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Diabetic Foot. Tools for the Identification of the Foot at Risk and its Timely Intervention.

Christian Pérez Calvo[1*], Brigitte García-García[2], Valentina Marrugo-Padilla[3], Daniel Montes-Sierra[4] ,Huber Alvarado-Castell[4], Daniela Ortiz-Hernández[4], Claudia Reyes-Merlano[2], Nehomar Pájaro-Galvis[5], Amilkar Almanza-Hurtado[5]

[1]Department of Internal Medicine, Free University, Barranquilla, Colombia.

[2] Department of Internal Medicine, Universidad del Sinú, Cartagena Colombia.

[3]Department of Internal Medicine, Faculty of Medicine, University of Cartagena, Cartagena, Colombia.

[4] Department of Internal Medicine, University of Cartagena, Cartagena, Colombia.

[5] Department of Internal Medicine, Universidad del Sinú, Cartagena, Colombia.

Correspondence: Christian Perez Calvo. Department o f Internal M edicine, Free University, Barranquilla, C olombia. Email: christianperez05@hotmail.com. Phone number: +57 324 274 2314

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Abstract

Diabetic Foot is called an anatomical or functional alteration determined by a chronic process at the neuropathic level with or without the presence of peripheral vascular disease characterized by infection, ulcer and / or destruction of deep tissues. The main cause of injury to the diabetic foot is the use of inappropriate footwear, which is the triggering reason in most cases, it is for this reason that treatment in these patients is conditioned to the use of therapeutic footwear, management with Antibiotic medications in the presence of infections, non-surgical debridement agents, dressings, hyperbaric oxygen therapy in patients with poor wound healing and, in the worst case, non-traumatic amputation of the lower limb.

Key Words: Diabetes Mellitus; Diabetic Foot; Infection (MeSH)

Introduction

Diabetes Mellitus is considered a serious systemic pathology, which generates a great impact on the health system worldwide, this disease is associated with multiple complications, such as injuries that occur in the lower limbs. Diabetic Foot (PD) is called an anatomical or functional alteration determined by a chronic process at the neuropathic level with or without the presence of peripheral vascular disease characterized by infection, ulcer and / or destruction of deep tissues [1].

We call an ulcer a solution of continuity that covers the entire thickness of the skin. On the other hand, amputation is defined as the separation of a limb from the body or part of it [2]. In our case, we consider amputation of non-traumatic origin, in people with diabetes.

The risk of amputation increases 8 times once an ulcer develops and is estimated to be 15 times higher in diabetic patients compared to healthy people [3].

The most common risk factors for the development of diabetic ulcers are male gender, hyperglycemia, duration of diabetes, increased glycosylated hemoglobin, foot trauma, peripheral neuropathy, previous ulcer and chronic kidney disease [4]. Considered most importantly, loss of protective sensation (PSP), peripheral arterial disease (PAD), and foot deformity [5]. Strategies that can reduce the burden caused by diabetic foot syndrome include preventive aspects, patient education and training of the professionals involved, multidisciplinary treatment and close supervision, as described in this document.

The main cause of injury in PD is the use of inappropriate footwear, which is the triggering reason in most cases, it is for this reason that treatment in these patients is conditioned to the use of therapeutic footwear, management with medications antibiotics in the presence of infections, non-surgical debridement agents, dressings, hyperbaric oxygen therapy in patients with poor wound healing and, in the worst case, non-traumatic amputation of the lower limb.

The objective of this review is to compile and update the main aspects related to the diabetic foot, we will emphasize the importance of taking a complete medical history, risk stratification and exhaustive physical examination to achieve the correct diagnosis of early manifestations. and timely management in each type of patient, taking into account that diabetes mellitus generates important repercussions in those who suffer from it, we consider it vitally important to provide health personnel with first-hand information to make adequate therapeutic decisions to try to prevent and, if it is possible to avoid limb amputation in this type of patient.

Definition

The term "diabetic foot" is imprecise. There are multiple definitions that describe factors influencing the development of this condition, all coincide in describing the presence of a break in the skin of the foot in a person with diabetes, which does not heal quickly, however, they do not indicate anything of this type of injury. , because each person is different and is influenced by multiple mechanisms for the development of an ulcer. Once the injury is established, there are many determining reasons for its inadequate healing, these factors will not only vary between people, but will also vary over time [6].Despite this controversy, the World Health Organization (WHO) clearly defines diabetic foot (PD) as “the presence of ulceration, infection, and / or gangrene of the foot associated with diabetic neuropathy (DN) and different degrees of peripheral vascular disease, resulting from the complex interaction of different factors induced by sustained hyperglycemia'' [7].

