

## Survival following lower-limb amputation in a veteran population

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**Abstract**—*Goal:* We sought to describe the common demographic and comorbid conditions that affect survival following nontraumatic amputation. *Methods:* Veterans Administration hospital discharge records for 1992 were linked with death records. The most proximal level during the first hospitalization in 1992 was used for analysis. Demographic information (age, race) and comorbid diagnosis (cardiovascular, cerebrovascular, and renal disease) were used for Kaplan-Meier curves to describe survival following amputation. *Main Outcome Measure:* Death. *Results:* Mortality risk increased with advanced age, more proximal amputation level, and renal and cardiovascular disease, and decreased for African Americans. No increased risk for persons with diabetes was noted in the first year following amputation but the risk increased thereafter. A higher risk of mortality in the first year was noted for renal disease, cardiovascular disease, and proximal amputation level. *Conclusion:* Survival following lower-limb amputation is impaired by advancing age, cardiovascular and renal disease, and proximal amputation level. Also, a small

survival advantage is seen for African Americans and those with diabetes.

**Key words:** *amputation, cardiovascular disease, diabetes, epidemiology, race, renal disease, survival, veterans.*

### INTRODUCTION

Amputation of the lower limb is generally viewed as an ominous event portending poor survival, with four-year survival reported from 22 percent (1) to 76 percent (2). This wide range of reported survival is undoubtedly affected by the differing characteristics of the amputee population. Survival is affected by demographic features of age and sex (3,4), level of amputation (3-6), and comorbid conditions (2,6). Most of the studies have been in Scandinavian populations with little data available on US populations.

The Veterans Health Administration provides about 5,000 amputations of the lower limb a year, representing over 8 percent of all amputations in US males (7). We undertook this analysis to describe the determinants of survival following amputation in US veterans discharged from the Veterans Health Administration facilities in 1992.

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## METHODS

### Study Population

All veterans discharged from a Veterans Health Administration hospital in 1992 were identified from the VA Patient Treatment File. This file contains up to five codes for each operation and 10 diagnosis codes for the hospitalization. The validity of this data has been established for selected diagnoses (8).

### Outcome Measure

All persons who underwent an amputation were linked to the VA Beneficiary Identification and Records Locator System (BIRLS) to identify mortality prior to September 1, 1998. The BIRLS database identifies 97.2 percent of all veteran deaths (9). Human subjects' approval was obtained for linkage, and strict confidentiality was maintained throughout the study.

### Study Variables

All lower-limb amputations (ICD-9-CM 84.11 to 84.19) during fiscal year (FY) 1992 were identified and grouped into toe (ICD-9-CM 84.11), transmetatarsal (ICD-9-CM 84.12), transtibial (ICD-9-CM 84.13-84.17), and transfemoral (84.18-84.19) amputations. Multiple procedures with the same ICD-9-CM code performed on the same day might represent bilateral amputations, but were considered as a single procedure for this analysis. Two amputation codes during the same operation were assigned as a single amputation at the most proximal level for this analysis. Approximately 15 percent of the veterans underwent two or more amputations during the same hospitalization, so the most proximal level during the first hospitalization in FY 1992 was used for analysis. Amputations were excluded if associated with a diagnosis of lower-limb cancer or major trauma (ICD-9-CM 820, 835-839, 890-897, 904, 905.4, 906.1, 907.5, and 928-929).

Comorbid conditions were identified from the diagnosis codes associated with the hospitalization for the amputation. Conditions included diabetes (ICD-9-CM 250.x), renal disease (ICD-9-CM 58x.x), and peripheral vascular disease (including complications from a prior vascular graft; ICD-9-CM 44x.x, 996.62, 996.7, 996.74, E878.2). Cardiovascular disease was dichotomized by the diagnosis of congestive heart failure (ICD-9-CM 428.x).

### Statistical Analysis

Simple descriptive statistics included frequencies, cross-tabulation, and Kaplan-Meier plots with log-rank tests using STATA 5.0.

## RESULTS

In 1992, 5,180 veterans were discharged with one or more amputations of the lower limb. They ranged from 24 to 104 years of age with a mean of 65.6 years. Almost half of all amputations (44.3 percent) were in persons age 65 to 74 years. The percent of amputation by the other age groups was 0 to 44 years (3.8 percent), 45 to 54 years (8.3 percent), 55 to 64 years (26.1 percent), 75 to 84 years (15.3 percent), and over 85 years (2.2 percent). Race identification for the amputees included African American (23.1 percent), White (63.7 percent), Asian and American Indians (8.5 percent), and unspecified (4.7 percent). Diabetes was diagnosed in 61.4 percent, renal disease in 9.3 percent, cardiovascular disease without congestive failure in 22.4 percent, congestive heart failure in 11.7 percent, cerebrovascular disease in 10.9 percent, and peripheral vascular disease in 56.7 percent. Over 99 percent were male and half were married. The most proximal amputation level during the first hospitalization was toe, 1,795 (34.7 percent); transmetatarsal, 439 (8.5 percent); transtibial, 1,381 (26.7 percent); and transfemoral, 1,565 (30.2 percent).

