



Clinical utility of diabetic ulcer severity score in patients with diabetic foot ulcers – A prospective study

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Abstract

Background: The most common reason for hospitalisation for diabetic people is diabetic foot ulcer (DFU). For diabetic foot ulcers, a variety of scoring systems and classifications are available with the goal of comparing treatment options and long-term results. Aim of the study was to evaluate the effectiveness of the diabetic ulcer severity score, a wound-based clinical scoring system for diabetic foot ulcers, in predicting clinical outcomes.

Materials and method: A prospective study was conducted on 65 diabetic ulcer patients. DUSS was applied during the admission. The DUSS consists of four clinical variables: 1) pedal pulses, 2) bone probing, 3) ulcer site, and 4) ulcer number. These wounds were scored as 0, 1, 2, 3, or 4. All patients received standard care in accordance with a protocol. The outcome of treatment was recorded.

Results: In this prospective study of 65 patients with diabetic foot ulcers, most common age group affected was between 51-70 years. Mean duration of diabetes was 8.13±4.28 years. Most commonly ulcers were of DUSS score 1. Of the 65 patients, 36 (55.38%) got conservative care, including wound debridement, 14 (21.54%) underwent skin grafting, and 15 (23.08%) underwent amputation. DFU with DUSS score 0 healed by 2 weeks, score 3 and 4 healed mostly only after surgical intervention. Comparison of amputation based on DUSS score showed statistical significance. The mean healing time was found to be 108.8±43.7 days.

Conclusion: This study conclude that DUSS system is a wound based diagnostic procedure to predict healing, amputation or need for surgery by combining the four sign in a safe manner.

Keywords: amputation; diabetes mellitus; duss scoring system; foot ulcer

Introduction

Diabetes mellitus, or type 2 diabetes, is a chronic disease and a complex lifelong condition that affects about 8.3% of the global population [1]. It is distinguished by a diverse range of metabolic abnormalities that cause an abnormal rise in blood glucose levels as a result of an absolute or relative lack of insulin secretion, action, or both [2]. The World Health Organisation (WHO) estimates that there were 171 million diabetic patients in 2000, and that figure raised around 380 million by 2020. By 2025, 57 million people in India are anticipated to have diabetes. The most concerning consequence among those with known instances of diabetes is diabetic foot, which has a 15% incidence [3]. The prevalence of diabetic foot is 10% in the US and UK, with an annual frequency of 3%. It is a significant issue for public health around the world. It causes considerable

problems for diabetics [4]. According to the WHO, the diabetic foot is an infection, ulceration, or destruction of the deep tissues of the foot that is linked to neuropathy, various degrees of peripheral vascular disease, and/or

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metabolic consequences of diabetes in the lower limb. Diabetes-related foot problems can result in ulceration and the potential for limb amputation [5]. It is one of the most expensive consequences of diabetes and might have a significant impact on the economy, society, and public health. Amputation is the main unfavourable outcome of foot ulceration, and the main risk factors for it include trauma, peripheral artery disease, and a loss of protective feeling caused by neuropathy [6]. The classification and scoring of diabetic foot ulcers varies. Their goal is to compare the methods of treatment and the results for patients with DFUs. These grading methods take into account a variety of factors, including the depth and location of the ulcer, whether it is infected or not, neuropathy, vascular insufficiency, bone involvement, and skeletal deformities.

Meggitt first described a wound categorization in 1975, and Wagner further popularised it in 1981. The Meggitt-Wagner system, which is still frequently used today, assessed ulcer depth solely without taking ischemia or pressure load into account. By adding ischemia and infection, the University of Texas classification enhanced the classification of foot ulcers [7]. Other categories include the Infectious Diseases Society of America infection grading system (IDSA) and the PEDIS Classification (Perfusion, Extent/size, Depth/tissue loss, Infection, Sensation). The future outcomes of the patients cannot be predicted by any of these complicated grading systems [8, 9]. The diabetic ulcer severity score (DUSS), which can be used in routine clinical practise, addresses these drawbacks. Beckert et al. [10]. conceptualised the DUSS, the most recent wound-based categorization, defines four clinical parameters: perceptible pedal pulses, probing to bone, ulcer location, and presence of multiple ulcerations.

Aim of the study was to evaluate the effectiveness of the diabetic ulcer severity score, a wound-based clinical scoring system for diabetic foot ulcers, in predicting clinical outcomes.

Materials and methods

A prospective study was conducted on 65 diabetic ulcer patients, attending the out-patient department (OPD) of surgery in Sree Mookambika Institute of Medical Sciences, Kulasekharam for a period of one year from July 2022 to June 2023. The study included patients who met the WHO criteria for diabetes mellitus (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), presenting with a foot ulcer.

