

Original Research Article

A prospective observation study on diabetic foot ulcer using diabetic ulcer severity score at tertiary care hospital

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ABSTRACT

Background: A number of scoring systems and classifications are available for diabetic foot ulcers with intention to compare the treatment modalities and future outcomes. Many of them are complex and don't predict future outcome within the patients. Aim and objectives of current study were to establish a wound-based clinical scoring systems (DUSS) as daily clinical practice by assessing the efficacy of diabetic ulcer severity score.

Methods: A total of 73 diabetic patients with foot ulcers were included in this prospective observational study conducted at Dr. S.N. Medical college, Jodhpur and attached hospitals from July 2018 to August 2020. Ulcers were assessed and DUSS score created. Patients were followed up for six months or until healing or amputation if either.

Results: In this prospective study of 73 patients with diabetic foot ulcers, most common age group affected was between 51-70 years. Mean age group was 58.57 ± 12.66 years. Mean duration of diabetes was 7.61 ± 5.72 years. Most commonly ulcers were of DUSS score 2. Mean DUSS score was 1.97 ± 1.15 . Majority of diabetic foot ulcer patients (37 out of 51) with DUSS score 0, 1 and 2 healed by primary intention after wound debridement. Those with score 3 & 4 majority of them (20 out of 22) had amputation.

Conclusions: This is a very simple scoring system that provides an easily accessible and a streamlined approach in the clinical setting without need of any advanced investigative equipment. Hence this can be applied in any set up.

Keywords: Diabetic foot ulcer, Diabetic ulcer severity score, Wound-based parameters

INTRODUCTION

Diabetes mellitus is a chronic disease and complex lifelong condition affecting nearly 8.3% of the world's population globally. It is characterized by a heterogeneous group of metabolic disorders resulting in an abnormal increase of blood glucose level due to absolute or relative deficiency in insulin secretion and/or action or both.¹

In the adult population the global prevalence of diabetes mellitus has nearly doubled since 1980, it has been rising from 4.7% to 8.5%. In year 2000 there were 171 million people in the world with diabetes mellitus and this is projected to extend to 366 million by 2030.² The American diabetes association (ADA) estimated the

national costs of diabetes in the USA for 2002 to be \$US132 billion, increasing to \$US192 billion in 2020.³ The rapid change in dietary patterns, physical inactivity, and increased body weight, especially the accumulation of abdominal fat are some of the primary reasons for increased prevalence of diabetes in India, therefore India has been called "the diabetes capital of the world" and "every fifth diabetic in the world is an Indian".⁴

WHO defines the diabetic foot as an infection, ulceration, or destruction of deep tissues of foot and these are associated with neuropathy and various degrees of peripheral vascular disease and/or metabolic complications of diabetes within the lower limb. The incidence of diabetic foot ulcers (DFUs) is up to 25%

over a patient's life time.⁵ Foot ulcers occur in 15- 25% of people with diabetes.⁵

There are various scoring systems and classification of diabetic foot ulcers. Their intention is to compare the treatment modalities and outcome in patients with DFUs. Diabetic ulcer severity score (DUSS) addresses these shortcomings by being easy enough to be applied in daily clinical practice. It includes four clinically assessable wound based parameters, namely absence or presence of pedal pulses, probing to bone, wound location, and presence or absence of multiple ulcerations. Categorizing diabetic foot ulcer as ulcer in the foot and ulcer in the toes is itself a new method. In the wound based system of classification, DUSS is one of the latest classification systems. This DUSS by Beckert et al ranges from 0 to 4.⁶ It is a very simple and easily producible scoring system which needs to be validated in our setup. Diabetic foot ulcer is commonly encountered in surgical outpatient department. The most dreaded complication of diabetic foot ulcer is amputation of the limb. An amputation almost doubles the hospital stay (increased morbidity) of the patient and is associated with significant mortality. This study is an effort to predict the chances of diabetic foot ulcers that may end in amputations.

METHODS

Study design, location and duration

Current study is a prospective observational study conducted at Dr S. N. Medical college, Jodhpur (Rajasthan) from July 2018 to August 2020.

Source of data and statistical tool

Patients with diabetic foot ulcers attending surgical outdoor patient departments or admitted in the department of General Surgery Dr S.N. Medical College, Jodhpur and attached hospital, Jodhpur (Rajasthan). GraphPad Prism was used as statistical tool.

Inclusion criteria

Patients with diabetes mellitus as per WHO criteria (symptoms of diabetes+random blood sugar >200 mg/dl or Fasting blood sugar >126 mg/dl and 2 hour post prandial glucose level >200 mg/dl) and more than fifteen years of age presented with lesions of foot i.e. ulcer, cellulitis, abscess, neuropathic ulcers, irrespective the duration of lesions and diabetes with consent to participate and follow up into the study were included.

