Journal of Investigational Biochemistry
www.scopemed.org
DOI: 10.5455/jib.20130821082557

Original Research

GESDAV

The study of biochemical parameters showing atherogenic effect in Type 2 diabetic nephropathy

Sureshbabu Kondaveeti[1], Anand Shaker Ivvala[2], Bhuvana Karthikeyan[3]

[1]Department of Biochemistry, Melmaruvathur Adhiparasakthi Institute of Medical Science & Research, Melmaruvathur, Kancheepuram, Tamil Nadu, India, [2]Department of Biochemistry, Melmaruvathur Adhiparasakthi Institute of Medical Sciences & Research, Melmaruvathur, Kancheepuram, Tamil Nadu, India, [3]Compulsory Rotatory Residential Internship, Adhiparasakthi College of Dental Sciences, Melmaruvathur, Kancheepuram, Tamil Nadu, India

Address for correspondence:
Kondaveeti Sureshbabu, Department of Biochemistry, Anna Medical College & Research Center, Mauritius.
E-mail: sureshbabu_kondaveeti@yahoo.com

Received: July 03, 2013
Accepted: August 21, 2013
Published: September 23, 2014

ABSTRACT

Aim: Diabetic nephropathy is one of the major complications of diabetes mellitus characterized by frequent microalbuminuria, elevated arterial blood pressure, a persistent decline in glomerular filtration rate and a high risk of cardiovascular morbidity and mortality. **Methods:** The study comprised of 30 diabetic mellitus (DM) with microalbuminuria patients (Group 3), 30 DM without microalbuminuria patients (Group 2) compared with 30 healthy controls (Group 1). Fasting glucose, post prandial glucose, lipid profile, fructosamine and microalbuminuria were investigated in all the groups. **Results:** A significant increase in serum fructosamine, fasting and post prandial glucose levels along with increased microalbuminuria observed in Group 3 patients compared to Group 2 and Group 1 patients. **Conclusion:** Hyperglycemia, increased fructosamine and increased cholesterol, triglycerides with decreased high-density lipoprotein-cholesterol levels indicates the major risk of atherogenicity.

KEY WORDS: Atherogenicity, diabetic nephropathy, fructosamine, microalbuminuria

INTRODUCTION

Diabetes mellitus (DM) is a disease in which the hallmark feature is elevated blood glucose concentrations due to loss of insulin-producing pancreatic β-cells (Type 1 diabetes) or through loss of insulin responsiveness in its target tissues (Type 2 diabetes). Type 1 diabetes usually begins to manifest in childhood and early adulthood, but Type 2 diabetes is typically a disease for which increased age is a risk factor [1]. Different studies have described diabetes as one of the main threat to human health in the 21st century [2]. DM is a major health problem worldwide. It is a serious debilitating and deadly disease that has now reached epidemic proportion, and the prevalence rates are expected to go even higher in the future. Diabetic nephropathy (DN) will affect approximately 30% of all patients with diabetes [3,4]. DN is one of the most common microvascular complications of diabetes [5] defined as a rise in urinary albumin excretion rate, often associated with an increase in blood pressure, but without evidence of other causes of renal disease [6].

High mortality in nephropathy is due to an excess of cardiovascular mortality [7], and to end stage renal failure [8]. Albuminuric

diabetes patients are 20 times more likely to die of cardiovascular disease than are non-albuminuric ones [9]. The relationship between arterial blood pressure and DN seems to be a complex one, nephropathy increasing blood pressure and blood pressure accelerating the course of nephropathy [10]. The present study was mainly conducted further to find out the biochemical parameters and their correlations. The biochemical analytes are lipid profile, fructosamine and microalbuminuria.

MATERIALS AND METHODS

The study was undertaken in MAPIMS College Hospital, Melmaruvathur, Kancheepuram. The evaluation was comprised of three groups and total subjects 90. One was a control group (males 20, females 10) 30 subjects who were non-diabetic, non-smoker, non-alcoholic and without any chronic diseases and illness. Group 2 was Type 2 diabetic with microalbuminuria patients (males 20, females 10) 30 subjects and Group 3 was Type 2 diabetic without microalbuminuria patients (males 20, females 10) 30 subjects. The subjects were in the age group of 42-75 years. Inform consent was obtained in written proforma and ethical clearance is obtained to carry out the study.

