International Surgery Journal
Menezes JVF et al. Int Surg J. 2019 Jul;6(7):2469-2474
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20192976

Original Research Article

Clinical utility of diabetic ulcer severity score in surgical practice

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Received: 25 April 2019
Accepted: 01 June 2019

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ABSTRACT

Background: In surgical practice we come across many diabetic foot ulcer patients who often present late, leading to limb loss and even death. In the search for an effective screening tool to assess the severity of the disease and predict the outcome we have adopted the DUSS.
Methods: Prospective study from October 2016 to April 2018 including 200 patients with diabetic foot ulcers conducted at Surgery Department in KIMS, Bangalore. DUSS was applied at the time of admission. DUSS comprises 4 clinical parameters: 1) pedal pulses, 2) probing to bone, 3) ulcer site and 4) ulcer number. These wounds were graded into score 0, 1, 2, 3, 4. Standard management was given to all patients according to a protocol. The outcome of treatment was recorded as healed ulcer, minor amputations, (toe or forefoot) or major amputations (below or above knee). Co-relation between the DUSS scores and final outcome was done.
Results: Healing rates were higher in those with lower DUSS scores (88.9% in score 0 compared to 0% in Score 4). Minor amputation rates for scores 0, 1, 2,3 were 11.1%, 30.5%,28.3% and 44.1% respectively. Major Amputation rates were higher in patients with high DUSS scores i.e. 3 (41.8%) and 4 (100%).
Conclusions: DUSS is an effective clinical tool to assess the severity of diabetic foot ulcers. DUSS scores help in predicting the outcome of treatment hence it can be used to counsel the patient regarding the disease and its prognosis. Patients with higher DUSS scores should require a more aggressive approach to minimise morbidity and mortality.

Keywords: Amputation, Diabetic foot ulcers, DUSS, Screening

INTRODUCTION

Diabetes mellitus (DM) is a major health problem that has increased dramatically over the past two decades.[1,2] The global prevalence of diabetes has risen from 4.7% in 1980 to 8.5% in 2014.[3]

In India, diabetes has risen to epidemic proportions. In urban areas the estimated prevalence is thought to be 9% and in rural areas is approximately 3% of the total population. This means that India actually has the highest number of diabetics in any one country. The WHO estimates that by 2025 India will be the 'diabetic capital of the world' with more than 300 million diabetics.

Surgical scenario

A majority of diabetic patients develop foot ulcers in one point of time or other during the course of their illness.[4] The etiopathogenesis of diabetic foot lesions is multifactorial: diabetic neuropathy, vasculopathy, poor control of diabetes and bacterial infection are some of them.[5] In our surgical practice we are seeing a rise in foot problems in diabetics such as ulceration, infections and gangrene. This results in frequent and prolonged hospitalisation. Many patients present at a late stage where limb salvage is impossible resulting in major amputations and even death. According to the International Working Group on the Diabetic Foot, a classification system appropriate for clinical practice

should facilitate communication between healthcare providers and influence daily management and provide information about healing potential of an ulcer.[6] Although there are many wound classification systems such as the Meggitt-Wagner classification, University of Texas system, Treece et al classification etc, they are either complex or incomplete as they do not take into account other clinical parameters such as vascularity, size, number etc.[7-10] In our search for a simple yet comprehensive clinical scoring system we came across the Diabetic Ulcer Severity Score (DUSS) described by Beckert et al.[11] This is a new scoring system comprising four wound-based clinical parameters with a score ranging from 0 to 4 (Table 1). DUSS could help in stratification of the severity of the disease for its management, as well as for research purposes such as surgical audit and prediction of the outcome of the disease. Hence in this paper we aim at studying the clinical utility of DUSS especially with regards to surgical practice.

Objectives of the study were to study the correlation between DUSS and the clinical outcome of the patients with diabetic foot ulcers. To study the efficacy of DUSS score in predicting the clinical outcome. To study the clinical utility of DUSS in management of diabetic foot ulcers.

METHODS

Source of data

Total 200 patients with diabetic foot ulcers admitted to Kempegowda Institute of Medical Sciences Hospital & Research Centre, Bangalore

Study design and duration

Non randomised, prospective cohort study, from October 2016 to April 2018.

