MORTALIDADE A CURTO E LONGO PRAZO APÓS AMPUTAÇÃO MAJOR DO MEMBRO INFERIOR NUMA POPULAÇÃO OCTAGENÁRIA

SHORT AND LONG TERM MORTALITY RATES AFTER MAJOR LOWER LIMB AMPUTATION IN PATIENTS OLDER THAN 80 YEARS.

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RESUMO

Introdução: A mortalidade após amputação major do membro inferior é elevada estando a idade associada a pior prognóstico. O objetivo deste estudo retrospectivo foi determinar a taxa de mortalidade após uma primeira amputação major do membro inferior numa coorte de doentes com mais de 80 anos de idade.

Métodos: Foi realizada uma análise dos fatores que afetam os outcomes precoces e tardios após a amputação major realizada no âmbito de doença arterial periférica ou complicações diabéticas no nosso centro de referência vascular terciário entre 2008 e 2015, em doentes com mais de 80 anos de idade.

Resultados: 557 doentes foram submetidos a amputação major (54% do sexo feminino), com idade média 86.3 ± 4.4 anos, com 20% de incidência de amputações bilaterais durante o período do estudo. O *follow-up* médio foi de 4.8 [0.8; 16.4] meses. As taxas de mortalidade aos 30 dias e 2 anos foram de 27% e 77% respectivamente. A taxa de mortalidade ajustada à idade 1 ano após a amputação trans-femoral (ATF) foi de 68%, quase o dobro da amputação trans-tibial (ATT) (36%, p =.04). A taxa de re-intervenção foi substancialmente maior após ATT (36% vs 17%, p <.01). Análises de regressão Cox e de sobrevivência demonstraram que a mortalidade a longo prazo se associou com a readmissão hospitalar (HR: 2.00, p <.05) doenças cerebrovascular e renal crónica (HR: 1.22 e 1.24, respetivamente, p <.05), amputação por isquémia aguda (HR 1.21 p <.05). Os amputados com revascularização prévia e as ATT sobreviveram mais tempo (HR 0.65 e 0.51, respetivamente, p <.01).

Conclusões: Este estudo acrescenta informação prognóstica para uma população bem definida de doentes com uma primeira amputação major transtibial ou proximal, devido a uma causa vascular ou relacionada com infecção. As taxas de mortalidade após amputação dos membros inferiores são notoriamente elevadas, com apenas 23% dos doentes a sobreviverem mais de dois anos.

Palavras-chave
Amputação; mortalidade; pé diabético; doença arterial periférica

ABSTRACT

Introduction: *Mortality rates after lower limb amputation are notoriously high and age is associated with increased mortality. The aim of this retrospective study was to determine mortality rates after a first major lower limb amputation in a cohort of patients older 80 years old.*

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Methods: *We performed an analysis of factors affecting early and late outcome after major lower limb amputation for peripheral vascular disease or diabetic complications at a tertiary referral vascular center between 2008 and 2015 in patients older than 80 years old.*

Results: *557 patients underwent a major amputation (54% female), of median age 86.3 ± 4.4 years and 20% had bilateral amputations during the study period. Median follow-up was 4.8 [0.8; 16.4] months. 30-day and 2-year mortality rates were 27% and 77%. Age adjusted 1-year mortality rate after trans-femoral amputation (TFA) was 68%, almost double that of trans-tibial amputation (TTA) (36%, p= .04). The rate of re-operation was substantially greater after TTA (36% vs 17%, p< .01). Survival and Cox regression analysis demonstrated that long-term mortality was associated with hospital re-admission (HR: 2.00, p <.05) cerebrovascular and chronic kidney disease (HR: 1.22 and 1.24 respectively, p <.05), acute ischemic amputation (HR 1.21 p <.05). Previous revascularized amputees and TTA survived longer (HR 0.65 and 0.51 respectively, p <.01).*

Conclusions: *This study adds prognostic information for a well-defined population of people with a first amputation at or proximal to a transtibial level, due to a vascular or a infection related cause. Mortality rates after lower limb amputation are notoriously high, with only 23% of these cohort patients living longer than two years.*

