an effect on numerous organ systems and cause the bulk of morbidity and mortality related to the condition.[2] It is a significant contributor to retinopathy, cardiovascular harm, and renal failure. Patients are more likely to experience a variety of consequences as the disease worsens, including metabolic imbalances, blood vessel ageing, effects on electrolyte concentration, and offsets in electrolyte proportion.[3] The maintenance of the acid-base balance, membrane potential, blood coagulation, muscular contraction, nerve conduction, and fluid regulation are all crucial functions that electrolytes support. Its imbalances are now one of the main factors affecting human health.[4] Potassium, magnesium, phosphate, and sulphate are the main electrolytes found in intracellular fluid, whereas sodium, chloride, and bicarbonate are found in extracellular fluid.[5] The main functions of sodium include the control of acid-base balance, preservation of osmotic equilibrium, and uniform distribution and conservation of bodily fluids. The main functions of potassium include maintaining the acid-base balance, regulating heart function, and acting as a co-factor for the enzyme pyruvate kinase. Chloride aids in maintaining blood volume, acid-base balance, and fluid balance both within and outside of cells. The management of diabetes may be impacted by the altered electrolyte distribution.[6] Electrolytes and blood glucose have a complicated relationship that depends on a variety of other variables, including age and underlying medical disorders.[7,8] In addition, diabetic nephropathy, a consequence of diabetes marked by reduced renal function, can result in an electrolyte imbalance because high blood sugar affects the nephrons, affecting how well they absorb and reabsorb electrolytes. Numerous studies have demonstrated the link between electrolyte levels and diabetes.[9,10] The purpose of this study was to explore electrolyte abnormalities in type 2 diabetic patients as well as the relationship between fasting plasma glucose and electrolytes.

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METHODOLOGY

It was a prospective study carried out at the Rama Medical College Hospital and Research Centre in Mandhana, Kanpur, in the biochemistry department. In this study, 50 patients with known diabetes and 50 healthy controls were both participants. Patients with known cases of diabetes mellitus, ranging in age from 35 to 60, were included in this study. The study excluded patients who had metabolic syndrome, thyroid dysfunction, diabetes complications, and other co-morbid conditions. Individuals in the control group were generally healthy, had normal glycemic control, and had no co-morbid conditions. There were two groups of patients. Type 2 diabetes mellitus cases that are known exist are in Group A. Individuals in Group B are generally in good health.

Sample Collection & Clinical Analysis: Each person had a total of 5 ml of venous blood collected from them under aseptic conditions using a disposable syringe. All individuals had fasted for at least 10 to 12 hours. The determination of plasma glucose level required about 2 ml of blood, which was dispersed in a tube containing sodium fluoride anticoagulant. The remaining blood was drawn into a gel tube to extract serum for the measurement of electrolytes. NuLyte Smart Electrolyte Analyzer was used to perform ion selective electrode-based serum analysis for Na+, K+, and Cl. Human glucose liquicolor was used to quantify plasma glucose using the glucose oxidase-peroxidase method, and the Erba Autoanalyzer EM200 was used to detect the concentration spectrophotometrically.[10,11] A P value of 0.05 or lower was regarded as statistically significant for all data that were gathered and examined in SPSS 20.0.

RESULTS

In total, 100 subjects were included in the study, 50 of whom were healthy volunteers (the control group) and 50 of whom were type 2 diabetic patients. The average age of the population under study was 48.25 ± 12.23 years, while the average age of type 2 diabetics and healthy controls was 45.12 ±11.23 years. With a p value of 0.01, the mean FBS level in type 2 diabetics (156.52 ± 29.26mg/dl) was substantially greater than that in healthy controls (92.21±14.65mg/dl). Similar to this, type 2 diabetics' serum potassium levels (4.27± 1.72mmol/L) were considerably higher than those of the healthy control group (4.08 ±1.25mmol/L) (p=0.01). Additionally, a p value of 0.05 was used to determine statistical significance for the mean difference in serum chloride levels between type 2 diabetic patients (108.73± 12.24) and healthy controls (105.54± 11.2). On the other hand, type 2 diabetics' mean blood sodium levels, which have a p value of 0.001, are considerably lower than healthy controls' (141.21 ±16.32mmol/L) (138.28 ±15.25mmol/L).

