

Epidemiological, clinical and prognostic factors in diabetic foot amputations at Souss Massa Agadir University Hospital

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Abstract

Introduction: The diabetic foot is a real public health problem whose prognosis is dominated by a still high rate of lower limb amputation, even in countries with a high socioeconomic level. We conducted this study with the aim of describing the clinical, paraclinical, therapeutic and evolutionary aspects of the diabetic foot hospitalized in our department and also to define the prognostic factors influencing the progression to amputation.

Materials and method: This is a retrospective descriptive and analytical study spread over a period of 11 months (June 2022-May 2023) involving 60 diabetic patients admitted for diabetic foot at the Department of Diabetology and Metabolic Diseases Endocrinology at the Souss Massa Hospital.

Results: The mean age was 62.45 years, and the sex ratio was 5. The majority of our patients had type 2 diabetes (93.3%), with a mean duration of diabetes of 14 years. The mean glycated hemoglobin (HbA1c) was 10.10%. The average consultation time was 36.5 days. All patients had associated risk practices (barefoot, inappropriate footwear, poor hygiene, etc.). The starting point of the foot lesions was trauma, which resulted in a superinfected wound in 43% of cases. Damage to the forefoot predominated (45% of cases). Gangrene was the main lesion found (53%). Neuropathy was the main etiopathogenic factor (83%). The majority of lesions (67%) were Wagner grade 4 and 5. 28.3% of patients underwent surgical debridement and 63.3% underwent amputation as follows 51.7% were minor amputations (toe regularisation in 19% of cases and forefoot amputation in 32.7% of cases). Major transtibial amputation was performed in 7 patients (11.7%). There were no deaths in the study.

In our study, factors favouring amputation were: patient age > 70 years ($p=0.01$), glycaemic control: $HbA1c > 8\%$ ($p=0.03$), lack of diabetes control ($p=0.03$), presence of arteriopathy ($p=0.003$), osteitis ($p=0.019$), Wagner stage 4 and 5 ($p < 0.001$), previous foot amputation ($p=0.005$), infection ($p=0.004$).

Factors not associated with amputation were (male) sex ($p=0.749$), nephropathy ($p=0.476$), hypertension ($p=0.457$), retinopathy ($p=0.274$), neuropathy ($p=0.400$), heart disease ($p=0.902$), dyslipidaemia ($p=0.096$).

Conclusion: The majority of our patients are unattended, unbalanced, late seekers with advanced lesions and a high amputation rate. This may be related to patient ignorance, illiteracy and lack of knowledge about diabetes and its complications, as well as difficulties in accessing care and low socio-economic status. The fight against diabetic foot is based on prevention: education of patients and caregivers on the one hand, and multidisciplinary, concerted management on the other.

Keywords: Diabetic foot; Amputation; Factors; Morbidity

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1. Introduction

The diabetic foot is defined as any infection, ulceration or destruction of foot tissue in a newly or previously diagnosed patient with diabetes mellitus, usually associated with neuropathy and/or peripheral arteriopathy of the lower limbs (1). It is a common and serious complication of diabetes; in fact, diabetic foot is the leading cause of disabling neuropathy and non-traumatic amputation worldwide: 5 to 10% of people with diabetes have or will have a toe, foot or leg amputation (2). In Morocco, the national Stepwise survey conducted in 2018 estimated that diabetes affects 12.4% of the adult population, but no statistics are available on the incidence and prevalence of diabetes-related lower limb amputations. In this context, we conducted this retrospective study with the aim of describing the epidemiologic, diagnostic, therapeutic and evolutionary profile of the diabetic foot in the Souss Massa Hospital Center, as well as defining the factors that increase the risk of amputation in our context.