Keywords
Amputation; mortality; diabetic foot; peripheral arterial disease

INTRODUCTION

Peripheral arterial disease (PAD) is the commonest indication for lower limb amputation (LLA)[1] and approximately 1% of patients will eventually need one.[2] Additionally lower extremity complications particularly diabetic foot ulceration, that frequently culminate in an amputation, are significant sources of morbidity in the diabetic population.[3] The total number of amputations has not decreased, largely because of the greater longevity of the population. In Portugal, the number of diabetic related major amputations was 5,7/100.000 in 2014.[4]

Mortality after lower limb amputation is high, with a 30-day mortality rates of 9–22%,[5] and can reach as high as 52% at 1 year and 100% at 5 years.[6] Additionally perioperative wound complications can be devastating in this already debilitated population and can range from 13% to 30%.[7] It is expected that these figures are more severe in a cohort of patients aged over 80 years.

Previous studies attempting to determine factors associated with short-term outcome have suggested age per 5-year increase, history of heart failure, renal disease, cancer, chronic obstructive pulmonary disease and dementia were all independently associated with death after major LE amputation.[8]

The primary aim of this study was to identify patient and procedural factors affecting peri-operative (30-day) and long-term (beyond 30-day) mortality after amputation in patients older than 80 years old.

MATERIALS AND METHODS

Setting and population

We carried out a retrospective case note review of all patients undergoing major lower limb amputation within Coimbra´s University Hospital between January 2008 and December 2015.

Medical records for all cases were reviewed between January 2016 and June 2016. People who had undergone amputation at transtibial level or proximal, on either limb, before 1 January 2008 were excluded. People with a previous amputation distal to, and including, ankle disarticulation, were included. Where multiple amputations occurred within the study period (re-amputation to a higher level, the date of the first amputation was used to calculate time to death. When a second contra-lateral amputation occurred the date of the second amputation was used to calculate time to death. Amputations that were the result of trauma, cancer, complex regional pain syndrome or congenital causes were excluded, thus leaving a cohort with amputation resulting from vascular disease, and/or diabetes. Amputation date and level (unilateral transtibial amputation (TTA), unilateral transfemoral amputation (TFA), or bilateral) were recorded for the study period, as well as any amputations performed in the following years.

Variables

The primary dependent variable was time to death. The date of death was recorded from patient national registry.
Characteristics of the population included as independent variables were: age; sex; living situation prior to admission for amputation (home, inpatient rehabilitation center, nursing home, other hospital); discharge destination (home, inpatient rehabilitation center, nursing home, other hospital, or died before discharge); and smoking history (ever, never). Most frequent medical diagnoses were presented under combined groups of cardiac disease, cerebrovascular disease, lung disease, renal disease, diabetes. Cerebrovascular disease was considered when there was a positive history of stroke. Renal insufficiency was defined by a serum creatinine > 1.5 g/dL. In addition, it was noted if a patient were receiving dialysis. Surgical history was recorded and included previous peripheral vascular procedures (e.g. embolectomy, *bypass* or angioplasty) as well as any previous minor amputations.
In cases of bilateral amputation, time to death, in months, was calculated from the date of the second amputation. People who had re-amputations were combined to one category, multiple major amputations, with the underlying notion that these cases had undergone multiple hospital admissions, anesthesia and surgery, probably giving them a different mortality risk than people with single amputations. This categorization procedure was chosen to enable sufficient numbers in each group for analyses.

Statistical analysis

To consider differences in mortality for the different population characteristics, survival was analyzed using Kaplan-Meier curves and stratified Log Rank tests to check for differences across independent and combined categories of sex, age, level of amputation and diagnosis of diabetes and peripheral revascularization. Missing data were right censored at the last confirmed contact date; missing data were not imputed. Characteristics of the population who died at 30-days, 1-year, 2-year were compared to those who survived using x2 tests for categorical variables and t-test for age (normal distribution). The potential predictors for survival were first analyzed with age-adjusted Cox proportional hazards models. The results were quantified by hazard ratios (HR) and their 95% confidence intervals (95% CI). Statistical significance for analyses was .05 (two-sided). Analyses were performed using SPSS statistics software (SPSS Statistics for Windows, Version 230. Chicago: SPSS Inc).

