STUDY OF ELECTROLYTE LEVELS IN DIABETIC PATIENTS

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Abstrak. Diabetes mellitus adalah gangguan/penyakit metabolik yang ditandai dengan kadar glukosa darah tinggi (hiperglikemia) dengan perubahan metabolisme karbohidrat, lipid, dan protein dalam tubuh akibat gangguan pada kerja insulin, sekresi insulin atau keduanya. Perubahan metabolisme tersebut mempengaruhi konsentrasi elektrolit. Elektrolit yang terdapat di dalam tubuh memainkan peran penting dalam banyak proses tubuh, seperti mengontrol kadar cairan, keseimbangan asam basa (pH), konduksi saraf, pembekuan darah dan kontraksi otot. Natrium, kalium dan klorida adalah makroelektrolit yang paling umum dan berkorelasi dengan diabetes mellitus. Dalam penelitian ini, kami meneliti prevalensi diabetes dan hubungannya dengan konsentrasi elektrolit pada 28 subjek, yang dibagi dalam dua kelompok: kelompok A terdiri dari 14 pasien diabetes di Rumah Sakit Labuang Baji dan kelompok B terdiri dari 14 subjek non diabetes. Hasil penelitian yang dilakukan menunjukkan bahwa tingkat serum elektrolit (Na^+, K^+, Cl^-) untuk kontrol semuanya berada pada range normal. Sebaliknya tingkat serum elektrolit (Na^+, Cl^-) terdapat dua pasien yang memiliki kadar elektrolit Na^+ dibawah range normal.

Kata Kunci : Diabetes Mellitus, Elektrolit, Natrium, Kalium, Klorida

Abstract. Diabetes mellitus is a metabolic disorder / disease characterized by high blood glucose levels (hyperglycemia) with changes in carbohydrate, lipid, and protein metabolism in the body due to disruption in insulin action, insulin secretion or both. These metabolic changes affect the concentration of electrolytes. Electrolytes contained in the body play an important role in many body processes, such as controlling fluid levels, acid base balance (pH), nerve conduction, blood clotting and muscle contraction. Sodium, potassium and chloride are the most common macroelectrolytes and correlate with diabetes mellitus. In this study, we examined the prevalence of diabetes and its relationship to electrolyte concentrations in 28 subjects, divided into two groups: group A consisted of 14 diabetic patients in Labuang Baji Hospital and group B consisting of 14 non-diabetic subjects. The results of the research conducted showed that serum electrolyte levels (Na +, K +, Cl-) for the control were all in the normal range. In contrast, serum electrolyte (Na +, Cl-) levels have two patients who have Na + electrolyte levels below the normal range.

Keywords : Diabetes Mellitus, Electrolytes, Sodium, Potassium, Chloride

INTRODUCTION

Diabetes mellitus is a metabolic disorder / disease characterized by high blood glucose levels (hyperglycemia) with changes in carbohydrate, lipid, and protein metabolism in the body due to disruption in insulin action, insulin secretion or both. This condition occurs when the β cells that produce insulin have been damaged. If there is a lack of insulin in the body, it can lead to decreased glucose transport through cell membranes, this condition results in cells lacking food thereby increasing fat metabolism in the body (Hasdianah, 2012). The main symptoms of diabetes include increased urination, increased thirst, fatigue, weight loss, blurred vision, increased hunger, and diabetes dermatomes (Hasona dan Elasbali, 2016)

The consequences of diabetes are numerous, starting from metabolic imbalances, degeneration of blood vessel walls which can cause dilution of electrolyte concentrations and offset the proportion of electrolytes. Electrolytes play an important role in many processes such as acid base, controlling body fluids, blood clots and muscle contractions. n addition, electrolytes are also important in the blood clotting process. Disturbed electrolyte distribution can affect diabetes and its control and is related to a number of other factors such as age and associated diabetes conditions (Al Jameil, 2014).

Potassium (K +), Sodium (Na +) and Chloride (Cl) are important ions in maintaining electrolyte balance. Electrolyte imbalances resulting from kidney failure, dehydration, fever, and vomiting have been suggested as one of the factors that contribute to complications of diabetes and other endocrine disorders (Hussain *et al.*, 2009). If people with diabetes mellitus lose too much electrolytes from excessive urination, the patient will experience severe dehydration which can cause mental confusion, dizziness, seizures and a condition called coma, non-ketoscopic hyperosmolar hyperglycemia (Hasdianah, 2012).

Hyperglycemia establishes an internal environment for osmotic diuresis while it can also cause dilution effects of electrolyte concentrations. The osmotic effect of glucose results in a decrease in blood circulation volume and a shift in fluid from the intracellular space causing cellular dehydration. The main objective of this experiment was to identify the relationship of serum electrolytes (sodium, chloride, and potassium) and lipid profiles with fasting blood glucose levels in diabetics. Examination of sodium, potassium and chloride concentrations in blood serum samples of patients with diabetes mellitus is done because all three are the most common macroelectrolytes and correlate with diabetes mellitus. Determination of electrolyte concentration was carried out using automatic analyzer, Cobch 6000 ROCHE module.