Inclusion criteria

All inpatients above 18 years suffering from diabetes mellitus who have foot ulcers (located below the ankle).

Exclusion criteria

- All non-diabetic ulcers
- Patients on immunosuppressive treatment for last 3 months
- Ulcers located above the ankle
- Any active neoplastic disease
- Necrotising fasciitis

Protocol

After taking a written informed consent a detailed history including duration of diabetes and treatment history is taken. A thorough clinical examination and the application of DUSS at the time of admission is done and recorded in the proforma sheets.

Table 1: DUSS.

Variables	Score 0	Score 1
Palpable pedal pulses	Present	Absent
Probing to bone*	No	Yes
Ulcer site	Toes	Foot
Ulcer number	Single	Multiple

*Probing to bone done with a sterile blunt probe.

DUSS (Table 1) includes ulcer site, ulcer number, probing to the bone and palpable pedal pulses. For each parameter a score of either 0 or 1 is given. The total score (minimum 0 to maximum 4) is obtained by adding each individual score. In patients with multiple ulcers, the wound with the highest grading was selected for analysis. Baseline investigations including fasting and post prandial blood sugars, glycosylated haemoglobin (HbA1C), blood routine, renal function tests, X ray foot, arterial doppler of lower limb, swab culture from ulcer were done.

Standard treatment care was given to all these patients which included glycaemic control with oral hypoglycaemics or insulin, diet, health education, antibiotics and regular wound care (dressing and debridement). In some cases, minor amputations such as toe or forefoot amputations, or major amputations like below or above knee amputations were required.

Patients were followed up in the surgical outpatient clinic once in a fortnight for 1st month, then once in a month till the ulcer healed or for a minimum period of up to 6 months.

Outcome and end points of ulcer treatment was recorded as:

- Complete healing without any surgical intervention.
- Healing with any surgical intervention other than amputation (debridement, grafting).
- Amputation [minor (toe disarticulations and fore foot amputations) or major amputation (below and above knee amputations)].

Data collection was done and recorded according to a proforma. Statistical analysis of the data was done. The probability of ulcer healing according to the DUSS was done using Kaplan Meier analysis.

RESULTS

Demographic profile

Majority of the patients were male (83.5%) with a mean age of 57.88 ± 13.56 years. More than 67% were from rural areas. Most of the patients in the study group were

diagnosed to have diabetes since 5 to 10 years (29.5%). Most of the study subjects had acute presentation like abscess, cellulitis as an initial presentation following trauma (42%).

Other observations

1) Co-existence of other comorbidities (Table 2) alongside diabetes resulted in poor outcomes even leading to minor/major amputations. 2) The incidence of osteomyelitis (Table 3) in diabetic foot ulcers was 18.5% Osteomyelitis was associated with uncontrolled diabetes resulting in poor wound healing and hence aggressively managed with amputations. 3) We also noticed that those with peripheral vascular disease (Table 4) had poor rates of wound healing. 4) The most common organism isolated (Table 5) on swab culture was enterococcus followed by proteus.

Table 2: Associated co-morbidities.

Co morbidities	Number	Percentage
HTN	75	37.5
IHD	11	5.5
CKD	38	19
Hypoalbuminemia	8	4
Hypothyroidism	5	2.5
HIV	1	0.5
COPD	62	31

Table 3: X-ray foot findings.

X ray findings	Number	Percentage (%)
Normal	87	43.5
Soft tissue swelling	40	20
Osteomyelitis	37	18.5
Fracture	14	7
Osteopenia	3	1.5
Not done	19	9.5

Table 4: Arterial Doppler findings.

Artery involved	Number	Percentage (%)
Doppler not done	15	7.5
Normal	48	24
Dorsalis pedis artery (DPA) alone	34	17
Posterior tibial artery (PTA) alone	42	21
DPA and PTA	36	18
Anterior tibial (ATA), DPA and PTA	25	12.5

DUSS parameters (ulcer characteristics)

- Ulcer site: In our study most of the subjects had ulcers over the foot 72%.
- Ulcer number: Majority of patients had single ulcers (66%) on presentation which showed positive results in terms of wound healing compared to those with multiple ulcers (34%).
- Peripheral pulses: 60.5% has palpable peripheral pulses. Those with absent peripheral pulses had higher amputation rates.
- Probing to bone: Probing to the bone by a sterile blunt probe indicates depth of ulcer. In our study 61 patients (30.5%) had probing to the bone. These patients had higher scores with poorer outcomes.