RESULTS

Population characteristics

We identified 557 patients undergoing 666 lower limb amputations (Table 1) during an 8-year *follow-up*. 29% of the overall amputations were performed by the Angiology and Vascular Surgery Department and 68% by General Surgery Departments. 60% of overall amputations were due to peripheral arterial disease. The majority of cases were woman (54%), the mean age was 86,3 ± 4,4 years and TFA was most frequent (76%). 38% patients were admitted from home. 20% did not survived to be discharged from the hospital. For those admitted from home, 50% returned to home, 40% to inpatient rehabilitation and 10% to a nursing home. 17% (97) need a second re-amputation procedure. The rate of re-operation was substantially greater after TTA (36% vs 17%, p<.01).
A revascularization procedure was previously performed in 14% (78) cases: most of them consisted of embolectomy due to cardio-embolic ischemia (38%), *bypass* (36%) and angioplasty (14%). Revascularized amputees tended to have a better functional status, more prevalence of cerebrovascular disease and arrhythmia and home provenience. The prevalence of TTA were superior in revascularized amputees (12% vs 3% p=.004). TFA revascularized amputees also had more cicatrization problems needing more re-amputation procedures (94% vs 6% p <.001).
Diabetes was diagnosed in 44% of the population (Table 2). People with diabetes had twelve as many TFA (73%) than TTA (6%), not significantly different to people without diabetes. Renal and cardiac disease was more prevalent in people with diabetes (26% and 35%) than people without (17% and 27%, p < .04), with no differences seen between these groups for other diagnoses. Previous minor amputations were significantly more likely for people with diabetes (17%) than people without diabetes (5%, P < .001) and need for major re-amputation was more frequent in non-diabetic patients (21% vs 13% p = .008). The incidence of wound complications was the same between diabetic and non-diabetic patients (6%). TFA cicatrization was significantly better in diabetic patients (88% vs 79% p =.006).

Table 1
Characteristics of included population, with comparison of people with revascularization and people without revascularization

	TOTAL	Revascularized amputees (14% n=78)	Non revascularized amputees (86% n=479)	OR (95% CI)	P
Females	54% (298)	51% (40)	54% (258)		ns
Age (years)	86,3 ± 4,4	85,3 ± 4,3	86,4 ± 4,4		ns
Level of amputation					
Transtibial	4% (25)	12% (9)	3% (16)	3.8 (1.6-8.8)	.004
Transfemoral	76% (423)	73% (57)	76% (366)		ns
Bilateral	20% (109)	15% (12)	20% (97)		ns
Comorbidities					
Diabetes	44% (246)	36% (28)	46% (218)		ns
Cardiac disease	30% (169)	31% (24)	30% (145)		ns
Arrhythmia	30% (152)	43% (30)	28% (132)	1.9 (1.2-3.2)	.011
Cerebrovascular disease	30% (169)	17% (13)	33% (156)	0.4 (0.2-0.8)	.005
Chronic lung disease	18% (101)	21% (16)	18% (85)		ns
Renal disease: In dialysis Not in dialysis	21% (116) 5% (29) 16% (87)	18% (14) 4% (3) 14% (11)	21% (102) 5% (26) 16% (76)		ns
Cancer	5% (27)	5% (4)	5% (23)		ns
Indication for amputation					
Acute ischemia	12% (68)	40% (31)	8% (37)		
CLI IV	60 (330)	60% (47)	60% (283)		ns
Diabetic infection	1 (8)	0%	2% (8)		
Pression lesions	27 (150)	0%	31% (150)		
Funcional Status					
Bedridden	72% (246)	10% (1)	74% (245)	0.04 (0.0-0.3)	<.001
Admitted from					
Home	38% (155)	84% (16)	36% (139)		.011
Nursing Home	47% (190)	16% (3)	48% (187)		
Inpatient rehabilitation	15% (60)	0%	15% (60)		
Hospital	1% (4)	0%	1% (4)		
Discharged to					
Died before discharge	20% (82)	15% (12)	15% (70)		ns
Home	23% (97)	9% (7)	19% (90)		.003
Inpatient rehabilitation	18% (75)	0%	16% (75)		
Nursing Home	38% (159)	6% (4)	29% (155)		
Hospital	1% (4)	0%	1% (4)		
Surgical history					
>1 previous minor amputation	10% (56)	14% (11)	10% (45)		ns
Major re-amputation (either limb)	17% (97)	86% (67)	6% (30)	91.2 (43.6-190.5)	<.001
Wound complications	6% (34)	8% (6)	6% (28)		ns

