Original Research Article

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A study to test the validity of diabetic ulcer severity score (DUSS) at tertiary care hospital

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ABSTRACT

Background: For classification of ulcer of feet in diabetes, various systems of classification are in use. Notable among them are the University of Texas (UT) system and the Wagner system. One of the most recent such type of classification system is DUSS (Diabetic Ulcer Severity Score). Studies are required to validate the same. Objective was to test the validity of Diabetic Ulcer Severity Score (DUSS).

Methods: Present follow up study was carried out among 50 known cases of diabetes having ulcer over foot. DUSS scoring was applied. Ulcer was graded into five grades. Patients were followed till the outcome was noted.

Results: Most common ulcers were of DUSS score of 3. Major amputation was done in 15 (30%) patients and minor amputation in 12 (24%) patients. Toe amputation was done in total of 15 patients. None of the patients had forefoot amputation. Below knee amputation was done in total of 11 (22%) patients. Majority of the foot ulcers among study population with DUSS score 0, 1 and 2 healed by primary intension or skin grafting i.e., 1 (100%), 3 (75%) and 6 (46.15%) respectively. However, among those with score 3 and 4 majority required amputation i.e., 14 (70%) and 10 (83.33%) respectively. This difference in the DUSS score among the three groups was found to be statistically significant (P=0.004). The probability of healing with DUSS score 0 was 100%, 75% with DUSS score 1, 84.61% with DUSS score 2, 30% with DUSS score 3, 16.67% with DUSS score 4. The mean time for healing was 77 days. The mean time for amputation was 100 days.

Conclusions: The proposed score classification system for the diabetic foot may enable better quality of life for diabetic patients and promote better low-cost care for millions of individuals worldwide.

Keywords: Amputation, DUSS scoring system, Probability

INTRODUCTION

Nowadays globally, diabetes mellitus is the most common health problem and one of the most challenging. Diabetes resembles the plague of 14th century in terms of number of deaths it accounts for in today modern-day era, as well as a fast increase in occurrence and morbidity. According to WHO, the number of diabetic patients in 2000 reached to 171 million and was predicted to increase to 380 million by 2020. The Indian diabetic population is expected to

increase to 57 million by the year 2025. The incidence of diabetic foot among known cases of diabetes is 15% and is the most disturbing complication among them. In US and UK the incidence of diabetic foot is around 10% and the yearly occurrence is 3%. It is an important public health problem globally. It causes significant disturbances among the diabetics.

Over 50% of the ulcers become infected resulting in high rates of hospitalization, increased morbidities and potential lower extremities amputation.⁸ Foot ulcers are

responsible for about 85% of amputations of lower limb among diabetics. People with diabetes with one lower limb amputation have a 50% risk of developing a serious ulcer in the second limb within 2 years. People with diabetes have a 50% mortality rate in the 5 years following the initial amputation. For classification of ulcer of feet in diabetes, various systems of classification are in use. Notable among them are the University of Texas (UT) system and the Wagner system. These are based on the depth of ulcer, site of ulcer, associated neuropathy, presence of infection etc. One of the most recent such type of classification system is DUSS (Diabetic Ulcer Severity Score). Studies are required to validate the same. Present study was planned to test the validity of Diabetic Ulcer Severity Score (DUSS).

METHODS

The Present study was prospective study. It was carried out among 50 subjects in the General Surgery department, Kamineni hospital, Kamineni Institute of Medical Sciences (KIMS), Narketpally from October 2014 to September 2016. In the present study, 50 known cases of diabetes with ulcer of diabetic foot were included based on criteria of the present study. Detailed history was recorded like sex, age, literacy, occupation, social class etc.

Using statistical software, a sample size of 50 was calculated with 95% confidence interval and taking accuracy of 805. On examination of ulcer if purulent discharge was found then that ulcer was classified as infected. A sterile blunt probe was used to determine wound depth. The diabetic foot ulcer was differentiated from osteomyelitis based on characteristic clinical signs of osteomyelitis. ¹⁰

If the dorsalis pedis artery pulsation was absent on both the sides, and then a clinical diagnosis of peripheral vascular disease was considered. Depending upon the number of ulcers present, patients were classified as having single or multiple ulcers. If the patient was found to have multiple ulcers, then the ulcer with high grade was analyzed. The patients, whose ulcers did not heal, were followed for six months. The outcome was taken as healing of ulcer by primary intention or grafting of skin or amputation of lower limb.

The DUSS was taken as scores based on following observations. The score was zero if the dorsalis pedis artery was palpable and one if not palpable. The score was zero if there was no probing to bone and one if yes. The score was zero if the ulcer site was toes and one if it was foot. The score was zero in case of single ulcer and one in case of multiple ulcers. The foot ulcer of diabetes was graded taking into consideration its depth. Grade one was considered if the depth of the ulcer was up to dermis, grade two if it was up to subcutaneous tissue, grade three if it was up to fascia, grade four if it was up to muscle and grade five if it extended to bone. The above procedure was carried out to assess osteomyelitis. All patients received proper treatment. During follow up proper care and treatment was given, and all events were recorded. Data was analyzed statistically. Proportions were used for descriptive tables. Mean was used in certain cases. Probability of healing was assessed by Kaplan-Meier test.

