



Correlation between Instability of Blood Glucose Levels and Initial Response of Patients to Wounds to the Degree of Diabetic Foot Ulcer (DFU)

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Abstract

Instability of blood glucose levels is one of the problems that occur in DFU patients and the patient's initial response to the wound is associated with poor wound healing, amputations, and increased mortality. The research design is an analytic observational study with a cross-sectional approach design. The research subjects were diabetic foot ulcers patients who underwent wound care at the Independent Nursing Practice in Bone Regency. Sampling technique with Total Sampling method. To find out the respondent's blood glucose level, a measurement was carried out using a Portable Glucometer and then an observation was made of the patient's initial response to the wound. DFU degree assessment using Meggitt-Wagner. The tool used to collect data is the respondent's observation data sheet to record all respondent data. After the Spearman correlation test was carried out, the test results were obtained with a value of $p = 0.008$ and a value of $r = 0.472$ so that it can be concluded that there is a significant positive correlation between blood sugar levels and the degree of diabetic foot ulcer with moderate correlation strength and based on the results of the Spearman correlation test, the p value is obtained = 0.026 and the value of $r = 0.405$ so that it can be concluded that there is a significant positive correlation between the patient's initial response to the wound and the degree of diabetic foot ulcer with a weak correlation strength.

Introduction

Diabetes Mellitus (DM) sufferers are estimated to be nearly 500 million people today, with predictions of an astonishing increase in the coming years. Indonesia is ranked 6th in the world with a prevalence of 10 million people according to the 2019 International Diabetes Federation (IDF). It is estimated that 463 million people suffer from diabetes and in 2030 this figure is projected to reach 578 million, and 700 million in 2045 (Saeedi et al., 2019). The results of Riskesdas show data on DM sufferers in South Sulawesi, with a prevalence of over 15 years of age, namely 1.83%, 65-74 years 5.48%, and all ages 1.3% (Ministry of Health RI, 2018). Patients with DFU continue to experience improvement. The International Diabetes Federation (IDF) also mentions that 9.1-26.1 million people with diabetes in the world experience complications in the form of diabetic foot. More than half of diabetic foot sufferers have a secondary infection, 20% of moderate to severe infections end in amputation.

Inadequate management and lack of knowledge can cause short-term complications and long-term complications while vascular defects that create circulation instability in the blood, thus triggering the occurrence of Diabetic Foot Ulcer (DFU) (Sucipto Hendra et al., 2019). Unstable blood glucose levels are one of the problems that occur in DFU patients and the patient's initial

response to injury is associated with poor wound healing, amputation, and increased mortality. (Mishra et al., 2017).

Methods

The research design is an analytic observational study with a cross-sectional approach design. The subjects of this study were DM patients with diabetic foot ulcers who underwent wound care at the Independent Nursing Practice in Bone District. Sampling technique using Total Sampling method. To determine the respondent's blood glucose level, a measurement was carried out using a Portable Glucometer and then an observation was made of the patient's initial response to the wound. DFU degree assessment using Meggitt-Wagner. The tools used to collect data are: respondent observation data sheets to record all information data results obtained from respondents.

Results and Discussion

The results of this study are presented in the characteristics of respondents based on gender, age, education and occupation as follows:

Table 1. Respondents' General Data

Characteristic Respondents		Percentage Frequency	
Gender	Man	8	26.7
	Woman	22	73.3
Total		30	100%
Age	40-50 years	10	33.3
	51-60 years	10	33.3
	>60 years old	10	33.3
Total		30	100%
Education	Not going to school	6	20.0
	Elementary School	7	23.3
	Junior School	4	13.3
	High School	5	16.7
	Diploma/Bachelor	8	26.7
Total		30	100%
Work	Not working	19	63.3
	Farmers / Fishermen	2	6.7
	Self employed	5	16.7
	Civil Servant /Army/Police	3	10.0%
	Other	1	3.3%
Total		30	100%

Table 1 shows that the most sexes were women with 22 people (73.3%) and men with 8 people (26.7%). Age group shows that each age group has the same number of 10 people (33.3%). In education, the highest number of respondents were diploma/graduate education with 8 people (26.7%) and the lowest was the junior high school education group with 4 people (13.3%). Most of the respondents did not work, namely 19 people (63.3%) and the lowest was another job, 1 person (3.3%).