Table 1: Age and Concentration of Electrolytes in Study Population with p-Value.

Variables	Group A (Mean±SD)	Group B (Mean±SD)	P value
Age in years	48.25 ± 12.23	45.12 ± 11.23	0.25
FBS (mg/dl)	156.52 ± 29.26	92.21 ± 14.65	0.01
Sodium (mmol/L)	138.28 ± 15.25	141.21 ± 16.32	0.01
Potassium (mmol/L)	4.27 ± 1.72	4.08 ± 1.25	0.01
Chloride (mmol/L)	108.73 ± 12.24	105.54 ± 11.2	0.01

The Pearson correlation test was used to determine the relationship between fasting plasma glucose and sodium, potassium, and chloride in type 2 diabetes patients. Fasting plasma glucose and sodium were found to have a negative correlation coefficient (r) that was statistically significant (p = 0.01, r = -0.35). On the other hand, a positive association between potassium and FPG was discovered and was likewise statistically significant at (p=0.01, r=0.34). The association between FPG and chloride was likewise positive and statistically significant (p=0.01, r=0.38).

DISCUSSION

Serum electrolytes and glucose interact in a variety of ways. Electrolyte abnormalities are occurring more frequently in people with diabetes mellitus. Numerous electrolytes are affected by hyperglycemia, which causes anomalies in them.[13] As a result of the migration of water out of the cells and subsequent dilution of serum sodium levels, hyperglycemia increases serum osmolality. Due to osmotic dieresis, uncontrolled diabetes mellitus can also cause hypovolemic hyponatremia.[14] The osmotic dieresis process results in the loss of both water and solutes. The interaction between water and solutes is strongly correlated with variations in serum osmolarity and serum sodium concentration.[15] Another potential occurrence in people with diabetes mellitus is hypernatremia. Due to the osmotic diuretic impact of glycosuria, it results in hypotonic fluid loss in urine.[16] Moving potassium from extracellular to intracellular space results in hypokalemia, which can happen after taking insulin, treating hypertonicity, or being stimulated by the 2 adrenergic receptor. When there is an insulin deficit, hypertonicity, or renal impairment, potassium may move from the intracellular to extracellular space, resulting in hyperkalemia.[17,18] In our investigation, we discovered a statistically significant difference between the diabetic and control groups in terms of hyponatremia in individuals with type 2 diabetes mellitus. However, type 2 diabetic patients had significantly higher serum levels of potassium and chloride than healthy controls. In 2016, Ogunleye, et al. conducted a study. In comparison to non-diabetic patients, his investigation revealed that diabetic patients had lower amounts of sodium, potassium, chloride, calcium, magnesium, phosphorus, and

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sulphur. Due to decreased absorption and/or increased excretion of these electrolytes in urine, there may be a loss of these electrolytes, which can cause deficiency or marginal states of elements in diabetes patients.[19,20] In their investigation, Dasgupta et al. discovered that hypomagnesemia was linked to poor glycemic control and an increased incidence of diabetic foot and retinopathy.[21] Diabetes patients were more likely to have hyperkalemia and higher levels of chloride, according to research by Datchinamoorthi et al.[22] When compared to other research, our investigation provided a slightly different picture of the electrolyte status in diabetes patients, revealing a multi-factorial and variable scenario for electrolyte abnormalities in diabetic patients.

CONCLUSION

After the research was complete, we came to the conclusion that type 2 diabetics have lower plasma sodium levels and higher plasma chloride and potassium levels. These abnormal electrolyte distributions are linked to hyperglycemia, which is linked to the pathogenesis of diabetes mellitus. Therefore, type 2 diabetes therapy must include an electrolyte profile test to track changes in electrolyte levels in order to lower the patient's risk of developing problems like neuropathy, nephropathy, and retinopathy.

