Original Research Paper

Volume : 5 | Issue : 11 | November 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

A Prospective Study of Diabetic Foot Infections (DIFs) in a Teaching Hospital of Semi Urban Setup

Microbiology

KEYWORDS : Antimicrobial sensitivity, Diabetic foot Infections (DFIs), Diabetes mellitus (DM), Escherichia coli , Staphyloccus aureus

Prof.Dr.BALLA MALLAYYA	Professor and Head, Department of General Surgery, Great Eastern Medical School RagoluVillage, Near Srikakulam, PIN- 532484, Andhra Pradesh, India
Prof.Dr.PERALA BALA MURALI KRISHNA	Professor, Department of Microbiology, Gayatri Vidya Parishad Institute of Health Care & Medical Technology, Marikavalasa, Madhurawada, Visakhapatnam – 530048, Andhra Pradesh, India
Dr.BANDARU SRIUSHASWINI	Senior Resident in General Surgery,Andhra Medical College/ King George Hospital Visakhapatnam – 530002
*** Prof.Dr.BANDARU NARASINGA RAO**	Professor & Head, Department of Microbiology, Gayatri Vidya Parishad Institute of Health Care & Medical Technology, Marikavalasa, Madhurawada, Visakhapatnam –530048 *Corresponding author

ABSTRACT

Background: Diabetic foot ulcer (DFIs) as the leading cause of lower limb amputation is one of the most important complications of diabetes mellitus (DM). The Indian diabetic population is expected to increase to 57 million by the year 2025. Mostly, the diabetic foot infections are mixed bacterial infections and the proper management of these infections requires an appropriate antibiotic selection, based on the culture and the antimicrobial susceptibility testing results. Hence, an attempt was made with the aim of determining the bacterial profile of infected diabetic foot ulcers and their antimicrobial resistance pattern. Patients and Methods: One hundred and twenty six diabetic patients with foot ulcers were included in the present study during a period of one and half years. Aerobic bacterial isolation was done from the specimens of these patients and their antimicrobial sensitivity pattern was studied using standard bacteriological techniques. Results: A total of 178 bacterial isolates were obtained from 126 patients with diabetic foot infections. Gram negative bacilli were predominant (67.42%) than gram positive cocci. The commonest isolate was Escherichia coli (31.46%) followed by Staphyloccus aureus (17.98%). The DFIs were of polymicrobial in nature. Majority of the bacterial isolates were highly sensitive to Amikacin, Cefotaxime, Ceftriaxone, Gentamicin in both gram positive and negative group whereas Staphylococcus aureus including MRSA were sensitive to Vancomycin. Conclusions: DFIs are common in diabetics and pose serious health problems for developing countries. Long duration of hospitalization of patients with high percentage of the amputations and overall mortality rates highlight the high burden of DFIs and the significance of its prevention and early treatment. To conclude, a multidisciplinary approach can confer better treatment and outcome with respect to DFIs.

INTRODUCTION

Infection is defined by overgrowth of microorganisms within a wound that promotes deleterious inflammation or tissue destruction[1]. Infection usually begins as a local process, manifested by the classic signs and symptoms of inflammation (redness, warmth, pain, tenderness, induration[2].) If not controlled, infection typically spreads—mostly often contiguously to deeper tissues. A host systemic inflammatory response syndrome (for example, fever, chills, hypotension, tachycardia, delirium, leukocytosis) may accompany this process[2]. Foot wounds are an increasingly common problem in people with diabetes mellitus (DM) and now constitute the most frequent diabetes-related cause of hospitalization[3]. People with diabetes have about a 25% chance of developing a foot ulcer in their lifetime[4], about half of which are clinically infected at presentation[3,5]. Diabetic Foot Infections (DFIs) cause substantial morbidity and at least one in five results in a lower extremity amputation[6]. Amputation is even more likely when DFI and foot ischemia coexist[5,7] . In fact, DFIs are now the predominant proximate trigger for lower extremity amputations worldwide[8,9]. The Indian diabetic population is expected to increase to 57 million by the year 2025[10]. The individuals with diabetes have at least a 10-fold greater risk of being hospitalized for soft tissue and bone infections of the foot than individuals without diabetes [10]. The local injuries and the improper foot wear further compromise the blood supply in the lower extremities[11]. While the foot infections in persons with diabetes are initially treated empirically, a therapy which is directed at the known causative organisms may improve the outcome[12]. Mostly, the diabetic foot infections are mixed bacterial infections and the proper management of these infections require an appropriate antibiotic selection, based on the culture and the antimicrobial susceptibility testing results[13]. Hence, we made an attempt with the aim of determining the bacterial profile of infected diabetic foot ulcers and their antimicrobial resistance pattern.