RESULTS

Table 1: Comparison of DUSS score with amputation (major + minor) (N=50).

DUSS score	Amputation done (%)	Amputation not done (%)
0	0 (0%)	1 (100%)
1	1 (25%)	3 (75%)
2	2 (15.4%)	11 (84.6%)
3	14 (70%)	6 (30%)
4	10 (83.33%)	2 (16.67%)
Total	27 (54%)	23 (46%)

 $\chi^2 = 23.684a \text{ df} = 4, P=.000.$

No one underwent amputation with DUSS score 0. 1 (25%) out of 4 with DUSS score 1, 2 (15.4%) out of 13, 14 (70%) out of 20 with DUSS score 3, 10 (83.33%) out of 12 with DUSS score 4 underwent amputation respectively. Overall 27 (54%) of 50 people had amputations.

Table 2: Comparison of DUSS score with types of amputation (n=50).

DUSS score	Toe amputation	Forefoot amputation	Below knee amputation	Above knee amputation
0 (N = 1)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
1 (N = 4)	1 (25%)	0 (0%)	0 (0%)	0 (0%)
2(N = 13)	2 (15.38%)	0 (0%)	0 (0%)	0 (0%)
3 (N = 20)	11 (55%)	0 (0%)	3 (15%)	0 (0%)
4 (N = 12)	1 (8.33%)	0 (0%)	8 (66.6%)	1 (8.33%)
Total	15 (30%)	0 (0%)	11 (22%)	1 (2%)

*NOTE: amputated cases are 27.

Toe amputation was done in total of 15 patients. None of the patients with DUSS score 0, 1 (25%) with DUSS score 1, 2 (15.38%) patients with DUSS score 2, 11

(55%) patients with DUSS score 3, 1 (8.33%) patient with DUSS score 4 had toe amputations.

Table 3: Distribution of ulcers (DUSS score 0-4) with study end points (N=50).

DUSS score	Primary healing n (%)	Skin grafting n (%)	Amputation n (%)	Total n (%)
0	1 (100%)	0 (0%)	0 (0%)	1 (100%)
1	3 (75%)	0 (%)	1 (25%)	4 (100%)
2	6 (46.15%)	5 (38.46%)	2 (15.39%)	13 (100%)
3	4 (20%)	2 (10%)	14 (70%)	20 (100%)
4	0 (0%)	2 (16.67%)	10 (83.33%)	12 (100%)
Total	14 (28%)	9 (18%)	27 (54%)	50 (100%)

 $[\]chi^2 = 22.614a$, df = 8, P=.004.

Majority of the foot ulcers among study population with DUSS score 0, 1 and 2 healed by primary intension or skin grafting i.e. 1 (100%), 3 (75%) and 6 (46.15%) respectively.

However, among those with score 3 and 4 majority required amputation i.e. 14 (70%) and 10 (83.33%) respectively. This difference in the DUSS score among the three groups was found to be statistically significant (P=.004).

Table 4: COX regression analysis for DUSS scores.

	Df	P 95.0% CI for Exp (B)		
	DI	value	Lower	Upper
DUSS SCORE (0)	4	0.000		
DUSS SCORE (1)	1	0.001	6.708	1629.282
DUSS SCORE (2)	1	0.000	6.914	381.486
DUSS SCORE (3)	1	0.009	1.671	34.438
DUSS SCORE (4)	1	0.036	0.423	10.382

Table 5: Kaplan-Meier analysis for DUSS scores.

DUSS	Total	Number of	Censored	
score	Total	events	N	%
0	1	0	1	100
1	4	1	3	75
2	13	2	11	84.61
3	20	14	6	30
4	12	10	2	16.67
Overall	50	27	23	46

Table 4 shows COX regression analysis for DUSS scores. It is seen that as the as the DUSS score increased, the probability of ulcer healing decreased. Also, the

probability of amputation increased with increase in DUSS score.

Table 5 shows Kaplan- Meier analysis for DUSS scores. The probability of healing with score 0 was 100%, 75% with score 1, 84.61% with score 2, 30% with score 3, 16.67% with score 4.

Table 6: Survival distribution for different DUSS scores.

Overall comparisons			
	Chi-Square	Df	P value
Log rank (Mantel- Cox)	52.648	4	0.000
Breslow (Generalized Wilcoxon)	47.773	4	0.000

Table 6 shows survival distribution of different DUSS scores. Test of equality of the survival distribution for the different levels of DUSS SCORE.

