Correlation of Peak Systolic Velocity Value with Wagner Score in Diabetic Foot Ulcer Patients in RSUP Dr. M. Djamil Padang

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A B S T R A C T

Background: Diabetic foot ulcers are one of the chronic complications of diabetes mellitus (DM) in the form of wounds on the skin surface of the feet of DM patients accompanied by internal tissue damage or tissue death, either with or without infection, which is associated with the presence of neuropathy and or peripheral arterial disease in patients with DM. The World Health Organization (WHO) states that at least 422 million people suffer from DM A new alternative parameter for assessing the degree of peripheral ischemia is ankle peak systolic velocity (PSV). The rationale for PSV is based on the observation that in the ischemic limb, blood travels at a much slower rate in the distal leg arteries than in the nonischemic limb. PSV is a quick and easy test to assess the patient's vascular status and monitor the development of diabetic foot ulcers, and can assess the degree of ischemia and predict healing of diabetic foot ulcers. This study aims to determine the Correlation of Peak Systolic Velocity Value with Wagner Score in Diabetic Foot Ulcer patients in RSUP Dr. M. Djamil Padang. **Methods:** This research is analytic observational with cross sectional design, the research uses primary data. This research will be conducted at the RSUP Dr. M. Djamil Padang from July 2021 to October 2021. The population in this study were diabetic foot ulcer patients who came for treatment at Dr. M. Djamil Padang. A sample of 32 patients Diabetic foot ulcer met the inclusion criteria. Univariate analysis was conducted to describe each of the variables studied. Numerical data is normally distributed, then it is presented in the form of mean ± standard deviation (SD), whereas if the numerical data is not normally distributed then it is presented in the form of median, minimum and maximum. Categorical data is presented in the form of frequency and percentage of each category. Bivariate analysis was started by using the data normality test using the Shapiro Wilk test (n<50). In testing the correlation between Peak Systolic Velocity and Wagner Score in diabetic foot ulcer patients, the Pearson correlation test is used if the data is normally distributed. Data analysis using SPSS version 22.0. **Results:** more than half of the subjects (65.6%) are male. The mean age of the subjects was 60.46 ± 10.06 years. More than half of the subjects (62.5%) had a normal body mass index. The average length of suffering from diabetes mellitus was 5.48 ± 2.26 years. Half had a history of smoking (59.4%), a small proportion of subjects had hypertension (21.9%), hypercholesterolemia (6.3%) and neuropathy (12.5%). More than half of the subjects (53.1%) had immunopathies. There is a correlation between the popliteal PSV value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a moderate correlation strength ($r=-0.463$) and a negative direction. There is a correlation between the PSV dorsali pedis value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a strong correlation strength ($r=-0.720$) and in a negative direction. Furthermore, there is a correlation between the posterior tibial PSV value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a moderate correlation strength ($r=-0.530$) and a negative direction. **Conclusion:** There is a correlation between the popliteal, tibialis posterior, dorsalis pedis PSV value and the Wagner score in diabetic foot ulcer patient.

1. Introduction

Diabetic foot ulcers are one of the chronic complications of diabetes mellitus (DM) in the form of wounds on the skin surface of the feet of DM patients accompanied by internal tissue damage or tissue death, either with or without infection, which is associated with the presence of neuropathy and or peripheral arterial disease in patients with DM.[1]

The World Health Organization (WHO) states that at least 422 million people suffer from DM, the majority are in low and middle income countries, and 1.6 million deaths are directly related to DM every year.[2]

Indonesia is included in the top 10 countries that

have a high prevalence of DM and tends to increase from year to year. The results of the 2018 Basic Health Research (Riskesdas) show that the prevalence of DM in Indonesia is 2% according to a doctor's diagnosis at the age of 15 years. This figure shows an increase compared to the 1.5% prevalence of diabetes in the population aged 15 years in the 2013 Riskesdas results. However, the prevalence of DM based on the results of blood glucose tests increased from 6.9% in 2013 to 8.5% in 2018. This figure shows that only about 25% of DM patients know that they have DM.[3]

Diabetic foot ulcers that are chronic and difficult to heal are the most common cause of non-traumatic amputation (lower leg amputation (ALL) in DM patients, reaching 82%. Observational research on 94 DM patients at Dr. Kariadi Hospital Semarang found that the incidence of lower extremity amputation increased in diabetic foot ulcers by 31.9%. lower extremity.[4]

Wagner classification, this classification system has been developed since 1970 where there are 6 grades to determine the degree of ulcers in diabetic feet. Grades 0.1, 2 and 3 are based on the depth of the wound and soft tissue involvement in the foot, while grades 4 and 5 are based on the presence or absence of gangrene. This classification has been widely used to date.[5]

