

# Hand Infections among Patients with Diabetes in Abidjan, Côte d'Ivoire: Epidemiological Characteristics, Clinical Presentation, and Therapeutic Management

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## Abstract

**Objective:** To investigate the factors associated with hand infections among people with diabetes in Abidjan. **Method:** This was a descriptive cross-sectional study with an analytical focus, conducted over a five-year period (January 2019 to December 2023) and based on the medical records of diabetic patients treated for hand infections. **Results:** The hospital incidence of hand infections in diabetic patients in Abidjan is 0.27% (30/10,912). There was a predominance of female patients (83%) and a mean age of  $49.03 \pm 12.39$  years. The most common occupational groups were manual workers, particularly those in the informal sector (53%), farmers (7%) and housewives (23%). A hand infection led to the diagnosis of diabetes in 30% of cases. Diabetes was type 2 in 93% of cases and had been present for an average of 4.67 years. The average blood glucose level was 2.86 g/L. Hand involvement was the result of trauma in 40% of cases and had been present for an average of 25.10 days. The lesions affected the dominant hand in the majority of cases and were classified as follows: Ulceration (14 cases), Phlegmons (10 cases), Whitlow (8 cases), Gangrene (7 cases), Necrosis (6 cases), Abscess (1 case). The causative organisms were *Klebsiella pneumoniae* and *Staphylococcus aureus*. Amputation was unavoidable in 8 cases (26.7%). Incision and drainage were the main surgical procedures used in 10 cases (33.3%). Disarticulation was performed in eight cases (23.3%). Surgical treatment was indicated for gangrene (100%) and necrosis (50%). **Conclusion:** The management of hand infections in diabetic

patients must be early and multidisciplinary. Delayed consultation and the severity of the lesions can lead to sequels.

## Keywords

Diabetic Hand, Infections, Factors, Abidjan

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## 1. Introduction

The natural course of diabetes is marked by numerous complications resulting from poor glycemic control. One of these is an infection, which rapidly worsens the prognosis due to the patient's compromised condition and the risk of metabolic decompensation. Diabetic foot complications, which are well known for its prevalence, are worrying due to the high risk of amputation [1]. The latter would be due to gangrene linked to frequent delays in seeking medical advice and hospital admission [2]. Lesions affecting the upper limbs, particularly the hand, were less common and have been described in the West since the 1970s by various authors [3] [4]. They are referred to as tropical diabetic hand syndrome when they involve an infectious component. In China, one study reported a prevalence of 0.37% compared with 9.7% for infections of the lower limbs [5].

In Africa, a few studies on hand infections in people with diabetes have been conducted. Indeed, in the Maghreb, 17 patients with hand lesions were reported in a Moroccan study [6]. In sub-Saharan Africa, the authors reported dozens of cases of hand infections [1] [7]. Apart from these patient cohorts, other authors have reported clinical cases of hand infections in people with diabetes [8].

These infectious hand conditions represent a major problem in Africa. They are life-threatening due to the harmful effects of the infection on diabetes. They can lead to disability and thus affect functional outcomes. Indeed, these hand infections can lead to amputation, resulting in the loss of grip and touch and, depending on the case, leading to partial or total dependence on others [9]. All of this undoubtedly has psychological and social repercussions. These conditions also pose an economic problem on a continent where the majority of jobs are manual and dominated by the informal sector, particularly agriculture [10].

In Côte d'Ivoire, several studies have focused on diabetes, but none have examined hand infections in people with diabetes or the factors associated with such infections. This lack of data on a complication with such significant prognostic and socio-economic implications prompted this study, the aim of which was to investigate the factors associated with hand infections in people with diabetes in Abidjan.

## 2. Patients and Methods

Study setting: Our study was conducted at two leading healthcare facilities in

Abidjan, Côte d'Ivoire. The Endocrinology, Metabolism and Nutrition Outpatient unit at the Cocody University Hospital (CHU), which is a tertiary-level hospital. The department has a capacity of 25 patients per day, and the Endocrinology, Metabolism and Nutrition Department at the Abidjan Military Hospital, which is a secondary-level hospital with a capacity of 20 beds.

