Clinical characteristics of diabetic patients with upper limb and hand infections

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ABSTRACT

Introduction: Patients with diabetes mellitus (DM) have an increased risk of infection resulting from neuropathy, vasculopathy and immunosuppression. Literature regarding infections of the hands and upper limb among patients with DM is limited. Furthermore, hand and upper limb infection are being recognised as a significant cause of morbidity and mortality. The purpose of this study is to investigate the clinical characteristics and surgical outcomes of upper limb infections in patients with DM. **Materials and Method**: A retrospective review of 18 months' duration of patients with DM admitted for hand and upper limb infections. **Results**: A total of 21 patients with average age of 49.7 years (range 16-79) were included in the analysis, of which 15 (71%) were females. Six (29%) were newly diagnosed DM. The average Glycosylated Haemoglobin (HbA_{1C}) level was high for both newly diagnosed and known DM, at 10.4% and 10.7% respectively. Patients presented on average of 10 days after onset of symptoms. Thirteen (62%) presented with abscess and the most common site of involvement was the hands. Culture studies revealed *Klebsiella* spp., *Escherichia coli* spp. and *Staphylococcus aureus* as the most common organism isolated. Three patients required amputation or joint disarticulation. Sixteen patients (76%) had good outcome at three months follow up. **Conclusion**: Poor glycemic control, duration of diabetes and delayed presentation were the main risk factors in diabetic patients presenting with severe infection of hands and upper limbs. In majority of patients, antibiotics and surgical treatment results in good outcome.

Keywords: Infections, upper limb, diabetes mellitus, sepsis, complications

INTRODUCTION

Patients with diabetes mellitus (DM) have increased risk of developing infection over the extremities as compared to non-diabetic individuals. [1] Longstanding diabetes results in neuropathy which impairs the ability of patients to detect early injury thus delaying presentation and treatment. [2] Atherosclerosis of larger vessels results in vascular occlusion causing ischaemia, with thickening of the basal membrane of small vessel inhibiting leucocytes migration and impairs vasodilatation and blood flow to the injured part. Overall consequence of neuropathy, vasculopathy and poor healing leads to increased susceptibility to local and systemic infections.

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Much has been documented in the literature on foot infections among patients with DM. Although relatively uncommon, infection involving the upper limbs and hands are being recognised as a significant cause of morbidity and mortality. [3] Most of the cases which are reported in the literature are from the sub-Saharan territory of the African continent and Indian subcontinent. [4] Pain, swelling and cellulitis have documented as the main presenting complaint. [5] Besides infection, diabetes also causes a condition characterised by limitation of movement in the joints of the hands, traditionally defined as 'Diabetic Hand'. [6] Risks factors implicated in the development of infection involving the upper limbs and hands include poorly controlled diabetes, neuropathy, insulin treatment or malnutrition. [7, 8] Although polymicrobial infection is not uncommon, previous studies revealed that gram-negative organism is frequently encountered in diabetic patients with hand and upper limb infections. [9, 10] Amputation rate have been documented as high as 16% [5] and up to 55% of patients have residual deformities and subjective dysfunction of the affected upper limb. [11]

This study aims to investigate the clinical characteristics, evaluate possible risk factors and determine functional outcomes of diabetic patient with upper limbs and hands infection.

MATERIALS AND METHODS

A retrospective review of 18 months duration from 1st of July 2013 until 31st December 2014 was performed. Patients with Type 1 or Type 2 DM with upper limbs and hands infection admitted to a general orthopaedic ward in a public hospital was included in the study.

Patients were treated based on their clinical presentation and no specific protocol was applied. All the patients were co-managed with a multidisciplinary team consisting of orthopaedic, internal medicine and rehabilitation team in the orthopaedic ward. Information gathered via hospital records included patients' demographic features, clinical information and follow up notes. A detailed diabetic history was taken including glycaemic control and patients' compliance to treatment was assessed. Metabolic state during admission, treatment given and patient's progress were reviewed.

For patients requiring any surgical interventions, the surgeries were performed under the emergency lists by the orthopaedic medical officer on duty under supervision of an orthopaedic specialist. Surgical findings, and postoperative progress and complications were reviewed. Functional outcome was determined based on patient's subjective description of ability to perform daily activities as documented in the medical records.

RESULTS

There 21 patients admitted infections involving the upper limbs (female=15, mean age 49.7 years [16-79]) and 90% of them are right hand dominant. Majority were housewives (n=11) and four were in the construction industry. Other occupations included a teacher, accounts officer, rubber tapper, cleaner, mechanic and a 16-year-old high school student. Only three patients (14%) in had tertiary level education.