PATIENTS AND METHODS

One hundred and twenty six diabetic patients with foot ulcers were included in the present study during a period of one and half years. The institutional ethical committee's clearance was obtained before conducting the study. A clinical history was elicited with regards to the duration of diabetes, the type of treatment which was received and the presence of other systemic illnesses which also included their age and sex. The patients were also assessed clinically and the ulcers were graded according to Wagner and Meggitt classification[14]. The samples were collected after obtaining informed consents from the patients. Samples were collected from the deeper portion of the ulcers using Levine Technique[15] by 2 sterile swabs. One swab was used for Gram staining and the other was used for culture. A direct Gram stained smear of the specimen was examined. The specimens were inoculated onto blood agar, chocolate agar, Mac Conkey's agar (Himedia, Mumbai,India). The inoculated plates were incubated at 37 ^{0}C overnight and the plates were examined for growth, the next day. The further processing of the isolate was done using standard microbiological techniques[16] . All staphylococcus aureus isolates were further tested for Methicillin resistance using cefoxitin(30

μg) disc as recent literature showed that MRSA testing is more sensitive and specific by using cefoxitin (30μg) disc rather than oxacillin (30 μg)disc[17,18]. An inhibition zone diameter of ≤ 21 mm was reported as Methicillin resistant and ≥ 22 mm was considered as Methicillin sensitive[19]. MRSA ATCC strain No. 43300 was included as a control strain. The antibiotic susceptibility testing was done by the Kirby Bauer disc diffusion method, as per the CLSI guidelines, 2011[20]. The antimicrobial discs(Himedia, Mumbai, India) included in the present study were Penicillin(10units), Ampicillin (10μg), Gentamicin (10μg), Amikacin (30μg), Cefazolin (30 μg), Cefuroxime (30μg) Ceftazidime (30μg), Cefotaxime (30μg), Ceftriaxone (30μg), Imipenem (10μg), Imipenem(10Ug). In addition, Vancomycin (30μg), Teicoplanin (30μg)), Linezolid (30μg) and were added to study the susceptibility patterns of the Gram positive cocci.

RESULTS

In our present study, the age of the patients ranged from 25 to 80 years. The maximum number of patients (58%) was in the age group of 46 to 65 years. Male were predominant than female with 62.68% (Table-1). A total of 178 bacterial isolates were obtained from 126 patients with diabetic foot infections. Gram negative bacilli were predominant (67.42%) than gram positive cocci. The commonest isolate was *Escherichia coli* (31.46%) followed by and *Staphyloccus aureus* (17.98%). Among these *Staphyloccus aureus* , 56.25% were Methicillin resistant *Staphylococcus aureus* (MRSA). The other organisms which were isolated were *Streptococcus pyogenes* (10.6%), *Pseudomonas aeruginosa*(13.48%), *Klebsiella spp* (11.24%), Proteus species (8.99%), (*Acinetobacter spp* (2.25%) among gram negative group , Streptococcus pyogenes(6.74%), Coagulase negative Staphylococci (CoNS) (6.18%) and *Enterococcus spp.* (1.69%) among gram positive group. The DFIs were of polymicrobial in nature with two organisms in 27 patients 3 organisms in 25 patients. The details of the organisms which were isolated from the infected foot lesions were shown in table-2. The antimicrobial sensitivity was shown in table-3. Majority of the bacterial isolates were highly sensitive to Amikacin, Cefotaxime, Ceftriaxone, Gentamicin in both gram positive and negative group where as Staphylococcus aureus including MRSA were sensitive to Vancomycin.

DISCUSSION

The maximum number of patients with infected diabetic foot ulcers belonged to Wagner and Meggitt grade 3 and 4 in our study. Most of our patients developed DFIs in 5th and 6th decades of their life. Other studies also have found the average age of developing DFIs to be about 45–65 years[21,22]. Male patients accounted for 62.68% of our total study population. Other investigators have also reported male patients to comprise 50–63.3% of their study populations[23,24] . polymicrobial infections were observed in 52% of our patients studied which were in accordance with the studies of Nima Madanchi et al.[25] Gram negative bacilli were more prevalent (67.42%)than gram positive cocci (32.58%). The commonest isolate was *Escherichia coli* (31.46%) followed by and *Staphyloccus aureus* (17.98%). The other organisms which were isolated were *Streptococcus pyogenes* (10.6%), *Pseudomonas aeruginosa*(13.48%), *Klebsiella spp* (11.24%), Proteus species(8.99%), *Acinetobacter spp* (2.25%) among gram negative group , Streptococcus pyogenes(6.74%), Coagulase negative Staphylococci (CoNS) (6.18%) and *Enterococcus spp* (1.69%) among gram positive group. These findings were coinciding with the results of Benwan et al[26,] and Asha Mandalia et al[27] . Majority of the bacterial isolates were highly sensitive to Amikacin, Cefotaxime, Ceftriaxone, Gentamicin in both gram positive and negative group where as Staphylococcus aureus including MRSA were sensitive to Vancomycin in our study. Similar findings were observed by Shanker et al[28] , Zubair et al[29] and Prabhakar et al[30].

