







## Mortality after emergency lower limb amputation due to ischemia: A case series

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### Abstract

**BACKGROUND:** Morbidity and mortality rates in patients with peripheral arterial disease range from 30% to 70% during the 5- to 15-year period after diagnosis. The objective of the present study was to evaluate the mortality rate after emergency leg amputation and analyze the cause of death.

**METHODS:** In this case series study, the incidence and cause of mortality, level of amputation, presence of chronic arterial disease, diabetes mellitus, smoking, and arterial hypertension were evaluated in 100 consecutive patient records.

**RESULTS:** Sixty-one male and 39 female patients with a mean age of 66 years were studied. Amputation was indicated urgently in 86% of patients. Most (60%) suffered supra-genicular amputation, with 11 (18.33%) deaths, and 40% infra-genicular amputation, with seven (17.5%) deaths. The total death rate was 18%.

**CONCLUSION:** Mortality in the perioperative period of emergency major lower limb amputation remains high, with infection being the leading cause.

**Keywords:** Mortality, Emergency, Surgery, Ischemia, Amputation, Lower Limb

## Introduction

Morbidity and mortality rates in patients with peripheral arterial disease (PAD) range from 30% to 70% during the 5- to 15-year period after diagnosis, with this condition being associated with poor health outcomes and reduced functionality and quality of life<sup>1</sup>. The mortality rate five to six years after major amputations is around 70%<sup>2</sup>; in a Brazilian study, the death rate was 72% within six years of the surgery<sup>3</sup>.

The ankle-brachial index is generally employed in the diagnosis of PAD, but this ratio may be limited in patients with diabetes and those with peripheral neuropathies, medial arterial calcification, incompressible arteries, and infection; the finger-brachial index and toe pressure are alternative screening tools<sup>4</sup>. One of the suggested assessments to identify critical ischemia is the evaluation of systolic pressure using Doppler ultrasound; critical ischemia is characterized when the arterial pressure is <50 mmHg or the transcutaneous partial pressure of oxygen (TcPO<sub>2</sub>) <30 mmHg<sup>5</sup>.

One study reported the results of using percutaneous transluminal angioplasty or stenting as the primary treatment strategy for intermittent claudication or chronic limb-threatening ischemia (CLTI). The overall survival and amputation-free survival are reduced in patients with CLTI, with chronic kidney disease being an independent risk factor for mortality and amputation, and smoking and ischemic heart disease being risk factors for death<sup>6</sup>.

Preventive treatment involves controlling cholesterol, diabetes, high blood pressure, and obesity together with smoking cessation and antithrombotic treatment, which should include antiplatelet therapy (100 mg acetylsalicylic acid or 75 mg clopidogrel); in those at low risk of bleeding, a combination of 100 mg acetylsalicylic acid and 2.5 mg rivaroxaban bid is indicated<sup>7</sup>.

Researchers report mortality rates of 5.7% during hospitalization, 15.7% in the perioperative period, 44% within the first year, 50% within the second year, and 72% within six years<sup>8</sup>. Furthermore, studies report that mortality after amputation remains high despite

all the measures taken<sup>9,10</sup>. Assessing the cause of death of these patients is essential to identify the factors involved and how to reduce them. The objective of the present study is to evaluate the incidence of mortality of patients who underwent emergency amputations and analyze the causes of death.

## Materials and methods

### Design

In this case series, patients' medical records from January to December 2022 at the Hospital de Base of São José do Rio Preto were reviewed to identify all patients who underwent lower limb amputations. One hundred consecutive patients who underwent major amputations of the lower limbs were evaluated. The frequency of mortality and its cause, level of amputation, and presence of chronic arterial disease, diabetes mellitus, dyslipidemia, smoking, and arterial hypertension were evaluated at one and three months.

All patients who underwent major lower limb below-knee amputations (BKA) were included, except for patients who underwent amputation for traumatic injuries. Moreover, patients who suffered minor amputations (feet and fingers) were excluded.

### Ethical considerations

This study was approved by the Faculty of Medicine of São José do Rio Preto (FAMERP) research ethics committee, number 5.012.332. Informed consent was waived due to the retrospective nature of the study and the analysis, which utilized only anonymous clinical data.

### Data analysis

The process of statistical analysis involved tabulating the data in an Excel spreadsheet, and descriptive statistical analysis was performed. Absolute numbers and percentages were presented in tables and figures. These data were compared with those from previous studies conducted by the authors at the same institution. The Analysis ToolPak add-in for Microsoft Excel

was used to perform the analysis.

**Results**

The study cohort consisted of 61 male and 39 female patients with an average age of 66 years. Table 1 shows the percentage of amputees by age group. Amputation was urgent, considered necessary for infection control, in 86% of the cases; 60% of the patients underwent supra-genicular amputations with 11 (18.33%) deaths, and 40% underwent infra-genicular amputations resulting in seven (17.5%) deaths. The total death rate was 18%. Of the patients who died, 14 died within the first postoperative month, two in the second, and two in the third month (Figure 1).

