

Creatinine plasma at uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus patients at primary health care in Binjai city, Indonesia

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Abstract. The aim of the study knowing the comparison creatinine plasma levels at uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus patients at Primary Health Care in Binjai city of North Sumatera in Indonesia. This cross-sectional study was conducted on 40 type 2 Diabetes Mellitus patients who attended Primary Health Care in Binjai. Patients with age > 40 years old, (both sexes) were included in the study. We recorded different demographic parameter as age, Body Mass Index, Blood Pressure, and personal history status. And we examined the biochemical parameters including HbA1c, Fasting Blood Sugar Levels (FBL) and creatinine serum. We separated into two groups based on HbA1c test, controlled type 2 diabetes mellitus and uncontrolled type 2 diabetes mellitus. We measured FBL by using the portable measuring instrument, and Thamrin clinical laboratory measured HbA1c, and we measured creatinine plasma by spectrophotometry in Biochemistry laboratory. With statistical analysis using T-test found that there was a significant difference in creatinine plasma levels between uncontrolled type 2 diabetes mellitus with controlled type 2 diabetes mellitus ($p < 0.005$).

1. Introduction

Diabetes has become a widespread epidemic, due to increasing prevalence and incidence of type 2 diabetes. [1] Diabetes is one of the leading causes of morbidity and mortality throughout the world, and it is a health problem worldwide. About 2.2% to 3% of the world's population suffers from type 2 diabetes mellitus. [2] Diabetes mellitus (DM) is a chronic metabolic disorder that can lead to severe cardiovascular, renal, blindness, neurological, nerve disease and retinal complications. [2,3]

HbA1c is a measure of erythrocyte haemoglobin glycation since erythrocytes have about 120 days lifespan, and reflects overall blood glucose levels over a period 2-3 months and further, used to monitor diabetic treatment. It has been recognized that HbA1c as an essential adjunct to regular self-blood glucose measurement assisting in the achievement of the best possible glycemic control. Renal failure can have complex influences on HbA1c formation and measurements. It is due that urea – derived isocyanate, which can be indistinguishable from HbA1c when using some glycosylated Haemoglobin methods. [4]

Creatinine is a waste product excreted by kidneys mainly by glomerular filtration and skeletal muscle is the most site of insulin resistance and accounts for approximately 90% of overall glucose disposal



after glucose infusion. Creatinine is the only metabolite of creatinine which is mainly (98%) located in striated muscle.[5] Since serum creatinine is highly correlated with 24-h urine excretion in subjects with normal renal function.[6] Low serum creatinine levels were associated with a higher risk of T2DM in a recent study of non-obese middle-aged Japanese men [7], it is speculated that low creatinine might reflect low muscle mass volume. This study was planned with objectives to measure creatinine plasma and analyze the relation between creatinine plasma and Hba1c in type 2 Diabetes Mellitus patients.

2. Method

This study is descriptive analytic research method with across-sectional design. It involved 40 patients, enrolled by consecutive sampling, sample population in the Primary Health Care in Binjai city of North Sumatera Indonesia. Uncontrolled type 2 diabetes 20 subjects and controlled type 2 diabetes 20 subjects, base on Hba1c test laboratory. Hba1c value 6.5-8 was category controlled type 2 diabetes mellitus and Hba1c value > 8 was category uncontrolled type 2 diabetes mellitus. In accordance with the inclusion criteria which are, aged > 40 years old and cooperative and have a will to join this research and exclusion criteria which are, using diuretic and the middle of cancer therapy. This research was approved by Health Research Ethical Committee, Medical Faculty of University Sumatera Utara /H.Adam Malik General Hospital number 591/TGL/KEPK FK USU-RSUP HAM /2016.