After 12 h fasting, blood samples were drawn by venipuncture and collected into a plain tube for the determination of lipid profile, fructosamine and fluoride tube used for plasma glucose. Second-blood sample was collected after 2 h post prandial for estimation of plasma glucose. A fasting urine sample was collected for microalbuminuria examination. All the blood biochemical parameters were estimated using auto analyzer slim (SEAC).

The fasting plasma sample and post prandial plasma sample used for the determination glucose by glucose oxidase and peroxidase method [11]. The plain tube containing blood was allowed to stand for 30-60 min, and serum was separated by centrifuging at 2500 rpm for 15 min at room temperature. Serum sample used for fructosamine and lipid profile estimations. Cholesterol determined by cholesterol oxidase and peroxidase method [12] and triglycerides by trinders glycerol phosphate oxidase-peroxidase method [13]. High-density lipoprotein (HDL) determined by polyethylene glycol method [14] and low-density lipoprotein (LDL) cholesterol by calculation method according to Friedewald formula [15]. The microalbuminuria was determined by pyrogallol red method [16], and fructosamine was estimated by Hill method [17]. Statistical analysis of the results was done using Student's *t*-test.

RESULTS

The results of the study are shown in Tables 1 and 2. The mean values of serum fructosamine and microalbuminuria in Group 1 (control normal healthy individuals), Group 2 (Type 2 diabetics without microalbuminuria) and Group 3 (Type 3 diabetics with microalbuminuria) were measured. The serum fructosamine and urinary microalbuminuria in Group 1, Group 2, and Group 3 were 210 ± 5.2, 267 ± 2.0, 310 ± 1.5 and 7 ± 2.5, 25 ± 2.2, 82 ± 3.7 respectively. Figure 1 indicates the values of fructosamine in Group 1 shows within the reference range, in Group 2 shows a little bit higher but within the reference range. Group 3 fructosamine values increased above the reference range. Figure 2 indicates the urinary microalbuminuria values within normal range in Group 1, but significantly values were increased in Group 2 and 3. The higher significant values of microalbuminuria observed in Group 2 and 3. The fructosamine variation was indicated due to the variation [Figure 1] in fasting and post prandial glucose levels. The lipid profile values were determined in all groups [Table 2]. The cholesterol values were 156 ± 9.0, 178 ± 8.2 and 221 ± 18.4 mg/dL for Group 1, Group 2 and Group 3 respectively. The triglycerides values were 145 ± 18.2, 228 ± 21.3 and 241 ± 85.5 mg/dL for Group 1, Group 2 and Group 3 respectively. The LDL value calculated by using Friedewald's formulae (HDL–cholesterol) and the values were 36 ± 5.0, 39 ± 4.4 and 34 ± 5.6 mg/dL for Group 1, Group 2 and Group 3 respectively. The values of cholesterol increased and HDL decreased in high significant. The ratio of cholesterol and HDL calculated as 6.5 for Group 3.

DISCUSSION

Fructosamine used as an index to monitor short-term diabetic control, and its measurement is sensitive to changes in diabetic control due to shorter life span of albumin. Thus, it alerts the physician to understand the glycemic status much earlier than glycosylated hemoglobin A1c therefore; a higher fructosamine value indicates the poor glycemic control [18,19]. In the present study the occurrence of hypercholesterolemia, hypertriglyceridemia and lower levels of HDL [Figure 3] seen in DN. There was also a increased occurrence of LDL cholesterol levels. There was a significant increase in microalbuminuria for Group 3 compared to without microalbuminuria groups. This is because DM is one of the systemic diseases affecting the renal function. Lipid profile parameters were altered in diabetic with increased levels of microalbuminuria. The prevalence of hypertriglyceridemia and low HDL levels seen in the present study is similar to the reports by the other workers [20,21]. The higher levels of triglycerides, cholesterol, LDL and lower levels of HDL accounts of the contribution to coronary heart disease risk [22].

