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Original Article

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Association of Hba1c and Diabetic Foot Ulcer Outcomes In Patients Attending Tertiary Care Hospital

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ABSTRACT

Introduction: Typically diabetic foot syndrome is characterized by foot infection, ulceration, or destruction of deep tissues in association with neurological abnormalities and divergent levels of peripheral vascular insufficiency. The factors that affect ulcer healing in diabetic patients are generally helpful in optimization of patient management strategy besides their routine application as predictors of the outcome. Hemoglobin A1c (HbA1c), an established marker to monitor blood glucose in diabetic patients, is currently being investigated for its association with ulcer healing.

Material and Method: A descriptive study was carried out in diabetic patients with foot ulceration (n = 70) to determine the role of HbA1c affecting the ulcer healing process. Ethical committee clearance was taken from the institution ethical committee. The study was conducted over 18month period from January 2021 to June 2022. Informed consent was obtained from the patients.

Conclusion: Our study results show that HbA1c levels have good association with the process of healing as well as time required for healing process to complete.

Key Words: *HbA1c, Diabetic foot ulcer, Diabetic neuropathy.*

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INTRODUCTION

Typically diabetic foot syndrome is characterized by foot infection, ulceration, or destruction of deep tissues in association with neurological abnormalities and divergent levels of peripheral vascular insufficiency.

Diabetic foot ulcer and infections are associated with substantial morbidity and mortality.[1,2]

Over 30 million have now diabetes in India. The crude prevalence rate in urban areas of India is thought to be 9%. In rural areas, the prevalence is approximately 3%of total population.[3]

The factors that affect ulcer healing in diabetic patients are generally helpful in optimization of patient management strategy besides their routine application as predictors of the outcome. Some of these predictors are useful in early identification of diabetic patients with high risk for foot ulcers and hence contribute toward lower rate of extremity amputations. Although prediction of diabetic foot ulcer healing may contribute toward optimized and individualized management of the patient, there is no single established and a universally accepted predictorto this end.[4]

Hemoglobin A1c (HbA1c), an established marker to monitor blood glucose in diabetic patients, is currently being investigated for its association with ulcer healing. As an elevated HbA1c predicts poor prognosis for ulcer healing in patients with diabetes, it has been observed that ulcer healing rate is significantly slower if the HbA1clevels are high. The prime objective of our study was to determine the significance of HbA1c level as predictors ofprognosis in patients with diabetic foot ulcers.[5-7]

Aims and Objectives

This study aims to study the role of HbA1c in the management of diabetic foot ulcers.

MATERIALS AND METHODS

A descriptive study was carried out in diabetic patients with foot ulceration (n = 70) to determine the role of HbA1c affecting the ulcer healing process. Ethical committee clearance was taken from the institution ethical committee. The study was conducted over 18month period from January 2021to June 2022. Informed consent was obtained from the patients.

Inclusion Criteria: All diabetic patients with foot ulcers, ischemic, neuropathic, or neuroischemic ulcers were included in the study.

Exclusion Criteria: Patients with non-diabetic foot ulcers were excluded from the study.

The data collection included demographics, medical diagnoses, HbA1c levels, and ulcer healing results. We employed our standard management protocol in the diabetic center for management of the foot ulcer patients. As a part of this management protocol, all patients underwent a regular wound debridement and dressing using normal saline, antiseptic, and hydrocolloid. For pressure ulcers and neuropathic ulcers, we aided the treatment intervention with off-loading strategy which primarily involved shoe offloading.[8,9] For the assessment of ulcer healing for each patient, we photographed his ulcerat the time of presentation followed by photographing the healing ulcers at stipulated time points (i.e., 2, 3, 6, and 12 months) as a follow-up. The photographs were then used to compare ulcer size, presence of necrotic tissue, and the granulation tissue formation to ascertain the progress of healing.[10-12]

OBSERVATION AND RESULTS [FIGURES 1-4]

A total of 70 patients (male n = 50, 71.57%; female$n$ = 20, 28.43%) were enrolled in the study .Prevalence of diabetes is greater in persons over the age of 50 years. Pedal infection is a devastating and severe complication of diabetes seen often is elderly patients.

