

Study of Glycated Haemoglobin and Lipid Profile in Patients with Diabetic Foot Ulcer

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ABSTRACT

Introduction: Diabetic foot ulcer is a major disabling complication of Diabetes Mellitus and often precedes lower extremity amputation. This study aims to evaluate the level of HbA1c and lipid profile in patients with diabetic foot ulcer as T2DM patients are

prone to diabetic dyslipidemia, which puts them at risk of developing macrovascular and microvascular diseases.

Material and methods: The study was accomplished at a tertiary care hospital in Jammu & Kashmir. One hundred ten subjects with T2DM were enrolled for the present study, this included 55 subjects with DFU and 55 subjects without DFU. The HbA1c and lipid profile of the subjects were measured with standard methods.

Results: In our study HbA1c level was found higher in diabetic patients with diabetic foot ulcer when compared with patients without. Also lipid profile was found deranged in diabetic foot ulcer patients in comparison to control group. It was found that approximately 78% DFU have HbA1c levels >7%. Unlike the DFU-patients, 79% of patients without DFU have HbA1c level controlled.

Conclusion: As diabetic foot ulcer is a major disabling complication of Diabetes Mellitus and often precedes lower extremity amputation, we conclude that HbA1c level should be maintained in normal range and regulating it is imperative for avoiding T2DM complications.

Keywords: Diabetic Foot Ulcers (DFU), Glycated Haemoglobin (HbA1c), Lipid Profile, Diabetes Mellitus Type-2 (T2DM).

of amputations were associated with diabetes.⁷

Dyslipidemia is more prevalent in T2DM patients which in turn puts them at more risk of developing complications like stroke, coronary artery diseases, nephropathy, neuropathy, etc. HbA1c is considered as a reliable marker of glycemic control, and its level should be maintained in normal range to prevent complications in long term. HbA1c is not only a reliable glycaemic index but can also be used as an important indicator in determining the risk of diabetes-related complications and mortality.^{8,9} The aim of this study was to check the level of HbA1c and lipid profile in patients with diabetic foot ulcer, hypothesising that elevated HbA1c predicts poor prognosis for ulcer healing in patients with diabetes.

MATERIAL AND METHODS

The study was accomplished at a tertiary care hospital in Jammu & Kashmir. One hundred ten subjects with T2DM were enrolled for the present study, this included 55 subjects with DFU and 55 subjects without DFU. The study participants were further divided into two groups based on the glycaemic control (i.e. with HbA1c ≥ 7 and HbA1c < 7). All patients with foot ulcer were included in the study. Patients on lipid-lowering drugs, steroids or having thyroid, hepatic, renal problems, sickle cell disease & endocrinopathies were excluded from the study. Those patients having history of any chronic illness or malignancy were also excluded from the study. A written informed consent was obtained from all participants and the study was conducted in accordance with the Declaration of Helsinki.¹⁰

Biochemical Parameters

Fasting morning blood samples were collected from the patients in plain vacutainer (5ml) & ethylene diaminetetraacetic acid (2ml). Serum was separated and

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a group of metabolic disorder rising rapidly and leading to public health issue with noticeable effects on human health and health care systems.¹ It has been indicated from the data and statistical analysis of International Diabetes Federation (IDF) that around 425 million adults have diabetes mellitus (DM) world wide and by 2045, the number of DM patients are estimated to rise around 629 million.² As diabetic patients are prone to develop foot ulcers and if not managed properly may be followed by neurological and vascular insufficiency resulting in substantial morbidity and mortality.^{3,4} Foot infections are one of the long term complications of Type 2 diabetes as 1-4% of people with type 2 diabetes develop a foot ulcer each year and it can result in gangrene, lower extremity amputation.^{5,6} Patients with diabetes are 25 times more likely to lose a leg and up to 70% of all leg amputations occur in people with diabetes. A study by The Global Lower Extremity Amputation Study Group revealed that 25%-90%

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analysed immediately on the same day for lipid profile levels (Abbott C4000, USA) and the other sample containing whole blood was used for the measurement of HbA1c

Laboratory investigations:

- Estimation of Glycated haemoglobin (HbA1c) in blood.¹¹
- Lipid profile: Total cholesterol (TC) was measured by cholesterol oxidase, triglyceride (TG) by glycerol oxidase-peroxidase, HDL by enzymatic assay.¹² LDL-cholesterol was measured according to Friedewald formula.¹³ LDL was calculated as follows: $LDL = TC - (HDL + TG/5)$.

STATISTICAL ANALYSIS

The data collection included demographics, medical diagnoses, HbA1c levels and lipid profile. Statistical analysis was done using SPSS for windows, Version 11.0. SPSS Inc. software. Data collected were compiled and were presented as mean \pm standard deviation analyzed using statistical tests, $P \leq 0.05$ was considered statistically significant.

RESULTS

A total of 110 T2DM patients participated in the study, this included 55 T2DM patients with DFU and 55 patients without DFU. We compared the level of HbA1c and lipid profile in T2DM patients with diabetic foot ulcer and patients without DFU. Based on the length of the disease, 47% of the patients had diabetes for 10 years, 40% for 10–

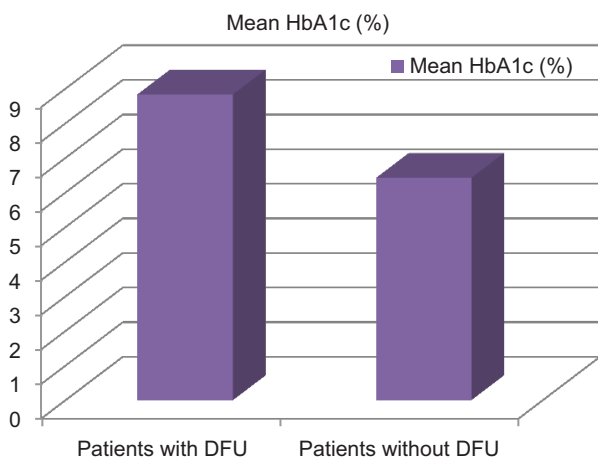


Figure-1: Mean values of HbA1c level in diabetic patients with DFU with respect to control.

