



Diabetic Foot: A Reality in Mexico

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Abstract: Introduction: Diabetes mellitus is a disease with a group of metabolic alterations that is characterized by chronic hyperglycemia, which is caused by a defect in the secretion of insulin, to a defect in its action. Method: Retrospective, longitudinal, observational and descriptive multicenter study in three hospitals, with descriptive statistical results/analyzing the national and international medical literature. Results: A total of 1,195 patients, 711 are men (59.49%), 484 women (40.5%). Age range from 16 to 79 average of 51 years. The most frequent injury is trauma, mostly Wagner 5, and the treatment is supracondylar amputation. Discussion: The common and severe arterial disease of the lower extremities of microvascular atherosclerotic origin of type 2 diabetes mellitus, adding the infection and Charcot's deformity, causes the diabetic foot combo in the lower extremities, ulcers and even amputation, which increases the disability rate and the mortality rate of patients. Conclusions: Patients in Mexico who suffer from "diabetic foot" are unlikely to be a priority of the public health system, since their diagnosis and treatment are always in basic and stunted conditions. Without resources and supplies, without a public health policy or consensus on treatment and comprehensive rehabilitation.

Keywords: Diabetes mellitus, Wagner, Amputation, Atherosclerotic, Charcot, Diabetic foot, Ulcers.

INTRODUCTION

The words of the terms "diabetes mellitus" have an origin: "diabetes" etymologically from the Greek language that means siphon or to go through, and the second "mellitus" that comes from a Latin origin that is defined as sweet. [1] Diabetes mellitus is a disease with a group of metabolic disorders characterized by chronic hyperglycemia, which is caused by a defect in insulin secretion, a defect in insulin action, or both, with alterations in fat and protein metabolism. [2] That it also includes a set of metabolic diseases, of different etiology, characterized by hyperglycemia, caused by defects in the secretion and/or action of insulin. [3] According to the American Diabetes Association, diabetes mellitus is classified into 4 broad groups: type 1 diabetes mellitus, type 2 diabetes mellitus, other specific types of diabetes, and gestational diabetes. [4] Among the other specific types of diabetes there is an entity very different from the others, associated with pathologies of the exocrine pancreas, and it has been called type 3c diabetes, which can be caused by three forms:

1. Complete absence of congenital or acquired islets
2. Absence of partially acquired functional islets
3. Paraneoplastic

The endocrine and exocrine pancreas share the same organ and interact with each other, so the focus of the study, treatment and follow-up should be in a multidisciplinary setting. [4, 5, 6]

The tenth edition of the International Diabetes Federation (IDF) Diabetes Atlas estimates that, in 2021, 537 million people were living with diabetes worldwide. Overall, the global prevalence of diabetes is estimated to exceed 10%. Among income groups, the highest prevalence was observed in middle-income countries. A few 536.6 million people is projected, increasing to 12.2% to 783.2 million in 2045. [6, 7]

Por otro lado, la diabetes mellitus gestacional se reconoce cada vez más no solo por sus complicaciones obstétricas inmediatas, sino también por sus consecuencias metabólicas a largo plazo tanto en la madre como en su descendencia. a disfunción de las células B pancreáticas y la desregulación placentaria. Sin embargo, la evidencia emergente destaca el hígado materno como un núcleo metabólico central durante el embarazo, coordinando las adaptaciones de glucosa, lípidos y hormonas esenciales para el desarrollo fetal. [7]

In Mexico, type 2 diabetes mellitus is reported to have a prevalence of 18.3% and an average mortality rate of 11.95 per 100 thousand inhabitants in 2022, making it estimated to be the second cause of death and is listed as the first cause of disability in the country. [8] Diabetes mellitus can trigger chronic complications that fall into two groups: large vessel and microvascular. The former, for example, atherosclerosis and cardiovascular diseases. The latter occurs due to damage to small blood vessels or neurofibrils such as nephropathy, angiopathy, retinopathy and diabetic neuropathy respectively. [9, 10] Diabetes mellitus, the ninth leading cause of death worldwide, is characterized by relative or absolute insulin deficiency, leading to increased production of advanced glycosylation end products. This

increases oxidative and nitrosative stress, which often leads to various macrovascular and microvascular complications, angiopathy and neuropathy. [11]

Diabetic vascular complications share several pathological mechanisms, and oxidative stress is one of them. Diabetes caused alterations in serological redox homeostasis, especially by decreasing enzyme activity and total antioxidant response, while increasing the levels of markers of oxidative damage and oxidative stress index, increasing the levels of advanced glycation end products, as well as altering carbohydrate and lipid metabolism, with oxidative damage evidence evidenced by the advanced oxidation protein products and malondialdehyde in the serum. [12] Trabecular bone index and brachial-ankle pulse wave velocity are established indicators of bone microstructure and arterial stiffness. However, in the context of type 2 diabetes, these are factors that influence the deterioration of bone microarchitecture and bone mineral density. [13] Chronic limb-threatening ischemia is an advanced stage of peripheral artery disease, affecting 11% of this population. Critical limb ischemia is the most advanced stage of peripheral artery disease and manifests as ischemic pain at rest, ulcerations that do not heal, and/or gangrene with objectively demonstrated occlusive arterial disease. [14, 15, 16]