Epidemiology

Type 2 diabetes mellitus (DM2) is a preventable and manageable condition, which has become a serious problem for health systems globally. The 2019 Atlas of the International Diabetes Federation (IDF) reports that the global prevalence of diabetes in adults reached 9.3%, representing 463 million cases, and is expected to increase by 51% by 2045 with 700 million cases [8].

On the other hand, based on data from a systematic review and a meta-analysis about the global epidemiology of diabetic foot ulcers, the prevalence of diabetic foot in North America, Asia, Europe, Africa and Oceania was estimated to be 13 , 0%, [9] figure that indicates that in these continents the prevalence was higher compared to the estimated values at a global level.

Diabetic foot is one of the severe chronic complications of diabetes. Approximately 25% of people with diabetes will develop a foot ulcer in their lifetime, which can progress to infection and limb amputation in severe cases [10]. The most important risk factors for the development of these ulcers are advanced age, increased body mass index, longer duration of diabetes, hypertension, diabetic retinopathy, and smoking [9]. Peripheral neuropathy is the main determining factor that induces pressure ulcers, and up to 67% of patients with diabetes mellitus develop it [11].

The amputation of a limb, in 85% of cases, is preceded by an ulcer, which later deteriorates to severe gangrene or infection, which significantly increases the risk of death in this population [12]. Diabetes accounts for 83% of all major amputations in the United States [13]. These types of amputations represent 40% to 60% of non-traumatic amputations at the hospital level. The risk of a diabetic individual of developing a foot ulcer is 25 times greater than that of a non-diabetic, and it is estimated that every 30 seconds a lower limb amputation is performed somewhere in the world as a consequence of diabetes.

Despite the epidemiological data mentioned, currently, there are no specific studies that define the percentage of global prevalence of diabetic foot ulcers, multiple investigations have been carried out in specific geographic areas and at specific times, taking into account some parameters that may vary Between one population and another, however, it has not been possible to calculate a universal prevalence, so larger studies are needed in order to create prevention, education, diagnosis and treatment strategies for diabetic foot ulcer and diabetes. this way to provide a better quality of life to patients. Despite multiple efforts for prevention, this disease continues to be a major problem in our health system.

Risk factors and risk stratification

There are a number of well-characterized risk factors that predispose to the development of foot ulcers in patients with diabetes. It is important to mention that not all patients with this disease will present ulcers in the lower limbs, these are more likely to occur in those who have key risk factors such as loss of protective sensation (PSP), peripheral arterial disease (PAD) and foot deformity [5].

Next, in Table 1, the most important risk factors are mentioned:

Table 1: Risk factors.

RISK FACTOR'S
History of previous ulcers Smoking
Diabetes of more than 10 years of diagnosis Diabetic neuropathy
Distal arterial occlusive disease
Structural deformities of the foot: Hyperkeratosis, Charcot, claw toes, piano foot and pes cavus, wrong foot (Achilles tendon narrowing)
Poor glycemic control
Changes in the quality of the skin: fissures, dryness, dyshidrosis, mycosis HT
Nephropathy, Retinopathy

The latest prevention guideline from the International Working Group on Diabetic Foot (IWGDF) defines a patient at risk as a person with diabetes who does not have an active ulcer, but who has at least PSP or PAD [5].

Based on the aforementioned, a risk stratification system was created (Table 2) based on a meta-analysis and a systematic review of several prospective studies on risk factors associated with ulceration. In this system, the 2 most important risk factors are evaluated and, according to the result, the frequency at which each foot should be evaluated is determined.

Table 2: IWGDF Risk Stratification System and its correspondence with the frequency of screening and examination of the foot.

CATEGOR IA	RISK OF ULCERA	CHARACTER ISTICS	FREQUENCY IA
0	Very low	Air P to PSP	Once a year
1	Low	PSP o EAP	Once every 6-12months
2	Moderate	or PSP + foot deformity o PAD + foot deformity	Once every 3-6 months

3	Alto	PSP or EAP and one or more of the following: • History of ulcer • Lower limb amputation (major or minor) • End-stage kidney disease	Once every 1-3 months

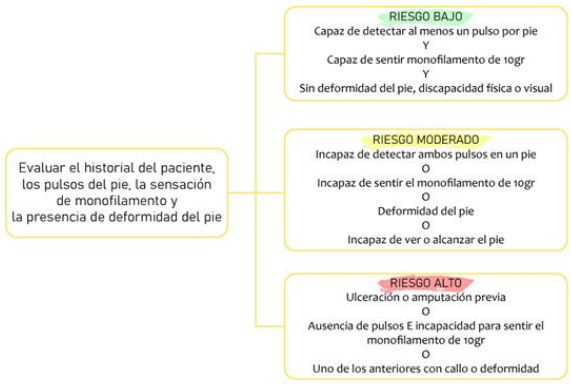
Note: PSP = Loss of feeling of protection; PAD = Peripheral Arterial Disease. * The frequency of reviews is based on expert opinion, as there is no evidence to support these ranges. When screening is close to a regular diabetes checkup, consider doing a foot exam at that checkup.