Each sample we examine weight, height, abdominal circumference, blood pressure, and laboratory tests such as fasting blood sugar levels. And Hba1c and creatinine plasma levels collect by using secondary data. Estimation of creatinine was done by the modified Jaffe's method using spectrophotometry with wavelength 492 nm. We collected the plasma with EDTA using standard protocols, and creatinine forms the orange-red colored complex in alkaline picrate solution. The difference in absorbance at fixed times during conversion is proportional to the concentration of creatinine in the sample. Creatinine + Picric acid → Creatinine picrate complex. And Hba1c was measured by Thamrin clinical laboratory. All subjects gave informed consent. The data were statistically analyzed, were carried out using T-Test. A p value < 0.05 was considered as significant.

3. Result

Among 40 known type 2 Diabetes Mellitus patients 30.4% were male and 69.6% female. Table 1 showed that the characteristics of the subjects of this study. Samples in this study were not below 40 years old. Maximum Body Mass Index (BMI) in this samples at uncontrolled type 2 diabetes mellitus were 33.78 and minimum 20.6, but means of it were 26.6 ± 3.5 , and maximum of body mass index at controlled type 2 diabetes mellitus were 35.25 and minimum of body mass index of the controlled type 2 diabetes mellitus were 18.95 but means of it were 25.7 ± 4.1 , in this research the waist size of the samples at uncontrolled found from 87.2-97.6 cm and waist size of the samples at controlled type 2 diabetes mellitus found from 84.1-102.1 cm, fasting blood sugar level at uncontrolled type 2 diabetes mellitus found from 126.7-311.5 mg/dL and fasting blood sugar at controlled type 2 diabetes mellitus found from 110.4-200.8 mg/dL, the Hba1c value of the samples at uncontrolled type 2 diabetes mellitus found from 9.6-9.8% and Hba1c value of the samples at controlled type 2 diabetes mellitus found from 7.2-8.8%, creatinine plasma of the samples with uncontrolled type 2 diabetes mellitus found 1.2-2.4 mg/dL and creatinine plasma of the samples at controlled type 2 diabetes mellitus found 1.4-2.4 mg/dL. Normal levels of creatinine plasma approximately 0.6 to 1.2 mg/dL in adults males and 0.5 to 1.1 mg/dL in adults females. As we see the creatinine value at the both of the samples groups, show the highest limit value of the normal. And this study both of the group of samples showed that creatinine plasma above the normal value. As we know that the creatinine plasma value showed the renal function.

Table 1. Baseline characteristic of the 40 samples.

	Uncontrolled Type 2 Diabetes Mellitus	Controlled Type 2 Diabetes Mellitus
Age	56.2±9.2	60.6±7.3
BMI	26.6±3.5	25.7±4.1
Waist Size	92.4±5.2	93.1±9.0
FBL	219.1±92.4	155.6±45.2
HbA1c	9.7±1.0	8.0±0.8
Creatinine	1.8±0.6	1.9±0.5
Systole	124.9±18.2	144±30.6
Diastole	77.6±7.3	89.1±17.3

4. Discussion

This study aimed to analyze the comparison of creatinine plasma levels in uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus patients, so we used the statistical analysis with T-test found that there was a significant difference in creatinine plasma between uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus patients ($p < 0.005$). The study showed that creatinine plasma value is the higher ($1.9 \pm 0.5 \text{ mg/dL}$) at controlled type 2 diabetes mellitus than uncontrolled type 2 diabetes mellitus ($1.8 \pm 0.6 \text{ mg/dL}$).

In this present study, the comparison creatinine plasma levels at uncontrolled and controlled type 2 Diabetes Mellitus in primary health care in Binjai of North Sumatera Indonesia. There is a significant difference in creatinine plasma levels between uncontrolled type 2 diabetes mellitus and controlled type 2 diabetes mellitus subjects. As we know that creatinine is the breakdown product of creatine phosphate and is released from skeletal muscle and it is filtered by the glomerulus, and a small amount is also secreted into the glomerular filtrate by the proximal tubule. The concentration of creatinine in plasma of a healthy individual is constant, independent of water intake, exercise, and rate of urine production. Therefore, increased plasma creatinine values always indicate decreased excretion of impaired kidney function.