Six patients were diagnosed with DM during presentation, with the rest known to have DM with average duration of illness of

5.5 years (2–10). Type 2 DM was more common. Ten patients out of 15 (67%) were on insulin monotherapy or in combination with oral hypoglycaemic agents. Two patients had defaulted treatment. With regards to HbA_{1c} level, known diabetics had average of 10.7% as compared to 10.4% for newly diagnosed diabetes. Table I summarises the demography and diabetic profile of patients included in this series.

The average duration of symptoms was 10 days (3–21) prior to presentation. Only one patient had documented increase in core body temperature during presentation. Seven out of 21 patients (33%) had metabolic derangements, four of which were septic and three acidotic. Infections involving the hands, defined as distal to the wrist crease, were the most common infection site (n=14). Other sites include the wrist, forearm, elbow and the arm. All patients presented with unilateral involvement, the right side being more commonly involved (n=15). Table II summarises the details of infection sites and surgical procedures done.

Eight patients (38%) had no identifiable source or precipitating factor for infection. Majority of the patients presented with local abscess (n=12). Among others, three patients (14%) were clinically diagnosed with necrotising fasciitis and two patients presented with gangrenous digit. Other presentations include, tenosynovitis, cellulitis and carbuncle. Two patients had past history of infection in the lower limbs (Case 7, a 53-year-old lady treated for wet gangrene of her left big toe with a ray amputation one year previously; and Case 11, a 43-year-old man treated for left ankle abscess 6 months previously). No other patients had concurrent lower limb infection.

All were immediately started on empirical intravenous antibiotics which was later adjusted according to culture results. The majority of patients (n=13) received empirical Ampicillin-Sulbactam antibiotics prior to results of culture studies. Three patients were started on Piperacillin/Tazobactam upon initial presentation based on the severity of local infection and systemic manifestations. The average duration of antibiotics during hospital

Table I: Demographics and diabetes profiles of patients with upper limb infections.

	Men (n=6)	Women (n=15)	Total (21)
Mean Age (years)	45.5	51.4	
Type 2 DM	5	13	18
Type 1 DM	1	2	3
Diabetic duration (years)	4.3	3.7	5.5
Past Treatment*			
- Insulin	1	3	4
- OHA	2	1	3
- Combination	3	3	6
- defaulted	0	2	2
Glycosylated Hemoglobin - HbA_{1c} (%)	10.4	11.28	11
Metabolic Status (On Admission)			
- Sepsis	2	2	4
- Ketoacidosis	2	1	3

DM: Diabetes mellitus; OHA: Oral hypoglycaemic agent
* = for known cases (n=15)

Fig. 1: Patient presenting with left middle finger infection with abscess formation, reguiring Ray's amputation.

Table I: Summaries of surgical outcomes.

Case	Gender	Age	Site	Pathology	Surgical Outcome
1	Female	49	Thumb	Tenosynovitis	Debridement
2	Male	53	Thenar	Abscess	Drainage
3	Female	39	Middle finger	Abscess	Ray Amputation
4	Female	53	Palm	Abscess	Drainage
5	Male	34	Webspace	Abscess	Drainage
6	Female	55	Forearm	Cellulitis	NIL
7	Female	53	Little Finger	Necrotising Fasciitis	Debridement
8	Male	41	Forearm	Necrotising Fasciitis	Debridement
9	Female	79	Wrist	Abscess	Drainage
10	Female	58	Palm	Abscess	Drainage
11	Male	43	Elbow	Necrotising Fasciitis	Debridement
12	Male	51	Index Finger	Gangrene	Metacarpophalangeal disarticulation
13	Male	51	Forearm	Abscess	Drainage
14	Female	53	Elbow	Abscess	Drainage
15	Female	33	Wrist	Abscess	Drainage
16	Female	52	Index Finger	Abscess	Drainage
17	Female		Arm	Abscess	Drainage
18	Female	55	Arm	Carbuncle	Saucerisation
19	Female	59	Index Finger	Gangrene	Metacarpophalangeal disarticulation
20	Female	16	Index Finger	Abscess	Debridement
21	Female	57	Dorsum	Abscess	Drainage

average duration of antibiotics during hospital admission was five days (1-15). Post-discharge, patients were prescribed on average 7.1 days of antibiotics (5-13).

All except one patient required surgical intervention. Waiting time for surgery was on average of 1.9 days. In three out of twenty patients (15%), amputation was needed due to control the infection. One patient required ray amputation (Figure 1) and another two required metacarpophalengeal disarticulation. Only two out of 20 patients (10%) required repeated surgery. Both were cases of necrotising fasciitis involving the forearm, and the elbow who required repeated debridement three and five times respectively. For each patient, debridement were done three to four days apart. Average duration of hospital stay was 7.4 days (2-26).

