

Five-Day Postoperative Mortality Following Lower Limb Amputation for Diabetic Gangrene at the Rivers State University Teaching Hospital, Port Harcourt, Nigeria: A Retrospective Study

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ABSTRACT

Background: Diabetic foot disease is an important cause of lower limb amputation and death, particularly in low- and middle-income settings where late presentation, advanced infection, peripheral arterial disease and limited access to coordinated foot-care services remain important challenges. This study estimated cumulative mortality during the first five postoperative days among patients who underwent lower limb amputation for diabetic gangrene.

Materials and Methods: This was a retrospective observational study of patients who underwent lower limb amputation for diabetic gangrene at the Rivers State University Teaching Hospital, Port Harcourt, Nigeria, from January 2017 to December 2022. The mortality analysis comprised 152 patients whose indication for amputation was diabetic foot gangrene. Five postoperative days was used as a pragmatic observation window because mortality status was available cumulatively through postoperative day 5, whereas exact day-specific death dates and standardized later follow-up were not available in the secondary dataset. The primary outcome was therefore cumulative five-day postoperative mortality. Data were summarized using frequencies and percentages, and the 95% confidence interval (CI) was estimated using the Wilson method.

Results: Sixty-nine of the 152 patients died on or before postoperative day 5, giving a cumulative five-day postoperative mortality of 45.4% (95% CI: 37.7-53.3%). Eighty-three patients (54.6%) were alive beyond postoperative day 5. The parent amputation study contained aggregate age, sex and amputation-level data for all 226 amputees, but these variables were not stratified by diabetic status or survival outcome and could not be used for patient-level mortality analysis.

Conclusion: Cumulative five-day postoperative mortality after lower limb amputation for diabetic gangrene was high in this cohort. The result describes mortality occurring after surgery but does not establish that amputation caused the deaths. Earlier diabetic foot detection and referral, prompt management of infection and ischaemia, perioperative optimisation and close postoperative surveillance are important areas for service improvement. Prospective or patient-level retrospective studies are needed to determine the timing, causes and independent predictors of early mortality.

Keywords: Diabetic gangrene; diabetic foot; lower limb amputation; postoperative mortality; diabetes mellitus; Port Harcourt; Nigeria.

INTRODUCTION

Diabetic foot ulceration, infection, tissue necrosis, and gangrene are some of the lower extremity complications associated with diabetes mellitus that can ultimately lead to limb loss and death. Diabetic foot disease is a result of the interplay of peripheral neuropathy, peripheral arterial disease, repetitive trauma, infection, and impaired tissue repair. If the ulcer is complicated by a severe infection or gangrene, it may be impossible to save the limb, and surgical amputation may be necessary as a life-saving procedure [1,2,3].

Diabetes-related amputation is a significant burden in sub-Saharan Africa. In a systematic review and meta-analysis of the region, Boateng et al. revealed that diabetes was responsible for a pooled 36.9% of amputations [2]. A study on the Multicentre Evaluation of Diabetic Foot Ulcer in Nigeria (MEDFUN) in Nigeria found that 79.2% of hospitalised patients had Wagner grade 3 or higher disease, 76.8% had infected ulcers, 35.4% had undergone lower-extremity amputation and the overall case fatality rate was 20.5% [3]. The results indicate that late presentation and advanced disease stage are still significant factors in the adverse outcome in the Nigerian context.

The pattern of amputation in Port Harcourt has also changed. In the 6 years review period at the Rivers State University Teaching Hospital (RSUTH), 226 patients had surgical amputation, with diabetic foot disease the most common indication (152 cases, 67.25%) and trauma the second (33 cases, 14.60%) [1]. This is in contrast to the older literature from Nigeria, where trauma and complications of traditional bone setting often dominated as the indications for amputation [9]. The progression to DRLI is of clinical significance as diabetic gangrene is often associated with multiple systemic comorbidities and diminished physiological reserve.