Table 2 Characteristics of included population, with comparison of people with diabetes and people without diabetes.

	TOTAL	With Diabetes (44% n=246)	Without Diabetes (56% n=311)	OR (95% CI)	P
Females	54% (298)	48% (118)	58% (180)	0.7 (0.5-0.9)	.02
Age (years)	86,3 ± 4,4	85,4 ± 4,0	86,9 ± 4,6		ns
Level of amputation					
Transtibial	5% (25)	6% (14)	4 (11)		ns
Transfemoral	75% (423)	73% (179)	79% (244)		ns
Bilateral	20% (109)	21% (53)	18% (56)		ns
Comorbidities					
Cardiac disease	30% (169)	35% (86)	27% (83)	1.4 (1.0-2.1)	.04
Arrhythmia	30% (162)	26% (64)	33% (98)		ns
Cerebrovascular disease	30% (169)	29% (72)	31% (97)		ns
Chronic lung disease	18% (101)	20% (48)	17% (53)		ns
Renal disease: In dialysis Not in dialysis	21% (116) 5% (29) 16% (87)	26% (64) 9% (23) 17% (41)	17% (52) 2% (6) 15% (46)	1.7 (1.2-2.6)	.008
Cancer	5% (27)	5% (13)	5% (14)		ns
Indication for amputation					
acute ischemia	12% (68)	6% (15)	17% (53)		<.001
CLI IV	60 (333)	63% (157)	56% (6)		
Diabetic infection	1 (8)	1% (2)	2% (6)		
Pression lesions	27 (149)	29% (72)	25% (77)		
Funcional Status					
Bedridden	72% (246)	65% (104)	79% (142)	0.5 (0.3-0.4)	.007
Admitted from					
Home	38% (155)	39% (75)	37% (80)		.011
Nursing Home	47% (190)	44% (86)	49% (104)		
Inpatient rehabilitation	15% (60)	15% (30)	14% (30)		
Hospital	1% (4)	2% (4)	0%		
Discharged to					
Died before discharge	20% (82)	13% (32)	16% (50)		ns
Home	23% (97)	20% (49)	15% (48)		.003
Inpatient rehabilitation	18% (75)	14% (35)	13% (40)		
Nursing Home	38% (159)	31% (77)	26% (82)		
Hospital	1% (4)	1% (2)	1% (2)		
Surgical history					
>1 previous minor amputation	10% (56)	17% (41)	5% (15)	3.9 (2.1-7.3)	<.001
Major re-amputation (either limb)	17% (97)	13% (31)	21% (66)	0.5 (0.3-0.8)	.008
Previous vascular surgery	14% (78)	11% (28)	16% (50)		ns
Wound complications	6% (34)	6% (15)	6% (19)		ns

Mortality

The Kaplan-Meier curve for the overall survival of the 557 amputees is show in Figure 1a. Our 30-day, 1-year, 2-year and 5-year mortality rates were 27%, 66% and 77% and 92% respectively. There were no significant differences in gender. The median time to death was 4,9 ± 0,7 months (95% CI: 3,6–6,3). Significant differences between median survival time were seen by age groups and level of amputation. People aged 85-years survived a median 7.7 months, while the remaining older age groups all survived 3.3 months, (p =.001). No differences were seen for people with or without diabetes (p =.88) (Figure 1b). Revascularized amputees had better survival than the ones not submitted to previous revascularization (31% vs 10% p <.001) Figure 1c. Deaths within 30-days of the operation totaled 27% (149), 55% (82) of which occurred during the surgical hospital stay and 45% (67) occurred after discharged.

