

Role of wound classification in predicting the outcome of Diabetic Foot Ulcer

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Abstract

Objective: To compare the effectiveness of Wagner and University of Texas (UT) classification systems of diabetic foot ulcers in directing appropriate therapy and possibly predicting outcomes.

Methods: A total of 383 patients with foot ulcer were seen. Details of socio-demographic and clinical profiles of 200 patients were completely available. Patients were assessed and classified into different grades and stages according to Wagner's and UT classification systems. Their duration of healing was recorded. The outcome end-points were defined as complete healing, major or minor amputations, or expired.

Results: Out of the 200 subjects, 65% were males and 35% were females. Mean age in males was 53.04 ± 10.33 years and in females was 51.14 ± 9.94 years. Average duration of treatment in males was 109.68 ± 82.26 days and in females was 85.10 ± 61.97 days. Forty five percent of the subjects had neuropathic ulcers. Median healing time increased with increase in Wagner grade and UT grade and stage. The higher the UT grade and stage at the time of presentation, the less the chances of ulcer to heal within the study period.

Conclusion: Our study has shown that grading and staging of diabetic foot ulcer affects and predicts the outcome. Amputation rates increase with increase in grade. Addition of stage to grade in UT classification helps further on assessing the severity of wound at the time of presentation and shows better association with the outcome (JPMA 56:444;2006).

Introduction

Diabetic foot ulcer is one of the main causes of mortality and morbidity among people with diabetes. Globally the lifetime incidence of foot ulcers in diabetic patients is around 15%.^{1,2} The yearly prevalence of foot ulcers in diabetics is approximately 2%.³ Local studies showed the prevalence of foot ulcer between 4 - 10.4%.^{4,5}

One of the major causes of lower extremity amputation is diabetic foot ulcer⁴, accounting for 70% of lower extremity amputations⁶ and having a mortality rate of 22% to 76% in four years.^{7,8} Neuropathy, ischaemia and immunopathy are some of the principal disorders underlying foot problems.^{9,10}

Risk of foot ulceration increases with the duration of diabetes, male sex, black race, advancing age, smoking habits, poor glycaemic control, peripheral neuropathy, vascular insufficiency, low level of HDL and retinal or renal complications.¹¹ Similar risk factors were identified in studies done in our population.^{5,12}

For appropriate diabetic foot ulcer treatment, a clear descriptive classification system that can possibly predict the outcome is required.¹⁰ The two classification systems used world wide are: (i) Wagner and (ii) University of Texas (UT) classification. Wagner classification is based on the depth or penetration of the wound, presence or absence of osteomyelitis or gangrene and the extent of tissue necrosis. On the other hand UT classification is not only based on the depth and penetration of wound, but it also takes into

account the presence or absence of infection and / or ischemia.¹ The aim of our study was, to compare the effectiveness of these two widely used classification systems in directing appropriate therapy' and possibly predicting outcomes.

Methods

Computerized records of diabetic subjects who visited the foot clinic of Baqai Institute of Diabetology and Endocrinology (BIDE) from January 1997 to December 2003 were reviewed. A total of 383 patients with foot ulcers were seen. Details of socio-demographic and clinical profiles of 200 patients were completely available. Patients were routinely examined by a team including a consultant diabetologist, associate diabetologist especially trained in diabetic foot, surgeon with special interest in diabetic foot, chiropodist and orthotist. Patients were assessed and classified into different grades and stages according to Wagner's and University of Texas classification system. Patients were classified in Wagner grade a if the feet were at risk, grade 1 superficial wound, grade 2 deep wound involving tendons and capsules but not bone, grade 3 bony involvement, grade 4 and 5 localized and generalized gangrene respectively. With respect to UT classification, patient with epithelialized wound or with feet at risk as grade 0, superficial wound as grade 1, deep wound involving tendons but not involving bone as grade 2, wounds that involves bones, localized and generalized gangrene as grade 3 of UT. There are four stages in each grade. No infection and ischemia (stage A),

presence of infection (stage B), presence of ischaemia (stage C) and presence of both infection and ischaemia (stage D).

Demographic and clinical features along with laboratory investigations were recorded for each patient using a detailed performa. The performa to collect data was based on standard protocol and procedures applied throughout the study period conducted by the same staff members and personnel. Sign and symptoms, appearance, cause, site and duration of ulcer, previous history of any treatment and foot wear used were all recorded. Previous history of ulcer and its outcome was also included in the analysis.

