Epidemiological factors associated with the evolution of the diabetic foot

Factores epidemiológicos asociados a la evolución del pie diabético

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Abstract

Diabetic foot ulcers are advanced chronic vascular lesions with tissue deterioration and with unfavorable prognosis; these ulcers predict the risk of amputation in 90% of cases. The aim of this research is to establish an association between the epidemiological factors and the evolution of the diabetic foot. For this, in this paper we present an analytical, transversal, prospective study. Our sample consisted of 95 outpatients and hospitalized men and women diabetic patients, who attended Hospital José Carrasco Arteaga in Cuenca, Ecuador, over the time frame encompassing December 2017 to September 2018. For each patient we conducted an interview with epidemiological data and physical examination of the feet was done to assess the Wagner scale degrees. Results revealed that 93% of individuals had some degree of injury of their feet. Out of the examined individuals 61% were males, 41% have completed elementary school, and 63% lived in urban areas. The average age was of 69 years, the average diagnostic time of the disease was 14 years, and the patients have a BMI (Body Mass Index) average of 26. Significant correlation was observed between the Wagner´s scale classification and the diagnosed time of the disease with a Chi-square of 47.02 and a P-value of 0.025 in the analysis of variance (ANOVA).

Key words: epidemiological factors, diabetic foot, Wagner classification

Resumen

Las úlceras del pie diabético son lesiones vasculares crónicas avanzadas con deterioro tisular y con pronóstico desfavorable; estas úlceras predicen el riesgo de amputación en el 90% de los casos. El objetivo de esta investigación es establecer una asociación entre los factores epidemiológicos y la evolución del pie diabético. Para ello, en este trabajo presentamos un estudio analítico, transversal y prospectivo. Nuestra muestra estuvo conformada por 95 pacientes diabéticos ambulatorios y hospitalizados, hombres y mujeres, que asistieron al Hospital José Carrasco Arteaga de Cuenca, Ecuador, en el lapso de tiempo comprendido entre diciembre de 2017 y septiembre de 2018. A cada paciente se le realizó una entrevista con datos epidemiológicos y se hizo un examen físico de los pies para evaluar los grados de la escala de Wagner. Los resultados revelaron que el 93% de los individuos tenían algún grado de lesión en los pies. De los individuos examinados, el 61% eran varones, el 41% habían completado la escuela primaria y el 63% vivían en zonas urbanas. La edad media era de 69 años, el tiempo medio de diagnóstico de la enfermedad era de 14 años, y los pacientes tenían un IMC (Índice de Masa Corporal) medio de 26. Se observó una correlación significativa entre la clasificación de la escala de Wagner y el tiempo de diagnóstico de la enfermedad con un Chi-cuadrado de 47,02 y un valor P de 0,025 en el análisis de la varianza (ANOVA).

Palabras clave: factores epidemiológicos, pie diabético, clasificación de Wagner

Introduction

Diabetes mellitus is a chronic disease considered a public health problem. The number of people affected has increased each year, involving high costs to the patients, their family, and the health system. Diabetes affects the quality of life; the number of people suffering from diabetes is increasing; while 108 million cases were reported in 1980, their number almost quadrupled in 2014, with 422 million diagnosed cases. The worldwide prevalence of diabetic foot varies between 1.3%-4.8% [1], the most prone group corresponds to older adults, the developing countries being the most affected[2]. As many as 2.2 million people died from hyperglycemia in 2012 [3].

At the global level, chronic complications of diabetes mellitus constitute a severe problem, engaging between 12 and 15% of the total of health services. The current prevalence of diabetes mellitus is estimated to be of 150 million of patients, but it is expected that by year 2025 their number will rise to a worldwide population of 250 million; this, along with the increase in the life expectancy alerts about being prepared to face it [4]. In Latin America diabetes affects almost 19 million people. In Brazil, it is estimated that the average occurrence of this disease is 7.6% in the population over 40 years [5].

World Health Organization (WHO) defines the diabetic foot as the infection, ulceration, and destruction of deep tissues, associated with neurological alterations and different degrees of periphery vascular disease in the lower extremities (loss of sensitivity) [5,6]. Diabetic feet become more vulnerable to wounds; the alteration in blood circulation in the lower extremities is of the utmost importance because it indicates the moment for using an effective method to revascularization.

