



BIOCHEMICAL EVALUATION, ANTHROPOMETRIC MEASUREMENTS IN ASSESSMENT OF MICROVASCULAR COMPLICATIONS IN FEMALES WITH TYPE-2 DIABETES MELLITUS

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ABSTRACT

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“All females more than 45 years requires comprehensive evaluation of anthropometric and biochemical parameters to avoid diabetic complications.”

Objective: To investigate the role of the biochemical parameters in the prediction of the microvascular complications in Type 2 diabetes and non-diabetes female patients.

Materials and Methods: The present study was conducted in R L Jalappa hospital attended to Sri Devaraj Urs Medical College, Kolar. Randomly selected 45 female type 2 diabetes and non diabetes patients with the age group of 45-55 years attending medicine outpatient department from March 2011 to January 2012 were included in the study. Anthropometric and biochemical parameters were analyzed by standard methods.

Results: Among variables studied height, obesity index and diastolic blood pressure (DBP) were statistically significant between diabetes and non-diabetes. Diabetic female subjects showed higher values for insulin (16.90mcU/ml), uric acid (4.36mg/dl), urine albumin (305.71mg/dl) and albumin creatinine ratio (13.18mg/g) when compared with non-diabetic female subjects. The mean values for total cholesterol (182.09mg/dl), triglycerides (209.04mg/dl), high density lipoproteins (HDL-c) (36.44mg/dl), low density lipoproteins (LDL-c) (100.09mg/dl), Non-HDL (145.64mg/dl) and eGFR (97.03) in diabetes females and in non diabetes females 187.69mg/dl, 143.78mg/dl and 43.46mg/dl, 115.20mg/dl, 144.22mg/dl, 87.03 for TC, triglycerides, HDL, LDL, non-HDL and eGFR respectively. Among parameters evaluated triglycerides and LDL-c were significant between diabetic and non-diabetic female subjects.

Conclusion: In this study we observed 26.6% of nephropathy, 13.3% of retinopathy and 6.6% of neuropathy in diabetes females. However non-diabetes female subjects showed higher significant TC and LDL-c levels. This suggests that above the age of 45 year females requires comprehensive evaluation of anthropometric and biochemical parameters to avoid micro and macro vascular complications.

Key words: Type 2 diabetes, Microvascular complications, Glycosylated hemoglobin, Diabetic retinopathy, Diabetic neuropathy, and Diabetic nephropathy.

INTRODUCTION

Diabetes mellitus currently affects more than 170 million people worldwide and projections for the future alarming.¹ It is expected that the number of patients with diabetes will double within the next 20 years due to epidemic rise in the prevalence of diabetes.¹ This estimate is conservative and based only on the expected population increase and the rising proportion of elderly people. In addition changes towards a more sedentary lifestyle with decreased physical activity and a rapid increase in the prevalence of obesity is likely to increase the future burden of diabetes and its associated micro and macrovascular complications even further.¹ They are prone to certain complications and evidence emerged in the 1990 and supporting the benefit of glycemic control as well as control of blood pressure and lipid levels in the prevention or delay in onset and severity of diabetes complications.²

Glycated hemoglobin (HbA1C) is a routinely used marker for long term glycemic control. In accordance with its function an indicator for the mean blood glucose level, HbA1C predicts the risk for the development of diabetic complications in diabetic patients.³ Several risk factors such as poor glycemic control, dyslipidemia, hypertension, obesity, etc., act synergistically to develop nephropathy and retinopathy in patients with type2 diabetes mellitus (T2DM).⁴

Approximately 25% of the people with a new detected diabetes already have microvascular disease, suggesting that they have had the disease for 4–7 years by the time of the diagnosis.⁵ In these patients, with earlier disease identification and the intensive treatment of hyperglycemia, the risk for microvascular complications can be reduced.⁶ Relative risk of cardiovascular disease is higher in diabetic women compared to diabetic men, but the mechanism behind the increased risk is not understood completely. Many experts believe that high triglycerides may be a sign of other heart disease risk factors. That is, high triglyceride levels could multiply the bad effects of high cholesterol, high blood pressure, and diabetes. Some research also suggests that high triglycerides are a more important risk factor for women than for men. Hence, the present study was undertaken to investigate the role of the biochemical parameters in the prediction of the microvascular complications in Type 2 diabetes and non-diabetes female patients.