Peripheral pulses of lower limbs i.e. femoral, popliteal, dorsalis pedis and posterior tibial were assessed for patency of circulation in each patient by palpation and were graded as (a) good volume (b) diminished volume and (c) absent. Sensory neuropathy or touch sensation was assessed by using 10g monofilament which was applied perpendicularly to the feet, buckling at the given force of 10g and the filament was pressed against various sites including the plantar aspect of the first toe, the first, third and fifth metatarsal heads, the plantar surface of the heel and dorsum of the feet, while taking care not to apply the filament to any callus, corn or ulcer site. Vibration sense was checked for neuropathies by using tuning fork. In both methods the response of the patients was categorized as normal (properly realizing) (b) diminished (vague feeling) (c) and absent (not feeling); Presence or absence of ankle and knee reflexes was also assessed in each patient.

Ulcers were graded as infected or not on the basis of presence or absence of purulent discharge along with at least two other local signs (warmth, erythema, lymphangitis, lymphadenopathy, edema and pain). Diagnosis of osteomyelitis was made on the basis of penetration of probe to the bone and radiological findings.

Assessment of glycemic control was done by measuring HbA1c, fasting and random blood glucose. HbA1c < 6.5% was regarded as good, b/w 6.6 to 7.5% as fair and > 7.5% as poor.

Fasting plasma glucose upto 120mg/dl was taken as good, between 120 to 140mg/dl as fair and above 140mg/dl as poor. Two hours post prandial plasma glucose < 160mg/dl was taken as good, between 160 to 180mg/dl as fair and above 180mg/dl as poor. Photographs of foot ulcer of all the patients were taken at the time of presentation and during various stages of treatment. Patients were seen in the foot clinic on weekly or fortnightly basis while domiciliary chiropody service was provided to majority of them during the treatment period. The outcome endpoints were defined as complete healing, major or minor amputations, or expired.

The data were analyzed using SPSS version 10.0. Descriptive statistics were given for the baseline characteristics by using frequencies and percentages. Chi square and Fisher's Exact tests were used to assess the association of Wagner grade and VT grade and stage with amputation. Since the distribution of healing time was right skewed therefore median values were reported. Inter Quartile range were used to estimate the median healing time and compared healing time of those with healed ulcers; with or without amputation and those who expired.

Results

Out of the 200 subject, 65% were males and 35% females. Mean age in males was 53.04 ± 10.33 years and in females was 51.14 ± 9.94 years. Average duration of treatment in males was 109.68 ± 82.26 days and in females was 85.10 ± 61.97 days. Forty five percent of the subjects had neuropathic ulcers, 54.5% had neuro-ischemic ulcers, while < 1% had pure ischemic ulcers, 72.5% ulcers completely healed, 24% healed with amputation and 3.5% of the patients expired.

Table 1 shows the percentage of patients classified according to Wagner and University of Texas classification

Table 1. Foot ulcers and amputation according to Wagner grade and University of Texas grades and stages.

		Foot Ulcers	No Amputation	%	Amputation	%
Wagner Group						
Wagner Grade 1		14	13	92.8	1	7.1
Wagner Grade 2		129	105	81.3	24	18.6
Wagner Grade 3		48	31	64.5	17	35.4
Wagner Grade 4		6	2	33.3	4	66.6
Wagner Grade 5		3	0	0	3	100
Grade I						
Superficial wound not involving tendon						
None	Stage A	1	1	100.0	0	0
Infection	Stage B	9	8	88.8	1	11.1
Ischaemia	Stage C	1	1	100.0	0	0
Both	Stage D	6	5	83.3	1	16.6
Grade 2						
Wound penetrating to tendon						
None	Stage A	0	0	0	0	0
Infection	Stage B	60	52	86.6	8	13.3
Ischaemia	Stage C	1	0	0	1	100.0
Both	Stage D	72	54	75.0	18	25.0
Grade 3						
Wound penetrating to bone or joint						
None	Stage A	0	0	0	0	0
Infection	Stage B	21	15	71.4	6	28.5
Ischaemia	Stage C	1	0	0	1	100.0
Both	Stage D	42	19	45.2	23	54.7

Table 2. Median healing time of foot ulcer patient with respect to different parameters.