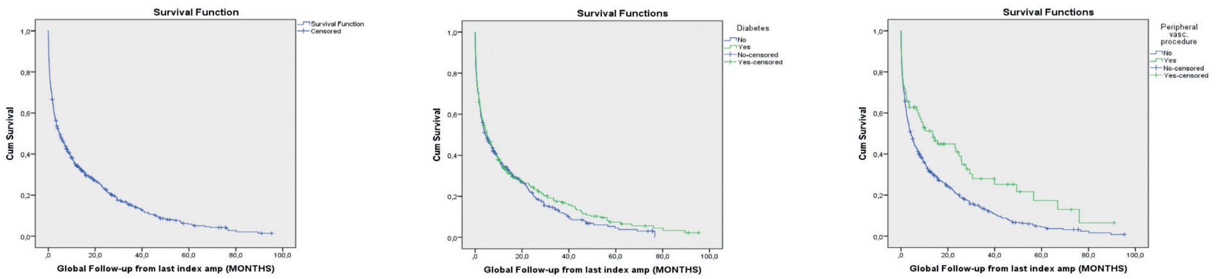

Figure 1 kaplan-Meier survival estimates in a) overall amputated patients (n=557) b) patients with (n=246) and without diabetes (n=313)), c) patients with (n=78) and without previous revascularization procedures (n=483).

1a) Life table for associated Kaplan-Meier survival analysis for all patients.

Interval Start Time; months	0	20	40	60	80	95
Number at risk	557	122	45	15	4	1
Number of terminal events	0	397	457	479	485	487
Cumulative proportion surviving; %	100	27	13	6	3	1

1b) Life table for associated Kaplan-Meier survival analysis for all patients.

	Interval Time; months	0	20	40	60	80	95
Diabetes	Number at risk	246	55	26	9	4	1
	Number of terminal events	0	175	197	210	213	215
	Cumulative proportion surviving; %	100	27	16	7	5	2
No Diabetes	Number at risk	311	67	19	22	0	0
	Number of terminal events	0	222	260	269	272	272
	Cumulative proportion surviving; %	100	26	15	5	0	0

1c) Life table for associated Kaplan-Meier survival analysis for all patients.

	Interval Time; months	0	20	40	60	80	95
Vascular procedure	Number at risk	78	23	9	4	1	0
	Number of terminal events	0	41	50	52	54	54
	Cumulative proportion surviving; %	100	45	25	17	6	0
No Vascular procedure	Number at risk	479	99	36	11	3	1
	Number of terminal events	0	356	407	427	431	433
	Cumulative proportion surviving; %	100	24	11	5	2	1

Factors significantly associated with 30-day mortality were re-hospitalization in the next 3 months, acute ischemia and a diagnosis of arrhythmia, renal or cardiac disease. TTA and previous revascularization are associated with a significant better survival at 1 and 2 years and overall survival (Table 3). Listed in table 3 are the variables found to be associated with mortality. Re-admission during the subsequent 3 months after discharged was the most significant predictor of both short and long term mortality.
The effect of level of amputation in mortality after LLA:
We found a statistically significant association between more distal amputation and increased survival (HR for TTA 0.51, 95% CI 0.31–0.84 p <.01). For people with unilateral TTA, time to death was on average longer at 22,9 ± 5,2 months and for TFA shorter at 4.2 ± 0,7 months. As shown in Figure 2, the mortality rate after TTA was 16%, 36% 60% and 73% at 30-day, 1, 2 and 5 years. The mortality rate after TFA was 27%, 68%, 78% and 92% at 30-day, 1, 2 and 5 years. The rate of re-operation was substantially greater after TTA (36% vs 17%, p <.01).
20% of overall amputations were bilateral. The mean age for second amputation was 88,2 ± 6,9 years. In 24% patients, the other leg was amputated during the same hospital stay. Time intervals between amputations of the first and the second lower limb ranged from 0 days to 4.8 years and averaged 3,8 [0,7;13,1] months. The average

Table 3 Predicting factor for 30-day, 1 year 2-year and global mortality (age adjusted).