Procedure

A total of 73 diabetic patients with foot ulcers irrespective of their duration and irrespective of duration of diabetes mellitus attending surgical outdoor patient departments or admitted into the general surgery

department in Dr S. N. Medical College, Jodhpur and attached hospital from July 2018 to August 2020 were taken into this prospective study based on the inclusion and exclusion criteria mentioned above. The baseline demographic data (age, sex, occupation, educational status, co- morbidities, personal habits, socioeconomic status, duration of diabetes mellitus and treatment history for diabetic management) were taken and relevant investigations (fasting blood glucose, post prandial blood glucose, glycosylated haemoglobin, haemoglobin, total leukocyte count, renal function test, serum electrolyte and foot X-ray) were done. As suggested by physician, all patients were treated using OHA (oral hypoglycaemic agents) or insulin, based on the blood sugar levels to obtain optimal control of blood sugar.

The diabetic foot ulcers were examined thoroughly to note down following points: ulcer location/site i.e. toes or foot. Ulcer number i.e. single or multiple (in patients with multiple ulcers, the wound with the highest grading was selected for analysis and with identical grading, the larger wound chosen). Peripheral vascular disease clinically detected by palpation of pedal pulses whether palpable or not palpable. Wound depth was evaluated using a sterile blunt probe to check probing to bone present or not. The ulcer which was bone depth, further assessed for bone involvement by taking foot X-ray to rule out osteomyelitis. Ulcer was labelled infected if there is purulent discharge was present, if present then it was swabbed for culture and sensitivity. For each ulcer a DUSS score was calculated by adding all four parameters and given a score, based on the defined parameters of DUSS mentioned below. After assessment of the ulcer, it was treated locally by debridement or disarticulation of toe or amputation, as needed and systemic treatment with antibiotics according to the culture and sensitivity reports and adequate analgesic given to the patients. All patients received proper care and treatment.

Diabetic ulcer severity score (DUSS)

The DUSS score was taken based on observations mentioned in (Table 1).

Table 1: Diabetic ulcer severity score.

| Parameter | Scoring | |
|------------------------------|---------|----------|
| | 0 | 1 |
| Palpable pedal pulses | Present | Absent |
| Probing of bone | Absent | Present |
| Ulcer location | Toes | Foot |
| Ulcer number | Single | Multiple |

The foot ulcer of diabetes was graded taking into consideration its depth as follows; grade one considered if the depth of the ulcer was up to dermis, grade two if up to subcutaneous tissue, grade three if up to fascia, grade

four if up to muscle and grade five if extended to bone. The mentioned procedure carried out to assess osteomyelitis (Table 2).

Table 2: Ulcer grading depending upon depth.

| Ulcer grade | Wound depth as measured by sterile blunt probe |
|-------------|--|
| G-1 | Dermis |
| G-2 | Subcutaneous tissue |
| G-3 | Fascia |
| G-4 | Muscle |
| G-5 | Bone |

Standard treatment care given to all the patients, like oral hypoglycaemic or insulin for good control of sugar as suggested by physician, health education, antibiotics and regular wound care. Healing was defined as complete epithelisation or healing after skin grafting. Amputation rate was defined as the percentage of patients undergoing either minor (i.e. toes or forefoot) amputations or major (i.e. below or above knee) amputation within the observation period.

Follow up

Patients were followed up in the surgical outdoor patient departments on regular basis and surgical intervention done with them were noted. They were followed up for six months or until healing or amputation if earlier. Ulcer healing was assessed as complete healing without any surgical intervention or healing with the help of any surgical intervention other than amputation or amputation. Patients who lost follow up for six months or without healing were excluded from our study.

RESULTS

In this study of 73 patients with diabetic foot ulcer, 56 (76.71%) were male and 17 (23.29%) were females i.e. males were commonly affected with diabetic foot ulcer. In this study maximum no of patients were in the age group between 51-70 years accounting for 57.53% followed by age group 31-50 years accounting for 26.3%. The mean age group was 58.57 ± 12.66 years and median age is 60 years. In this study of 73 patients with diabetic foot ulcer, 56 (76.71%) were male and 17 (23.29%) were females i.e. males were commonly affected with diabetic foot ulcer. In our study majority of patients had duration of diabetes mellitus between 6-15 years accounting for 46.58%. mean duration of diabetes mellitus was 7.61 ± 5.72 years. In table1, 35(47.95%) patients with foot ulcer healed with primary intention, 13 (17.81%) with skin grafting and remaining 25 (34.25%) had amputation. In this study of 73 patients with diabetic foot ulcer, 25 (34.25%) patients had amputation. In (Figure 2), it was observed that most of the patients with duration of diabetes mellitus less than 10 years managed by wound debridement (primary

healing) while with duration of diabetes mellitus more than 10 years managed by amputation. This difference among the study group was found to be statistically significant ($p < 0.010$). Majority of ulcers were of DUSS score 2 (34.25%) followed by score 1 (26.03%). Mean score was 1.97 ± 1.15 . Median score of 2 (IQR=2 score).

