Inter-observer agreement of the Wagner, University of Texas and PEDIS classification systems for the diabetic foot syndrome

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ABSTRACT

Background: The aim of this cohort study was to assess the inter-observer agreement of three diabetic foot classification systems: the Wagner, the University of Texas and the PEDIS.
Methods: We included 250 consecutive patients diagnosed of diabetic foot syndrome in 2009–2013. Wound scores were recorded at admission and a reevaluation was performed simultaneously or 24 h later by a different evaluator. Demographical, laboratory data and associated risk factors were obtained from the patients' medical records.
Results: The Kappa coefficient showed a moderate inter-observer agreement between the first evaluation and the reevaluation for Wagner scale (Kappa = 0.55; 95% CI: 0.507–0.593), University of Texas scale (Kappa = 0.513; 95% CI: 0.463–0.563) and for PEDIS scale (Kappa = 0.574; 95% CI: 0.522–0.626).
Conclusions: This moderate agreement shows that these scales should not be used alone for management decisions regarding diabetic foot syndrome and should, therefore, be integrated with other clinical data to ensure an adequate handover.

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1. Introduction

The foot ulcer is among the late complications of diabetes. It is the most frequent cause of hospitalization (25%), with prolonged stays, among the diabetic patients [1]. Between 14 to 20% of this ulcers will require an amputation [2,3].

Because of the diversity in presentation of diabetic foot ulcers, the treatment strategy selection depends on the experience and skills of the local team of clinicians to classify the wound [4]. Inter-observer variation in wound classification may lead to erroneous interpretations [5]. Any clinical classification system should, therefore, have a high reproducibility in terms of inter-observer agreement (IOA) (i.e. repeated measurements of a stable characteristic produce similar results when scored by different observers)

and accuracy, i.e. the ability to assess the true condition of the wound [6].

There are several scales to evaluate the degree of severity of a diabetic ulcer analyzing the characteristics of the ulcer, ischemia and infection. The most used and globally accepted scales are the Wagner scale, University of Texas and PEDIS [7–9]. These scales have demonstrated their utility correlating their degree of severity with the risk of amputation [7–9]. The Wagner scale is easy to use and evaluates the depth of the wound, with the presence of osteitis in intermediate stages and gangrene in advanced stages. It does not evaluate ischemia specifically, but the gangrene can be due to the infection or ischemia in the advanced stages. The University of Texas scale is a little more complex, evaluating the presence of ischemia and infection with the depth of the wound. The PEDIS scale is the most focused on infection [10].

The knowledge of the IOA of these wound classifications could help choose a reliable tool for clinical decision taking regarding the diabetic foot syndrome (DFS). The aim of this study was to assess the IOA of these three wound classification systems: the Wagner, the University of Texas and the PEDIS.

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Secondary aims where to establish the rates of amputations and analyze the factors contributing to this outcome.

2. Material and methods

This was a prospective cohort study of 250 consecutive patients diagnosed of DFS and admitted to the Angiology and Vascular Surgery Unit of the San Cecilio University Hospital in Granada, Spain, between January 2009 and September 2013. We included diabetic patients with ulcers with extensive soft tissue and/or bone involvement, with infection and/or ischemia signs, that we did not consider candidates for ambulatory treatment, with either neuropathic, neuroischemic or ischemic etiology. Follow up was during one year in our outpatient clinic. The local Ethics Committee approved the study and all the patients signed an informed consent for participation.

A score sheet was used for this study (see Supplementary material).

It contained information on demographical and laboratory data and associated risk factors, obtained from the patients' medical records and by direct interview, including data on age, sex, height and weight, type of diabetes, retinopathy, bone deformities, excessive alcohol intake (35 U or more a week for men, 21 U or more for women), smoking, cardiac disease, renal disease, pulmonary disease, hypertension, stroke, prior amputations and revascularizations. It also recorded data on the current wound, such as time of evolution, type of wound, type of dressings used, prior use of antibiotics, presence of osteitis (assessed using plain radiographs and Magnetic Resonance when the radiographs were negative) and vascular status (assessed with pulse palpation and ankle brachial index plus pulse volume recording).

