ISSN 1669-9106 MEDICINA (Buenos Aires) 2023: 83: 428-441

Original article

CLINICAL FEATURES AND OUTCOMES OF DIABETIC FOOT IN ARGENTINA: A LONGITUDINAL MULTICENTER STUDY

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Recibido: 7-III-2023
Aceptado: 17-IV-2023

Abstract

Introduction: The diabetic foot (DF) is a complication with high rate of morbi-mortality. There are no data about amputation rates and mortality in Argentina related to this disease. The aim of this study was to describe clinical features of adult patients with diabetes that consulted for a foot ulcer in a 3 months' period and to evaluate outcomes six months later.

Methods: This is a multicenter longitudinal study with six months follow up.

Results: Three hundred and twelve patients from 15 health centers in Argentina were analyzed. During the follow up, the rate of major amputation was 8.33% (IC95; 5.5-11.9) (n = 26) and minor amputation 29.17% (IC95%; 24.2-34.6) (n = 91). After six months, the mortality rate was 4.49% (IC95%; 2.5-7.4) (n = 14), and 24.3% (IC95%; 19.6-29.5) remained with open wounds (n = 76) while 58.0% (IC95%; 52.3-66.5) (n = 181) healed and 7.37% became lost to follow up (n = 23). From those who required a major amputation during the study (n = 24), 5 patients died (20.8%) and in patients without amputation, 3% died (p = 0.001). Major amputation was related to age, ankle brachial index (ABI), Saint Elian score (SEWSS), SINBAD, WIfI classification, ischemia and some aspects of the wound.

Discussion: Knowledge about local data will enable better decisions on health policies related to prevention and treatment of diabetic foot patients.

Key words: diabetic foot, mortality, major amputation, outcomes

Resumen

Características clínicas y evolución de pacientes con pie diabético en argentina: estudio longitudinal multicéntrico

Introducción: El pie diabético (PD) representa una complicación con elevada morbimortalidad. En Argentina, carecemos de datos acerca de tasas de amputación y mortalidad relacionada a esta enfermedad. El objetivo de este estudio fue describir las características de todos los pacientes adultos con diabetes que consultaron por PD durante 3 meses y evaluar su evolución a 6 meses.

Métodos: Se realizó un estudio descriptivo longitudinal con seguimiento a 6 meses.

Resultados: Se estudiaron 312 pacientes de 15 centros de Argentina. Durante el estudio, el porcentaje de amputación mayor total fue de 8.3% (IC95; 5.5-11.9) (n = 26) y el de amputación menor de 29.17% (IC95%;

24.2-34.6) (n = 91). En el seguimiento a 6 meses, el porcentaje de muerte fue de 4.49% (IC95%; 2.5-7.4) (n = 14), el 24.3% (IC95%; 19.6-29.5) presentaba la herida aún abierta (n = 76), el 58.0% (IC95%; 52.3-63.5) (n = 181) cicatrizó y 7.37% se perdió del seguimiento (n = 23). De los pacientes que sufrieron una amputación mayor antes de los 6 meses (n = 24), 5 fallecieron (20.8%) en contraste con el 3% de quienes no se amputaron (p = 0.001). La amputación mayor se relacionó con la edad, el índice tobillo brazo (ITB), la escala de San Elián, la de SINBAD y la clasificación de WIfI, la isquemia y con algunos aspectos de la herida. Discusión: El conocimiento de datos locales permitirá mejorar la toma de decisiones en cuanto a políticas de salud relacionadas a la prevención y el tratamiento de los pacientes con PD.

Palabras clave: pie diabético, mortalidad, amputación mayor, resultados

KEY POINTS

- The lack of data on the evolution of patients with diabetic foot in Argentina makes it difficult to develop guidelines for its approach.
- This article provides information about the rates of major amputation (8.3%), death (4.49%) and healing (58.0%) at a 6-month follow-up together with ulcer characteristics that will allow directing resources towards more efficient health policies.

Diabetic foot (DF) is a complication that occurs in 19 to 34% of patients with diabetes, with an annual incidence of 2%[1, 2]. In Latin America, it is the reason for hospitalization in 3.7% of cases. and in 20% of hospitalized patients with diabetes mellitus[3]. Ulcers in DF are associated with different degrees of neuropathy and peripheral arterial disease (PAD) as well as other characteristics (infection, presence of osteomyelitis, location, presence of Charcot neuroarthropathy (CN)) that give this disease different degrees of severity that can threaten the preservation of the limb and the life of the patient. There are different forms of presentation of a patient who consults for a DF lesion, ranging from a superficial ulcer on the sole of the foot that only requires adequate offloading and local treatment, to complex forms of presentation called diabetic foot attack[1, 2] that constitute an emergency and include an infinity of relationships between different factors (ischemia, location, degree of infection, involvement of different structures, compartment syndrome, area, bone disease, among others). Timely identification and treatment requires sufficient skills from the treating team and adequate resources to avoid amputation, although often this objective cannot be achieved. At present, there is a great diversity in the care criteria, diagnostic methods and treatment of patients. It has been studied that their health care should be given within the framework of interdisciplinary, since their approach requires different specialties[4]. Despite this, there is little agreement between them when it comes to defining surgical criteria, antibiotic treatments, and often hospitalization criteria, given that patients with severe presentations of DF usually have the infection without fever or systemic symptoms, which is why this condition is underestimated and undertreated, resulting in a delay in the implementation of adequate treatment that leads to a high rate of major amputation. Furthermore, patients with chronic ischemia with threat of a limb (chronic PAD with injury or gangrene), in a few cases present intermittent claudication despite having significant obstructions, and attend the consultation once the injury has appeared, in terminal stages that require rapid identification and revascularization, which is often delayed due to the accessibility and complexity of the studies required for its resolution. The heterogeneity in the presentation, the severity of the lesions at the time of consultation, the lack of specific local data about the evolution of the patients and the rates of amputation added to a lack of interest in the pathology of the different specialties and the belief that major amputation is a better and faster solution than attempted limb salvage, creates a dearth of clear guidelines for patient care and treatment. The lack of data also reaches the evolution of amputee patients, since those of us who treat these patients in the public sphere note that less than 20% of those who suffered a major amputation are equipped with prostheses, destining the patient to develop his life managing himself in a wheelchair with a high 5-year mortality rate[5, 6]. DF is also one of the main causes of hospital admission