CONCLUSION

According to the study, it indicates the evidence for biochemical parameters causing atherogenic potency in DN that results

Table 1: Comparison of mean and SD±value of FBS, PPBS, microalnuminuria and fructosamine in different groups

Parameter	Normal range	Control group (G1)	Type 2 DM without microalbuminuria (G2)	Type 2 DM with microalbuminuria (G3)
FBS (mg/dL)	70-110	81±7.2	109±5.5	141±8.5
PPBS (mg/dL)	Up to 150	101±6.5	172±7.4	225±5.5
Microalbuminuria (mg/dL)	1-35	7±2.5	25±2.2**	82±3.7**
Fructosamine (mmol/L)	205-285	210±5.2	267±2.0*	310±1.5*

*$P<0.05$: Significant, **$P<0.001$: Highly significant, FBS: Fasting blood glucose, PPBS: Postprandial blood sugar, DM: Diabetic mellitus, SD: Standard deviation

Table 2: Comparison of mean and SD±values of cholesterol, HDL ratio, triglycerides and LDL in different groups

Parameter	Normal range	Control group (G1)	Type 2 DM without microalbuminuria (G2)	Type 2 DM with microalbuminuria (G3)
Cholesterol (mg/dL)	130-220	156±9.0	178±8.2**	221±18.4**
HDL (mg/dL)	35-55	36±5.0	39±4.4*	34±5.6*
Triglycerides (mg/dL)	Up to 165	145±18.2	228±21.3**	241±85.5**
LDL (mmol/L)	Up to 132	91±12.5	93±15.4*	139±35.5*
HDL ratio	Up to 4.5	4.3	4.6	6.5**

*$P<0.05$: Significant, **$P<0.001$: Highly significant, HDL: High density lipoprotein, LDL: Low density lipoprotein, SD: Standard deviation

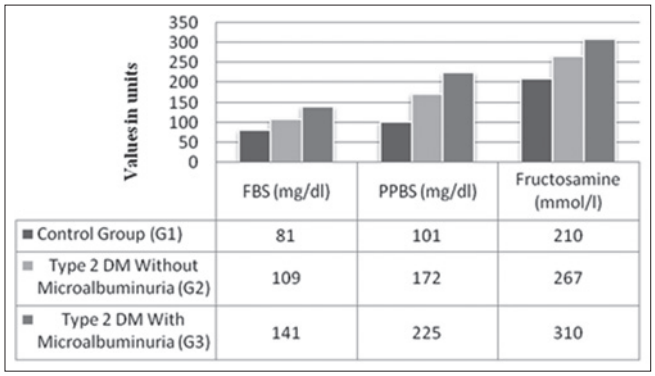

Figure 1: Comparison of serum fructosamine values in all groups

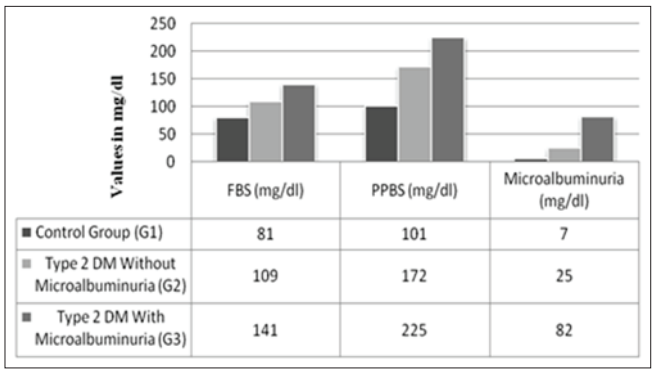

Figure 2: Comparison of microalbuminuria values in all groups

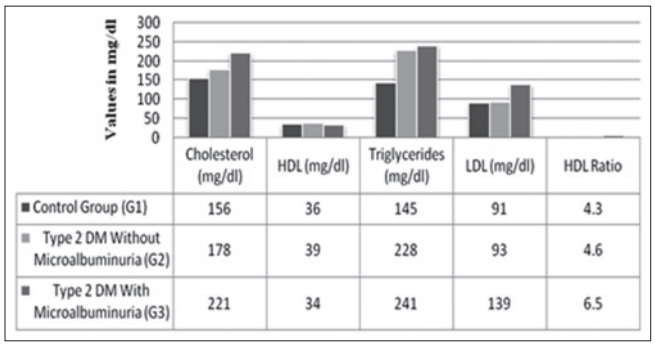

Figure 3: Comparison of cholesterol, high-density lipoprotein (HDL), triglycerides, low-density lipoprotein and HDL ratio of all groups

in alarming indication of cardiovascular complications. The glycemic control along with the lipid profile values and regular monitoring of microalbuminuria should be kept under strict control so that complications associated with diabetes would be postponed and also correlated with increased risk of cardiovascular diseases.