Laboratory data was also recorded on the sheet, including C reactive protein (CRP) and white blood cell (WBC) count as a measure of infection.

The sheet also included the Wagner, University of Texas and PEDIS scales with the description of each category.

The first evaluation of the scores was performed at admission, by the admitting vascular surgeon that was part of the study. The second evaluation was performed at the same time if other vascular surgeon was present at admission or 24 h later (the first and the second evaluators were always different physicians). These evaluations where always performed with the score sheets at hand (with the description of each category of the 3 scales) and using surgical tools to determine the depth of the wounds, and performing a probe-to-bone testing. The members of the Angiology and Vascular Surgery Unit (3 senior fellows and 9 staff members; all vascular surgeons) performed these evaluations randomly, including the first and the second evaluation. They had on average 12 years of clinical experience in evaluating and treating diabetic ulcers. This is a reference center for this pathology and many patients are treated every year; therefore, we did not consider any specific training was necessary for this study. Also, since all the physicians involved in this clinical study belong to the same team, their criteria regarding this entity is quite homogeneous.

This study was in a clinical setting, using the available tools in an everyday practice.

We also recorded the rates of minor (toe, ray or transmetatarsal) and major (above or below the knee) amputation in the cohort, and analyzed the factors contributing to these outcomes, including the severity of the wounds according to the 3 scales.

2.1. Statistical analysis

Continuous variables are expressed as mean + standard deviation; categorical variables are presented as percentages.

Comparison between quantitative variables was performed using Student's t-test and U Mann–Whitney test and for analysis of the qualitative variables the Chi-square and Fisher's exact tests. Data analysis IOA was calculated as an unweighted Cohen's Kappa (κ) coefficient. The κ-coefficient is a measure of agreement beyond chance. A κ-value above 0.8 is interpreted as 'very good', between 0.8 and 0.6 is 'good', between 0.6 and 0.4 'moderate' and below 0.4 'poor' [11]. Statistical significance was set at $P < 0.05$. Statistical analysis was performed using SPSS version 20.0 (SPSS, Chicago, IL, USA).

Table 1
Demographic and laboratory information and risk factors of the cohort.

N	250
Male sex	199 (80%)
Age	66 years (SD 11.3)
Height	167 cm (SD 8)
Weight	77 kg (SD 12)
Type of diabetes	
Type 1	221 (88%)
Type 2	29 (12%)
Prior amputations	
1 toe	27 (11%)
Several toes	29 (12%)
Contra lateral	35 (14%)
Bilateral	15 (6%)
Prior revascularizations	
Angioplasty	7 (3%)
By-pass	9 (4%)
Contra lateral	17 (7%)
Type of ulcer	
Neuropathic	104 (42%)
Neuroischemic	122 (49%)
Ischemic	23 (9%)
Site of ulcer	
Forefoot	219 (88%)
Midfoot	17 (7%)
Hindfoot	14 (5%)
ABI	0.7 (SD 0.28)
Laboratory data	
Blood glucose	235 mg/dl (SD 108)
WBC	$12.6 \times 1000/mm^3$ (SD 4.6)
Hemoglobin	12.8 g/dl (SD 6)
Creatinin	1.2 mg/dl (SD 0.9)
Urea	60 mg/dl (SD 33)
Total cholesterol	137 mg/dl (SD 37)
Albumin	3.5 g/l (SD 0.5)
CRP	10.8 mg/l (SD 9)
HbA1c	8.3% (67 mmol/mol) (SD 2)
Retinopathy	109 (44%)
Bone deformities	44 (18%)
Excessive alcohol intake	32 (13%)
Smoking	
Current	48 (19%)
Prior	106 (42%)
Cardiac disease	
Coronary disease	38 (15%)
Congestive heart failure	8 (3%)
Arrhythmia	23 (9%)
Renal disease	53 (21%)
Pulmonary disease	15 (6%)
Hypertension	155 (62%)
Stroke	23 (9%)