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Surgical Management of Severe Lower-Limb Infections in Patients with Diabetes at Toamasina University Hospital, Madagascar: A Retrospective Study During the COVID-19 and Post-Lockdown Period

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Abstract

Introduction: Severe lower-limb infections in patients with diabetes are medico-surgical emergencies. During the COVID-19 period and its immediate aftermath, continuity of chronic care was weakened, which may have contributed to delayed consultations, treatment interruptions, and advanced clinical presentations.

Objective: To describe the clinical, therapeutic, and in-hospital outcomes of patients with diabetes who underwent surgical management for severe lower-limb infection in the Orthopedic Surgery Department of Toamasina University Hospital, Madagascar.

Methods: We conducted a retrospective descriptive and analytical study at Toamasina University Hospital from January 1, 2020, to June 30, 2021. Among 356 orthopedic admissions recorded during this period, 18 patients with diabetes who underwent surgery for severe lower-limb infection were included. Demographic, diabetological, clinical, microbiological, surgical, and outcome data were analyzed.

Results: Included patients represented 5.1% of admissions during the study period. The mean age was 66.9 ± 10.4 years, with a slight male predominance (55.6%). Type 2 diabetes was predominant (77.8%). The mean HbA1c was $10.24 \pm 1.57\%$. Therapeutic non-adherence was found in 13 patients (72.2%), and delayed diagnosis in 14 patients (77.8%). The median time to consultation was 28 days. Seven patients had osteitis, six had deep soft-tissue infection, and nine required amputation. Two in-hospital deaths were recorded. Hospital stay was longer among amputated than non-amputated patients (30.3 versus 21.0 days; $p = 0.027$).

Conclusion: The COVID-19 and post-lockdown period appears to have magnified pre-existing weaknesses in diabetic care pathways: late access to care, irregular follow-up, and difficulty maintaining continuous foot prevention. In this context, the response cannot be surgical alone; it requires a rapid, clear, and multidisciplinary organization.

Keywords: Amputation, COVID-19, Diabetes, Diabetic Foot Infection, Delayed Diagnosis, Lower Limb, Orthopedic Surgery, Osteitis

Introduction

In patients with diabetes, a lower-limb wound may progress rapidly to deep infection, osteitis, or gangrene. The risk seems to increase when neuropathy, peripheral arterial disease, poor glycaemic control, and delayed consultation occur together. The IWGDF guidelines emphasize that assessment of infection severity, screening for bone involvement, and timely surgical management should be integrated into a coordinated care pathway [1]. In Madagascar, available data remain scarce. However, a study conducted in Antananarivo had already highlighted the importance of podiatric risk, poor glycaemic control, and therapeutic education in the prevention of diabetic foot lesions [2].

The COVID-19 period gave this issue particular relevance. Movement restrictions, fear of hospital exposure, fewer scheduled consultations, and limited access to care may have delayed the management of diabetic foot wounds. Recent reports have described more severe presentations or proposed rapid triage pathways to preserve access to urgent diabetic foot care [3, 4].

Against this background, we analyzed patients who underwent surgery at Toamasina University Hospital, Madagascar.

Patients and Methods

This was a retrospective, descriptive and analytical study conducted in the Orthopedic Surgery Department of Toamasina University Hospital, Madagascar. The study period extended from January 1, 2020, to June 30, 2021, corresponding to the COVID-19 and early post-lockdown phase, during which hospital and outpatient care pathways were reorganized. From January 2020 to June 2021, the orthopedic department recorded 356 admissions. Among them, 18 patients with diabetes were retained for surgical management of a severe lower-limb infection. Patients aged 18 years or older, with known diabetes or diabetes diagnosed during hospitalization, admitted for severe lower-limb infection and treated surgically by debridement, drainage, lavage, surgical wound excision, or amputation were included. Patients without diabetes, superficial infections treated without surgery, traumatic wounds unrelated to diabetes, and insufficiently documented records were excluded.

The collected variables were age, sex, type and duration of diabetes, antidiabetic treatment, HbA1c, therapeutic non-adherence, time to consultation, site of infection, presence of osteitis, deep soft-tissue infection, gangrene or necrosis, clinical peripheral arterial disease, isolated pathogen, surgical procedure, type of amputation, length of hospital stay, and in-hospital outcome.

Results

Between January 1, 2020, and June 30, 2021, the Orthopedic Surgery Department recorded 356 admissions. Eighteen patients with diabetes ultimately underwent surgery for a severe lower-limb infection, representing 5.1% of admissions during the study period.

The mean age was 66.9 ± 10.4 years, with a range from 51 to 82 years. There was a slight male predominance: 10 of 18 patients were men (55.6%). Type 2 diabetes was the most frequent form, found in 14 patients (77.8%), with a mean diabetes duration of 14.1 ± 7.6 years.

Twelve patients (66.7%) were already receiving antidiabetic treatment before admission. Even so, metabolic control was generally poor: the mean HbA1c was $10.24 \pm 1.57\%$, with a median of 10.2%. This finding suggests an unfavorable background for wound healing and infection control.

Delayed care-seeking was a dominant feature. Therapeutic non-adherence was recorded in 13 patients (72.2%), and delayed diagnosis in 14 patients (77.8%). The mean time to consultation was 23.8 ± 14.9 days, with a median of 28 days. The study period coincided with COVID-19-related

healthcare disruptions; however, the medical records did not allow us to quantify the independent effect of the pandemic on consultation delay. Locally, lesions were often advanced (Figure 1). Seven patients (38.9%) had osteitis and six (33.3%) had deep soft-tissue infection. Gangrene or necrosis was observed in ten patients (55.6%) (Figure 2), while clinical peripheral arterial disease was suspected in eleven patients (61.1%) (Table I).