The 30-day mortality rate was 1.7 percent for toe amputation, 2.7 percent for transmetatarsal amputation, 7.0 percent for transtibial amputation, and 11.1 percent for transfemoral amputation. Almost 20 percent of the persons undergoing transtibial amputation died before discharge. The three-year mortality rate for all amputations was 41.5 percent and the five-year mortality rate was 55.5 percent. The five-year mortality rate by level was toe, 46 percent; transmetatarsal, 45 percent; transtibial, 56 percent; and transfemoral, 70 percent.

Kaplan-Meier curves demonstrated worse survival outcomes with advancing age, proximal amputation level, renal disease, and cardiovascular, cerebral vascular, and peripheral vascular disease; and better survival outcomes for African Americans and veterans with diabetes. Kaplan-Meier curves are shown for amputation level, cardiovascular disease, renal disease, diabetes, and race in **Figures 1** through **5**. **Figure 1** depicts increasingly poorer survival with more proximal amputation levels. The survival outcomes for toe and transmetatarsal

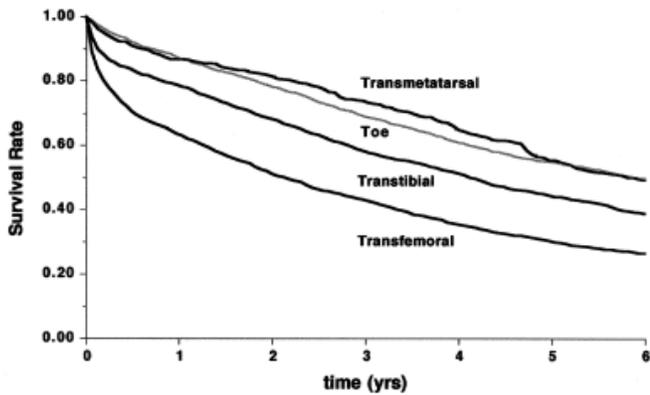


Figure 1. Kaplan-Meier curves of survival rate by amputation level.

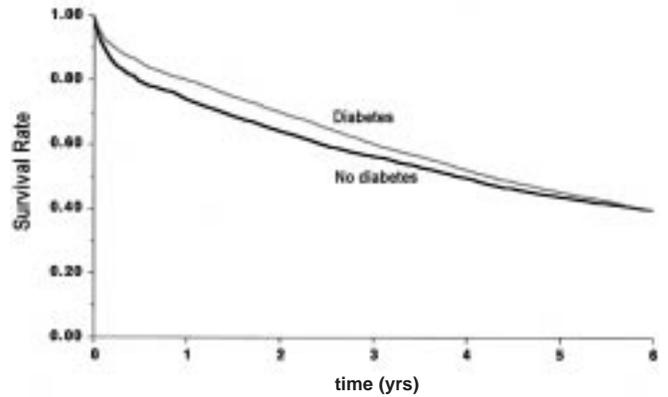


Figure 4. Kaplan-Meier curves of survival rate by diabetes status.

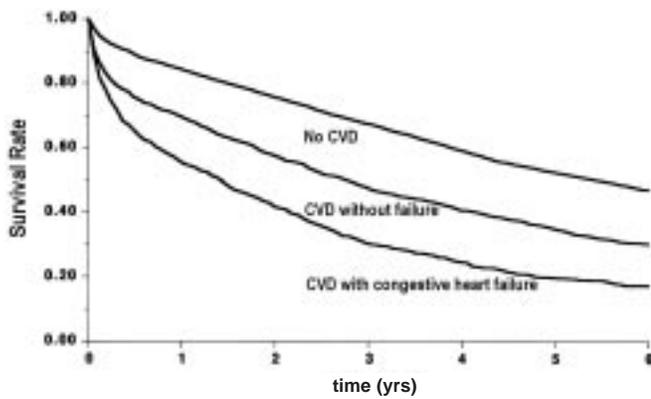


Figure 2. Kaplan-Meier curves of survival rate by cardiovascular status.

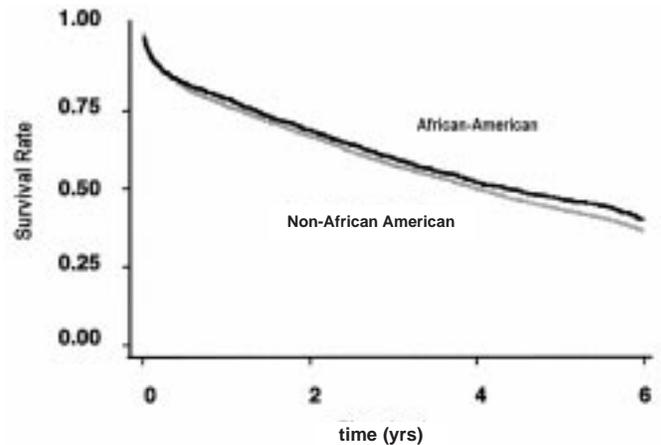


Figure 5. Kaplan-Meier curves of survival rate by race.