Variables	Hazard ratio Exp (B)	95% CI for Exp (B)		P-value
30-day death				
Cardiac disease	1.37	0.98	1.91	.067
Arrhythmia	1.47	1.01	2.07	.026
Renal disease	1.61	1.23	2.30	.009
Acute ischemia	1.19	1.28	2.88	.002
Bilateral amputation	0.93	0.58	1.51	.780
Bedridden	1.71	0.95	3.07	.068
Acute ischemia	1.19	1.28	2.88	.002
Bedridden	1.71	0.95	3.07	.068
Re-admission < 3 months	2.14	1.24	3.70	.007
Diabetes	0.97	0.66	1.42	.877
Bilateral amputation	0.93	0.58	1.51	.780
1-year death				
Age	1.02	1.00	1.05	.036
Bedridden	1.57	1.15	2.13	.004
Arrhythmia	1.24	0.99	1.55	.064
Cerebrovascular disease	1.22	0.99	1.52	.067
Renal disease	1.56	1.22	2.00	<.001
Transfemoral	1.32	1.02	1.70	.036
Transtibial	0.56	0.31	1.03	.065
Previous revascularization	0.69	0.49	0.96	.027
Diabetes	1.08	0.75	1.51	.720
Bilateral amputation	0.69	0.45	1.67	.096

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Variables	Hazard ratio Exp (B)	95% CI for Exp (B)		P-value
2-year death				
Age	1.03	1.14	1.83	.005
Female	0.82	0.68	1.00	.053
Arrhythmia	1.21	0.98	1.50	.073
Cerebrovascular disease	1.26	1.03	1.54	.028
Renal disease	1.44	1.14	1.83	.002
Bedridden	1.53	1.15	2.32	.014
Re-admission < 3 months	2.15	1.64	2.83	<.001
Transtibial	0.56	0.32	0.97	.039
Previous revascularization	0.64	0.46	0.87	.005
Diabetes	0.93	0.64	1.37	.719
Bilateral amputation	1.20	0.73	1.97	.466
Global death				
Age	1.03	1.01	1.05	.026
Arrhythmia	1.22	1.00	1.48	.051
Cerebrovascular disease	1.22	1.01	1.48	.041
Renal disease	1.24	1.00	1.53	.047
Re-admission < 3 months	1.98	1.53	2.57	<.001
Transtibial	0.51	0.31	0.84	.008
Previous revascularization	0.65	0.49	0.86	.003
Diabetes	0.95	0.79	1.14	.555
Bilateral amputation	1.00	0.81	1.26	.959

interval in patients who had diabetes mellitus was 2.4 and 3.2 years in non-diabetics. The indication for amputation of the second lower extremity was ischemic rest pain and/or tissue loss in all patients. 1% underwent an ultimately unsuccessful attempt of revascularization. The primary level of amputation of the second leg was TTA in 5 (4%), and TFA in 104 (96%). We found no differences in mortality between patients undergoing unilateral and patients with bilateral amputations. Median time to death after a second amputation was 5,3 ± 2,1 [1,11;9,5] months.

DISCUSSION

Our cohort consisted of all patients who underwent a major lower limb amputation for non-traumatic causes within an age range older than 80 years. It seemed to constitute a sample of severely ill patients with diabetes and end stage peripheral diseases that are summed to a high prevalence of co-morbid conditions.

