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Mortality in diabetic and nondiabetic patients after amputations performed from 1996 to 2005 in a tertiary hospital population: a 3-year follow-up study

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Abstract

Aims: Diabetes is the leading cause of lower-extremity amputations worldwide. The objective of this study was to look at the survival after first amputation between subjects with and without diabetes in a sample of Greek population. **Method:** We performed a retrospective study of all nontrauma, nonneoplasm–related amputations performed in a tertiary centre during the years 1996–2005 in diabetic (n=183) and nondiabetic patients (n=75). Survival status was assessed from the first amputation until December 31, 2005. **Results:** A total of 54.6% of amputees with diabetes and 51.6% of those without diabetes died in a mean [95% confidence interval (CI)] time of 4.3 (3.5–5.1) and 6.6 (4.6–8.6) years after the first amputation, respectively (P=.65). Diabetic patients underwent a second amputation (P=.003) and contralateral amputations (P=.02) more often in comparison with nondiabetic subjects. Predictors of all-cause mortality in the diabetic group, after adjustment for sex, were age [hazard ratio (HR) (95% CI), 1.04 (1.02–1.06); P<.001] and the level of amputation (major vs. minor) [HR, 1.55 (1.00–2.40), P=.05]. The respective values in the nondiabetic patients were HR of 1.06 (1.03–1.08; P<.001) and HR of 3.12 (1.27–7.64; P=.01). Median length of hospital stay was comparable between the two groups. **Conclusion:** Mortality rates after amputation were high in both patients with and without diabetes. Older age and a higher level of amputation were associated with poorer survival. Diabetic patients more often underwent a second amputation to the same and the contralateral limb. Additionally, mortality rates, length of hospital stay, and perioperative mortality were not different between patients with and without diabetes.

Keywords: Amputation; Diabetes; Survival; Mortality; Hospital stay; Greece

1. Introduction

Diabetes mellitus is the leading cause of all nontraumatic lower limb amputations worldwide (Trautner, Haastert, Giani, & Berger, 1996). The risk of amputation of the lower limb in diabetic subjects is 10–30 times higher in comparison with the general population (Katsilambros, Tentolouris, Tsapogas, & Dounis, 2003; Siitonen, Niskanen, Laakso, Siitonen, & Pyorala, 1993). Previous studies demonstrated increased mortality after amputation in both diabetic and nondiabetic patients (Chaturvedi, Stevens, Fuller, Lee, & Lu, 2001; Van Houtum and Lavery, 1996). In addition, reamputation rates are high in these patients (Apelqvist, Ragnarson-Tennvall, Persson, & Larsson, 1994),

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resulting in high direct health care cost (Ashry, Lavery, Armstrong, Lavery, & Van Houtoum, 1998).

Little information is available on the survival after an amputation in Greece at present. The aim of the present retrospective study was to evaluate survival after first amputation over the last decade in a general, tertiary hospital in Greece. In addition, predictors of survival and parameters such as level of amputation, perioperative mortality, and length of hospital stay were also examined.

2. Method

We reviewed all nontrauma, nonneoplasm-related amputations performed at the Laiko Hospital in Athens, between January 1, 1996, and December 31, 2005. Data on amputations were collected from the patients' medical records, the theatre records, and the hospital discharge files. A total of 294 amputations had been performed during this period; however, in the analysis, we included 258 amputations because data on survival status were not available in the remaining 36 cases. Patients for whom survival data were not available did not differ from those included in the analysis in terms of age of first amputation (69.7±16.7 years, P=.58), sex (male/female %: 77.7/22.3, P=.35), and diabetes status (nondiabetic/diabetic %: 68.4/31.6, P=.75). Participants in the diabetes group were patients who had been diagnosed with diabetes according to their medical records. Additionally, patients with unknown diabetes but with fasting serum glucose values ≥126 mg/dl measured twice were considered as having diabetes according to the American Diabetes Association criteria (The Expert Committee on the Diagnosis and Classification of Diabetes Mellitus, 2001).

The exact level of amputation was reported. Major amputation refers to any amputation above the midtarsal level (International Working Group on the Diabetic Foot, 1999). Second amputation refers to any amputation performed to the same or the contralateral leg after healing of the first amputation. When multiple amputations were performed on the same patient during the same hospitalization, only the most proximal amputation was used in the data analysis. Perioperative mortality refers to deaths that occurred in the first 28 days after an amputation. Patients who had an amputation before 1996 and a new amputation in the study period were excluded from the study. Follow-up was from the time of the first amputation until death or December 31, 2005, whichever came first.