ACKNOWLEDGMENT

The authors would like to thank management and staff of MAPIMS, and APDCH, Melmaruvathur, Kancheepuram - 631 501, Tamil Nadu, India for permitting and providing necessary lab facilities to carry out this research work.

REFERENCES

1. Schwarz PE, Li J, Lindstrom J, Tuomilehto J. Tools for predicting the risk of type 2 diabetes in daily practice. Horm Metab Res 2009;41:86-97.
2. Zimmet P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. Nature 2001;414:782-7.
3. Caramori ML, Fioretto P, Mauer M. Enhancing the predictive value of urinary albumin for diabetic nephropathy. J Am Soc Nephrol 2006;17:339-52.
4. Hovind P, Tarnow L, Rossing K, Rossing P, Eising S, Larsen N, *et al.* Decreasing incidence of severe diabetic microangiopathy in type 1 diabetes. Diabetes Care 2003;26:1258-64.
5. Giunti S, Barit D, Cooper ME. Diabetic nephropathy: From mechanisms to rational therapies. Minerva Med 2006;97:241-62.
6. Viberti GC, Hill RD, Jarrett RJ, Argyropoulos A, Mahmud U, Keen H. Microalbuminuria as a predictor of clinical nephropathy in insulin-dependent diabetes mellitus. Lancet 1982;1:1430-2.
7. Zimmermann J, Schramm L, Mulzer E, Heidbreder E, Henrich HA, Wanner C. Cardiovascular risk factors in diabetic nephropathy. Med Klin (Munich) 1997;92:74-8.
8. Knowles HC Jr. Long-term juvenile diabetes treated with unmeasured diet. Trans Assoc Am Physicians 1971;84:95-101.
9. Borch-Johnsen K, Andersen PK, Deckert T. The effect of proteinuria on relative mortality in type 1 (insulin-dependent) diabetes mellitus. Diabetologia 1985;28:590-6.
10. Parving HH, Rossing P. Calcium antagonists and the diabetic hypertensive patient. Am J Kidney Dis 1993;21:47-52.
11. Barham D, Trinder P. An improved colour reagent for the determination of blood glucose by the oxidase system. Analyst 1972;97:142-5.
12. Allain CC, Poon LS, Chan CS, Richmond W, Fu PC. Enzymatic determination of total serum cholesterol. Clin Chem 1974;20:470-5.
13. Bucolo G, David H. Quantitative determination of serum triglycerides by the use of enzymes. Clin Chem 1973;19:476-82.
14. Demacker PN, Hijmans AG, Vos-Janssen HE, van't Laar A, Jansen AP. A study of the use of polyethylene glycol in estimating cholesterol in high-density lipoprotein. Clin Chem 1980;26:1775-9.
15. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clin Chem 1972;18:499-502.
16. Watanabe N, Kamei S, Ohkubo A, Yamanaka M, Ohsawa S, Makino K, *et al.* Urinary protein as measured with a pyrogallol red-molybdate complex, manually and in a Hitachi 726 automated analyzer. Clin Chem 1986;32:1551-4.
17. Hill RP, Hindle EJ, Howey JE, Lemon M, Lloyd DR. Recommendations for adopting standard conditions and analytical procedures in the measurement of serum fructosamine concentration. Ann Clin Biochem 1990;27:413-24.
18. Baker JR, Metcalf PA, Holdaway IM, Johnson RN. Serum fructosamine concentration as measure of blood glucose control in type-1 diabetes mellitus. Br Med J 1983;24:863-7.
19. Lim YS, Staley MJ. Measurement of plasma fructosamine evaluated for monitoring diabetes. Clin Chem 1985;31:731-3.

20. Koenig RJ, Peterson CM, Jones RL, Saudek C, Lehrman M, Cerami A. Correlation of glucose regulation and hemoglobin AIc in diabetes mellitus. N Engl J Med 1976;295:417-20.
21. Taskinen MR. Diabetic dyslipidemia in NIDDM. Int Diabetes Monit 1996;8:1-7.
22. Vigstrup J, Mogensen CE. Proliferative diabetic retinopathy: At risk patients identified by early detection of microalbuminuria. Acta Ophthalmol (Copenh) 1985;63:530-4.

Source of Support: Nil, Conflict of Interest: None declared.