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ORIGINAL ARTICLES

Clinical profile of limb amputation cases: a retrospective study

Perfil clínico de casos de amputação de membros: um estudo retrospectivo

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Abstract

Objective: to identify the profile of patients who underwent limb amputation in a sample of Brazilian patients.

Method: a retrospective study was conducted by reviewing the medical records of patients who sought medical care between January 2011 and December 2020 at a single tertiary referral university hospital. Data collection included age, sex, indications for amputation, amputated limb, level of amputation, and comorbidities.

Results: four hundred medical records of amputation cases were reviewed. The median age of the patients was 71 (63-80) years, and the majority were male (69%). Diabetes (60%) and systemic arterial hypertension (55.6%) were the most frequent comorbidities. Lower limb amputations were the most common, and the leading causes were diabetes (41.2%), acute arterial obstruction (17.2%), chronic peripheral vascular disease (14.2%), and trauma (12.7%). Trauma was more frequent in males than in females (p = 0.005), but the other causes were similar between sexes. Knee and above-knee amputations were observed in 47.8%, transmetatarsal and toe amputations in 29.4%, and below-knee amputations in 17.1%.

Conclusion: the primary cause of amputations was diabetes, followed by vascular conditions, while trauma was significantly more common among men. Lower limb amputations predominated. These findings underscore the importance of prevention strategies and control of chronic diseases, especially diabetes and vascular diseases, particularly in men.

Keywords: amputation, diabetes complications, hypertension, lower extremities.

Resumo

Objetivo: identificar o perfil dos pacientes submetidos à amputação de membros em uma amostra de pacientes brasileiros.

Método: estudo retrospectivo feito com a revisão de prontuários de pacientes que buscaram atendimento médico entre janeiro de 2011 e dezembro de 2020 em um único hospital universitário de referência terciária. A coleta de dados incluiu: idade, sexo, indicações de amputação, membro amputado, nível de amputação e comorbidades.

Resultados: quatrocentos prontuários de casos de amputação foram revisados. A mediana de idade dos pacientes foi de 71 (63-80) anos e a maioria era do sexo masculino (69%). Diabetes (60%) e hipertensão arterial sistêmica (55,6%) foram as comorbidades mais frequentes. As amputações de membros inferiores foram maioria e as causas mais comuns foram: diabetes (41,2%), obstrução arterial aguda (17,2%), doença vascular periférica crônica (14,2%) e trauma (12,7%). O trauma foi mais frequente no sexo masculino do que no feminino (p= 0,005), mas as demais causas foram semelhantes em ambos os sexos. Amputações de joelho e acima do joelho foram encontradas em 47,8%, transmetatarsais e de dedos em 29,4% e abaixo do joelho em 17,1%.

Conclusão: a principal causa das amputações foi o diabetes, seguido por condições vasculares, enquanto o trauma foi significativamente mais comum entre os homens. As amputações de membros inferiores predominaram. Esses achados

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reforçam a importância de estratégias de prevenção e controle de doenças crônicas, especialmente diabetes e doenças vasculares, particularmente em homens.

Palavras-chave: amputação, complicação do diabetes, hipertensão, membros inferiores.

Introduction

Amputation is the elimination of whole or part of a limb, frequently as a form of life saving treatment (1). It is one of the most antique surgical procedures, dating back to the time of Hippocrates, with a history of more than 2500 years (2,3).

Historically, amputation was used as a form of punishment measure. The Babylonian Code of King Hammurabi (circa 1750 BC.) imposed limb amputations to slaves who used force against citizens. (4) There are also reports from ancient Peru that punitive amputation was used as early as the 4th century BC. In Roma, the emperor Constantius Flavius Valerius Aurelius implemented a legislation that introduced amputation as punishment for slaves caught trying to escape imprisonment (4). Nowadays, punitive limb amputation is considered a violation of human rights but still happens in Arab and African countries to penalize those who practice robbery (4).