Of the patients who died, 11 (61.1%) were diabetics and seven (38.9%) were not. Eleven (61.1%) deaths were due to septicemia, two (11.1%) to bronchopneumonia, one (5.5%) to

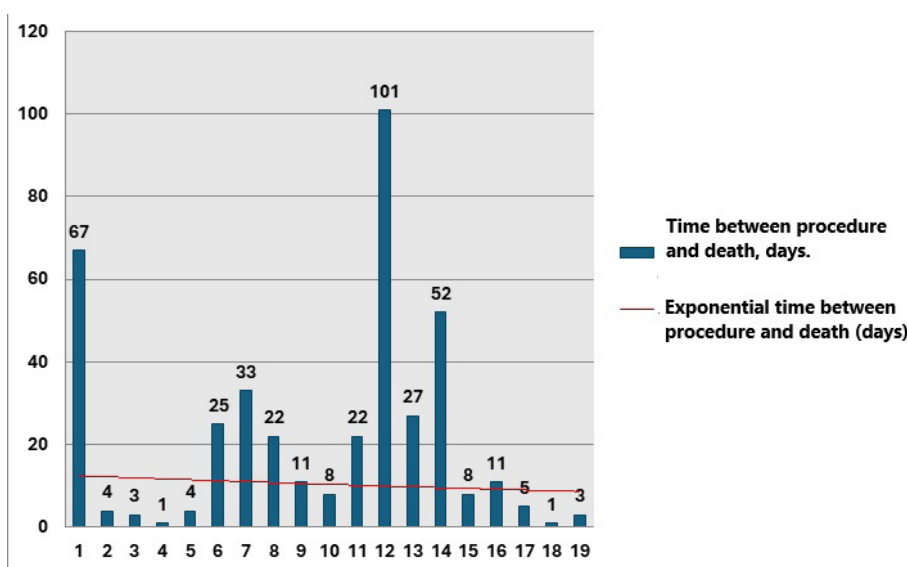
diabetic ketoacidosis, two (11.1%) to non-specific shock (several factors associated with these cases, considering physiological instability and no identified cause), one (5.5%) to cardiogenic shock, and one (5.5%) to arterial embolism with limb ischemia. The most common comorbidities were chronic arterial disease in 83% of cases, followed by diabetes in 65% and systemic arterial hypertension in 65% (Figure 2).

**Discussion**

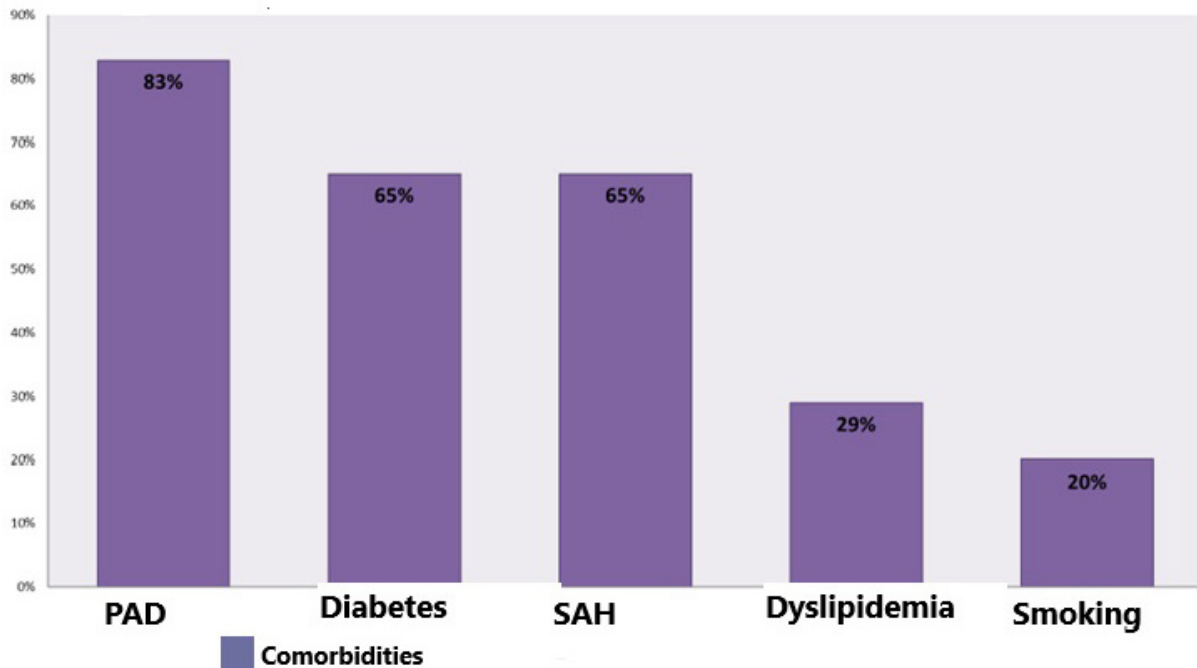
The present study provides a current assessment of the leading causes of mortality in amputees and analyzes the evolution over the past ten years at the institution. Mortality is particularly challenging, as no reduction has been observed in recent years. In a study carried out in 2005, the mortality rate in the first year was 44% with an average patient age of 67.3 years; currently, the death rate is 47.5% with an average age

**Table 1.** Percentage of amputees grouped by age group

Age group (years)	%
31-40	3
41-50	12
51-60	19
61-70	25
71-80	23
81-90	16
90-101	2



**Figure 1.** Time between procedure and death (days)



**Figure 2.** Comorbidities and smoking in patients who underwent supra-genicular and infra-genicular amputations (n = 100)

of 69 years. This indicates that the overall survival of these patients has not increased significantly, despite a nearly two-year increase in survival reported previously<sup>11,12</sup>. In the same institution in 2009, the mortality rate in the first postoperative month was 15.7%<sup>8</sup>. Currently, the rate is 14% for the first month and 18% for the next three months.

