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A study of Serum Electrolyte levels and Lipid Profile in chronic Type 2 Diabetes Mellitus

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Abstract: Diabetes Mellitus type 2 is a group of disorders characterized by high glucose levels. Electrolyte abnormalities are commonly encountered in chronic diabetes mellitus type 2 patients. These patients usually have Potassium, Magnesium and Phosphate depletion. This study was conducted to investigate the electrolytes and lipid abnormalities in chronic type 2 diabetes mellitus in patients attending Rajiv Gandhi Institute of Medical Sciences and Hospital Adilabad. This study was conducted in the Department of General Medicine and Biochemistry, Rajiv Gandhi Institute of Medical Sciences [RIMS], Adilabad. The study included male and female subjects diagnosed with chronic diabetes mellitus type 2. Chronic diabetics were defined as those diagnosed with diabetes mellitus type 2 and on medications, for the duration of 5 years or more they were designated as Group I. Similarly age and sex-matched controls from the normal population were included in Group II as controls. Fasting blood samples will be collected in Vacutainer 10ml and serum fasting blood sugar, Serum Electrolytes and lipid profile will be estimated in fully automatic chemistry analyzer 'Beckman Coulter Au 400'. The results obtained were recorded and analyzed using statistical software. Results: A total of 100 patients were included in the study divided into two groups Group I (diabetics) and group II (controls). The serum fasting blood glucose was measured in group I the mean values was 174.5 ± 25.6 mg/dl and in group II 96.5 ± 20.5 mg/dl the p values were found to be significant. The triglyceride levels as compared to controls the mean values in group I was 201.55 ± 35.8 mg/dl and group II was 190.5 ± 30.12 mg/dl the p values were found to be significant. The potassium levels were also elevated in the group I (diabetic) as compared to group II and the p values were found to be significant. It can be concluded that type 2 diabetes patients have abnormal lipid and electrolyte balance. The impaired mineral metabolism can result in disturbances in enzymatic activities, hormone secretions, and antioxidant levels. Therefore monitoring of these patients every 3 months will help in preventing the occurrence of long-term complications related to diabetes.
Keywords: Electrolytes, Lipids, Type 2 Diabetes Mellitus.

INTRODUCTION

Diabetes Mellitus Type 2 (T2DM) is a chronic and progressive metabolic disorder characterized by insulin resistance and pancreatic beta islet cell failure. Diabetes mellitus is usually characterized by hyperglycemia either due to relative or absolute lack of insulin action, or both [1]. The incidence of diabetes mellitus is increasing in recent times and it is considered one of the highly prevalent diseases worldwide. Diabetes and its complications are one of the important causes of economic burden to the country's health care system. At present in India, it is estimated about 30 million people are suffering from diabetes [2]. The three specific abnormalities present in diabetes mellitus are impaired insulin secretion, increased hepatic glucose production, and decreased insulin-stimulated uptake of glucose in peripheral tissues. Electrolytes play an important role in maintaining acid-base balance, blood clotting, control body fluid and muscle contractions. Disturbed electrolyte distribution may affect the course of diabetes and its management [3]. The relation between blood glucose and electrolytes is complex and is related to a number of other factors like age and associated conditions [4]. Glucose is an osmotically active substance and hyperglycemia increases serum osmolality and results in movement of water out of the cells and reduction of sodium levels by the dilutional effect. The osmotic effect of glucose also causes osmotic diuresis causing a decrease in circulating blood volume and cellular dehydration due to the shift of water from intracellular spaces causing cellular dehydration. Diabetics also suffer from lipid abnormalities and they are more prone to develop atherosclerosis which is the major cause of premature deaths in diabetic patients both type 1 and type 2 [5-7]. Hyperinsulinemia, hypertension, obesity and hypertriglyceridemia and impaired glucose tolerance is

a strong predictor of coronary artery disease. With this background, we in the present study tried to investigate the electrolytes and lipid abnormalities in chronic type 2 diabetes mellitus in patients attending Rajiv Gandhi Institute of Medical Sciences and Hospital, Adilabad. District of Adilabad is a remote area predominated by tribal population and no such previous study was conducted in this group of the population. The information from this study will be helpful in treating the patients affected by Diabetes mellitus type 2 effectively and preventing long-term complications related to diabetes.

