Study to Determine the Complications and Treatment of Diabetic Foot Ulcer

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Diabetic foot ulcer is a solitary most costly and severe complication of diabetes mellitus. Foot ulcers are the after-effect of a combination of various causes, counting peripheral arterial disease and peripheral neuropathy. Patients with diabetic foot ulcers for the most part require lower limb amputation.

Objective: The purpose of this examination is to survey the outcomes and complications of diabetic foot ulcers in diabetic patients and to explore the impacts of certain hazard factors on ulcer healing.

Place and Duration: In the Orthopedic unit, Dow University Of Medical and Health Sciences, SMBBIT Karachi, for nearly a two-year duration from March 2018 to April 2020.

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**Methods:** This study was conducted on 120 patients. All patients with diabetes and DFU 18 to 90 of age were selected. 120 grown-up patients with DFUs were selected for the analysis. The diabetes duration and demographic data were recorded. Clinical proof of infection has been accounted for, as indicated by the American Association for Infectious Diseases. At that point debridement and careful treatment were begun to evacuate all the dead tissue. Follow-up was done week by week for two-year. SPSS 22 was utilized for data collection and statistical analysis. Data are introduced as a percentage and p < 0.05 was considered as the significance level. The Fisher’s test and χ2 test were utilized to test the variables relationship. Multivariate logistic regression analysis was utilized to change different variables when testing the impact of each risk factor on the outcome of DFU.

**Results:** A sum of 120 patients with diabetic foot ulcers were selected. 60% of patients had relieved ulcers, 8% still not resolved; In 27% of patients, minimum amputation, 7% more protuberant amputation, 2% repetitive ulcer and mortality rate was 1%. The investigation indicated that there is a measurably noteworthy connection between the foot ulcers healing with diabetes and the accompanying factors: HbA1c level, patients’ age, diabetes duration, diabetes complications (ulcer size and peripheral neuropathy).

**Conclusion:** The outcomes and complications of diabetic foot ulceration can be anticipated by a few factors, some of which can be changed. Changing compatible factors, for example, better diabetes control, peripheral neuropathy treatment and early treatment of ulcers can reduce complications and encourage healing of ulcers.

**Keywords:** Diabetic foot ulcers; complications; infection.

1. INTRODUCTION

Diabetes (DM) is a worldwide pestilence and diabetic foot ulcer (DFU) is one of the most costly and severe complications of diabetes and is one of the most widely recognized reasons for hospitalization of diabetic patients. DFU is chronic complex wounds that have a chief influence on mortality, morbidity, and personal satisfaction for patients [1-2]. After the skin layer is broken, deep tissue is presented to a quickly dynamic bacteria’s that's spreads fast. Patients with DFU regularly need amputations of the lower limb, and in the majority of cases, the most prevailing variable factor is infection. It has been accounted for that about 25% of individuals with diabetes will create DFUs through the span of their lives. Also, it is evaluated that the lower limb is amputated mostly at regular intervals because of diabetic complications [3-4]. Though 5% of diabetics create foot ulcers every year, and amputation is required in 1 %. In many patients, peripheral neuropathy, PAD, or both assume a key part in foot ulcers. An intensive appraisal of the consequence of foot ulcers requires delicate tissue wound assessment, palpation, and soft tissue probing of the foot at first and at follow-up of the patient. There have never been any past investigations clarifying the DFUs outcomes [5-6]. The point of this investigation is to assess the complications and outcomes treatment of DFU in diabetic patients and assess them by devoting them to the accompanying classes: persisting unhealed, healing, recurrence, major amputation, minor amputation, and mortality rate [7-8]. It likewise centers around the investigation of the impacts of certain hazard factors on the healing of the ulcer, for example, HbA1c patients’ age, diabetes duration, diabetes complications, for example, ulcer size and peripheral neuropathy [9]. We expect that the above hazard variables will influence DFU results. This investigation gives essential information for DFU analysis in Pakistan.