Table 3: Gender-wise distribution of study population.

| Gender | N | % |
|--------|----|--------|
| Male | 56 | 76.71 |
| Female | 17 | 23.29 |
| Total | 73 | 100.00 |

Table 4: Management of diabetic foot ulcer in study population.

| Parameters | Males | | Females | | Total | |
|-------------------|-------|-------|---------|-------|-------|-------|
| | N | % | N | % | N | % |
| Amputation | 22 | 39.29 | 3 | 17.65 | 25 | 34.25 |
| Wound debridement | 25 | 44.64 | 10 | 58.82 | 35 | 47.95 |
| Skin grafting | 9 | 16.07 | 4 | 23.53 | 13 | 17.81 |
| Total | 56 | 100 | 17 | 100 | 73 | 100 |

Table 5: Distribution of DUSS score in study population.

| DUSS score | Males | | Females | | Total | |
|------------|-------|-------|---------|-------|-------|-------|
| | N | % | N | % | N | % |
| 0 | 4 | 57.14 | 3 | 42.86 | 7 | 9.59 |
| 1 | 14 | 73.68 | 5 | 26.32 | 19 | 26.03 |
| 2 | 19 | 76 | 6 | 24 | 25 | 34.25 |
| 3 | 12 | 92.31 | 1 | 7.69 | 13 | 17.81 |
| 4 | 7 | 77.78 | 2 | 22.22 | 9 | 12.33 |
| Total | 56 | 100 | 17 | 100 | 73 | 100 |

In (Figure 3), 35 (47.95%) patients managed with conservative management by wound debridement, 13 (17.81%) patients with skin grafting and remaining 25 (34.25%) patients had amputation. In this study of 73 patients with diabetic foot ulcers, majority of diabetic foot ulcer with DUSS score 0, 1 and 2 healed by primary intention after wound debridement only i.e. 4 (57.14%) out of 7, 14 (73.68%) out of 19 and 16 (64.00%) out of 25 respectively. However among those with score 3 and 4 majority had amputation in the form of major or minor amputation i.e. 11 (84.62%) out of 13 and 9 (100.00%) out of 9 respectively. This difference in the DUSS score among the three group was found to be statistically significant ($p < 0.001$). In our study there were 7 patients with score 0. Majority of these patients were healed by wound debridement or skin grafting i.e. 4 (57.14%) and 2 (28.57%) respectively while only one (14.29%) had amputation in the form of minor amputation followed by

19 patients with score 1. Majority of these patients were healed by primary intention or skin grafting i.e. 14 (73.68%) and 4 (21.05%) respectively while only one (5.26%) had amputation in the form of minor amputation. We found that there were 25 patients with score 2. Majority of these patients were healed by primary intention or skin grafting, i.e. 16 (64.00%) and 6 (24.00%) respectively while 3 (12.00%) had amputation in the form of minor amputation followed by 13 patients with score 3. Majority of these had amputation in the form of major or minor amputation accounting for 84.62% while only 7.69% healed by primary intention and one 7.69% healed by skin grafting. In this study of 73 patients with diabetic foot ulcer, there were 9 patients with score 4. All patients with score 4 had amputation in the form of major or minor amputation accounting for 100%.

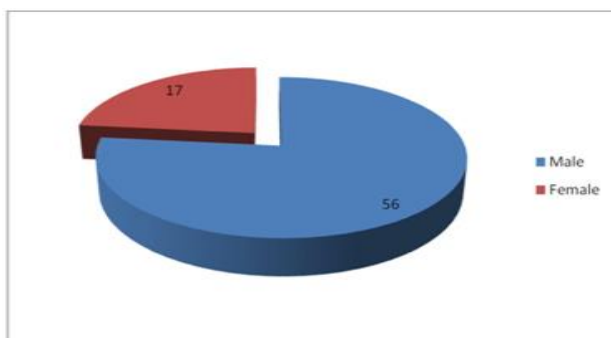


Figure 1: Gender based distribution.