We conducted a cross-sectional descriptive study among patients with diabetes during the period from 1 January 2019 to 31 December 2023. This study included all diabetic patients with a hand infection who attended the dressing room of the diabetic endocrinology department at the Abidjan Military Hospital and the endocrinology-diabetology unit at the Cocody University Hospital in Abidjan.

The analysis was based on a questionnaire recording:

- Age, gender and occupation.
- Type of diabetes, duration of the condition, and glycaemic control on admission.
- Acute and chronic complications of diabetes.
- Time taken to seek consultation.
- Type of lesion, its location, and triggering and associated factors.
- Isolated pathogen, treatment and clinical course.

Treatment adherence was assessed using the MORISKY score via the questionnaire below

Self-assessment questionnaire to measure adherence to treatment.

|   |                                                                                                                                                                                                                         |                |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1 | Do you sometimes take your tablets for...<br>(name of the condition)                                                                                                                                                    | <b>No = 1</b>  |
| 2 | Sometimes people do not take their medication for reasons other than simply forgetting. Thinking back over the last two weeks, were there any days when you did not take your medication for... (name of the condition) | <b>Non = 1</b> |
| 3 | Have you ever reduced the dose or taken your medication for... (name of the condition) without telling your doctor, because you felt unwell whilst taking it?                                                           | <b>No = 1</b>  |
| 4 | When you travel or leave home, do you ever forget to take your medication for... (name of the condition)?                                                                                                               | <b>No = 1</b>  |
| 5 | Have you taken your medication for... (name of the condition)?                                                                                                                                                          | <b>Yes = 1</b> |
| 6 | When your symptoms are much less severe, or have even disappeared completely, do you sometimes stop taking your medication?                                                                                             | <b>No = 1</b>  |
| 7 | Having to take medication for... (name of condition) every day is a real inconvenience for some people. Do you sometimes find it frustrating to have to stick to a treatment for... (name of the condition)?            | <b>No = 1</b>  |

**Continued**

|              |                                                                                                            | Response options and<br>score for question 8 |
|--------------|------------------------------------------------------------------------------------------------------------|----------------------------------------------|
|              |                                                                                                            | Never/Rarely = 1                             |
| 8            | Do you sometimes find it difficult to remember to take all your medication for... (name of the condition)? | Never/rarely = 1                             |
|              |                                                                                                            | From time to time = 0.75                     |
|              |                                                                                                            | Sometimes = 0.5                              |
|              |                                                                                                            | Regularly = 0.25                             |
|              |                                                                                                            | All the time = 0                             |
| <b>SCORE</b> |                                                                                                            |                                              |

Interpretation:

Above 8: good adherence, 6 to 7: average adherence, below 6: poor adherence.

**Data Analysis**

EpiInfo version 7.2.1.0 was used for data entry and analysis. Graphs and tables were produced using Excel 2020; the document was typed using Word 2020. Measures of central tendency (mean) and dispersion (standard deviation) were used to describe quantitative variables, and proportions were used to describe qualitative variables.

**3. Results****3.1. Epidemiological Characteristics**

During the study period, 10,912 patients were recorded, of whom 30 diabetics had a hand infection. The hospital admission rate for hand infections among diabetic patients was 0.27%. There was a predominance of female patients (83%) with a sex ratio (male/female) of 0.2. The mean age of patients was 49.03 years (range: 10 to 68 years).

The predominant socio-occupational category was those from the informal sector (manual workers, traders) in 53% of cases. The majority of patients were right-handed in 93% of cases. Twenty-eight (93%) had type 2 diabetes, with an average duration of diabetes of 9 years (range: 8 months to 20 years).