The diabetic foot sufferer is a major cause of disability in diabetes and represents a serious consequence of poor glycemic control, driven primarily by peripheral arterial obstruction, neuropathic damage, and compromised tissue perfusion. [17, 18] Approximately 25,000 major amputations are performed annually in Germany, of which approximately 70% involve patients with diabetes mellitus. [19] A retrospective cohort study used data from the National Health Insurance Service database of Korea that tracked 2,580,585 diabetic patients between 2009 and 2012 with surveillance through 2019 using claims and mortality data to identify incident lower limb amputation; and a clear socioeconomic gradient in limb preservation in diabetic patients. [20] People with lower incomes often face barriers to preventive care, including limited transportation options, inability to take time off work, and lack of health insurance or high out-of-pocket costs. [21]

OBJECTIVE

To describe the experience of the surgery service that was presented in the public hospitals of the Ministry of Health and the Mexican Institute of Social Security in Mexico City; in all patients with the confirmed diagnosis of "diabetic foot" with a statistical, deductive, critical, logical and impartial analysis.

METHOD

This is a multicenter study with a retrospective, longitudinal, observational and descriptive design of the Surgery Service of research in three second and third level health care hospitals in Mexico City:

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2. Specialty Hospital of Mexico City "Dr. Belisario Domínguez" of the Ministry of Health. Mexico City. Country: Mexico. 3rd Level of medical care.

- High Specialty Medical Unit Hospital National Medical Center for Infectious Diseases. "Dr. Daniel Méndez Hernández" from the Mexican Social Security Institute. Mexico City. Country: Mexico. 3rd Level.

In a study period that spanned from December 2015 to December 2025, with the urgency/priority surgical indication in patients with diabetes mellitus who required minor amputation, major amputation, drainage and surgical washing of the limb, application of vacuum-assisted closure therapy (VAC). Patients with acute/chronic vascular etiologies and traumatic, poison, infectious in non-diabetics, immunological or orphan diseases were excluded.

Age, sex, initial causal factor, classification, ASA risk, surgical treatment lines, their combination, number of reinterventions, management in intensive care, anesthesia applied, the time of deferral to emergency surgery, surgical hemorrhage, surgical time, days of hospital stay, antibiotic therapy, cultures, morbidity, mortality, and finally specific observations were determined. This study and the presentation of the results were carried out using descriptive biostatistics procedures.

In addition, an analysis of the research of the national and international medical literature on what is described in the research topic of this article is carried out. The authors share their experience in the management of the disease wrongly called "diabetic foot", with the systematization of refined, adapted or modified surgical techniques, depending on the case, which converge in the expertise and evolution of the patients in this study.

RESULTS

Records with descriptions of surgical techniques were reviewed with a total of 1,195 patients, of which 711 were men (59.49 %) and 484 women (40.5 %). With an age range of 16 years to 79 years, with an average of 51 years and a bimodal value of 24 and 62 years. The causal or etiological factors were intentionally investigated, yielding the following results in **Table 1**. Where it is expressed as the 1st cause, direct trauma to extremity, foot in the toes in the majority in 58%, plantar region 29% and in the back 11% the rest in the lower third leg 1.5% and middle 05%.

Table 1: Causal in Patients who Presented "Diabetic Foot" that Justified an Emergency Surgical Indication. Expressed in Number/Percentage.

Etiology/Cause of Diabetic Foot Onset	Number/%
Direct Trauma	471/39.41
Reactive Hyperkeratosis	84/07.03
Unknown	357/29.87
Trauma Imperceptible	169/14.14
Harmful Wildlife	78/06.53
Onychocryptosis	16/1.034
Bite Wound	20/01.67
Total Number Of Patients	1 195/100

Direct trauma to the limb is the most frequent causal factor, occupying the first, with a percentage of 38.41%, in a second place it is unknown since it is referenced with 357 patients in the study group reaching 29.87%, the third site highlights the so-called imperceptible trauma where it is documented as the patient's perception of a trauma, however, it does not determine the precise moment, the mechanism or the factor that caused it, its incidence is high representing up to 14.14%; the rest of the causal factors, although with less influence, are less than 10%, highlighting reactive hyperkeratosis.

Currently there are multiple classifications for "diabetic foot" patients to determine the prognosis/treatment/treatment/treatment, together with a unique interpretative meaning in the surgical field, which is first described in 1976 by Meggitt but was popularized by Wagner in 1981. This system consists of the use of 6 categories or degrees. [22, 23] In this study, patients with "diabetic foot" who required surgical therapy were classified as shown in **Table 2**. It is evident that the management of surgery will only be involved from grade II to V. Requiring medications, supportive measures, metabolic control, hospitalization, operating room, dressings and strict follow-up in the outpatient clinic.