MATERIALS AND METHODS

The study was conducted in the Department of General Medicine and Biochemistry, Rajiv Gandhi Institute of Medical Sciences [RIMS], Adilabad. Institutional Ethical committee Permission was obtained for the study. A written consent was obtained from all the participants of the study after explaining the study in the local language. Only those patients voluntarily willing to participate in the study were included. A total of 100 patients were included in the study. They were divided into two groups Group I and Group II of 50 each. Group, I included male and female subjects diagnosed with chronic diabetes mellitus type 2. Chronic diabetics were defined as those diagnosed with diabetes mellitus type 2 and on medications for the duration of 5 years or more. These patients were examined clinically to exclude the presence of any presence of micro- or macrovascular complications like retinopathy, peripheral vascular disease, and coronary heart disease. Similarly, age and sex-matched controls from the normal population were included in Group II (n=50) as controls. Fasting blood samples will be collected in Vacutainer 10ml and serum fasting blood sugar, Serum Electrolytes and lipid profile will be estimated in fully automatic chemistry analyzer 'Beckman Coulter Au 400' HbA1C estimation was done by ion exchange resin method. The anonymity of patients was maintained by coding the sample. The results obtained were recorded and analyzed using the statistical software Statistical Package for the Social Sciences (SPSS version 13.0) p values of <0.05 was considered significant.

RESULTS

A total of 100 patients were included in the study divided into two groups Group I (diabetics) and group II (controls). The Group I consisted of male (n=38) and female (n=12) the age range was from 46 - 70 years and the mean age was 59.5 ± 8.5 years. In group II there were male (n=27) and female (n=23) the age ranges were 38 – 55 years the mean age was 45.5 ± 5.5 years. The serum fasting blood glucose was measured in group I the mean values was 174.5 ± 25.6 mg/dl and in group II 96.5 ± 20.5 mg/dl the p values were found to be significant. Glycosylated Hemoglobin levels HbA1c values in group I was 7.74 ± 1.25 % and in group II 6.2 ± 1.25 % the p values were not found to be significant. The lipid profile of the patients was measured by estimating serum triglycerides, cholesterol, HDL, and LDL. The group I patients showed the significant increase in triglyceride levels as compared to controls the mean values in group I was 201.55 ± 35.8 mg/dl and group II was 190.5 ± 30.12 mg/dl the p values were found to be significant. Although cholesterol levels were found to be higher in Group I as compared to group II the values were not found to be significant. Similarly, the HDL values were found to be higher in group II 42.5 ± 4.5 mg/dl as compared to group I 37.5 ± 3.5 mg/dl but it was found to be significant. The LDL-C values in group I was 110.25 ± 24.9 mg/dl as compared to group II 95.5 ± 20.5 mg/dl the p values were not found to be significant shown in Table-1.

Table-1: Showing the levels of glucose and lipid profile in diabetic and control subjects

Parameter	Group I [Diabetes Mellitus] (n=50)	Group II [Normal Patients] (n=50)	P values
Age (yrs)	59.5 ± 8.5	45.5 ± 5.5	>0.1
Fasting blood glucose (mg/dl)	174.5 ± 25.6	96.5 ± 20.5	< 0.05*
HbA1c %	8.74 ± 2.51	6.2 ± 1.25	>0.145
Triglycerides (mg/dl)	201.55 ± 35.8	190.5 ± 30.12	<0.05*
Cholesterol (mg/dl)	190.65 ± 40.9	181.65 ± 35.5	>0.453
HDL-C (mg/dl)	37.5 ± 3.5	42.5 ± 4.5	>0.05*
LDL-C (mg/dl)	110.25 ± 24.9	95.5 ± 20.5	>0.5

* Significant

The serum electrolyte levels were measured in the patients the sodium, potassium, chloride and bicarbonate levels were estimated because they are the most important macro electrolytes found to vary in patients suffering from diabetes mellitus. The serum sodium levels were slightly elevated in group II as compared to group I, however, the p values were not found to be significant. The potassium levels were also elevated in the group I (diabetic) as compared to group II and the p values were found to be significant. The chloride levels were found be almost equal in both the groups and not significant. The bicarbonate levels were very slightly elevated in group I but the values were not significant shown in Table-2.