REFERENCES

1. Zimmet P, Alberti KG, Shaw J. global and societal implications of the diabetes epidemic. Nature. 2001;414:782- 7.
2. Thanpari C., Thakelmayum R & Kumar R. Correlation of Lipid Profiles, Electrolytes and Antioxidant Status In Type 2 Diabetic Patients With Hypertension In Sikkimese Population: A Case Controlled Study. Jour. Of Med. Sci. & Tech.1(2), pp 71-74.
3. King H. and Rewers M. "Global estimates for prevalence of diabetes mellitus and impaired glucose tolerance in adults. WHO Ad Hoc Diabetes Reporting Group." Diabet. Care. 1993; 16: 157-7.
4. Hosen B, Buiyan AR, Hasan S, Hassan M, Uddin M. Estimation of Serum Electrolytes in non-Insulin Dependent (type 2) Diabetic Patients in Bangladesh, Scientific research journal (SCRJ). 2014;2(4):29-32.
5. Martini FH, Halyard RA. Fluid electrolytes and acid-base balance. In: Fundamentals of Anatomy and Physiology Interactive. (Media Edition) 4th ed; USA; Person Education, Inc. 1998.
6. Ojiako OA, Chikezie PC. Blood Na+/K+ and Cl- Levels of Hyperglycemic rats Administered with traditional Herbal Formulations, Pharmacognosy Communications. 2015;5(2):140-5.
7. Shahid SM, Rafique R, Mahboob T. Electrolytes and sodium transport mechanism in diabetes Pak. J Pharm. Sci. 2005; 18(2): 6-10.
8. Uribarri J, Oh MS, Carroll HJ. Hyperkalemia in diabetes mellitus. J Diabetes [9] Complications. 1990;4:03-07.
9. Hosen B, Buiyan AR, Hasan S et al. Estimation of serum electrolytes in type 2 diabetic patients in Bangladesh: Scientific research journal 2014;12: 2201-2796.
10. Parmar SK, Singh S, Singh GK. Role of hyperglycemia in the pathogenesis of Na^+/K^+ disturbance. International J Res Med Sci.2016 Apr:4(4):1167-1171.
11. Albert V, Subramanian A, Rangarajan K et al. agreement of two different laboratory methods used to measure electrolytes. Journal of laboratory physicians. 2011 JulDec;3(2):104-109[PMID:22219564].
12. Sharma SP, Anjankar AP, Kale A. Comparison of glucose levels using glucometer and GOD-POD method in diabetic patients. International journal of clinical biochemistry and research. 2017;4(1):6-10.
13. Ebenexer A, Nyenwe AEK. Evidence-based management of hyperglycemic emergencies in diabetes mellitus. Diabetes Res Clin Pract 2011; 94(3): 340-51.
14. Datchinamoorthi S, Rajagopalan B, Nadu T. Research article evaluation of serum electrolytes in type ii diabetes mellitus. Int J Pharm Sci Rev Res 2016; 40(45): 251-3.
15. Overgaard-Steensen C, Ring T. Clinical review: Practical approach to hyponatraemia and hypernatraemia in critically ill patients. Crit Care 2012; 17(1): 1-14.
16. Liamis G, Tsimihodimos V, Doumas M, Spyrou A, Bairaktari E, Elisaf M. Clinical and laboratory characteristics of hypernatraemia in an internal medicine clinic. Nephrol Dial Transplant 2008; 23(1): 136-43.
17. Darmon M, Timsit JF, Francais A, et al. Association between hypernatraemia acquired in the ICU and mortality: A cohort study. Nephrol Dial Transplant 2010; 25(8): 2510-5.
18. Article R. Electrolyte and acid-base disturbances in patients with diabetes mellitus. N Engl J Med 2015; 373: 548-59.
19. Palmer BF, Clegg DJ. Physiology and pathophysiology of potassium homeostasis. Adv Physiol Educ 2016; 40(4): 480-90.
20. Ogunleye AZ, Asaolu MF. Evaluation of macro minerals in patients with type II diabetes mellitus in southern nigeria. Int J Biochem Res Rev 2016; 9(2): 1-9.
21. Stelfox HT, Ahmed SB, Zygun D, Khandwala F, Laupland K. Characterization of intensive care unit acquired hyponatremia and hypernatremia following cardiac surgery. Can J Anesth 2010; 57(7): 650-8. [21] Dasgupta A, Sarma D, Saikia UK. Hypomagnesemia in type 2 diabetes mellitus. Indian J Endocr Metab 2012; 16: 1000-3.
22. Datchinamoorthi S, Rajagopalan B, Nadu T. Research article evaluation of serum electrolytes in type ii diabetes mellitus. Int J Pharm Sci Rev Res 2016; 40(45): 251-3.