2. Materials and Methods

This is a retrospective descriptive and analytical study covering an 11-month period from June 2022 to May 2023, during which 60 diabetic patients with foot lesions were treated at the Endocrinology, Diabetology and Metabolic Diseases Department of the Souss Massa Agadir Hospital. The study was carried out using a data collection sheet, and the parameters studied were collected from the hospital medical records and manually entered into an Excel spreadsheet, while maintaining the anonymity of the patients. The parameters studied were epidemiological data (age, sex, NSE, origin), diabetes characteristics (type, age in months, glycemic control (HbA1c), presence of other cardiovascular risk factors (obesity, hypertension, dyslipidemia, smoking, enolism), degenerative complications: Retinopathy based on fundus examination, nephropathy based on microalbuminuria ≥ 30 mg/24 h, renal insufficiency based on creatinine clearance < 60 mL/min, neuropathy based on at least two of the following criteria: functional signs (pain, paresthesias), impaired ipsilateral test, osteotendinous areflexia, etc.

Coronary artery disease (CAD) is defined by the presence of clinical (angina) and electrocardiographic signs, while obliterative arteriopathy of the lower limbs (PAD) is defined by the presence of: intermittent claudication, weak or absent pedal and posterior tibial pulses. The study also examined foot characteristics (location and type of lesion, Wagner stage classification, presence of infection on clinical examination, osteitis on standard radiography, favorable factors, and high-risk practices). Amputations were classified as major (above the ankle) and minor (below the ankle). The analytical study examined the various factors that influence the use of amputation. Statistical analysis of the data was performed using IBM SPSS Statistics 25 software, and the chi-squared test was used to compare percentages, with a significance level of $p < 0.05$.

3. Results

The study included 60 patients. The mean age of our patients was 62.45 years, with a clear male predominance (75%). The majority of patients had type 2 diabetes (93.3%) with a mean age of onset of 14 years. The mean HbA1C of our patients was 11.50% (7-17%). Almost all patients (90%) had at least one degenerative complication of diabetes, including 83% with diabetic neuropathy. Hypertension, smoking, dyslipidemia and obesity were the major associated cardiovascular risk factors. (Table 1)

Table 1 Study population characteristics

	N =60	%	Average
Average Age	-	-	62.54(28-84)
Gender			
- Male	45	75	
- Female	15	15	
Diabetes			
-type 1	4	6.7	
- Type 2	56	93.3	
Progression time (years)			14

Glycated hemoglobin (%)			11.5 (7-17)
Complications :			
- Neuropathy		83	
- Retinopathy		33	
- Kidney Failure		37	
- Heart Disease		33	
- Lower Extremity Arteriopathy		66.7	
Risk Factors			
- Hypertension		52	
- Dyslipidemia		15	
- Cigarette Smoking		50	
- Obesity		22	

3.1. Characteristics of foot lesions

The mean consultation time was 36.5 days (0 to 280 days). All patients had risky behaviors, especially walking barefoot (30%), wearing inappropriate footwear (18%), poor hygiene, and cutting raw nails; these behaviors were often associated in the same patient. The precipitating factor was trauma (43% of cases), intertoe intertrigo (neglected or poorly treated) in 8% of cases, and no factor was found in 36% of patients. In addition, burn was found in 1 patient.

Approximately 20% of patients had a history of foot amputation. Most lesions were located on the forefoot (43.3% of cases). Infection was the most common clinical manifestation (92%). Wet gangrene and ischemic necrosis were the most common lesions (69%). The majority of patients had multifactorial neurological and arterial involvement. Lesions were classified as Wagner grade 4 and 5 in 67% of cases (Table 2).

Table 2 Describes the characteristics of the foot lesions

	%
Affected foot	
- Right foot	53
- Left foot	40
- Bilateral	7
History of foot amputation	20
Inciting factors :	
- Trauma	43
- Unsuitable footwear	18
- Ilio	8
- Burns	1.66
- No factors	36
Average consultation time in days	36
Injury Location :	
- Toes	38.3
- Forefoot	43.3

- Heel	6.7
- Lower leg	11.7
Type of lesion :	
- Wet gangrene	42
- Ischemic necrosis	27
- Phlegmon	17
- Mpp	11
- Ulceration	3
Infection	92
Wagner classification ≥ 4	67

Bacteriologic sampling was performed in 7 patients and showed mainly BGN. Foot radiographs in 58 patients showed osteitis in 32% of cases. Evaluation of the vascular bed by echodoppler (6 patients) and CT angio (11 patients) revealed significant arterial stenosis in the majority of patients.

