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Correlation of Serum Vitamin D Levels with the Severity of Diabetic Foot Ulcers in Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

Vidro Alif Gunawan[1*], Kemas Muhammad Dahlan[2], Legiran[3]

[1]Specialized Residency Training General Surgery, Department of Surgery, Faculty of Medicine, Universitas Sriwijaya/Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

[2]Division of Vascular and Endovascular Surgery, Department of Surgery, Faculty of Medicine, Universitas Sriwijaya/Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

[3]Department of Anatomy, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

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***Corresponding author:**
Vidro Alif Gunawan

E-mail address:
vidroalif@yahoo.com

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A B S T R A C T

Background: Vitamin D has a role in diabetes mellitus. Low levels of vitamin D are associated with the development of diabetic foot infections. Effects of vitamin D supplementation on wound healing, insulin resistance, inflammatory biomarkers, and oxidative stress are mediated by effects on induction of phagocytosis and bacterial killing by macrophages, suppression of interferon-gamma mediating macrophage activation, activation of insulin receptor expression, and downregulation from cytokines. This study aimed to determine the correlation between serum vitamin D levels and the severity of diabetic foot ulcers in Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. **Methods:** This study was an observational analytics study, where as many as 30 research subjects participated in this study. The study observed vitamin D levels and the severity of diabetic foot ulcers as assessed by the classification of the wound, ischemia, and foot infection (WIfI). Univariate and bivariate data analysis was carried out using SPSS. **Results:** The results of Sommer's correlation statistical test obtained a value of p = 0.001 (p <0.05) with a correlation strength of r = 0.564, which means sufficient strength (r = 0.40-0.70). This means that the higher the deficiency in serum Vitamin D levels, the higher the degree of WIfI classification experienced. **Conclusion:** There is a correlation between serum vitamin D levels and the severity of diabetic foot ulcers in Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

1. Introduction

Diabetes mellitus (DM) is a group of metabolic disorders characterized by hyperglycemia. Diabetes mellitus complications can be divided into microvascular and macrovascular or acute and chronic. The prevalence of microvascular complications is 46%, and macrovascular is 65%. Glucose control will improve with increased activity physical activity such as walking. Studies state that an increase in walking for 1 hour per day will lower the risk of developing diabetes by 34%. One of the complications of DM that is often experienced by diabetic patients is the diabetic foot, which begins with the formation of a diabetic ulcer until an amputation occurs. Diabetic foot problem is a major global problem, as well as a major consequence of neuropathy and peripheral arterial disease (PAD). The course of diabetic foot disease to the occurrence of amputation starts from chronic hyperglycemia, which causes neuropathy leading to ulceration. Infection occurs so that the tissue experiences ischemia and necrosis. The main pathogenesis which plays an

important role in the emergence of diabetic ulcers is insulin resistance, dyslipidemia, inflammation, and oxidative stress. The prevalence of diabetic peripheral neuropathy is 30%, ischemic neuropathy is 28%, neuro ischemic is 60%.[1-5]

Vitamin D has a role in diabetes mellitus. Low levels of vitamin D are associated with the development of diabetic foot infections. Some researchers report that there is an immune effect in brokered T cells, insulin secretion by the pancreas, and insulin function plays a role in cell growth and healing. Other studies suggest that calcitriol can repair endothelial and migration of keratinocyte cells in diabetic ulcers. Effects of vitamin D supplementation on wound healing, insulin resistance, inflammatory biomarkers, and oxidative stress are mediated by effects on induction of phagocytosis and bacterial killing by macrophages, suppression of interferon-gamma mediating macrophage activation, activation of insulin receptor expression, and downregulation from cytokines.[6-11] This study aimed to determine the correlation between serum vitamin D levels and the severity of diabetic foot ulcers in Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

2. Methods

This study was an analytic observational study and study used primary data obtained from diabetic foot ulcer patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. A total of 30 research subjects participated in this study, where the research subjects met the inclusion criteria. The inclusion criteria in this study were patients with diabetic foot ulcers, aged over 18 years, who were treated at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia, and were willing to participate in this study by signing informed consent. Patients who received vitamin D supplementation within the last three months were excluded from this study. This study was approved by the research and medical ethics committee of the Faculty of Medicine, Universitas Sriwijaya No. LB.02.03/XVII.5.11/ETIK/07/2023.

This study observed sociodemographic data, serum vitamin D levels, and the severity of diabetic foot ulcers. Vitamin D levels were assessed using the enzyme-linked immunosorbent assay (ELISA) method. The severity of diabetic foot ulcers is assessed by WIfI criteria (judged by the depth of the ulcer or whether there is gangrene, ischemia based on ABI, toe pressure, or $TcPO_2$, and foot infections). Data analysis was carried out using SPSS software version 25. Univariate analysis was performed to serve data frequency distribution for each variable test. Bivariate analysis was performed to determine the correlation between vitamin D levels and the severity of diabetic foot ulcers, $p<0.05$.

3. Results

Correlation analysis between vitamin D levels and WIFI classification is shown in Table 1. The results of Sommer's correlation statistical test obtained a value of p = 0.001 (p <0.05) with a correlation strength of r = 0.564, which means sufficient strength (r = 0.40-0 .70). This means that the higher the deficiency in serum vitamin D levels, the higher the degree of WifI classification experienced.

Table 1. Correlation of serum vitamin D levels with WifI classification.

Vitamin D levels	WIfI classification			r	P-value
	Low	Moderate	High		
20-29	2	0	0	0,564 (0,40-0,70)	0,001
10-19	2	9	7		
0-9	1	0	9		
Total	5	9	16		

Sommer's test, p=0,05.

4. Discussion

Diabetic foot ulcers are characterized by the classic triad of neuropathy, ischemia (or a combination of both), and infection. This factor is supported by the presence of mechanical stress due to the deformity of the foot shape of diabetic patients. Diabetic neuropathy is a syndrome that attacks the peripheral nervous system involving somatic and autonomic. Neuropathy is a major factor causing failure of wound healing, erectile dysfunction, and cardiovascular disorders in diabetic patients, and vitamin D deficiency will increase the risk of insulin resistance.[12-15]

Other studies state that severe vitamin D deficiency correlates significantly with an increased risk of diabetic foot ulcers, and there is a significant decrease in vitamin D levels in diabetic foot ulcers. 25(OH)D levels were significantly lower in cases of diabetic ulcer infection. Low levels of 25(OH)D play a significant role in the pathogenesis of foot ulcers. Hyperglycemia in diabetic patients will interfere with the normal process of cytokine production, causing failure of wound healing. Vitamin D inhibits the secretion of T helper type 1 cytokine IFN-gamma and IL-2 but stimulates Th2 production, which promotes wound healing.[16-18]

5. Conclusion

There is a correlation between serum vitamin D levels and the severity of diabetic foot ulcers in Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

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