Diabetes mellitus should be considered the first cause of non-traumatic amputation in lower limbs. WHO set criteria to describe a person with diabetes, such as: (i) the amount of glucose in the blood is equal to or higher than 126 mg/dL; (ii) glycosylated hemoglobin concentration exceeds 6.5%; or (iii) glycaemia in an oral glucose overload test is equal to or greater than 200 mg/dL. Characteristics of diabetic patients are the followings: the increase of glucagon and a higher production of glucose in the liver, in addition to alterations in the sensation of satiety related to hyperglycemia. [8]

Diabetic feet and their lesions constitute one of the major causes of morbidity and disability in people with diabetes, being the most frequent cause of hospital admission in this group, with prolonged and recurrent hospital stay. This population endures up to 70% of the amputations, mostly triggered by the infection. Peripheral vasculopathy, peripheral neuropathy associated with metabolic control play an important role in its genesis. Knowledge in primary care associated with preventive measures will contribute to the reduction of this problem that affects millions of people nowadays. [3]

Foot neuropathy combined with reduced blood flow increases the risk of foot ulcers, infection, and ultimately leads to amputation. Loss of the cutaneous barrier is the most important predisposing factor to infections of diabetic patients' feet. As an effect of diabetic neuropathy, in which the protective sensation is lost, favoring the appearance of skin affections, particularly, the skin barrier is broken, and can cause the penetration of microorganisms [9].

The Spanish Society of Angiology and Vascular Surgery considers that the diabetic foot is a clinical alteration of neuropathic etiology induced by time-sustained hyperglycemia in which ischemia can coexist, while the foot injury [10] or ulceration appears to be a previous traumatic trigger. Foot ulcers can cause lower extremity amputations.

The appearance of ulcers in the foot is one of the serious secondary problems in patients and affects the quality of their life. Diabetic foot is the result of the combined effect of angiopathy, neuropathy, and the increased risk of infections, along with the effect of intrinsic and extrinsic pressures secondary to bony malformations in the foot [8].

Diabetes mellitus is a group of metabolic disorders characterized by chronic hyperglycemia, due to a defect in the secretion of insulin and its action, or both. In addition to hyperglycemia, there are alterations in the metabolism of fats and proteins. Time-sustained hyperglycemia is associated with damage, dysfunction, and failure of various organs and systems, especially of kidneys, eyes, nerves, heart, and blood vessels [11,12,13].

Diabetes can be of different types:

- Type 1 diabetes mellitus (DM1): Its distinctive feature is the autoimmune destruction of β cells, causing absolute insulin deficiency and a tendency to ketoacidosis. Such destruction is mediated in a high percentage by the immune system, which can be evidenced via determining the antibodies. DM1 may also be of idiopathic origin, where the measurement of the above antibodies gives negative results [11,12].
- Type 2 diabetes mellitus (DM2): It is the most common form, often associated with obesity or increased visceral fat. Spontaneous ketoacidosis occurs very rarely. The problem originates from a predominant resistance to insulin, accompanied by a relative deficiency of the hormone, up to a progressive defect in its secretion [11,14].
- Gestational diabetes Mellitus (DMG): It specifically groups the intolerance to glucose detected for the first-time during pregnancy. Hyperglycemia prior the twenty-four weeks of pregnancy is considered pre-existing undiagnosed diabetes [15].

There are different causes that cause the development of diabetic foot, as well as its presentation and clinical evolu-

tion, reason for which different classifications were created and have been accepted worldwide. Among them the Wagner classification is based on the depth, presence of osteomyelitis or gangrene, and the extent of tissue necrosis. The Wagner classification has shown excellent correlation with morbidity and mortality.

The Wagner classification of the diabetic foot [16,17]:

Grade 0: Absence of ulcers in a high-risk foot.
Grade 1: Superficial ulcer that compromises all the thickness of the skin, but no underlying tissues.
Grade 2: Deep ulcer, penetrating to ligaments and muscles, but without compromising bones or the abscess formation.

Grade 3: Deep ulcer with cellulite or abscess formation, almost always with osteomyelitis.
Grade 4: Localized gangrene.
Grade 5: Extensive gangrene that compromises the entire foot.

Handling a patient with diabetic foot will demand teamwork with different specializations in the health area, allowing an integral support of the affected person; additionally, the nurse plays a very important role in the identification of risks and in the orientation to patient for the prevention of complications, as many depend on self-care and family support for optimal recovery.

