Correlation of Ankle Brachial Index (ABI) with Degrees of Diabetic Ulcer

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ABSTRACT

Background: Foot ulcer is a common complication of Diabetic Mellitus (DM) that has high morbidity and mortality rate and associated with prolonged treatment conditions and increased risk of surgery and amputation. Peripheral arterial disease (PAD) can cause intermittent claudication for the occurrence of foot ulcers in DM. The Ankle Brachial Index (ABI) value can be used as an initial diagnosis for PAD. This study aims to examine the values of ABI in patients with a diabetic foot ulcer and its correlation to diabetic ulcer based on Wagner’s classification.

Method: The study design was cross-sectional, from April to June 2018. Demographic, clinical and anthropometric data of diabetic ulcer patients who were hospitalized or outpatient at Wahidin Sudirohusodo Makassar Hospital were recorded for 41 patients. The degree of injury is assessed based on Wagner’s criteria, ABI examination is performed, and blood sugar checks are performed using blood sugar check strips. Data analyzed using the Spearman’s Correlation and Chi-Square test.

Results: Subject ABI levels were between 0.85-1.33 with mean of 1.14. Clinical examination results showed 18 (43.9%) subjects had normal, and 18 (43.9%) had mild ABI and only 5 (12.2%) subjects with moderate degrees. There is a correlation between ABI and Wagner classification, even though the statistical test results showed no significance (p>0.08). Percentage of subjects with Wagner III, IV and V was high in mild ABI (i.e. 40.0%, 40.0% and 20.0%), while the percentage of subjects with Wagner I and II were found to be high in normal ABI (27.8% each).

Conclusion: There was a correlation between ABI and Wagner’s classification, that the lower of ABI value, the higher the degree of Wagner’s classification but statistically insignificant.

KEYWORDS Diabetes Mellitus, Ankle Brachial Index, neuropathy, angiopathy, Wagner classification

Introduction

A diabetic ulcer is a macrovascular complication that has fairly high morbidity and mortality rate. The risk of getting foot infections in Diabetic Mellitus (DM) patients is reported to be 1.21 compared to non-DM. Clinical data reports the prevalence of diabetic foot ulcers that occur in people with DM varies between 10-25%. Jeffcoate et al., in 2006, reported infection with diabetic foot infections of 16.7. In RSUPN Dr. CiptoMangunkusumo reported death and amputation rates of 16% and 25% in 2003. A total of 14.3% died within a year after amputation, and as many as 37% died within 3 years after amputation.[1,2,3] Some researchers have also reported the presence of risk factors for DM patients who aggravate and are closely associated with the occurrence of diabetic ulcers such as age, duration of DM, obesity, smoking, poor glucose control, dyslipidemia, and hypertension.[4,5]

Diabetic foot infection and its complications are associated
with prolonged treatment conditions and an increased risk of surgery and amputation. Generally, infections that only begin with a small wound can develop into an infection involving soft tissue, joints or bones if not treated properly. The National Health Interview Survey reports that patients with diabetic ulcers are having more risk of amputation than non-diabetics. As many as 70-85% of patients with diabetic ulcers are reported to need lower limb amputations. Trautner et al., in Germany reported that amputation in diabetic foot ulcer patients was 76% compared to only 24% in non-diabetic ulcers.[6,7]

The Peripheral Artery Disease (PAD) causes infections in the diabetic foot. Anatomic changes reduce the elasticity of capillary walls and interfere with the ability for vasodilation.

Ankle-Brachial Index (ABI) is the ratio of systolic blood pressure at the ankle and the wrist. This examination is measured with the patient in the supine position using a vascular doppler and sphygmomanometer. ABI examination aims to assess circulation function in the leg arteries.[8,9,10]

The ABI value has a specificity of 83.33-99.0%, and high accuracy (72.1-89.2%) indicates that a patient’s patient has enabled stenosis. In populations aged between 40-75 years old with at least one vascular risk factor (such as diabetes, dyslipidemia, hypertension, and smoking), ABI values can be used as an initial diagnosis for PAD.[10]

Methods

The study design was cross-sectional. This research was conducted at Wahidin Sudirohulosodo Hospital, Makassar. The time of the study is from April to June 2018 with the sampling technique that is purposive sampling. The subjects of the study were inpatient or outpatient diabetic foot ulcer patients who met the inclusion criteria, those included in the exclusion criteria were severe foot oedema which can interfere the Ankle Brachial Index (ABI) examination. The degree of injury was assessed based on Wagner’s criteria, the ABI examination, and blood sugar that examined using the blood sugar examination strip. Ankle-brachial index (ABI) was measured with patients in supine positions using a vascular doppler and sphygmomanometer. Systolic pressure is measured on both arms of the brachial artery and on the posterior tibialis artery and dorsal pedis at both limbs. Data processing includes data collection and data tabulation. The collected data is processed using the Microsoft Excel program and the SPSS program, which then presented in a descriptive table format. This research was approved by the ethics committee of the University of Hasanuddin, Makassar, Indonesia, Number: 855/H4.8.4.5.31/PP36-KOMETIK/2018.

