Prevalence of peripheral artery disease in patients with infectious diabetic foot ulcer in Imam Reza Hospital in Kermanshah during 2019–2020

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Abstract:

BACKGROUND: Diabetes mellitus (DM) is one of the main public health troubles diabetic foot ulcer (DFU) is one of the most important and relatively common causes of hospitalization. This study investigates the prevalence of peripheral artery disease (PAD) in Imam Reza Hospital of Kermanshah during 2017–2018.

MATERIALS AND METHODS: This study is descriptive-analytical. The study population was 196 cases with infectious DFUs admitted to Imam Reza Hospital of Kermanshah during 2019–2020. The presence or absence of PAD was assessed in these cases. The collected data were analyzed by SPSS software (version 18.0).

RESULTS: Among 196 patients studied, 120 (61.22%) patients had PAD. The prevalence of PAD was higher in men than in women and it was more common in Type 2 DM patients than in Type 1 DM patients. The majority of ulcers were located on the nonplantar surface of the foot. Moreover, the prevalence of PAD had a significant relationship by increasing the duration of diabetes (P = 0.041), history of amputation (P = 0.002), history of diabetic foot (P = 0.006), and peripheral neuropathy (P = 0.005).

CONCLUSION: A considerable number of diabetic patients with DFU had PAD. This necessitates more intense interventions to manage PAD as a strong risk factor for DFU in diabetics. Neurovascular assessment of diabetic patients and early diagnosis of PAD may be appropriate interventions to prevent development of DFUs. We recommend trial studies to find out the best methods to address early detection of PAD in diabetics.

Keywords:
Diabetes, diabetic foot ulcer, peripheral artery disease

Introduction

Diabetes mellitus (DM) is characterized by high levels of blood sugar and alternation in the metabolism of carbohydrate, fat and protein lead to dysfunction of eyes, kidneys, cardiovascular, and nervous system. Over the past decade, the incidence of diabetes has increased by about 6% annually and the world has faced an epidemic of diabetes.[1] The World Health Organization (WHO) predicts that by 2025, adults with diabetes will reach 300 million.[2] DM is the most common causes of chronic renal failure and amputation in which diabetic foot account for 70% of all limb amputations.[3] According to the WHO, a diabetic foot ulcer (DFU) has the potential for complications such as ulceration and wound infection as well as
vascular and neurological defects, is termed diabetic foot.\textsuperscript{14}

In modern countries, 20\% of health-care resources are an exclusively DFU. In developing countries, not only the problem is common but also treatment costs are even up to 40\% of the resources allocated to health.\textsuperscript{9} DFU affects about 25\% of patients throughout their lives and cost the health system about $28,000. The average hospitalization of these patients is 4 weeks in Iran in which 15\%–20\% requiring amputation. Risk factors for DFU include diabetes for more than 10 years, peripheral artery disease (PAD), peripheral neuropathy, dialysis, previous amputation, ulcer, poor blood sugar control, male gender, foot deformity, and visual impairment.\textsuperscript{6} DFU can present under the form of cellulite, myositis, abscess, necrotizing fasciitis, and osteomyelitis and eventually lead to lower extremity amputation. In half of the DFU, 18 months after amputation, the remaining limbs lead to an infectious lesion, and 3 to 5 years after the first amputation, 50\%–65\% of amputations occur in the other organs.\textsuperscript{7}

DFU evaluation requires careful examination of clinical histories, examinations, and procedures. Proper screening of diabetic patients has a significant role in preventing lesions and their treatment.\textsuperscript{8}

Clinical examinations are essential for an effective treatment plan. For all diabetic patients, physicians should be examined at least once a year by their physician, even if they do not complain of foot problems.\textsuperscript{9,10}