Surgical treatment was indicated in 91% of our patients (n=55), 28.3% benefited from conservative treatment (n=17), 63.3% of our patients (38 cases) underwent amputation, of which 51.7% of cases (31 of 38) were minor amputations and 11.7% were major amputations (7 cases).

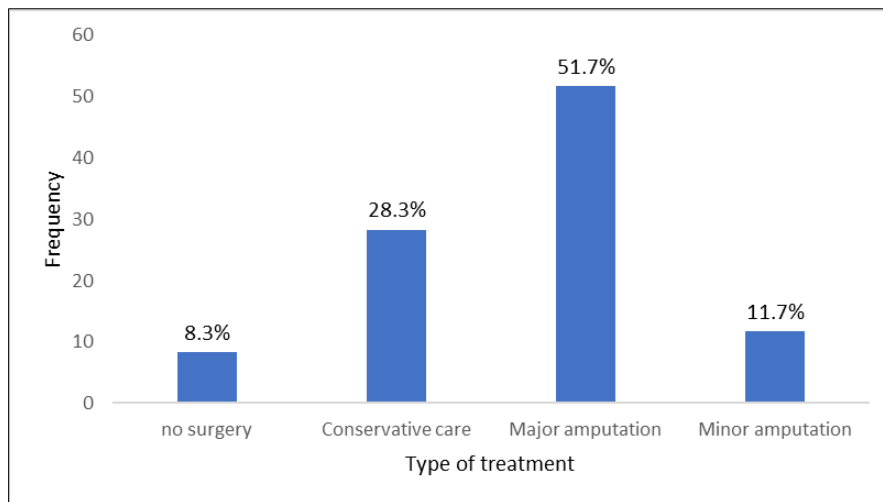


Figure 3 Distribution of patients by type of treatment

The results of statistical analysis show that amputation is significantly associated with age >70 years, diabetes duration >15 years, smoking, diabetic imbalance HbA1C >8%, osteitis, arteriopathy and Wagner grade ≥ 4 .

Table 4 The principal significant factors

	Number	Frequency %	P
Age > 70 years	37	61.7	0.04
Evolution of diabetes > 180 months	33	55	0.03
No follow-up	36	60	0.002
HbA1C > 8%	44	73	0.03
smoking	30	50	0.016

Obliterative arteriopathy of the lower limbs	39	65	0.001
history of foot amputation	12	20	0.005
Infection	55	91.7	0.004
Wagner classification 4 and 5	40	66.7	<0.001
Osteitis	19	31.7	0.019

The outcome was favorable in 51% of our patients. The main complications were superinfection and necrosis of the amputation stump (in 14 and 5 patients, respectively). There were 9 cases of ketoacidosis decompensation and one case of septic shock in a 78-year-old patient requiring intensive care. No deaths were reported in our series.

4. Discussion

The mean age of our patients was 62.45 years. The mean age reported in the European literature is 68.94 years (5). Male predominance is a phenomenon confirmed by several authors. Sani et al (6) found a sex ratio of 2.46. The mean duration of diabetes was 14 years (0 to 30 years). The diabetic foot revealed previously unrecognized T2DM in 4 patients. This is confirmed by several Moroccan studies (7,8). The main cardiovascular risk factors associated with diabetes in our series were hypertension (52%) and smoking (50%). Nan Xia et al presented a study confirming the role of smoking in all stages of foot ulcer disease, from onset to healing (9). In our study, the majority of patients (70%) were seen within 30 days or less. This result is close to that of Dia DG [3], who found that 78.6% of patients were admitted after two weeks of lesion evolution. Ignorance of the disease may have led to underestimation of lesions in addition to neuropathy by suppressing the warning sign of pain, thus contributing to the delay in consultation. Clinically, foot lesions were dominated by wet gangrene (42%) and ischemic necrosis (27%). In Quassimi's series, 32.65% of patients presented with phlegmon, 28.57% with plantar perforator, 14.28% with ischemic necrosis; gangrene was found in only 8.16% of cases (8). The severity of the foot lesions, characterized by a high frequency of grade 4 and 5 lesions (67%) according to Wagner's classification, in itself represents a higher risk of major amputation. A number of factors can contribute to the serious progression of a diabetic foot to amputation:

- The incidence of lower limb amputation increases in older subjects, whether diabetic or not. Jean Doucet found that the rate of amputation in diabetic patients increased significantly with age ($p < 0.01$) (10). In our series, the frequency of amputation is significantly related to age ($p = 0.04$). This may be explained by the decrease in angiogenesis and local growth factor synthesis (11) and the high incidence of arteriopathy in the elderly.
- According to several authors, the amputation rate is higher in men [12,13]. However, other series [14] have found no correlation between male sex and lesion progression. In our series, the frequency of amputation was not correlated with male sex ($P=0.749$).

According to the literature, the age of diabetes and the presence of degenerative complications (retinopathy, nephropathy and macroangiopathy) increase the relative risk of amputation (13). In our series, duration of diabetes >180 months was significantly correlated with the rate of amputation ($p=0.03$), whereas the presence of microangiopathy did not influence this rate, as also reported by EL Alami (11);

- Renal insufficiency is an adverse factor in the case of foot lesions (15,16): amputation is 10 times more frequent than in the diabetic population with normal renal function, and 4% of dialysis patients per year are amputated, but in our series this correlation was not significant.
- Osteitis is significantly correlated with amputation ($p < 0.001$) (17,18,19). This was also observed in our series ($p = 0.019$). We associate this rate either with a delay in consultation in advanced stages of lesions involving deep tissues or with the attitudes of treating physicians, who perform a minor amputation in the presence of phalangeal osteitis in order to rapidly control the infection and reduce the duration of antibiotic therapy;
- Arteriopathy is common in diabetic patients and is found in 30% of patients on echodoppler, making it the most common factor associated with amputation (20,21). However, the diagnostic criteria for AOMI vary from study to study, ranging from intermittent claudication and pathological ankle-arm indexes to arterial thrombosis on color Doppler or arterial angiography. This is a critical factor in the evolution of lesions. In our series, AOMI was significantly associated with amputation ($p=0.001$). Revascularization surgery combined with intensive management promotes healing in 75% of chronic wounds and allows limb salvage in 83% of patients (11).
- The type of lesion is a major risk factor for the extent of amputation. Gangrene of the foot is the most common cause of minor and major amputation (22,23). The presence of signs of local or systemic infection is also a determining factor in the increased risk of amputation, as is the initial severity of the lesion: Wagner stages 4

and 5 or stage 3 according to the IWGDF classification were most correlated with major amputation (20,21,22). In our series, these parameters were significantly correlated with amputation rate (infection: $p=0.004$, Wagner stages 4 and 5: $p<0.001$).

- Smoking has also been described in the literature as a determining factor in the prevalence of foot amputation in diabetic patients (24,25). In our series, smoking was strongly correlated with amputation rate ($p=0.019$). Smoking cessation may be a good way to reduce the risk of diabetic foot amputation.

5. Conclusion

We note that the majority of our patients are unattended, unbalanced, consulted late at an advanced stage of lesions with a high rate of amputation. This may be related to patients' ignorance, illiteracy and lack of knowledge about diabetes and its complications, as well as difficulties in accessing care and low socioeconomic status. The fight against diabetic foot is based on prevention, education of patients and healthcare professionals, and multidisciplinary, coordinated management.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors'.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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