2.1. Data analysis

Analysis was preformed using the SPSS statistical package (SPSS 10.0, Chicago, IL, USA). The Student's t test or the Mann–Whitney U test was used to assess differences in parametric and nonparametric variables, respectively, while a χ^2 test was used for categorical data. All-cause survival as a function of age of first amputation (<65 years vs. >65 years), sex, and diabetes status, and level of amputation (minor vs. major) was based on Kaplan–Meier estimates and compared by the log-rank test. Cox proportional univariate and multivariate hazards regression analyses were performed to look for predictors of all-cause mortality.

3. Results

Of the 258 amputations, 70.9% (n=183) had been performed in patients with diabetes and 75 (29.1%) in patients without diabetes. The age distribution of the amputees is shown in Fig. 1. The peak distribution was observed in the age group of 67–76 years in the diabetic and in the age group of >77 years in the nondiabetic patients.

There were no significant differences between diabetic and nondiabetic amputees in terms of age of the first amputation (P=.22), sex (P=.59), and level of amputation (major vs. minor) (P=.82) (Table 1). There were six cases with Chopart's and three cases with Syme's amputations, all in the patients with diabetes. When we included these cases in the analysis as minor, the results on the survival according to the level of amputation in the group of patients with diabetes did not change (P=.74).

Diabetic patients underwent a second amputation (29.7% vs. 12.7%, P=.003) and contralateral amputations more often in comparison with nondiabetic patients (19.9% vs.

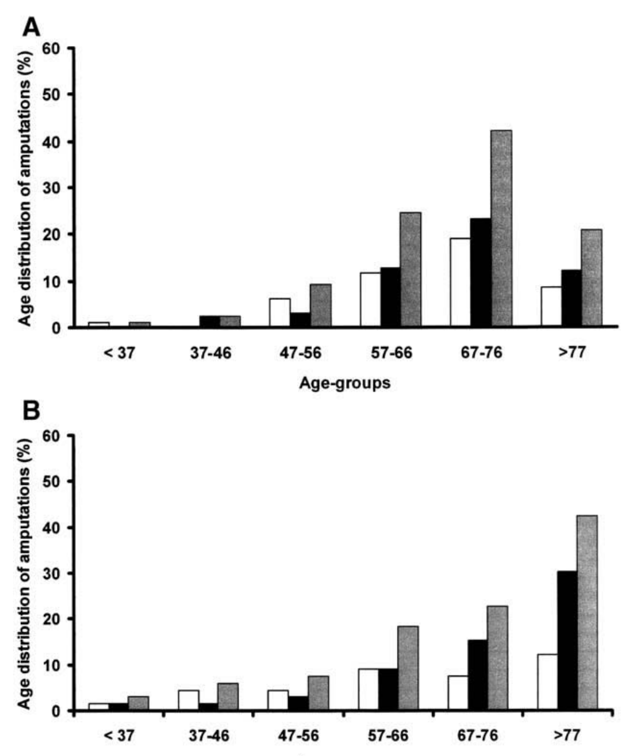

Fig. 1. Age distribution of amputations in patients with (A) and without (B) diabetes. □, Minor amputations; ■, major amputations; ▒, total number of amputations.

Table 1
Baseline demographic characteristics in amputees with and without diabetes

	Diabetic patients	Nondiabetic patients	*P*
n	183	75	
Men/women n (%)	129 (70.5)/54 (29.5)	51 (68.0)/24 (32.0)	.69
Age of first amputation (years)	68.4±10.7	70.5±17.1	.22
Follow-up (years)	3.2± 2.3	2.9±2.3	.69
Time to death (years)	1.8±2.1	1.2±1.8	.13
Major amputation *n* (%)	99 (54.1)	46 (61.3)	
Minor amputation *n* (%)	84 (45.9)	29 (38.7)	.28
Perioperative mortality *n* (%)	27 (14.7)	16 (21.3)	.19

Data are shown as mean±S.D. or as *n* (%).

