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Original Article

Epidemiological study of patients with diabetic foot

Fernando Viamont Guerra[1], Thomas Yi Teh Lee[1], Edward Patrick Sinibaldi Eagers[1], Marcelo Marcucci Chakkour[1], Noé De Marchi Neto[1], Jordanna Maria Pereira Bergamasco[1], Marco Túlio Costa[1]

1. Santa Casa de Misericórdia de São Paulo, São Paulo, SP, Brazil.

Abstract

Objective: Describe the epidemiological profile of patients with diabetic foot registered and followed in an orthopedic outpatient clinic.

Methods: A retrospective study was conducted, analyzing the medical records of 500 patients. The reason for the initial consultation, age, smoking, alcoholism, body mass index, sex, type of diabetes, and need and type of surgery were analyzed.

Results: The reason for the initial consultation was foot ulcer in 198 patients (39.6%), followed by infection in 122 (24.4%). One hundred and twenty patients (24%) had Charcot arthropathy and 60 (12%) diabetic neuropathy. Most patients were male (67.2%), and the mean age was 65 years, with almost 70% over 50 years in initial care. The mean body mass index was 26.11. Most patients reported being non-smokers (81.4%) and non-alcoholics (85.2%). Type II diabetes predominated (94.4%). Amputations were performed in 306 patients (81.4%) at some point during outpatient follow-up, being classified as minor in 182 patients (59.5%) and major in 124 (40.5%).

Conclusion: Most patients at the diabetic foot outpatient clinic are men aged over 50 years, non-smokers and non-alcoholics, and with a slightly high body mass index of 26.1. They have already attended the outpatient clinic with foot complications and suffered some level of foot amputation.

Level of Evidence IV; Therapeutic Studies; Case Series.

Keywords: Diabetic foot; Epidemiology; Complications.

Introduction

Diabetes Mellitus is a chronic disease with high prevalence in Brazil and worldwide[1-3]. In 2021, according to the International Diabetes Federation, one in ten adults had diabetes. According to the organization, diabetes in adults between 20 and 79 years old tripled between 2000 (4.6% worldwide) and 2021 (10.5% worldwide). In Brazil, this number is estimated to be 15.7 million[4].

Among the complications, peripheral arterial disease and neuropathy are responsible for diabetic foot syndrome, which includes ulcers, Charcot arthropathy, and infection that may end in amputation[1]. The importance of diabetic foot extends beyond the impact on individuals; it is also a public health concern[5,6]. Almost 25% of health expenditures in the diabetes population are due to foot complications. It is estimated that, annually, in the US and the UK, this expenditure reaches 11 billion dollars and almost half a billion dollars, respectively[7]. In Brazil in 2014, this expenditure exceeded 500 million reais[8]. Investing in preventing diabetic foot is deemed essential for mitigating associated complications and reducing consequent healthcare expenses[3,5]. According to Al-Rubeaan et al.[7], implementing programs to prevent diabetic foot syndrome can reduce the amputation rate by up to 70%.

The medical records of patients registered in the foot and ankle group were evaluated to understand the profile of patients who attend the diabetic foot outpatient clinic at our institution and to outline an adequate prevention program for the future. The initial impression is that the patients who attend our outpatient clinic are, for the most part, type II

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Correspondence: Marco Túlio Costa. Avenida Albert Einstein 627, Bloco A1, Pavilhão Vicky Joseph Safra, 3º andar, Sala 306, Morumbi, São Paulo, SP, Brazil. **Email:** marcotulio9@me.com. **Conflicts of interest:** none. **Source of funding:** none. **Date received:** October 16, 2023. **Date accepted:** April 30, 2024. **Online:** April 30, 2024.

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diabetics, obese, and smokers, and the attendance is already to treat some complications, and they do not fit into a prevention program for wound and foot amputation.

The objective of the study is to describe the epidemiological profile of patients with diabetic foot registered and followed in an outpatient clinic of the foot and ankle group of the Department of Orthopedics of Santa Casa de Misericórdia de São Paulo.

Methods

This study was approved by the Institutional Review Board under the number 69935823.3.0000.5479. The first 1000 patients registered at the outpatient clinic were analyzed. The data collected were obtained from the medical records routinely updated at each new consultation.