MATERIAL AND METHODS

This research will be carried out at the Muhammadiyah Makassar Health Analyst Chemistry laboratory and Labuang Baji Hospital Integrated Laboratory with the implementation stages:

Stage 1. Preparation of venous blood serum samples of patients with diabetes mellitus

Stage 2. Biochemical test determination of electrolyte concentration with automatic analyzer

Materials and Tools

The tools used in this study were tourniquet AVICO, Disposable Syringe OneMed, 100 µl and 50 µl micropipette H Model, Laboratory Glass test tube, Karter Scientific 208U2 Test Tube Rack for 15/17 mm Tubes, drip pipette, sample cup, centrifuge 5425and electrolyte AFT-300/500 cornley, Photometer 5010.

The materials used in this research are blood serum, 70% alcohol cotton, distilled water, and sodium reagent kit, chloride reagent kit, potassium reagent kit.

Preparation of Venous Blood Sampling

Prepared tools and materials to be used, the tourniquet is placed above the stab, cleaned with 70% alcohol cotton in the area to be stabbed, left to dry, the needle is inserted in the vein with the pinhole position facing up at an angle of 15-30 degrees, then the tourniquet bond is released after the blood flows, after the desired volume is obtained, the needle is released slowly and everything is pressed with an alcoholic cotton, then the needle is released from the syringe, then put in a test tube. Next, centrifuge for 5 minutes and separate serum and blood.

Sample preparation was carried out in the Clinical Chemistry laboratory, Muhammadiyah Makassar Health Analyst Academy. A total of 28 subjects were used in this study, divided into two groups: group A consisted of 14 diabetic patients and B14 group subjects as controls. Fasting glucose

in diabetics ≥ 110 mg / dL. The subjects of this study were in the age range of 30-70 years. Patients diagnosed especially type 2 DM and do not consume alcohol and are not pregnant. The purpose of this study is well explained to patients. The patient's anonymity is maintained by encoding the sample.

Electrolyte Level Check

Prepared tools and materials to be used. Serum ± 150 µL was prepared in a small sample cup then the instrument should be poised ready (press NO) and press 4 (blood serum) after the words "Lift Probe To Aspirate" appear red (orange) probes and put serum on the tip of the needle, then put the YES button (make sure the serum is sucked) wiped the tip of the needle with a clean tissue and then lower the red probe again as before. then, a process of ± 1 minute is awaited and the results are automatically printed. After, "Lift Probe To Aspirate" reappears and re-enter the second sample (if there is a subsequent sample). if all samples are finished press the NO button.

Interpretation of Results   :
- Sodium (Na +) levels in serum: 135-145 mEq / L
- Potassium (K +) in serum: 3.0-5.5 mEq/L
- Chloride (Cl-) levels in serum: 95-105 mEq/L

RESULT AND DISCUSSION

A total of 28 subjects were included in this study, ranging in age from 30 to 70 years. Subjects were divided into two groups depending on serum glucose levels.

Group A consisted of 14 patients who had serum glucose below 110 mg / dL (normal control). Group B consisted of 14 patients with serum glucose more than 110 mg / dL (diabetic subjects). Electrolyte parameters were carried out using sodium, potassium and chloride because the three were the most common macro electrolytes and correlated with Diabetes Mellitus. Serum electrolyte levels (Na +, K +, Cl-) for controls are all in the normal range. In contrast, serum electrolyte (Na +, Cl-) levels have two patients who have Na + electrolyte levels below the normal range 135-145 mEq / L and Cl - below the normal range of 95-105 mEq / L, as shown in tables 1 and 2.

Table 1. Electrolyte Examination Results in the Control Group

No.	Fasting Glucose	Electrolyte Parameters (mEq/L)					
		Na^+	Reference	K^+	Reference	Cl^-	Reference
1	90	141	135-145	4.0	3-5.5	102	95-105
2	103	138		3.8		102	
3	98	139		4.4		103	
4	95	139		4.1		104	
5	80	140		3.3		101	
6	89	148		4.2		103	
7	90	141		3.9		104	
8	102	142		4.8		105	
9	85	140		3.9		104	
10	88	140		3.8		101	
11	74	142		3.8		107	
12	82	141		4.4		105	
13	83	138		3.7		103	
14	78	138		4.1		105	

Table 2. Electrolyte Examination Results in DM Patient Groups

No.	Fasting Glucose	Electrolyte Parameters mEq/L					
		Na^+	Reference	K^+	Reference	Cl^-	Reference
1	301	174	135-145	6.2	3-5.5	136	95-105
2	302	140		4.0		102	
3	290	136		3.7		98	
4	302	139		4.9		101	
5	310	137		4.7		103	
6	289	128		3.6		91	
7	308	137		3.6		102	
8	285	131		5.3		93	
9	340	142		4.1		103	
10	252	144		4.5		105	

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11	204	142	5.8	104
12	400	144	5.0	105
13	196	138	4.4	101
14	205	142	4.4	107

People with DM are at risk for hyponatremia, hypokalemia and hypoglycemia. Based on the results of this study 14.29% of patients experienced hyponatremia and hypochloremia. Hyponatremia is circumstances where serum sodium is <135 mEq / L, this occurs due to water retention or excessive water loss through urine. Whereas hypochloremic is a condition where serum chloride is below <95 mEq / L.