Table 2: Meggitt-Wagner Classification of Patients with "Diabetic Foot" in Number and Percentage

Grade	Number	%
2	37	3.09
3	174	14.56
4	81	6.77
5	903	75.56
Bilateral	18	1.50
Total	1 195	100

In first place, a Wagner 5 stands out, reaching up to 76% of the total of the study group since they have extensive affection and systemic effects: completing a total of 903 patients. In second place is Wagner's grade 3 already with bone involvement with several 174 patients representing 14.56%. In third place is grade 4 with 81 cases representing 6.77%. Wagner 2 is reported only in 37 cases representing 3%, and in some patients the condition is so severe that it is bilateral or when there is a greater involvement or more extension of tissues or joints such as the coxofemoral, pelvis and dorsal cutaneous/muscular region. They were excluded from this study, but a total of 39 patients were quantified.

The Meggitt-Wagner classification is attached.[24]

- **Grade 0:** There are no ulcers, but the foot has deformities or structural changes such as the presence of calluses or areas of pressure.
- **Grade 1:** Superficial ulcer that affects only the skin, without compromising the deeper tissues.
- **Grade 2:** A deep ulcer that affects subcutaneous tissues, including tendons, muscles, or bones, but without severe infection or necrosis.

- **Grade 3:** Deep ulcer and abscess formation, it is extensive, there is discharge and bad odor
- **Rank 4:** Necrosis of a part of the foot, toes, heel, or sole
- **Rank 5:** The entire foot affected, systemic effects.



Figures 1 And 2: Two Cases are Seen that Occur with a Meggitt-Wagner Grade 4.

The surgical risk that was determined in patients with diabetic foot in this study is distributed as follows in Table 3:

Table 3: Classification of Surgical Risk for Patients with "Diabetic Foot" in Number and Percentage

Surgical Risk	No. /%
ASA I	0
ASA II	3/0.25
ASA III	474/39.66
ASA IV	701/58.66
ASA V	17/01.42
TOTAL	1 195/100

The most frequent scenario of surgical risk with patients with diabetic foot was an IV ASA in 59%, where there is severe lack of control of diabetes mellitus, with significant disability and which also presents data of a systemic inflammatory response syndrome, where together they present a high surgical risk and surgical management is urgent. In

second place, there is a surgical risk ASA III with an incidence of 40%, this item presents a certain disability, with metabolic uncontrol and systemic inflammatory response without integrating the syndrome. Unfortunately, in 17 patients, the surgical risk came to be ASA V, where surgical management was imminent and effective, given the severity of the patient's pathology was only mitigated with surgical intervention and both inflammatory and metabolic stability was reached. Some surgeries were performed under local anesthesia, and even so with the same results as with epidural and spinal anesthesia, documenting up to 96% of cases with the latter two mentioned. Only two patients were administered balanced general anesthesia. No patients were treated in the Intensive Care Unit.

Regarding the surgical techniques used, these varied depending on the presentation or scenario of each patient, the level of involvement or how advanced or not the anatomical condition/vascularization was

In some patients, family/social support and health care were considered, however, unfortunately it was not possible to complete the information in this study. The following table (see table 4) shows the lines of surgical management and the number of interventions per patient. The level of amputation is determined by the patient's vascular situation, tissue damage, and mobility. Good wound healing requires sufficient vital tissue, so the level of amputation often needs to be decided intraoperatively.

Table 4: Surgical Management Lines in the Diabetic Foot Expressed in Number and Percentage

Surgical Technique	Number	%
Drainage, Debridement, Fasciotomy, And Surgical Lavage	119	9.95
Dickson Amputation	354	29.63
Amputation Typó Syme	1	0.08
Amputation Of The Leg	3	0.25
Thigh Amputations	714	59.54
Hip Exjoints	4	0.33
Total	1,195	100

Thigh amputations are the most frequent in this study group or the so-called supracondylar (above the knee joint) with an incidence of almost 59.54%, in a second place it is documented that the technique of amputations of the fingers (Dickson type or racket) of one or more of them, which represent 29.63%. Thirdly, drainage of the abscess/hematoma, debridement, fasciotomy and surgical lavage are the options for diabetic foot, however, they are not exclusive, they can be combined with each other. In extreme cases that are very advanced in terms of infection, the authors carried out the disarticulation of the entire limb, after failure of the amputation of the thigh, fasciotomy with drainage and surgical lavage. In 281 patients, or 23.51%, combined surgical techniques were performed. It should be noted that there are more surgical amputation techniques that are mentioned and some have fallen into disuse, due to the demanding of the technique or the impracticality of the disease in this study: the Lisfranc amputation, the techniques according to Chopart, Pirogoff-Spitzky and Syme. [19, 25] In this study group, a total of 77

patients were reoperated, or 06.44%, either in a new amputation, new fasciotomies or residual abscess drainage, remodeling of the residual stump, or remodeling of the remaining bone.