Obviously, in patients with DFU, these examinations should be done further, although there is no specific universal guideline. Imaging X-ray, vascular, and neurological examinations are also used as a contributor to aid in a more accurate diagnosis and evaluation of lesions. In diabetic patients, who have symptoms of DFU, a simple X-ray of the foot will help.\textsuperscript{11} If there is evidence of foot ischemia in the history or clinical examination, a noninvasive vascular examination is recommended. Nerve conduction velocity is not needed for most cases if careful clinical examination is performed. On the other hand, most patients with neuropathic wounds have severe sensory neuropathy that can be easily detected on clinical examination.\textsuperscript{12}

Rapid diagnosis and control of foot ulcer factors in diabetic patients are consequential. An annual examination of the lower extremities should be carried out on these clients. The evaluation of small and large arterial blood flow is performed by physical examination, vascular Doppler ultrasound, and oxygen pressure measurement.\textsuperscript{13} Controlling blood sugar and stopping smoking can slow the progression of vascular disease and neuropathy. Vasodilators such as calcium-channel blockers as well as aspirin and pentoxifylline are effective. Infected foot ulcer is one of the most common complications of diabetes that approximately 25\% of people develop it throughout their lives. PAD is present in more than half of diabetic foot patients.\textsuperscript{14} Therefore, with regards to the significance of the problem, identifying and treating PAD is a significant necessity in diabetic foot patients and is one of the most important strategies in reducing amputation.\textsuperscript{15} Therefore, the present study aimed to investigate prevalence of PAD in patients with infectious DFU in Imam Reza Hospital in Kermanshah during 2019–2020.

Materials and Methods

This study was a descriptive-analytical study. The study population was 196 patients with DFU presented to Imam Reza Hospital in Kermanshah during 2019–2020. All patients were recruited in the study with written agreement and were assessed by an international protocol that incorporated the diagnosis, treatment, and determination of vascular status. At first, a list was created that included variables such as age, sex, heart failure, end-stage renal disease, PAD, wound size, peripheral neuropathy, and type of diabetes, duration of diabetes, history of DFU, wound location, and amputation histories from the patients’ records. If the diagnosis of PAD was confirmed by arterial Doppler ultrasound, the patient underwent angiography and revascularization if necessary. Topical dressing and wound debridement were also performed. Diabetes control procedures were performed for all patients, and appropriate antibiotics were administered as well as vasodilators, such as calcium blockers and pentoxifylline have been recommended in the treatment of wound ischemia.

The collected data were entered into SPSS Statistics software (version 23.0, SPSS Inc., Chicago, IL, USA). Statistical analysis was performed. As most data were scored as categories, the data are expressed as frequencies. Comparisons between groups were made using the Chi-square ($\chi^2$ test); statistical significance was defined as a $P < 0.05$.

The study protocol was reviewed and verified by the Research Deputy of Kermanshah University of Medical Sciences (Code: 97263).

Results

The prevalence of peripheral artery disease

Our result demonstrated that between 196 clients, 120 cases (61.22\%) had PAD, which indicates there is a significant relationship between DFU and PAD ($P < 0.05$).
Sex and age and outcome

The prevalence of PAD in each group was evaluated, and the results were analyzed in SPSS software. Between 196 patients, 67 (34%) were female and 129 (66%) were male. According to the report, the prevalence of PAD in patients with DFU was higher in men than women, but there was no significant relationship between the variables. In addition, our study reveals that from 196 patients, 168 (85.71%) were over 45 years and 28 (14.2%) were between 25 and 45 year. According to the results, the prevalence of PAD was higher in the 55–65 ages than other groups and there was a significant relationship between the age of patients and prevalence of PAD ($P < 0.05$) [Figure 1].

Type and the duration of diabetes, site of ulcer and the duration of wound incidence and outcome

It was demonstrated that from 196 patients, 5 (2.55%) had Type 1 diabetes and 191 (97.45%) had Type 2 diabetes, respectively. There was a significant relationship between the prevalence of PAD and Type 2 diabetes ($P < 0.05$).

Furthermore, the prevalence of PAD according to the duration of diabetes (year) was studied separately. 62 cases had diabetes over 10 years and 41 cases had 5–10 years, and 17 cases had <5 years, respectively. There was a significant relationship between the variable and the prevalence of PAD ($P < 0.05$).