and a frequent cause of prolonged hospitalizations. Currently, there is no information about consultations for DF, their severity, the rate of major amputations, and the mortality of these patients in our country and in the region. The main objective of this study was the evaluation of all patients with diabetes who consulted for a new foot lesion, either in the emergency department or ambulatory medical office in different institutions in Argentina of different levels during a period of 3 months, in order to classify them. according to their risk, determine the characteristics of the lesions and evaluate their evolution at 6 months, describing the percentage of mortality, healing and major amputation and their relationship with different factors.

Materials and methods

This is a prospective, observational and longitudinal study. Consecutive non-randomized non-probabilistic sampling was carried out in a 3-month time period in 15 diabetic foot care centers in Argentina of different levels of complexity. They were chosen given that the members of the Diabetic Foot Committee of the Argentine Diabetes Society work in the diabetic foot teams of that institutions, which facilitated data collection. The characteristics of the participating centers are shown in Table 1 and the levels of each center referring to the complexity of diabetic foot care are shown in Table 2[7,8]. Responsibility in data collection and in the veracity of the information corresponds to the researchers of each center. Patients with diabetes over 18 years of age who consulted for a new foot lesion between 04/01/22 and 06/30/22 were included. Pregnant patients or those who did not sign informed consent were excluded. Different characterization variables were recorded, such as age, sex, years of diabetes evolution, type of diabetes (1, 2 or others), history of cardiovascular disease (stroke, acute myocardial infarction), arterial hypertension, history of major amputation, history of minor amputation, chronic renal failure on dialysis, cause of injury (trauma, shoe rubbing, nail clipping, neuropathic ulcer, burn, mycosis), smoking, history of heart failure. The infection was assessed according to the IDSA9 classification in mild infection: cellulitis < 2cm without osteomyelitis or systemic symptoms; moderate infection: cellulitis >2cm, gangrene, abscess, gas, deep tissue involvement, osteomyelitis and severe infection: presence of systemic inflammatory symptoms and signs (fever, leukocytosis, leukopenia, tachycardia, tachypnea. Ischemia was assessed using the ankle-brachial index (ABI). It was performed with portable Doppler equipment with an 8 MHz probe and consists of the highest pressure of the limb (posterior tibial or pedal artery) on the highest of the two arms. Patients with mild ischemia were defined as those with an ABI 0.7 to 0.89 or slightly decreased pulses, moderate ischemia as those with an ABI 0.50 to 0.69 or barely palpable pulses, and severe ischemia as those with an ABI <0.5 or absent pulses. No ischemia was defined as a value of 0.9 to 1.4 or palpable pulses. A higher value was interpreted as arterial calcification and in this situation the pulses were taken into account as in those in whom the ABI could not be performed for some reason. The patients were classified according to their risk using the application of the Argentine Diabetes Society "Classifications in diabetic foot/ Risk score" for Android. The Saint Elian (SEWSS), IDSA, Texas, SINBAD, WIfI classifications were used.[9-13] WIfI consists of classifying patients with diabetic foot and assigning a higher amputation risk and revascularization benefit according to the characteristics of the wound. This risk ranges from 1 (very low) to 4 (high). Saint Elian is a score in which the sum of points can give a score from 6 to 30, with higher values being more serious and with a worse prognosis. SINBAD is a score, with dichotomous variables that add up to one point when present and can add up to a maximum of 6 points. Assess the site of the lesion, presence of ischemia, neuropathy, infection, area, and depth. IDSA is a classification that divides infections into 4 categories (no infection, mild, moderate, and severe) previously described. Texas is a table with 16 boxes, where 4 degrees and 4 stages are combined, relating the depth of the lesion with the presence of ischemia, infection or both. Neuropathy was assessed by clinical methods (monofilament, tuning fork). Charcot Neuroarthropathy was assessed based on clinical presentation and radiographs. A 6-month follow-up was carried out, where the date of admission to the operating room, revascularization, percentage of minor amputation, primary result (if it was amputated, died or healed before 6 months) and the result in the 6-month follow-up were recorded (major amputation, death, lost to follow-up, healing or persistence of the lesion). Major amputation above the infrapatellar or supracondylar level, minor amputation below that level (transmetatarsal, toe amputation) and healing of fully epithelialized lesions were defined.