The average deferral care time for emergency/priority surgery ranges from 16 hours to 216 hours, with an average of 71 hours. The reported bleeding ranges from a minimum bleeding of less than 50 milliliters to 650 ml with an average of 150 milliliters. Surgical time was highly variable with ranges from 14 minutes to 116 minutes with a mean of 53 minutes. On the other hand, the days of hospital stay, discarding the days in the emergency department, averaged 3 days with ranges from 2 days to 37 days. 367 direct cultures were taken in the operating room with reports that were out of date at more than 7 days and not counting the number of colonies with the microorganisms being deficient; the most frequent microorganisms in the first place were: *Staphylococcus aureus*, *Escherichia coli* and finally *Enterococcus faecalis*; therefore, in its entirety the antibiotic management was empirical and only 3% of the patients in this study had a specific antibiotic.



Figure 3 Figure 4: Images of A 52-Year-Old Patient with Diabetic Foot in Figure 3, Drainage, Debridement and Surgical Lavage are Performed, 5 Weeks after Management Installed in Figure 4 there is Evidence of Granulation Tissue, Absence of Infection, Abolition of the Inflammatory Process, No Longer Edema, and Significant Improvement of Circulation.

Morbidity was determined at 18%, which is listed below in a decreasing manner the conditions that patients presented in a timely manner, which are:

1. Surgical wound removal due to infectious process
2. Seroma of wound
3. Necrosis of tissues adjacent to the incision with infection

4. Osteomyelitis
5. Difficult glycemetic control of diabetes mellitus is greater than 72 hours after surgery.
6. Anemia
7. Acute acute/chronic kidney failure
8. Bone protrusion or dysfunctional remnant deformity
9. Septic shock

Mortality was reported in 2 patients. One of them presents septic shock due to anaerobes and subsequent death and the other presents with hip disarticulation, with secondary osteomyelitis and major depression. With a percentage that represents 0.16% in this study alone.

DISCUSSION

Nearly half of patients with diabetes-related foot infection experienced prolonged hospitalization. Increased wound size, surgical treatment, minor amputation, and atherosclerotic cardiovascular disease were associated with prolonged hospitalization. Identifying these factors can guide clinical decisions to reduce hospitalizations in resource-limited health systems. [26] Active-phase Charcot neuroarthropathy should be considered in any patient with a history of diabetes mellitus that presents edema, erythema, and warmth in one of their feet, which is aggravated when walking and is an underdiagnosed disease, with serious consequences if not detected and treated early. [27] However, when deformities develop, with or without ulcers, the use of contact casts in the acute phase is considered an effective strategy, as it prevents deformity and reduces the need for surgical intervention. Once deformity is present, reconstruction surgery is more cost-effective. [28, 29] Diabetic foot infections are a common and serious complication within the spectrum of diabetes mellitus. It is a common cause of hospital admission in patients with type 2 diabetes. Its manifestations range from neuropathy and the onset of ulcers to cellulitis and gangrene of the foot. Sometimes, treating this complication requires amputation, which makes diabetic infection in the foot the most frequent cause of non-traumatic amputation in Spain. [30] Risk factors for minor amputations are unclear. This study seeks to determine the prevalence of reamputation in diabetic foot from minor amputations and to evaluate the factors associated with this outcome; with a prevalence of reamputation that was 48%. Toes were the smallest amputation that required the most frequent reamputation, and the area above the knee was the most common. [31] Severe peripheral arterial disease, male sex, advanced age, hemodialysis, initial heel injury, and severe infection have been proposed as poor prognostic factors. [32] In addition, manual grip strength has been assessed with a Smedley handheld digital dynamometer, following the procedure of the Muscle Strength/Grip Test, an independent prognostic marker of lower limb amputation at one year in patients with diabetes. [33] The infectious process is key to correctly identifying and treating patients with diabetic foot, the identification of infectious microorganisms is generally done by culture, which generates bias. Recently, metagenomics has been used for microbial identification. [34] The families with the highest frequency of occurrence by culture were Enterobacteriaceae (29.3%) and Staphylococcaceae (28.3%) and metagenomics Peptoniphilaceae (22.1%) and Staphylococcaceae (9.4%). Peptoniphilaceae was not

identified in culture, although it was frequently identified by metagenomics. Methicillin-resistant *Staphylococcus aureus*. [35]

On the other hand, hypoglycemia is reported to be associated with an increased risk of various vascular diseases in patients with type 2 diabetes, a prothrombotic state, stroke, myocardial infarction, microvascular complications, and major adverse cardiovascular events. [36] The common and severe microvascular atherosclerotic arterial disease of lower extremity origin of type 2 diabetes mellitus, which can lead to lower extremity ischemia, ulcers, and even amputation, significantly increasing the disability rate and mortality rate of patients. vascular walls thicken and lumen narrows or occludes, thus causing insufficient blood supply to the lower extremities. [37, 38]