Those who do not present PSP or PAD are classified as risk 0 of the IWGDF, presenting a very low risk of ulceration. These people are going to need an annual checkup. On the other hand, the rest of the categories will be considered "at risk", requiring more frequent check-ups of your feet [5]. The times and ways of evaluating the diabetic foot will be mentioned later.

There are several risk stratification systems. Most of these systems share the same variables, such as diabetic neuropathy, PAD, foot deformity, ulcer, and previous foot amputation. The Scottish Intercollegiate Guideline Network (SIGN) system has shown the best diagnostic accuracy [14].

The SIGN system is based on criteria that are very similar to other strategies, however, in a more detailed way, it allows the patient to be classified into three groups: low risk, moderate risk and high risk (Figure 1). Neuropathy was defined as the inability to detect a 10 g monofilament in more than one plantar site on each foot, using pressure that could only bend it; absence of pulses such as absence of dorsal foot pulse or absence of posterior tibial pulse in either foot; foot deformity such as a change in the foot that makes it difficult to fit into standard shoes; physical disability such as the inability to reach your feet and visual impairment such as difficulty seeing your nails to cut them safely [15]. The aforementioned classification is shown below:

Figure 1: SIGN system. Adapted from: Stratification of foot ulcer risk in patients with diabetes: a population-based study. IJPC 2006 [15].



Due to the low precision, variability and low evidence of these clinical strategies [14], there was a need to create a more precise and objective detection method. Sudomotor dysfunction can occur even before sensory loss, in addition to playing an important role in the genesis of the ulcer, for this reason the assessment of this function has been accepted to stratify the risk of complications, showing better performance than classification systems clinic [16]. However, one of the main limitations of this method could be the low availability on top-level sites.

Etiology and pathogenesis

Diabetic foot ulcers are rarely the result of a single pathologic factor; a large number of potential factors that may contribute to their development are well described in the literature. Traditionally, diabetic foot rupture was considered the result of an interaction between peripheral vascular disease, distal symmetric polyneuropathy, and infection [17]. However, there is insufficient evidence that infection is a contributing factor, but rather a complication of ulceration. Key risk factors for developing foot complications in diabetes are the presence of peripheral neuropathy and / or peripheral arterial disease, foot deformity, and a previous history of ulcers or amputation of the toes or part of the foot [17].

Diabetic foot ulceration can be classified as vascular (10%), neuropathic (40%), or neuroischemic in origin (40%). The most common causal pathway for diabetic foot ulceration can be identified as a combination of loss of sensation, abnormal foot structure, stress, missed trauma, and poor treatment of the associated foot injury [18].

Neuropathy

Distal symmetric polyneuropathy is an important factor in the pathogenesis of foot ulceration. The gradual loss of nerve function affects almost every element of the foot, including the skin, connective tissue, bones, and blood vessels. Distal polyneuropathy is characterized by chronic and progressive sensory-motor loss [19].

Sensory neuropathy results in the loss of protective sensation, allowing the injury to go unnoticed [20]. Chronic repetitive injuries, often from improper footwear, may not be apparent until tissue degradation occurs [20]. Altered proprioception has negative effects on gait, and loss of protective changes in biomechanical load distribution can result in sustained stress and tissue damage [20]. Sensory deficits include decreased perception of pain, temperature, light touch, and pressure [21]. Although some patients present with symptoms such as paresthesia or pain, many patients have no significant symptoms and are unaware of the diminished protective sensation; This neuropathy is frequently accompanied by distal autonomic neuropathy, leading to decreased sweat secretion and increased blood flow from the thermoregulatory shunt, resulting in hot, dry foot [20]. In turn, neuropathy is associated with decreased muscle strength and atrophy in the foot, where an imbalance of the extensor and flexor muscles would result in the typical gripping or hammering of the fingers; such a deformity would increase the biomechanical load of the metatarsal heads or the fingertips during standing and walking [20]. Microcirculation

Impaired diabetic foot microcirculation has been postulated to be an important factor in poor wound healing associated with chronic diabetic foot ulcerations [22]. Therefore, a deep understanding of the specific microvascular alterations in diabetes is useful to consolidate the concepts involved in the pathogenesis of diabetic foot disease [23].