The following data were analyzed: the age the patient started follow-up at the outpatient clinic, sex, type of diabetes, body mass index (BMI), habits (smoking and alcoholism), regular control of diabetes, use of insulin therapy, history of ulcers (evaluating the site of lesions and possible recurrences), presence of Charcot arthropathy and its classifications (anatomical and evolutionary of Einchenholtz)[9-12], and previous surgery. Other diabetes-related factors were also noted, such as ophthalmological, renal, and vascular disorders, which were reported by the patient. If amputation was performed, what was the reason for it, and what was the level of amputation. The reason for initial care was also documented and classified into peripheral neuropathy (only loss of sensation without other disorders), ulcer, infection, or Charcot arthropathy. When there were two of these disorders in the initial care, we considered this reason in the following order: Charcot arthropathy, infection, ulcer, and loss of sensation.

The BMI was calculated based on the weight performed at the patient's last visit. Six groups were considered: underweight, BMI less than 18.5; ideal weight, BMI between 18.6 and 24.9; slightly overweight, BMI between 25.0 and 29.9; grade I obesity, BMI between 30.0 and 34.9; grade II obesity, BMI between 35.0 and 39.9; and grade III obesity (morbid), BMI above 40. The patients were considered smokers when they declared smoking daily. The patients were considered alcoholic when there was daily declared alcohol intake. Adequate regular control of diabetics was defined as clinical outpatient visits every four months at least. Recurrent ulcer was defined as the appearance of a new ulcer in the same foot with previous involvement, regardless of whether or not it was on the same topography as the last. Appropriate footwear was considered when the patient came to the outpatient clinic with the correct shoe, insole, or orthosis suitable for the level of amputation. Charcot arthropathy and its classifications were detected from the changes seen on the foot and ankle radiographs (in amputees, the radiographs before amputation were considered). Minor amputation was defined when part of the foot was preserved, while major amputation was considered when amputation was performed at the level of the tibia or more proximal. Ophthalmological and renal disorders were determined by the self-declaration of any problem that the person feels regarding the vision and any diagnosis by other medical services related to the urinary tract.

Patients without written records or with incomplete data, those who did not return after the first consultation, or those who lost follow-up after some consultations were excluded from the study. Therefore, data from patients who did not maintain outpatient follow-up were excluded from the study. Patient data were tabulated and evaluated after applying the inclusion and exclusion criteria. In some of these medical records, when data regarding visual acuity, renal function, smoking, weight, and height were not described, but the group considered that it would be possible to include the patient in the study due to the other parameters described, this patient was included in the analysis. We report, therefore, that some of this information is unknown in the results and tables.

Results

The reason for the initial care among the 500 patients who maintained outpatient follow-up was foot ulcer in 198 patients (39.6%), and the second reason was infection in 122 patients (24.4%). In 120 (24%), Charcot arthropathy in different stages was the cause for attendance, and 60 (12%) patients had diabetic neuropathy without other comorbidities in the foot. Three hundred and thirty-six patients were male (67.2%). The mean age was 65 years (ranging from 20 to 85 years), with almost 346 patients (70%) older than 50 years in initial care. Excess weight was a common characteristic, with a mean BMI of 26.11, noting that not all patients reported their weight (this information was available in 443 medical records). Most reported that they were non-smokers (81.4%; 407 patients) and non-alcoholics (85.2%; 426 patients). Type II diabetes predominated in the cases evaluated (94.4%; 472 patients). However, only 331 patients reported regular clinical visits (62.2%), and 18 did not know how often they visited the regular clinic to control diabetes (Table 1).

A minority of patients failed to comply with the recommendation for regular fundus examinations, leading to a lack of clinical data regarding their vision. In addition, a portion did not adhere to the laboratory tests indicated to evaluate renal function, while another portion neglected the vascular evaluation, resulting in a lack of information about these complications. Table 2 shows the data collected regarding visual acuity, renal function, and vascular disorders.

Amputations were performed in 306 (81.4%) patients at some point during outpatient follow-up, being classified as minor in 182 (59.5%) patients and major in 124 (40.5%). Eighty-seven patients (23.1%) were submitted to bone resections. In 34 (9%) patients it was performed some type of arthrodesis and isolated Achilles elongation, in 22 (5.9%) cases, 12 (54.5%) were open, and ten (45.5%) were percutaneous.

The anatomical and classifications of Eichenholtz are represented in Table 3. Charcot Arthropathy was observed in 126 (25.2%) patients.