MATERIALS AND METHODS

The present study was conducted in R L Jalappa hospital attended to Sri Devaraj Urs Medical College, Kolar. Randomly selected 45 female type 2 diabetes and non diabetes patients with the age group of 45-55 years attending medicine outpatient department of R L Jalappa hospital, Kolar from March 2011 to January 2012 were included in the study. The study was approved by institutional ethical clearance and a written informed consent was obtained from all the participants. Patients suffering from other causes of secondary dyslipidemia, self-reported pregnancy; any chronic infectious disease and weight loss by > 6kg during past 6 months were excluded from the study.

Patient weight and height were measured to the nearest 0.1 kg and 0.1 cm respectively. BMI was calculated by Quetlet index formula.⁷ Systolic blood pressure (SBP) and Diastolic blood pressure (DBP) were measured in all subjects in the supine position, inflating the cuff tied at the level of heart to the left arm confirming that the patient is in the relaxed state. Hypertension was defined as the need for antihypertensive therapy or untreated patients with SBP \geq 130mmHg and/or DBP \geq 80 mmHg.⁸

Biochemical parameters were measured after an overnight fast, and the parameters were estimated by using Johnson & Johnson vitros 250 dry chemistry Auto analyzer which works on the principle reflectance Photometry. The blood glucose estimation was done by Glucose Oxidase Peroxidase method (GOD-POD)⁹, HbA1C was estimated by HPLC, serum creatinine was estimated by Jaffes reaction¹⁰, uric acid estimation by Uricase method¹⁰, total cholesterol was estimated by cholesterol oxidase method¹¹, triglycerides estimation was by Enzymatic colorimetric test- GPO PAP¹¹, High density lipoproteins (HDL) estimation was done by Direct Enzymatic colorimetric¹², spot urine albumin was done by dip stick method and urine creatinine by jaffes reaction. LDL-C, Non-HDL-Cholesterol, eGfr was calculated.^{13, 14, 15}

Statistical analysis was carried out by the Student t-test by using the SPSS version 16.0, and p-value < 0.05 was considered significant.

RESULTS

The mean (table 1) age (54.93 years), height (155.15cm) weight (63.28kg), waist circumference (92.28cm), hip

circumference (97.28 cm), waist hip ratio (0.95), body mass index (26.32kg/m²), obesity index (55.13), SBP (124.76mmHg), DBP (78.35mmHg) in female diabetes subjects and in non diabetes females are age (49.86 years), height (150.29cm) weight (55.48kg), waist circumference (88.73cm), hip circumference (95.26 cm), waist hip ratio (0.93), body mass index (24.85kg/m²), obesity index (50.20), SBP (122.02mmHg), DBP (78.62mmHg) was observed respectively. Among these variables height, obesity index and DBP were statistically significant.

Significant difference were observed between diabetes and non-diabetes females (table 2) with Fasting blood sugar (FBS)(147mg/dl) in diabetes and (90.71 mg/dl) in non diabetes females, percentage of HbA1C in diabetic subjects was 9.22% and in non diabetic subjects was 6.24%, serum creatinine in diabetes females was 0.84mg/dl and 0.65mg/dl in non diabetes females and urine creatinine 57.73 g/dl in diabetes and 97.60 g/dl in non-diabetes. Diabetic female subjects showed higher values for insulin (16.90mcU/ml), uric acid (4.36mg/dl), urine albumin (305.71mg/dl) and Albumin creatinine ratio (ACR) (13.18mg/g) when compared with non-diabetic female subjects. But, there was no significant difference.

The mean values (table 3)for total cholesterol (182.09mg/dl), triglycerides (209.04mg/dl), HDL(36.44mg/dl), LDL (100.09mg/dl), Non-HDL (145.64mg/dl) and eGFR (97.03) in diabetes females and in non diabetes females 187.69mg/dl, 143.78mg/dl and 43.46mg/dl, 115.20mg/dl, 144.22mg/dl, 87.03for TC, triglycerides, HDL, LDL, non-HDL and eGFR respectively. Among these parameters triglycerides and LDL were significant when compared between diabetic and non-diabetic female subjects.