Table 2. Current Blood Glucose Levels, Initial Response to Wounds and Grade of Wounds Based on Meggitt – Wagner

GDS levels	Frequency	Percentage
<200 mg/dl	9	30
>200 mg/dl	21	70

Total	30	100%
Initial Response	Frequency	Percentage
Take Care of It Independently	2	6.7
Untreated	9	30
Treated in Independent Practice	19	63.3
Total	30	100%
Degree of Injury	Frequency	Percentage
Grade 0	4	0
Grade 1	4	13.3
Grade 2	12	40.0
Grade 3	11	36.7
Grade 4	2	6.7
Grade 5	1	3.3
Total	30	100%

Table 2 shows that the respondents who had the most GDS >200 mg/dl were 21 people (70%) while the respondents who had GDS levels <200 mg/dl were the lowest, namely 9 people (30%). The initial response to injuries, most respondents were treated in independent practice as many as 19 people (63.3%) and the lowest was treated independently by patients as many as 2 people (6.7%). In the degree of diabetic foot ulcer wound, the most respondents were in grade 2 wound as many as 12 people (40%) and the lowest was grade 0 (0%).

Table 3. Results of the Spearman Correlation Test of GDS Levels with Degrees of Diabetic Foot Ulcer (DFU)

<i>p-value</i>	0.008
Correlation Coefficient	0.472

Based on table 3 above, after the Spearman correlation test was carried out, the test results were obtained with a value of $p = 0.008$ and a value of $r = 0.472$ so that it can be concluded that there is a significant positive correlation between GDS levels and the degree of diabetic foot ulcer with a moderate correlation strength. So it can be concluded that the higher the GDS level in diabetic foot ulcer patients, the higher the degree of the wound.

Table 4. Results of the Spearman Correlation Test on Early Response to Wounds with the Degree of Diabetic Foot Ulcer (DFU)

<i>p-value</i>	0.026
Correlation Coefficient	0.405

Based on table 4 above, after the Spearman correlation test was carried out, the test results were obtained with a value of $p = 0.026$ and a value of $r = 0.405$ so that it can be concluded that there is a significant positive correlation between the patient's initial response to wounds with the degree of diabetic foot ulcer with a weak correlation strength. So it can be concluded that the higher the patient's initial response to the wound, the higher the degree of the wound

Diabetic Foot Ulcer (DFU) Overview

Diabetes Mellitus is characterized by the occurrence of hyperglycemia and disturbances of carbohydrate, fat and protein metabolism associated with absolute or relative deficiencies of insulin action and/or secretion. Symptoms that are complained of in patients with Diabetes Mellitus are polydipsia, polyuria, polyphagia, weight loss and tingling.

Diabetes Mellitus is called the silent killer because this disease can affect all organs of the body and cause various kinds of complaints. Diseases that will be caused include visual

impairment, cataracts, heart disease, kidney disease, sexual impotence, wounds that are difficult to heal and fester/gangrene, lung infections, blood vessel disorders, strokes and so on. Not infrequently, patients with severe DM undergo limb amputation due to decomposition. To reduce the incidence and severity of type 2 Diabetes Mellitus, prevention is carried out such as lifestyle modifications and medications such as oral hyperglycemic drugs and insulin. The incidence of DM in Indonesia has increased significantly.

Foot ulceration is a common complication of diabetes which has potentially disastrous consequences for the patient. Fortunately, better control of blood sugar levels, early recognition of complications of peripheral neuropathy and ischemia, and use of an evolving multidisciplinary therapeutic approach can alleviate this problem.

The results of the study in table 1 show that 22 people (73.3%) of respondents who had DM with Diabetic Foot Ulcer (DFU) were women and most had hyperglycemia. This is in line with research conducted by (Chokkalingam et al., 2021) which stated that women more often than men. because physically women have a greater chance of increasing body mass index. From a hormonal point of view, women who experience DFU are higher than men because of a decrease in the hormone estrogen due to menopause. Estrogen functions to maintain the balance of blood sugar levels and fat storage.

In addition to the hormone estrogen, there is also the hormone progesterone, these two hormones have an important role and are responsible for various characteristics in the female body. The hormones estrogen and progesterone can influence cells to respond to insulin because after women experience menopause changes in hormone levels will trigger irregular fluctuations in blood sugar levels. The increase in glucose levels caused by the buildup of glucose results in obstruction of the flow of nutrients to the surface of cells through blood vessels and the absence of other nutrients that supply cells other than glucose (Nugroho, 2007)

This study also shows that currently the age of DM patients with DFU varies greatly and is no longer dominated by a certain age range. This was shown from 30 respondents, who had the same percentage, namely 33.3% in the age range 40-50, 51-61 and >60 years. This is in line with a study conducted by (Saha et al., 2015) which suggested that American DM patients were diagnosed when they were younger than 40 years and diabetic foot ulcers occurred some time later. Aging causes skin cells to reduce their elasticity as a result of decreased vascularization of fluid in the skin and reduced fat glands which further reduce skin elasticity. Skin that is not elastic will reduce the ability of cell regeneration when the wound is about to close and begins to close so that it can slow down wound healing (Nugroho, 2007).