**3.2. Characteristics of Diabetes**

A hand infection revealed diabetes in 30% of cases. In 50% of cases, patients were being treated with oral antidiabetic drugs; 33% were on insulin; and 28% were receiving herbal medicine (traditional treatment). The mean blood glucose level on admission was 2.86 g/l (range 1.05 - 6.50 g/l). The mean HbA1c was 9.58% (range 5% - 14%). Ketoacidosis was found in 4 (13%) patients and diabetic foot in three (10%) patients. Two (7%) patients presented with hyperglycaemic hyperosmolar syndrome. The mean time to consultation for a hand infection was 25 days (range: 2 to 180 days). Nine patients had a comorbidity associated with diabetes; hypertension was present in 30% of cases. Fetal macrosomia was the most com-

mon history, found in 28% of cases. More than half of the patients were non-compliant with treatment (59%).

### 3.3. Characteristics of the Injuries

Spontaneous causes, particularly skin infections, were the most common (60%), compared with traumatic causes (40%). As regards traumatic causes, these were mainly cuts caused by a sharp object (5 cases) and puncture wounds caused by a fish bone (5 cases), and, to a lesser extent, one case of an animal bite and one case of a burn.

The dominant upper limb was affected in 20 out of 30 (71%) cases. The injury was located on the palm in one case (4%), on the back of the hand in five cases (18%), on the thumb in seven cases (28%), on the index finger in four cases (14%), on the middle finger in five cases (18%), on the ring finger in two cases (8%) and on the little finger in one case (4%).

Extension of the lesion to the forearm was found in six cases (21%). Osteitis was found in 33% of cases (4 cases). The different types of lesions found were: phlegmon in 10 (33%) cases, paronychia in 8 (27%) cases, gangrene in 7 (23%) cases, necrosis in 6 (20%) cases, one case (3%) of abscess, and ulceration was found in 14 (47%) cases (**Photos 1-3**).



**Photo 1.** Gangrene of the hand following a boil in a 46-year-old diabetic patient.



**Photo 2.** Progress after treatment.



**Photo 3.** Gangrene of the fourth finger in a 37 year-old diabetic patient following a paronychia.

### 3.4. Bacteriological Samples

Bacteriological samples were taken from our patients; these revealed a predominance of *Staphylococcus aureus* in 4 (13.3%) cases, followed by *Klebsiella pneumoniae* in 7 (23.3%) cases.

### 3.5. Treatment

Adherence to antidiabetic treatment was moderate in 41 per cent of cases. More than half of the patients were non-compliant in 59% of cases. All patients received drug treatment (30%), local care (30%), surgical treatment (18%) and lifestyle and dietary measures (30%). Beta-lactams, quinolones and imidazoles were the main classes of antibiotics prescribed to patients, in 60%, 47% and 43% of cases respectively. Ofloxacin and metronidazole were the most commonly used, in similar proportions (43%). A combination of at least two antibiotics was the most common approach in 63% of cases. Incision and drainage were the main surgical procedure used (33%). Amputation was unavoidable in eight patients (27%).

Management consisted of enhanced glycaemic control via insulin therapy in 27 (90%) cases, combined with antibiotic therapy tailored to the antibiogram and daily dressing changes.

Incision and drainage was the primary surgical procedure used in ten (33.3%) cases. Surgical debridement was required in seven (23.3%) cases. Amputation was unavoidable in eight (27.6%) cases (**Photo 4**). Our surgical cases involved gangrene (100%), necrosis (50%) and phlegmon (40%).



**Photo 4.** Disarticulation of a finger following gangrene in a 34-year-old patient.

### 3.6. Evolution

The rate of favourable outcome was 67% (**Photo 5** and **Photo 6**).



**Photo 5.** Wound epithelialization adjacent to the disarticulation.



**Photo 6.** Complete healing after disarticulation.

## 4. Discussion

The hospital admission rate of 0.27% (30 out of 10,912) for hand infections among diabetic patients in Abidjan (Ivory Coast) reported in our study is similar to those reported by Wang *et al.* in China (0.37%) [5] and Raherison in Madagascar (0.45%) [3].

It is, however, significantly lower than those reported by Mbaye *et al.* in Senegal (9.7%) [1] and Sidibé in Mali (34.8%) [7]. Methodological differences may explain why the number of people affected by this condition varies considerably in the literature. For example, a postal survey conducted in Africa indicated that diabetic hand infection was well known in Ethiopia, The Gambia, Libya, Nigeria, South Africa and Tanzania, but that it was rare, or even unknown, in Botswana, Malawi, Zambia and Nigeria [11]. Cases of upper limb infections in diabetic patients have been most frequently reported in African countries, hence the term ‘diabetic hand syndrome’ given to this condition.

