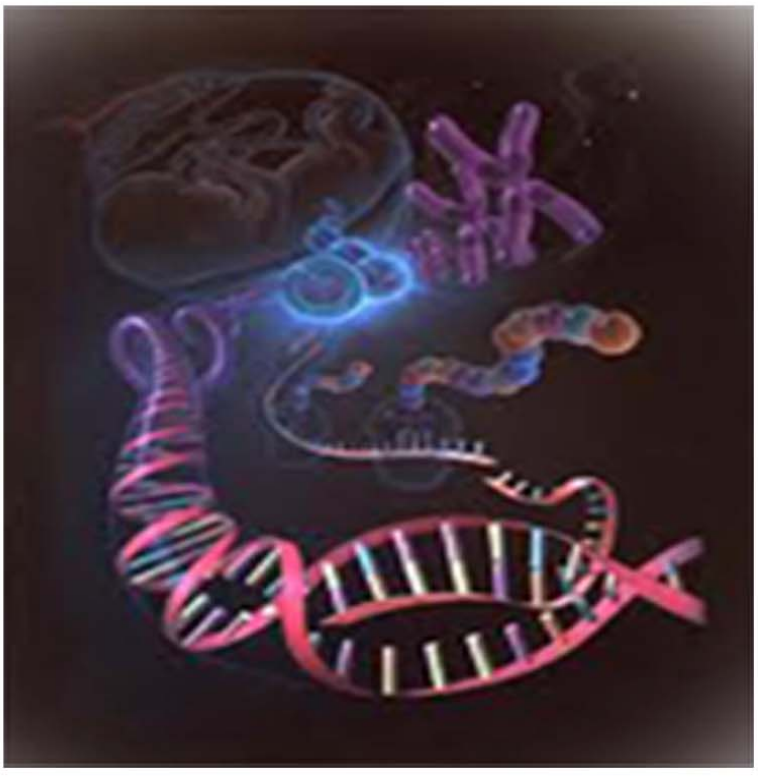
IJLBPR

ISSN 2250 - 3137
Vo1. 2, No. 1, January 2013

International Journal of

Life Sciences Biotechnology and Pharma Research



International Journal of Life Sciences Biotechnology and Pharma Research
Hyderabad, INDIA

www.ijlbpr.com

Email : editorijlbpr@gmail.com or editor@ijlbpr.com

International Journal of Life Sciences Biotechnology and Pharma Research

ISSN 2250-3137 www.ijlbpr.com
Vol. 2, No. 1, January 2013

Research Paper

THE EFFECT OF VITAMIN-C THERAPY ON HYPERGLYCEMIA, HYPERLIPIDEMIA AND NON HIGH DENSITY LIPOPROTEIN LEVEL IN TYPE 2 DIABETES

Shreyasi Vaksh[1§], Mukesh Pandey[1§], U S Zingade[2] and Varikasuvu Seshadri Reddy[3*]

Corresponding Author: **Varikasuvu Seshadri Reddy, ✉ lifeschemistry@yahoo.com*

India is standing top in the prevalence of type 2 diabetes mellitus. Hyperglycemia and hyperlipidemia are important factors that develop diabetes associated complications. Vitamin C is known for its beneficial effects on serum lipids. Therefore, we evaluated the effects of Vit-C supplementation (1g/day) for four week duration among 30 patients by measuring fasting blood sugar (FBS), serum levels of total cholesterol (TC), triglycerides (TG), reduced high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) and non-HDL-C (nHDL-C). The results obtained were compared with baseline values and with 30 age and sex matched controls. The differences between male and female patients were also studied. Patient group had hyperlipidemia compared to control group. Upon Vit-C therapy, patients showed a significant decrease in FBS, TC, LDL-C and nHDL-C versus baseline values before treatment. Female patients had higher levels of TC and nHDL-C compared to male patients, both before and following Vit-C supplementation. Our findings conclude that Vit-C was effective in improving hyperglycemia and hyperlipidemia recommending the supplementation of Vit-C in addition to regular management of diabetic patients as a therapeutic measure preventing associated complications.