A new alternative parameter for assessing the degree of peripheral ischemia is ankle peak systolic velocity (PSV). The rationale for PSV is based on the observation that in the ischemic limb, blood travels at a much slower rate in the distal leg arteries than in the nonischemic limb. PSV is a quick and easy test to assess the patient's vascular status and monitor the development of diabetic foot ulcers, and can assess the degree of ischemia and predict healing of diabetic foot ulcers.[6]

Research by Bishara et al showed that PSV has a high level of accuracy in predicting the non-healing of diabetic foot ulcers.[7] Several studies have stated that the pulse wave handheld Doppler value in diabetic foot ulcer patients has a correlation with the ABI value[8], the PSV value has a correlation with the patient's ABI value. Peripheral arterial disease (PAD) with type 2 DM.[9]

2. Methods

This research is analytic observational with cross sectional design, the research uses primary data. This research will be conducted at the RSUP Dr. M. Djamil Padang from July 2021 to October 2021. The population in this study were diabetic foot ulcer patients who came for treatment at Dr. M. Djamil Padang.

Univariate analysis was conducted to describe each of the variables studied. Numerical data is normally distributed, then it is presented in the form of mean ± standard deviation (SD), whereas if the numerical data is not normally distributed then it is presented in the form of median, minimum and maximum. Categorical data is presented in the form of frequency and percentage of each category.

Bivariate analysis was started by using the data normality test using the Shapiro Wilk test (n<50). In testing the correlation between Peak Systolic Velocity and Wagner Score in diabetic foot ulcer patients, the Pearson correlation test is used if the data is normally distributed and the Spearman correlation test is used if the data is not normally distributed.

The test was carried out with 95% confidence interval (CI) and = 0.05. The conclusion from the test results is that if the p value 0.05 then H0 is rejected, meaning that there is a correlation between the Peak Systolic Velocity value and the Wagner Score in diabetic foot ulcer patients. All data analysis using SPSS program.

3. Results

The normality test in this study used the Sapiro Wilk normality test to determine whether the data distribution was normal or not. The results of the data normality test can be seen in table 1

Based on table 1, it is known that the Wagner score and PSV normality tests in diabetic foot ulcer patients were normally distributed with p > 0.05, so the analysis continued on parametric statistics.

The characteristics of the subjects in this study can be seen in table 2. Table 2 shows that more than half of the subjects (65.6%) are male. The mean age of the subjects was 60.46±10.06 years. More than half of the

subjects (62.5%) had a normal body mass index. The average length of suffering from diabetes mellitus was 5.48 ± 2.26 years. Half had a history of smoking (59.4%), a small proportion of subjects had hypertension (21.9%), hypercholesterolemia (6.3%) and neuropathy (12.5%). More than half of the subjects (53.1%) had immunopathies.

Wagner score in diabetic foot ulcer patients and PSV values can be seen as table 3 below. Wagner score mean is 3.38±0.97. the popliteal PSV value was 54.47±9.94, the dorsali pedis PSV was 31.70±12.18 and the posterior tibial PSV was 32.69±12.13.

Table 4 shows that there is a correlation between the popliteal PSV value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a moderate correlation strength ($r=-0.463$) and a negative direction. There is a correlation between the PSV dorsali pedis value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a strong correlation strength ($r=-0.720$) and in a negative direction. Furthermore, there is a correlation between the posterior tibial PSV value and the Wagner score in diabetic ulcer patients ($p<0.05$), with a moderate correlation strength ($r=-0.530$) and a negative direction.

Table 1. Normality test

Variabel	Mean±SD	p-value
Wagner score	3,38±0,97	0,056*
PSV *poplitea*	54,47±9,94	0,322*
PSV *dorsalis pedis*	31,70±12,18	0,908*
PSV *tibialis posterior*	32,69±12,13	0,670*

p>0,05 normally distributed

Table 2. Characteristic subjects of the study

Variabel	f (%)	Mean±SD
Gender		
Male	21 (65,6)	
Female	11 (34,4)	
Aged		60,46±10,06
Body Mass Index		
Underweight	5 (15,6)	
Normal	20 (62,5)	
Overweight	5 (15,6)	
Obese	2 (6,3)	
Length of suffering DM		5,48±2,26
Smoking	19 (59,4)	
Hipertention	7 (21,9)	
Hyperkolesterole	2 (6,3)	
Neuropathy	4 (12,5)	
Imunopathy	17 (53,1)	

Table 3. Wagner score in diabetic foot ulcer patients and PSV value

Variabel	Mean±SD
Wagner score	3,38±0,97
PSV poplitea	54,47±9,94
PSV dorsali pedis	31,70±12,18
PSV tibialis posterior	32,69±12,13

Table 4. Correlation of PSV value with Wagner score in diabetic foot ulcer patients

PSV		R	p-value
PSV poplitea	**Nilai *wagner score***	-0,463	0,002*
PSV dorsali pedis		-0,720	<0,001*
PSV tibialis posterior		-0,530	<0,001*

From this study, there are 2 factors that are assumed to be confounding factors, for that a test will be carried out on these 2 factors. Based on table 5, it is known that the neuropathy and immunopathy variables based on analysis using Levene's test for equality of variances were not proven as confounding factors in the study (p> 0.05).