Females accounted for 83% of the participants in our study, as in several others. Indeed, the teams led by Mbaye in Dakar (Senegal) [1], Mahamane in Niamey (Niger) [12], Mofikoya in Lagos (Nigeria) [13], Raherison in Antananarivo (Madagascar) [3], and Azgaon in Marrakesh, Morocco [6] reported a percentage of women ranging from 52.38% to 82.35%. A different finding, with a male predominance, was reported in an Asian study, notably that of Wrang *et al.* [5]. This variability in results is likely linked to the cultural and socio-demographic diversity of the different countries. Indeed, in sub-Saharan Africa, the observed female predominance may be explained by the fact that in Africa in general, and in Côte d’Ivoire in particular, women are responsible for daily manual activities such as housework and farming, which expose their hands to various injuries.

The mean age of our patients was 49.03 years. The same finding was reported in sub-Saharan Africa, where the mean age ranges from 47 years [13] to 50.1 years [1]. In Asian countries, the authors reported a similarly higher mean age of 51 years [5].

The most common socio-occupational groups were patients engaged in manual labour, particularly those working in the informal sector (53%), farmers (7%) and housewives (33%). This predominance of manual workers had been reported by several authors, including Mahamane [12]: housewives (53.6%), farmers (17.3%) and Mbaye [1]: manual labourers in 57.8% of cases. This predominance of manual workers can be explained by the fact that in Africa, which remains underdeveloped and under-industrialised, the majority of work is done by hand.

However, in Morocco, Obbiba *et al.* observed a male predominance (13 men to 7 women, *i.e.*, a sex ratio of 1.85) [14], which they attributed to the fact that in Morocco, men are responsible for farm work. For both sexes, the determining factor therefore appears to be occupational activity. Manual labour appears to be a factor in exposure to hand trauma [1].

Hand infections revealed diabetes in 30% of cases. The occurrence of these hand infections could be explained by non-adherence to treatment among some of our

patients (59%) and the use of traditional treatments by others (28%) instead of conventional treatment. A similar finding was reported by Mahamane [12]. Indeed, in this Nigerien study, diabetes was newly diagnosed in 44.6% of cases, and among known diabetic patients, only 22.58% were receiving regular diabetes care, whilst 64.52% had discontinued treatment [12].

The main causes of this non-adherence are thought to be the high cost of medicines, the mismatch between the African socio-economic context and the diabetic regimen, a lack of infrastructure and healthcare staff, and the prevalence of traditional medicine, as highlighted by Gning *et al.* [15].

In our study, diabetes had been present for an average of 4.67 years, ranging from 1 month to 14 years. Mofikoya *et al.* [13], Abbas *et al.* [16] and Wrang [5] reported similar figures, with average durations of 4.7 years, 5 years and 5.3 years respectively.

Abbas *et al.*, in a study on risk factors associated with tropical diabetic hand syndrome, found a significant association between a long duration of diabetes and the onset of this syndrome ( $p < 0.05$ ) [16].

Our patients presented with ketosis, diabetic foot and hyperglycaemic hyperosmolar syndrome in 13%, 10% and 7% of cases, respectively. In their study, Mbaye *et al.* [1] reported a higher incidence of ketosis, at around 45%.

Hand involvement had been present for an average of 25 days, ranging from 2 to 180 days. This delay in seeking medical attention was noted by Raherison *et al.* [3], Azzaou *et al.* [6] and Mbaye *et al.* [1], who reported average delays of 17 days, 13 days and 10 days, respectively. This appears to be a common situation in our developing countries and is thought to have an impact on the severity of the injuries and the prognosis of the condition.

Spontaneous causes, particularly skin infections, were predominant (60%) compared with traumatic causes (40%). These mainly comprised cuts (5 cases) and puncture wounds (5 cases), with one case each of a bite and a burn. This variability in causes had been reported by certain Senegalese authors. Indeed, similar percentages regarding traumatic causes were found by the teams led by Mbaye [1] and Diop [17], who reported 42.3% and 37.5% respectively.