Statistical analysis

For qualitative variables, frequencies, proportion measures and confidence intervals were used in the description. Chi2 test was performed for double entry tables to analyze the association of two categorical variables. Continuous variables were described as mean and standard

Table 1 | Participating centers and researchers' data

Name of the center	Complexity level	N	Principal researcher	Other researchers	Mail
Hospital Nacional Dr. B Sommer Buenos Aires	2	17	Dicatarina Losada María Victoria		mvictoriadicatarinal@gmail.com
Hospital Nacional Prof. A Posadas Buenos Aires	3	100	Carro Gabriela	Rodriguez Rey Gabriela, Noli Maria Laura, Ticona Ortiz Miguel Ángel, Fuentes Mariana	gabivcarro@yahoo.com.ar
Hospital Perrupato Mendoza	2	16	David Raúl A.	Argerich Inés, Moy Oscar	dr_rauldavid@yahoo.com.ar
Sanatorio Güemes CABA	3	12	Issa Claudia	Berton, Celeste	clauissa@gmail.com
Hospital Provincial de Rosario Santa Fe	3	11	Badías María Florencia	Savarecio Nicolás, Finuci Curi Baltazar	florenciabadias@hotmail.com
Clínica Centro médico Nexo Junín. Buenos Aires	3	10	Dituro Claudio	Lourdes Soledad	docclaudiodituro@yahoo.com.ar
Hospital Centro de Salud Zenón J. Santillán Tucumán	3	10	Casen María Alejandra		doccasen@hotmail.com
CER - Centro de endocrinología Neuquén	2	10	Illuminati Gabriela		gabrielaillu2015@gmail.com
Hospital Regional de Rio Grande Tierra del Fuego	3	10	Torres Julio	Parada Ana, Custo Carla, Nader Julián, Ojeda Luis, Romero Graciela, Salva Eloy	juliocesartorresdiabetologo@gmail.com
Hospital San Martin Entre Ríos	2	10	Alterini Pablo	Martínez Lacabe Gustavo, Cantero Aníbal, Volpe Luis, Ciardi Juan Pablo	alterini_ccv@hotmail.com.ar
Centro de la Tercera Edad "Dr Salvador Abudara". La Pampa	2	10	Witman Érica	Reynoso Alejandra	telediabetes.telesalud@gmail.com
Hosp. Dr. J.R.Vidal Corrientes	3	12	Kremer Sandra		sandra.kremer.sendros@gmail.com
Centro de rehabilitación, Obesidad y Diabetes. Formosa	3	7	Romero Élida		elybeat83@hotmail.com
Hospital de Clínicas José de San Martín CABA	3	16	Braver José Daniel		josedanielbraver@hotmail.com
Polo Sanitario Malvinas Argentinas Buenos Aires	3	61	Saurral Rubén	Carrió Mabel, Pool Ramiro, Vaisman Ailén, Serrudo Miranda Vania, Garibay Liana, Ianigro Analía	rsaurral@gmail.com

Table 2 | Characteristics of levels referring to the complexity of diabetic foot care

	Minimal model (level 1)	Intermediate model (level 2)	Excelence model (level 3)
Resources	Clinic, health center, small hospital. General practitioner, podiatrist and/or nurse	Hospital Diabetologist, surgeon (general or traumatologist), general surgeon, podiatrist and/or diabetes oriented nurse, orthotic or prosthetic technicia	University Hospital Center specialized in diabetic foot care, with multiple experts in different disciplines. Tertiary reference center
Activities	Primary prevention, basic wound healing	Regional catchment area, healing and prevention. More advanced assessment and diagnostics surgeries	Specialized curative care for complex cases, angiography, complex surgeries, operating room, intensive care, tomography, magnetic resonance imaging. National reference center

Adapted from IWGDF[7, 8]

deviation or median and interquartile range depending on their distribution. For the evaluation of the elements of the Saint Elian scale in relation to mortality, healing and major amputation, binary logistic regression was used with a study of the variables categorized individually. Student's T test was used for the comparison of means and the Wilcoxon Mann Whitney or Kruskal Wallis test for more than 2 groups for the comparison of means. The statistical programs VCCstat and INFOSTAT were used.

Ethical qualms

This is a descriptive study, patients were registered with the initials of the name and surname. The data of the patients will not be disclosed and each physician is responsible for the veracity of the data that was sent for analysis. The Declaration of Helsinki and its modifications, the Good Clinical Practices guidelines, the resolution of the Ministry of Health 1480/11, ANMAT provision 6677/10 and the personal data protection law no. 25326 were observed and taken into account as guiding principles. It is stated that the researcher has no conflict of interest. The study was approved by the Ethics Committee of the Hospital Nacional Prof. A. Posadas with the code LMnP0S0/21 and by the committees of each center according to the responsibility of the researchers.

This is a study that received a subsidy from the Argentine Diabetes Society during 2022. The subsidy funds were allocated to the validation of the *App* and the purchase of 4 Doppler equipment for some of the centers that participated in the study and lacked this resource. It is a portable Doppler device, with an 8 MHz transducer for data collection of the ankle-brachial index.

Results

A total of 312 patients belonging to 15 centers in Argentina were analyzed, of which 76.6% (n = 239) were male, with a mean age of 58.1 (12.1). Ninety five percent (n = 295) had type 2 diabetes. 43% (n = 133) required hospitalization at the time of the first visit. Their background and characteristics are summarized in Table 3.