DISCUSSION

The anthropometric measures were not significantly differed between diabetes and non-diabetes. However diabetes were more obese compared to non diabetics in this study. Similar results was observed by Le Nguyen et.al.¹⁶ Fasting insulin levels were within its normal reference range in both diabetes and non diabetes female subjects. However when compared to non-diabetes and diabetes female subjects showed increased insulin levels this indicates the early risk of

insulin resistance in diabetes and obese individuals.¹⁷

The higher values of HbA1C was observed in diabetes compared to non diabetes this may be due to Advanced glycated end products progressively accumulate in the tissues and organs and cause microvascular complications of diabetes mellitus.¹⁸ Serum creatinine levels were significantly increased in diabetes compared to non diabetic females indicating the onset of the microvascular complications of nephropathy. However, the mean eGFR of diabetics was increased compared to non diabetes females and this could be due to hyperfiltration, the predominance of hemodynamic factors rather than the metabolic factors in pathogenesis of diabetic nephropathy.¹⁹

Higher uric acid levels were observed in diabetics compared to non diabetics. Similar results were observed by Butturini U et.al.²⁰ This indicates that the uric acid levels have a tendency to increase with the onset of retinopathy with the progression of renal involvement.²¹ Studies have shown that serum uric acid levels depends on insulin resistance and independent of age, sex, excess body weight, fat distribution and blood pressure.²¹

The excretion of albumin in urine can be regarded as the involvement of kidney and results in vessel damage throughout the body. These results support our study even though, the reports of spot urine albumin and ACR were not significant, and the values were elevated in diabetes compared to non diabetes. This occurs mainly due to raised blood pressure and poor glycemic control. Tissue damage and vessels of retina and kidney damage also occurs when there is an elevated level of blood sugar and blood pressure.²² Besides common mechanisms, renal damage accelerate retinopathy and shows that albuminuria is one of the predictor of diabetic retinopathy.²² In a study by Haffner SM et.al, no association between the level of glycemia and microalbuminuria was observed²³, and in another study Mattock B.et.al, found that there was association of poor glycemic control and raised blood pressure with microalbuminuria, this occurs only in females.²⁴

Diabetic dyslipidemia is known to be associated with increased cardiovascular complications. In our study triglycerides level was significantly increased and this was similar to the findings by Mulec et.al, who observed

Table 1: Mean \pm SD of anthropometric measurements of T2DM and Non diabetes

| Variables | Diabetes | Non-Diabetes | p-value |
|--------------------------------------|----------------|----------------|---------|
| Age (years) | 54.93 (10.46) | 49.86 (9.24) | 0.457 |
| Height (cm) | 155.13 (6.94) | 150.29 (11.62) | 0.029* |
| Weight (kg) | 63.28 (10.65) | 55.48 (11.53) | 0.50 |
| Waist Circumference (cm) | 92.28 (13.60) | 88.73 (13.95) | 0.91 |
| Hip Circumference (cm) | 97.28 (12.25) | 95.26 (8.78) | 0.29 |
| Waist Hip Ratio | 0.95 (4.41) | 0.93 (0.16) | 0.49 |
| Body Mass Index (kg/m ²) | 26.32 (4.41) | 24.85 (6.15) | 0.19 |
| Obesity Index | 55.13 (6.94) | 50.20 (11.62) | 0.01* |
| Systolic BP (mmHg) | 124.76 (12.63) | 122.02 (13.81) | 0.75 |
| Diastolic BP (mmHg) | 78.35 (11.08) | 78.62 (7.91) | 0.02* |

*p-value (< 0.05) significant

Table 2: Mean \pm SD of biochemical parameters between T2DM and Non diabetes

| Variables | Diabetes | Non-Diabetes | p-value |
|--------------------------|-----------------|-----------------|---------|
| FBS (mg/dl) | 147 (65.75) | 90.71 (30.53) | 0.00* |
| Fasting insulin (mcU/ml) | 16.90 (17.86) | 14.84 (18.84) | 0.68 |
| Glycated Hb (%) | 9.22 (2.48) | 6.24 (1.69) | 0.001* |
| Serum creatinine | 0.84 (0.32) | 0.65 (0.12) | 0.001* |
| Uric acid | 4.36 (1.00) | 3.94 (1.16) | 0.29 |
| Spot urine albumin | 305.71 (287.37) | 267.16 (324.53) | 0.19 |
| Spot urine creatinine | 57.73 (51.95) | 97.60 (178.84) | 0.04* |
| ACR | 13.18 (27.57) | 9.36 (40.29) | 0.86 |