Methods

This study is analytical, transversal, and prospective, where the epidemiological factors associated with the diabetic foot of patients in were evaluated. The inclusion criteria were the followings: patients with diabetes mellitus type 1 and 2 of both genders, without age restriction. Our sample frame was 95 diabetic patients, with or without the presence of diabetic foot, men and women age 38 through 90, who were hospitalization or outpatients from December 2017 to September of 2018, at Hospital José Carrasco Arteaga.

The interview was conducted with the prior authorization of the patient, in which different variables related to epidemiological factors were analyzed (age, sex, degree of instruction, and place of residence). Weight and size were controlled for the BMI (Body Mass Index). Arterial hypertension was defined as an arterial pressure > 140/90 mmHg and/or using hypertensive WHAT (???), and it was measured with the same blood pressure monitor. The physical examination of the feet was evaluated by means of the Wagner scale and its degree of injury, then the association with the epidemiological factors was established.

Tabulated information was entered in a database in the statistical program SPSS version 22. Quantitative variables are provided with percentages, mean value, ± standard deviation; qualitative variables with estimated percentages. The inferential analysis was performed with ANOVA for the quantitative variables

Our hypothesis is that "there is a significant correlation between the diabetic foot by the assessment with the Wagner scale and the epidemiological factors of the diabetic patients of Hospital José Carrasco Arteaga".

Results

According to our scrutiny, 56% out of the 95 patients had grade 0 lesions. Even though there were no risks of ulcers, deformity of the fingers was observed, as well as hypothermia, callosities in the sole of the foot, in the fingers, dryness of skin, i.e., a certain degree of tissue problems. The next group formed of 18% of the subjects had superficial ulcers that compromise the skin, areas with ecchymosis. Only 7% of patients did not present injury of their feet (Table 1).

The epidemiological factors of patients are listed in Table 2. Out of the 95 diabetic patients surveyed, males predominate with 61% (58 individuals); 41% (39) of patients completed elementary school, and 24% (23) that finished high school; 63% (60) have been living in the urban area; 25% (24) were diagnosed in the past 5 years, and present hypertension and take antihypertensive medication, therefore, blood pressure was taken manually.

An in-depth examination revealed that out of 56% (53 individuals) of the patients, who presented 0 degree on the Wagner scale, i.e., had alterations in the anatomy of the foot, could be sub-divided as follows: 31% (29 individuals) were males, 23% (22) finished elementary school; 39% (37) lived in urban areas; 17% were diagnosed with diabetes over the past 5 years, followed by 15% that were diagnosed 6 to 10 years earlier; 44% (42) of the patients were found to have hypertension.

Significant correlation between the Wagner scale classification and time, when the disease was found, with a Chi-square of 47.019 and a P-value of 0.025, in the analysis of variance (ANOVA). The average age of patients was 69 years with a deviation of ±10 years; the average in diagnosis of the disease was 14 ± 10 years, the BMI average is 26 ± 5 (Table 3).

Discussion

Foot ulcers in diabetic patients is a major public health problem that generates high cost for the patient, family, and the health systems. They represent the main cause of the non-traumatic amputation of lower limbs. Diabetic foot is considered a clinical syndrome with multiple origins, which include neuropathic, angiopathy, and infectious factors that produce tissue damage and determine the prognosis of the extremity. [18]

Romero [6] showed that this condition occurs in 82.6% in males; Fernández Montequín [19] also mentions that men are more prone to the disease. Similarly, studies carried out at the Angiology Institute in Havana report more diabetic foot injuries in men [20]. Additionally, results by García Oreja S. indicate 80.7% in men [21], information in agreement with our study, where males represent 61% of affected patients. Diabetic foot is common in male patients, given that as compared to females, men are more frequently exposed to micro-trauma related to labor activities, they postpone seeing a doctor, have poor metabolic control in relation to women, and normally use closed shoes, favoring less hygienic conditions of the feet.

With regard to age, in a study conducted in Colombia with 200 diabetic patients Mildred (2012)[22] found an average age of 64 years; García Oreja S. [21] in an analysis of 68 diabetic patients a mean age of 59.8 ± 13.0 years was reported. In an investigation conducted in Peru, in 2013, screening patients with type 2 diabetes mellitus uncovered an average age of 62 years [23]. A study carried out in Cuba in 2016 on epidemiological factors associated with the diabetic foot presents an age prevalence of 60-69 years. [24] With regards to patient age all mentioned literature data agree with our research, showing an average age of 69 ± 11 years for 195 diabetic patients.