2. MATERIALS AND METHODS

This study was conducted in the orthopedic unit, Dow University of Medical and Health Sciences, SMBBIT Karachi, for a two-year duration from March 2018 to April 2020. All patients with diabetes and DFU 18 to 90yrs of age were selected. 120 grown-up patients with DFUs were selected for the analysis. The diabetes duration and demographic data were recorded. The finding of peripheral neuropathy depended on symptoms and side effects clinically, in addition to the loss of vibration perception evaluated by 128-Hz tuning fork on the dorsal aspect of the big toe and medial malleolus, foot insensitivity to 10-g Semmes-Weinstein monofilament, and ankle reflexes absent. The conclusion of ischemia in the feet by estimating the particular signs and symptoms (shiny and dry skin, brittle nails, no hairs on the affected side of the limb, and the dermis which is sensitive to cold. A score of 1-1.2

86
was viewed as standard. The outcome was considered abnormal if less than 0.9. In the research center, a blood test for hba1c was performed. Also, a clinical preliminary and the size of ulcers were estimated. Clinical proof of infection has been accounted for, as indicated by the American Association for Infectious Diseases (IDSA). At that point debridement and careful treatment were begun to evacuate all the dead tissue. Follow-up was done week by week for two-year and the outcomes were partitioned into one of the accompanying six classifications:

1. Healing was previously defined as unceasing, viable epithelium layer the complete open wound.
2. Permanent without healing, distinct as incomplete wound re-epithelialization.
3. Minor amputation (tarsal, metatarsal, or Lisfranc amputation) is defined as a limited amputation of the foot that does not affect walking ability.
4. Major amputation is defined as an amputation done above the ankle.
5. Relapse, defined as a new ulcer, most often occurs in the same foot.
6. Decease

SPSS version 22 was utilized for data collection and statistical analysis. Data are introduced as a percentage and p < 0.05 was considered as the significance level. The Fisher’s test and χ² test were utilized to test the variables relationship. Multivariate logistic regression analysis was utilized to change different variables when testing the impact of each risk factor on the outcome of DFU.

3. RESULTS

120 total patients were taken on the examination. 61 of them are men and 59 are females. The selectee's mean age was 53.6 ± 9.6 years. 61% of the members were obese or overweight. A large portion of them had type II diabetes mellitus. 26.66% were taking insulin in a mix with oral diabetes drugs or all alone. Just 17.5% of the reviewed populace smoked cigarettes (Table 1).

We separated members into 3 age groups: 25-45, 46-64, and ≥65 years old. Most patients (60.8%) in the age group of 46-64 have healed, while age group 65 had bad results, half had amputation of minor level, 36% had a significant amputation, mortality was 7% and recurrence was noted in 7% (p = 0.006). In terms of the relationship between diabetes duration and DFUs scores, 39 percent of individuals with a diabetes duration > 10 years improved compared to 100 percent of those with a span of 10 years (p = 0.0001). In terms of the relationship between HbA1c levels and DFU scores, individuals with HbA1c 7% had a 100% fix rate compared to those with HbA1c > 7%, who only had 53.6 percent ulcer healing (p = 0.007). Regarding the relationship between DFUs result and peripheral neuropathy, half of those with peripheral neuropathy cured their ulcers compared to those who did not have peripheral neuropathy (p = 0.03).

| Characteristic          | Subjects, n |
|-------------------------|-------------|
| Gender                  |             |
| Male                    | 61          |
| Female                  | 59          |
| BMI                     |             |
| Normal                  | 46          |
| Overweight              | 40          |
| Obese                   | 34          |
| Type of DM              |             |
| Type 1                  | 14          |
| Type 2                  | 106         |
| Treatment of DM         |             |
| Oral antidiabetic       | 40          |
| Insulin                 | 41          |
| Combined                | 32          |
| No treatment            | 7           |
| HbA1c                   |             |
| <7%                     | 24          |
| >7%                     | 96          |
| Infection (clinical)    |             |
| Present                 | 55          |
| Absent                  | 65          |
| Smoking                 |             |
| Current smoker          | 21          |
| Ex-smoker               | 47          |
| Nonsmoker               | 52          |

At last, while analyzing the connection between outcome and ulcer size of DFUs, 73% of cases with ulcers more prominent than 5 cm end up with a minor amputation. Surprisingly, Subjects with ulcers (<1 cm in distance across) had a healing rate of 100% (p = 0.001).