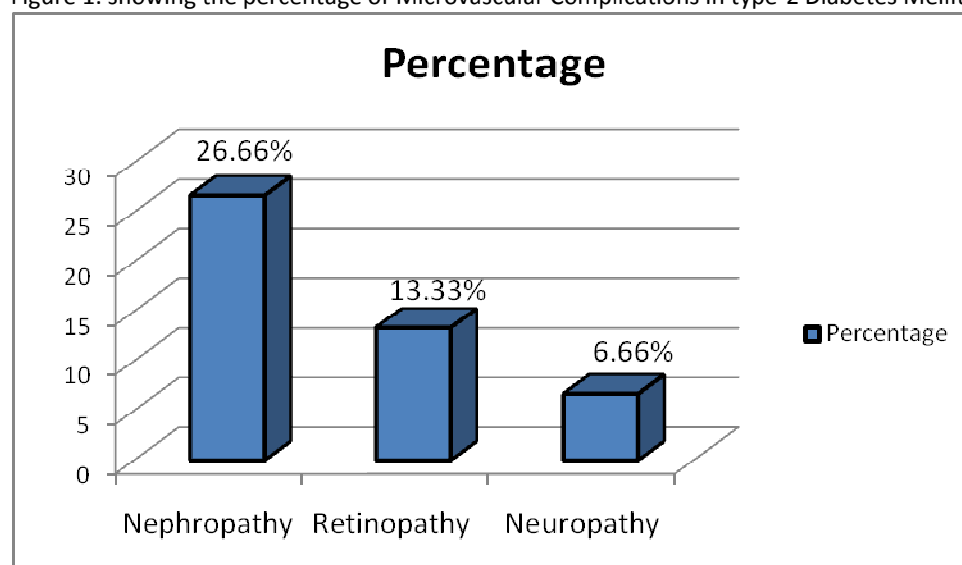
*p-value (< 0.05) significant

Table 3: Mean \pm SD of Lipid profile and calculated parameters for T2DM and Non diabetes

| Variables | Diabetes | Non-Diabetes | p-value |
|-----------------------------------|-----------------|----------------|---------|
| eGFR (ml/min/1.73m ²) | 97.03 (29.17) | 87.03 (32.10) | 0.28 |
| Total cholesterol (mg/dl) | 182.09 (38.75) | 187.69 (31.57) | 0.63 |
| Triglycerides (mg/dl) | 209.04 (112.70) | 143.78 (69.25) | 0.00* |
| HDL (mg/dl) | 36.44 (8.48) | 43.46 (10.65) | 0.00* |
| Non- HDL(mg/dl) | 145.64 (38.93) | 144.22 (29.52) | 0.32 |
| LDL (mg/dl) | 100.39 (40.65) | 115.20 (24.02) | 0.00* |

*p-value (< 0.05) significant

Figure 1: showing the percentage of Microvascular Complications in type-2 Diabetes Mellitus



that diabetic nephropathy and declining kidney function to be associated high levels of total cholesterol and triglycerides.²⁵ However, in our study total cholesterol levels were not found to be elevated significantly. Studies conducted by Larsson I. et.al, have shown increased levels of total cholesterol and Non-HDL-Cholesterol levels in diabetics and this was found to be associated with increasing severity of diabetic

retinopathy.²⁶ In the ACCORD (Action to Control Cardiovascular risk in Diabetics) group studies it was found that intensive glycemic control and therapy for dyslipidemia found significantly reduced progression rates of diabetic retinopathy.²⁷

CONCLUSION

In this study we observed 26.6% of nephropathy, 13.3% of retinopathy and 6.6% of neuropathy were observed

in diabetes females. However non diabetes female subjects showed higher significant TC and LDL-c levels. This suggests that above the age of 45 year females requires comprehensive evaluation of anthropometric and biochemical parameters to avoid micro and macro vascular complications.

