



Original Research

Diabetes as an Isolated Cause of Minor Lower Limb Amputations

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Abstract

Objectives: Amputation is a devastating but preventable complication of diabetes and peripheral arterial disease. The aim of the present study was to investigate whether diabetes mellitus is an important isolated cause of toe amputation.

Methods: A cross-sectional study was conducted involving the records of 108 patients with minor lower limb amputations and 80 with major lower limb amputations. Association between diabetes/chronic arterial insufficiency and level of amputation was tested. Statistical analysis was performed using Fisher's exact test.

Results: The prevalence of diabetes was 87.5% among patients submitted to minor amputations and 52.5% among those submitted to major amputations with or without chronic arterial disease. This difference was statistically significant ($p < 0.0001$, Fisher's exact test). A total of 44.44% of the patients submitted to minor amputations had diabetes alone (no chronic arterial insufficiency), whereas only 14.81% of the patients submitted to major amputations did not have chronic arterial insufficiency. Thus, diabetes was significantly associated with minor lower limb amputations ($p < 0.0004$, Fisher's exact test).

Conclusion: Based on the present findings, patients with diabetes are at greater risk of toe amputation compared to those with chronic arterial disease.

Keywords: Amputations, Chronic arterial disease, Diabetes

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Amputation is a devastating but preventable complication of diabetes and peripheral arterial disease (PAD). Diabetic patients undergoing an amputation related to PAD have a 5-year mortality rate ranging from 50% to 74%.

^[1] Foot ulcers are present in about 85% of amputations related to Type 2 diabetes, but prevention substantially reduces the risk of amputation.^[1,2] The lower limb amputa-

tions related to diabetes, PAD, or both have increased in the last decade, underscoring the need for renewed efforts to avoid the loss of toes and limbs.^[2]

Treatment of diabetic foot ulcers should begin when a possible pre-ulcer is found, as prophylactic treatment can reduce the occurrence of more severe clinical conditions. Once an ulcer has developed, patient care should be op-

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timized.^[3] Transcutaneous oxygen pressure (TcPO₂) measurements are useful to determining the level of the lower limb amputation and predicting wound healing problems when an amputation level with TcPO₂ <40 mmHg is chosen. In transtibial amputations, however, TcPO₂ ≥40 mmHg does not reliably predict wound healing.^[4]

There is a limited evidence regarding the reliability of tools for the clinical evaluation, although some instruments have proven to be valid and reliable for the evaluation of diabetic neuropathy, the risk of ulceration, the assessment of diabetic foot ulcer, the amputation score, and the diabetic foot ulcer risk and depth score.^[5]

The aim of the present study was to investigate whether diabetes mellitus is an important isolated cause of toe amputation.

Methods

Patients and Setting

One hundred and eight medical records of patients with minor lower limb amputations and 80 with major amputations (below or above the knee) were evaluated in a cross-sectional study conducted at Sao Jose do Rio Preto Hospital from July 2018 to July 2019.

Design

A cross-sectional study was conducted with the records of 108 patients with minor lower limb amputations and 80 with major lower limb amputations, with an analysis of the association between diabetes/chronic arterial insufficiency and level of amputation. The prevalence of these conditions was also determined.

Inclusion Criteria

Consecutive patients who underwent minor and major lower limb amputations were included in the study. Minor amputations included toes and transmetatarsal amputations.

Exclusion Criteria

Thigh amputations, upper limb amputations, and those resulting from trauma were excluded from the study.

Randomization

Patients were chosen at random in the study period until reaching more than 100 patients with minor amputations.

Development

The medical records of patients who underwent minor and major amputations were evaluated and causes, such as diabetes and chronic arterial insufficiency, were analyzed.

Patients with diabetes alone, those with chronic arterial insufficiency alone and those with both diabetes and chronic arterial insufficiency were included in the study.

Ethical Considerations

The study received approval from the Human Research Ethics Committee (FAMERP #461) and was conducted in accordance with the ethical precepts set down in the Declaration of Helsinki. Informed consent of the subjects was waived by the ethics committee because the sample consisted of medical records.

Statistical Analysis

The data were placed in an Excel table and submitted to statistical analysis with the aid of the StatsDirect 3.0® software (StatsDirect Ltd ver. 3.2.7/2019). The prevalence of the conditions of interest was determined. Comparisons were performed using Fisher's exact test considering a 5% of alpha error.

Results

The medical records of 108 patients who underwent minor amputations and 80 who underwent major amputations were analyzed (Table 1). The number of men (n=122) was significantly larger than the number of women (n=48) (Table 2). Fifty-two patients (30.58%) were <60 years of age and 118 (69.4%) were older. After 60 years of age, a significant reduction was found in amputations due to diabetes alone (p<0.0001), whereas significant increases in amputations were found in patients with chronic arterial insufficiency.

Table 1. Frequency of minor and major lower limb amputations in cases of diabetes mellitus and/or chronic arterial disease

	Minor amputations	Major amputations
DM	48 (44.44%)	16 (20%)
CAD	8 (7.4%)	38 (47.5%)
DM+CAD	52 (48.14)	26 (32.5%)
Total	108 (100%)	80 (100%)

DM: Diabetes mellitus; CAD: Chronic arterial disease.