In our study of 70 patients age was ranging from 29 years to 70 years. It was found that age group 51-60 years, had the highest number of28 (40%) patients.

52.38% of diabetic patients with controlled HbA1c (7 mmol/L) had foot ulcer healing within 3 months, 38.10% had healing in 3–6 months, and 9.52% took 7 months for complete healing of the foot ulcers. On the other hand, in patients with uncontrolled diabetes indicated by highly elevated HbA1c(10 mmol/L), a significant delay in foot ulcers was observed in majority of the patients Comparing patients with controlled, highly elevated HbA1c, only 21.42% of patients had healed foot ulcers within 3 months, 28.58% between 3 and 6 months, and 50% 7 months. While studying the healing process in relation to HbA1c levels, we observed that 71.43% of patients with normal HbA1c had completely healed foot ulcers, whereas 19.05% showed partial healing .The remaining 9.52% of patients required graft placement. Among the patients with high HbA1c, 42.85% showed complete healing, whereas 33.14% had partial healing, 21.49% progressed to grafting process, and 3.57% had unhealed foot ulcers. A direct comparison of the foot ulcer healing time duration, as well as completion of healing, was made with HbA1c. (Table no.2 and 3)

DISCUSSION

Typically, diabetic foot syndrome is characterized by foot infection, ulceration, or destruction of deep tissues inassociation with neurological abnormalities and peripheralvascular insufficiency.[13,14] Despite in-depth studies of therisk factors associated with diabetic foot ulcer development and the seriousness ofthe pathological consequences that may culminate into limb amputation and fatality, there is no standardcriterion yet established to predict the prognosis of diabetic foot ulcer healing. Ours is one of the many studiesthat report increased prevalence of problems associated with diabetic foot syndrome and search for a predictor that would be helpful in predicting the prognosis at the end of the treatment. The main findings of the study are that HbA1c as an indicator of glycemic control in the body shows significant association with foot ulcer healing and therefore can be usedas reliable predictors of diabetic foot ulcerprognosis.[15,16]

Multiple risk factors have been studied to discriminate between healing and non-healing ulcers by standard therapeutic intervention. Of these, modifiable factor HbA1c has gained special attention of researchers and has been extensively studied in relation with diabetic foot ulcers, gangrene, and limb amputation.[17] It is generally considered that a persistently elevated glucose level due to compromised glycemic control in the body results in impaired oxygen and nutrient supply to the ulcer area and a concomitantly compromised immune response due to impaired chemotaxis and phagocytosis. Given that glycated HbA1c is a reliable marker of glycemic control spanning over the previous 2–3 months, it is now being recommended by the American Diabetes Association and World Health Organization as a reliable marker for diagnosis of diabetes. A validated relationship has also been established between HbA1c levels and various pathological complications in diabetic patients such as diabetic retinopathy and foot ulcers.[18,19]