Variables	Total (n=200)	Completely healed (n=193)	Healing time Median (IQR)	P-value
Gender				
Male	130	127	90, 146-60	0.06
Female	70	60	70, 120-46	
Age(years)				
<45	35	35	80, 146-45	0.31
45-55	93	91	72, 120-45	
56-65	53	48	105, 150-60	
>65	19	19	90, 150-46	
Duration of Diabetes(years)				
<10	36	35	76, 120-60	0.09
10-15	52	50	60, 105-41	
16-20	60	58	90, 136-51	
>20	51	49	93, 170-60	
Cholesterol(mg/dl)				
<200	86	82	75, 132-46	0.71
≥200	46	44	75, 120-51	
Fasting Blood Sugar(mg/dl)				
≤120(good)	37	36	62, 112-44	0.20
121-40(fair)	17	17	113, 143-60	
>140(poor)	102	100	86, 150-51	
Random Blood Sugar(mg/dl)				
<160(good)	25	24	93, 180-60	0.51
160-80(fair)	19	18	68, 113-45	
>180 (poor)	133	129	80, 134-50	
HBA1c				
≤ 6.5(good)	9	9	90, 150-75	0.01
6.6-7.5(fair)	11	11	75, 150-68	
>7.5 (poor)	109	105	71, 120-45	
Wagner Grade				
Wagner Grade 1	14	13	29, 53-8	0.005
Wagner Grade 2	129	99	90, 128-45	
Wagner Grade 3	48	31	75, 139-41	
Wagner Grade 4	6	02	135, 362-53	
Wagner Grade 5	3	3	120, 180-90	
UT Grade 1				
UT Stage B	7	6	17, 38-5	
UT Stage D	7	6	30, 102-11	
UT Grade 2				
UT Stage B	59	50	75, 98-45	0.004
UT Stage D	70	49	90, 150-45	
UT Grade 3				
UT Stage B	21	15	60, 135-38	
UT Stage D	36	18	90, 150-30	

IQR: Inter Quantile Range

system with and without amputation. In Wagner's classification 7% of foot ulcer classified in grade 1, 64.5% in grade 2, 24% in grade 3, 3% in grade 4 and 1.5% in grade 5. By applying UT classification system, < 1% classified in UT grade 1 stage A, 3% classified in grade 1 stage B, 3.5% in grade 1 stage D, 29.5% in grade 2 stage B, 35% in grade

2 stage D, 10.5% in grade 3 stage B, 0.5% in grade 3 stage C, and 17.5% in grade 3 stage D. Using Wagner grade patients were 46 times more likely to have amputation if they had foot ulcers with localized or generalized gangrene when compared with grade 1. (OR 45.5; 95% CI; 3.48 - 594.68). As compared to UT grade 1 patients were three times more likely to have amputation in UT grade 2 (OR 2.9; 95% CI; 0.37 - 23.83). Grade 3 patients were 9 times more likely to undergo amputation when compared With grade 1 (OR 9.5; 95% CI; 1.15 - 77.27. Patients in stage C and D were 3 times more likely to undergo amputation when compared with patients in stage A and B. (OR 2.7; 95% CI; 1.31- 5.41).

Table 2 shows the median healing time with respect to physical and biochemical parameters. Median healing time is higher (p value <0.05 in patients with increasing HbA1c, advance Wagner grade and UT grade and stage.

Discussion

For appropriate diabetic foot ulcer treatment, a clear descriptive classification system is required as a diagnostic tool and ideally this tool should be able to suggest appropriate therapy and predict the outcome.^{10,13-15}

This study has shown that higher the grade of ulcer, greater will be the number of amputations and similar suggestions have been made in other studies.¹⁶⁻¹⁸ In this study healing time had positive relationship with Wagner grade and UT grade and stage i.e. higher the grade more is the healing time, and vice versa. Significant difference in the amputation rate was noted as the grade or stage increased.

This study assessed the power of two commonly used classification systems (i.e. Wagner and U.T. classification systems) in designing management strategy and predicting outcomes. Main factors contributing to cause foot ulcers are neuropathy and ischaemia usually with super added infection. A classification system encompassing these factors would have more predictive power. By comparing the two classification systems it is found that grade 0 of Wagner matches with grade 0 of UT classification. Similarly, grade 1 and 2 of Wagner matches with grade 1 and 2 of UT classification and grade 3 of UT represents grade 3, 4 and 5 of Wagner's classification. Although Wagner's system of classification has been used more often and is the one with the longest track record but its grading is basically anatomical, only grade 3 address infections.¹⁵ On the other hand UT classification system is based not only on the anatomical size and depth of the ulcer but also on the presence of infection, ischaemia and a combination of ischaemia and infection.¹⁵

Within the grading, the presence and absence of

ischaemia and/or infection makes UT classification system more descriptive and improves the predictive power of wound classification system as compared to Wagner classification.¹⁶

This study has shown the relationship between the grades of foot ulcers at the time of presentation with the outcome. The higher the grade, the greater the number of amputations done, but staging used in UT classification made it more descriptive and helped further in predicting the outcome of diabetic foot ulcer.

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