



Original Article

Bacteriological Profile of Diabetic Foot Infection and Its Effect on Limb Salvation

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Abstract

Background: Foot ulceration has been reported as the leading cause of hospital admission and amputation in individuals with diabetes. Diabetes-related foot ulcers require multidisciplinary management and care, including debridement, offloading, dressings, management of infection, modified footwear and management of extrinsic factors.

Objective: To identify the bacterial pathogens responsible for diabetic foot infections and its effect on limb salvation.

Methods: This prospective observational and cross sectional study was conducted among 100 diabetic foot ulceration patients in Mainamati Medical College Hospital, Cumilla between the period of January, 2017 to December, 2018. The patients with diabetic foot ulcer Wagner Grade (2-5) irrespective of age and sex were included in the study. They were thoroughly examined and swab from ulcer base was collected by sterile swab stick and container supplied by the microbiology department. A pre-structured, peer reviewed, interview and observation based data collection sheet was prepared that was used as a research tool. Data regarding clinical, hematological and bacteriological profile were recorded by data collection sheet. Data were entered, managed and analyzed.

Results: Diabetic foot was very common in the elderly age group (51-60yrs) 38% and male predominant (78%). Staphylococcus aureus (35%) is the commonest pathogens affecting as the gram positive cocci whereas pseudomonas (23%) is the commonest among the gram negative bacilli. Chloramphenicol, Amikacin, Vancomycin were the most sensitive drugs against gram positive cocci whereas, Cefuroxin, Co-trimoxazole and Gentamycin found the most sensitive drugs against gram negative bacilli. Incision, drainage and dressing (31%) found the commonest treatment modality. The other treatment modalities were debridement, dressing and reconstruction conservative dressing, above and below knee amputation, toe disarticulation etc.

Conclusion: Diabetic foot is usually affected by Staphylococcus aureus and streptococcus among the gram positive cocci and pseudomonas whereas Chlamydia and E. coli among the gram negative bacilli. For the limb salvage incision & drainage as well as debridement, excision and reconstruction are the mostly chosen procedure.

Key words: Diabetic foot, bacteriological profile, in diabetic foot infection, limb salvation.

Introduction

Diabetic foot is one of the most dreadful complications of uncontrolled diabetes mellitus. This metabolic endocrine chronic clinical entity, now-a-

days, has become a major public health issue the prevalence of which is hacking up globally at an alarming rate¹. The annual incidence of diabetic foot ulcer is chronologically 2, 6.5 and 33 times more frequent than diabetic coronary angiopathy, neuroangiopathy and renal angiopathy². It has been observed that approximately 15% of diabetic patients develop a foot ulcer during life time. Besides, 20% diabetic patients suffer from some type of foot infection in their life time³.

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The diabetic foot can be defined as an infection, ulceration and destruction of deep tissues of the foot, associated with neuropathy and/or PAD in the lower extremity of people with diabetes^{4,5}. The major components of pathophysiology are five in numbers including atherosclerosis, infection, peripheral neuropathy, impaired tissue metabolism and AV fistulation⁶. Infection in diabetic foot is usually due to polymicrobials including aerobic, anaerobic bacteria and fungi. The Wagner classification of diabetic foot ulcer classifies the severity and depth of tissue injury into five grades. In superficial grades (Wagner 1 and 2), aerobic bacteria (*Staphylococcus* Spp. *Enterobacteriaceae*) are predominant pathogens while anaerobic bacteria add up in Wagner grade 3 to 5 ulcer⁷.

Materials and Methods

The study was undertaken in Department of Surgery of Mainamati Medical College Hospital from January, 2017 to December, 2018. One hundred patients with diabetic foot ulcer were enrolled in the study. The patients with diabetic foot ulcer Wagner Grade (2-5) irrespective of age and sex were included in the study. All the patients were initially informed regarding the study and written consent was obtained. They were thoroughly examined and swab from ulcer base was collected by sterile swab stick and container supplied by the microbiology department for culture and sensitivity. A pre-structured, peer reviewed, interview and observation based data collection sheet was prepared that was used as a research tool. Data regarding clinical, hematological and bacteriological profile were recorded by data collection sheet. Data were entered, managed and analyzed using computer software.