The most prominent structural changes observed in diabetic microcirculation are the thickening of the capillary basement membrane, the decrease in the size of the capillary lumen, and the degeneration of the pericytes (contractile cells that surround the endothelial cells of the capillaries and venules of all the body and are found on the basement membrane) [24]. A possible explanation for microvascular dysfunction in diabetic neuropathic foot is the hemodynamic hypothesis. This suggests that dysregulation of blood flow is mediated by hyperglycemia in the early stage of diabetes. This process is known to stimulate the polyol pathway that ultimately limits nitric oxide production. The result is an increase in microvascular flow and capillary pressure that subsequently induces an endothelial injury response [18].

A thorough understanding of the etiopathogenesis of ulceration is essential if we are to be successful in reducing the incidence of foot injuries and ultimately amputations [25]. Pathways to foot ulceration are summarized in Figure 2, and key contributing factors are also listed. The combination of two or more of the risk factors listed below commonly results in ulceration.

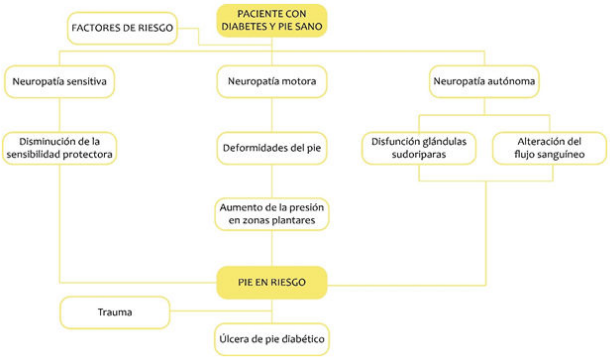
Figure 2: Pathways to diabetic foot ulceration.

Adapted from: Diagnosis and Management of Diabetic Foot Complications. Diabetes- 2018

Pathophysiology

The hyperglycemic states that diabetic patients face produce oxidative stress at the nerve cell level, due to this cellular damage neuropathy begins; subsequently, nerve dysfunction secondary to glycation of the proteins in these cells continues and a greater state of ischemia occurs. Due to neuronal damage, there is motor, sensory, and autonomic dysfunction. Motor injuries are manifested by imbalance of the flexors and extensors of the foot, anatomical deformities, and skin ulcerations. In the autonomous component, the dryness of the skin is a consequence of damage to the sweat glands, so the skin is more prone to injury. People are often unaware of foot injuries due to sensory damage (Figure 3).

Figure 3: Pathophysiology of diabetic foot ulcers.

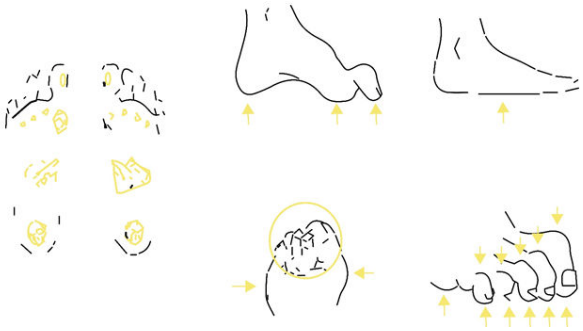


Additionally, ulcerations can become chronic because the oxygen demand required by the injury to heal is greater than that supplied due to ischemia [26].

Diabetic foot ulcers occur in diabetic patients who have at least two risk factors, and additionally suffer from neuropathy and / or PAD [27].

Because patients with diabetic neuropathy have insensitivity in the foot, where protective sensitivity is affected; joint deformities and limitation of foot movements, suffer from abnormal biomechanical loads on the foot (Figure 4).

Figure 4: Abnormal biomechanical loads.



Due to this abnormal load on some areas of the foot, hyperkeratosis occurs, often accompanied by subcutaneous hemorrhage. If you add minor trauma to this, it will trigger a skin ulcer. PAD is present in up to half of diabetic patients with ulcers, however, in isolation it does not seem to be responsible for diabetic foot ulcers, generally the ulcers are neuroischemic or clearly neuropathic [27,28]. It has recently been suggested that diabetic microangiopathy is not the main cause of ulcers or poor wound healing [27]. Adapted from: IWGDF- The International Working Group on the Diabetic Foot Guidelines-2019

Diabetic foot exam

Patients with diabetes should have a foot exam at least once a year, which can be performed by their treating physician or a podiatrist [29]. This is essential for the prevention of ulcers and amputations, as well as the morbidity and mortality associated with diabetes, with a level of evidence B, so it is highly recommended to carry it out [30,31]. In those subjects who have identified risk factors, including peripheral neuropathy, the frequency of evaluation of the foot should increase to more

than once a year, then performed every one to six months depending on the severity of the case [32] .

Health professionals, including nurses to podiatrists, must have the ability to recognize changes and abnormalities in the foot at the time of their evaluation. This evaluation includes the history of the patient and a concise physical examination of the foot, in which the vascular, neurological, muscular, skeletal and dermatological characteristics of the foot are addressed. In addition, this space can be used to learn about the management and care that the patient is having in order to have control of his diabetes or also to educate him on this subject, as necessary [33].