Characteristics of the lesions

The median time of evolution of the lesions before the consultation was 20 days (7-39). The most frequent causes were trauma in 30% of the cases (n = 93), shoe rubbing in 22% (n = 68), unknown in 18% (n = 57) and in the remaining 30% shoe cuts. nails, foreign bodies in footwear and walking barefoot among others. Sixty one percent of the patients (n = 189) had previously consulted another center or professional for the lesion. The severity of the lesions was assessed using different scales. The median of the Saint Elian scale was 17 (14-20), which corresponds to moderate severity, with 18.2% (n = 55) of patients with a score greater than 21 (severe), 73% (n = 223) of 11 to 20 (moderate) and 7.9% (n = 24) less than 10 (mild). According to the WIfI clas-

Table 3 | Antecedents and comorbidities of the patients

Antecedents and Comorbidities	n (%)	IC95%
Arterial hypertension	227 (72.8)	67.4-77.6
Minor amputation	83 (26.6)	21.8-31.9
Cardiovascular disease	80 (25.6)	20.9-30.9
Previous smoker	77 (24.7)	19.9-29.9
Smoker	67 (21.5)	17-26.5
Cardiac failure	41 (13.1)	9.6-17.4
CRD dyalisis	29 (9.3)	6.3-13.1
Major amputation	17 (5.4)	3.2-8.6

CRD: chronic renal disease

sification, 24.3% of the patients presented high risk of amputation and 31.8% moderate. The rest were distributed between low and very low risk.

Peripheral arterial disease and infection

In relation to vascular compromise, ischemia was assessed with ABI in 253 patients and by palpation of pulses in the rest. The median ABI was 0.90 (0.64-1.10), excluding from the analysis patients with arterial calcification, that is, ABI>1.4 (n = 32).

Patients without ischemia constituted 52.9% of the total (n = 165), those with mild ischemia 18.3% (n = 57), moderate 16.3% (n = 51) and severe 12.5% (n = 39). Angiography was performed in 50 patients (16%). Median days to angiography was 12 (3-34). In 32 (64% of those in whom angiography was performed) some type of revascularization was performed (endovascular 68.8% (n = 22), surgical 25% (n = 8) or both 6.3% (n = 2)). The median number of days to revascularization was 14 (6-39). The reasons for which the rest of the patients were not revascularized were renal failure, non-revascularizable ischemia, poor condition of the patient, extensive loss of tissue, delay in the provision of supplies (stent, balloon). With regard to infectious involvement, 234 patients (75%) had some degree of infection at the time of consultation. The distribution of patients according to its severity (IDSA) is shown in Figure 1.

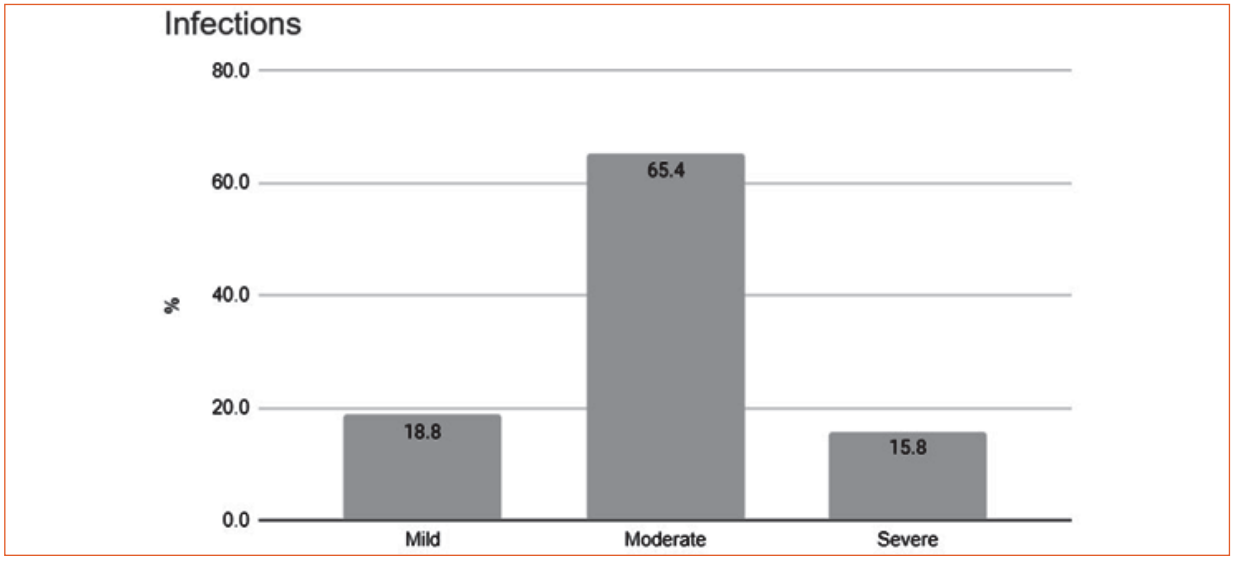
Charcot neuroarthropathy

During the 3 months of data collection, 29 patients with CN (9.3%) were identified, of whom 15 (51.7%) were in the acute phase, 3 (10.3%) in the coalescence phase, and 11 (37.9%) in the reconstruction phase. Forty eight percent of these patients (n = 14) had previously consulted other centers and no discharge had been indicated. The evolution time of the CN symptoms until the moment of consultation was 60 days (25-90). Five patients presented without ulcer (Texas A0), of which 1 developed a lesion at the end of follow-up.