The proportion of ulcers healed by each variable is given in Table 2. One-way statistical significance was sustained using multiple logistic regression as given in Table 3. Age and duration of diabetes mellitus are the independent variables for dfu healings.
Table 2. Percentage of healed ulcers according to different variables

| Risk factor          | Groups     | Healed DFUs, % | p value |
|----------------------|------------|----------------|---------|
| Age                  | 25–45 years| 12             | 0.006   |
|                      | 46–64 years| 60.8           |         |
|                      | ≥65 years  | 0              |         |
| DM duration          | <5 years   | 12             | 0.0001  |
|                      | 5–10 years | 18             |         |
|                      | >10 years  | 51             |         |
| HbA1c                | ≥7%        | 12             | 0.007   |
|                      | >7%        | 65             |         |
| Peripheral neuropathy| Present    | 63             | 0.03    |
|                      | Absent     | 12             |         |
| Ulcer size           | <1 cm      | 12             | 0.001   |
|                      | 1–5 cm     | 59             |         |
|                      | >5 cm      | 0              |         |
| Amputation           | minor      | 50             | 0.006   |
|                      | significant| 36             |         |
|                      | Mortality  | 7              |         |
|                      | Recurrence | 7              |         |

DFUs, diabetic foot ulcers; DM, diabetes mellitus.

Table 3. Multiple logistic regression model of the effect of risk factors on ulcer healing

| Risk factor          | Odds ratio | 95% CI    | p value |
|----------------------|------------|-----------|---------|
| Age                  | 1          | 0.99–1.10 | 0.25    |
| Diabetes mellitus duration | 1.01      | 0.89–1.15 | 0.3     |
| HbA1c                | 1.05       | 0.94–1.18 | 0.54    |
| Peripheral neuropathy| 1.21       | 0.97–1.51 | 0.51    |
| Ulcer size           | 1.1        | 0.98–1.24 | 0.95    |

4. DISCUSSION

This examination was led on 120 patients with DFU. There was no sexual orientation contrast and the vast majority of the members were moderately aged. Most members had type II diabetes, which is more normal than type 1 diabetes [10-11]. Furthermore, around 34.16% were taking insulin, which may mirror long-term diabetes among patients [12]. The examination shows that patients who 65 years old and more established have poor results with other age groups; This finding was like that announced in the investigation by Katsilambros et al, amputation incidence increases with age, 1.6% in the 18-44 age group, 3.4% in the 45-64 age group and 3.6% in the age group of patients above 65 and over. As we can see with age, wound healing is impacted by numerous elements, including peripheral blood vessel damage, debilitated resistances, and diminished invulnerability [13]. The more drawn out the term of DM, the more noteworthy the possibility that DFUs will be of non-treatment impact. This is like the aftereffects of an Indian investigation that found a reasonable and huge connection between diabetic foot inconveniences and the level of glycemic control [14-15]. Poor glycemic control is a significant hazard factor for creating diabetic complexities. Thusly, ideal control of plasma glucose levels will end the movement all things considered, including DFUs [16]. Peripheral neuropathy is one of the significant hazard factors for all diabetic foot complications. The investigation found that all individuals without peripheral neuropathy accomplished straightforward ulcer healing [17-18]. This solid relationship of diabetic foot intricacies and peripheral neuropathy was additionally noted in a Saudi Arabian investigation where 33% of diabetic patients experience the ill effects of ceaseless nerve pressure [19-20]. Peripheral neuropathy opens the patient to rehashed foot wounds. Additionally, pressure applied to the region reaches out without the patient being taken note of. Wound size likewise assumes a key job in visualization, and this examination found that individuals with UPD> 5 cm in distance across had more regrettable results than those with litter ulcers [21-22]. These discoveries are like the discoveries of another US study that found that risk factors or wound.
qualities most drastically connected with wound recuperating disappointment expanded the size and length of wound healing [23]. Ideal glycemic control is a key advance in teaching patients about the significance of foot care and making human services better.

5. CONCLUSIONS

The outcomes and complications of diabetic foot ulceration can be anticipated by a few factors, Age, for instance, is linked to an increased risk of amputation. Changing compatible factors, for example, better diabetes control, peripheral neuropathy treatment, Glycemic control and early treatment of ulcers can reduce complications and encourage healing of ulcers.

CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline patients consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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