In this study, the locations of the wounds were divided into three sections: Plantar, nonplantar, and heel. The prevalence of PAD in each group was assessed separately. The prevalence of PAD was 68 in the plantar foot, 41 in the nonplantar foot, and 11 cases in the heel, respectively. The highest prevalence of PAD in DFU was in the heel and nonplantar area, but there was no significant relationship between the variables.

Moreover, the duration of wound incidence was divided into; <1 week, 1 week to 3 months, and more than 3 months. The prevalence of PAD was evaluated in each group separately. According to the results, the highest duration of ulcer in patients with PAD was between 1 week and 3 months with significant relationship between the variables ($P < 0.05$) [Table 1].

Wound size and outcome

In our study, 196 patients with DFU were divided into three groups based on the size of the wound and then the prevalence of PAD in each group was analyzed. None of the patient had below 1 cm, 66 cases had 1–5 cm, and more than 54 cases had 5 cm wound size. There was a significant difference between the wound size and PAD variables ($P < 0.05$).

Concurrent factors (peripheral neuropathy, history of diabetic foot ulcer, history of amputation, presence of heart failure, and chronic renal failure)

Our study demonstrated that from 196 patients, 139 cases (70.91%) had peripheral neuropathy, 110 (56.12%) had the history of DFU, 49 (25%) had the history of amputation, 47 (23.97) had the presence of heart failure and 43 (21.93%) had chronic renal failure. The history of amputation in DFU was the most important factor in the concurrent variables of PAD and there was a significant relationship between the variables ($P < 0.05$) [Table 2].

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Table 1: The prevalence of peripheral artery disease based on type and the duration of diabetes (year); wound location and the duration of wound incidence

| Variables                                      | PAD, prevalence (%) | $P$  |
|------------------------------------------------|---------------------|------|
|                                              | Negative            | Positive |
| Type of diabetes                              |                     |       |
| Type 1                                        | 4 (80)              | 1 (20) | 0.075 |
| Type 2                                        | 72 (37.7)           | 119 (62.3) |       |
| Sum                                           | 76 (38.78)          | 120 (61.22) |       |
| Duration of diabetes (years)                   |                     |       |
| <5                                            | 22 (56.4)           | 17 (43.6) | 0.041 |
| 5–10                                          | 21 (33.9)           | 41 (66.1) |       |
| >10                                           | 33 (34.7)           | 62 (65.3) |       |
| Sum                                           | 76 (38.78)          | 120 (61.22) |       |
| Wound location                                |                     |       |
| Plantar (not heel)                            | 35 (34)             | 68 (66.1) | 0.751 |
| Nonplantar                                    | 38 (48.1)           | 41 (51.9) |       |
| Heel                                          | 3 (21.42)           | 11 (78.57) |       |
| Sum                                           | 76 (38.78)          | 120 (61.22) |       |
| The duration of wound incidence               |                     |       |
| <1 week                                       | 8 (61.5)            | 5 (38.5) | 0.046 |
| 1 week to 3 months                            | 59 (35.8)           | 105 (64.2) |       |
| >3 months                                     | 9 (47.4)            | 10 (52.6) |       |

**Note:** PAD=Peripheral artery disease

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Figure 1: The prevalence of diabetic foot ulcer according to age

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Table 2: The prevalence of peripheral artery disease in patients with infectious diabetic foot ulcer

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Table 2: The distribution of PAD in patients with diabetic foot ulcer according to the desired variables

| Valuable                              | PAD, prevalence (%) | P    |
|--------------------------------------|---------------------|------|
|                                      | Negative            | Positive |
| The presence of chronic kidney failure | 16 (37.2)           | 27 (62.8) | 0.811 |
| History of DFU                        | 33 (30)             | 77 (70) | 0.006 |
| History of amputation                 | 10 (20.4)           | 39 (79.6) | 0.002 |
| The presence of heart failure         | 14 (29.8)           | 33 (70.2) | 0.147 |
| Peripheral neuropathy                | 44 (31.9)           | 95 (68.1) | 0.005 |

DFU=Diabetic foot ulcer, PAD=Peripheral artery disease

The outcome of each of the 196 ulcers was noted after a minimum follow-up, 40 patients 33.33% underwent angiography and revascularization procedure. Several factors prevented PAD patients from angiography included: High patient creatinine, drug sensitivity, as well as neuropathy in heel ulcer cases, and diffuse atherosclerosis in the lower extremity vessels.