As age progresses, the risk of diabetic patients to suffer from diabetic foot increases, since at the age of 60 and above, there is a number of changes in the structure and the functioning of the arteries, coupled with the truth that elderly people are more prone to neglect their feet, have poor metabolic control of their basic disease and infections in the poorly treated inferior limbs, leading to serious complications and increasing the incidence of diabetic foot. [24]

In a study conducted in Bogota, Pinilla and co-workers [25] report on the importance of urban vs. rural residence of the affected patients. Their paper entitled "Prevention of the diabetic foot in first level outpatients" conclude that patients coming from urban areas correspond to 98% of the total number of individuals, being the most representative of the sample. Proenza and co-workers [24] examined 140 patients with diabetic foot and showed that 64% come from urban areas, while only slightly more than ⅓ of them (36%) originate from rural areas. The latter information agrees with this study in which the urban area also predominates with 63% of the total number of patients relative to only 37% from rural areas. Reasons are that urban population has a more centralized lifestyle, people's diet includes more junk food and processed food, they experience more stress caused by their work, unlike the rural population, where owing to field work, there is little or no pressure at work. Also, individuals living in rural areas are more active and physically stronger; therefore, their nutrition is more natural and healthier.

The Association of Diabetes Mellitus and Arterial Hypertension (HBP) has introduced the term "epidemic in progress" for various reasons: the prevalence of HBP among diabetic population is roughly twice as high as in the non-diabetic population; furthermore, HBP causes the development and progression of diabetic nephropathy, being demonstrated that an adequate treatment of hypertension can slow down the progression of neuropathy. Finally, HBP is one of the most important risk factors for the development of cardiac and cerebrovascular complications in diabetics. [26]

Proenza et al. [24] indicate that 53.5% of diabetic patients are affected by hypertension. Another study that involved 122 patients with diabetic foot showed that 66.4% suffered from hypertension. [27] Relevant to our research, 73% of diabetic patients were found with high blood pressure.

In relation to the diagnosis time of diabetes, a study carried out in Paraguay (2016) [28] with 86 patients evidenced an average duration of diabetes of 11 ± 8years. Independently, Nuñez observed an evolution average of 10 years[27], which corresponds to our findings of an average of 14 ± 10 years. Being diagnosed for over 10 years may favor the development of diabetic foot and other complications, as well.

With respect to the BMI, a study in Cuba (2014) on 670 type 2 diabetics [29] discloses a value of 24.2 ± 3.6; Damas (2017) [30] reports a BMI average of 26.9 ± 4.8; data that are in relation to our study of BMI, which is of 26 ± 5. Patients investigated in various studies are included in the BMI classification that corresponds to overweight persons (25.0-29.9).

In a study published in 2017, 382 medical histories of diabetic patients were reviewed [30], and it was assessed that 43.7% of them have completed junior high school, 38 (????); 8% attended only elementary school, 10% have graduated from universities, while 8% were illiterate. Another study [31] revealed that out of the scrutinized diabetic patients 48 (11.3%) were illiterate, 154 (36.3%) have finished elementary school; 172 (40.6%) have completed junior high school, and 50 (11.8%) have graduated from universities, this data not agreeing with the findings of the research, where 41% of the patients had elementary school studies and 24% attended high school.

Conclusions

Diabetic foot can appear at any age and in male and female patients. It is conditioned by factors such as physical inactivity, smoking, bad eating habits, lack of sanitary hygiene, neglect of foot care, inadequate footwear, and poor metabolic control [6]. In addition, lifestyle exerts significant influence on the frequency and evolution of diabetic foot. More affected is the urban population with a more clocalized activity and a diet, which includes more junk food and processed food, experiencing more stress caused by their work, as compared to people living in rural areas, performing field work, being more active and physically stronger; also, their nutrition is more natural and healthier.On the other hand, it would be interesting to conduct empirical studies on COVID-19 awareness in the face of the health emergency due to the COVID-19 pandemic both in the confinement, distancing and vaccination stage in various populations [32,33,34] related to emotional [35] and educational [36,37,38] aspects.

Conflict of interest

There are no personal, professional or other conflicts of interest.

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