Table 1: showing no. of patient according to level of HbA1c

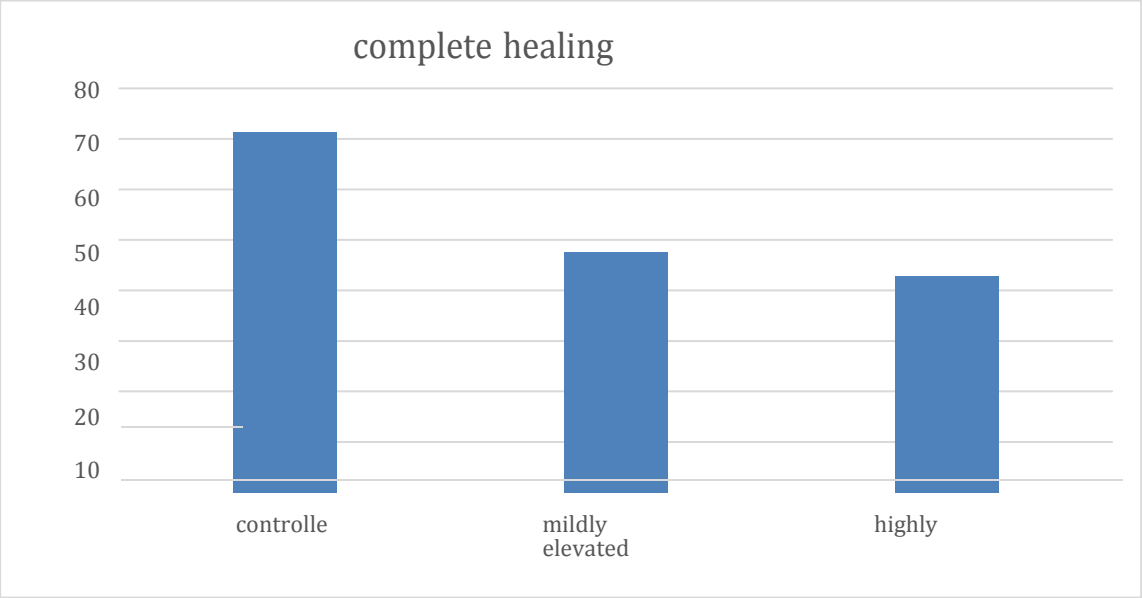
SL.NO	HbA1CLEVEL	No. ofpatient	Percentage
1	<7 gm/dl(Normal)	21	30
2	7-9 gm/d -l(Elevated)	21	30
3	>10 gm/dl(highly elevated)	28	40
	Total	70	100

Table 2: Association of HbA1c and healing time duration

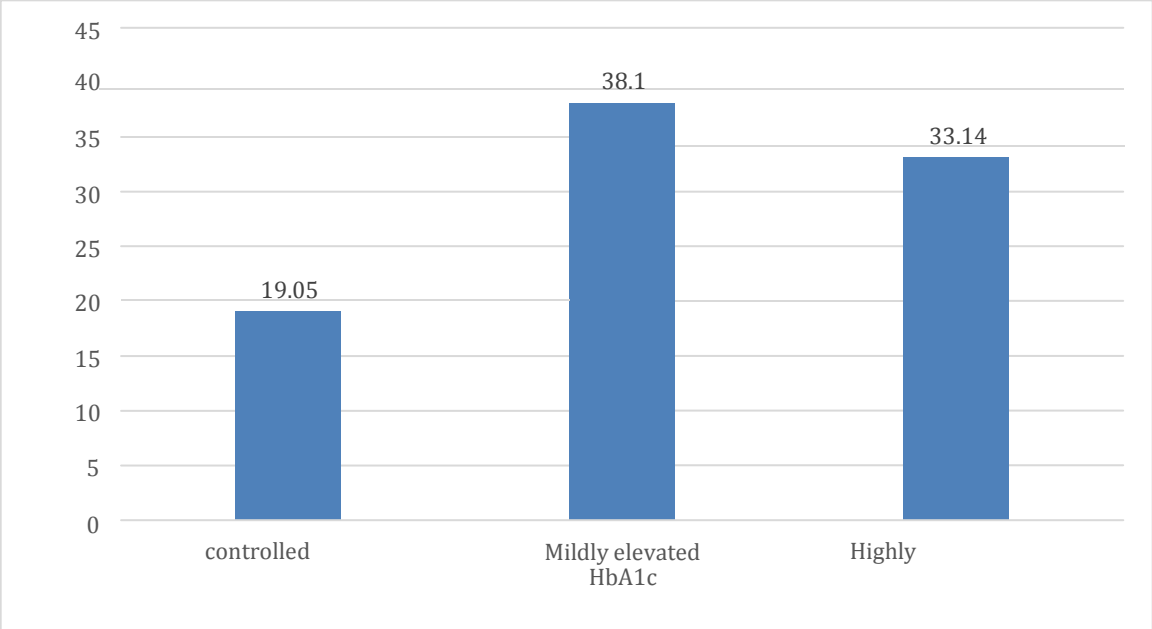
HbA1	Duration to ach ieve healed foot ulcers			Tota
	<3 months	3–6 months	7 months–1 year	
HbA1c				
Controlled	11 (52.38)	08 (38.10)	02 (9.52)	21
Mildly elevated	08 (38.10)	08 (38.10)	05 (23.80)	21
Highly elevated	06 (21.42)	08 (28.58)	14 (50)	28
Total	25	24	21	70