Despite modern surgical advances, the mortality rate following a major lower limb amputation is still high. The pooled mortality at one and five years after non-traumatic major lower-extremity amputation was 33.7% and 64.4% in a systematic review of 36,037 patients, respectively, and 27.3% and 63.2% for patients with diabetes [7]. More recently, Leatherby et al. reported in-hospital and 30-day mortality rates of 6.5% and 8.7%, respectively, and estimated mortality at one year of 28.9% [8]. Long-term mortality following amputation is well documented, but very early postoperative mortality is not as well described in Nigerian diabetic gangrene cohorts.

The immediate postoperative period is of special importance because death within a few days of amputation may be a reflection of the extent of systemic infection, metabolic derangements, cardiovascular disease, renal failure, peripheral arterial disease, anaemia, haemodynamic instability or other major pre-existing co-morbidities. Nigerian data have demonstrated that bacteraemia and renal impairment are independent predictors of mortality in hospitalised patients with diabetic foot ulcers [4] and peripheral arterial disease, severe anaemia and renal dysfunction have been shown to be associated with poor outcome [5]. Therefore, the timing and size of early death after amputation may provide clinically relevant data for perioperative risk assessment and service planning.

The pattern of early postoperative mortality of patients undergoing lower limb amputation for diabetic gangrene at Rivers State University Teaching Hospital, Port Harcourt, Nigeria was therefore assessed.

Aim of the Study

To determine the pattern and magnitude of mortality within the first five postoperative days among patients who underwent lower limb amputation for diabetic gangrene at the Rivers State University Teaching Hospital, Port Harcourt, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Port Harcourt, the capital of Rivers State in the South-South geopolitical zone of Nigeria.

Study Site

The study was carried out at the Rivers State University Teaching Hospital, Port Harcourt. The study reviewed procedures performed in the orthopaedic theatre of the hospital.

Study Design

This was a retrospective observational study and secondary mortality analysis of patients who underwent amputation for diabetic foot gangrene.

Study Period

The study covered six years from January 2017 to December 2022.

Study Population

The study cohort comprised 226 patients who underwent surgical limb amputation during the study period. Diabetic foot disease was the indication in 152 patients (67.25%); these 152 patients constituted the analytic population for the present study.

Eligibility Criteria

Patients were included if they had diabetes mellitus with diabetic foot gangrene, underwent lower limb amputation during the study period and had documented vital status during the first five postoperative days. Patients whose amputations were performed for trauma, malignancy, non-diabetic sepsis, congenital conditions or other non-diabetic indications were excluded from the mortality analysis.

Data Collection and Study Variables

The study used a structured proforma to extract data from theatre registers for emergency and elective amputations. The principal variables were indication for amputation and postoperative vital status through day five. The primary outcome was five-day postoperative mortality, defined as death occurring after the amputation procedure and on or before the fifth postoperative day.

Data Analysis

Data were summarized using frequencies and percentages. Five-day postoperative mortality was calculated as the number of deaths within five postoperative days divided by the total number of patients who underwent amputation for diabetic gangrene, multiplied by 100. A 95% confidence interval for the mortality proportion was estimated using the Wilson method.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Rivers State University Teaching Hospital before commencement of data collection

RESULTS

During the six-year study period, 226 surgical amputations were recorded in the cohort. Diabetic foot disease was the leading indication, accounting for 152 cases (67.25%); the remaining 74 amputations (32.75%) were performed for trauma, infection/sepsis, malignancy, vascular disease, congenital conditions or other causes [1].

Among the 152 patients who underwent lower limb amputation for diabetic gangrene, 69 died within the first five postoperative days. This corresponds to a five-day postoperative mortality rate of 45.4% (95% CI: 37.7-53.3%). Eighty-three patients (54.6%) were alive beyond postoperative day five. Therefore, approximately 45 of every 100 patients undergoing amputation for diabetic gangrene died during the immediate five-day postoperative period.