Patient history

The medical history of the patient is essential because it allows identifying the risk factors that may increase the probability of presenting complications in the lower limbs and additionally orienting the main approach that the physical examination should have [34]. This examines the comorbidities that the patient presents, his diabetic history, blood glucose control and diabetes complications that he has previously presented [35]. It is essential to have the levels of More recent glycosylated hemoglobin (HbA1c), as this provides the clinician with a more general view of the patient's glucose control [36]. Likewise, he asked about surgeries or operations on the lower extremities, history of hypertension, hyperlipidemia, peripheral vascular disease, peripheral diabetic neuropathy, and smoking, to name a few [37]. The latter is implicated in the development of arterial and coronary disease [38]. Finally, it is questioned by subjective symptoms of the patient that suggest peripheral neuropathy, such as paresthesias, burning sensation, stinging, stabbing pain in the feet and numbness, although more than 50% of the patients who present this complication are asymptomatic, which in turn once involves a risk for your foot injury [33].

Those patients in whom a lack of control of their diabetes is evident are the most susceptible to developing chronic ulcers and wound infections, therefore; They are the ones that most require medical education that makes them aware of their pathology and the care that they should include in their lifestyle, such as constantly looking at the soles of their feet in search of early injuries, appropriate footwear that prevents foot deformities, the use with daily change of special stockings that prevent lesions in diabetic foot, keep the skin clean, fresh and moisturized, among others [39,40].

Physical exam

The physical examination consists of a careful inspection of the feet for premature signs of infection, changes in skin temperature, induration, ulcer formation, edema, pain, deformities, skin breakdown, and palpation of pulses, which when not are achieved require the performance of an evaluation of arterial flow by means of a continuous wave Doppler examination [41]. All of the above encompasses dermatological, musculoskeletal, vascular and neurological aspects, which will be described in more detail below. - Neurological examination: Diabetic peripheral neuropathy is a fatal complication of diabetes and one of the main risk factors for foot ulceration with amputation outcomes [42]. This entity is characterized by being a symmetric polyneuropathy with a sensory and motor component that results from metabolic changes in the microvasculature due to its chronic exposure to high glucose levels [43]. Symptoms can vary depending on the fibers affected, when it comes to small fibers, paresthesia and pain occur, if large fibers are involved then numbness and loss of protective sensation (LOPS) will occur [43].

Neuropathic LOPS can be easily detected, despite this; it is the cause of approximately 75% of nontraumatic diabetic amputations [44]. Its diagnosis is made through the anamnesis and also by means of the observation of the way in which the patient walks, as well as the exploration with the feet without shoes and the patient at rest, where several observations are made, for example, early autonomic neuropathy in the skin is diagnosed if present manifestation of dryness, the motor fiber is also evaluated through the tendon and achillian reflexes, in addition, the vibration perception threshold is examined, which is decreased in patients with LOPS and is considered the best predictor of long-term complications in the lower extremities (Four. Five). Likewise, there are different tools that help to make this diagnosis, among which are the Semmes-Weinstein monofilament of 10g that should evaluate four areas of the foot avoiding the regions of callosity, which are the ball of the first joint and metatarsal heads of first, third and fourth toes, other instruments are test tubes with cold and warm water, which are placed on the back of the foot and the patient is asked if he can discriminate the different temperatures, or the test of Ipswich Touch (IpTT) that does not require devices in its execution, only the doctor's index finger is needed, who tells the patient to close his eyes while he rests his finger on each of the first, third and fifth fingers for two seconds of the patient. The latter answers “yes” every time he feels that he is being touched [46]. A test in which the results obtained with the IpTT method were evaluated showed that these were directly parallel to those of the monofilament for the detection of LOPS, with equal sensitivity and specificity, which together with its easy application and permanent availability, make it the first-line neurological test to rapidly examine the feet of patients with diabetes [47]. Dermatological examination: Checking the skin of a diabetic person is important in the examination of the foot, since this constitutes the first barrier or line of defense against infectious agents, which when affected becomes vulnerable to the entry of pathogens from the outside to the organism and can even serve as a reservoir for microorganisms [48]. Thus, this evaluation begins with a general inspection from the proximal region of the leg to the distal part of the toes in search of calluses, discolorations, deformities, wounds, fissures, changes in temperature, edema and paronychia [49]. Patients with skin breakdown, calluses, and hypertrophic skin may be more susceptible to foot ulceration, on the other hand; those in which skin discoloration or hair loss is found may be the first manifestations of vascular disease [50,51]. In all cases, a thorough examination of the skin located between the toes should be performed, where the deeper lesions often go unnoticed [32]. - Vascular examination: Peripheral arterial disease (PAD) is common in patients with diabetes, this constitutes a risk factor not only qualitative, but also