Results

Table 1. Age and sex distribution of study population (n=100)

Age in years	Male No (%)	Female No (%)	p- value
31-40	08	04	
41-50	20	08	
51-60	31	07	0.34. ^{NS}
>60	19	03	
Total	78	22	
Mean±SD (age in yrs)	59.18± 11.13	52.15±12.69	

p-value was calculated by student's t test
NS: Not significant.

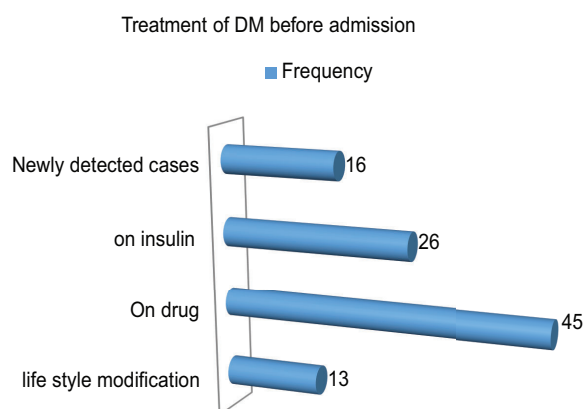


Figure 1. Treatment of DM before admission

Table 2. Distribution of patients with different presentation of Diabetic Foot (n=100)

Presenting Feature	Number of patients		Total (%)	p-value
	Male	Female		
Cellulitis	3	8	11	0.397 ^{NS}
Abscess	29	7	36	
Ulceration	36	4	40	
Gangrene	10	3	13	

p-value was calculated by chi square test

NS: Not significant.

Table-3. Distribution of patients with peripheral neuropathy (n=100)

Changes	Number of patients		Total (%)	p-value
	Male	Female		
Sensory loss	27	13	40	0.495 ^{NS}
Motor changes				
Ankle jerk diminished	23	3	26	
Patellar Tendon Reflex Diminished	17	3	20	
No sensory/Motor changes	13	1	14	

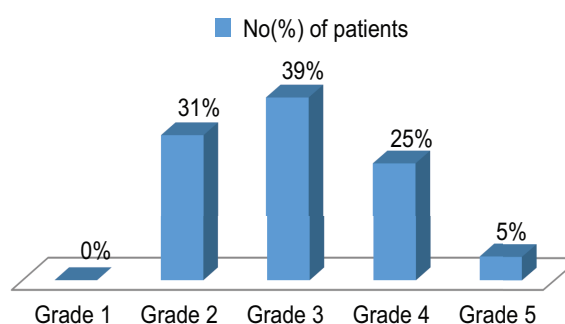
p-value was calculated by chi square test

NS: Not significant.

Table-4. Different types of pathogens isolated from the DFU (n=100)

Gram positive aerobes	Number (%)
Staph aureus	35%
MRSA	6%
Streptococcus	5%
Gram negative aerobes	
Pseudomonus aeruginosa	23%
Proteus	21%
E. coli	10%

No(%) of patients with different Wagner Grading Score

**Figure 2.** Wagner's Grading of wound**Table-V.** Antimicrobial sensitivity of gram positive cocci(n=46)

Antimicrobial agents	Staphylococcus aureus		MRSA		Streptococcus	
	No.(n=35)	(70%)	No(n=6)	(12%)	No.(n=5)	(%)
Amikacin	21	60%	-	-	16	100
Chloramphenicol	26	74.28%	-	-	-	-
Tetracycline	6	17.14%	2	33.33%	2	13.33
Co-trimaxazole	-	-	1	16.67%	-	-
Penicilin	2	5.71%	-	-	-	-
Ciprofloxacin	8	22.86%	1	16.67%	-	-
Cloxacilin	7	20%	-	-	-	-
Ofloxacin	-	-	2	33.33%	-	-
Erythromycin	4	11.43%	1	16.67%	-	-
Gentamycin	14	40%	-	-	-	-
Vancomycin	-	-	5	83.33%	-	-