Tissue samples obtained intraoperatively isolated organisms in 14 (70%) patients. *Klebsiella* spp./*Escherichia coli* spp. and *Staphylococcus aureus* (*S. aureus*) were equally common (n=4 each). Two cases yielded a mixed growth. Other organisms detected were Coagulase Negative *S. aureus*, Multi-resistant *S. aureus*, *Streptococcus agalactiae* and *Acinetobacter baumanii*. Table III summarises the microbiological profile.

All the patients were reviewed two weeks post discharge. Four patients defaulted follow-up. There was no mortality in our series. None of the reviewed patients required re-admission, but one patient had persistent local signs of infection and was treated with oral antibiotics for a further total of 13 days. Final follow-up at three months revealed five patients (28%) had subjective functional impairment in which they had difficulty in performing their previously routine activities. Otherwise the rest (72%) had good recovery and returned to their

Table III: Microbiological profiles.

Organism	n = 20
Staphylococcus aureus (*S. aureus*)	4
Escherichia coli/Klebsiella sp.	4
Coagulase negative staphylococcus	1
Methicillin resistant *S.aureus*	1
Streptococcus agalactiae	1
Acinetobacter baumanii	1
Mixed growth	2
No growth	6

premorbid function.

DISCUSSION

Patients in this series were predominantly female with a relatively lower mean age of 49.7 years old as compared to 62.1 years with male predominance in a similar study from China. [12] We also found that majority of patients were housewives, a similar finding to an African study. [11] Furthermore, majority of subjects lack tertiary education, which may represent reduced level of knowledge and awareness about DM, and its complication. Type 2 DM, poor glycaemic control (mean HbA_{1C} of 10.7%) and long standing DM were the contributing factors in development of infection of the upper limbs in our patients, as shown by another previous study. [12] In our series, there was a higher incidence of upper limb sepsis (33%) at the initial presentation, as compared to a previous study. [11] This could be due to long delay before presentations (mean 10 days, range 3-21).

No identifiable causative trauma or source could be found in 38% in our patients. This is lower than the findings by Ahmed *et al*. in Sudan where 48.7% did not have any identifiable cause. [3] Other causes reported in the literature include chronic habitual finger biting [13], dogbite [14], and fish bone injuries. Iatrogenic causes such as trans-radial coronary angiography [16] and carpal tunnel release. [17]

This study found that the most common anatomical site involvement was the hands, which could be explained by the fact that the hands are prehensile organs, which increases its risk of undetected trauma and subsequent infection. In our study, due to incomplete data on medical records, no analysis regarding incidence of upper limb sensory neuropathy have been done. However, it has been shown in a study that up to 22.7% of patients with diabetes have sensory neuropathy involving the hands. [3] Furthermore, in that study of 119 patients, the most common presentation was cellulitis and the amputation rate was found to be 14.3%. In comparison, our study found that the most common presentation was an abscess and a comparable amputation rate of 15%.

Microbiological studies of intraoperative tissue samples revealed equal occurrence of *Klebsiella* sp/*E. Coli* sp and *S. aureus*. In contrast, other studies found *S. aureus* as the main causative organism. [5] Furthermore, polymicrobial infection have been shown to occur in 41 to 47% of cases of diabetic hand infections and this important fact must be considered when choosing an initial approach to antibiotic coverage. [18]

Seventy-two percent of patients in our series had good recovery and function at follow up at three months, which is comparable to a study involving hundred and nineteen patients with hand sepsis. [3] Our study is limited by its retrospective nature and limited number of subjects, thus lacking sufficient statistical significance in determining prognostic risk factors of the condition.

The term 'Tropical Diabetic Hand Syndrome' have been used to describe progressive infections of the hand among diabetic patients especially in the sub-Saharan continent and areas with tropical climate. It must be differentiated from The 'Diabetic Hand Syndrome', which is characterised by limited

joint mobility, Dupuytren's contracture and trigger finger. [6] With regards to our study, no attempts were made to analyse the presence of these features in our patients.

In conclusion, infections involving the upper limbs and hands of patients with diabetes are characterised by long standing poorly controlled DM. The hands are the most commonly affected and in a proportion of cases, the causative agent is unknown. Antibiotic treatment, combined with surgical debridement results in good outcome in more than two-thirds of cases. Further prospective studies are needed to determine the prognostic risk factors that will influence the overall outcome of this condition.

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