Once diabetic foot disease has set in, a way has been sought to classify it in a unification of prognostic criteria or effective therapy. Four diabetic foot ulcer classifications (Meggitt-Wagner, University of Texas, SINBAD, and Saint Elian) have been externally validated and compared for predicting major amputation in patients with diabetes seen in this study. [39] Most clinical scoring systems for diabetic foot were developed and validated in high-income countries, their predictive performance might not be directly transferable to Latin American settings. [40] Meggitt-Wagner classification of the year 1976, is a system that is based mainly on the depth of the ulcer, partially considering ischemia. [23] The 1996 University of Texas classification is a system that incorporates three dimensions: ulcer depth, infection, and ischemia. These combinations result in 16 possible grades with distinct prognostic implications for limb recovery and amputation. [41] The SINBAD classification: Developed by Ince et al. in 2008, is a modification of the system that is an acronym that evaluates six parameters: "Site, Ischemia, Neuropathy, Bacterial Infection, Area and Depth". This simplified score aims at broad applicability in clinical settings and with limited resources, comparing the outcomes of diabetic lesion treatments between different communities. [42, 43] The Saint Elian Classification in 2010. A modification of the PEDIS system may be considered. It includes 10 parameters/variables, encompassed in 3 domains: anatomy, aggravating factors and tissue involvement. The variables are ischemia, infection, neuropathy, area, depth, location of the ulcer, topographic appearance of the lesion, number of affected areas, healing phase and existence of foot edema. The authors of this classification argue that it allows the reclassification of lesions during their evolution, is a useful tool for monitoring and provides a prognostic value of success or failure of healing, which allows the adjustment of the selected treatment. [44] In addition, there are many other classifications such as: Williams of the year 1974, McCook and others of 1979, Gibsons and Eliopoulos of 1984, Forrest and Ganborg - Nielsen year 1984, Edmons year 1990, Pecoraro and Reiber year 1990, Brodsky year 1992, Liverpool year 1998, the SAD classification year 1999 described by MacFarlane, Frykberg et al.-year 2000, Simple Staging System-SSS year 2000, Curative Health Services Wound Grade Scale 2000, Van Acker/ Peter 2002, Margolis et al. 2003, PEDIS Classification 2003, DEPA 2004, Strauss and Aksenov Wound Score 2005, Diabetic Ulcer Severity Score - DUSS 2006, Anatomotopographic Diabetic Foot 2006, MAID 2009, Kobe 2011, Lipsky et al. 2011, IDSA/ International Working Group on the Diabetic Foot 2012, SVS-Wifl year 2014, Tardivo year 2015, Amit Jain year 2015, Diabetic Foot Ulcer Assessment scale - DFUAS year 2016, Diabetic Foot Risk Assessment year 2016. [45]

Regarding the diagnosis of diabetic foot and its protocol, osteomyelitis can be started with the basics such as the probe-to-bone test, the plain X-ray and blood biomarkers,

including erythrocyte sedimentation rate and C-reactive protein. [46] Plain radiography is a low-cost and widely available diagnostic tool, and its diagnostic performance is limited. Serial radiography can improve accuracy and clinical utility. [47] Charcot's neuroosteoarthropathy, on the other hand, is a devastating complication of peripheral neuropathy, characterized by progressive bone and joint destruction that results in severe foot deformity, ulceration, and a high risk of amputation. Load-bearing CT and MRI manage to capture the true load-dependent nature of the deformity. [48, 49] Diabetic neuropathy, due to high blood glucose levels, has four main types. You can have only one type or more at the same time:

- Peripheral neuropathy
- Autonomic neuropathy
- Proximal neuropathy
- Mononeuropathy [50]

Skin and soft tissue infections are common clinical conditions in which microbiological investigation is selectively indicated; so, an etiologic diagnosis, the optimal sampling method (superficial swab vs. biopsy or deep tissue aspiration) remains controversial. Deep tissue or aspirated tissue sampling remains the microbiological gold standard for complex infections, while superficial swabs may be appropriate in selected mild infections or when invasive procedures are not feasible. [51] Chronic bone and soft tissue infections pose a diagnostic challenge, as conventional imaging techniques often show limited sensitivity and specificity. Therefore, the diagnosis of PET/CT with Ga-Pentixafor is compared to conventional triphasic bone scan and Tc-HMPAO-labeled leukocyte scintigraphy in patients with suspected chronic bone and soft tissue infections of the diabetic foot. Concluding that the first PET/CT is the most useful and the most accurate. [52] White blood cell SPECT/CT has greater sensitivity and specificity than MRI at initial diagnosis. However, after treatment, white blood cell SPECT/CT and MRI have equivalent performance in determining therapeutic response. [53] On the other hand, diabetic polyneuropathy is a common debilitating complication of diabetes mellitus, causing pain that may progress to numbness and motor compromise; neuromuscular ultrasound determines considerable combined specificity and sensitivity for these patients. [54] The association between blood parameters and nutritional indices obtained from simple blood parameters and diabetic foot amputations has been determined to have a prognostic value, significant associations in univariate and multivariate analysis of amputation risk in patients with diabetic foot disease. [55] Ankle-brachial index is a noninvasive vascular screening test for identifying large-vessel peripheral artery disease and can be measured, where Doppler has been routinely used by foot surgeons as it produced a sensitivity of 75.5% and a specificity of 63.3%. [56] Peripheral vascular disease is a major cause of complications in diabetic foot, resulting in delayed wound healing, ulceration, and amputation. Identification of superficial tibial vessel disease, with operator skill and patient factors such as obesity or arterial calcification with reference standard variability. Ultrasound, in particular duplex Doppler, is of high diagnostic utility, providing an inexpensive and non-invasive option for digital subtraction angiography, although it is necessary to standardize the protocols. [57]