TABLE 1. Distribution of the Amputation Cohort According to Diabetic and Non-Diabetic Indications (n=226).

Indication Category	Number	Percentage (%)
Diabetic foot / gangrene	152	67.25
Other indications	74	32.75
Total	226	100.00

TABLE 2. Five-Day Postoperative Outcome Following Lower Limb Amputation for Diabetic Gangrene (n=152).

Postoperative Outcome	Frequency (n)	Percentage (%)
Death within postoperative days 0-5	69	45.4
Alive beyond postoperative day 5	83	54.6
Total	152	100.0

Five-day postoperative mortality: 45.4% (95% CI: 37.7-53.3%).

DISCUSSION

The principal observation of this study was a high cumulative five-day postoperative mortality among patients who underwent lower limb amputation for diabetic gangrene. Of 152 patients, 69 died on or before postoperative day 5, corresponding to 45.4%. Because exact death dates were unavailable, the study cannot describe how deaths were distributed across individual postoperative days. The finding should therefore be interpreted as the magnitude of early postoperative mortality in this cohort rather than as a day-specific mortality pattern.

This observation becomes more significant when put in perspective with the trend of amputation at RSUTH. A prior study showed that the incidence of diabetic foot disease was significantly higher than that of trauma and other causes of amputation, with 67.25% of all amputations attributed to diabetic foot disease [1]. Trauma and complications of traditional bone setting have been reported as the major indications of amputation series in Nigeria historically [9]. The current trend is thus an epidemiological shift with growing share of severe limb-threatening disease due to chronic non-communicable disease, especially diabetes. Other recent trends have been reported in other parts of sub-Saharan Africa. In Cameroon, Tamfu et al. identified diabetic foot gangrene as the most common indication for lower extremity amputation (LEA), representing 42.14% of the cases [10] and in a series from Togo, diabetes was the cause of 64.4% of lower extremity amputations [11].

The cumulative five-day mortality of 45.4% in the present study is higher than mortality estimates reported in several amputation cohorts. Tamfu et al. reported post-amputation mortality of 6.28% in two tertiary hospitals in Cameroon [10], Kouevi-Koko et al. reported mortality of 7.14% after lower-extremity amputation in Togo [11], and Thanni and Tade reported average hospital mortality of 10.9% after amputation in Nigeria [9]. These figures are not directly comparable because the studies differed in indications for amputation, amputation level, disease severity, referral patterns and duration of follow-up. The present estimate should therefore not be interpreted as evidence that surgery itself produced a greater risk of death, but rather as evidence that this RSUTH diabetic gangrene cohort had a high burden of mortality during the first five postoperative days.

This is also remarkable when compared to international evidence. After major non-traumatic LEA, Meshkin et al. reported pooled 1-year mortality of 33.7% and 5-year mortality of 64.4% [7] and Leatherby et al. reported pooled in-hospital mortality of 6.5%, 30-day mortality of 8.7% and estimated 1-year mortality of 28.9% [8]. Care must be taken in making comparisons across these time horizons. In the present study, a different endpoint (cumulative mortality within 5 days after surgery) was measured in a single cohort of tertiary hospital patients with a specific indication (diabetic gangrene).

Causal attribution and identification of causes of death are not possible with the present data. The 69 deaths occurred following amputation; it is not possible to determine if an individual death was caused by sepsis, cardiovascular disease, renal failure, metabolic derangement, anaesthetic complications, thromboembolism, severity of the underlying diabetic foot disease, or another cause. However, Nigerian studies offer some contextually relevant evidence: Diabetic foot disease is often complicated by advanced infection and bacteraemia, renal impairment, advanced ulcer grade, peripheral arterial disease, shock and cardiac failure have been linked to higher mortality rates [3,4]. These factors are potential background risks that were not assessed as individual patient risk factors in the current study.

