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Factors affecting lifespan following below-knee amputation in diabetic patients

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ABSTRACT

Introduction: Untreatable foot problems in diabetics may require lower extremity amputation, which has a high level of patient mortality. This high mortality rate is worse than most malignancies. The present study aimed to identify parameters that can be used to estimate survival in DM patients undergoing below-knee amputations for diabetic foot problems.
Materials and methods: A total of 470 patients (299 males, 171 females) with a mean age of 64.32 years who underwent below-knee amputation for diabetic foot problems between 2004 and 2014 were enrolled in the study. The length of time from the operation to time of death was recorded in days. Patient details were obtained, including age during surgery, BMI, oral antidiabetic and insulin usage, dialysis therapy history, lower extremity endovascular intervention, previous amputation at the same extremity, the need for stump revision surgery during follow-up, and above-knee amputation at the same site. Biochemical test results of pre-operative HbA1c, ESR, and levels of CRP, BUN, and creatinine were also obtained.
Results: A total of 333 patients (70.9%) died and 137 (29.1%) survived post-surgery. Survival rates were 90% in the first 7 days, 84% in the first 30 days, and 64% after the first year. Patient median life expectancy post-surgery was 930 ± 106 days. Hemodialysis treatment ($p = 0.001$), endovascular intervention ($p = 0.04$), sex ($p = 0.004$), age ($p = 0.001$), BUN level ($p = 0.001$), and duration of insulin use ($p = 0.003$) were shown to be effective predictors of mortality.
Conclusions: Life expectancy is low (<3 years) in DM patients requiring below-knee amputations for untreatable foot problems. Survival could be predicted by duration of insulin use, age, sex, and renal insufficiency.

Introduction

The diabetic foot syndrome encompasses a number of pathologies, including diabetic neuropathy, peripheral vascular disease, Charcot's neuroarthropathy, foot ulceration, osteomyelitis, and the potentially preventable end point amputation.[1] Epidemiological studies have shown that each year 2.5% of patients with diabetes are affected by diabetic foot ulcers, and that 15% of patients with diabetes will ultimately be affected by diabetic foot ulcers.[2,3] The incidence of foot problems ranges from 10% to 25% throughout the lifetime of a Diabetes mellitus (DM) patient,[4] and is strongly correlated with mortality and lover extremity major amputations (LEMAs).[5,6]

Mortality following amputation ranges from 13 to 40% in 1 year, 35–65% in 3 years, and 39–80% in 5 years, being worse than most malignancies.[7] Therefore, amputation-free survival is important in assessing the management of diabetic foot problems.

The aim of the present study was to determine parameters that can be used to estimate survival in DM patients with a planned below-knee amputation for a diabetic foot problem.

Patients and methods

Patient selection

Retrospective review of prospectively collected data from Başkent University research and training hospital Orthopaedic

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department database was performed. A total of 1134 patients who had undergone the major joint bone amputation between 2004 and 2014 were evaluated. Of the 608 diabetic transtibial amputated patients who were enrolled with the help of International Classification of Disease (ICD) codes, 470 were included in the study, the remainder were excluded for the following criteria's; if they had disarticulation at or above the knee joint (n = 101), if they were attending another center for diabetes and for whom inadequate information was available (n = 25), if they had received a diagnosis of malignant cancer before the surgery (n = 5), and if they died from unnatural reasons according to Social Security Institution data (n = 3; traffic accident, n = 1; firearm injury, n = 1; falling from a height).

We also obtained the following biochemical data: glycated hemoglobin (HbA1c) levels, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP), blood urea nitrogen (BUN), and creatinine levels. Patient data acquired were: age during the operation (the date of the first amputation was used if bilateral amputation was performed on different dates), history of dialysis therapy, the lower extremity endovascular intervention procedures, history of previous amputations at the same extremity, the need for stump revision surgery during follow-up, and above-knee amputation at the same site. Body mass index (BMI), DM, and periods of oral antidiabetic and insulin use were also recorded. Data are presented in Tables 1 and 2.

Statistical analysis

Normally distributed data were analyzed by the Shapiro–Wilk test. The Student's *t*-test was used to compare two independent groups of normally distributed variables, while the Mann–Whitney U test was used for non-normal data. Pearson's chi-squared test was used to investigate relationships between categorical variables. Logistic regression analysis estimated odds ratios and 95% confidence intervals (CIs). Survival probabilities were estimated using Kaplan–Meier curves. Cox regression analysis was performed to determine the important factors affecting overall survival probabilities. Statistical analyses were performed using SPSS v22.0 (Chicago, IL, USA). p values < 0.05 were deemed statistically significant.