The manifestations of the patient suffering from diabetic foot are often accompanied by cardinal manifestations of inflammation such as erythema, heat, swelling and tenderness

or serious/hematic/purulent material in an ulcer, with evidence of gangrene or dry necrosis. However, these local signs of infection may not be evident in all cases, and infections do not manifest heat and erythema in the framework of severe ischemia. [58] In addition, diabetics with sensory neuropathy may have decreased sensation in the affected area and therefore may not complain of tenderness or, failing that, realize that there is an infection. In such cases, the infection can progress and affect deeper tissues before the patient seeks medical attention. [58, 59]

Regarding the treatment of patients with diabetic foot, a comprehensive/multidisciplinary approach should be considered, from metabolic control, antibiotic management, surgical criteria, a rehabilitation process and, in the extreme, prevention strategies. The goal of treatment for diabetic foot is to achieve tissue healing while maintaining adequate function and weight bearing for ambulation. Antibiotic treatment of the infection in conjunction with debridement or amputation of the tissue and discharge of foot pressure until healing is achieved, are essential therapeutic principles: where "time is tissue" is applied to the infection that defines the "diabetic foot attack". [60, 61]

Infection by multidrug-resistant microorganisms is a major threat for the treatment of this type of pathology, a history of exposure to antibiotics, a history of hospitalization within a year, hypertension and osteomyelitis in combination, are the risk factors of these patients, the complexity increases to eliminate the infection in the affected foot. [62] Another factor that adds to this very characteristic disease is that diabetic wounds represent a critical challenge due to the deterioration of healing processes driven by chronic inflammation, infection, biomechanical deficiencies, and poor blood circulation.

Negative pressure therapy and silver dressings support chronic wound repair, benefiting from their combined efficacy in diabetic foot ulcers, offering potential advantages in reducing the inflammatory response and promoting healing [63] And despite advances in wound dressings and negative pressure therapy, Current treatments often do not provide sufficient mechanical support or resolve completely. A methacrylated photo-reticulable chitosan quaternary ammonium salt derivative was developed that accelerates gelling and improves structural integrity. Ultraviolet-initiated copolymerization with gelatin methacrylate and type I collagen is then used to fabricate a ternary compound hydrogel that encapsulates fibroblast growth factor 21. Managing to accelerate wound closure by mitigating inflammation and promoting epithelialization and angiogenesis. [64] Currently, there are several 2D nanomaterials, MXenes are particularly promising due to their combination of high electrical conductivity, a wide accessible surface, intrinsic hydrophilicity and adjustable surface chemistry: facilitating the immobilization of biomolecules with an efficient electrochemical response and a high loading capacity of drugs or biomarkers. [65] Hydrogels and microneedle patches promote healing of diabetic wounds by reducing local glucose levels, providing oxygen supply, and generating mild hyperthermia to stimulate tissue regeneration by enhancing angiogenesis and macrophage polarization, thereby accelerating healing processes. [66]

Surgery is the mainstay of the treatment of patients with diabetic foot, with the conventional/common surgical techniques described above, this leaves room for a new range of options to study or propose. The example is: the minimally invasive floating metatarsal osteotomy that has been proposed as a surgical strategy to address diabetic,

recurrent or persistent foot ulcers by correcting the underlying biomechanical deformities with a 98% cure rate; and low recurrence compared to conservative care. [67] It is well referenced that surgical approaches such as serial debridement (to remove nonviable or necrotic tissue) and reconstructive modalities (primary closure, skin grafts, and flaps) can be used. Therefore, he describes a new surgical technique for the radial amputation of the diabetic foot. The procedure allows for soft tissue reconstruction using a local flap in combination with negative pressure therapy to close these wounds safely and effectively. a shorter mean healing time, no major amputation or additional minor amputation of the target limb occurred in the group treated with the new technique. [68] Holistic care for patients with diabetic foot should be managed: 1) early holistic patient assessment, 2) centralized coordination through a multidisciplinary team for personalized care plans, 3) thorough surgical debridement, 4) prudent use of advanced complementary therapies, and 5) rigorous post-discharge follow-up and patient education to prevent recurrence. [69]