Table 1. General characteristics of the 500 patients analyzed in the study

Category	Number of patients	Percentage (%)
Sex		
Male	336	67.2
Female	164	32.8
Age		
≥ 50 years	346	69.2
< 50 years	154	30.8
Body Mass Index		
Low weight (< 18.5)	2	0.4
Ideal (between 18.6 and 24.9)	133	26.6
Overweight (between 25.0 and 29.9)	182	36.4
Grade I obesity (between 30.0 and 34.9)	80	16.0
Grade II obesity (between 35.0 and 39.9)	35	7.0
Grade III obesity (over 40.0)	11	2.2
Did not reveal	57	11.4
Life habits		
Smokers	88	17.6
Non-smokers	407	81.4
Not informed	5	1.0
Alcoholic	66	13.2
Non-alcoholic	426	85.2
Not informed	8	1.6
Comorbidities and clinical control		
Diabetes type 1	28	5.6
Diabetes type 2	472	94.4
Insulin as treatment	307	61.4
Oral anti-diabetics	7	1.4
Regular clinical control	331	66.2
No regular follow-up	151	30.2
They were unable to answer	18	3.6

Table 2. Distribution of diabetes complications observed in the initial care

Category	Number of patients	Percentage (%)
Visual disorders		
Altered vision	219	43.8
Normal vision	253	50.6
Not informed	28	5.6
Kidney disorders		
Altered kidney function	76	15.2
Preserved kidney function	376	75.2
Not informed	48	9.6
Vascular disorders		
Vascular normality	234	46.8
Vascular disorders	248	49.6
Not informed	18	3.6
Ulcer		
With plantar ulcers	318	63.6
No plantar ulcers	182	36.4
Surgical indication		
Surgery performed	376	75.2
Surgery not indicated	124	24.8
Type of surgery*		
Amputations	306	81.4
Bone resections	87	23.1
Arthrodesis	34	9
Achilles stretch	22	5.9

Table 3. Eichenholtz anatomical and classification

Category	Number of patients	Percentage (%)
Anatomical classification		
Forefoot	13	10.3
Lisfranc	25	19.8
Chopart	8	6.4
Ankle and subtalar	42	33.3
Mixed involvement	33	26.2
The limit of involvement is not set	5	4
Eichenholtz classification		
Acute	9	7.1
Consolidation	28	22.2
Sequelae	78	62
Classification not defined	11	8.7

Discussion

It is believed that approximately 25% of patients diagnosed with diabetes will have foot complications related to neuropathy and vasculopathy[13,14]. Diabetic foot is one of the main causes of hospitalization in diabetic patients and is responsible for most amputations currently performed[2,13,15]. Knowledge of the profile of this diabetic patient who develops foot disorders is important to adjust an adequate prevention program, reduce hospitalizations and amputations, and reduce the cost to the health system[6,13,16]. In our study, we tried to trace the profile of patients seen at the foot outpatient clinic and found some interesting data.

In most patients in the study, the first visit was due to a foot ulcer (39.6%; 198 patients) or infection (24.4%; 122 patients). In 64% of patients, an already serious disorder was the reason for seeking specialized medical care. Both ulcers and infections are known factors that increase the risk of amputation, and these factors were of concern after our study's results. The focus of diabetic foot treatment should be the prevention of ulcers and infection[1,6,7]. Ideally,

we should have more patients with insensitivity in the feet than patients with ulcers. Clarification campaigns on diabetic foot and prevention strategies should be conducted more strongly in our country[1,6,16]. Zhang et al.[2] drew attention to the fact that prevention is usually paid for by patients (specific shoes, socks, insoles, etc.) and the treatment by the health system, which could be unfavorable for wound prevention. A program in which the health system granted insoles and shoes to diabetic patients with neuropathy could reduce the number of complications and, consequently, the cost of treating them[8].

In our study, most patients (67.2%) were male. Evidence suggests an association between the male gender and a higher risk (up to 1.5) of developing foot complications[2,13,16]. One of the hypotheses for this association is the possibility of more daily physical activity among men[2].