Table 5: Organisms isolated on swab culture.

Organism	Number	Percentage (%)
Enterococcus	35	17.5
Proteus	32	16
Klebsiella	30	15
Acinetobacter	29	14.5
Pseudomonas	27	13.5
Staphylococcus aureus	14	7
E. coli	9	4.5
Streptococcus	4	2
Citrobacter	2	1
Enterobacter	2	1
Non fermenting gram-negative bacteria	2	1
Diphtheroids	1	0.5

DUSS score distribution (Table 6)

Most of the patients in the study group had score 1 (42.5%) followed by score 2 (26.5%) and score 3 (22%). Least number had score 0 (4.5%) and score 4 (4.5%).

Table 6: DUSS distribution.

Score	Number of patients	Percentage (%)
0	9	4.5
1	85	42.5
2	53	26.5
3	44	22
4	9	4.5

DUSS score outcomes (Table 7)

There was significant association between DUSS and healing without surgical intervention. With increase in score there was decrease in healing rates and increase in amputation rates.

Those with scores 0, 1 and 2 had no major amputations. Whereas all 9 patients (100%) with score 4 underwent major amputations. There was a positive correlation between the severity of DUSS and the outcome of the disease (Table 8).

Table 7: DUSS score outcomes.

Outcome		DUSS scores					P value
		0	1	2	3	4	
Healing without any surgical intervention	No	7 (77.8%)	83(97.6%)	50 (94.3%)	44(100%)	9(100%)	0.015*
	Yes	2 (22.2%)	2 (2.4%)	3 (5.7%)	0 (0%)	0 (0%)	
Healing with debridement and negative pressure wound therapy	No	3 (33.3%)	45(52.9%)	36 (67.9%)	40(90.9%)	9(100%)	<0.001*
	Yes	6 (66.7%)	40 (47.1%)	17 (32.1%)	4(9.1%)	0 (0%)	
Healing with skin grafting	No	9 (100%)	68 (80%)	35 (66.0%)	42 (95.5%)	9(100%)	0.001*
	Yes	0 (0%)	17(20%)	18(34.0%)	2 (4.5%)	0 (0%)	
Minor amputation	No	8 (88.9%)	59 (69.4%)	38 (71.7%)	25(56.8%)	9(100%)	0.061
	Yes	1(11.9%)	26 (30.6)	15 (28.3%)	19 (43.2%)	0 (0%)	
Major amputation	No	9 (100%)	85(100%)	53(100%)	26 (59.1%)	0 (0%)	<0.001*
	AKA	0 (0%)	0 (0%)	0 (0%)	81 (18.2%)	4 (44.4%)	
	BKA	0 (0%)	0 (0%)	0 (0%)	10 (22.7%)	5 (55.6%)	

BKA- below knee amputation, AKA-Above knee amputation.

Table 8: Correlation between DUSS score and outcome.

Outcome	DUSS score									
	0		1		2		3		4	
	Number	%	Number	%	Number	%	Number	%	Number	%
Healing	8	88.9	59	69.4	38	71.7	6	14	0	0
Amputation	1	11.1	26	30.6	15	28.3	37	86	9	100

$\chi 2 = 57.69$, df=4, p <0.001.

Table 9: Validity of DUSS in predicting the outcome.

Area under the curve				
Test result variable (s): DUSS				
Area	SE	P value	Asymptotic 95% Confidence Interval	
			Lower bound	Upper bound
0.744	0.037	<0.001*	0.672	0.815

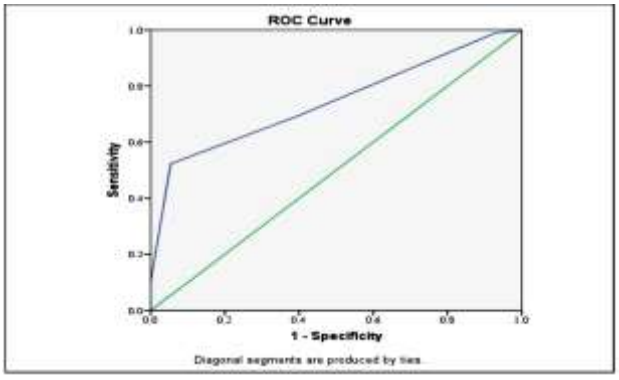

Figure 1: ROC curve.