**Discussion**

The aim of the present study was to assess the prevalence of DFU in Imam Reza hospital in Kermanshah. This study was performed on 196 patients with infectious DFUs. In our study, 120 cases (61.22%) had PAD, which indicates there is a significant relationship between DFU and PAD. In patients with DFU, the prevalence of PAD varies substantially between several studies; ranged from 10% to 60%. Previous studies have demonstrated the inhibitory effects of diabetes and the duration of diabetes may be as important as overall blood glucose control. In contrast, a study of diabetic patients attending hospital clinics reported an overall prevalence of 32% in Type 2 diabetic patient. Unfortunately, Hospital clinic-based studies may not reflect the true prevalence of lower-extremity complications in diabetic patients in the community and this is especially true of Type 2 diabetic patients. In contrast to Type 1 diabetic patients, a large proportion of Type 2 diabetic patients (50% of whom are aged over 65 years) are cared for in the community by their general practitioners.

Our overall prevalence rate of the wound area is similar to that observed in Prompers et al., which the ulcers are mainly based on heel and nonplanter area and are associated with more extensive tissue loss as they were also deeper and larger. Moreover, the duration of the wound had a significant effect on the prevalence of DFU. According to the results, the highest duration of ulcer in patients with PAD had a significant relationship with PAD (P < 0.05). Furthermore, 66 cases (57%) had 1–5 cm and more than 54 (43%) cases had 5 cm wound size with a significant difference between the wound size and PAD (P < 0.05).

In our study, among 196 patients, 49 (25%) had the history of amputation, 47 (23.97%) had the presence of heart failure and 43 (21.93%) chronic renal failure in the past with significant relationship between variables (P < 0.05). Al Kafrawy et al. revealed that 42% of patients had a history of previous amputation. In the present study, 70.91% of patients had neuropathy and there was a significant relationship between neuropathy and PAD. Forouzandeh et al. revealed that 23.9% of the patients had neuropathy whether Bakri et al. denoted that this percentage is 14.9%. Our finding was consistent with the results of above studies, and therefore, the presence of vasculopathy may be an important risk factor for predicting the need for amputation in diabetic patients.

According to Marie DFU, diabetes is the most common reason for hospitalization and is often the main cause...
of amputation.[17] In the present study, 51 (25%) patients had amputation and 40 (33.33%) angiography was performed. These results, reflecting the average patient with a DFU in Kermanshah, contain an important message: Many patients with DFUs are severely ill, and this is reflected by the severe underlying pathology and the presence of disabling comorbidity.[25,27,28] Follow-up data on these patients, could give us more insight into the implications of the severity of this disease for clinical outcome, resource utilization and quality of life. Fluorescence angiography is a safe, rapid, reproducible and time-effective minimally invasive procedure that provides objective data on the functional perfusion to a region of interest on the lower extremity and was done in 33.33% of patients and prevented from limb amputation. Results of this vascular assessment are valuable when data from other studies are limited.

Conclusion

In this study, all patients were evaluated by an infectious disease specialist and a specialist in the vascular surgeon, which is one of the strengths of this study. One of the limitations in this study is the lack of extensive native studies within this field to allow comparisons of study. Hence, further studies are recommended in the future, and it is recommended to increase the accuracy of study results with higher sample size, There are also several studies on the relationship between the pattern of peripheral arterial involvement and risk factors for DFU to reduce the deleterious effects of DFU in society and reduce the incidence of amputation. It is recommended that in future studies the role of education of diabetic patients by health-care providers regarding early recognition of neurovascular complications of DM be investigated.

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Conflicts of interest

There are no conflicts of interest.

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