Lower extremity amputations are performed in large numbers worldwide. While some studies report a decrease in the number of amputations due to ischemic prevention by vascular interventions, other claim that lower extremity amputation rates have remained relatively unchanged during the past two decades.9 Amputations rates performed at our institution have not dropped during the past 8 years. The aim of this study was to understand and provide more detailed prognostic information to patients and most of the times caregivers since often patients are no longer able to provide an informed consent.

30-day, 1-year and 5-year mortality rates were 27%, 66% and 92% respectively. According to the literature the 30-day mortality ranges from 6% and 22%[10,11] and 45% of 30-day deaths occurred after discharged.[11] According to Thorud et al systematic review[12], the overall 5-year mortality rate ranged from 52% to 80%. Age is universally associated with increased mortality after major amputation. In a nationwide study that included 186,338 PAD related amputations, Jones et al8 found that age per 5-year increase was associated with an 1.29 statistically

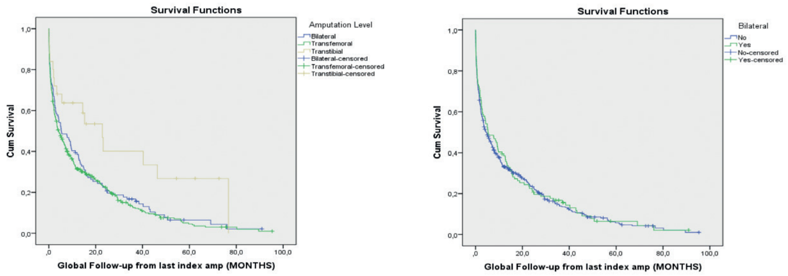

Figure 2 The effect of level of amputation on the occurrence of death after major LE amputation a) level of amputation, b) bilateral vs not bilateral.

2a) Life table for associated Kaplan-Meier survival analysis for all patients..

	Interval Time; months	0	20	40	60	80	95
Transfemoral	Number at risk	423	87	28	9	3	1
	Number of terminal events	0	305	352	366	369	371
	Cumulative proportion surviving; %	100	26	11	5	3	1
Transtibial	Number at risk	25	8	6	3	0	0
	Number of terminal events	0	11	13	15	16	16
	Cumulative proportion surviving; %	100	54	40	27	0	0
Bilateral	Number at risk	109	27	11	3	1	0
	Number of terminal events	0	81	92	98	100	100
	Cumulative proportion surviving; %	100	25	14	7	2	0

2b) Life table for associated Kaplan-Meier survival analysis for all patients.

	Interval Time; months	0	20	40	60	80	95
Bilateral amputation	Number at risk	109	27	11	5	1	0
	Number of terminal events	0	81	92	87	100	100
	Cumulative proportion surviving; %	100	25	14	7	2	0
Unilateral amputation	Number at risk	448	95	34	12	3	1
	Number of terminal events	0	316	365	381	385	387
	Cumulative proportion surviving; %	100	27	12	6	3	1

significant higher hazard of death. The risk factors described in the literature included increased age, renal disease, proximal amputation, diabetes and PAD and this predictors were found to be the same for early and late mortality.[12,13] Although not specifically addressed, the authors were left with the notion that it is a population characterized by a precarious nutrition and overall health.

Diabetes prevalence in this study (44%) was similar to other series (30% to 61%).[2,6,8,13] The incidence of revascularization procedures was the same between diabetic and non-diabetic patients but they underwent 12x more TFA than TTA. In Fortington´s study by contrast, people with diabetes had twice as many TTA than TFA, significantly different to people without diabetes. Association between increased 5-year mortality and diabetes is not consistent. Also renal disease was associated with increased mortality in nearly all studies, although the definitions varied from study to study.[12]

The reason for amputation was sometimes difficult to apply because many patients have a mix of pression lesions with peripheral vascular disease (most of these patients were bed-ridden patients with diabetes were a calcaneous lesion was found and a sonoDoppler presenting monophasic arterial sounds). In most of published reports, the reason for amputation was infrequently reported.[12]