Validity of DUSS in predicting the outcome (amputation and healing)

In our study, out of 200 patients, 88(44%) underwent amputation and 111 (56%) had healing of ulcer (Table 9). Area under ROC curve (Figure 1) analysis showed significant validity for DUSS in predicting amputation and healing.

DISCUSSION

The demographic profile of this study group is comparable to other studies.[1,11-14] In National Hospital Discharge Survey, it was revealed that elderly diabetics have twice the risk of developing a foot ulcer, three times the risk of developing a foot abscess and four times the risk of developing osteomyelitis.[15,16] Studies have shown that patients with diabetes of more than 10 year duration and poor glycaemic control (HbA1c >9.5±1.8) are at higher risk of developing foot ulcers.[1] In our study we noticed that these patients also had higher DUSS at the time of presentation. Those patients that had underlying osteomyelitis had poor healing rates in spite of having low DUSS scores. Hence these patients need a more aggressive approach in the management of diabetic foot

ulcers. Generally, the lower extremity amputation rate is 15 to 40 times higher in the diabetic versus non diabetic populations, and the amputation rate is at least 50% higher in men compared to women. In our study the amputation rate in the male group was 4.9% compared to 1.4% in female group. Out of 88 patients who underwent amputations, 30.5% had toe and forefoot amputation whereas below knee amputation was done in 7.5% of patients, above knee amputation was done in 6% of patients. In the original study conducted by Beckert et al, wounds with high DUSS showed a high probability for major amputation. As shown by Kaplan-Meier analysis, patients with a score of 0 had no risk of major amputation, while patients with a score of 1,2,3 and 4 had 2.4%, 7.7%,11.2%, and 3.8% probability of losing their limb.[11] In our study Kaplan Meier curve shows that DUSS was effective in predicting the outcome of the disease The healing rates in our study was highest (88.9%) for score 0, decreasing to 0% in those with score 4. This proved that those with higher DUSS had a higher probability of amputation. In total, 61patients underwent minor amputations and 27 underwent major amputations. Minor amputation rates were 11.1%, 30.5%, 28.3%, 44.1%, and 0% for scores 0,1,2,3 and 4 respectively. None of the patients with score 0,1, and 2 had major amputations. However, those with score 3 and 4 had high major amputation rates (41.8% and 100% respectively).

Majority of the ulcers with DUSS score 0 healed by 2weeks follow up, ulcers with score 1 healed by 2nd and 3rd follow up, ulcers with score 2 healed by 3rd and 4th follow up. Those ulcers with score 3 and 4 healed mostly only after surgical intervention by repeated debridement, skin grafting and amputations.

Clinical utility of DUSS: Since DUSS is based on 4 clinical wound based parameters which is easy to use it can be used as a screening tool by primary care physicians and even paramedical staff to identify 'at risk' patients and refer them to tertiary care hospitals. Ultimately the primary aim of surgical management of diabetic foot ulcer is revascularization, wound debridement, and eradication of the infection.[17] DUSS helps the surgeon to decide which patients require admission and which can be managed by out-patient care. It helps in risk stratification, planning treatment and in triage such that those patients with higher DUSS receive more intensive care and aggressive surgical wound management. This will also reduce the unnecessary burden of added investigations for patients with low risk of limb loss. Surgeons can use the DUSS during counselling to explain the probable outcome of the disease and treatment.