7.1%, P=.02). Diabetic patients tended to have earlier a second amputation to the same or the contralateral limb in comparison with those without diabetes in a median (interquartile range) time of 1.0 (0–2.0) and 2.0 (1.0–3.5) years, (P=.08), respectively, after the first amputation.

The median (interquartile range) length of hospital stay was not different between the diabetic and the nondiabetic patients [20 (10–35) vs. 28 (27–30) days, respectively, P=.89]. Perioperative mortality was 14.7% in diabetic patients and 21.3% in nondiabetic patients (P=.19) (Table 1).

A total of 54.6% of the patients with and 51.6% of the patients without diabetes died during follow-up. Kaplan-Meier survival curves showed that mortality rates at 1, 3, and 5 years were 36%, 47%, and 48% in the diabetic patients compared with 28%, 44%, and 46% in the nondiabetic patients (Fig. 2), respectively. Mean [95% confidence intervals (CIs)] survival time after the first amputation was 4.3 (3.5–5.1) years in the diabetic patients and 6.6 (4.6–8.6) years in the nondiabetic patients (P=.65).

Mean (95% CI) survival time after the first amputation was not different between men and women with diabetes [4.0 (3.3–4.8) and 4.9 (3.3–6.4) years, respectively, P=.96] nor between men and women without diabetes [7.1 (4.9–9.3) and 5.3 (2.2–8.3) years, respectively, P=.27]. Survival was better in the younger than in the older subjects (65 vs. >65 years of age of the first amputation) in both diabetic (P<0.001) and nondiabetic (P=.05) patients.

Multivariate Cox regression analysis, after controlling for sex, demonstrated that age of the first amputation [HR 1.04 (1.02–1.06), P<.001] and the level of amputation (major vs. minor) [HR 1.55 (1.00–2.40), P=.05] were associated with increased mortality in the diabetic amputees. The same analysis in the nondiabetic group, after controlling for sex, showed increased mortality with the age of the first amputation [HR 1.06 (1.03–1.08), P<.001] and the level of amputation [HR 3.12 (1.27–7.64), P=.01].

4. Discussion

This study has shown that mortality after the first amputation was high in a sample of Greek population. Almost half of the amputees died in the first 5-year period after the first amputation. Additionally, it was shown that survival and hospital stay were comparable between diabetic and nondiabetic amputees.

In agreement with previous reports (Lee et al., 1993; Subramaniam, Pomposelli, Talmor, & Park, 2005; Tentolouris, Al-Sabbagh, Walker, Boulton, & Jude, 2004), the present study has shown that amputees have high mortality rates. Comorbid conditions and especially macrovascular disease is more often among patients undergoing an amputation (Markowitz, Gutterman, Magee, & Margolis, 2006). Additionally, prospective data have shown foot ulceration, even in the absence of any macrovascular complication, is associated independently with high mortality rates in patients with diabetes (Moulik, Mtonga, & Gill, 2003). Moreover, previous data suggest that foot ulceration and/or amputation has a detrimental effect on the quality of life (Goodridge, Trepman, & Embil, 2005; Ismail, Winkley, Stahl, Chalder, & Edmonds, 2007). Collectively, these data might explain the high mortality rates among amputees.

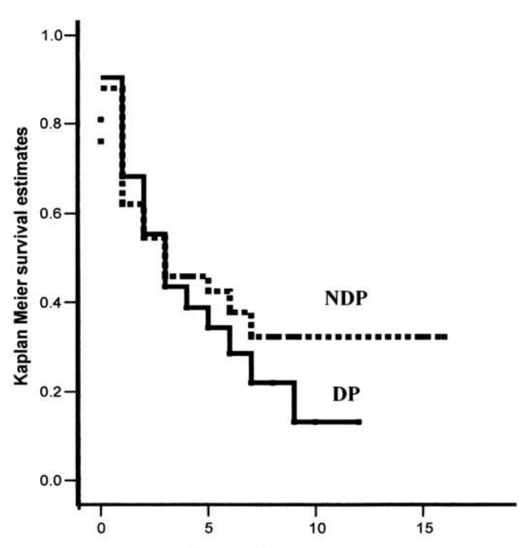

Fig. 2. Kaplan–Meier estimates of the survival curves, all-cause mortality considered, for diabetic patients (DP) and nondiabetic patients (NDP) after the first amputation. Log-rank test for the equality of the survivor function between the two groups: χ^2=0.20 (P=.65).