Keywords: Diabetes, Hyperglycemia, Hyperlipidemia, Vitamin-C

INTRODUCTION

Recently, it was reported that 194 million people representing a global prevalence exceeding 3% of the world population were diabetic and is expected to reach 6.3% by the year 2025, with the type 2 diabetes mellitus (t2DM) representing the major part (85-90%) (Boutayeb *et al*., 2004). India is standing top in the prevalence of t2DM and cardiovascular (CV) risk (Ramachandran *et al*., 2008). Diabetes increases the CV risk

[1] Department of Physiology, Hi-tech Medical College & Hospital, Rourkela-769004, Odisha, India.

[2] Govt. Medical College, Aurangabad, India.

[3] Department of Biochemistry, Hi-tech Medical College & Hospital, Rourkela-769004, Odisha, India.

§: equally contributed.

leading to high morbidity and mortality in diabetic patients (Fox *et al*., 2007). It was reported an independent association of hyperglycemia with CV risk (Stratton *et al*., 2000).

In diabetes, dyslipidemia in the form of increased levels of total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C), very low density lipoprotein cholesterol (VLDL-C) and reduced high density lipoprotein cholesterol (HDL-C) may substantially contribute to the excess CV risk in diabetes (Garg A and Grundy, 1990). It was reported that the newly addressed Non-HDL-C (nHDL-C) as a better predictor than LDL-C in diabetes (Liu *et al*., 2005). Moreover, the Adult Treatment Panel (ATP-III) of the National Cholesterol Education Program has recommended using non-HDL-C (nHDL-C) in assessing CVD risk (Executive Summary of 3rd report of NCEP, 2001).

Furthermore, oxidative stress due to hyperglycemia and dyslipidemia in diabetes is known to initiate and promote either of micro and macro vascular complications (Maritim *et al*., 2003). In addition to hyperglycemia, it was reported that dyslipidemia may also contribute to excess free radical generation leading to oxidative stress (Suchitra *et al*., 2011). In a recent report, we found elevated levels of malondialdehyde, a lipid peroxidation marker and decreased levels of vitamin-C due to its increased utilization as an important antioxidant counteracting free radicals (Suchitra *et al*., 2011). The present study was taken up to evaluate the effect of vitamin-C supplementation on hyperglycemia, dyslipidemia and more important CV risk predictor, the non-HDL-C in patients with type 2 diabetes mellitus.

MATERIALS AND METHODS

The recent study recruited 30 t2 DM patients (14 male, 16 female; 43-77 years age) of 1-8 year disease duration from the outpatient clinic of diabetes, Government medical college, Aurangabad, India. All patients had fasting blood sugar (FBS) >125 mg/dl and are on oral hypoglycemic drugs. A cohort of 30 age and sex matched healthy individuals were included under control group. The criterion for exclusion were patients receiving insulin, myocardial infarction, hypertension, hepatic, renal disorders, active infection, chronic or acute illnesses, smokers, alcoholics, pregnant, lactating females, and patients suffering from endocrine disorders other than t2DM. After inclusion of patients into the study, all patients were supplemented with 1g of vitamin-C (Tablet LIMCEE, Piramal health care) a day for four weeks. Patients were instructed for uniform medication, diet plan and exercise. Compliance to the therapy was monitored by receiving back the empty wrappers of the supplement at weekly follow-ups and telephonic communications. The study was approved by the institutional ethical committee and informed consent was taken from the participants.