The results of statistical analysis using Statistical Package for Social Sciences (SPSS) are presented using the mean ± Standard Error Mean (M ± SEM) for all quantitative electrolyte values of diabetic patients and control subjects. The results are presented in the following table 3.

Table 3. Comparison of serum electrolytes in diabetic patients and control subjects

Electrolyte	Group A: Control Subject	Group B: Diabetes patient
Sodium (mEq / L)	140,50 ± 0,685	141 ± 2,822
Potassium (mEq / L)	4,01 ± 0,097	4,58 ± 0,213
Chloride (mEq / L)	103,50 ± 0,454	103,64 ± 2,76

As shown in Table 3, when compared to the normal group Na +, K + and Cl levels of diabetics increased slightly. This result is probably due to venous blood sampling in some DM patients after hospitalization and infusion, thus preventing electrolyte disturbances. Patients with diabetes insipidus due to decreased secretion of diuretic hormones often experience loss of hyperosmolar type fluid. Giving hypertonic fluid also increases the amount of solute in the bloodstream (Tamsuri, 2009).

Detection of a decrease in sodium, potassium and chloride concentrations in patients with diabetes mellitus occurs due to renal dysfunction, diabetic nephropathy or dehydration. This electrolyte imbalance may also occur due to inhibition of the angiotensin-aldosterone rennin system, which plays a key role in regulating fluid and electrolyte balance. This enzyme system has been studied to influence endocrine and cardiovascular diseases, especially diabetes (Cowie CC *et al*., 1995). Disorders of fluid and electrolyte balance can occur in subjects with diabetes mellitus, resulting from insulin deficiency, hyperglycemia and hyperketonemia (Kitabchi AE, *et al*. 2006).

CONCLUSION

In the study we conducted an examination of electrolyte levels in patients with diabetes mellitus in 28 subjects with an age range of 30 to 70 years. From the results of the research conducted, it can be concluded that the serum electrolyte level (Na^+, K^+, Cl^-) for the control are all in the normal range. In contrast, serum electrolyte (Na^+, Cl^-) levels have two patients who have Na + electrolyte levels under the normal range 135-145 mEq/L and Cl^- below the normal range of 95-105 mEq/L.

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REFERENCES

Al Jameil, N. 2014. Estimation of Serum Electrolytes in Diabetes Patients of Saudi Region. *Life Science Journal*. 11(7): 378-380.

Anthony . 2004. Health Promotion and Health Education about Diabetes Mellitus, *The Journal of the Royal Society for the Promotion of Health*, 124 (2): 70-73.

Cowie CC, Harris MI. 1995. *Physical and metabolic characteristics of persons with diabetes*, Diabetes in America, 2nd ed. National Institutes of Health. 1995, 117- 164.

Hasdianah H. R, 2012. *Get to know diabetes mellitus in adults and children with herbal solutions*. Nuha Medika, Yogyakarta.

Hasona dan Elasbali. 2016. Evaluation of Electrolytes Imbalance and Dyslipidemia in Diabetic Patients. *Medical sciences*. 7 (4): 1-4.

Hussain F, M Arif Maan, MA Sheikh, H Nawaz, A Jamil. 2009. *Trace elements status in type 2 diabetes. Bangladesh Journal of Medical Science*. 8 (3): 1-5.

Kitabchi AE, Umpierre GE, Murphy MB, Kriesberg RA. 2006. Hyperglycemic crisis in adult patients with diabetes: A consensus statement from the American diabetes association. *Diabetes Care*. 29: 2739-2748.

Tamsuri, Anas. 2009. *Client Disorders of Liquid and Electrolyte Balance*. EGC Medical Book, Jakarta.

Upoyo, A. Muniroh. Maryana. 2015. Description of Electrolytes (Sodium-Potassium Serum) Patients with Diabetes Mellitus in the Hospital of Prof. Dr. Margono Soekarjo Purwokerto. *Jurnal Kesehatan Samodra Ilmu*. 6(1) : 35-39.

World Health Organization. *Expert Committee on Prevention and Treatment of Diabetes Mellitus*; WHO Technical Series No 844; World Health Organization: Geneva, Switzerland, 1994.