It is known that revascularization reduces the rate of major amputation in diabetic patients presenting with critical limb ischemia. However, the risk of amputation still exists also in revascularized patients, both in the early and *follow-up* period, for several reasons: the procedure may not succeeded, gangrene may require removal of a huge part of the foot or graft/PTA restenosis/clusure.[14] In this cohort 14% of major amputations were performed in patients who had a previous revascularization procedure. This low procedure prevalence can be explained by the fact that we are studying a cohort of patients older than 80 years old and only 38% of these were considered to have a not bed-ridden situation. Data from this study, in consistence with others series[12-15], demonstrated that the revascularization, even when unable to avoid major amputation, allowed for better patient survival than that of nonrevascularized patients. Overever we can not forget that revascularized patients have also less dependency or bed-ridden status that confers a protection against primary amputation indication for CLI treatment.

The complexity of the decision-making process for amputation includes whether to use amputation, its timing ant its type which all are partially surgeon dependent. In some cases amputation can be delayed, and often the surgeon may find this is an optimal course if he fells that avoiding amputation would increase life expectancy.

But also, there is a counterpart: it could also lead to a extended non-weightbearing situation and recurrence of infections. Proximal amputations were associated with increased mortality in nearly all studies; however, the tendency was that those with proximal amputations were older, potentially confounding this association. The 30-day and 5-year mortality rate was 16% and 73% for BKA and 27% and 92% for AKA. In Thorud et al systematic review[12], 5 year mortality rate ranged from 40–82% for BKA and 40–90% for AKA.

The rate of BKA amputation was higher in revascularized amputees (in consonance with previous studies[14]). But what comes in to light from this study is that only 5% of overall amputations were BKA amputations. Three important points mostly explain this. The first is that this study refers mostly to patients older than 80 years, being 65% in a bed-ridden situation. The surgeon, the patient and many times de caregiver must make conscious decision in terms of time and type of amputation. Having in mind that above the knee amputations are associated with better cicatrization rates, this may be the reason for selecting this procedure for most of the patients. Some physicians will even use a limited life expectancy as part of the indication for a major amputation. So, it is difficult to determine whether proximal amputation leads to death or whether patients likely to experience a poor outcome were more likely to undergo more proximal amputations. Secondarily, many patients presented with tissue loss (with tendons exhibition and calcaneous deep ulcers) that makes revascularization unfeasible. Finally, most of these amputations were performed in an urgent basis by the general surgery on duty in that day. The vascular department performed most of BKA amputations while general surgery department tended to perform more AKA.

Also noteworthy is the high rate of bilateral and re-amputations. In this study, 20% had bilateral amputations and 17% of the patients needed secondary re-amputations (mostly revascularized patients) and it is in consonance with other series (up to 25%).[1,2,6,16] Surprisingly survival between bilateral amputation and unilateral amputation was the same. Median survival of bilateral amputation described in the literature are dispar ranging from a median of 3 months (95% CI 0.4–5.6)[2] to 3 years.[17]

In conclusion, mortality rates after major LE amputation remain high. Specific populations like older patients with a bed-ridden status, where most of the times revascularization procedures don't have a place have a higher mortality. The significantly higher event rates in those patients requiring extensive amputation (ie, TFA) suggest that every opportunity should be taken to avoid TFAs. Furthermore, a uniform treatment algorithm to determine amputation level at the time of major LE amputation is needed, as much of the decision making about the level of amputation is determined by physician expertise and preference. Finally, there remains a critical need for education programs that focus on prevention, early diagnosis, and aggressive treatment for patients with PAD at high risk for major LE amputation and subsequent death.

RESPONSABILIDADES ÉTICAS

Proteção de pessoas e animais. Os autores declaram que para esta investigação não se realizaram experiências em seres humanos e/ou animais.

Confidencialidade dos dados. Os autores declaram que não aparecem dados de pacientes neste artigo.

Direito à privacidade e consentimento escrito. Os autores declaram que não aparecem dados de pacientes neste artigo.

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