Table-2: Comparison of Serum electrolytes in 2 study groups

Electrolyte	Group I [Diabetes Mellitus] (n=50)	Group II [Normal Patients] (n=50)	P values
Sodium (mmol/L)	139.15 ± 5.2	141.5±3.9	>0.1
Potassium (mmol/L)	4.6±0.8	3.9±0.75	<0.05*
Chloride (mmol/L)	103.2± 4.8	107.4±5.5	>0.2
Bicarbonate (mmol/L)	25.3±3.5	26.1±1.9	>0.5

* Significant

DISCUSSION

Diabetes mellitus is associated with a cluster of interrelated plasma lipid and electrolyte abnormalities. Chronic diabetes mellitus damages every organ in the body, mainly the kidneys, leading to end-stage renal diseases [8-10]. These patients suffer from the electrolyte and acid-base disturbances. It is due to chronic elevation of glucose, renal diseases and medications used [11]. In the present study, we found an increased mean glucose level in group I patients suffering from chronic diabetes. We in this study included patients of >5 years of diabetes because some of the abnormalities and disturbances of electrolytes may not appear in the fresh cases and it takes time for development of these abnormalities. The mean duration of diabetes in all the present study was 6.74 ± 1.53 years. The mean HbA1c levels in Group I diabetics was 8.74 ± 2.51 % and in control Group II normal was 6.2 ± 1.25 % the values were not found to be significant. HbA1c is correlated with blood glucose levels as reported in earlier studies [12]. It has been also shown that elevation of HbA1c increases the risk for development of microangiopathy [13, 14]. In a similar study by N Kumar J in Bihar found the mean HbA1c levels of 8.5 ±2.1 % in the diabetic group [15]. Lipid abnormalities have been commonly associated with diabetes mellitus. The type of abnormality depends on a number of factors such as the type of diabetes, endogenous insulin reserve, degree and distribution of obesity and the presence of nephropathy [16]. In the present study, we found the most significant abnormality was the elevation of serum triglycerides in diabetic patients. It has been seen that in type 2 diabetes, there is an elevation of serum triglycerides 1.5 – 3.0 times as compared to age and sex-matched non-diabetic controls. Although in our study there was a slight elevation and it was found to be significant. We in the present study also observed that there is a reduction of HDL-C and elevation of LDL-C in diabetic patients. The reduction of HDL cholesterol is said to occur by 10 -20% in diabetic patients and the LDL is expected to be normal range. However, in the present study, it was slightly increased although not found to be significant. The cause of increased total cholesterol and LDL in type 2 diabetics is linked to increased rates of synthesis of LDL cholesterol [17, 18]. In a study by Zargar Ah *et al.,* in Jammu [19] done on 50 obese type 2 diabetic patients found both cholesterol and triglycerides were significantly elevated along with the elevation of LDL cholesterols in agreement with results of our study. Disturbances of water and electrolyte balances are known to occur in subjects with diabetes mellitus, resulting from Insulin deficiency, hyperglycemia, and hyperketonemia [20]. In the present study we found the serum sodium levels were slightly more in group II as compared to group I, however, the p values were not found to be significant. DM is independently (irrespective of drugs or hyperglycemia) is associated with hyponatremia [21]. In one study of 5179 community subjects of >55 years with DM associated with hyponatremia (OR = 1.98; 95%CI: 1.47-2.68), with the serum glucose levels being too low to fully explain the degree of hyponatremia [22]. Some of the possible causes proposed are altered vasopressin metabolism, the interaction between insulin and vasopressin, both of which act on renal collecting ducts and resorption of more hypotonic fluid due to slower stomach emptying have been elucidated [23-25]. In the present study, it was found that the potassium levels in diabetics were significantly more than normal subjects. There are conflicting reports regarding potassium levels in diabetes mellitus. Whereas Mcdonnell *et al.,* have reported insignificant different in potassium levels in diabetes mellitus [26]. Ugwuja *et al.,* reported low serum K+ in diabetics than controls [27]. Wang *et al*., reported only 0.6% of diabetes had hypokalemia and 1.2% of diabetes subjects had hyperkalemia [28]. Some of the causes of disturbance in potassium levels are a redistribution of potassium from the extracellular compartment (shift hyperkalemia) without an increase in potassium levels of the body. In diabetes mellitus, acidosis causes fall in pH, for each 0.1 fall in pH potassium increases by 0.4 mmol/L. The important factor causing chronic hyperkalemia in diabetics is reduced the tubular secretion of K^+ due to the syndrome of hyporeninemic hypoaldosteronism [29]. The other ions like chloride and bicarbonates levels were not significantly associated with diabetes mellitus in the present study.