quantitative, since for every 1% increase in HbA1c there is a 25% increase in the risk of developing PAD [52]. The prevalence of PAD in the population of diabetic subjects is 10% to 40%, and this contributes to the development of healing problems in up to half of foot ulcers and amputation due to the alteration that limits blood flow [53]. Hingorani, et al. reported in a study that the mortality of a diabetic patient who suffers from PAD and has an amputation is 50% at 2 years, so it is essential to carry out a correct assessment of the vascular aspect in the foot, due to risk stratification for ulceration in the lower extremities and its association with the pr obability of dying [53]. The vascular evaluation begins with the history of symptoms that the patient refers to, in the face of which the pain in the lower limbs at rest, including feet, legs and calves, as well as intermittent claudication (Table 3), which refers to pain in the legs, are alarming. lower extremities after walking a reproducible distance, and that forces the patient to stop to relieve symptoms [54]. At the time of physical examination, the bilateral femoral, popliteal, posterior tibial or dorsal foot pulses should be palpated, if they are diminished or absent, this is a key indication of vascular compromise [55].

Table 3: Fontaine Stadiums.

STUDIOS IOS DE FONTA INE	
GRADE I	Symptomatic patient. With atherosclerosis but with no significant reduction in arterial lumen
GRADE II LIA IIB	Intermittent claudication Remote> 15om Remote <15om
GRADE 111	Pain at rest Ulcerations that do not heal
GRADE IV	Gangrene and necrosis

Adapted from: Colombian Guides for the Prevention, Diagnosis and Treatment of Diabetic Foot. An Integral Management, 2019 [40].

The diagnostic test that is most used in the asymptomatic population is the ankle-brachial index (ABI), which is the result of dividing the systolic blood pressure of each ankle, choosing the highest value between the pedial artery and the posterior tibial artery, between the value of the highest systolic blood pressure in any of the brachial arteries. It is considered a normal value between 0.9 and 1.2. Values less than 0.6 are indicative of ischemia [40].

- Musculoskeletal examination: This includes evaluation of bone deformities, biomechanical failures and muscle strength, and even the shoes worn by the individual should be analyzed, as they can increase plantar pressure and facilitate ulcerative processes [56]. The examination begins by inspecting bony deformities in the foot, including claw toes, hammer toes, and bunions, which can impair gait, cause significant pain, and also increase the risk of ulcerations in patients [57]. Neuromuscular disorders, such as loss of strength to perform movements such as dorsiflexion and plantar flexion, can be a sign of complicated neurological compromise [58].

On the other hand, Charcot neuroarthropathy is a complication that classically presents as an edematous, hot and reddened foot; this last characteristic has the particularity of disappearing when the limb is elevated [59]. This complication is believed to appear due to dysregulation of physiological bone metabolism as a consequence of diabetic neuropathy accompanied by repeated minor trauma, leading to joint instability and disorganization of the normal bone architecture of the midfoot, which requires specialist treatment or podiatrist [60]. Table 4 summarizes the essential aspects that the foot examination should include [33].

Table 4: Essential examination of the diabetic foot Adapted from: The Diabetic Foot Assessment. Orthop Nurs, 2018 [33].

ESSENTIAL EXAMINATION OF THE DIABETIC FOOT
VASCULAR
Palpate dorsalis pedis and posterior tibial pulses
If no pulses, Doppler pulses
Evaluate shiny, thin, and atrophic skin without hair growth
Assess skin color and temperature
NEUROLOGICAL
Evaluate the protective sensation with Semmes Weinstein monofilament, if the
monofilament is not available, I pswich touch test
Other clinical test: Tuning fork vibratory sensation or VPT if a
biotheometer, ankle reflexes, prick sensation
DERMATOLOGICAL
Evaluate open injuries, wounds, cracks or fissures in the skin
Assess the skin for dryness or possible fungal infection
Look between the patient's toes to see if the skin is broken or macerated
Assess toenails for color, thickness, length, and ingrown nails
MUSCULOESQUELETIC
Inspect the foot for deformities or prominences 6seas
Ankle range of motion and first MPJ
Ankle dorsiflexion and plantar muscle strength
MPJ: metatarsophalangeal joint; VPT: vibration perception threshold

Diagnosis

The diabetic foot is the result of suffering from diabetes together with the exposure of two or more risk factors, where diabetic neuropathy and PAD play a fundamental role [61]. That is why the identification of the signs and symptoms characteristic of the latter should represent an alert for the treating clinician [62].

