# Risk Factors Related Amputation on Diabetic Foot Patients in Dr. M. Djamil General Hospital Padang

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**A B S T R A C T**

**Backgrounds.** Diabetic foot is the most common cause of nontraumatic lower-extremity amputation. This study aims to assess the relationship of risk factors with the incidence of amputation in diabetic foot patients based on the Wagner classification at Dr. M. Djamil General Hospital Padang. **Methods:** The study design is an analytic observational study with a cross-sectional approach. A total of 46 diabetes mellitus patients with diabetic foot complications participated in this study. The risk factors assessed were gender, age, smoking status, hypertension, uncontrolled blood sugar, hypoalbumin, peripheral arterial disease, infection, and peripheral neuropathy. The assessment of the degree of diabetic foot complications was carried out using the Wagner classification. **Results:** The most age group for diabetic foot sufferers is the age group of 41-60 years, which is 57.7% with the male sex being more dominant (59.6%) than the female gender. In the subject, there were more patients with the Wagner 4 classification (32.7%) than the other classification levels. Based on direct observation of patients, it was found that 53.8% of diabetic foot patients were amputated. Based on the results of the analysis, it was found that PAD (peripheral arterial disease) and peripheral neuropathy are variables that significantly affect amputation. **Conclusion**: Peripheral neuropathy and peripheral arterial disease are associated with amputation and peripheral arterial disease is a major risk factor for amputation in diabetic foot patients based on the Wagner classification.

## 1. Introduction

Diabetes mellitus (DM) is a degenerative disease with an increasing number of cases until now.[1] DM patients have hyperglycemia caused by defects in insulin secretion, impaired insulin action, or both.[2] Based on data from the World Health Organization (WHO), there were 120 million people with DM in the world in 1996 which is estimated to double by 2025. This increase is caused by increasing age, being overweight (obesity), and lifestyle.[1] Chronic hyperglycemia in DM patients is associated with long-term damage, dysfunction, and failure of various organs, such as the eyes, kidneys, nerves, heart, and blood vessels. Long-term complications of DM include retinopathy with risk for vision loss, nephropathy leading to kidney failure, peripheral neuropathy with risk for diabetic ulcers, amputation, Charcot joints, and autonomic neuropathy.[2] In developing countries, the prevalence of diabetic foot is much greater than in developed countries, namely 2-4%, this high prevalence is caused by a lack of knowledge of the patient about the disease, the lack of attention from doctors to these complications and the complexity of the current

examination methods to detect the disorder accurately. early. Management of diabetic foot includes blood sugar control, tissue debridement, administration of antibiotics, vascular drugs, and amputation.[1]

Diabetic foot is the most common cause of non-traumatic lower-extremity amputations. Most complications of diabetic foot result in amputation which begins with the formation of an ulcer in the skin. The risk of lower extremity amputation is 15-46 times higher in people with diabetes than in people without diabetes. In addition, diabetic foot is the most common reason for hospitalization in DM patients, accounting for approximately 25% of DM referrals in the United States and the United Kingdom.[1] The classification system is very helpful in the course of treatment. Classification is also useful in the standardization and analysis of multicenter research. Classification is useful for analyzing infection, neuropathy, vasculopathy, and extent (surface and depth) of ulcers. In addition, the classification system also helps in predicting *outcomes*.[3] best known and widely available classifications are the Wagner, Gibbon, Frykberg and Coleman Forrest, Knighton, Texas classification, and the Ten-Level Seattle classification.[4] Each of these classifications was developed to achieve a specific goal, using different criteria, and categorizing lesions according to different reasons. Only a few of these classifications are used to assess the prognosis in the management of diabetic ulcers or vascular damage in DM. [5,6] The Wagner classification is better known and most frequently used. The classification system is based on three characteristics, namely the depth of the ulcer, the degree of infection, and the presence or absence of gangrene and expansion. Grades 1 to 3 is mainly based on neuropathy, whereas 4 and 5 represent ischemic lesions. The scoring system was adapted in 1988 by Calhoun et al to incorporate medical and surgical elements in therapy for monitoring the treatment of diabetic foot infections.[7,8]

A study stated that the highest amputation rate occurred in patients with Wagner grades 3-5 with the proportions 35.5%, 31.9%, and 16.3%, respectively. In contrast to other studies that get a higher proportion of the amputation rate at Wagner grade 5, which is 78.9%

of the sample.[9-11] A study found that older people and males are more likely to have an amputation. For every 10 years of age increase, there is also an 11% increase in the risk of amputation, while the male gender increases the risk of amputation by 3.5 times. Other studies have shown that increased BMI, uncontrolled blood sugar, hypertension, peripheral neuropathy, peripheral vascular disease/gangrene, and infection are associated with amputation in patients with hypertension and hyperglycemia.[12-14] This study aims to assess the relationship of risk factors with the incidence of amputation in diabetic foot patients based on the Wagner classification at Dr. M. Djamil General Hospital Padang.