CONCLUSION

Within the limitations of the present study, it can be concluded that type 2 diabetes patients have abnormal lipid and electrolyte balance. The impaired mineral metabolism can result in disturbances in enzymatic activities, hormone secretions, and antioxidant levels. Therefore monitoring of these patients every 3 months will help in preventing the

occurrence of long-term complications related to diabetes.

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REFERENCES

1. Lobo, D. N. (2004). Fluid, electrolytes and nutrition: physiological and clinical aspects. *Proceedings of the Nutrition Society*, *63*(3), 453-466.
2. Khubchandani, A. S., & Sanghani, H. (2013). Study of serum magnesium and HbA1C in diabetic patients along with changes in their lipid profiles. *Indian Journal of Clinical Practice*, *23*(11), 717-9.
3. Rao, G. M. (1992). Serum electrolytes and osmolality in diabetes mellitus. *Indian journal of medical sciences*, *46*(10), 301-303.
4. Shahid, S. M., Rafique, R. O. O. M. A. N. A., & Mahboob, T. A. B. A. S. S. U. M. (2005). Electrolytes and sodium transport mechanism in diabetes mellitus. *Pak J Pharm Sci*, *18*(2), 6-10.
5. Kannel, W. B., & McGee, D. L. (1979). Diabetes and cardiovascular disease: the Framingham study. *Jama*, *241*(19), 2035-2038.
6. Welborn, T. A., & Wearne, K. (1979). Coronary heart disease incidence and cardiovascular mortality in Busselton with reference to glucose and insulin concentrations. *Diabetes care*, *2*(2), 154-160.
7. Eschwege, E., Richard, J. L., Thibult, N., Ducimetiere, P., Warnet, J. M., Claude, J. R., & Rosselin, G. E. (1985). Coronary heart disease mortality in relation with diabetes, blood glucose and plasma insulin levels. The Paris Prospective Study, ten years later. *Hormone and metabolic research. Supplement series*, *15*, 41-46.
8. Harris, M. I., Flegal, K. M., Cowie, C. C., Eberhardt, M. S., Goldstein, D. E., Little, R. R., ... & Byrd-Holt, D. D. (1998). Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in US adults: the Third National Health and Nutrition Examination Survey, 1988–1994. *Diabetes care*, *21*(4), 518-524.
9. Bojestig, M., Arnqvist, H. J., Hermansson, G., Karlberg, B. E., & Ludvigsson, J. (1994). Declining incidence of nephropathy in insulin-dependent diabetes mellitus. *New England Journal of Medicine*, *330*(1), 15-18.
10. Frei, U., & Schober-Halstenberg, H. J. (1999). Annual Report of the German Renal Registry 1998. QuaSi-Niere Task Group for Quality Assurance in Renal Replacement Therapy. *Nephrology, dialysis, transplantation: official publication of the European Dialysis and Transplant Association-European Renal Association*, *14*(5), 1085-1090.
11. Amenabar, J. J., Garcia-Lopez, F., Robles, N. R., Saracho, R., Calero, M., Gentil, M. A., ... & Lorenzo, V. (1999). 1997 Spanish Nephrology Association (Sociedad Espanola de Nefrologia) report on dialysis and transplantation. *Nephrology Dialysis Transplantation*, *14*(12), 2841-2845.
12. Davis, R. E., Nicol, D. J., McCann, V. J., & Calder, J. S. (1978). Glycosylated haemoglobin levels in patients with diabetes mellitus. *The Medical journal of Australia*, *1*(10), 530-532.
13. Rohlfing, C. L., Little, R. R., Wiedmeyer, H. M., England, J. D., Madsen, R., Harris, M. I., ... & Goldstein, D. E. (2000). Use of GHb (HbA1c) in screening for undiagnosed diabetes in the US population. *Diabetes care*, *23*(2), 187-191.
14. Khaw, K. T., Wareham, N., Luben, R., Bingham, S., Oakes, S., Welch, A., & Day, N. (2001). Glycated haemoglobin, diabetes, and mortality in men in Norfolk cohort of European Prospective Investigation of Cancer and Nutrition (EPIC-Norfolk). *Bmj*, *322*(7277), 15.
15. Jha, N. K. Study of lipid profile & electrolyte levels in diabetes. *International Journal of Medical and Health Research*, 3(9):146-48.
16. Mohsin, R., Badar, B., Saeed, A., & Rehman, A. (2007). Type 2 Diabetes: the relationship between the serum cholesterol and triglycerides. *Professional M Ed J*, *14*, 337-43.
17. Kesaniemi, Y. A., & Grundy, S. M. (1983). Increased low density lipoprotein production associated with obesity. *Arteriosclerosis: An Official Journal of the American Heart Association, Inc.*, *3*(2), 170-177.
18. Kissebah, A. H., Alfarsi, S. A. L. M. A. N., Evans, D. J., & Adams, P. W. (1983). Plasma low density lipoprotein transport kinetics in noninsulin-dependent diabetes mellitus. *The Journal of clinical investigation*, *71*(3), 655-667.
19. Zargar, A. H., Wandroo, F. A., Wadhwa, M. B., Laway, B. A., Masoodi, S. R., & Shah, N. A. (1995). Serum lipid profile in non-insulin-dependent diabetes mellitus associated with obesity. *Age*, *50*, 20.
20. Kitabchi, A. E., Umpierrez, G. E., Murphy, M. B., & Kreisberg, R. A. (2006). Hyperglycemic crises in adult patients with diabetes: a consensus statement from the American Diabetes Association. *Diabetes care*, *29*(12), 2739-2748.
21. Beukhof, C. M., Hoorn, E. J., Lindemans, J., & Zietse, R. (2007). Novel risk factors for hospital-acquired hyponatraemia: a matched case–control study. *Clinical endocrinology*, *66*(3), 367-372.
22. Liamis, G., Rodenburg, E. M., Hofman, A., Zietse, R., Stricker, B. H., & Hoorn, E. J. (2013). Electrolyte disorders in community subjects:

prevalence and risk factors. *The American journal of medicine*, *126*(3), 256-263.

23. Bankir, L., Bardoux, P., & Ahloulay, M. (2001). Vasopressin and diabetes mellitus. *Nephron*, *87*(1), 8-18.
24. Bustamante, M., Hasler, U., Kotova, O., Chibalin, A. V., Mordasini, D., Rousselot, M., ... & Féraille, E. (2005). Insulin potentiates AVP-induced AQP2 expression in cultured renal collecting duct principal cells. *American Journal of Physiology-Renal Physiology*, *288*(2), F334-F344.
25. Davis, F. B., & Davis, P. J. (1981). Water metabolism in diabetes mellitus. *The American journal of medicine*, *70*(1), 210-214.
26. McDonnell, C. M., Pedreira, C. C., Vadamalayan, B., Cameron, F. J., & Werther, G. A. (2005). Diabetic ketoacidosis, hyperosmolarity and hypernatremia: are high-carbohydrate drinks worsening initial presentation?. *Pediatric diabetes*, *6*(2), 90-94.
27. Ugwuja, E., & Eze, N. (2006). A comparative study of serum electrolytes, total protein, calcium and phosphate among diabetic and HIV/AIDS patients in Abakaliki, Southeastern, Nigeria. *The Internet Journal of Laboratory Medicine*, *2*(1).
28. Wang, S., Hou, X., Liu, Y., Lu, H., Wei, L., Bao, Y., & Jia, W. (2013). Serum electrolyte levels in relation to macrovascular complications in Chinese patients with diabetes mellitus. *Cardiovascular diabetology*, *12*(1), 146.
29. Komjati, M., Kastner, G., Waldhäusl, W., & BRATUSCH-MARRAIN, P. (1989). Effect of hyperosmolality on basal and hormone-stimulated hepatic glucose metabolism in vitro. *European journal of clinical investigation*, *19*(2), 128-134.