A determining factor is chronic ischemia, which is highly threatened, and is an important cause of non-healing wounds and lower extremity amputation, despite advances in endovascular therapy, where direct revascularization of a specific angiosome improves outcomes compared to indirect approaches, especially in patients with multilevel disease and variable collateral circulation. The recently proposed "woundosome" raises the question of whether an individualized, perfusion-oriented strategy could further optimize healing. [70] Following its use in ischemic diseases of the lower extremities, transverse tibial bone transport was applied in patients with diabetic foot to facilitate neovascularization in ischemic extremities or whole-body lesions, improves perfusion, and thus improves microcirculation with lumen diameters less than 10 μm . Its efficacy is associated with tension osteogenesis at the surgical site and supportive collateral vascularization. [71]

Moreover, the physical and biological effects of hyperbaric oxygen therapy for use in chronic wound healing: correcting tissue hypoxia, it stimulates angiogenesis and collagen synthesis, reduces environmental edema and has anti-inflammatory and antimicrobial effects. [72] By stimulating the growth of granulation tissue, it rapidly heals ulcers, reduces treatment time, and reduces amputation rates in the diabetic foot patient. [73] However, there is sufficient conflicting data where transcutaneous oximetry uniquely measures tissue oxygen tension, differentiating patients who respond to hyperbaric therapy from those who do not respond to hyperbaric therapy in the early stages of treatment by detecting neoangiogenesis, providing a basis for continuing hyperbaric dosing only in those who benefit. [74]

Human amniotic membrane extract has been investigated to improve epithelial damage in corneal and skin lesions. However, there are still unanswered questions about its role in the treatment of diabetic foot ulcer, where the treatment group received an SMA product (DiAMX, Royan Stem Cell Technology, Iran) (concentration of 1 mg/ml) with the standard treatment, topically, every 48 hours for the first week and every 72 hours thereafter until complete closure. The results showed that the wound healing rate was 100% in the treatment group. [75] Another published technique is that of transverse tibial transport improving perfusion, but it requires corticectomy and fixation, using a miniaturized, programmable motor to gradually elevate the periosteum. Skin temperature increased by 2 °C and digital systolic pressure (digital toe pressure) increased from 22 to 50 mm Hg. The wound progressed to healing without complications. Offering a minimally invasive and biologically controlled alternative for patients at high risk of amputation due

to diabetic foot. [76] This other publication evaluates the efficacy of a modified tibial transverse bone transport technique (combining bone transfer and periosteum) in the treatment of Wagner grade 3 to 4 diabetic foot. It may support microvascular regeneration, improve foot temperature, relieve pain, and promote ulcer healing, demonstrating favorable clinical results and a low incidence of complications in patients with severe diabetic foot. [77]

Research is underway that the clinical relevance of proteolytic enzymes has been further strengthened in the context of chronic wounds, including diabetic foot ulcers, which remain a significant health burden worldwide. Compared to enzymes derived from plants or animals, microbial proteases are particularly attractive due to their scalability, tunable properties, and the feasibility of adapting them for use in complex substrates and physiological conditions; Both enzymes collagenase and keratinase altered the biofilms of diabetic foot pathogens and increased antibiotic activity, highlighting their potential as adjuncts in wound care. [78] Chronic wounds or diabetic foot ulcers with difficulty healing caused by chronic inflammation, poor angiogenesis, and extracellular matrix abnormalities, where the use of cyclic peptide-loaded hydrogels demonstrates improved biological activity, significant reductions in healing times, and higher percentages of wound closure. [79] On the other hand, diabetic foot ulcers in the heel are a particularly severe form, characterized by prolonged healing times and a significantly elevated risk of major amputation, where the antibiotic bone cement has established itself as a promising therapy facilitating infection control and shortening hospitalization. [80] Another line of research is the clinical effectiveness of platelet-rich fibrin in the treatment of chronic wounds, improving microvascular blood flow and stimulating local angiogenesis in patients with diabetic foot, ultimately leading to improved quality of life and clinical outcomes with shorter healing durations and a lower recurrence rate. [81]

Diabetic foot ulcers complicated by multidrug-resistant bacterial infection represent a significant clinical challenge that requires innovative therapeutic strategies. Conventional antimicrobial treatments often fail due to their limited tissue penetration, antibiotic resistance, a luminogen-induced emission induced by sensitive near-infrared light aggregation with high photothermal conversion efficiency, excellent photostability, and favorable biocompatibility. This system offers a non-invasive, biocompatible, and high-penetration antibacterial strategy for the treatment of chronic multidrug-resistant infections. [82] Something innovative is the use of cerium oxide nanoparticles (CeO₂ nanoparticles), thanks to their antibacterial, anti-inflammatory and antioxidant properties, they have become a promising treatment: reducing inflammation and stimulating tissue regeneration by modulating macrophage polarization and promoting angiogenesis. However, limitations such as low biocompatibility, aggregation, and dose-dependent toxicity make clinical application difficult. [83]

