ISSN: 0975-3583, 0976-2833 VOL15, ISSUE5, 2024

Original Research Article

To Explore the Prevalence of Micronutrient Deficiencies in Patients with Diabetic Foot Ulcers

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Abstract

Background & Methods: The aim of the study is to explore the prevalence of micronutrient deficiencies in patients with diabetic foot ulcers. Specimens were handled and transported as per collection guide and all processed. Demographic information and clinical data were prospectively obtained during patient assessment including age, gender, weight, height, BMI and smoking status.

Results: 26% of patients had normal levels of vitamin C. The remainder had suboptimum levels with just over half of all the patients having low or no measurable plasma levels of this vitamin. Suboptimal levels of vitamin C affected 31% of diabetic patients with foot ulcers comprising of marginal levels. Zinc deficiency was found in approximately 17% of the patients. Vitamin A deficiency was present in approximately 11% of the patients. Although further research needs to be performed to determine the clinical implications of our findings, micronutrient deficiency should be considered in diabetic patients with foot wounds.

Conclusion: The prevalence of micronutrient deficiency, especially vitamin D, vitamin C, Zinc and vitamin A, is high in diabetic patients with foot ulcers. Currently there is evidence to support micronutrient supplementation to improve wound healing and this study correlation with outcomes significantly. However, in light of the physiological role of some micronutrients, especially Vitamins C, A and Zinc, the complexity of the diabetic foot disease and the high prevalence of micronutrient deficiency found in this study, we suggest assessing the levels of these vitamins and minerals in patients with diabetic foot ulcers and considering supplementary treatment if deficiency is found.

Keywords: Prevalence, Micronutrient, Deficiencies Diabetic & Foot Ulcers.

Study Design: Prospective Observational Study.

1. INTRODUCTION

Diabetes is one of the oldest diseases known to mankind. The Ebers Papyrus of 1500 B.C. mentions its symptoms and suggests treatment [1]. However, the history of gangrene of the foot goes back to Biblical time, when, in Chronicles II, the first case of gangrene of the feet, perhaps due to diabetes, is described.

Vitamins and minerals are required in small amounts, yet they are critical to cellular metabolism, including the wound healing process. This study has demonstrated that micronutrient deficiencies are very common in diabetic patients with foot ulcers/wound [2].

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Diabetic foot problems are a major cause of hospitalization and prolonged hospital stays. Twenty percent of all diabetic persons who enter the hospital do so because of foot problems. In the series of Smith et al, foot problems were responsible for 23% of the hospital days over a two-year period [3]. At the Indian Institute of Diabetes in Bombay, India, more than 10% of all admissions for diabetes are primarily for foot management. More than 70% required surgical intervention and in more 40% of those interventions there was a toe or limb amputation.

In the U. K. more than 50% of bad occupancy of diabetics are due to foot problems. It is obvious from these figures that throughout the world diabetic foot problems are a major cause of hospitalization, morbidity and mortality [4].

The signs and symptoms of either ischaemia or neuropathy may predominate. However, neither is present to the total exclusion of the other. The clinical picture is therefore the result of complications stemming from a combination of both. Peripheral neuropathy is the leading cause of most diabetic foot lesions [5-7]. A majority of patients who enter the hospital because of diabetic foot lesions do so because of ulceration secondary to painless trauma.

2. MATERIAL AND METHODS

This study is part of a major project assessing factors influencing outcomes in patients with diabetic foot disease. Subjects consisted patients seen or admitted under the Vascular Surgery service.

A total of 100 patients were recruited for the study for 01 Year. Plasma levels of Vitamin A, C, D, E; copper, zinc and ferritin were measured at recruitment. All the samples were of venous blood taken by a phlebologist in hospital or outpatient pathology collection centre.

In addition, grip strength was also recorded. Grip strength is a measurement of muscle function as indicator of functional as well as nutritional status.

Eligibility criteria included being diabetic, age ≥ 18 years, able to have follow ups and presence of foot ulcer(s).

