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A Prospective Study on Bacterial Isolation from Diabetic Foot Ulcer in Department of Surgery

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ABSTRACT

Background: There are various wound classification systems to assess the severity of diabetic foot ulcer and involve different factors specifically depth, site, presence of neuropathy, ischemia etc. Wagner's system classification is the most widely used in grading of diabetic foot ulcers.
Methods: The case study was carried out in the Department of Surgery, Geetanjali Medical College and Hospital, Udaipur.
Results: 173 cases were enrolled in study and grade-3 Wagner's ulcers were predominant. Males were predominant. Peripheral arterial disease was more common than peripheral neuropathy and both were found significantly associated with development of ulcers. Methicillin resistant Staphylococcus aureus and Klebsiella pneumoniae were most common isolates. MRSA exhibited maximum sensitivity to vancomycin, clindamycin and linezolid. Gram negative isolates exhibited maximum sensitivity to meropenems, piperacillin-tazobactam.
Conclusions: This study conclude that prospective multicenter studies are required to assess the appropriate antibiotic regimen in diabetic foot ulcers and proper management of antibiotics must be started to decrease the incidence and development of MDR organisms.

Keywords: *Diabetes mellitus, MRSA, MSSA, Klebsiella pneumoniae*

INTRODUCTION

Diabetes mellitus (DM) is one of the most important and rapidly evolving non-communicable diseases which needs top priority throughout the world. 61.3 million persons have been reported to be suffering from DM in India (2011 estimates) and this number is expected to rise by 101.2 million by the end of 2030. 10-25% of diabetics have been found to develop diabetic foot infections [DFI's].[1-3] Foot ulceration and infections are the most common and stern complication of DM.[1] The annual incidence of leg and foot ulcers have been reported to be 6.5 and 33 times more common than diabetic coronary disease, stroke and renal failure respectively.[4-5] DFIs are a major medical, economic and social problem for diabetics as well as a leading cause of hospitalization. Peripheral neuropathy is the major underlying cause for the development of DFI's and it affects almost 30% of diabetic population. Peripheral neuropathy leads to loss of protective sensation of pressure and pain, as well as reduced joint mobility.[3] In various studies, *Staphylococcus aureus* have been reported as the main causative pathogen of DFIs.[6-8] It is important to know the microbiological profile of the ongoing infection for selecting the most appropriate antimicrobial therapy for better treatment of DFI. It has been revealed in several studies that DFIs are usually polymicrobial.[9-10] These microbial infections of the diabetic foot ulcers are usually difficult to control efficiently because of multiple associated factors such as strict glycemic control along with associated complications like vascular disease and neuropathy which increases the chances of amputation of lower limb.[3]

There are various wound classification systems to assess the severity of diabetic foot ulcer and involve different factors specifically depth, site, presence of neuropathy, ischemia etc. Wagner's system classification is the most widely used in grading of diabetic foot ulcers. The present study was done to assess the microbial flora as per Wagner's classification for diabetic foot disease to identify and isolate the aerobic bacterial pathogens as well as their drug sensitivity pattern with reference to ESBL production.[11]

METHODS

Study population:- One seventy three patients included in this study each from foot ulcer.

Study Area:- The case study was carried out in the Department of Surgery, Geetanjali Medical College and Hospital, Udaipur.

Sampling technique & Data collection:- All the cases were admitted in the clinic and followed until discharge. The age, sex, duration of diabetes, duration of ulcer, type of ulcer, glycaemic control, associated complications like peripheral ischemia signs (intermittent claudication with or without peripheral pulses) were noted. Size of the ulcer was measured by multiplying the longest and widest diameters and expressed in centimeters squared. Assessment of the ulcer and grading as per the Wagner's classification was done by one General surgeon throughout the study to obviate inter observation bias. The Wagner's system assesses ulcer depth and grades as follows: grade-0 (pre-or post-ulcerative lesion), grade-1 (Partial/Full thickness ulcer), grade-2 (probing to tendon or capsule), grade-3 (deep with osteitis), grade-4 (partial foot gangrene) and grade-5 (whole foot gangrene) (Table 1).7 Ulcers were labelled infected if purulent discharge was present with signs of inflammation or lymphangitis / lymphadenopathy or edema. Osteomyelitis was diagnosed based on suggestive radiological findings or bone scan. All the cases were monitored until discharge.

Data analysis:- Data were analyzed by the using Microsoft excel.

RESULTS

In the present study, 173 patients were included from the department of surgery. Among the 173 patients 71.6% were male and 28.4% were female and 42.8% belongs to 41-50 age groups over the (36.9%) and (20.6%).In all patients 4.6% were suffering from Type I Diabetes mellitus & 95.4% were suffering from Type II Diabetes mellitus. In this study, the duration of Diabetes 16.2% occurs in less than 5 year & 40.4 % Diabetes occurs in 6-10 year. In our study, prevalence of gram positive and gram-negative bacteria were 52.6% and 47.3% respectively.