Table 2. Distribution of sexes in cases of diabetes and/or chronic arterial insufficiency among patients submitted to minor and major lower limb amputations

	Female	Male
DM	10 (20.83%)	44 (36.06%)
CAI	10 (20.43%)	34 (27.86%)
DM+CAI	28 (58.33%)	44 (36.06%)
Total	48	122

DM: Diabetes mellitus; CAI: Chronic arterial insufficiency.

ciency alone ($p < 0.0002$) and those with both diabetes and chronic arterial insufficiency ($p < 0.0007$) (Table 3).

Among the 108 minor amputations, 48 patients (44.44%) had diabetes alone, 8 (12.5%) had chronic arterial insufficiency alone, and 52 (48.14%) had both diabetes and chronic arterial insufficiency. Among the 80 major amputations, 16 patients (20%) had diabetes alone, 38 (47.5%) had chronic artery insufficiency alone, and 26 (32.5%) had both diabetes and chronic arterial insufficiency.

The prevalence of diabetes was 87.5% among patients submitted to minor amputations and 52.5% among those submitted to major amputations ($p < 0.0001$, Fisher's exact test) whether or not cooccurring with chronic arterial disease. As 44.44% of the patients submitted to minor amputations had diabetes alone and only 14.81% of the patients submitted to major amputations did not have chronic arterial insufficiency, diabetes was significantly associated with minor lower limb amputations ($p < 0.0004$, Fisher's exact test).

Discussion

The present study was carried out at the second largest teaching hospital in the country, where around 400 minor and major amputations are performed each year on vascular patients. In the past 35 years, approximately 14,000 amputations have been performed and one of the noteworthy factors is the close association between minor amputations and diabetes mellitus. A previous study found that 85% of minor amputations were associated with diabetes.^[6] These data led the authors to analyze the occurrence of minor and major amputations in patients with diabetes mellitus and/or chronic arterial insufficiency.

The previous studies involving major amputations detected a mortality rate of 5.7% during hospitalization and 15.7% in the 1st month. Another study reported a 44% mortality rate in the 1st year, 50% in the 2nd year, and 72% in 6 years.^[7,8] Therefore, diabetes is a disease with a high mortality rate.

The present results showed that diabetes mellitus with or without chronic arterial disease is an important independent cause of the lower limb amputations. Indeed, 87%

of patients submitted to minor amputations and 52.5% of those submitted to major amputations were diabetic. Another noteworthy aspect was the fact that 44.44% of patients with minor amputations did not have chronic arterial disease, whereas only 14.81% of patients submitted to major amputations did not have chronic arterial disease.

A possible explanation for this difference is that most diabetic patients seek medical care when necrosis appears on a toe, which is often associated with trauma and infection. Thus, these patients arrive at the hospital with tissue necrosis, for which the conduct is amputation of the affected area. The fact that arterial disease is not always present in such cases makes diabetes mellitus an important isolated cause of minor lower limb amputations.

The two main conditions associated with amputations (diabetes mellitus and chronic arterial disease) should receive prophylactic care. The experience of the authors shows that diabetic patients should be approached as early as possible, as appropriate antibiotic therapy can prevent major amputations.^[9,10] The delay in referring these patients to a specialized center for a more complete evaluation can lead to considerable worsening. The two main aspects to be addressed are the need for revascularization of the limb and the control of infection.

Another important aspect of the present study was that 14.81% of major amputations had diabetes as the main risk factor and not chronic arterial disease. This alerts to the problem of the infectious condition. Anaerobic infections are the most serious and generally require a higher level of amputation,^[9] further underscoring the need for early prophylactic care. Therefore, the infectious aspect and the need for an earlier approach are evident.

One of the most important factors in the diabetic foot is the condition of the foot microcirculation of this patient. A review study reports that the protective role of microcirculation may be the missing link in the chain of events that leads to foot ulceration in people with diabetes.^[11] It is known that microvasculature assists in tissue perfusion, homeostasis of fluids, cutaneous oxygen supply, and recruitment of collateral vessels to facilitate the healing process.^[12] Simple activities such as exercise can improve plantar microcirculation and decrease plantar tissue hardness in people with T2DM.^[13] The assessment of microcirculation in diabetic patients is essential and brings important alerts regarding the circulation in the limb.

Conclusion

Based on the present findings, patients with diabetes are at greater risk of toe amputation compared to those with chronic arterial disease.

Table 3. Distribution of age groups in cases of diabetes and/or peripheral arterial disease among patients submitted to minor and major lower limb amputations

	<60 years	>60 years	p
DM	30 (17.64%)	24 (14.11%)	<0.0001
CAI	10 (5.88%)	34 (20%)	<0.0002
DM+CAI	12 (7.05%)	60 (35.29%)	<0.0007
Total	52 (30.58%)	118 (69.41%)	

DM: Diabetes mellitus; CAI: Chronic arterial insufficiency.

Disclosures

Ethics Committee Approval: The study received approval from the Human Research Ethics Committee (number #461) and was conducted in accordance with the ethical precepts set down in the Declaration of Helsinki. Informed consent of the subjects was waived by the ethics committee because the sample consisted of medical records.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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