In medicine, the most common indications for amputations are trauma, peripheral vascular disease, infections, malignancy and diabetes, although the proportion of each condition may vary according to the area studied (5, 6).

Limb amputation has severe repercussions not only in physical function but also in the emotional, social and economic aspects as they may render the individual incapable of working (2, 7). So, all efforts should be made to prevent it. It is important to know the major causes of amputation to direct such efforts through public education, and the provision of proper health care as many of the causes are preventable.

This study reviews the most common causes of amputation in a tertiary referral hospital from Southern Brazil, aiming to recognize the indications and the epidemiology of individuals that needed this procedure.

Methods

This is a retrospective study approved by the local Committee of Ethics in research under protocol number 5.098.163. Charts from a single tertiary hospital that cares for patients from the Public Health System in Southern Brazil, from January 2011 to December 2020 were reviewed. The following data were collected: age, sex, indications for amputation, amputated limb, level of amputation, and comorbidities.

For statistical purpose the software Graph Pad Prism version 9.5.1 for Windows was used. Comparison of numerical data was done using the Mann Whitney test and of nominal data, using the Fisher and chi-squared tests. The adopted significance was 5%.

Results

Table 1 shows the description and amputation levels of the sample studied. A sample of 400 patients of 5 to 104 years of age (median 71; IQR= 63-80) was obtained. On this sample a proportion of 2.2 males:1 female was observed. Diabetic foot and acute arterial occlusion (AAO) were the most common etiologies followed by chronic peripheral arterial obstructive disease. Trauma occupied the 4th place in the ranking. About amputation levels, the great majority was in the lower limb (above knee and trans-metatarsal and digit amputations). Two patients had bilateral amputation of lower limb; both were males with 64 and 91 years of age respectively, with gangrenous complications of diabetes and peripheral vascular disease. In both cases, amputations were above the knees.

TABLE 1 – Description of samples studied and levels of amputation.

Variable	n (%)
Male sex	276 (69.0)
Underlying disease:	
Diabetic foot	165 (41.2)
Acute arterial occlusion	69 (17.2)
Chronic peripheral artery disease	58 (14.5)
Trauma	51(12.7)
Osteomyelitis	6 (1.5)
Others	52 (12.7)
Co-morbidities (n=325)	
No comorbidities	54 (16.8)
Arterial hypertension	178(55.6)
Diabetes mellitus	192 (60.0)
Chronic renal insufficiency	15 (4.6)
Hypothyroidism	7 (2.1)
Vasculitis	5 (1.5)
Malignancy	2 (0.5)
Lepra	1 (0.3)
Levels of amputation (n=325)	
Amputated limb	
Upper limb	13 (3.5)
Lower limb	312 (96.4)
Amputation level	
Upper limb - Shoulder girdle	2 (15.3)
Brachium and elbow joint	1 (7.6)
Forearm and wrist joint	7 (53.8)
Hand and fingers	3 (23.0)
Lower limb	
Knee and above knee amputations	148 (47.4)
Below knee amputations	55 (17.6)
Foot (Syme)	17 (5.4)
Trans-metatarsal and digit	92 (29.4)

The comparison of males and females with amputations is on **Table 2**, which shows that males were younger with median age 71 (60.2-79.0) for males and 74.0 (65.2-84.0; p=0.008). In

addition, men had more below knee amputations than females.

TABLE 2 – Comparison of epidemiological, etiological and levels of amputation between males and females.