DISCUSSION

Most common age group affected with Diabetic foot was between 51-65 years, second group being between 66-80 years. Mean age group was 57.32±10.712 years. Median age was 60.0 (IQR= 34.0 to 71.0 years). Males were commonly affected by Diabetic foot ulcers accounting to 56%. Most commonly ulcers were DUSS score 3 followed by score 2. Mean score was 2.76±0.981. Median score was 3.00 (IQR 0 to 4). A study undertaken in the USA in 2004 through the 2002 National Hospital Discharge Survey, evaluated 275,000 in patient records from 500 hospitals from 1996 onwards. This study revealed that the old aged cases of diabetic two times more chances of having ulcer over foot than younger diabetics.¹¹

Toe amputations comprise the majority of Diabetesrelated lower limb amputations. Both the age adjusted forefoot amputation rate and above-knee amputation rate was 0.8 per 1,000 persons. 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. Lower extremity amputation rate among diabetic men was 0.7% compared to females which were 0.33%. 12

In the present study one third of patients underwent toe amputation, 22% of the patients underwent below knee amputation, and 2% had above knee amputation. Similar findings were reported by Beckert et al. ¹³ Overall 27 (54.0%) of 50 people had amputations in the present study. In the present study, 24% patients underwent major amputation and 30% underwent minor amputation. There was 100% probability of healing in patients with zero score using Kaplan-Meier analysis. This probability came down to 75% when the score increased to one. It decreased further to 30% on having score of three and with scores four it became 16.7%. Similar findings were noted by Beckert et al. 13 They reported that as the score increased, the probability of healing ulcer decreased.

The present study showed that ulcers with lower score healed earlier when compared to those ulcers with higher scores. 1 out of 1 (100%) ulcer with DUSS SCORE 0 got healed by 4th follow up visit. With DUSS SCORE 1, 2 ulcers out of 4 got healed by 3rd follow up visit, 1 ulcer healed by 4th follow up visit, and 1 ulcer underwent amputation by 4th follow up visit. With DUSS SCORE 2, 7 (53.84%) out of 13 got healed by 4th follow up and 4 got healed by 5th follow up visit. Patients underwent amputation by 5th follow up visit. With DUSS score 3, out of 20, 1 ulcer in 3rd follow-up, 4 in 4th follow-up, 1 in 5th follow-up got healed and 14 underwent amputation in 5th follow up visit. With DUSS score 4 out of 12, 1 patients got healed in 4th follow up visit and one in the 5th follow up visit. 7 patients underwent amputation in 5th and 3 underwent amputation in 6th follow up visits respectively.

In a study conducted by Margolis et al 6.7% underwent amputation. ¹⁴ Among these, 46.3% were of toe. The amputation percentage was compared with DUSS. It was found that as the score increased, the probability of amputation increased.

The most common was ulcer with DUSS Score 3. Mean score was 2.76 ± 0.981 . None of the patients with DUSS score 0 underwent amputations. 1 (25%) out of 4 people with DUSS score 1 had amputation, 2 (15.4%) out of 13 people with DUSS score 2 had amputations, 14 (70%) out of 20 people with DUSS score 3 had amputations, 10 (83.33%) out of 12 people with DUSS score 4 had amputations.

The above data showed that ulcers with lower score healed earlier when compared to those ulcers with higher scores. Majority of ulcers with score 0 healed by the end of 4th follow up, most ulcers with score 1 healed by 3rd or

4th follow up, most ulcers with score 2 healed by 5th follow up. Patients with Score 3 and 4 healed mostly after surgical intervention by repeated surgical debridement or either after amputation or SSG. Time taken for healing was also found to be greater than lesser scores. When DUSS score is low most of the diabetic foot ulcers healed within 80 days and when the DUSS score is high it took greater time for healing >80 days. Majority of foot ulcers among study population with DUSS score 0, 1 and 2 healed by primary intention or skin grafting i.e., 1 (100%), 3 (75%) and 11 (84.61%) respectively. However, among those with score 3 and score 4 majority required amputation i.e., 14 (70%) and 10 (83.33%) respectively. The mean healing time was found to be 77.86 days. The mean time for amputation was found to be 100.48 days. Similar findings were observed by Beckert et al. 13

In the present study mean age was 57 years compared to Beckert et al study where mean age was 69 years. ¹³ In the present study males 28 (56%) were more commonly affected with ulcers than females 22 (44%), when compared to a study conducted by Beckert et al where males were 675 (67.5%) and females were 325 (32.5%) respectively. ¹³ Among various studies on diabetic foot ulcers, higher costs were observed among younger patients, patients with inadequate vascular status, and patients whose ulcer progressed to a higher severity level. Costs averaged \$4,465 higher for patients less than 65 years compared with older patients. ¹⁵ Primary healing rates reported by various studies were 74% by Beckert et al, 77% by Prompers et al, 65% by Oyibo et al, 66% by Jeffcoate et al and 72% by Gul et al.. ^{13,16-19}

CONCLUSION

For assessing probability of foot ulcer healing or probability of amputation, DUSS scoring is an easy and effective tool. It also tells us about whether the patient should be admitted or not. The proposed score classification system for the diabetic foot may enable better quality of life for diabetic patients and promote better low-cost care for millions of individuals worldwide.

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Institutional Ethics Committee

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