Biochemical Analysis

After overnight fasting venous blood samples were collected twice; before starting vitamin therapy and after completion of therapy for four weeks. Blood samples were drawn into fluoride-added and additive free tubes for the immediate analysis of sugar and lipids, respectively. Serum was obtained by centrifugation at 3000rpm for 10 min. Before the start of Vitamin-C therapy, the blood glucose level was estimated by enzymatic method using commercial kits (ERBA diagnostics). Serum TC, TG, and LDL-C were

measured by enzymatic methods using commercial kits (RECKON diagnostics). Serum LDL-C and VLDL-C were calculated using the Friedewald formula (Friedewald WT *et al*., 1972). The nHDL-C level was calculated by subtracting the HDL-C value from the TC values. Following values were considered normal; FBS <126 mg/dl, TG< 200 mg/dl, TC< 200 mg/dl, HDL-C > 35 and LDL-C< 100 mg/dl. Whole biochemical analyses were repeated after the completion of therapy for four weeks and the data obtained were recorded.

Statistical Analysis

All data obtained were expressed as mean ± standard deviation (SD). A two-tailed, un-paired student's t-test was used to test differences between control and patient groups. The differences in observations before and after therapy were studied using student's paired t-test. A statistical significance was reported at a two-tailed p value of <0.05. All the statistical analyses were done using the SPSS software version 11.5 (SPSS Inc, Chicago, IL, USA).

RESULTS AND DISCUSSION

Mean and SD of various biochemical parameters studied in control and patient groups before and after Vit-C therapy are shown in Table 1. The male/female differences in the variable studied in the patient group were presented in Table 2. Diabetic patients had significantly high levels of FBS when compared to controls ($p < 0.01$). The serum levels of TC ($p < 0.01$), TG ($p < 0.01$), LDL-C ($p < 0.05$), and VLDL-C ($p < 0.01$) were significantly increased, where as there was no significant change in HDL-C levels in the patients when compared to controls. The nHDL-C level studied as atherogenic/CV risk factor was found to be significantly elevated in diabetic patients compared to controls ($p < 0.01$). These results indicate that our patients showed hyperlipidemia and increased CV risk associated with diabetes. Our study findings are well in line with the previous studies (Rani *et al*., 2005; Suchitra *et al*., 2011). The abnormally high concentration of serum lipids in diabetes is mainly a result of the increase in mobilization of free fatty acids from peripheral

Table 1: The Mean±SD Values of Biochemical Parameters Studied in Control and Diabetes Groups

Variable (mg/dl)	Control Group	Diabetes Group	
		Before Vit-C Therapy	After Vit-C Therapy
FBS	93.30±12.01	141.9±39.1*	129.0±29.5*#
TC	164.0±27.2	194.2±45.4*	176.0±28.5#
TG	149.4±29.4	220.7±52.4*	208.3±54.7*
HDL-C	50.9±4.3	49.0±9.4	51.2±7.6
LDL-C	81.03±20.2	101.0±38.9**	83.0±26.8#
VLDL-C	29.2±13.1	44.1±10.4*	41.6±10.9*
Non-HDL-C	114.9±23.7	145.2±41.2*	126.7±24.0#

Note: FBS; fasting blood sugar, TC; total cholesterol, TG; triglycerides, HDL-C; high density lipoprotein cholesterol, LDL-C; low density lipoprotein cholesterol, VLDL-C; very low density lipoprotein cholesterol, Non-HDL-C; Non-high density lipoprotein cholesterol, Vit-C; vitamin C. *(p<0.01 Vs controls), **(p<0.05 Vs controls), #(p<0.01 before & after Vit-C therapy in patients)

Table 2: The Mean±SD Values of Biochemical Parameters Between Male and Female Patients