CONCLUSION

DUSS is a simple and effective clinical tool for screening of diabetic foot ulcers. Since it combines four clinically assessable wound based parameters without any other specialised investigative equipment or blood tests it can be applied even in primary care and in rural areas. This will help in triage and selecting patients that require referral to a tertiary hospital and in-patient treatment/care. This scoring system helps in predicting the probable outcome of treatment as shown in this study i.e. wounds with lesser scores underwent healing earlier compared to wounds with higher scores. Patients with DUSS of 4 had very high major amputation rates. This suggests that those patients with scores 3 and 4 require a more aggressive approach with surgical debridement for limb salvage. In addition, presence of peripheral vascular disease and underlying osteomyelitis had poorer outcomes. Finally, the application of DUSS during initial presentation can be used to counsel patients regarding prognosis and the probable outcome of the disease and helps the clinician to plan an active, targeted approach to surgical management of diabetic foot ulcer.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee Kempegowda Institute of Medical Sciences and Research Centre, Bangalore

REFERENCES

1. Shahbazian H, Yazdanpanah L, Latifi SM. Risk assessment of patients with diabetes for foot ulcers according to risk classification consensus of International Working Group on Diabetic Foot (IWGDF). Pak J Med Sci. 2013;29(3):730-4.
2. Ramachandran A, Snehalatha C, Shetty AS, Nanditha A. Trends in prevalence of diabetes in Asian countries. World J Diabetes. 2012;3:110-7.
3. Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio, et al. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analysis of 102 prospective studies. Emerging Risk Factors Collaboration. Lancet. 2010;26(375):2215-22.
4. Leone S, Pascale R, Vitale M, Esposito S. Epidemiology of diabetic foot. Infez Med. 2012;20 (Suppl 1):8–13.
5. Boulton AJM. Foot problems in patients with diabetes. In: Holt RIG, Cockram CS, Flyvbjerg A, Goldstein BJ, eds. Textbook of Diabetes. 4th ed. Wiley-Blackwell; 2010;725-42.
6. Schaper NC. Diabetic foot ulcer classification system for research purposes: a progress report on criteria for including patients in research studies. Diabetes Metab Res Rev. 2004;20:90–5.
7. Meggitt B. Surgical management of the diabetic foot. Br J Hosp Med. 1976;16:227–32.
8. Wagner FW Jr. The dysvascular foot: a system for diagnosis and treatment. Foot Ankle. 1981;2:64–122.
9. Lavery LA, Armstrong DG, Harkless LB. Classification of diabetic foot wounds. J Foot Ankle Surg. 1996;35:528-31.

10. Treece KA, Macfarlane RM, Pound N, Game FL, Jeffcoate WJ. Validation of a system of foot ulcer classification in diabetes mellitus. Diabet Med. 2004;21:987-91.
11. Beckert S, Witte M, Wicke C, Königsrainer A, Coerper S. A new wound-based severity score for diabetic foot ulcers: a prospective analysis of 1000 patients. Diabetes Care 2006;29:988-92.
12. Prompers L, Schaper N, Apelqvist J, Edmonds M, Jude E, Mauricio D, et al. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODIALE Study. Diabetologia. 2008;51:747-55.
13. Boyko EJ, Ahroni JH, Davignon D, Stensel V, Prigeon RL, Smith DG. Diagnostic utility of the history and physical examination for peripheral vascular disease among patients with diabetes mellitus. J Clin Epidemiol. 1997;50:659-68.
14. Oyibo SO, Jude EB, Tarawneh I, Nguyen HC, Armstrong DG, Harkless LB, et al. The effects of ulcer size and site, patient's age, sex and type and duration of diabetes on the outcome of diabetic foot ulcers. Diabet Med. 2001;18:133-8.
15. NHDS -National Hospital Discharge Survey Homepage. Available at: https://www.cdc.gov/nchs/nhds/index.htm. Accessed on 17 September 2016.
16. Reed JF. An audit of lower extremity complication in patients with Diabetes mellitus. International Journal Lower Extremity Wounds. 2004;3:161-4.
17. Mavrogenis AF, Megaloikonomos PD, Antoniadou T, Igoumenou VG, Panagopoulos GN, Dimopoulos L et. al. Current concepts for the evaluation and management of diabetic foot ulcers. EFORT Open Rev. 2018;3:513-25.

Cite this article as: Menezes JVF, Sreenidhi GM, Vani SK. Clinical utility of diabetic ulcer severity score in surgical practice. Int Surg J 2019;6:2469-74.