3. RESULT

Table No. 1: Patient Characteristics

Gender	No.	Percentage
Male	77	77
Female	23	23
Smokers	No.	Percentage
Current	23	23
Ex-smoker	48	48
Never	29	29

Table No. 2: Mean Stats

	Mean	SD
Age	63.7	12.4
Duration of diabetes (years)	16.3	11.8
HbA1c (%)	8.6	4.1
Grip Strength (Kg)	28.1	2.2

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Table No. 3: Percentage of Participants with Vitamin and Mineral Deficiencies

Vitamin & Mineral	No.	Percentage	P Value
Vitamin D	35	35	.031637
Vitamin C	31	31	
Zinc	17	17	
Vitamin A	11	11	
Ferritin	06	06	
Vitamin E	00	00	
Copper	00	00	

The prevalence of micronutrient deficiencies, the elements most frequently found to be deficient, in descending order were: vitamin D, vitamin C, zinc, ferritin and vitamin A. None of the patients had low levels of vitamin E or copper.
The chi-square statistic is 3.1176. The p-value is .031637. The result is significant at $p < .05$.

Table No. 4: Vitamin C Levels

Vitamin C levels	No.	Percentage	P Value
<3	20	20	.043488
≥ 3 and ≤11.4	31	31	
> 11.4 and < 22.7	23	23	
> 22.7	26	26	

26% of patients had normal levels of vitamin C. The remainder had suboptimum levels with just over half of all the patients having low or no measurable plasma levels of this vitamin. The chi-square statistic is 7.6081. The p-value is .043488. The result is significant at $p < .05$.

4. DISCUSSION

The prevalence of deficiencies in vitamin C, zinc, and vitamin A was higher than anticipated, and concerning, given the pivotal roles these nutrients play in wound healing. Iron status was assessed by ferritin levels, which is a marker of iron stores in the body. Six percent of the patients had ferritin less than 30 lg/L and were considered deficient. However, the prevalence of iron deficiency is likely higher than identified by our study. Ferritin is an acute-phase reactant, and a significantly higher cutoff level for ferritin is used to define iron deficiency accompanied by inflammation [8].
Vitamins and minerals are required in small amounts, yet they are critical to the cellular metabolism, including the wound healing process. This study has demonstrated that micronutrient deficiencies are very common in diabetic patients with foot ulcers/wound.
Vitamin D deficiency was the most common deficiency detected, and its prevalence is consistent with previous reports. This was expected as vitamin D deficiency is recognized as a global public health problem, usually related to sunscreen use and sun avoidance behaviors. Diabetic patients with foot ulcers may be at particular risk of vitamin D deficiency due to reduced level of physical activity, which is often considered a surrogate for the amount of time spent outdoors and therefore sun exposure [9].
Vitamin D is well recognized for its role in the bone homeostasis. However, vitamin D signalling has also many extraskeletal effects. These include regulation of cell proliferation,

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immune and muscle function, skin differentiation, and reproduction, as well as vascular and metabolic properties [10]. Despite the abundance of preclinical data regarding vitamin D and skin cell interaction, there is no good-quality evidence to support a substantial role in wound healing.

Complications of diabetes that arise in the foot are considered the most preventable among the complications of diabetes, with lack of knowledge and poor foot care practices being recognised as significant risk to diabetes foot ulcers[11-13].

According to educating patients and spreading information among patients about diabetes mellitus related complications and how to establish a foot care plan are the best recommended ways to avoiding diabetes foot ulcers [14]. Screening is important in the prevention of diabetes foot ulcers as they state that with appropriate, careful, effective screening and management standards severe diabetic foot complications can be delayed and prevented. Screening requires the detection of asymptomatic individuals who are at high risk of diabetes and its complications.

5. CONCLUSION

The prevalence of micronutrient deficiency, especially vitamin D, vitamin C, Zinc and vitamin A, is high in diabetic patients with foot ulcers. Currently there is evidence to support micronutrient supplementation to improve wound healing and this study correlation with outcomes significantly. However, in light of the physiological role of some micronutrients, especially Vitamins C, A and Zinc, the complexity of the diabetic foot disease and the high prevalence of micronutrient deficiency found in this study, we suggest assessing the levels of these vitamins and minerals in patients with diabetic foot ulcers and considering supplementary treatment if deficiency is found.

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