## 2. Methods

The study design was an analytical observational study with a cross-sectional approach to assessing the association of risk factors with the incidence of amputation in diabetic foot patients based on the Wagner classification at Dr. M. Djamil General Hospital Padang. A total of 46 diabetes mellitus patients with diabetic foot complications participated in this study. The inclusion criteria are patients diagnosed with diabetic foot who seek treatment at Dr. M. Djamil General Hospital Padang and patients who have complete and clear basic data, physical examination, supporting examination, and therapy. The risk factors assessed were gender, age, smoking status, hypertension, uncontrolled blood sugar, hypoalbumin, peripheral arterial disease, infection, and peripheral neuropathy. The assessment of the degree of complications of diabetic foot was carried out using the Wagner classification.

Data analysis was performed with the help of SPSS version 25 software. Univariate analysis was performed to present the frequency distribution of each test variable. Bivariate analysis to see the relationship between the dependent and independent variables with the chi-square test. Then proceed with multivariate analysis.

## 3. Results

Table 1 shows that the most age group of diabetic foot sufferers is the age group of 41-60 years, which is 57.7% with the male sex being more dominant (59.6%) than the female gender. In the subject, there were more patients with the Wagner 4 classification (32.7%) than the other classification levels. From the medical records of the patients, 71.2% of the subjects were smokers. Most (69.2%) subjects did not suffer from hypertension. Blood sugar in most of the patients (63.5%) was found to be uncontrolled. On examination of albumin levels, it was found that more patients had hypoalbuminemia (78.8%). When collecting peripheral arterial disease (PAD) data, most of the patients (59.6%) had PAD. For information regarding infection, as many as 88.5% of patients were documented to have an infection. Data collection regarding peripheral neuropathy showed that most (63.5%) patients had peripheral neuropathy. Generally, study subjects had complications of the diabetic foot on the right foot and only one subject had bilateral diabetic foot complications. Based on direct observation of patients, it was found that 53.8% of diabetic foot patients were amputated.

Table 1. Characteristics of diabetic foot patients at Dr. M. Djamil General Hospital Padang

| Characteristics | N | % |
|---|---|---|
| **Age** | | |
| 20-40 | 7 | 13.5 |
| 41-60 | 30 | 57.7 |
| >60 | 15 | 28.8 |
| **Gender** | | |
| Male | 31 | 59.6 |
| Female | 21 | 40.4 |
| **Wagner Classification** | | |
| Wagner 1 | 9 | 17.3 |
| Wagner 2 | 4 | 7.7 |
| Wagner 3 | 12 | 23.1 |
| Wagner 4 | 17 | 32.7 |
| Wagner 5 | 10 | 19.2 |
| **Smoking Status** | | |
| Non-Smoker | 15 | 28.8 |
| Smoker | 37 | 71.2 |
| **Hypertension** | | |
| No | 36 | 69.2 |
| Yes | 16 | 30.8 |
| **Uncontrolled Blood Sugar** | | |
| No | 19 | 36.5 |
| Yes | 33 | 63.5 |
| **Hypoalbumin** | | |
| No | 11 | 21.2 |
| Yes | 41 | 78.8 |
| **Peripheral Arterial Disease (PAD)** | | |
| No | 21 | 40.4 |
| Yes | 31 | 59.6 |
| **Infection** | | |
| No | 6 | 11.5 |
| Yes | 46 | 88.5 |
| **Peripheral Neuropathy** | | |
| No | 19 | 36.5 |
| Yes | 33 | 63.5 |
| ***Outcome*** | | |
| No Amputation | 24 | 46.2 |
| Amputation | 28 | 53.8 |
| **Total** | 52 | 100 |

In Table 2, each variable and it is found that PAD (disease peripheral arteries) and peripheral neuropathy variables were significantly affecting amputation with p-values as follows: 0.000 and 0.006, respectively. Age, gender, smoking status, hypertension, uncontrolled blood sugar, and hypoalbumin were not associated with the incidence of amputation in diabetic foot patients.