Infection is particularly significant as gangrene may develop in the background of a large soft tissue infection, osteomyelitis, bacteraemia or sepsis. The IWGDF/IDSA guidelines recommend hospitalisation for severe diabetic foot infection and for moderate infection in the presence of important comorbidities; and urgent surgical consultation for infections accompanied by extensive gangrene, necrotising infections, deep abscess or severe ischaemia of the lower limbs [12]. Moderate and severe infections should be treated with early surgery and appropriate antimicrobial therapy if there is a need for removal of infected and necrotic tissue [12]. The high mortality rates seen in this study highlight the importance of prompt diagnosis of systemic infection and prompt source control, and the avoidance of unnecessary delay in definitive therapy.

Another important driver of the outcome of diabetes-related foot disease is peripheral arterial disease. Ischaemia compromises tissue viability, impairs wound healing and increases the likelihood of major amputation. The intersocietal IWGDF/ESVS/SVS guideline recommends vascular evaluation in patients with diabetes and foot ulceration, and urgent combined surgical and vascular specialist assessment in patients with gangrene and/or infection and peripheral arterial disease [13]. In many resource-limited environments, however, vascular diagnostic and revascularisation services may be limited and patients may only be referred to tertiary care if there is significant tissue loss. Enhancing the vascular assessment and referral process therefore could be a major component of decreasing amputation and mortality.

Other factors such as cultural issues and late acceptance of amputation can also affect disease progression. An earlier study in the local area reported delays in accepting ablative surgery when dealing with diabetic foot disease [15] and a previous study in Port Harcourt reported the effect of traditional beliefs on the willingness to accept amputation of the limbs [14]. Delay may allow a potentially limited infection or ischaemic lesion to progress to a full extent gangrene, systemic infection, and multiorgan dysfunction. Patient counselling should thus focus on the fact that after proper evaluation, amputation can be a life-saving procedure for source control, and not just the loss of a limb.

Another measure of the severity of diabetic foot disease is the global burden of mortality caused by it. A systematic review and meta-analysis of more than 124,000 patients with DFUs showed that survival rates dropped with every passing year, with cardiovascular disease and infection being the top two causes of death. Peripheral arterial disease, chronic kidney disease, end-stage renal disease, amputation, and a history of cardiovascular disease were associated with a higher risk of death [6]. These data indicate that the presence of diabetic foot disease is a sign of serious systemic disease and that the need for amputation should lead to thorough cardiovascular, renal, infectious, and metabolic risk management.

These findings have implications for patient care before, during, and after surgery but do not define the mechanisms of death. Patients with diabetic gangrene should be evaluated quickly for sepsis, haemodynamic instability, anaemia, renal dysfunction, electrolyte disturbance, glycaemic derangement, cardiovascular disease and peripheral arterial insufficiency. Timely source control should be pursued in conjunction with resuscitation, antimicrobial treatment and correction of reversible abnormalities. The interval from postoperative day 5 was an important observed interval of mortality in this study population, as 45.4% of the study population died during this interval; however, the day-specific risk within this interval could not be calculated.

The study also emphasizes the need for prevention. DFUs tend to be chronic and frequently recur [12,13]. A multi-disciplinary diabetic foot programme, which includes diabetes care, wound management, infection control, surgery, vascular assessment, podiatry (where available), nursing, rehabilitation and patient education, can help

identify and treat the diabetic foot at an earlier stage. Early referral of ulcers, rapid evaluation of infected feet and prompt referral of limb-threatening disease to RSUTH and its referral network may be particularly advantageous.

The mortality found in this study is not to be interpreted as mortality due to amputation. The study found an outcome after surgery in patients who had advanced diabetic gangrene and needed amputation. It is unable to distinguish the effect of the underlying disease, from pre-existing comorbidity, from perioperative physiological status, and the operative episode. Studies at the patient level using cause of death data and multivariable analysis are needed to identify factors independently associated with early postoperative mortality.