Follow-up results

During the study, the percentage of total major amputation was 8.33% (CI95; 5.5-11.9) (n = 26) and that of minor amputation was 29.17% (CI95%; 24.2-34.6) (n = 91). At the 6-month follow-up, the percentage of death was 4.49% (95%CI; 2.5-7.4) (n = 14), 58.0% (95%CI; 52.9-64.2) (n = 181) healed, 24.3% (95%CI;19.6-29.5) had the wound still open (n = 76) and 7.37% were lost to follow-up (n = 23). During follow-up, 25 patients (8%) (95%CI; 5.2-11.6) developed a new lesion. Of the patients who underwent a major amputation before 6 months (n = 24), 5 died (20.8%) in contrast to 3% of those who did not have an amputation (p = 0.001). The results of the 6-month follow-up for each center are described in Table 4. Patient factors and severity of lesion in relation to major amputation and mortality in Table 5. In Table 6, a logistic regression was performed with analysis of each variable of the Saint Elian scale separately in a categorized manner in relation to death, healing and major amputation. The condition of more than two aspects, moderate or severe ischemia, unilateral or bilateral edema, moderate or severe infection, depth of the lesion, area greater than 10 cm^2 and the healing phase (granulation or in-

Figure 1 | Distribution of patients according to the severity of the infections Mild infection: cellulitis < 2cm. No osteomyelitis or systemic symptoms Moderate infection: cellulitis > 2 cm, gangrene, abscess, gas, deep tissue involvement, osteomyelitis. Serious infection: presence of systemic inflammatory symptoms and signs (fever, leukocytosis, leukopenia, tachycardia, tachypneaThe values correspond to binary logistic regression with bivariate analysis. Categorized variables



flammation), were factors that were related in inversely with healing. The characteristics associated with major amputation were tarsal location, topographic appearance, multiple locations, severe ischemia, bilateral edema, and severe infection. Finally, those related to death were severe ischemia and location in multiple areas. Table 7 shows the evolution of the patients at 6 months in relation to the degree of ischemia and revascularization procedure.

Discussion

The evolution of patients with DF in Argentina in a multicenter longitudinal analysis has not been previously published to our knowledge. In recent years, some studies have been carried out in our region in order to provide local data on the prevalence of DF in hospitalization, local microbiology in diabetic foot infections, and the use of classifications[3, 10, 14-16] although the amputation and mortality rates in these patients had not been studied up to now. In this study, it was possible to collect information that was previously unknown in the country, regarding the percentage of major amputation, death, minor amputation, and healing in patients who consulted for diabetic foot in a 6-month follow-up. Although the major amputation rate at 6 months was 8.33%, this number varies according to each center, as shown in Table 4, with values ranging from 3.3% to 27.3%. This high variability could be explained by the heterogeneity in the care teams, the resources available for treatment, the seriousness with which patients arrive, and the lack of networks for timely referral. Many patients consult after several weeks and even months from the development of the lesion, having been incorrectly treated, causing delays in the establishment of adequate treatment. In fact, in our work, the median number of days since the lesion developed was 20, 61% had previously consulted another doctor and 43% of the patients required hospitalization at the first consultation given the severity of the lesion. It is also important to mention the diversity of criteria for the surgical approach that is often at the mercy of the availability of operating rooms and the will of the surgeon on duty who is generally not a specialist in DF. In general, DF teams lack a surgeon or traumatologist with knowledge and commitment on the subject and, even if they do, many decisions in the emergency depend on who is attending in the emergency department. Despite having national and international guidelines that mention the treatment algorithms for these patients, the heterogeneity of

Table 4 | Results at 6-month follow-up

Name of the center	Level	N	Saint Elian Mean (IQ)	Major Amp* n (%)	Healing n (%)	Death n (%)	Open Wound n (%)	Lost n (%)	Total major amp** n (%)
Hospital Nacional Dr. B Sommer Provincia de Buenos Aires	2	17	14 (11-17)	1 (5.9)	9 (52.9)	1 (5.9)	4 (23.5)	2 (11.8)	2 (11.8)
Hospital Nacional Prof. A Posadas Provincia de Buenos Aires	3	100	19 (16-21)	5 (5)	59 (59)	6 (6)	25 (25)	5 (5)	8 (8)
Hospital Perrupato Mendoza	2	16	13 (11-16)	1 (6.3)	14 (87.5)	0 (0)	0 (0)	1 (6.25)	1 (6.3)
Sanatorio Güemes CABA	3	12	17 (16-18)	0 (0)	8 (66.7)	0 (0)	2 (16.7)	2 (16.7)	1 (8.3)
Hospital Provincial de Rosario Santa Fe	3	11	16.5 (13-19)	2 (18.2)	4 (36.4)	0 (0)	1 (9.1)	3 (27.3)	3 (27.3)
Clínica Centro Médico Nexo Junín. Buenos Aires	3	10	22 (20-24)	2 (20)	5 (50)	0 (0)	3 (30)	0 (0)	2 (20)
Hospital Centro de Salud Zenón J. Santillán. Tucumán	3	10	17.5 (15-20)	0 (0)	1 (10)	1 (10)	7 (70)	1 (10)	0 (0)
CER - Centro de Endocrinología Neuquén	2	10	15 (15-17)	0 (0)	7 (70)	0 (0)	2 (20)	1 (10)	0 (0)
Hospital Regional de Río Grande Tierra del Fuego	3	10	16 (12-18)	2 (20)	7 (70)	0 (0)	1 (10)	0 (0)	2 (20)
Hospital San Martin Entre Ríos	2	10	15.5 (13-16)	1 (10)	4 (40)	2 (20)	2 (20)	1 (10)	2 (20)
Ctro de la Tercera Edad "Dr Salvador Abudara". La Pampa	2	10	14.5 (12-20)	1 (10)	7 (70)	0 (0)	2 (20)	0 (0)	1 (10)
Hosp. Dr. J.R.Vidal Corrientes	3	12	15 (11-18)	1 (8.3)	6 (50)	0 (0)	3 (25)	2 (16.7)	2 (16.7)
Centro de rehabilitación, Obesidad y Diabetes Formosa	3	7	16 (14-18)	0 (0)	6 (85.7)	1 (14.3))	0 (0)	0 (0)	0 (0)
Hospital de Clínicas José de San Martín CABA	3	16	15.5 (11-17)	0 (0)	12 (75)	0 (0)	4 (25)	0 (0)	0 (0)
Polo Sanitario Malvinas Argentinas Provincia de Buenos Aires	3	61	16 (12-20)	2 (3.3)	32 (52.5)	3 (4.9)	19 (31.2)	5 (8.2)	2 (3.3)
Totales		312	17 (14-20)	18 (5.77)	181 (58.0)	14 (4.49)	76 (24.3)	23 (7.37)	26 (8.33)