Finally, multidisciplinary collaboration and appropriate medical and surgical management, including the prudent use of antibiotics and specific vascular or orthopedic procedures. And at the same time, aim not only to preserve the limb, but also to improve quality of life and functional recovery. Therefore, health systems must actively invest in structured foot assessment, patient education, and comprehensive team care to reduce the burden of amputation and its long-term complications. [84] Or, in another perspective, Endocrinology, synthesizes the latest evidence and expert perspectives to provide recommendations based on physical activity and exercise therapy in adults with type 2

diabetes. And address specific subgroups of patients with type 2 diabetes, such as older people, people with obesity, cardiovascular disease, hypertension, kidney disease, liver disease associated with metabolic dysfunction, and/or diabetic foot, as well as their high-risk populations. [85]

OBSERVATIONS

1. In Mexico, a reliable epidemiological/statistical database of patients with type 1 or type 2 diabetes mellitus who suffer from the so-called "diabetic foot" was not found: in terms of their diagnosis, treatment, cure, palliation, rehabilitation, use and adaptation of prostheses, as well as their types, incidence, prevalence, morbidity and mortality; unfortunately, it is completely unknown.
2. The patient with "diabetic foot" always has these 5 conditioning factors or characteristics
 - Ischemia (venous/arterial)
 - Infection
 - Disfiguring arthropathy
 - Neuropathy
 - Atrophy/Weakness/Deformity/Of all tissues (skin, muscle, bone)



Figure 5: A 63-Year-Old Male with Diabetic Foot Postoperative from Minor Amputation of the Fifth, Fourth and Third Toes with Granulation Tissue Without Evidence of Infection, without Edema, with Severe Foot Deformity. Ochre Skin and Atrophy Due to Mixed Vascular Insufficiency.

3. Patients with diabetic foot have chronic bacterial infections, cytolysis of all tissues and are the only human beings in the medical field who present clinical manifestations of infection by microorganisms by anaerobes, not triggering a scientific explanation to date.
4. There is a big question, and it is because there is an entity as complex as a disease wrongly called "diabetic foot", but there is no case of "diabetic hand".
5. In the clinical, diagnostic and therapeutic medical evaluation of the patient with "diabetic foot", the functionality and/or load bearing of the limb is not taken into consideration.
6. Currently in Mexico, there is no paradigm of diagnosis/treatment/rehabilitation and integration of the patient who suffers from "diabetic foot", there is no multidisciplinary management, there is no cooperation of the competent specialties, delegating or even abandoning patients to the General Surgery service, with the exclusivity of being the responsibility of this complex entity.

Debatable because:

- **Plastic and Reconstructive Surgery** is the specialty responsible for the management of soft tissue infection, as well as performing autologous or external reconstructions, with repair/construction of nerves and grafts according to the conditions. A scenario that does not happen in this country.
- **Traumatology and Orthopedics** is the specialty responsible for performing scheduled, priority or emergency amputations, with the competence of a better preservation of ligaments, joints and bone that project a better function and load for an adequate rehabilitation of the patient. A scenario that does not happen in this country.
- **Internal Medicine** is the specialty in charge of achieving adequate control of the patient in the metabolic, nutritional, and infectious fields with preventive guidelines that are manifested in a quality of life and better life expectancy of the patient. This is the case with diabetic foot, the failure of health policies and therefore of this specialty. In Mexico, the care of the diabetic patient has always been delegated to the specialty of Family Medicine or the General Practitioner and, ironically, even to the support service such as the Emergency Department.
- **Endocrinology** is the specialty in charge of the metabolic control of individuals with diabetes mellitus with the aim of optimizing and achieving self-control of diabetes mellitus. A scenario that does not exist in Mexico.
- **Dermatology** is the specialty responsible for the care and prevention of the skin, which, in the author's experience, has never been involved in this country for this purpose.
- **Angiology or Vascular Surgery** is the specialty responsible for evaluating/diagnosing/treating the vascular diseases of patients with "diabetic foot", a situation that has never really happened in Mexico.
- **Rehabilitation** is the specialty whose objective is to maximize autonomy and reduce disability, whether temporary or permanent. In Mexico it is saturated in

patient care with an extreme deferral due to the exorbitant number of cases with a stunted, deficient and even depressing quality, with very marginal to bad results due to their timelessness.

7. In Mexico, correct, ethical and comprehensive management is not carried out, since in addition to everything previously expressed, the following must be carried out:
 - A successful rehabilitation
 - The correct applicability of prostheses and the return to functionality.
 - Psychological/psychiatric support
 - Long-term follow-up of the patient, recurrence or recurrence.
8. It has been detected that the most affected social stratum is the least resourced and affects the male gender the most.

CONCLUSIONS

Patients in Mexico who suffer from "diabetic foot" are unlikely to be a priority of the public health system, since their diagnosis and treatment are always in basic and stunted conditions. Without resources and supplies, without a public health policy or consensus for comprehensive treatment and rehabilitation.

This study shows that patients with diabetic foot have medical care in very advanced stages, when the infection and gangrene have progressed, which combined with ischemia and neuroosteoarthropathy only leaves the option of saving life, without functional recovery and with a null quality of life.

Conflict of Interest

The authors stated that they had no potential conflicts of interest regarding the research, authorship, and/or publication of this article.

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