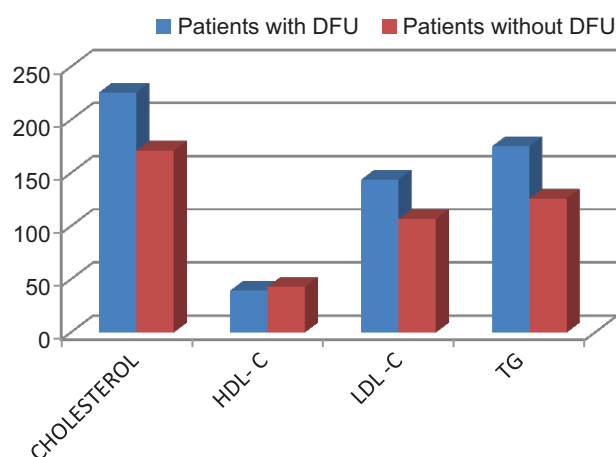


Figure-2: Mean values of lipid profile in diabetic patients with DFU with respect to control.

20 years, and 13% for 20 years. In addition, 79% and 77% of total patients with DFU were found male and aged more than 55 years respectively. The data analysis revealed that, the HbA1c, Cholesterol, LDL and TG levels are significantly higher in DFU-patients (8.83%, 225.76 mg/dl, 143.79 mg/dl and 175.10 mg/dl respectively) than that of patients without DFU (6.42%, 171.18 mg/dl, 106.65 mg/dl, 126.07 mg/dl respectively). Values of HDL are significantly higher in patients without DFU as compared with patients of DFU. Table No 1.

It was found that approximately 78% foot ulcer patients have HbA1c levels $>7\%$. Unlike the DFU-patients, 79% of patients without DFU have HbA1c level controlled.

DISCUSSION

HbA1c has gained special attention of researchers and has been extensively studied in relation with diabetic foot ulcers, gangrene, and limb amputation.¹⁴ Our study showed a significant increase in HbA1c level and lipid parameters in patients with diabetic foot ulcer when compared to control group and it was found 78% and 75% of total patients with DFU were male and aged more than 55 respectively, which indicates that male persons and patient aged more than 50 are at the greater risk of foot ulcer.^{15,16} Further, the study evaluated the high percentage (78%) of DFU patients with HbA1c > 7 . Poor glycemic control in the body results in diminished oxygen and nutrient supply to the ulcer area and compromised immune system due to impaired chemotaxis

Parameters	Patient with Diabetic Foot Ulcer	Patient without Diabetic Foot ulcer	P value
HbA1c (%)	8.83 \pm 1.68	6.42 \pm 1.21	< 0.001*
Cholesterol (mg/dl)	225.76 \pm 38.19	171.18 \pm 28.21	< 0.001*
HDL cholesterol HDL-C (mg/dl)	39.27 \pm 8.0	42.94 \pm 5.57	< 0.001*
LDL cholesterol LDL-C (mg/dl)	143.79 \pm 44.82	106.65 \pm 32.63	< 0.001*
TGs (mg/dl)	175.10 \pm 27.74	126.07 \pm 23.20	< 0.001*

Note: *Significant p-value.

Abbreviations: HbA1c- Glycated haemoglobin; LDL-C- Low-density lipoprotein cholesterol; HDL-C- High-density lipoprotein cholesterol; TG's- Triglycerides.

Table-1: Mean values of HbA1c, Lipid profile in patients with and without DFU (Mean \pm SD).

and phagocytosis.^{17,18} These findings are in accordance with those of other studies, which report 86% of DFU patients have the HbA1c = 8.86%.¹⁵ The finding can be correlated to the fact that diabetic mellitus being a metabolic disorder causes altered protein and lipid metabolism and there by abnormal granulation tissue formation. Findings of our study are in accordance with Goldin A. *et al* who indicated that persistently high blood glucose levels in the body end up in uncontrolled binding of sugars to protein or lipid covalently without any normal glycosylation enzymes.¹⁹ The accumulation of these products called advanced glycation end product (AGEs) over the surface of cell membranes on extracellular matrix proteins collagen, vitronectin and laminin results in increased stiffness and increased synthesis of granulation tissue.

HbA1c is considered as a diagnostic marker for diagnosis of diabetes by American Diabetes Association and World Health Organization and is a good marker for glycemic control as its levels indicate the average level of blood sugar over past 2 to 3 months. HbA1c is not only a reliable glycemic index but its higher values can also be used as a sign of dyslipidemia.¹ A 1% drop in the HbA1c level decreases the 40% risk of microvascular complications.²⁰ A valid association has been established between HbA1c levels and various complications in diabetic patients such as diabetic retinopathy and foot ulcers.^{17,18} The healing time for foot ulcers in patients with lower HbA1c was shorter than patients with higher values. Clinical study reported by Markuson et al reported HbA1c as a significant determinant of foot ulcer healing in diabetic patients.²¹

CONCLUSION

As diabetic foot ulcer is a major disabling complication of Diabetes Mellitus and often precedes lower extremity amputation, we conclude that HbA1c level should be maintained in normal range and regulating it is imperative for avoiding T2DM complications.

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