Major amp: major amputation

**Major amputation: includes all patients with major amputation that were alive at 6 months*

*** Total major amputation: includes all major amputations (alive and dead at 6 months)*

Table 5 | Patient factors and lesion severity associated with major amputation and death

Characteristics of the patients/ severity of lesions	With major amputation n = 26	Without major amputation n = 286	p	Dead n = 14	No Dead n = 298	p
Age (mean)	62 (57-72)	58 (49-66)	0.042	67.5 (62-72)	58 (49-66)	0.003
Male n (%)	9 (34)	222 (77)	0.15	9 (64)	230 (77)	0.26
CRD dyalisis n (%)	1 (4)	28 (10)	0.31	2 (14)	27 (9)	0.51
Minor amputation antec n (%)	7 (27)	76 (27)	0.96	5 (36)	78 (26)	0.42
Major amputation antec n (%)	1 (4)	16 (6)	0.71	1 (7)	16 (5)	0.77
CV Antec n (%)	7 (27)	73 (26)	0.87	10 (71)	70 (23)	< 0.001
ABI (mean)*	0.68 (0.4-0.9)	0.91 (0.7-1.1)	0.01	0.40 (0-0.53)	0.90 (0.68-1.12)	< 0.001
Saint Elian (mean)	21 (18-24)	16 (13-19)	< 0.001	20 (17-23)	17 (14-20)	0.008
WIfI AR (mean)*	4 (3-4)	3 (1-3)	< 0.001	4 (4-4)	3 (1-3)	0.001
SINBAD (mean)	5 (5-6)	4 (3-5)	< 0.001	5 (4-5)	4 (3-5)	0.03
Days of evolution of the lesion (mean)	30 (15-60)	15 (7-35)	0.09	25.5 (10-60)	20 (7-36)	0.3

CRD: chronic renal disease; CV: cardiovascular; ABI: ankle brachial index; AR: amputation risk
**214 patients*

the lesions, the scarce symptomatology and the lack of interest of doctors in this pathology often leads to make decisions without experience or knowledge of it. Some studies mention that the personal beliefs of physicians result in suboptimal treatments when there are no clear guidelines for care (surgical, infectious, and revascularization treatments)[17, 18]. Table 8 describes the results of other similar studies in other countries, showing great variability in the results of the different regions in terms of major and minor amputation, healing, and death. This fact may be related to a number of reasons (besides the ones listed above) and this is why knowledge of local data is important. An example of this is the percentage of patients with ischemia in the different studies that can condition the results, since it has been a factor constantly associated with poor evolution (amputation and death). Ford et al. published in 2020 a retrospective study on the follow-up of 98 patients with DF[19]. A 5-year follow-up was performed, reporting an amputation rate of 28.6% and a death rate of 13.3%. This amputation rate is higher than in other studies and could be related to the high percentage of patients with ischemia (72% of the patients had diabetes, all ischemic), which may influence the results. Also, a sample with a high percentage of patients with serious infections such as diabetic foot attack can increase mortality, as in the study by Vas et al[20]. In this study, 106 patients with diabetic foot attack were followed up for 18 months. This research group reported a mortality of 40% at the end of follow-up, higher than in other studies. Other factors that may be related to amputation and mortality rates are the resources available for prevention, diagnosis, and treatment of patients. In a review carried out on studies in African countries[21] on 56173 patients with diabetes, an amputation rate greater than 15.5% and death rate of 14.2% (95% C.I. 9.9-19.0) were reported in contrast to the Eurodiale study[18], where different countries in Europe and the major amputation rate was 5% and mortality 6%. Certain characteristics of the patients and injuries are related to major amputation in most studies (Table 8), such as age, presence of ischemia, CRF on dialysis, gangrene, neuropathy, and certain scales and classifications. In our study, age, WIfI classification, the Saint Elian and SINBAD scales, and the ABI were associated with major amputation and death. A history of cardiovascular disease was also related to the latter. Among the characteris-

Table 6 | Characteristics of the lesions included in the Saint Elian score related to major amputation, healing and mortality OR 95% CI