All non-diabetic ulcers, those who had been receiving immunosuppressive medication for the previous three

months, ulcers that were higher than the ankle, any neoplastic conditions that remain active, necrotizing fasciitis, and people who were unwilling to participate in the study were eliminated. The study enrolled a total of 65 participants with diabetic ulcers. Age, gender, occupation, educational level, co-morbidities, personal habits, socioeconomic status, length of diabetes mellitus, and treatment history for diabetic management were taken as the baseline demographic information. DUSS was utilised during admission. The following points were noted after a detailed examination of the diabetic foot ulcers: the area where the ulcer is located (toes/foot), single or multiple ulcers (in patients with multiple ulcers, the wound with highest grading was chosen for study, and in cases where the grade was the same, the larger wound was chosen). Peripheral vascular disease is clinically identified by palpating pedal pulses, whether perceptible or not. Wound depth was measured with a sterile blunt probe to determine probing to bone was present or absent. By performing a foot X-ray, the bone-depth ulcer was further evaluated for bone involvement in order to rule out osteomyelitis. A score of 0 or 1 is given for each parameter. Each separate score is added together to produce the overall score, which ranges from 0 to 4 (Table 1).

Table 1: Diabetic ulcer severity scoring (DUSS).

Parameter	Score 0	Score 1
Palpable pedal pulses	Presence	Absence
Probing to bone	No	Yes
Ulcer site	Toes	Foot
Ulcer number	Single	Multiple

Diabetes-related foot ulcers were rated according to their depth in the following ways: grade one was given if the ulcer reached the dermis, grade two if it reached subcutaneous tissue, grade three if it reached the fascia, grade four if it reached the muscle, and grade five if it reached the bone (Table 2).

Table 2: Grade of ulcer.

Grade	Wound depth as measured by sterile blunt probe
1.	Dermis
2.	Subcutaneous tissue
3.	Fascia
4.	Muscle
5.	Bone

All of these patients received standard medical care, which included frequent wound care (dressing and debridement), antibiotics, glycemic management using oral hypoglycemic medications or insulin, diet, health education, and amputation if necessary. Amputations

can be classified as minor, like those of the toe or forefoot, or major, such those below or above the knee. The percentage of patients who had a minor or major amputation throughout the observation period was referred to as the amputation rate. The results of the therapy were documented. Patients received follow-up care in the surgical outpatient clinic once every two weeks for the first month, then once a month until the ulcer healed or for a minimum of six months. After a skin graft, healing was referred to as complete epithelization or healing. Results were analysed using SPSS 20.0 version. Mean and standard deviation was used for continuous data, and frequency and percentage were used for categorical data. Chi Square test was used to identify the statistically significant risk factors, where p value less than 0.05 was considered as significant.

Results

In the present study among 65 DFU patients, most of the patients 27(41.53%) were in the age group of 61 to 70 years followed by 51 to 60 years with 16(24.62%) patients. The mean age group was 59.43±9.45 years. The study showed male predominance, 57 (87.69%) were males and 8(12.31%) were females. When the

DUSS parameters (ulcer characteristics) were examined, 59(90.76%) patients had ulcers in the foot, 53(81.54%) patients had single ulcers, 12(18.46%) patients had multiple ulcers, 23(58.46%) patients had palpable peripheral pulses, and 18(27.69%) patients had probing to the bone. Score was assigned based on these criteria. The majority of patients in the study group 25(38.46%) had score 1, followed by 18(27.69%) with score 2, 13(20%) with score 3, 7(10.77%) with score 4, and the remaining 2(3.08%) with score 0. The patient had diabetes mellitus with an average of 8.13±4.28 years and 29 (44.62%) of those patients had it for between 11 and 15 years. When the duration of diabetes is less than 10 years, the majority of ulcers had a score of 1 or 2; when the duration is longer than ten years, the majority of ulcers had a score of 3 or 4. It was found that there was a statistically significant difference in DUSS scores between the duration of Diabetes (p<0.05). Skin grafts, primary healing, or amputation, whether major or minor, were all options for treating wounds. Of the 65 patients, 36 (55.38%) got conservative care, including wound debridement, 14 (21.54%) underwent skin grafting, and 15 (23.08%) underwent amputation. Comparison of amputation based on DUSS score showed statistical significance (Table 3).

Table 3: Comparison of amputation based on DUSS score.

Amputation	0	1	2	3	4	p value
Yes	0(0%)	0(0%)	3(16.67%)	5(38.46%)	7(100%)	0.001
No	2(100%)	25(100%)	15(83.33%)	8(61.54%)	0(0%)	

The majority of foot ulcers in the study population with DUSS scores of 0, 1, and 2 were treated with primary intention or skin grafting with 2(100%), 25(100%) and 15 (83.33%) patients respectively. However, the majority of patients with scores of 3 and 4, that accounts

for 5 (38.46%) and 7(100%), respectively who needed amputations. It was shown that there was a statistically significant difference in DUSS scores between these groups (p<0.001) (Table 4).

Table 4: Correlation between DUSS score and outcome.