Table3 : Association between HbA1c levels and the process of diabetic foot ulcer healing

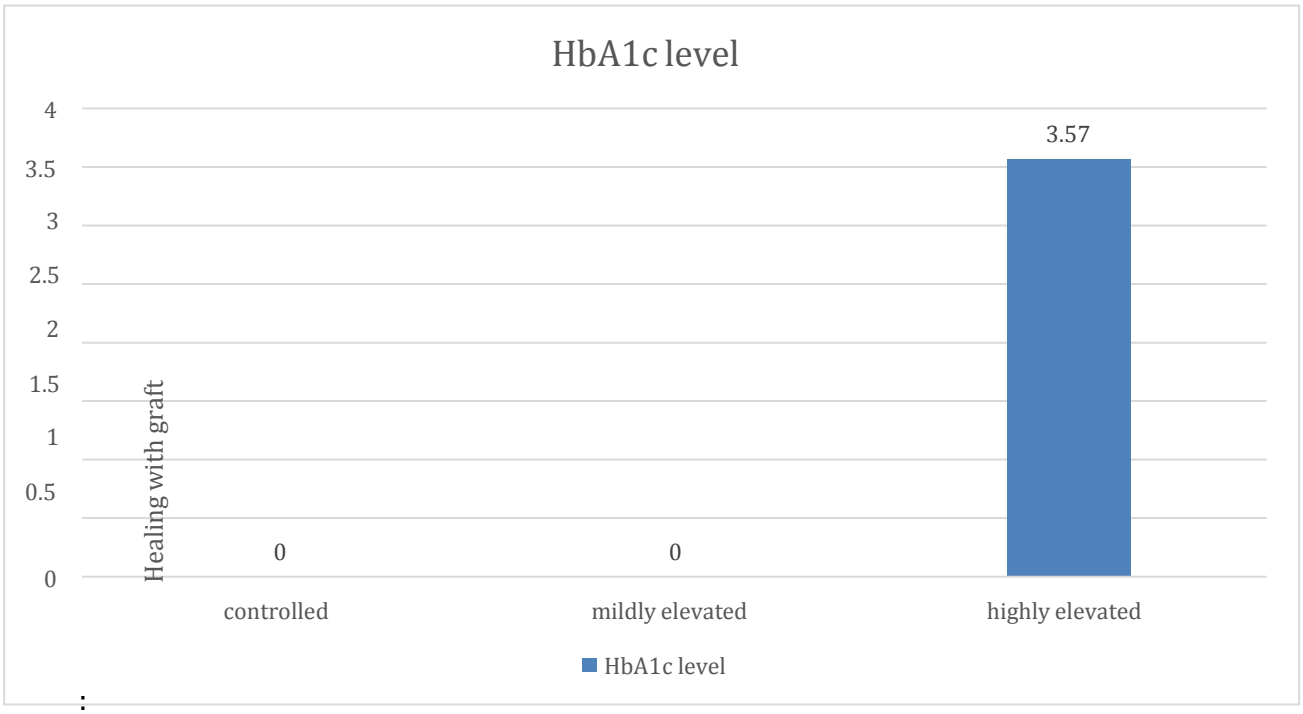
HbA1c	Healing process (*n* %)				Total
	Complete healing	Partial healing	No healing	Healing with Graft	
HbA1c					
Controlled	15 (71.43)	04 (19.05)	0	02 (9.52)	21
Mildly elevated	10 (47.62)	08 (38.10)	0	03 (14.28)	21
Highly elevated	12 (42.85)	09 (33.14)	01(3.57)	06(21.49)	28
Total	37	21	01	11	70



