DOI Number: 10.5958/2320-608X.2019.00065.9

Dyselectrolytaemia in Middle Aged Type II Diabetes Mellitus – A Harbinger of Cardiac Function Abnormalities

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Abstract

Background : Diabetes mellitus(DM) is a chronic metabolic disorder. The management of blood glucose and other modifiable risk factor is a key element in the multifactorial approach to prevent complications of diabetes and decreasing the mortality and morbidity.

Aim and Objective of the Study: To determine the serum electrolyte (sodium & potassium) in asymptomatic type II diabetic cases and with controls. **Materials and Method:** Fifty type II DM cases aged between 30-55 years and fifty age and sex matched controls were selected from general population. Detailed physical and systemic examination was done. Ethical clearance and informed consent was taken. Estimation of Serum electrolytes (Sodium and Potassium) is done by Ion selective electrode method. Unpaired t-test was used to compare the parameters between type II DM cases & controls by using SPSS version 16. Level of significance was set at $p<0.05$. **Results:** There was statistically significant increase in Serum potassium level among type II diabetics when compared to controls ($p< 0.001$) **Conclusion:** There was significant increase in Serum potassium level among type II diabetics when compared to controls . Hence the screening tests such as estimation of serum electrolytes are strongly recommended at the time of diagnosis for proper interventions which could prevent the complications at an earlier date.

Keywords: *Type II Diabetes mellitus, Serum electrolytes. Cardio vascular abnormalities, Serum Potassium, Serum Sodium.*

Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder[1]. The management of blood glucose and other modifiable risk factor is a key element in the multifactorial approach to prevent complications of diabetes and decreasing the mortality and morbidity.

Materials and Method

Estimation Serum Sodium and Potassium[2]

Method: Ion selective electrode method (ISE) using undiluted specimens (ISE direct method)

Principle; Analyzer fitted with ISEs usually contain Na^+ electrodes with glass membrane and K^+ electrodes with liquid ion exchange membranes that incorporate valinomycin. Potentiometry is the determination of change in electromotive force (E potential) in a circuit between a measurement electrode, as the selected ion interacts with the membrane of the ISE. In instrument applications the measuring system is calibrated by introduction of calibrator solutions containing defined amounts of Na^+ and K^+.The potentials of the calibrators are determined, and the $\Delta E/\Delta \log$ concentration is stored in microprocessor memory as a factor for calculating unknown concentration when E of the unknown is measured.

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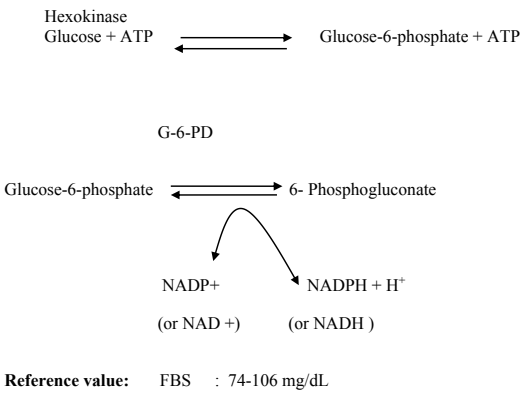
Normal Values S.Sodium : 135-148 mmol/L

S.Potassium : 3.7-5.3 mmol/L

Blood Sugar level

Estimated by Hexokinase method [3]

Glucose is phosphorylated by ATP in the presence of hexokinase and magnesium (Mg^{2+}). The glucose-6-phosphate formed is oxidized by glucose-6-phosphate dehydrogenase(G6PD) to 6- phosphogluconate in the presence of nicotinamide adenine dinucleotide phosphate(NADP+) . The amount of NADPH produced is directly proportional to the amount of glucose in the sample and is measured by absorbance at 340 nm. G6PD derived from yeast is used in the assay with NADP+ as the cofactor. The oxidized form of nicotinamide adenine dinucleotide (NAD+) is the cofactor if bacterial (Leuconostoc mesenteroides) G6PD is used , and the NADH produced is also measured at 340nm.



Reference value: FBS : 74-106 mg/dL

Findings

Subject Information

Sex Distribution: Out of 50 subjects 20 were male's and 30 were female in type II DM cases and controls of each group respectively (Table- 01).