In this vein, the first step is to periodically check the feet of all patients with diabetes to detect the presence of manifestations of neuropathy or PAD even when the process is just beginning [61]. In the case of PAD, the relevant antecedents are identified and the pulses in the foot of the posterior tibial artery and the foot are palpated, temperature, skin color are also evaluated

and the patient is asked about the distance that he is capable of walk before pains and cramp s appear in the lower limbs [63] [64]. In fact, diabetic subjects who complain of discomfort in their legs when walking should be considered to have PAD until proven otherwise [65]. Important signs of mild to moderate ischemia are the lack of hair on the feet and legs, redness, decreased capillary filling, pseudomycosis, and subcutaneous fat atrophy. In severe ischemia, the lower limbs may already present ulcerations, petechiae, ecchymosis, and severe pain [66,67].

Since the physical examination does not exclude with complete certainty the presence of PAD, the measurement of the ABI mentioned above and the type of arterial waves with Doppler examination should be performed. The isolated interpretation of these tests has not been shown to be appropriate and there is no established threshold value that conclusively excludes the presence of PAD, but the diagnosis of PAD is less likely with the presence of an ABI between 0.9 - 1.3 and triphasic Doppler waves in the foot [61,68].

On the other hand, diabetic neuropathy is diagnosed with a very specific history and physical examination [69]. Table 5 summarizes the methods implemented for the diagnosis of diabetic neuropathy, given by the Colombian Diabetic Foot Association [40].

Table 5: Adapted from: Colombian Guidelines for Diagnosis Prevention and Treatment of Diabetic Foot. An Integral Management, 2019 [40].

VER SION 1	RIGHT	LEFT
Vibration perception threshold 128Hz pitch; Back deldedo greater behind one o'clock. Normal (distinguishes vibration) = o. Abnormal (does not distinguish it) = 1. Abnormal (absence of vibration) = 1 Temperature perception on the back of the foot Using tuning fork with hot / cold water reservoir Normal = o Abnormal = 1		
Pin pressure Apply the proximal pin to the upper toe just as the foot is deformed. You must distinguish between acute and blunt Do not cut or injure Normal = o Abnormal = 1		
Far Ref Aquiliano Present = o With reinforcement = 1 Absent = 2		
Total possible NSD for both members = 10		
TO SEE ZION 1 IS ADDED:	**THE ECHO**	**LEFT**
Pressure sensitivity with 1og SW monofilament Receive all points = or Abnormal = 1 Absent = 2		
Total possible NSD for both members = 14		
Add the score for each separate pair leg 3 = normal; 3-6 = mild disturbance; 6-9 = moderate disturbance;> 9 = severe disturbance		

Adapted from: Colombian Guidelines for Diagnosis Prevention and Treatment of Diabetic Foot. An Integral Management, 2019 [40].

The Toronto Diabetic Neuropathy Expert Group classifies dibetic polyneuropathy (PND) as follows:

Confirmed PND: abnormal nerve conduction and a symptom or sign of neuropathy.

Probable PND: 2 or more of the following signs or symptoms. Neuropathic symptoms, decreased distal sensation or decreased / absent ankle reflexes; or

Possible PND: any of the following symptoms: decreased sensation, positive neuropathic sensory symptoms such as, "numbness during sleep," pricking / shooting, burning or pain, predominantly in the toes, feet, or legs. legs; Operating room signs, including symmetric decrease in distal sensation or decreased / absent ankle reflexes [70].

In the physical examination, a minimum of four observations should be made to diagnose diabetic neuropathy, among which are, evaluation of the long fiber with the 128 Hz tuning fork when placed on top of the nail region and asking the patient if he feels the vibration, evaluation of the motor fiber with reflex exploration, the Semmes Weinstein monofilament test described previously, as well as the Ipswich Touch Test [71].

Treatment

The mainstays of treatment today include surgical debridement, dressings that maintain a moist wound environment, vascular evaluation, treatment of active infection, and glycemic control [72]. Debridement attempts to remove all non-viable tissue that prevents healing, as well as the callus surrounding the injury. It is important in the re-epithelialization of the lesion and in the reduction of areas of plantar pressure; in addition, it is important for infection control [72,73].

Dressings have little scientific evidence so their use cannot be recommended or discouraged. The purpose of this strategy seeks to create humid environments in the lesion that promote healing and angiogenesis; in addition to absorbing the ulcer toilet. At present there is no preference for a specific type of dressing, based mainly on cost effectiveness, professional experience and the patient's decision to choose it [72,73].

Because PAD predisposes to higher amputation rates and slower healings, it is important that those suspected of PAD undergo alternative tests to confirm this diagnosis [72].