Graph 1: Complete healing percentage



Graph 2: Partial healing percentage



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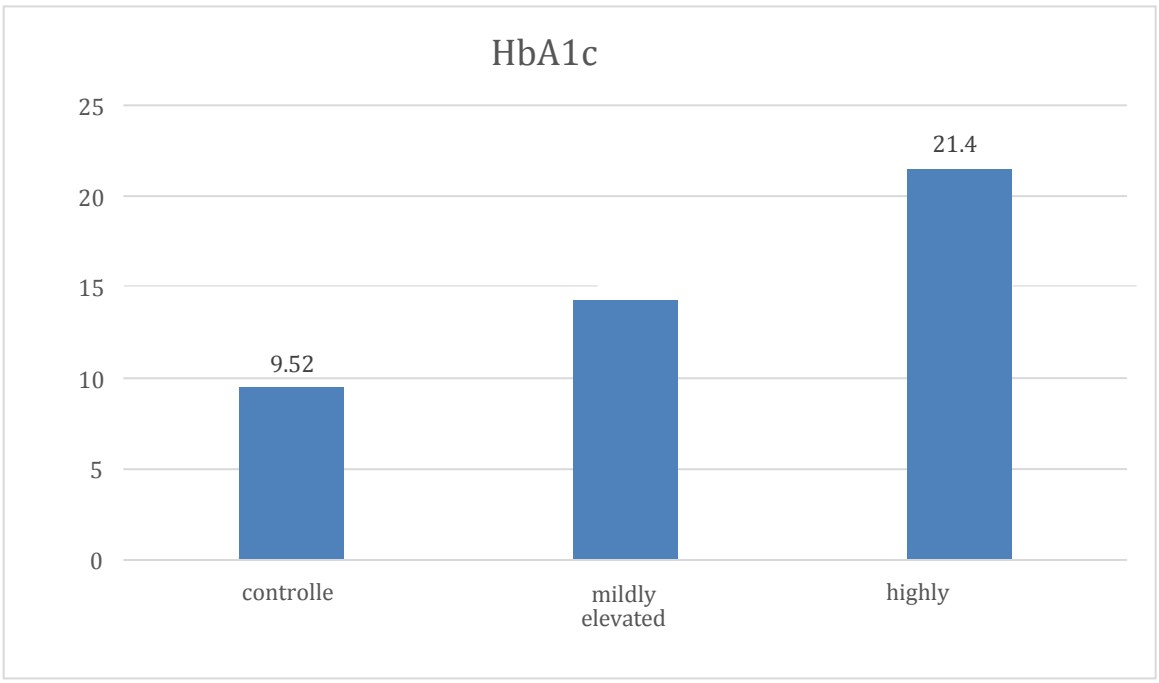
Graph 3 : No healing percentage



Graph 4: Healing with graft percentage

However there are conflicting data published regarding HbA1c levels as a determinant of ulcer healing process. A prospective study involving 314 diabetic patients with foot ulcers showed a significant association between various clinical risk factors and the healing process but with little evidence of association with short-term metabolic control assessed by HbA1c analysis.[20] On the contrary, more recent studies contradict this observation and report not only that there is a significant association of HbA1c with foot ulcerdevelopment but also that HbA1c is a reliable predictor of foot ulcer healing.[5,18] A retrospective cohort study involving 183 diabetic patients (average age 61 years) showed that HbA1c was significantly associated with ulcer-area healing rate and was a superior biomarker to predict ulcer- area healing rate as compared to all the othermeasures assessed during the study.[5] It was observed thatfor every 1% increase in HbA1c levels, the rate of ulcer-area healing decreased by 0.028 cm^2/day. Another

clinical study has reported similar findings implying HbA1c as a significant determinant of foot ulcer healing in diabetic patients.[21] The healing time for foot ulcersin patients with lower HbA1c was shorter than patients with higher values. Although foot ulcer healing has also been reported in patients with higher HbA1c, the healingtime was significantly longer. Our study results were in concordance with these data and showed a significant association between controlled glycemia and the ulcer healing. We observed that patients with lower HbA1c hadshorter healing duration compared with patients withhigherlevel of HbA1c.

CONCLUSION

Our study results show that HbA1c levels have good association with the process of healing as well as time required for healing process to complete. Elevated HbA1c was associated with slower and incomplete healing of foot ulcers in diabetic patients. Given their reliability as tools to diagnose and monitor diabetes and its related complications, HbA1c parameter can be used as dependable predictors of foot ulcer healing in the diabetic.

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