Results

A total of 470 patients were enrolled (299 males and 171 females) in the study. The mean age of the patients was 64.32 years (range, 20–101 years). The mean age of male patients was 63.21 years (range, 29–88 years), whereas female patients were 66.26 years (range, 20–101 years). One unit of increase in age was associated with a 1.034-fold (95%CI, 1.024–1045) increase in mortality.

Following the below-knee amputation, a total of 137 patients (29.1%) survived, and 333 (70.9%) died (Table 2, Fig. 1). During the first 7 days post-surgery, the survival rate was 90%; this fell to 84% in the first 30 days, and to 64% by the end of the first year. The life expectancy of patients was median 930 ± 106 days. The mean age of women undergoing below-knee amputation was higher than that of males (Table 1), and their post-operative lifetime was significantly (1.38 times) shorter (95% CI, 1.113–1.728, p = 0.040; Table 2).

The life expectancy of patients undergoing dialysis treatment was 674 ± 174 days (95% CI, 710–1038), whereas it was 1132 ± 140 days (95%CI, 1276–1628) in patients not receiving dialysis treatment, so hemodialysis was shown to increase mortality by 1.53 times (95% CI, 1.218–1.936) (Table 2). Only 96 (72.7%) of women and 128 (63.6%) of men losing their lives were receiving dialysis therapy. Also, one unit of increase in the BUN value was associated with a 1.009-fold (95%CI, 1.005–1.014) increase in mortality (Table 1).

Patients who underwent preoperative endovascular intervention also had a 1.26-fold higher in mortality than those who did not (hazards ratio (HR): 1.262, 95% CI, 1.011–1.575, p = 0.040).

Patients had been diagnosed with DM and had received oral antidiabetic drug (OAD) and insulin therapy for an average of 10 and 7 years, respectively (Table 1). A 1-year increase in the use of

Table 1
Results of univariate cox regression method to determine important factor on survival probabilities.

Variables	Total	Total exitus (n (%))	Exitus male (n (%))	Exitus female (n (%))	Median living day ± std. error	Mean age during surgery (min–max)	HR [95%CI]	P
Gender	470	333 (70.1)	201 (43)	132 (28)		64.32 (20–101)	1.38 [1.112–1.728]	0.004*
Male	299	201 (67)			1171 ± 109.46	63.21 (29–88)		
Female	171	132 (77)			457 ± 153.76	66.32 (20–101)		
Dialysis							1.535 [1.218–1.936]	0.001*
+	336	224 (67)	128 (38)	96 (29)	674 ± 174.65	61.07 (29–84)		
–	134	109 (81)	73 (54)	36 (27)	1132 ± 140.09	65.61 (20–101)		
Revision surgery							1.116 [0.868–1.436]	0.392
+	115	80 (70)	50 (43)	30 (26)	1147 ± 141.05	63.68 (20–86)		
–	355	253 (71)	151 (43)	102 (29)	853 ± 118.07	64.52 (29–101)		
Periferic arterial disease							1.152 [0.868–1.436]	0.365
+	74	48 (65)	24 (32)	24 (32)	1239 ± 311415	67.20 (43–89)		
–	396	285 (72)	177 (45)	108 (27)	888 ± 105.21	63.78 (20–101)		
Embolectomy							0.834 [0.496–1.401]	0.492
+	24	15 (63)	10 (42)	5 (21)	1567 ± 317.49	71.13 (46–89)		
–	446	318 (71)	191 (43)	127 (28)	893 ± 104.52	63.95 (20–101)		
Angiography							1.262 [1.011–1.575]	0.040*
+	191	126 (66)	71 (37)	55 (29)	1208 ± 116.15	64.72 (32–101)		
–	279	207 (74)	130 (47)	77 (28)	734 ± 126.95	64.04 (20–90)		
Previous amputation surgery	240	94 (39)	61 (25)	33 (14)	1029 ± 155.08	63.51 (31–89)	1.060 [0.834–1.346]	0.634
Small bone and joint amputation	93	65 (70)	45 (48)	20 (22)	906 ± 182.61	62.77 (31–89)	1.025 [0.779–1.350]	0.859
Middle bone and joint amputation	47	29 (62)	16 (34)	13 (28)	1196 ± 312.10	64.98 (40–84)	0.800 [0.545–1.178]	0.260
Above to knee amputation	132	96 (73)	64 (48)	32 (24)	674 ± 190.66	64.28 (32–88)	1.054 [0.830–1.337]	0.667
Side								
Right vs bilateral	214	155 (73)	89 (42)	66 (31)	906 ± 179.36	65.60 (20–90)	0.837 [0.603–1.161]	0.286
Left vs bilateral	188	120 (64)	71 (38)	49 (26)	960 ± 160.77	63.40 (36–87)	0.693 [0.494–0.972]	0.034
Bilateral	56	47 (84)	32 (57)	15 (27)	876 ± 264.44	62.25 (29–101)		

*Significant at 0.05 level.

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