Variable	**Males,** n(%)	**Females** n (%)	**P***
n (%)	276 (69,0)	124 (31,0)	
Caused by trauma	44 (15.9)	7 (5.6)	0.005†
Non traumatic causes			
Diabetes mellitus	111 (40.2)	55 (44.3)	0.43
Acute arterial occlusion	49 (17.1)	20 (16.1)	0.69
Chronic peripheral artery disease	38 (13.7)	20 (16.1)	0.53
Upper limb amputation	9 (3.2)	4 (3.2)	>0.99
Lower limb amputation			
Knee and above knee	98 (46.2)	50 (51.0)	0.43
Below knee	46 (21.6)	7 (7.1)	0.001‡
Foot (SYME)	12 (5.6)	5 (5.1)	0.84
Trans-metatarsal and digit	55 (25.9)	36 (36.7)	0.052§

SYME: refers to disarticulation of the ankle, preserving a part of the heel.
* Fisher and chi-squared tests; †OR=3.08 (IC95% = 1.4-7.3); ‡OR=3.6 (IC95%= 1.6-8.6); §OR=1.6 (IC95%= 0.97-2.75).

A tendency towards increase in the number of minor amputations (trans-metatarsal and digit) was seen in females. It also shows that males suffer three times more amputations because of trauma than females.

Regarding the levels of lower limb amputation according to the main causes of amputation, the major cause of trans-metatarsal and digit amputation was diabetes followed by AAO and trauma. Amputations below knee were more common in trauma than in other causes such as diabetes and AAO. The most common level was knee or above knee.

Table 3 presents the profile of limb amputations based on age, highlighting the primary causes and amputation levels for lower limb cases. Most of the sample consisted of individuals over 65 years of age. The table shows that as patient age increases, the male-to-female ratio decreases, along with the proportion of amputations due to trauma.

Finally, patients with upper limb amputations had a median age of 37.0 (20.5-68.5) years, a proportion of 2.25 between males/ females and the most common cause was trauma (84.6%).

Discussion

The analysis of this sample of Brazilian patients with limb amputation revealed a clear profile. It displayed a male predominance that decreased as the age increased and a higher proportion of lower limb than upper limb amputation; it was more commonly seen in individuals over 65 years of age. A male predominance is commonly found in other studies (2, 8, 9) but the age of this sample was higher than those from previous studies. Hazmy et al. (8) studying 204 major limb amputations in Malaysia patients found a mean age of 39.4 years with nontraumatic causes (diabetes and peripheral vascular disease) as the principal causes. In the study by Chalya et al. (2) of 162 individuals from Tanzania, the mean age was 28 years, with diabetes and trauma as the main causes; Naaeder et al. (9) studied a sample of 53 individuals with mean age of 47 years, also having diabetes and trauma as the leading causes.

Variability in prevalence of diseases underlying the amputation may explain differences in the age distribution. In the present sample having diabetes and vascular diseases that are common in elderly people were the main causes.

TABLE 3 – Lower limb amputation according to patient's age.

Age (y)	n total	n male (male/female ratio)	Causes – n (%)	Lower limb amputation level * n = 120
<20	4	2 (1.0)	Trauma - 3 (75) Congenital malformation 1 (25)	Trans-metatarsal and digit - 1 (100,0)
21- 50	52	42 (4.2)	Trauma -31 (59.6) Diabetes -6 (11.5) AAO -5 (9.6) CPAD - 7 (13.4) Others -3 (5.7)	Trans-metatarsal and digit - 8(21.0) Foot (SYME) -1 (2.6) Below knee - 13 (34.2) Knee and above knee – 16 (42.1)
51 - 65	77	58 (3.0)	Trauma - 6 (7.7) Diabetes -37 (48.0) AAO - 11 (14.2) CPAD – 10 (12.9) Others – 13 (16.8)	Trans-metatarsal and digit 31 (44.9) Foot (SYME) -1 (1.4) Below knee - 12 (17.3) Knee and above knee - 25 (36.2)
> 65	267	174 (1.9)	Trauma 11 (4.1) Diabetes – 117 (43.8) AAO 53 (19.8) CPAD - 46 (17.2) Others – 40 (14.9)	Trans-metatarsal and digit - 52 (25.4) Foot (SYME) 15- (7.3) Below knee -30 (14.7) Knee and above knee -107 (52.4)

AAO= acute arterial occlusion; CPAD= chronic peripheral artery disease; SYME: refers to disarticulation of the ankle, preserving a part of the heel. * data available in 312 patients.