CONCLUSIONS

DFIs are common in diabetics and pose serious health problems for developing countries. Long duration of hospitalization of patients in with high percentage of the amputations and overall mortality rates highlights the high burden of DFIs and the significance of its prevention and early treatment. To conclude, a multidisciplinary approach can confer better treatment and outcome with respect to DFIs.

Table-1: Age and Sex distribution of DFIs studied

S.No.	Age	Number (n=126)	Male	Percent	Female	Percent	Total Percent
1	25-35	14	9	7.14	5	3.97	11.11
2	36-45	19	12	9.52	7	5.56	15.08
3	46-55	30	17	13,49	13	10.32	23.81
4	56-65	43	26	20.63	17	13.5	34.13
5	66-75	14	11	8.73	3	2.38	11.11
6	Above 75	6	4	3.17	2	1.59	4.76
Total		126	79	62.68	47	37.32	100.00

Table 2: Bacterial isolates among DFIs studied

Organisms isolated	Number	Percent
GRAM NEGATIVE (120) (67.42%)		
Escherichia coli	56	31.46
Pseudomonas aeruginosa	24	13.48
Klebsiella species	20	11.24
Proteus species	16	8.99
Acinetobacter species	4	2.25
GRAM POSITIVE (58) (32.58%)		
Staphylococcus aureus	32	17.98
Streptococcus pyogenes	12	6.74
Coagulase negative Staphylococci (CoNS)	11	6.18
Enterococcus species	3	1.69

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Table - 3: Antimicrobial Sensitivity Pattern of Bacterial Isolates among DFIs studied

S.No.	Antimicrobial	Gram Positive						Gram Negative											
		S.aureus (32)		Strepto. Pyogenes (12)		Coagulase Negative Staphy-loco. CoNS (11)		Entero-cocc-us spp. (3)		Esch.coli (56)		Pseudomo. spp. (24)		Klebsiella spp. (20)		Proteus spp.(16)		*Acinetobacter spp.(4)*	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1	Amikacin (30µg)	28	87.5	11	91.67	10	90.90	2	66.67	48	85.71	18	75.00	16	80.00	12	75.00	3	75.00
2	Ampicillin (10µg)	11	34.38	7	58.33	6	54.55	1	33.33	23	41.07	5	20.83	4	20.00	2	12.50	1	25.00
3	Cefotaxime (30µg)	28	87.5	10	83.33	10	90.90	2	66.67	46	64.29	16	66.67	16	80.00	10	62.50	3	75.00
4	Ceftazidime (30µg)	26	81.25	8	66.67	8	72.73	1	33.33	37	66.07	14	58.33	12	60.00	8	50.00	2	50.00
5	Ceftriaxone (30µg)	27	84.38	10	83.33	10	90.90	2	66.67	47	83.93	17	70.83	16	80.00	11	68.75	3	75.00
6	Cefuroxime (30µg)	24	75.00	9	75.00	7	63.63	1	33.33	38	67.86	12	50.00	11	55.00	9	56.25	2	50.00
7	Gentamicin (10µg)	31	96.88	11	91.67	10	90.90	2	66.67	50	89.29	22	50.00	18	90.00	14	87.50	4	100.00
8	Imipenem (10µg)	26	81.25	10	83.3	9	81.82	1	33.33	46	64.29	22	50.00	18	90.00	10	62.50	2	50.00
9	Linezolid (30µg)	29	90.63	10	83.33	10	90.90	1	33.33	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	Penicillin(10units)	0	0	9	75.00	0	0	1	33.33	12	21.43	0	0	6	30.00	2	12.50	1	25.00
11	Teicoplanin (30µg))	30	93.75	10	83.33	10	90.90	1	33.33	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	Vancomycin (30µg)	32	100.00	12	100.00	11	100.00	3	100.00	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

NT= Not Tested

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