Fig 1: Advanced soft tissue infection of the foot in a diabetic female patient after six weeks of progression



Fig 2: Hallux gangrene in a patient with poorly controlled diabetes after ten days of progression

When microbiological documentation was available, streptococci and Enterobacteriaceae were the most frequently identified pathogens, each in four cases. Nine patients underwent amputation, corresponding to 50.0% of the cohort. Six amputations were major: four above-knee and two below-knee amputations. The three minor amputations consisted of two toe amputations and one ray amputation.

The mean length of hospital stay was 25.7 ± 9.4 days, with a median of 29.5 days. Two in-hospital deaths were recorded, corresponding to a mortality rate of 11.1%. In the exploratory analysis, patients who underwent amputation had a longer hospital stay than those who did not (30.3 versus 21.0 days; $p = 0.027$).

Table I: Baseline characteristics of the study population

Variable	Result
Orthopedic admissions from January 2020 to June 2021	356
Included patients	18
Proportion among admissions	5.1%
Mean age	66.9 ± 10.4 years
Male sex	10 (55.6%)
Type 2 diabetes	14(77.8%)
Mean duration of diabetes	14.1 ± 7.6 years
Receiving antidiabetic treatment	12 (66.7%)
Mean HbA1c	10.24 ± 1.57%
Therapeutic non-adherence	13 (72.2%)
Delayed diagnosis	14 (77.8%)
Median time to consultation	28 days
Osteitis	7 (38.9%)
Deep soft-tissue infection	6 (33.3%)
Gangrene or necrosis	10 (55.6%)
Clinical peripheral arterial disease	11 (61.1%)
Amputation	9 (50.0%)
In-hospital death	2 (11.1%)

Discussion

This retrospective series describes a demanding clinical situation observed during a particular moment in hospital practice: the COVID-19 and early post-lockdown period. The included patients were not merely presenting with infected wounds; many arrived after several weeks of progression, with poorly controlled diabetes and uncertain treatment adherence. This pattern makes surgery necessary, yet it also narrows the possibilities for limb preservation from the outset.

Delayed diagnosis appears to be the central thread of this cohort. A median time to consultation of 28 days suggests that many patients probably did not seek care when the lesion was still a simple wound. During the health crisis, this delay may have been reinforced by fear of SARS-CoV-2 exposure, travel restrictions, reduced non-urgent consultations, and disruption of chronic disease follow-up. This interpretation is consistent with the data reported by Liu *et al.* in 2020, who observed fewer hospitalizations for diabetic foot ulcers, deferred care, and more severe infections at admission [5].

The high frequency of clinical peripheral arterial disease in our series is a reminder that diabetic lower-limb infection is not only a bacterial problem. Ischaemia impairs healing, limits antibiotic diffusion, and leaves tissues more vulnerable. During lockdowns, a vascular surgery study reported an increase in major amputations, suggesting that continuity of vascular care should be protected even during a health crisis [6]. In our setting, early vascular assessment should therefore have held a central place, ideally using a Wifi-type stratification [7].

The 50% amputation rate may seem very high. It should, however, be interpreted cautiously, because this cohort does not represent all patients with diabetic wounds. It includes a subgroup already selected by severity and referred to orthopedics for surgery. Here, amputation appears to be the endpoint of a long process: neglected wound, interrupted follow-up, deep infection, sometimes ischaemia, and delayed hospital presentation. Publications from the COVID-19 period have stressed the need to maintain dedicated diabetic foot pathways to avoid this unfavorable sequence [4, 8, 9].

The frequency of osteitis and deep infections confirms the

anatomical extension of lesions at the time of surgery. Microbiologically, the range of isolated pathogens - streptococci, Enterobacteriaceae, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and polymicrobial infections - is consistent with what is usually observed in chronic, necrotic, or previously antibiotic-treated wounds. This finding supports the use of deep specimens, preferably obtained in the operating room, so that antibiotic therapy can be adjusted promptly [1].

In the comparative analysis, only length of hospital stay differed significantly according to amputation status. This is more likely a marker of severity than a causal factor: amputated patients require more postoperative care, closer infectious monitoring, metabolic stabilization, and sometimes additional surgery.

The practical challenge is to identify high-risk wounds earlier, strengthen therapeutic education, secure access to antidiabetic medication, and maintain reachable consultations even when a health crisis places heavy pressure on hospitals. Multidisciplinary diabetic foot teams have shown their value in reducing major amputations; their role becomes even more important when access to care is weakened [10].

The Malagasy context gives this interpretation a particular resonance. In a study conducted in Antananarivo, Raharinavalona *et al.* reported a high podiatric risk, frequent poor glycaemic control, and limited practical knowledge of foot care [2].

Therapeutic education should focus on simple but decisive messages: do not trivialize a wound, avoid self-medication, continue antidiabetic treatment, seek care promptly in case of necrosis or discharge, and maintain wound care even when usual consultations are disrupted. The COVID-19 crisis reminded us that chronic diseases do not pause; their complications continue to progress.

Conclusion

This study suggests that infected diabetic foot disease may serve as a sensitive indicator of continuity of care. The COVID-19 and post-lockdown period probably made pre-existing weaknesses in care pathways more visible. At Toamasina University Hospital, a realistic response could rely on a simple and resilient local protocol: rapid identification of high-risk wounds, immediate referral, and early surgical decision-making when the limb or the patient's life is threatened. The goal is not only to operate better, but also to reduce the time lost before surgery becomes the only remaining option.

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