Healing	0	1	2	3	4	p value
Conservative management	2(100%)	18(72%)	13(72.22%)	3 (23.08%)	0(0%)	<0.001
Skin grafting	0(0%)	7(28%)	2(11.11%)	5 (38.46%)	0(0%)	
Amputation	0(0%)	0(0%)	3(16.67%)	5(38.46%)	7(100%)	
Total	2	25	18	13	7	

The majority of ulcers with a DUSS score of 0 healed after two weeks, ulcers with a score of 1 healed after two and three weeks, and ulcers with a score of 2 healed after three and four weeks. The majority of those ulcers with scores of 3 and 4 cured only with surgical intervention, which included skin grafts, and amputations. It was found that the mean recovery time was 108.8±43.7 days.

Discussion

Diabetic foot problems account for 23-50% of diabetic hospital room occupancies. DFU are a regular occurrence in clinical practise, and a patient with diabetes has a lifetime risk of up to 25% of having an ulcer [11]. Based on the previously specified inclusion and exclusion criteria, a total of 85 diabetic patients with foot ulcers, regardless of the duration of the

ulcers, who were attending surgical outpatient clinic or hospital admission, were recruited into the study. Most of the patients affected with diabetic foot were between the age group of 51-70 years. The mean age group was 59.43 ± 9.45 years. This was comparable to the study done by Kummarkandath et al. [12] and Kumar VH et al. where the most common age group was 5th to 6th decade with mean age group of 54.6 ± 12.4 and 57.32 ± 10.712 years respectively. Similar to the present study Kummarkandath et al, Kumar et al, Ravoori et al and Saraswat et al. found male predominance with 59% 56%, 75% and 76.71% patients respectively [12-15]. Mean duration of diabetes was 7.61 ± 5.72 years in the study done by Saraswat et al [15] This was similar to the present study. Ulcers were graded, and DUSS was computed by summing these variously scored factors to a theoretical maximum. Comparison of most common DUSS score with other studies was given in table 5.

Table 5: Comparison of DUSS score with other studies.

Studies	Common DUSS score	Percentage
Kummarkandath et al [12]	Score 1	78.79%
Kumar et al [13]	Score 3	52%
Ravoori et al [14]	Score 2	65%
Saraswat et al [15]	Score 2	34.35%
Present study	Score 1	38.46%

In the current study, DFUs with DUSS scores of 0 through 1 and 2 healed via primary intention or skin grafting, however the majority of patients with scores of 3 and 4 required amputation. DFU with a DUSS score of 0 healed after two weeks, while scores of 3 and 4 mainly recovered following surgical intervention. It was found that the mean recovery time was 108.8 ± 43.7 days. In their study, Kumar et al. [13] found that primary intention or skin grafting successfully treated the majority of foot ulcers in the study population with DUSS scores of 0, 1, and 2, in 1 (100%), 3 (75%) and 6 (46.15%) patients respectively. The majority of individuals with scores of 3 and 4, 14 (70%) and 10 (83.33%) respectively needed amputations. It was determined that there was a statistically significant difference in DUSS scores between the three groups ($P=0.004$). The likelihood of recovery was 100% with a DUSS score of 0, 75% with a DUSS score of 1, 84.61% with a DUSS score of 2, 30% with a DUSS score of 3, and 16.67% with a DUSS score of 4. The recovery process took a mean of 77 days. Similar findings were made by Saraswat et al. who found that the majority of foot ulcers with DUSS scores of 0, 1, and 2 were treated with primary intention or skin grafting in proportions of 85.71%, 94.74%, and 88.00%, respectively. However, the majority of patients with scores of 3 and 4, 84.62%

and 100.00%, respectively, required amputation ($p < 0.001$). In the Menezes et al [16] and Ponnusamy et al [17] study, patients with lower DUSS scores had higher healing rates. Patients with higher DUSS scores, specifically 3 and 4, had increased amputation rates.

Among the different scores, George et al [18] found that the chance of healing was 100% for score 0, 97.9% for score 1, 83.4% for score 2, 17.7% for score 3, and 4.8% for score 4. A lower score is closely linked to primary healing, while a higher score is linked to amputations. Jain et al. [19] studied patients who received debridement, amputation, or skin grafting as a form of treatment and had DUSS scores of 1 or 2. While amputation was required for every patient with a DUSS of 3 or 4.

Limitations: The limitation of study is less number of sample and single centre study. This study results provide the base for future studies.

Conclusion

This scoring system is useful for forecasting the likely course of treatment because wounds with lower scores healed more quickly than wounds with higher scores. DUSS can be applied upon initial presentation to assist clinicians design an active, targeted approach to surgical care of diabetic foot ulcers and to counsel patients regarding prognosis and the likely outcome of the condition. This can therefore be used in any setting, even in busy out-patient clinics, to evaluate patients with DFUs.

Conflicts of interest

Authors declare no conflicts of interest.

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