Results

Data collected from 41 subjects, fulfilling the inclusion and exclusion criteria of the study.

A. Sample Characteristics

The samples studied were 41 DM patients with diabetic feet. Subject age between 21-79 years old with an average of 57 years old. Subject ABI levels were between 0.85-1.33 with an average of 1.14, as shown in Table 1. According to table 2, most of the subjects were male (61.0%), aged between 50-69 years (68.2%), Wagner class II degree (22.0%). Clinical examination results showed most subjects had normal and mild ABI (43.9% each) and only 5 subjects with moderate degrees (12.2%).

B. Correlation between ABI and Wagner Classification

The results of the correlation analysis using the Spearman’s Correlation test as shown in figure 1, indicate a correlation tendency between ABI and Wagner classification, the lower the ABI value, the higher the Wagner classification degree, even though the statistical test results showed no significance (p>0.05).
Ankle-brachial index (ABI) is the ratio of systolic blood pressure to the ankle with the arm. This examination is measured by the patient in the supine position using a vascular doppler and sphygmonanometer. Systolic pressure is measured on both arms of the brachial artery and in the posterior tibialis artery and dorsum pedis in the respective limbs. ABI examination aims to assess circulation function in the leg arteries. An ABI examination is recommended by the American Heart Association (AHA) to find out the process of atherosclerosis, especially in people at risk of vascular disorders aged 40-75 years.[8,9,10] The ABI value has a specificity of 83.33-99.0%, and high accuracy (72.1-89.2%) indicates that a patient’s patient has enabled stenosis. In populations aged between 40-75 years with at least one vascular risk factor and sphygmonanometer. Systolic pressure is measured on both arms of the brachial artery and in the posterior tibialis artery and dorsum pedis in the respective limbs. ABI examination aims to assess circulation function in the leg arteries. An ABI examination is recommended by the American Heart Association (AHA) to find out the process of atherosclerosis, especially in people at risk of vascular disorders aged 40-75 years.[8,9,10] The ABI value has a specificity of 83.33-99.0%, and high accuracy (72.1-89.2%) indicates that a patient’s patient has enabled stenosis. In populations aged between 40-75 years with at least one vascular risk factor (such as diabetes, dyslipidemia, hypertension, and smoking), ABI values can be used as an initial diagnosis for PAD[17]. PAD occurs due to a long-lasting process of atherosclerosis, which can be accelerated due to various metabolic disorders such as hyperglycemia, hypertension, dyslipidemia, increased coagulation factors especially in people with diabetes mellitus.[10]

There is a correlation between the value of ABI, and the incidence of diabetic foot ulcer, one of the causes of foot ulcers formation in patients with DM is the presence of vascular abnormalities which is of peripheral blood vessel occlusion in the lower extremities. Hyperglycemia that occurs due to excess carbohydrate input, reduced use of glucose in the tissues, increased glucose production, insulin defects which occur in long-duration will initiate various forms of abnormalities such as neuropathy and peripheral arterial disease (PAD).

In this study, there was a correlation between ABI values and diabetic ulcer degrees based on Wagner’s classification although the results of the chi-square test were not significant, possibly due to other factors that could affect the patient’s condition when measuring ABI (limb oedema), or a lesser number of samples. The normal ABI value obtained in diabetic foot ulcer patients also shows that the vascular condition is still in good condition, where the occurrence of foot ulceration may be caused by another factor such as neuropathy and infection without PAD.

The weakness of this study is that this study uses a cross-sectional research design that it is difficult to establish a causal mechanism because the measurement of risk factors and effects is carried out at the same time. Therefore the level of trust is still under other studies conducted using research design case-control or cohort.

Conclusion

The results of ABI examination in diabetic foot ulcer patients, most subjects had normal and mild ABI with the results of correlation analysis using the Spearman’s Correlation test showing a correlation between ABI and Wagner classification, where the lower the ABI value, the higher the Wagner classification degree.

Suggestions

Further research is needed with more and diverse samples, better research methods, and includes other factors that affect the degree of diabetic foot ulcers.

Competing Interests

No conflict of Interest.

Ethical approval

Ethical clearance Hasanuddin University.

Funding

None

References


Table 3: Correlation between ABI and Wagner Classification.

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Chi Square test (p=0.441)