Variable (mg/dl)	Diabetes Group (30)					
	Before Vit-C Therapy			After Vit-C Therapy		
	Male(14)	Female(16)	*P*-value	Male(14)	Female(16)	*P*-value
FBS	136.6±40.2	146.5±38.8	0.49	134.1±31.1	124.6±28.4	0.38
TC	176.7±26.7	209.5±53.3	0.04*	162.6±14.2	187.7±32.9	0.01*
TG	197.07±46.1	241.3±49.9	0.01*	208.7±47.3	238.2±61.3	0.15
HDL-C	44.6±7.0	52.8±9.9	0.01*	46.0±7.5	52.1±7.1	0.03*
LDL-C	85.5±19.8	88.8±26.8	0.70	76.3±16.8	72.5±24.1	0.62
VLDL-C	53.9±24.9	61.0±22.9	0.42	55.8±21.6	59.4±22.5	0.65
Non-HDL-C	132.1±19.7	156.7±43.4	0.06	116.6±13.0	135.5±25.8	0.02*

Note: FBS; fasting blood sugar, TC; total cholesterol, TG; triglycerides, HDL-C; high density lipoprotein cholesterol, LDL-C; low density lipoprotein cholesterol, VLDL-C; very low density lipoprotein cholesterol, Non-HDL-C; Non-high density lipoprotein cholesterol, Vit-C; vitamin C. *($p<0.05$; statistically significance between male and female patients).

depots, due to loss of the inhibitory actions of insulin over hormone-sensitive lipase (Pasupathi P *et al*., 2009).

We also found a significant decrease in FBS, TC, LDL-C and nHDL-C in diabetic patients after Vit-C therapy ($p < 0.01$), suggesting the role of Vitamin supplementation. The decreased levels of TC, LDL-C, and nHDL-C following Vit-C therapy in diabetes patients were similar to that of controls and there was also no statistical difference between controls and patient group after therapy ($p > 0.05$). However, the decreased levels of FBS, TG, and VLDL-C after therapy were still at the higher side when compared to controls ($p < 0.01$). Our findings confirm the beneficial effect of Vit-C therapy in improving hyperlipidemia and the levels of nHDL-C in diabetic patients.

Improvement of lipid profile and reduction of diabetic complications was reported after supplementation of Vit-C in t2 DM (Ardekani and Ardekani, 2007), whereas better results can be seen upon combined supplementation Vit-C and Vit-E (Huang *et al*, 2002). Hyperglycemia would lead to altered homeostasis leading to excess free radical generation, increased lipid peroxidation, depletion of antioxidants and thereby enhanced oxidative stress in subjects with t2DM (Whiting *et al*., 2008). In addition, lipid peroxidation is known to be associated with dyslipidemia which is very common in diabetes. Moreover, oxidative stress increases with hyperlipidemia (Moriel *et al*., 2000), and plays a major role in the development of diabetic complications (Kaneto *et al*., 2010). LDL particles are small and dense in type 2 diabetes and are susceptible to oxidation and Vit-C prevents LDL oxidation by regenerating α-tocopherol (Mullan *et al*., 2002). It may be possible that vitamin C as an antioxidant can decrease oxidative stress and probably reduce insulin resistance by improved lipid abnormalities.

We also studied the male/female differences both before the start and after the completion of Vit-C therapy and the results were depicted in Table 2. Before treatment, female patients

showed significantly higher levels of TC, and HDL-C, whereas there was no significant change in FBS, LDL-C and nHDL-C when compared to male patients. This finding indicates both male and female patients are equally at increased risk of developing diabetes associated complications. However, female patients of our study are at increased risk as we found high levels of nHDL-C compared to male patients, even though not significant, it was borderline (p=0.06). This statement is further supported by our finding of significantly high TC though the HDL-C was high in females, compared to male patients ($p<0.05$) after therapy. Furthermore, it is noteworthy to mention here that the nHDL-C level was significantly high (p=0.02) in female patients versus male patients after the completion of therapy.

CONCLUSION

To conclude, supplementation with 1g/day of vitamin C in addition to the routine management of diabetic patients may help in improving lipid abnormalities and hence the development of complications associated to diabetes. The low sample size and short duration of Vit-C are the notable limitations of this study.