It can be said that patients aged > 45 years have a longer time in the process of healing diabetic ulcers due to decreased skin elastin and collagen regeneration processes which also decrease due to reduced cell productivity than before. Skin that is not elastic will reduce the ability of cell regeneration when the wound will and begins to close so that it can slow down wound healing and even be vulnerable to exposure to bacterial infections.

If associated with general data in the form of education and employment, these two factors play a role in the incidence of diabetes mellitus. As it is known that for education, most of the respondents had diploma/graduate education, namely as many as 8 people (26.7%). As for work, most of them are people who do not work, namely as many as 19 people (63.3%). These two general factors are supported by research results (Kyrou et al., 2020) which say that modifiable risk factors for diabetes mellitus include smoking habits, level of education, occupation, physical activity, alcohol consumption, body mass index and waist circumference.

Correlation of Current Blood Glucose Levels with Grade Diabetic Foot Ulcer (DFU)

The results of the study in table 2 show that the most respondents who had GDS levels > 200 mg/dl were 21 people (70%) and the most grade 2 were 12 people (40%). Table 3 shows that there is a significant positive correlation between GDS levels and the degree of diabetic foot ulcer with moderate correlation strength. So it can be concluded that the higher the GDS level in diabetic foot ulcer patients, the higher the degree of the wound. It is widely suggested that blood glucose can be controlled to enhance wound healing and limit adverse effects on cellular immunity and infection. Several observational studies have found a positive correlation with glycemic control and wound healing. The research conducted (Lede et al., 2018) shows that there is an effect of blood sugar levels on the healing time of diabetes mellitus wounds at the Dinoyo Malang Health Center with a Sig. = 0.002 ($\alpha \leq 0.05$) and there is a negative correlation as evidenced by the correlation coefficient of -0.520.

These results are in line with research (Boulton et al., 2018) Ulcer patients have suffered from DM since 1 to 5 years ago with uncontrolled blood sugar levels. Uncontrolled blood sugar levels in ulcer patients are found to be more than 200 mg/dl. Hyperglycemia affects the development of diabetes complications through several metabolic pathways that take place in the body (Decroli, 2019). The World Health Organization, namely WHO, believes that individuals aged after 30 years will experience an increase in blood glucose levels of 1-2 mg/dl during fasting and will rise 5.6-13 mg/dl 2 hours after eating so that they can accumulate insulin in the cells. -body cells that can reduce the effectiveness of substances such as proteins and other minerals in the wound healing process in diabetic ulcers. (Taylor, 2010) suggested that the cause of the large number of DM incidents in women was due to a decrease in the hormone estrogen due to menopause.

Individuals who suffer from DM with diabetic ulcers can result in complications other than physical complications, namely psychological complications in the form of anxiety. Another thing that can be done to control anxiety which can cause an increase in blood glucose levels is to do complementary therapy in the form of progressive muscle relaxation which has an effect on reducing anxiety in diabetic foot ulcer patients (Mas'ud & Mardiana, 2021) and can do foot massage which is proven effective in lowering blood glucose levels (Mardiana, 2021). People with poor blood glucose control are 5.8 times more likely to have diabetic ulcers than people who control their blood glucose well. It is important to control blood sugar levels by checking HbA1c at least 2 x a year in addition to following the management of DM properly (Van et al., 2020).

Early Response to Wounds And Wound Grade Diabetic Foot Ulcer (DFU)

In Table 3 it was found that the initial response to injuries, most respondents were treated in independent practice as many as 19 people (63.3%) and the lowest was wounds treated independently as many as 2 people (6.7%). In terms of diabetic foot ulcer wound degree, the highest number of respondents were in grade 2 wounds as many as 12 people (40%) and the lowest was grade 0 (0%). The results of the correlation test in table 4 show that there is a significant positive correlation between the patient's initial response to the wound and the degree of diabetic foot ulcer with a weak correlation strength.

The results of this study are in line with the results of a study conducted by (Rakhmawati et al., 2021), namely as many as 72.7% of diabetic ulcer sufferers who have longer hospitalization days for wounds are the age group over 50 years or the elderly group because the amount of skin elastin decreases and the process of collagen regeneration decreases with age. In a study (Hardianti et al., 2018; Pujiati & Suherni, 2019) which stated that the high number of diabetic ulcer sufferers was caused by a lack of knowledge and concern for diabetic ulcer sufferers to immediately treat their wounds when the initial

wound occurred and tended to be regarded as something negative. Most ordinary people prefer to keep their wounds open with the assumption "an open wound will dry quickly and if the wound is dry it means the wound has healed". Open wounds are susceptible to friction, trauma, and even infection, thereby hindering the healing process of diabetic ulcers and prolonging wound care.

Conclusion

The higher the blood sugar level in diabetic foot ulcer patients, the higher the degree of the wound and the higher the response to the wound, the greater the grade of the wound.

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