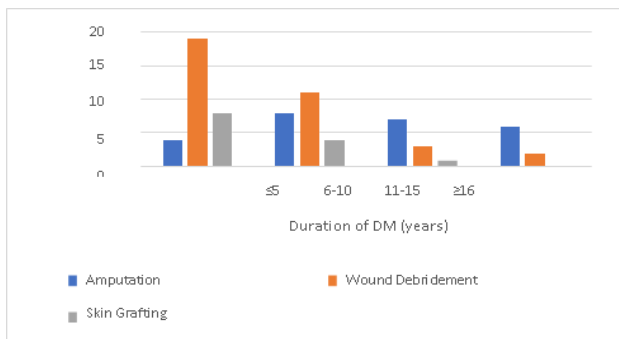


Figure 2: Management of diabetic foot ulcer in relation to duration of diabetes mellitus.

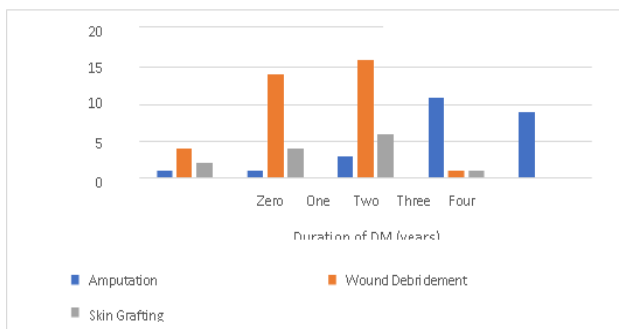


Figure 3: Distribution of ulcers (DUSS score 0-4) with end results of study.

DISCUSSION

Diabetic foot ulcer is very common complication in diabetic patients and important cause of morbidity to patient. Beckert et al in a prospective study of 1000 patients with diabetic foot ulcers, proposed a clinical severity scoring system, diabetic ulcer severity score (DUSS).⁶ It was based on four clinically assessable wound-based parameters namely, palpable pedal pulses, probing to bone, ulcer location (foot or toe ulcer) and ulcer number, categorizing the wounds into specific severity subgroups for comparison of outcome.⁶ In this study of 73 patients with diabetic foot ulcer, 56 (76.71%) were male while 17 (23.29%) were female i.e. the majority of patients were male.

Beckert et al studied 1000 patients and found that 675 (67.5%) were male and 325 (32.5%) were female.⁶ There were 81% male and 19% female in a study conducted by Kumar et al, 68% male and 32% female in Sharma et al and Shashikala et al.⁷⁻⁹ In this study, majority of patients with duration of diabetes mellitus less than 10 years were in score 0, 1 and 2 while with duration of diabetes mellitus more than 10 years were in group 3 and 4. This difference in the DUSS score in the study group was found to be statistically significant ($p < 0.001$), same was found in a study conducted by Kummankandah et al.¹⁰ In this study, there was 85.71% probability of healing in patients with zero score which came down to 15.38% on having score three and with score four it became 00.00%. From this study it was noted that a lower DUSS score was strongly associated with better healing, similar findings were noted by Beckert et al.⁶ Beckert et al reported primarily healing of 74% ($n=1,000$), Prompers et al 77% ($n=1,229$), Oyibo et al 65% ($n=194$), Jeffcoate et al 66% ($n=449$).

The above data showed that patients with a high DUSS score were more likely to undergo surgery.¹¹⁻¹³ Similar findings were noted by Beckert et al.⁶ They reported that as the score is increased, probability of ulcer healing decreased. We conclude that diabetic ulcer severity score provides a simple and efficient diagnostic tool for predicting probability of healing or amputation by combining four clinically assessable wound based parameters namely, presence or absence of pedal pulses, probing to bone, wound location and presence or absence of multiple ulcerations. Lower diabetic ulcer severity score was strongly associated with healing while higher score was associated with amputation.

Limitations

Limitation of this study is that patients with foot ulcers due to cause other than Diabetes mellitus, with severe medical illness, the patients unfit for surgery, receiving immunosuppressive agents, radiation or chemotherapy were excluded. Venous stasis ulcer with diabetes mellitus, ulcers located above the ankle and ulcers with evidence of gangrene were also excluded from the study.

CONCLUSION

This is a very simple scoring system that provides an easily accessible and a streamlined approach in the clinical setting without need of any advanced investigative equipment. Hence this can be applied in any setup, even in busy OPDs to assess the patients with diabetic foot ulcer, although subsequent adequate and standardized wound care is an essential prerequisite to the diabetic ulcer severity score being a valid diagnostic tool.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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