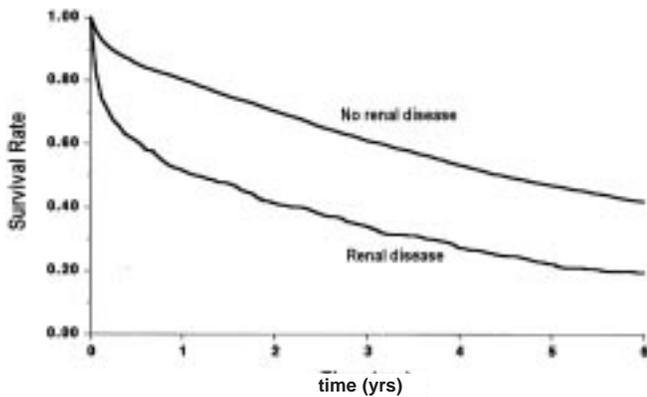


Figure 3. Kaplan-Meier curves of survival rate by renal disease status.

amputations intersect twice and are not significantly different. The survival is compared by cardiovascular status in **Figure 2**. The subset of veterans with congestive heart failure demonstrated extremely poor survival rates, with almost half dying within one year. A high initial rate of death in the first year following amputation is also seen with renal disease, as shown in **Figure 3**. A poorer survival rate was noted for those with cerebrovascular disease as compared to those without (Kaplan Meier not shown). This effect was independent of cardiovascular disease.

Persons with diabetes had a better survival rate than those without diabetes in the first several years following amputation, with the risk merging at around 5 years following amputation, as shown in **Figure 4**. A small but significantly better survival rate was noted for African

Americans following amputation as compared to non-African Americans as shown in **Figure 5**.

All of the relationships described above were statistically significant with  $p < 0.001$ , greatly due to the large size of the data set. Review of the Kaplan-Meier curves provides the magnitude of the clinical significance of these factors on survival.

## DISCUSSION

Survival following lower-limb amputation is poorer with advancing age, comorbid conditions of renal disease, cardiovascular disease, cerebrovascular disease, and more proximal amputation level, and somewhat better for African Americans and those with diabetes.

Our finding of worse survival with more proximal amputation level (**Figure 2**) has been reported previously (3,6,10–13). Proximal amputation level is also associated with increasing age (6,10), African-American race (14), peripheral vascular disease (10), and other comorbid conditions (2,6), and is negatively associated with diabetes status (10,14). Proximal amputation was associated with an accelerated mortality in the year following amputation that remained elevated, even after adjustment for sex and age in one analysis (11). We found an initial accelerated risk of death following amputation not only for those with more proximal amputation, but also for those with renal and cardiovascular disease (**Table 2**). The amputation level may be confounded by these other risk factors in a very complex fashion. The association between mortality and proximal amputation has also been reported with traumatic amputation (15,16). There may be additional factors that we have not captured in this analysis that may influence both the choice of the amputation level and survival. More research is needed to understand the complex relationship of amputation level to subsequent mortality.

The better survival of persons with diabetes was unexpected. The survival rates for persons with and without diabetes intersect at about 5 years following amputation (**Figure 4**). A similar pattern was noted in the comparison of amputees with diabetes to those with arteriosclerotic amputation in a Finnish population (3). These two diagnoses comprise almost all amputations, so the comparison between them is similar to a comparison of diabetes *versus* no diabetes. Amputation in persons with diabetes has been associated with more distal amputation (13,14), younger age (3,13), and African-American race (14), all factors that have been associated with better survival.

Peripheral vascular disease has been associated with poor survival (17). We did not analyze our population for this risk factor, however, because it was so prevalent within the population.

The association of advancing age with poor survival is well known and expected, but our finding of improved survival for African Americans is novel and without an obvious explanation. Our veteran's population includes too few females for stable estimates of survival, but survival of female amputees from other populations has reportedly been worse than for males (3,11,14).

We have demonstrated that survival following amputation depends upon amputation level, and demographic and comorbid characteristics. Differences in these underlying population characteristics complicate comparison of survival among different populations. Our 30-day mortality rate following lower-limb amputation (10 percent) was similar to rates reported for the US in 1989–1992 (5.8 percent) (18) and lower than 1967 rates from 21 VA hospitals reported as toe/transmetatarsal (9.4 percent), transtibial (8.5 percent), and transfemoral (13.0 percent) (13). Our two-year survival of 67.6 percent was better than the 58.8 percent survival reported in the 1967 VA study (13).

## CONCLUSION

In summary, the survival following nontraumatic lower-limb amputation is worse with advanced age, renal, cardiovascular, and cerebrovascular disease, and amputation level, and is better for African Americans. Diabetes imparts no influence on survival in the first year, but the survival worsens thereafter. Proximal amputation level, renal disease, and cardiovascular disease were independent risk factors for early, accelerated risk of mortality. Comparisons of amputation survival among populations should take into consideration the complex relationship among demographic features, comorbid conditions, and amputation level of the amputee population.

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