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Original Article

Common pathogens isolated in diabetic foot infection in Bir Hospital

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Abstract

Aim: Foot ulcers are a frequent complication of patients suffering with diabetes mellitus, accounting for up to 20% of diabetes-related hospital admission[6]. Secondary infection of these ulcers is by far the leading cause of amputation of feet and legs and the polymicrobial nature of diabetic foot infection has been well documented in the literature. The present study sought to reveal the bacterial etiology of diabetic foot ulcer in patients presenting to Bir Hospital.

Method: A 1 year retrospective study was carried out to analyse the bacterial isolates of all patients admitted with diabetic foot infection presented with Wagner grade 2 -5 ulcers. Bacteriological diagnosis and antibiotic sensitivity profiles were carried out and analysed using standard procedures.

Results: Diabetic polyneuropathy was found to be common in (51.1%) and gram positive bacteria were isolated more often than gram-negative ones in the patients screened. The most frequent bacterial isolate were Staphylococcus aureus (38.4%), Pseudomonas aeruginosa (17.5%), and Proteus (14%). Imipenem was the most effective agent against gram-negative organisms. Vancomycine was found to be most effective against gram-positive organisms.[13]

Conclusion: Staph aureus and Pseodomonas aeruginosa were the most common causes of diabetic foot infections in Bir Hospital. Theses wounds require use of combined antimicrobial therapy for initial management, repeated dressing and wound debridements were done.

Foot ulceration and infections are one of the leading causes of mortality and morbidity, especially in developing countries one of like Nepal. The numbers of cases and problems associated with diabetic foot infections (DFI) have dramatically increased in recent years[1, 2]. The main reason for this increase is the growing diabetic population in younger groups. Ulceration of the foot in diabetes is a common and disabling and frequently leads to amputation of the leg. Mortality is high and healed ulcers often recur. The pathogenesis of foot ulceration is complex, clinical presentation is variable, and its management requires early expert assessment[3]. Interventions should be directed towards infection control, peripheral ischaemia management, and abnormal pressure loading management caused by peripheral neuropathy and limited joint mobility. Despite treatment, ulcers readily become chronic wounds. Diabetic foot ulcers have been neglected in health-care research and planning, and clinical practice is based more on opinions than the scientific figures and facts. Furthermore, the pathological processes are poorly understood and poorly taught Communication between the many specialties involved is disjointed and is insensitive to the needs of the patients. Ischemia, neuropathy, and infection in patient with DM combine to produce tissue necrosis and ulcers. Early recognition of lesions and prompt initiation of appropriate antibiotic therapy, as well as aggressive surgical debridement of necrotic soft tissues and bones, and a modification of host factors i.e., hyperglycaemia, concomitant arterial insufficiency are all equally important for successful outcome[4]. Initial therapy of diabetic foot infections is frequently empiric because reliable culture data is lacking. There is variability in prevalence of common bacterial pathogens isolated, as shown in different studies[5]. The choice of empirical antimicrobial therapy is influenced by various factors. These include the severity of the illness (Wagner grading), the most likely type of causative organism[6], and coexisting complications, such as underlying osteomyelitis. Host factors, for example comorbid conditions, good glycaemic control, concomitant renal and cardiovascular diseases can affect the need for hospital admission and the choice of specific agents or their dosing intervals[7].

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The aim of this paper was to study the common pathogens isolated in diabetic foot ulcers at Bir Hospital. We also included the antimicrobial susceptibility to varieties of commonly used antimicrobial agents, through culture and sensitivities test.

Material and methods

This is a retrospective study which was conducted at Bir Hospital, NAMS General Surgery Unit III. A total of 43 patients were included in this study, from November 2004 to November 2005. The clinical data taken were, duration of Diabetes disease, type of diabetes, treatment history and other associated comorbid conditions e.g. Hypertension, Pulmonary Tuberculosis, Ischemic heart diseases, cardiovascular disease, Liver disorders, renal disorders. There were obtained at the time of admission. All the data were collected from the hospital record section and was analyzed. The materials used for the microbiological evaluation were wound swabs, Curetted materials from the base of the ulcers, needle aspiration of the abscess and aspiration of material through infected skin, deep tissues by tissue culture.