Anaerobic infections constitute one of the challenges, with mortality in 2008 being 30% and currently 22% (in print); diabetes was identified in more than 80% of cases<sup>13</sup>. Between 2005 and 2007, our institution performed 231 major amputations; subsequently, 17 (7.3%) were re-hospitalized due to stump infection, with mortality occurring in five cases (29.4%) due to multidrug-resistant infections<sup>14</sup>.

Another critical assessment was the causes of rehospitalization that led to death in patients after major amputations in 2018<sup>15</sup>. After one month, 25 patients were re-hospitalized: 10 (40%) for pneumonia, 5 (20%) for a second amputation, 5 (20%) for kidney problems, 2 (8%) for cerebral hemorrhage, 2 (8%) for strokes, and one (4%) for intestinal obstruction. These data are essential because they show that pneumonia

in amputees can lead to death. A second amputation, chronic kidney disease, and stroke are the leading causes, with arteriosclerosis being a decisive risk factor. It should be noted that these patients died after rehospitalization, while home deaths, which may have included other causes such as myocardial infarction, were not included in this analysis.

What draws attention in the present study is that infection at the site of the amputation, with extensive soft tissue necrosis including necrotizing fasciitis (NF), myositis, gas gangrene, and Fournier gangrene (FG), is the leading cause of mortality. Patients often arrived with advanced infectious clinical conditions, and some even with sepsis. The greatest problem is the difficulty in quickly assessing patients at the reference institution, which allows the infectious condition to worsen. Chronic arterial disease and diabetes mellitus were the main associated aggravating factors.

For six of the eight domains investigated using the 36-Item Short Form Health Survey, the quality of life after major amputations was unsatisfactory when compared with a control group matched for gender and age, as well as

the caregivers of these patients<sup>16,17</sup>. Religion was the main coping mechanism sought by amputees after surgery<sup>18</sup>.

On evaluating a series of patients who were hospitalized due to critical ischemia and received only clinical treatment, it was found that 251 were hospitalized approximately seven times. More than 95% of them were hospitalized on four specific wards: 52.84% in vascular surgery with a mortality rate of 3.5%, 29.79% in cardiology with a mortality rate of 21.42%, 10.9% in neurology with a mortality rate of 9.6%, and 6.38% in nephrology with a mortality rate of 11.1%<sup>19</sup>.

In the same service, patients with chronic arterial disease who underwent revascularization had a significantly lower mortality rate compared to major amputees. Of the 404 patients who underwent femoropopliteal revascularization, six (1.48%) died. Of the 30 who underwent femoral revascularization with saphenous vein bypass grafts, one (3.3%) died, and of the 37 patients who underwent iliofemoral reconstructions, one (2.7%) died, totaling 1.9%. This compares to 15.6% mortality due to major amputations in the same period<sup>20</sup>.

In the literature, a recent article from 2023 cites mortality at 30 days, one year, and three years as 16.6%, 38.3%, and 60.1%, respectively, with age over 65 years being the only variable associated with death within 30 days, and diabetes and chronic kidney disease within three years<sup>21</sup>. However, one study shows that the death rate of patients undergoing endovascular revascularization for more advanced stages of chronic arterial disease remains high at 28% in one year, 40% in two years, and 51% in three years<sup>22</sup>. Therefore, a preventive approach must be prioritized in these patients.

The present study is of fundamental importance in analyzing mortality and long-term evolution in our reality. Identification of the causes of death suggests that earlier intervention is essential to prevent progression to sepsis, especially in diabetic patients. The challenge is to accelerate referrals as early as possible to reference hospitals.

## Conclusion

Postoperative mortality of major lower limb amputees in the perioperative period after emergency surgeries remains high, with infection being the leading cause. The indication for amputation should be as early as possible to avoid systemic progression of infection, where mortality is greater. Early revascularization, when necessary, as well as culture-guided antibiotic therapy, is suggested.

## Conflict of interests

The authors declare no conflict of interest.

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## Author's Contributions

Study Conception or Design: GH, CL, MB, LT, CJ, GJ

Data Acquisition: GH, CL, MB, LT, CJ, GJ

Data Analysis or Interpretation: GH, CL, MB, LT, CJ, GJ

Manuscript Drafting: GH, CL, MB, LT, CJ, GJ

Critical Manuscript Revision: GH, CL, MB, LT, CJ, GJ

All authors have approved the final manuscript and are responsible for all aspects of the work.

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