Diabetic foot ulcer infections are also associated with poor healing rates and the need for amputation. Early diagnosis and treatment of infections is necessary [72]. According to the recommendations of the IDSA guide, in the event of at least two local inflammatory signs or symptoms (erythema, warmth, tenderness, pain, and induration) or discharge, a deep culture should be obtained by biopsy after debridement and antibiotic therapy should be started [72,74]. The types of infections that can occur are cellulitis, myositis, abscesses, necrotizing fasciitis, septic arthritis, tendonitis, and osteomyelitis [74].

It is important when deciding on the start of antibiotic therapy, to consider that diabetic foot ulcers are frequently colonized by various

microorganisms, mainly aerobic and anaerobic bacteria, reserving the administration of antibiotics to patients in whom an infection is suspect ed or documented [74]. Although some diabetic foot ulcer infections are monomicrobial, it is much more common for them to be polymicrobial, with gram-positive

aerobic cocci predominant, especially Staphylococcus and Streptococcus [74,75].

If there is a risk of infection by resistant microorganisms, broad-spectrum therapy should be selected, as in severe infections, previously treated infections, or chronic infections [75]. If it is a chronic infection or one that has not responded to previous antibiotic therapy, coverage of gram-negative aerobic pathogens should be included; In patients with necrotic or gangrenous infections in an ischemic limb, therapy directed at anaerobic pathogens should be included. Table 6 [74].

Parenteral antibiotic therapy is only recommended in patients with systemic disease, severe infections, intolerant of oral antibiotics, or suspected pathogens not susceptible to available oral antibiotics [74].

Some studies suggest that more research is necessary to evaluate the effectiveness of antibiotics in these patients, since they consider that not enough high-quality articles [73]. In mild infections, a course of antibiotics should be done for 1 to 2 weeks, and moderate and severe infections should be done for 2 to 3 weeks [72] [74].

Table 6: Antibiotic scheme.

TYPE OF INFECTION	FREQUENT PATHOGENS	ANTIBLOTIC FAMILY
Acute, without previous treatment; low risk of MRSA	Great positive aerobic cocci	Penicillins, first generation cephalosporins
Associated with health; high local MRSA rates	Gram-negative bacilli, Gram-positive and anaerobic coconuts	fHactamics and inhibitors of j) lactamase, second or third generation cephalosporin, group 1 carbapenemics, fluoroquinolone
Chronic, previous treatment	SAMR	Cotrimoxazole; doxycycline; clindamycin; glycopeptide; linezolid; daptomycin
metronidazol y fluoroquinolona;	Gram negative rods, cocci	Clindamicina y fluoroquinolona;
Hong Kong people	gram positive and anaerobic . estnctos	B-lactamic and B-lactamase inhibitor; carbapenemics
Hydrotherapy; color drain green Blue	Pseudomonas aeruginosa SAMR: Staphilococcus aureus meticilino resistente	Fluoroquinolona, penicilina o cefalosporina antipseudomonas

Adopted from: Ghotaslou R, Memar MY, Alizadeh N. Classification, microbiology and treatment of diabetic foot infections. J Wound Care. 2018 Jul 2; 27 (7): 434-41.

Glycemic control is imperative since it favors the healing and control of infections. In those patients who undergo intensive glycemic control, the risk of amputation is reduced by up to 35% [72].

Patients with neuropathy should wear well-fitting walking shoes or athletic shoes, seeking to redistribute pressure zones. If the person has bone deformities, they should wear extra wide and deep shoes. People with neuropathy or evidence of increased plantar pressure (eg, erythema, heat, or calluses) can be adequately treated with well-fitting walking shoes or athletic shoes that cushion the feet and redistribute pressure. If it is not possible to fit into these therapeutic shoes, they should wear custom designed shoes [75].

In general, it is not necessary to routinely prescribe therapeutic footwear, however, all patients should be encouraged to select shoes that have a wide and square toe, laces with three or four eyes per side, a padded tongue, and that have sufficient space to accommodate cushioned insoles [75]. For patients with ulcers that do not heal, hyperbaric oxygen therapy has been proposed as an alternative, a procedure that consists of keeping the patient in a chamber breathing 100% oxygen, the justification for this is that chronic ulcers are hypoxic and the supply of oxygen it can improve your healing [76]. Its efficacy has been very controversial, even in the most recent update of the ADA, they do not recommend the use of hyperbaric oxygen therapy [75]. However, a systematic review and meta-analysis has recently been published that concludes that hyperbaric oxygen therapy is effective in completely curing ulcers and reducing the rates of major amputations, and clarifies that efficacy probably depends on the number of sessions used. On the other hand, it warns more adverse effects with this therapy than with standard therapy, which is why it suggests designing safety protocols for patients. Finally, they express the need for multicenter trials to evaluate its efficacy and safety.

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