Table 5. confounding factor analytic

Confounding factor	p-value (*Levene's test for equality of variances*)
Neuropaty	0,384*
Immunopathy	0,309*

p>0,05 not proven as *confounding factor*

4. Discussion

This research was conducted in the period from July 2021 to September 2021. There were 32 cases of diabetic foot ulcers in the Surgery Department of Dr. RSUP. M. Djamil Padang. From this amount, it was found that there were more men than women as much as 65.6%. These data are in accordance with the literature reference which states that the male sex has a high risk factor for diabetic foot ulcers. Another epidemiological study of diabetic foot ulcers by Bishara et al[7] also showed that the incidence of diabetic foot ulcers was highest in men with a ratio of 2:1. This is not in line with the study by Kristendi [10] Manado which reported that there were more women than men.

The results of this study found that the incidence of diabetic foot ulcers was the most common in the age group with a mean of 60.46 years (Table 2). This is in line with research by Zaine et al[11] and Limpeleh et al[12] who reported that the incidence of diabetic foot ulcers occurred in the 6th decade. Elderly patients usually have limited movement, reduced visual acuity and other disease problems so that the incidence of diabetic foot ulcers is at high risk for elderly patients.

BMI in this study obtained an average BMI of normal (62.5%), Pham et al through their research showed that diabetic foot ulcers are often associated with obesity. Meanwhile, Syauta et al[13] stated that the BMI ratio did not have a significant relationship with the prevalence of diabetic foot ulcers. As few data are available regarding the significance of obesity in causing foot ulceration, it can therefore be considered as one of the risks associated with the given problem.

The average duration of DM in this study was 5.54 years. In another study, it was found that from one hundred DM patients with diabetic foot ulcers, it was found that 58% were DM patients who had suffered from DM for more than 10 years. The results of the regression analysis for all outpatients at the Veterans Affairs Internal Medicine Clinic, Washington concluded that the mean duration of diabetic ulcer DM patients was 11.40 years with an RR of 1.18 (95% CI).[14] The difference between the results of this study and other studies is estimated due to lack of patient awareness in conducting initial screening for the incidence of DM. Patients in Indonesia tend to seek medical help only when their condition has worsened.

This study found comorbidities such as smoking (59.4%), hypertension (21.9%), and hypercholesterolemia (6.3%). Research by Rizk et al showed the incidence of comorbidities in diabetic foot ulcer patients respectively as follows; smoking 51.25%, hypertension 43.7% and hypercholesterole 32.5%. [15]

Prior to the bivariate test, the normality test was carried out in this study using the Sapiro Wilk

normality test to determine whether the data distribution was normal or not. Based on table 1, it is known that the normality test of the Wagner score and PSV values in diabetic foot ulcer patients is normally distributed with p> 0.05, so the analysis continues on parametric statistics.

Table 4 shows that there is a correlation between the popliteal PSV value and the Wagner score in diabetic ulcer patients (p<0.05), with a moderate correlation strength (r=-0.463) and a negative direction. There is a correlation between the PSV dorsalis pedis value and the Wagner score in diabetic ulcer patients (p<0.05), with a strong correlation strength (r=-0.720) and in a negative direction. Furthermore, there is a correlation between the posterior tibial PSV value and the Wagner score in diabetic ulcer patients (p<0.05), with a moderate correlation strength (r=-0.530) and a negative direction. It can be concluded that the abnormal PSV score tends to have a higher Wagner score. This study is in line with the research conducted by Johannes where there is a significant relationship of the PSV value to diabetic foot ulcers.[8]

Diabetic foot ulcers occur through three mechanisms, namely immunopathy, angiopathy and neuropathy. Ulcers can occur as a result of one or all of the three mechanisms. From this study, there are 2 factors that are assumed to be confounding factors, namely neuropathy and immunopathy. This study was tested on these two factors with Levene's test for equality of variances. Based on table 5, it is known that neuropathy and immunopathies based on analysis using Levene's test for equality of variances were not proven as confounding factors in this study (p> 0.05).

5. Conclusion

There is a correlation between the popliteal PSV value and the Wagner score in diabetic ulcer patients (p<0.05), with a moderate correlation strength (r=-0.463) and a negative direction. There is a correlation between the PSV dorsalis pedis value and the Wagner score in diabetic ulcer patients (p<0.05), with a strong correlation strength (r=-0.720) and in a negative direction. There is a correlation between the posterior tibial PSV value and the Wagner score in diabetic ulcer

patients (p<0.05), with a moderate correlation strength (r=-0.530) and a negative direction.

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