Research by Blessing O. Idonije etc. shows that plasma creatinine level in type 2 diabetes mellitus is increased in male and female compared with their levels in apparently healthy non-diabetic controls. The other research by Gulab, Kanwar etc observed that 58% Type 2 Diabetes Mellitus showed elevated serum urea (68.85 ± 46.87) and 50% serum creatinine levels (1.91 ± 1.34) and by Judykay (2007) in his submission suggested that high creatinine levels observed in diabetic patients may be due to impaired function of the nephrons. [9]

Serum creatinine can be used as useful prognostic markers and predictors of renal damage in diabetic patients. [10] Effective control of blood sugar levels can stop progression to diabetic nephropathy and thus remarkably reduce the morbidity and mortality associated with this metabolic disease.

5. Conclusion

The result of this research shows that there was a significant difference in creatinine plasma levels between uncontrolled type 2 diabetes mellitus with controlled type 2 diabetes mellitus ($p < 0.005$).

References

- [1] Soo K K, Park S W 2012 Exercise and type 2 diabetes *Kor. Diabet.* **13(2)** 61-8
- [2] U.S. Department of Health and Human Services Centers for Disease Control and Prevention National Diabetes Fact Sheet 2007 *General information and national estimates on diabetes in the United States*
- [3] Pasaoglu H, Sancak B and Bukan N 2004 Lipid peroxidation and resistance to oxidation in patients with type 2 diabetes mellitus *Thoku. J. Exp. Med.* **203** 211-8

- [4] Saudek C D, Kalyani R R and Derr R L 2005 Assessment of glycemia in diabetes mellitus: hemoglobin A1c *J. Assoc. Physic. India* **53** 299–304
- [5] Hjelmeth J, Roislien J, Nordstrand N, Hofso D, Hager H and Hartmann A 2010 Low serum creatinine is associated with type 2 diabetes in morbidly obese women and men: a cross-sectional study *BMC Endocrine Disord.* **10** 6 doi:10.1186/1472-6823-10-6
- [6] Yonemura K, Takahira R, Yonekawa O, Wada N and Hishida A 2004 The diagnostic value of serum concentrations of 2-(alpha-mannopyranosyl)-Ltryptophan for normal renal function *Kidney Int.* **65** 1395-9 doi:10.1111/j.1523-1755.2004.00521
- [7] Harita N, Hayashi T, Sato K K, Nakamura Y, Yoneda T and Endo G 2009 Lower serum creatinine is a new risk factor of type 2 diabetes: the Kansai healthcare study *Diabetes Care* **32** 424–6 doi:10.2337/dc08-1265
- [8] Ashavaid T F, Todur S P and Dherai A J 2005 Establishment of reference intervals in Indians population *Ind. J. Clin. Biochem.* **20** 110-8
- [9] Judykay T 2007 Nutrition for reducing urea and creatinine in the blood *Diabetes Care* **27** 2191-2
- [10] Adler A, Stevens R J, Manley S E, *et al.* 2003 Development and progression of nephropathy in type 2 diabetes (the United Kingdom prospective diabetes study) *Kidney Int.* **63** 225-32
- [11] Blessing O I, Olorunoba, *et al.* 2011 Plasma glucose, creatinine and urea levels in type 2 diabetic patients attending a nigerian teaching hospital *Res. J. Med. Sci.* **5(1)** 1-3
- [12] Kanwar G, Jain N, *et al.* 2015 Significance of serum urea and creatinine levels in type 2 diabetic patients *IOSR J. Dental Med. Sci. (IOSR-JDMS)* **14(8)** 65-7
- [13] Bowers L D 1980 Kinetic serum creatinine assays: The role of various factors in determining specificity *Clin. Chem.* **26** 551-4