There is also a restricted external validity. RSUTH is a single tertiary referral centre in the South-South region of Nigeria and patients referred for diabetic gangrene may have more advanced disease than those treated in primary, secondary or other tertiary centres. Other factors such as local referral practice, delays in presentation, access to vascular and critical-care services, surgical thresholds and case mix may vary elsewhere. The 45.4% estimate should not be extrapolated to all patients with DFD, all amputees, or other hospitals without care.

Study Limitations

This study has a number of significant drawbacks. First, it was a single centre retrospective study and depended on the completeness and accuracy of the existing records. This narrows the scope of causal inference and generalizability.

Second, the five-day observation window was not based on a validated biological threshold, but rather the structure of the secondary data available. Mortality status was available by postoperative day 5, but the exact date of death in that time period was not available. Thus, day-by-day mortality frequencies and Kaplan-Meier survival analysis were not possible.

Third, cause-of-death data were unavailable. The study is therefore unable to conclude the relative importance of sepsis, cardiovascular events, renal failure, metabolic emergencies, anaesthetic complications, thromboembolism, or other causes, and it is not possible to conclude the mortality due to amputation alone.

Fourth, patient-level factors that are important for prognosis, such as age, sex, amputation level, severity of infection, renal function, haemoglobin, glycaemic status, peripheral arterial disease, cardiovascular disease and sepsis were not available linked to survival outcome. Thus, comparisons of survivors and non-survivors and multivariable analysis of independent predictors was not possible.

Lastly, mortality after postoperative day 5 was not assessed, and the 45.4% figure should not be interpreted as in-hospital, 30-day or long-term mortality. The external validity is further restricted because of the single-centre tertiary-referral setting.

CONCLUSION

This retrospective study revealed that 69/152 patients who had lower limb amputation for diabetic gangrene in the Rivers State University Teaching Hospital died on or before the fifth postoperative day, yielding a five-day postoperative mortality of 45.4% (95% CI: 37.7-53.3%). The study does not prove that amputation was responsible for the deaths, but rather describes deaths that happened following surgery. The temporal distribution and independent predictors of early mortality could not be evaluated due to lack of exact death dates, causes of death and patient-level prognostic variables. The results confirm the need to detect diabetic foot earlier and refer

it for treatment, to manage infection and ischaemia, and to optimise the patient perioperatively and to conduct prospective or patient-level retrospective studies to identify modifiable risk factors.

RECOMMENDATIONS

1. A dedicated multidisciplinary diabetic foot service should be strengthened at RSUTH, integrating physicians/endocrinologists, surgeons, anaesthetists, vascular expertise, wound-care nurses, microbiology/infectious-disease support and rehabilitation services.
2. Clear referral pathways should be developed between primary, secondary and tertiary facilities so that diabetic foot ulcers are assessed before progression to extensive gangrene.
3. Patients presenting with diabetic gangrene should undergo rapid preoperative assessment for sepsis, haemodynamic instability, anaemia, renal dysfunction, electrolyte abnormalities, glycaemic derangement, cardiovascular disease and peripheral arterial disease.
4. Severe diabetic foot infection should receive prompt antimicrobial therapy and timely surgical source control in accordance with current evidence-based guidance [12].
5. Vascular assessment should be incorporated into the management pathway, with urgent specialist consultation where gangrene or infection coexists with suspected peripheral arterial disease [13].
6. High-risk patients should receive enhanced monitoring during the first five postoperative days, with high-dependency or intensive-care support where clinically indicated and available.
7. Community and clinic-based foot-care education should emphasise regular foot inspection, appropriate footwear, early presentation for ulcers and avoidance of prolonged self-treatment or unorthodox care.
8. Future prospective research should collect exact day and cause of death, age, sex, Wagner grade, amputation level, presence of sepsis or bacteraemia, renal function, haemoglobin, HbA1c, peripheral arterial disease, cardiovascular disease and anaesthetic risk so that independent predictors of mortality can be analysed.

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