Age : The mean age (yrs) was 45.8 ± 4.9 and 45.9 ± 5.0 in type II DM cases and type II DM controls respectively (Table-01).

Height : The mean height (in cms) were 161.58 ± 8.3 and 160.98 ± 6.02 in type II DM cases and controls respectively (Table-02). There was no significant difference in height between type II DM cases and controls (p>0.05).

Weight : The mean weight (in kgs) were 64.44 ± 7.78 and 57.46 ± 5.65 in type II DM cases and controls respectively (Table-02). There was statistically highly significant increase in weight in type II diabetics when compared to controls (p< 0.001).

Body Mass Index (BMI) : The BMI (in kg /m^2) were 24.55 ± 2.19 and 22.15 ± 1.37 in Type II DM cases and controls respectively (Table-02). There was highly significant increase in BMI among type II diabetics when compared to controls (p < 0.001).

Pulse : The mean pulse rates (bpm) were 75.18 ± 1.11 and 76.21 ± 10.2 in type II DM cases and controls respective (Table-02). There was no significant difference in pulse rate between type II diabetic cases and controls (p> 0.05).

Systolic Blood Pressure: The mean SBP (in mmHg) were 123.5 ± 1.11 and 120.42 ± 12 in Type II DM cases and controls respectively (Table-02). There was no significant difference in SBP among type II diabetics and controls (p>0.05).

Diastolic blood Pressure: The mean DBP (in mmHg) were 79.44 ± 3.23 and 79.16 ± 2.65 in Type II Diabetics and controls respectively (Table-02). There was no significant difference in DBP among type II DM cases and controls (p >0.05).

Bio-Chemical Parameters

Fasting blood Sugar: The fasting blood sugar (in mg/dl) levels were 162.32 ± 57.09 and 86.98 ± 9.66 in type II DM cases and controls respectively (Table-03). There was statistically high significant increase in FBS level in Type II diabetics when compared to controls (p< 0.001).

Serum Sodium: The mean serum sodium (in mmol /L) levels were 141.12 ± 3.50 and 140.96 ±2.04 in type II DM cases and controls respectively (Table-03). There was no significant difference in serum sodium levels among type II diabetics when compared to controls (p> 0.05).

Serum Potassium: The mean serum potassium (in mmol/L) levels were 4.86 ± 0.49 and 4.40 ± 0.13 in type II DM cases and controls respectively (Table-03). There was statistically highly significant increase in Serum potassium level among type II diabetics when compared to controls (p< 0.001).

Table -01: Age and Sex Comparison of the Group's Studied

Variables		DM- II	CONTROLS
Subjects	NO	50	50
Gender	Male	20	20
	Female	30	30
Age (yrs)	Mean ±SD	45.8 ± 4.9	45.9± 5.0
	Range	35-54 Yrs	35-54 Yrs

Table-02: Comparison of variables Between Type - II DM cases and Controls

Type II DM					
Variable	**Group**	**Mean**	**SD**	**t value**	**p value**
HEIGHT(cms)	DM II	161.58	8.34	0.41	0.68
	Controls	160.98	6.02		
WEIGHT(kg)	DM II	64.44	7.78	5.13	0.000 **
	Controls	57.46	5.65		
BMI(kg/m^2)	DM II	24.55	2.19	6.57	0.000 **
	Controls	22.15	1.37		
PULSE(mmHg)	DM II	75.18	1.11	0.70	0.47
	Controls	76.21	10.2		
SBP(mmHg)	DM II	123.5	1.11	1.74	0.08
	Controls	120.42	12.4		
DBP(mmHg)	DM II	79.44	3.23	0.47	0.64
	Controls	79.16	2.65		
Unpaired t test					
** $p < 0.001$, HS					
$p > 0.05$: not Sig.					

Table - 03: Comparison of FBS, Electrolytes and Lipid Profile Parameters between Type II DM Cases and Controls

Variable	**Group**	**Mean**	**SD**	**t value**	**p value**
FBS(mg/dl)	DM II	162.32	57.09	9.20	0.000 **
	Controls	86.98	9.66		
SODIUM(mmol/L)	DM II	141.12	3.50	0.29	0.775
	Controls	140.96	2.04		
POTASIUM(mmol/L)	DM II	4.86	0.49	6.38	0.000 **
	Controls	4.40	0.13		
	Controls	32.97	16.76		
Unpaired t test					
* $p < 0.05$, Sig					
** $p < 0.001$, HS $p > 0.05$: not Sig.					