We did not compare data from diabetic patients without foot disorders with those with diabetic foot, but in general, patients with diabetic foot tend to be older, have a longer diagnosis of diabetes, lower BMI, higher incidence of smoking, hypertension, and diabetic retinopathy[2,17]. The mean age in our study was 65 years, with almost 70% over 50 years in initial care. Zhang et al.[2] showed a mean age of 61.3 years for diabetic patients with foot ulcers, while those who do not have ulcers a mean age of 56.1 years. Pedras et al.[16] showed a mean age of 66 years. Although overweight was a common feature (mean BMI 26.11), we expected this number to be higher. Morbid obesity was not a common problem in our study group. Despite obesity being linked to the onset of diabetes, its contribution to the risk of diabetic foot ulcers still seems to be inconclusive[2]. Another fact that caught our attention was that more than 80% of patients declared not to be a smoker.

We expected a higher incidence of smoking. Smoking also interferes with peripheral microcirculation and, consequently, wound healing. As already described in the literature, diabetic smokers have a higher incidence of foot disorders[2,13,17]. As expected, type II diabetes predominated in our sample (94.4%). However, only 331 patients (62.2%) reported regular clinical control of the disease, and 18 patients did not know how often to visit the clinician to control diabetes (Table 1). Unfortunately, as we have found in certain cases, some patients are only diagnosed with diabetes after having a serious foot complication, which often leads to amputation immediately. Among the 1000 medical records evaluated, we only obtained data to perform this study in 500. Many patients submitted to minor/major amputation shortly after the initial care did not return to the outpatient clinic for follow-up. These patients were not included in our evaluation.

Charcot arthropathy is another serious complication of diabetic foot. Deformities resulting from this process of bone and capsulo-ligamentar destruction can lead to bony prominences, facilitating the appearance of ulcers[10-12]. Treatment in the early stages may decrease the number of severe sequelae of this condition. However, 62% of patients in the sample studied presented an already consolidated Charcot arthropathy in the sequelae phase. These patients have already arrived late to our outpatient clinic, and often, surgery was the only solution to the issue.

Among the 500 patients included in our sample, 306 patients (81.4%) were submitted to minor/major amputation due to infection, ulcers and/or deformity. This finding highlights the seriousness of the problem. It should be noted that, currently, the diabetic foot is the main factor for most amputations recorded[2,13,15]. We also observed that approximately 60% of the total amputations performed were classified as minor. It is worth noting that, whenever possible, it was decided to preserve the length of the lower limb to facilitate the ambulation of patients and promote an improvement in treatment adherence, glycemic control, and emotional well-being.

In our analysis of 500 patients submitted to diabetic foot treatment at the specialized outpatient clinic, a significant prevalence of patients who already had complications at the initial care was observed. Notably, most of these patients had skin ulcers or infections related to diabetic foot. Additionally, Charcot arthropathy in the sequelae phase was predominant among the patients evaluated. In the minority of our sample, only preventive measures were necessary, without direct intervention to treat established sequelae. Only 12% had exclusively diabetic neuropathy.

There are some limitations in our study. The retrospective design has bias. Half of the patients registered at the outpatient clinic were not evaluated (500 patients did not have sufficient follow-up or data in the medical record for inclusion in the study). This fact can completely change the evaluations of the study but also draw attention to the lack of adherence of the diabetic patient to the treatment. As mentioned above, many of the patients have already arrived at the clinic in need of amputation and sometimes did not even know they had diabetes. The trauma generated by hospitalization and emergency amputation often shocks the patient, who begins to deny the problem and does not return for follow-up. Another important point not evaluated in our study was the number of deaths. We did not have this information available for the entire sample evaluated and preferred not to include it.

The findings in our study are a warning about the need to direct efforts towards disseminating information and the implementation of prevention strategies to reduce the complications associated with diabetic foot.

Conclusions

Most patients followed at the diabetic foot outpatient clinic are men aged over 50 years, non-smokers and non-alcoholics, and with a slightly high body mass index of 26.1. They have already attended the outpatient clinic with foot complications and suffered some level of foot amputation.

Authors' contributions: Each author contributed individually and significantly to the development of this article: FVG *(https://orcid.org/0000-0002-3453-4364), and TYTL *(https://orcid.org/0000-0001-9491-7802), and EPSE *(https://orcid.org/0009-0005-5027-4207) Participated in the data collection, interpretation and writing of the article; MMC *(https://orcid.org/0000-0001-8133-7892), and NMN *(https://orcid.org/0000-0001-7696-2220), and JMPB *(https://orcid.org/0000-0002-5280-1673), and MTC *(https://orcid.org/0000-0001-9411-9376) Interpreting and writing the article; writing and final revision of the article. All authors read and approved the final manuscript.*ORCID (Open Researcher and Contributor ID).

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