	Healing	p	Major amputation	p	Death	p
Location						
Phalanges	Basal		Basal		Basal	
Metatarsal	1.88 (0.89-3.95)	0.09	1.33 (0.50-3.50)	0.55	1.17 (0.36-3.8)	0.78
Tarsal	1.17 (0.54-2.54)	0.69	4.07 (1.43-11,61)	0.009	1.43 (0.28-7.19)	0.66
Topographic Aspects						
Dorsal o plantar	Basal		Basal		Basal	
Lateral or medial	0.90 (0.48-1.7)	0.76	1.55 (0.42-5.72)	0.5	0.90 (0.17-4.81)	0.91
Two or more	0.48 (0.288-0.81)	0.006	3.78 (1.41-10.11)	0.008	1.95 (0.6-6.34)	0.26
Affected zones						
One	Basal		Basal		Basal	
Two	6.47 (2.72-15.4)	<0.01	6.81 (2.50-18.47)	<0.01	3.88 (1.08-13.91)	0.04
Entire foot	1.34 (0.50-3.57)	0.55	9.45 (3.04-29.44)	<0.01	6.72 (1.69-26.67)	0.007
Ischemia						
No ischemia	Basal		Basal		Basal	
Mild	0.59 (0.29-1.22)	0.15	1.15 (0.27-4.82)	0.84	0.0	0.99
Moderate	0.35 (0.15-0.77)	0.01	1.15 (0.22-6.02)	0.86	1.74 (0.15-19.85)	0.65
Severe	0.27 (0.11-0.64)	0.003	3.93 (1.10-14.07)	0.04	15.42(2.91-81.7)	0.001
Edema						
No edema	Basal		Basal		Basal	
Periwound	1.03 (0.56-1.88)	0.9	0.95 (0.26-3.38)	0.93	0.23 (0.02-2.09)	0.19
Affected leg only	0.49 (0.27-0.89)	0.02	2.47 (0.83-7.44)	0.10	1.89 (0.54-6.72)	0.21
Bilateral (systemic disease)	0.21 (0.74-0.60)	0.004	4.45 (1.08-18.38)	0.04	2.5 (0.46-14-69)	0.31
Infection						
No infection	Basal		Basal		Basal	
Mild	0.56 (0.25-1.26)	0.16	6.8 (0.73-62.98)	0.91	2.45 (0.39-15.2)	0.33
Moderate	0.48 (0.26-0.89)	0.02	5.26 (0.66-41.63)	0.11	1.84 (0.38-8.94)	0.44
Severe	0.24 (0.10-0.56)	0.001	21.85 (2.64-180.7)	0.004	0.93 (0.08-10.6)	0.95
Neuropathy						
No neuropathy	Basal		Basal		Basal	
Diminished protective sensation	0.19 (0.02-1.6)	0.12	0.0	ns	0.0	0.99
Loss of protective sensation	0.14 (0.2-1.19)	0.07	0.0	ns	0.57 (0.06-4.8)	0.61
Charcot neuroarthropaty	0.17 (0.02-1.69)	0.13	0.0	ns	0.0	0.99
Depth						
Superficial (skin)	Basal		Basal		Basal	
Deep ulcer (below dermis)	0.24 (0.10-0.53)	0.001	2.24 (0.46-10.96)	0.31	2.76 (0.31-24.31)	0.35
Bone/ joint	0.25 (0.11-0.55)	0.001	2.85 (0.63-12.92)	0.17	2.95 (0.36-24.1)	0.31
Area						
Small < 10 cm^2	Basal		Basal		Basal	
10 to 40 cm^2	0.55 (0.33-0.91)	0.02	2.38 (0.97-5.88)	0.06	1.41 (0.42-4.74)	0.57
> 40 cm^2	0.24 (0.10-0.57)	0.001	3.15 (0.89-11.06)	0.07	3.45 (0.81-14.74)	0.09
Wound healing phase						
Epithelization	Basal		Basal		Basal	
Granulating	0.11 (0.01-0.89)	0.04	0.0	ns	0.27 (0.02-4.73)	0.37
Inflammatory	0.11 (0.014-0.82)	0.03	0.0	ns	0.68 (0.08-5.67)	0.72

The values correspond to binary logistic regression with bivariate analysis. Categorized variables

Table 7 | Evolution of the patients at 6 months in relation to the degree of ischemia and revascularization procedure

	Angiography n%	Revascularization n%	Wound healing patients n%	Healing in revascularized n%	Healing in not revascularized patients n%	p	Major amputation n%	Major amputation in revascularized n%	Major amputation in not revascularized n%	p
Mild Ischemia n = 57	6 (10.5)	4 (7.0)	34 (59.6)	0 (0)	34 (64.1)	0.13	4 (7)	0 (0)	4 (7.54)	0.99
Moderate Ischemia n = 51	14 (27.5)	8 (15.7)	21 (41.2)	1 (12.5)	20 (46.5)	0.43	4 (7.8)	0 (0)	4 (9.3)	0.6
Severe Ischemia n = 39	26 (66.6)	18 (46.2)	12 (30.8)	6 (33.3)	6 (28.6)	0.33	12 (30.8)	5 (27.8)	7 (33.3)	0.74