REFERENCES

1. Ardekani M A and Ardekani A S, (2007), "Effect of vitamin C on blood glucose, serum lipids & serum insulin in type2 diabetes patients", *IJMR*, Vol. 126, pp. 471-74.
2. Boutayeb A *et al*. (2004), "A mathematical model for the burden of diabetes and its complications", *BioMedical Engineering OnLine*, Vol. 3, No. 20.
3. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adult (Adult Treatment Panel III), (2001), *JAMA*, Vol. 285, pp. 2486-2497.
4. Fox C S *et al*. (2007), "Increasing cardio-vascular disease burden due to diabetes mellitus: the Framingham Heart Study", Circulation, Vol. 115, pp. 1544-1550.
5. Friedewald W T *et al*. (1972), "Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge", Clin Chem, Vol. 18, pp. 499-502.
6. Garg A and Grundy S M (1990), "Manage-ment of dyslipidemia in NIDDM", Diabetes Care, Vol. 13, pp. 153–169.
7. Huang H Y *et al*. (2002), "Effects of vitamin C and vitamin E on in vivo lipid peroxidation: results of a randomized controlled trial", *Am J Clin Nutr*, Vol. 76, pp. 549-555.
8. Kaneto H *et al*. (2010), "Role of Reactive Oxygen Species in the Progression of Type 2 Diabetes and Atherosclerosis", Mediators of Inflammation.
9. Liu J *et al*. (2005), "Joint Distribution of Non-HDL-C and LDL Cholesterol and Coronary Heart Disease Risk Prediction Among Individuals With and Without Diabetes", Diabetes Care, Vol. 28, pp. 1916-1921.
10. Maritim A C *et al*. (2003), "Diabetes, OS and antioxidants: A review", *J. Biochem. Mol. Toxicol.*, Vol. 17, pp. 24-38.
11. Moriel P *et al*. (2000), "Lipid peroxidation and antioxidants in hyperlipidemia and hypertension", *Biol. Res.*, Vol. 33, pp. 105-112.

12. Mullan B A *et al*. (2002), "Ascorbic acid reduces blood pressure and arterial stiffness in type 2 diabetes", *Hypertension*, Vol. 40, pp. 804-809.

13. Pasupathi P *et al*. (2009), "Evaluation of OS and Antioxidant Status in Patients with Diabetes Mellitus", *Journal of Applied Sciences Research*, Vol. 5, pp. 770-775.

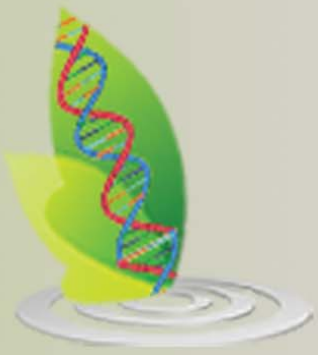
14. Ramachandran A *et al*. (2008), "High Prevalence of Diabetes and Cardiovascular Risk Factors Associated With Urbanization in India", *Diabetes Care*, Vol. 31, pp. 893-898.

15. Rani H S *et al*. (2005), "Risk factors for coronary heart disease in type II diabetes mellitus", *IJCB*, Vol. 20, pp. 75-80.

16. Stratton I M *et al*. (2000), "Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study", *BMJ*, Vol. 321, pp. 405-412.

17. Suchitra M M *et al*., (2011), "Lipid peroxidation measured as serum malondialdehyde and vitamin-C as oxidative-antioxidative biomarkers in type II diabetic patients", *IJBAR*, Vol. 2, pp. 378-388.

18. Whiting P H *et al*. (2008), "The relationship between chronic glycaemic control and oxidative stress in type 2 diabetes mellitus", *Br J Biomed Sci*, Vol. 65, pp. 71-74.



International Journal of Life Sciences Biotechnology and Pharma Research
Hyderabad, INDIA. Ph: +91-09441351700, 09059645577
E-mail: editorijlbpr@gmail.com or editor@ijlbpr.com
Website: www.ijlbpr.com