Table 2. The relationship of independent variables with amputation in patients with diabetes foot classification Wagner at Dr. M. Djamil General Hospital Padang

| Variable | Outcome | | Total | OR (95 % CI) | *P-Value |
| | No amputation n(%) | Amputation n(%) | | | |
| --- | --- | --- | --- | --- | --- |
| **Age** | | | | - | 0.064 |
| 20-40(Young Adults) | 6(11,5) | 1(1.9) | 7(13,5) | | |
| 41-60(Old Adults) | 13(25) | 17(32,7) | 30(57,7) | | |
| >60(Elderly) | 5(9,6) | 10(19,2) | 15(28,8) | | |
| **Gender** | | | | 2,429 (0.769-7.673) | 0.214 |
| Male | 17(32.7) | 14(26.9) | 31(59.6) | | |
| Female | 7(13.5) | 14(26.9) | 21(40, 4) | | |
| **Smoking status** | | | | 1.5 (0.45-5.0) | 0.723 |
| Non-Smoker | 8(15.4) | 7(13.5) | 15(28.8) | | |
| Smoker | 16(30.8) | 21(40.4) | 37(71,2) | | |
| **Hypertension** | | | | 1,150 (0.352-3,762) | 1,000 |
| No | 17(32,7) | 19(36,5) | 36(69,2) | | |
| Yes | 7(13,5) | 9(17,3) | 16(30, 8) | | |
| **Blood sugar** | | | | 0.926(0.299-2.871) | 1,000 |
| Controlled | 9(17.3) | 1019.2) | 1936.5) | | |
| Uncontrolled | 15(28,8) | 18(34,6) | 33(63,5) | | |
| **Hypoalbumin** | | | | 0.357(0.083 -1.540) | 0.283 |
| No | 3(5.8) | 8(15.4) | 11(21.2) | | |
| Yes | 21(40.4) | 20(38.5) | 41(78.8) | | |
| **Infections** | | | | 1.19 (0.217-6.531) | 1,000 |
| No | 3(5,8) | 3(5,8) | 6(11,5) | | |
| Yes | 21(40,4) | 25(48,1) | 46(88,5) | | |
| **Peripheral Arterial Disease (PAD)** | | | | 135 (13,99 – 1301,91) | 0.000 |
| No | 20(38,5) | 1(4,8) | 21(40,4) | | |
| Yes | 4(7,7) | 27(51,9) | 3159,6) | | |
| **Peripheral neuropathy** | | | | 6.44 (1.822-22.76) | 0.006 |
| No | 14(26.9) | 5(9.6) | 19(36.5) | | |
| Yes | 10(30.3) | 23(69.7) | 33(63.5) | | |

* Chi-Square Test, p<0.05

It was previously mentioned that PAD and peripheral neuropathy were significant variables (p<0.05) based on the Chi-square test. After multivariate analysis, it was found that peripheral arterial disease (PAD) had an OR of 234,015 with 95% CI 14.7-3710.13 and peripheral neuropathy had an OR of 14,895 with 95% CI 1.3-162.5 so that it can be concluded that PAD is a factor dominant risk of amputation in diabetic foot patients.

Table 3. Multivariate analysis of risk factors for amputation in diabetic foot patients based on the Wagner classification at Dr. M. Djamil General Hospital Padang

| No. | Variable | B | Wald Test | *p-value | Adjusted OR | 95% CI | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower | Upper |
| 1. | Peripheral Arterial Disease | 5,455 | 14,971 | 0,000 | 234,015 | 14,760 | 3710,130 |
| 2. | Peripheral Neuropathy | 2,701 | 4,908 | 0,027 | 14,895 | 1,365 | 162,506 |

*Multivariate logistic regression, p <0.05

## 4. Discussion

Two significant risk factors associated with the incidence of amputation in diabetic foot patients are peripheral neuropathy and PAD. This is following the study which found that arterial disease and neuropathy were specific factors of limb for amputation. A study also found the same thing where peripheral neuropathy was associated with the incidence of amputation in diabetic foot patients. This is caused by repeated trauma that can be caused by conditions that are not realized, causing pre-existing wounds to the feet that do not heal which end in worsening of the diabetic foot and result in amputation being performed to save healthy tissue.[15-19]

Another study found patients with an ABI <4 or severe ischemia at risk for amputation. However, according to another study, the isolated peripheral arterial occlusive disease was responsible in only 15% of cases, whereas, in 35% of diabetic feet, foot ulceration developed as a combination of neuropathy and angiopathy. Another study found medial artery sclerosis was associated with a two-fold higher risk of developing ulcers and a three-fold higher risk of amputation.[20-23] PAD is one of the multifactorial causes of diabetic foot. The presence of PAD alters the body's normal response to foot ulcers and causes the ulcer does not heal due to decreased blood supply to the ulcer area. PAD causes the development of infection, increases tissue damage, and decreases delivery of oxygen, nutrients, and antibiotics. All of these factors further contribute to the potential for amputation of the leg.[24-25]

## 5. Conclusion

Peripheral neuropathy and peripheral arterial disease are associated with amputation and peripheral arterial disease is a major risk factor for amputation in diabetic foot patients according to the Wagner classification.

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