Discussion

India leads the world today with the largest number of diabetics in any given country. Diabetes is a major cause of mortality, but several studies indicate that diabetes is likely under reported as a cause of death. A recent estimate suggested that diabetes was the fifth leading cause of death worldwide.

Weight and Body Mass Index

In this study increase in weight and BMI was seen in both type I and type II diabetics when compared to controls.

This increased weight and BMI in diabetics could be due to increase in adiposity associated with insulin resistance attributed to more of sedentary life style and less physical activity. Increase in body weight and BMI are important predictors of metabolic disturbances including dyslipidemia, hypertension and cardiovascular diseases .[4]

Similar findings were also seen in study done by Sani FB et al .[1]

Fasting blood sugar

There was significant increase in blood sugar level in both type I and type II diabetics when compared to controls. This higher blood sugar values observed in diabetics were expected because, a person is said to be diabetic if fasting blood sugar is more. The increased FBS level in diabetics arises from the deficiency of insulin, the key hormone in the regulation of glucose metabolism.[5]

This increased blood sugar level can be taken as a simple biochemical marker in diabetic subjects to indicate their state of metabolic control and to intervene early in the treatment. The persistent hyperglycemia is an indicator of developing early complications in diabetics.

Similar findings were consistent with the study done by Onwuliri VA et al,[5] Banerjee S et al [6] and Gayoum AGAA et al.[7]

Serum Sodium

In our study there was statistically significant increase in serum sodium levels in type I diabetics when compared to controls and no significant difference in type II diabetics and controls.

This increase in serum sodium level can be explained as that, the $Na^+ – K^+$ ATPase is a ubiquitous enzyme that ensures that the transmembrane gradient of sodium and potassium concentrations are maintained. Alterations of this transport enzyme are thought to be linked to several complications of diabetes mellitus. As the activity of $Na^+ – K^+$ ATPase enzyme is dependent on insulin and the dysfunction of this enzyme is probably connected with the relative insulinopenia of hyperglycemic type I diabetic patients promoting sodium retention and causing expansion of total body sodium levels. This increased serum sodium level could also be attributed by the transitionary sodium retention due to increased sodium reabsorption from proximal renal tubules.[8]

Similar findings were also reported in earlier studies done by Shahid SM et al,[8] Onwuliri VA et al[5] and Saito T et al.[9]

Serum Potassium

In our study serum potassium level was significantly increased in type II diabetics whereas it was decreased in type I diabetics when compared to controls.

This altered distribution of serum potassium levels in diabetics could be due to hyperglycemia. The higher level of plasma glucose level results in greater reduction in circulating blood volume, as there was a significant negative correlation between plasma glucose and percent changes in blood volume. These changes might have increased the serum potassium levels. Also hyperosmolality would promote cellular dehydration, thus providing an increase in K^+ efflux from the cells leading to increased serum potassium levels in diabetics. The altered distribution of electrolytes is not merely dependent on hyperosmolality but also on insulin which affects the activity of $Na^+ – K^+$ ATPase enzyme. The dysfunction of $Na^+ – K^+$ ATPase is implicated in the altered distribution of electrolytes (Na^+& K^+) between intra and extracellular spaces.

Similar findings were also reported in earlier studies by Shahid SM et al,[8] Onwuliri VA et al,[5] and Saito T et al.[9]

Conclusion

The following conclusion can be drawn from the results of our study.

There was significant increase in weight, BMI and fasting food sugar level in both type I and type II diabetics when compared to controls.

Pulse rate was significantly increased in type I diabetics than non diabetics.

Serum sodium levels were significantly increased in type I diabetics than controls.

Serum potassium level was significantly decreased among type I diabetics whereas it in increased in type II cases when compared to controls.

Conflicts of Interest: Nil

Ethical Clearance: Taken from JJMMC Davangere ethical committee

Source of Funding: Self

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