Table 6. Antimicrobial sensitivity of gram negative bacilli(n=54)

Antimicrobial agents	P. aeruginosa		Proteus		E coli	
	No.(n=23)	(46%)	No(n=21)	(42%)	No.(n=10)	(20%)
Amoxyclav	8	34.78%	8	38.09%	3	30%
Gentamycin	12	52.17%	11	52.38%	4	40%
Ciprofloxacin	11	47.82%	10	47.62%	2	20%
Co-trimaxazole	12	52.17%	6	28.57%	-	-
Pefloxacin	-	-	3	14.23%	-	-
Amikacin	-	-	3	14.23%	-	-
Imipenam	4	17.39%	4	19.04%	-	-
Cefuroxim	15	65.22%	4	19.04%	1	10%
Ceftazidime	11	47.82%	-	-	1	10%

Discussion

Diabetes mellitus is a complex metabolic disorder. It can give rise to many tissue complications among which foot is particularly vulnerable to circulatory and neurological disorder. So, even minor trauma can lead to ulceration and infection. Careful observation and assessment of the wound is essential to ensure that the integrity of the limb is not threatened which could result in amputation. A multi-disciplinary team approach is the key to the successful management of diabetic foot.

In this study, diabetic foot was dominated by males (78%) which is comparable with a previous study⁸. This may be due to increased exposure of males to trivial trauma to the foot where as females are mostly indoors.

Patients with diabetic foot can manifest in various forms ranging from trivial non healing ulcer, abscess, toe gangrene, callosities to the florid necrotising fasciitis and wet gangrene. In this study, majority of them presented with ulceration (40%), followed by abscess (36%) and then gangrene (13%) and cellulitis (11%) of the patients. the majority of patients presented with ulceration (40%) in one study done in America⁹.

The Wagner's classification is the most commonly and widely accepted classification for grading of diabetic foot based on the depth of the wound. In this study, all grades except grade I & V wound were found. Grade 3 was the most predominant group constituting 39% which is comparable with one study

where Wagner grade 2(31%) and grade 4(25%) were the observations⁹.

In this study Staphylococcus was mostly sensitive which was subsequently followed by Chloramphenicol and Amikacin. On the contrary, MRSA showed most sensitivity which was subsequently followed by Vancomycin and then Ofloxacin & Tetracycline. Streptococcus showed more sensitivity in comparison to Amikacin & Tetracycline.

On the other hand, among the gram negative strains *Pseudomonas Auerigonosa* showed mostly sensitivity to Co-trimoxazole & Gentamycin followed by Ciprofloxacin whereas Proteus showed most sensitivity to Gentamycin followed by Ciprofloxacin. E.coli were mostly sensitive to Gentamycin followed by Amoxiclav.

In our study, mostly the surgeons tried to salvage the limb. So in the treatment procedure it was found that the incision & drainage and debridement plus reconstructive procedures were the method of choice in maximum patients. But minimum number of patients (11%) underwent amputations as treatment. Out of 11 patients, 6 achieved below knee amputation (BKA) and 5 achieved above knee amputation (AKA). Interestingly, the isolated pathogens from cases underwent above knee amputations were mostly polymicrobials and gram negative bacilli. So, it can be said that the fate of diabetic foot ulcer infected by these pathogens are very much aggressive.

Conclusion

The commonest mode of presentation of diabetic foot is ulceration. Staphylococcus is the major pathogens affecting diabetic ulcer in gram positive cocci groups whereas in the gram negative aerobes pseudomonas, Chlamydia and the E. coli are the more settling commensals. Ampicilin and Cephalixin are the most effective drugs for the gram positive group whereas Co-amoxycylav, Cephalosporine and Ciprofloxacin are the most effective in case of gram negative pathogens. For limb salvage in case of diabetic foot ulcers, incision and drainage as well as debridement & reconstructive surgery will be the effective procedure.

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