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REFERENCES

1. Wild. S, Roglic G, Green A. Global prevalence of diabetes and estimation for the year 2000 and projections for 2030. *Diabetes Care* 2000; 27:1047-1053.
2. American Diabetes Association (2004). Dyslipidemia management in adult with diabetes. *Diabetes Care* 24:S68-S71.
3. Glycosylated Hemoglobin, HbA1C. [http://clinabnavigator.60mltestinterpretations/hemoglobin-a1c.html? letter=h](http://clinabnavigator.60mltestinterpretations/hemoglobin-a1c.html?letter=h) (updated on june 2010)
4. American Diabetes Association. Nephropathy in Diabetes. *Diabetes Care*. 2004; 27 Suppl. 1:S79-83.
5. Diabetes Public Health Resource, National Center for Chronic Disease Prevention and Health Promotion: <http://www.cdc.gov/diabetes/pubs.estimates07.htm#1>. Cited 13 August 2010.
6. Harris MI, Klein R, Welborn TA, Knudman MW. The onset of NIDDM occurs at least 4-7 years before its clinical diagnosis. *Diabetes Care* 1992; 15:815-19.
7. Rudan D, Balic S, Metelko Z. Eating disorders in women with type I diabetes. *Diabetologia Croatica* 2003;32-34.
8. Ashwell M, Chinn S, Stalley S, Garrow JS. Female fat distribution — a simple classification based on two circumference measurements. *Int J Obes*. 1982; 6:143-52.
9. David B Sacks MB. Estimation of Blood Glucose. In: Teitz, Burtis CA, eds. *Clinical chemistry and Molecular Diagnostics*. 4th ed. New Delhi: Elsevier, 1999, pp 870-871.
10. Edmund Lamb, David J, Cristopher P. Creatinine estimation. In: Teitz, Burtis CA, eds. *Clinical chemistry and Molecular Diagnostics*. 4th ed. New Delhi: Elsevier, 1999, pp 798
11. Nader Rifai, G. Russell Warnick. Cholesterol estimation. In: Teitz, Burtis CA, eds. *Clinical chemistry and Molecular Diagnostics*. 4th ed. New Delhi: Elsevier, 1999, pp 940-946.
12. Bittner V, Non-HDL cholesterol measurement, Interpretation and significance. 2007; 7, 1.
13. Nader Rifai, G. Russell Warnick. Friedewald Equation. In: Teitz, Burtis CA, eds. *Clinical chemistry and Molecular Diagnostics*. 4th ed. New Delhi: Elsevier, 1999, pp 842-843.
14. Levy AS, Bosch JP, Lewis JB, et al. A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Modification of diet in renal disease study group. *Ann Intern Med* 1990; 130:461-70.
15. Roche AF, Siervogel RM, Chumlea WC, Webb P. Grading body fatness from limited anthropometric data. *Am J Clin Nutr* 1981; 34: 2831-2838.
16. Le Nguyen T, Duc Son MD, Hanh TM, Kusama K, Tohru Sakai T. Anthropometric Characteristics, Dietary Patterns and Risk of Type 2 Diabetes Mellitus in Vietnam. *Journal of the American College of Nutrition*. 2005; 24:229-234.
17. Diabetes Prevention Program (DPP). 2006 Relationship of body size and shape to the development of diabetes in the diabetes prevention program. *Obesity* 14; 2107-2117.
18. Retbrock N. Advanced glycation end products and the progress of Diabetic vascular complications. 2004;53:131-142.
19. Zat ZR, Mayer TN, Renne HG, Brenner BM. Predominance of hemodynamic rather than metabolic factors in the pathogenesis of diabetic glomerulopathy. *Proc Natl Acad sci USA*. 1985;82:5963-7.
20. Butturini U, Coscelli C, Zavaroni I. Insulin release in hyperuricemic patients. *Harefuah*. 1995;128:681-683.
21. Ashakiran. S, Krishnamurthy N, Navin S, Patil S. Behaviour of serum uric acid and lipid profile in relation to glycemic status in proliferative and non-proliferative diabetic retinopathy. 2010;2(1):57-61.
22. Manaviat MR, Afkhami M, Shoja MR. Retinopathy and microalbuminuria in type II diabetic patients. *BMC Ophthalmology* 2004;4:9.
23. Haffner SM. Management of dyslipidemia in adults with diabetes. *Diabetes Care* 1998; 21:160-178.
24. Mattock MB, Keen H, Viberti GC, Murrellis TJ, Jackson RG. Cross-sectional associations with urinary albumin excretion rate in type II patients. *Proceedings of the 13th International Diabetes Federation Congress* 1988, Hobart, Tasmania.
25. Mulec H, Johnsen SA, Wiklund O, Bjorck S. Cholesterol: A renal risk factor in diabetic nephropathy? *Am J Kidney Dis* 1993; 22:196-201.
26. Larsson LI, Alm A, Lithner F, Dahlen G, Bergstrom R. The association of hyperlipidemia with retinopathy in diabetic patients aged 15-50 years in the county of Umea. *Acta Ophthalmol Scand* 1999;77:585-591.
27. The ACCORD study Group and ACCORD Eye study Group. The effects of medical therapies on retinopathy progression in type 2 diabetes. *N Eng J Med* 2010;363:233-244.

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MU: Concept and Design of the study, analysis and interpretation, manuscript preparation, critical revision of the manuscript, and literature search.

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HR: Concept and Design of the study, Clinical studies manuscript preparation, critical revision of the manuscript, statistical analysis, and literature search.

MR: Data collection and analysis.

LV: Data acquisition.

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