Results

The clinical characteristics of 43 patients studied are shown in Table 1. In general, the patients were elderly and had been on oral hypoglycaemic. Diabetes was uncontrolled or poorly controlled in 71 % of the cases. The vast majority of these patients had the infected foot ulcer for more than one month duration.

Table 1: General clinical features of 43 consecutive diabetic patients with infected foot ulcers

Features	Number of patients	Percentage (%) of patients
Age (Years)	Mean age 61 ± 1.7	range 37-96 yrs
Sex		
Male	24	55.8%
Female	19	44.2%
Diabetic medication		
Oralhypoglycaemic	27	63%
Insulin dependant	16	38%
Associated other diseases		
Diabetic polyneuropathy	22	51.1%
Ischaemic heart disease (IHD)	11	25.5%
Diabetic retinopathy	9	20.9%
Diabetic nephropathy	7	16.2%
Peripheral Vascular disease	5	11.6%
Duration of foot infection		
> 1 month	36	83.7%
< 1 month	7	16.2%
Type of surgery		
Debridement	22	51.1%
Toe amputation	7	16.2%
Ray amputation	5	11.6%
Transmetatarsal	2	4.5%
Syme's amputation	2	4.5%
Below knee amputation	1	2.3%
Above knee amputaion	1	2.3%

All diabetic foots were classified and grouped according to Wagner grading system, In the Wagner classification system, foot lesions are divided into six grades based on the depth of the wound and the extent of tissue necrosis,

Grade 0 — Preulcer. No open lesions, skin intact; may have deformities, erythematous areas of pressure or hyperkeratosis.
Grade 1 — Superficial ulcer. Disruption of skin without penetration of the subcutaneous fat layer. Superficial infection with or without cellulitis may be present.
Grade 2 — Full-thickness ulcer. Penetrates through fat to tendon, or joint capsule without deep abscess or osteomyelitis.
Grade 3 — Deep ulcer which may or may not probe to bone, with abscess, osteomyelitis, or joint sepsis. Includes deep plantar space infections or abscesses, necrotizing fasciitis, and tendon sheath infections.
Grade 4 — Denotes gangrene of a geographical portion of the foot such as toes, forefoot or heel. The remainder of the foot is salvageable though it maybe infected. (Fig. 2)
Grade 5 — Gangrene or necrosis to the extent that the foot is beyond salvage and will require a major limb- or life-sparing amputation.

Failure of the Wagner classification to specifically address infection and ischemia within each grade (30) has been recognized and hybrid schemes have been developed to account for these important attributes of foot ulcers (16,134). A simplified system which only attaches modifiers for ischemia (A) and infection (B) to the well-known Wagner system is presented (Table 2), recognizing that grades 3 through 5 usually have some degree of infection inherent within these lesions. Another hybrid method for classifying diabetic foot lesions has been popularized by the University of Texas and has been retrospectively validated within that centre (135,136). This scheme employs four grades of depth with four associated stages based on ischemia, infection, or both. This system is also generally accepted and reasonable and a modified well Wagner was introduced.

Table 2: Modified Wagner Classification System

Grade Lesion
0 No open lesions: may have deformity or cellulitis
A Ischemic B Infected
1 Superficial ulcer
A Ischemic B Infected
2 Deep ulcers to tendon, or joint capsule
A Ischemic B Infected
3 Deep ulcers with abscess, osteomyelitis, or joint sepsis
A Ischemic B Infected
4 Localized gangrene — forefoot or heel
A Ischemic B Infected
5 Gangrene of entire foot
A Ischemic B Infected

Fig. 1: Classic diabetic "malperforans" foot ulcer

Fig. 2: Ischemic gangrene of the forefoot

Fig. 3: Limb-threatening infection with large midfoot ulceration

Fig. 4: Infected diabetic foot ulcer and pus collected in test tube from same patient.

Table 3: Wagners grade number of patients in each grade and their percentage in our study.