Interestingly, we showed that survival after amputation was comparable between patients with and without diabetes. A potential explanation for this finding is that amputations are performed at a younger age in diabetic patients. Indeed, our data showed that although the mean age of the first amputation was not significantly different between diabetic and nondiabetic patients, the peak prevalence of the first amputation is observed at an earlier age group in the diabetic in comparison with the nondiabetic patients. Another explanation might be the improvement in the management of diabetes and the comorbid conditions in the last years (Booth, Kapral, Fung, & Tu, 2006).

Previous reports also described that diabetes status is not associated with higher either postoperative or 3- to 5-year mortality postamputation (Subramaniam et al., 2005; Tentolouris et al., 2004), although the later study showed that diabetes predicted mortality over a longer (10-year) observational period (Subramaniam et al., 2005). Furthermore, in agreement with previous reports (Faglia, Favales, & Morabito, 2001; Lavery et al., 1997; Mayfield et al., 2001), we showed that although the mean age of the first amputation was at the age of 70 years in both study groups, the peak prevalence of amputations was observed almost a decade earlier in the diabetic group, implying that amputations in diabetic patients are performed in a younger age.

Predictors of mortality in our study patients were older age and higher level of amputation. Older age is associated with high prevalence of comorbid conditions, mainly cardiovascular and renal diseases, both of which are associated with high mortality rates (Lerner & Kannel, 1986; Kistorp et al., 2005; Resnick et al., 2004). In addition, our findings of poorer survival in patients undergoing major amputations agree with previous reports (Faglia et al., 2001; Pohjolainen & Alaranta, 1998; Sandnes, Sobel, & Flum, 2004).

We did not find differences in the level of amputation between patients with and without diabetes. Published data concerning differences at the level (major vs. minor) of amputation between subjects with and without diabetes are not unanimous. Some studies showed that diabetic patients undergo minor amputations more often in comparison with nondiabetic individuals (Calle-Pascual et al., 1997; Tentolouris et al., 2004; Vaccaro, Lodato, Mariniello, & De Feo, 2002), while other no differences at the level of amputation between diabetic and nondiabetic patients (Romagnoli et al., 2003). In addition, our results showed that diabetic, in comparison with nondiabetic amputees, underwent almost two times more often a second and almost three times more often a contralateral amputation, corroborating previous observations (Ebskov, 1998; Siitonen et al., 1993).

The length of hospital stay (20 days in our diabetic patients) was comparable with data from the UK (28 days) (Tentolouris et al., 2004), Australia (24.7 days) (Payne, 2000), longer than in the USA (15.9 days) (Lavery et al., 1997), and shorter than in the Netherlands (42 days) (Lavery, Van Houtum, & Harkless, 1996). In addition, this study showed that the length of hospital stay and perioperative mortality were not different between the diabetic and nondiabetic patients. Our results agree with reports from other countries, showing that the length of hospital stay is comparable between diabetic and nondiabetic patients (Romagnoli et al., 2003; Vaccaro et al., 2002). In addition, perioperative mortality was not different between the two groups. Similar perioperative mortality rates have been reported in diabetic amputees in England (10%) (Deerochanawong, Home, & Alberti, 1992), and Turkey (13.2%) (Gurlek, Bayraktar, Savas, & Gedik, 1998).

5. Limitations

A recent study showed that theatre records may underreport amputations (Rayman, Krishnan, Baker, Wareham, & Rayman, 2004). We used data from theatre records, patients' medical files, and hospital discharge summaries in order to eliminate biases due to inaccurate report of amputations. In addition, this one-center study, being retrospective and observational by design, has some limitations. Thus, data on glycemic control, renal function, presence and severity of peripheral vascular disease or neuropathy, and cause of amputation were not available. In addition, as data were collected from a referral tertiary center, they cannot be extrapolated to the total population. On the other hand, it has the advantage that parameters such as differences in surgeons, and pre- and postoperative care could be controlled because the patients were managed in the same hospital.

6. Conclusion

In conclusion, this study has shown that over the last decade, mortality postamputation was high in both patients with and without diabetes. The main determinants of the survival status after amputation were the age of the first amputation and the level of amputation in both groups. Additionally, mortality rates, length of hospital stay, and perioperative mortality were not different between patients with and without diabetes.

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