Table 1: Distribution of cases according to gender

Gender	No. of Patients	Percentage
Male	124	71.6%
Female	49	28.4%
Total	173	100%

Table 2: Distribution of cases according to age

Age	No. of Patients	Percentage
31-40	35	20.6%
41-50	74	42.8%
>51	64	36.9%
Total	173	100%

Table :- 3 Distribution of cases according to types of Diabetes mellitus

Diabetes mellitus	No. of Patients	Percentage
Type I	8	4.6%
Type II	165	95.4%
Total	173	100%

Table :- 4 Distribution of cases according to duration of Diabetes

Duration of Diabetes	No. of Patients	Percentage
<5 year	28	16.2%
6-10 Year	75	43.4%
>10 Year	70	40.4%
Total	173	100%

Table :- 5 Risk factor of cases in this study

Risk factor	Yes	NO
Smoking	106	67%
Alcoholism	101	72%
Hypertension	149	24%

Table:- 6 Risk factor of cases in this study

Hb1C	No. of Patients	Percentage
<6.5	72	41.6%
>6.5	101	58.4%
Total	173	100%

Table :- 7 Size & Duration of ulcer of cases in this study

Size & Duration ulcer	<3 months	>3 months
<2.5 cm	62	26%
>2.5 cm	51	34%
Total	113	60%

Table :- 8 Profile of gram positive bacteria isolated from diabetic foot infections

Gram Positive Organisms	No. of organisms		Percentage	
Staphylococcus aureus	55		60.4%	
MRSA MSSA	24	31	26.3%	34.0%
Enterococcus spp.	16		17.5%	
Streptococci	12		13.1%	
CONS	8		8.7%	
TOTAL	91 (52.6%)		100%	

Table :- 9 Profile of gram negative bacteria isolated from diabetic foot infections.

Gram negative Organisms	No. of organisms	Percentage
Klebsiella pneumoniae	29	35.3%
Pseudomonas aeruginosa	15	18.6%
Proteus sp	16	19.6%
Citrobacter sp	22	26.8%
TOTAL	82 (47.3%)	100%

DISCUSSION

DFIs are one of the most severe complications, with a diabetic individual, encountered during his uncontrolled glycemic control and with other associated complications. In

the present study, DFI is more prevalent in males (71.6%) than females (28.4%). The prevalence of 71.7% has been reported in males in the present study supported by findings of Jeffcoate EJ.[12] Majority of the cases in our study are of Grade-3 just like the findings of some other studies[13-14] but contrary to the findings of Mayfeild JA who reported prevalence of grade-2 in his study.[15] Our findings, of the increased chances of developing DFIs in persons having DM for more than ten years, are almost similar to the findings of Yonem.[16] Incidences of Peripheral neuropathy (PN) and peripheral arterial disease were observed respectively to be 25.4% and 37% in our study almost similar to the findings of Gershater MA.[17] In our study, association was observed between development of DFI and significant risk factors of poor glycaemic controls with raised levels of HbA1c and long duration of hypertension just like reported in other studies.[18,19] While other risk factors like smoking, alcoholism, site of the ulcer, past history of treatment for DFI had not shown any significant association. In our study, Gram positive pathogens were more common than gram negative pathogens contrary to the findings of Viswanathan V but similar to the findings of Baba M. [20-21]

In our study methicillin resistant *Staphylococcus aureus* (60.4%) was the most common gram-positive pathogen followed by *Klebsiella pneumoniae* (35.3%) among gram negative. These findings are similar to various works of southern India but are contrary to the studies of northern India who reported *Escherichia coli* as the most common gram-negative pathogen and Coagulase Negative *Staphylococci* as gram positive pathogen. Coagulase Negative *Staphylococci* prevalence was found to be 8.7% in our study indicating an increasing trend in the emergence of CONS as an important pathogen of DFI alone or as a part of polymicrobial infections. Among the gram-negative pathogens, *Citrobacter spp (26.6%)* was next in prevalence to *Klebsiella pneumoniae* (35.3%) and was resistant to most of the commonly used drugs. Findings of the present study were almost similar to many worldwide studies stating *Klebsiella* and *Proteus spp.* as most important pathogens implicated in serious infections of the diabetic foot ulcer.[22] Vancomycin, linezolid and clindamycin followed by netilmicin, amikacin, amoxyclavulanic acid are the most susceptible drugs against the gram-positive pathogens. MRSA has been a pathogen of concern in DFI for past two decades. All the strains were found to be susceptible to clindamycin, vancomycin and linezolid.

Multidrug resistance is a serious concern among gram negative pathogens due to the production of extended spectrum B-lactamases (ESBL). In our study, *Pseudomonas aeruginosa* was one of the major ESBL producers with 15% prevalence followed by *Klebsiella pneumoniae* and Most of the worldwide studies are concerned with the development of drug resistance due to ESBL production which was also observed in our study. MDR isolates were found to be susceptible to meropenem, piperacillin-tazobactam and ceoperazone-sulbactum in our study.

CONCLUSION

DFIs are a serious concern in uncontrolled DM and proper

management is necessary.

Outcome of the DFIs depends upon the grading of the ulcer as per Wagner's classification and the nature of the infection either with a single pathogen or polymicrobial. The present study presented the bacteriological profile of the DFIs with Wagner's grading of ulcer and associated risk factors in management and outcome of the ulcer. It can be suggested by the present study that prospective multicenter studies are required to assess the appropriate antibiotic regimen in diabetic foot ulcers and proper management of antibiotics must be started to decrease the incidence and development of MDR organisms.

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