Wagner Grades	Number	Percentage (%)
0	0	0
1	5	11.6
2	23	53.4
3	9	20.9
4	5	11.6
5	1	2.9

The commonest among all in our studies were grade two ulcers. Total of 23 (53.4%) patients, Grade three in a case e.g. 20.9% (Table 3). The organisms that were isolated from the diabetic foot infection are presented in Table 4. Staphylococcus aureus (38.4%), Pseudomonas aeruginosa (17.5%), and Protues mirabilis (14%) were the commonest bacterial species most commonly isolated from the patients with the diabetic foot lesions. Aerobic gram-positive cocci represents 73.6% of the isolates, gram-negative aerobes were represented in 36.4%. 27 patients had more than one organism isolated from their lesions. 16 patients had only one organism isolated from the diabetic foot lesion. Staph. aureus was the most predominant isolate, being isolated from 8 patients (50%) , Protues in 4 patients (25%), Streptococci in 2 patients (12.5%) and Pseudomonas aeruginosa in 2 patients (12.5%). The antimicrobial susceptibility pattern of the gram-positive cocci is shown in Table 5. In 82.2% of cases Staph aureus were resistant to Ampicillin and 100% of streptococci were resistance to Ampicillin. The most sensitive drug was found to be Gentamicin. Cloxacillin and Ciprofloxacin were second most in sensitivity having a resistance of only 11.6% of Staph aureus. Cloxacillin and Ciprofloxacin were sensitive to streptococcus with 0% of resistance in this study. The antimicrobial susceptibility pattern of the gram-negative bacilli is shown in Table 6. E. Coli were resistant to almost all the drugs studied. Amikacine had a slightly better sensitivity to E coli. Amikacin remains the best antibiotic for proteus and pseudomonas also.

Table 4: Shows isolates from the diabetic foot infection of 43 patients

Bacteria Isolated	Number	%
Gram-positive aerobes		
Staph aureus	17	38.4
Streptococci	5	10.6
Gram-negative aerobes		
Pseudomonas aeruginosa	8	17.5
Proteus	6	14
E.Coli	4	9.3

Table 5: Antimicrobial resistance pattern of gram-positive cocci

Antimicrobial agent	Staph aureus		Streptococcus	
	N = 17	%	N = 7	%
Ampicillin	15	88.2	7	100
Amoxycillin	-	-	-	-
Chloramphenicol	-	-	-	-
Cephalexin	3	17.6	1	14.2
Ciprofloxacin	2	11.6	0	0
Cloxacillin	2	11.6	0	0
Ofloxacin	-	-	-	-
Erythromycin	6	35.2	0	0
Cefotaxim	-	-	-	-
Gentamicin	1	5.8	0	0
Amikacin	-	-	-	-

Table 6: Antimicrobial resistance pattern of gram-negative bacilli

Antimicrobial agent	Pseudomonas aeruginosa		Proteus		E.Coli	
	N = 8	%	N = 6	%	N = 4	%
Ampicillin	-	-	-	-	-	-
Co/Amoxyclav.	8	100	2	25	3	75
Chloramphenicol	-	-	-	-	-	-
Cephalexin	8	100	2	25	4	100
Ciprofloxacin	5	52.5	0	0	4	100
Cloxacillin	-	-	-	-	-	-
Ofloxacin	-	-	-	-	-	-
Erythromycin	-	-	-	-	-	-
Cefotaxim	3	37.5	0	0	4	100
Gentamicin	2	25	0	0	4	100
Amikacin	1	12.5	0	0	1	25

Discussion

Diabetic foot infections are generally polymicrobial. It is classified NLTI (Non limb threatening infection) and LTI (Limb threatening infection). Cellulitis < 2 cm is termed as NLTI, where as cellulitis > 2 cm is called LTI. Among the most frequently isolated micro organisms from the lesions are Staph aureus, Pseudomonas aeruginosa, and Protues mirabilis but anaerobes and fungal infections are also responsible for diabetic foot infection.

Our study was designed to analyze culture sensitivity patterns and nature of the pathogens in diabetic foot infected patients admitted in Bir Hospital with various complications. Most of them our patients were of grade 2 and 3 ulcers according to Wagner grade. In this study Amikacin was found to be sensitive for the gram positive cocci like Staph. aureus but a combination of therapy were found to be satisfactory. For the gram negative organisms cephalosporins, aminoglycides and fluoroquinolone were effective. The choice of antimicrobial therapy should be based on the result of culture sensitivity pattern. So we recommend starting an Empirical combination rather than any single antibiotics. Later on when the result of culture sensitivity report is available switch over to an antibiotic with highest sensitivity. The limitation of this study was that anaerobes and fungi were not isolated. This is probably due to lack of culture media facilities. If we all adhere to this simple rule and follow the basic principles many limbs will be salvaged, and this will be more productive for the nation.

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