As for Sidibé *et al.* in Mali [7], they reported trauma in 4 cases, a burn and an ingrown toenail in two cases each.

In our study, the right hand was affected in more than half of our patients (61%). Several authors have made the same observation. Indeed, Raherison *et al.* [3] and Diop *et al.* [17] reported 77.8% and 56.3% of right-hand involvement in diabetic patients, respectively. Bilateral hand involvement was rare (4%) in our population, as it was in that of Diop *et al.* (1%) [17]. Lesions affected the dominant hand in the majority of our patients, accounting for 71% of cases. Mbaye *et al.* reported a similar percentage of 72% [1].

The different types of lesions found were: ulcerations (47%), phlegmons (33%), whitlows (27%), gangrene (23%), necrosis (20%), and an abscess (3%).

With regard to the diversity and types of lesions, similar findings have been

reported in the African literature. Indeed, Mahamane *et al.* in Niger [12] reported abscesses (57.1%), phlegmon (23.2%), paronychia (10.9%) and gangrene (5.4%). As for Raheison *et al.* in Madagascar [3], the lesions found were phlegmon (44.5%), wet gangrene (33.3%) and paronychia (22.2%).

As for Diop *et al.* in Senegal [17], the hand lesions were phlegmon (31.7%), paronychia (22.7%), abscess (12.9%), onychitis and perionychitis (11.5%) and gangrene (6.4%).

Although the proportions found differ from those in our patient cohort, in all these series the authors reported the presence of gangrene. The severity of the lesions is thought to be related to delayed presentation.

Blood glucose levels on admission ranged from 1.05 to 6.50 g/l, with a mean of 2.86 g/l. Our findings are consistent with those of most authors, who consider hyperglycaemia above 2.69 g/l to be a risk factor for tropical diabetic hand syndrome. Average values similar to those in our study population were reported by the teams led by Mbaye and Diop, at 2.93 g/l and 2.7 g/l respectively. Raheison *et al.* found a higher average blood glucose level (4.21 g/l).

In the literature, bacteriological examination of infected hand wounds in diabetic patients is essential and often reveals polymicrobial infection involving Gram-positive, Gram-negative and anaerobic bacteria. In our study, bacteriological examination of the samples revealed a predominance of *Staphylococcus aureus* in 4 cases (13.3%), followed by *Klebsiella pneumoniae* in 7 cases (23.3%). In Antananarivo, Raheison *et al.* reported that only one patient had undergone a bacteriological examination, which identified *Staphylococcus aureus*. In contrast, in Dakar, Mbaye *et al.* had taken samples from all patients making it possible to identify in order of frequency, of: *Staphylococcus aureus*, *Klebsiella pneumoniae*, Streptococcus A and B, *Pseudomonas aeruginosa*, *Escherichia coli* and *Citrobacter freundii* [1].

In the study by Mahamane *et al.* [12] in Niamey, a larger sample of bacteriological specimens was recorded. The most commonly isolated pathogen in this study was *Staphylococcus*, followed by *Klebsiella* and *Streptococcus*.

Apart from the methodology, one of the reasons that could explain the lack of bacteriological testing is the lack of financial resources among our patients and the inadequate medical coverage in our countries in sub-Saharan Africa.

All our patients received antibiotic therapy, antidiabetic treatment, local care and therapeutic education. Surgery was performed in 60% of patients. The treatment approach used in our study is similar to that reported by teams such as Wrang *et al.* [5], Raheison *et al.* [3], Azgaou *et al.* [6], Mahamane *et al.* [12] and M'Baye *et al.* [1].

## 5. Conclusion

The hospital prevalence of hand infections among people with diabetes in Abidjan is 0.27%. Hand infection in people with diabetes requires early and multidisciplinary management to prevent amputations. Therapeutic education is an essential

tool in our resource-limited African countries to prevent infections. Successful diabetes management will help prevent limb amputation or other disabilities.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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