Diabetes complications such as abnormal blood flow caused by autonomic neuropathy, vascular disease favored by poor glycemic control, polyneuropathy causing gait abnormalities and ulcerations, and amplified risk of infections favor the risk of limb amputations (10-12). According to Payne et al., (10) having diabetes increases the risk of amputation up to 15-fold. In the presently studied sample, trans-metatarsal and digit amputations, which are minor amputations, were the most common in diabetes patients but there was, also, an almost similar proportion of knee and above knee level of amputation. Type 1 diabetes is slightly more common in males, (9) while type 2 is more commonly seen in females (13). In this sample, the prevalence of diabetes as the disease underlying amputation was similar in both sexes. In a Brazilian study with 253 diabetic patients (14), the authors found that amputations were positively associated with male sex (PR: 1.61 (1.23-2.11)) and not working (PR: 3.83 (1.48-9.95)) and negatively associated with age >60 years (PR: 0.57 (0.45-0.74)). Other study in Portugal with 206 patients with type 2 diabetes and a diabetic foot ulcer indicated for amputation surgery found results comparable with ours, showing social demographic variables play an important role in diabetic foot ulceration (15).

Diabetes is tightly linked to obesity and both diseases have shown, currently, a tendency to increase in prevalence (13, 14). Therefore, the number of amputations due to this problem may increase in the future. Control of risk factors for diabetes as well as the correct treatment of the established disease is crucial for preventing amputations. Most diabetes-related amputations can be avoided with good blood sugar management, regular foot examination, and prompt wound care when needed (14, 15). So, raising awareness of these measures may help to prevent limb loss.

Trauma was responsible for almost all cases of upper limb amputation; it was more commonly

seen in younger individuals (lower than 50 years of age) and in men. This profile may be linked to road traffic crashes that usually affect men in their productive years. Almost half of the patients with lower limb amputation by trauma had above knee amputations. In the study by Chalya et al. (2) trauma was the second most common cause; in the study by Nwosu et al. (1) in 112 patients from Nigeria, trauma was the principal cause of amputations. In the present study, it was the fourth cause of amputations. Educational and behavioral factors may influence such numbers.

This work is limited by its retrospective design. In addition, data on surgery complications could be enlightening. Further prospective studies may help to understand better the risk factors associated with limb amputation. On the other hand, the present analysis has the value to show the importance of the correct treatment of diabetes and vascular disease in order to decrease the number of amputations.

Culturally, Brazilian men are more likely than women to avoid medical appointments and healthcare, a topic widely discussed in some studies (16, 17). Research suggests that traditional masculinity norms in Brazil, as in other cultures, promote the belief that men must be strong, self-reliant, and refrain from showing vulnerability, including seeking medical help (18). These norms reinforce the perception that visiting a doctor is a sign of weakness or dependency, leading to lower adherence to preventive care and treatments. Consequently, men often delay seeking medical attention, resulting in the worsening of potentially manageable chronic conditions (18). To optimize patient support and try to reduce the risk of amputations in this group, a multidisciplinary team – including physician, psychologist, and dietician – can enhance well-being, improve treatment adherence, address health-related stigmas.

Concluding, in this sample, the primary cause of amputations was diabetes, followed by vascular diseases, while trauma was significantly more prevalent among men. Lower limb amputations were the most common. These findings underscore the importance of effective prevention and management strategies for chronic diseases, particularly diabetes and vascular conditions, with a specific focus on the male population.

Notes

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The authors declare no competing interests relevant to the content of this study.

Authors' contributions

All the authors declare to have made substantial contributions to the conception, or design, or acquisition, or analysis, or interpretation of data; and drafting the work or revising it critically for important intellectual content; and to approve the version to be published.

Availability of data and responsibility for the results

All the authors declare to have had full access to the available data, and they assume full responsibility for the integrity of these results.

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