p calculated by difference of proportions

tics of the lesions, we found that tarsal location, multiple involvement, severe ischemia, bilateral edema, and severe infection were related to major amputation. The presence of neuropathy was not related to major amputation, unlike the original study of the Saint Elian scale (SEWSS)[12]. It should be noted that parameters of glycemic control, autonomic neuropathy, microalbuminuria, or CRP (C-reactive protein) were not analyzed in our study. Regarding PAD, our study did not show a statistically significant improvement in the results of patients with ischemia who underwent revascularization, as shown in Table 7, probably because the sample was insufficient to perform this analysis. We consider it necessary to conduct research on patients with ischemia by increasing the sample size in order to assess the implication of revascularization on the results. The lack of early diagnosis of NC and its consequences make this a very fearsome disease with serious consequences. Forty-eight percent of the patients in our work consulted previously and their disease was never recognized nor was an appropriate discharge indicated. The consequences of the lack of discharge can be irreducible foot deformations that lead to recurrent ulcers (in these cases the therapeutic solution is amputation or very complex surgeries). Twenty-four patients in our series with Charcot presented with an ulcer, perhaps as a consequence of the aforementioned. The education of primary care physicians in the recognition of this disease in its early stages is essential to avoid its serious consequences. Finally, we believe it is necessary to mention that the mortality of patients who underwent a major amputation is around 35% to 50% at five years[6,22], compared to 9% mortality from breast cancer, 30% mortality from any cancer and only less than that caused by lung cancer (80%)[22]. In our study, of the patients who underwent a major amputation before the 6 months follow up (n = 24), 20.8% died within that period. But also, although the death of these patients is generally of a cardiovascular cause[6,20] DF and major amputation are not only disease markers but are also independent factors of premature death[23]. For this reason, we consider as a priority the need to avoid major amputations, which also constitute an increase in health costs, loss of income, financial aid allocations, deterioration of the quality of life of the patient and family members. For this, it is necessary to know the characteristics of the patients who consult in our environment in order to prioritize the care of those most prevalent factors and assign and optimize the means for their prevention and treatment based on this information. It is necessary to determine what would be the best distribution of resources, optimizing hemodynamic studies for care of ischemia (more than half of the patients had some degree of ischemia), improving the provision of antibiotics for the treatment of infection (75% had infection), assigning the payment of trauma modules to suitable and interested professionals to reduce hospitalization rates and times (43% required hospitalization and 29% required a minor amputation), or allocating more resources to primary care to improve prevention and training of primary care

Table 8 | Published studies with longitudinal follow-up of patients with diabetic foot and factors related to major amputation

Study	Site/ follow up	N	Age	% Major amputa-tion	% Woung healing	% Minor amputa-tion	% Death	Factors asssociated with major amputation
Eurodiale 2003-2004 (18)	Europe (10 countries) 1 year	1088	65	5	77	18	6	Infection. Ischemia
Martinez de Jesús 2010 (12)	Mexico 13 monts	235	64.4	5.9	69.7	10.6	sd	SEWSS Ischemia Topographic Aspects, Neuropathy, Area
Zhan 2015 (25)	US 2 years	201 (93% diabetes and ischemia)	58	21	sd	sd	sd	WIfI, RF
Rigato 2017 (21)	Africa Meta analysis	56173	55.8	15.5			14.2	PAD, infection, Wagner
Mathioudakis 2017 (26)	US 12 months	217 (437 wounds)	58.3	6.5	85.2	16	sd	
Ward 2017 (27)	US 12 months	98 (72% with diabetes and ischemia)	62.8	26.5	sd	39.8	sd	DLP, RF, gangrene, WIfI
Hicks 2018 (28)	US 12 months		59	9.2	84.9	sd	sd	WIfI
Weaver 2018 (29)	US 12 months	99 (225 heridas)	63.3	5.6	63.1	sd	sd	
Marzoq 2019 (30)	Iraq 8 months	100	53.6	5	60	sd	1	
Forde 2020 (19)	Ireland 5 years	98	57	28.6	24.5 (33.5 recurrence)	25	13.3	HbA1C, RF, CVD, Type of diabetes
Bekele 2020 (31)	Ethiopia 3 months	115	44.4	13	69.6	17		Overweihgt, obesity, metabolic control, neuropathy, Wagner
Vas 2020* (20)	England 18 months	106	60.4	5.6	57.5	47	23.5	CRP, dialysis, previous minor amputation, gram positive germs
Abhinav 2020 (24)	India 3 months	65	58.4	7.7	57	38.5	3.1	Palpables pulses
Carro 2022 (10)	Argentine 5 months	101	59.2	11.3	53.6	13.4	0	Ischemia, SEWSS, WIfI
Meloni 2023 (32)	Italy 6 months	367	69	7.1	81.7	33.8	5.44	Severity in fast track, RF, PAD
This study 2023	Argentine 6 months	312	58.1	8.33	58.0	29.2	4.49	Ischemia, SEWSS, Age, CVD, WIfI, SINBAD

SEWSS: Saint Elian Score; HbA1c glycosylated hemoglobin; RF renal failure; CVD cardiovascular disease; PAD peripheral arterial disease; sd no data; DLP dyslipidemia;CRP c reactive protein sd=no data
**They were diabetic foot attacks*

physicians and residents in a combined approach on prevention, routine screening, and aggressive intervention protocols for cardiovascular risk factors (more than 60% of patients had consulted another professional previously)[23]. Actions are needed at the governmental level that indicate clear guidelines in the treatment of patients and arbitrate the means to support interdisciplinary teams that work to reduce hospitalizations, major amputations and death. Knowledge of local data about the amputation rate, mortality, hospitalization rate, and patient characteristics will improve decision-making in terms of health policies based on solid data, access to diagnostic resources by different institutions. and treatment, optimization of referral and counter-referral, and training of the different levels in the timely diagnosis and treatment of these patients in order to avoid major amputations.

Acknowledgements: To the Argentine Diabetes Society for the Subsidy. To the Diabetic Foot Committee of the Argentine Diabetes Society for their participation: Gabriela Illuminati, María Victoria Dicatarina Losada, Elizabet Mendez, Walter Vega, Sandra Kremer Sendros, Julio Torres, Alejandra Casen, Claudio Dituro, Elida Romero, Florencia Badías. To Research Department of Hospital Posadas (Marcela Mariano and Daniel Drago), to Jaime Segovia and Carlos Eghi for their help in the statistical analysis of the data. To the Ethics Committee of the Hospital Nac. Prof A Posadas and the rest of the participating centers for their collaboration in writing.

Conflict of interests: None to declare

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