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Clinical and Microbiological Profile of Diabetic Foot Infections in Inpatients at a Tertiary Care Hospital

Dhanaleha P¹, Anand MR², Jayapradha S³, Abarna V⁴

¹Assistant Professor, Department of Microbiology, Sri Lakshminarayana Institute of Medical Sciences (SLIMS), Puducherry, India;

²Assistant Professor, Department of Orthopaedics, Govt. Thiruvavur Medical College, Thiruvavur, Tamil Nadu, India; ³Professor, Department of Microbiology, Sri Lakshminarayana Institute of Medical Sciences, Puducherry, India.

ABSTRACT

Introduction: Chronic foot infections in patients with diabetes mellitus are a common and difficult problem. The optimal management of these diabetic foot infections requires isolation and identification of the various pathogens and selection of appropriate antibiotic therapy according to the sensitivity patterns.

Aims and Objectives: To determine the prevalence of various bacterial pathogens in diabetic foot infections (DFIs).

Materials and Methods: A retrospective analysis of the culture of bacterial isolates of pus, pus swabs and tissue samples obtained from diabetic patients admitted in surgical wards at SLIMS, were carried out over 4 years from August 2016 to September 2020.

Results: Total growth constituted 131(95%) monomicrobial growth was 107 (78%) and polymicrobial growth was 24(17.5%). In our study, Gram-negative isolates were 77 (79%) with *Pseudomonas spp* being the most predominant. Most of the Gram-negative bacteria were found to be sensitive to amikacin (56.9%), imipenem (66.6%) and piperacillin-tazobactam (47.1%). Gram-positive isolates were 11 (11.3%) with *Staphylococcus aureus* being the most predominant. In our study Gram, positive isolates were sensitive to erythromycin (81.8%), ciprofloxacin (81.8%) and cotrimoxazole (54.5%). 100% sensitivity was observed with linezolid, teicoplanin and vancomycin. A total of 21 (27.3%) patients who presented with gangrene were amputated.

Conclusion: There is an increase in the prevalence of organisms as Wagner's grade increased with Gram-negative growth being more predominant. Frequent surveillance of antibiotic-resistant patterns would be useful for deciding empiric antibiotic therapy.

Key Words: Clinical and microbiological profile, Diabetic foot infections (DFI), Polymicrobial, Retrospective study, Sensitivity pattern, Wagner's Grading

INTRODUCTION

Chronic foot infections in patients with diabetes mellitus are common and difficult to treat. Diabetic individuals have at least a 10-fold greater risk of being hospitalized for soft tissue infections of the foot than normal individuals. The diabetic population in India will be expected to increase to 57 million in 2025. ¹The subcutaneous wounds have a likely chance of spreading into deeper tissues thus resulting in complications like gangrenous changes and amputations.³They usually complicate the initially uninfected ulcerations that follow minor trauma in patients with neuropathy resulting in chronic neuropathic ulcers and tissue necrosis or osteomyelitis with draining sinus.

Infection plays a major role in the development of moist gangrene. *Pseudomonas spp*, *Enterococcus spp* and *Proteus spp* are organisms which are responsible for extensive tissue destruction as there is poor blood circulation of the foot.

The optimal management of these diabetic foot infections requires isolation and identification of the various pathogens and selection of appropriate antibiotic therapy according to the sensitivity patterns. A retrospective study is carried out to find out the various bacterial pathogens in diabetic foot infections and their impact on the outcome of the patients.

Aims and Objectives: To determine the prevalence of various bacterial pathogens in diabetic foot infections (DFIs) and their susceptibility to antimicrobial agents. To investigate the

Corresponding Author:

Dr. Dhanaleha P, Assistant Professor, Department of Microbiology, Sri Lakshminarayana Institute of Medical Sciences (SLIMS), Puducherry, India; Mob: 9994196203; Email: danasamy1@gmail.com

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microbiological profiles of DFIs concerning different grades of Wagner classification and outcome for DFIs.

MATERIALS AND METHODS

A retrospective analysis of bacterial isolates from pus, pus swabs and tissue samples from diabetic patients admitted for surgical care was done covering a period of 4 years from August 2016 to September 2020. Processing of the samples for culture, bacterial identification and antimicrobial susceptibility pattern was done as per standard procedures.²A record of all samples received, details of the organism isolated along with its antibiotic sensitivity pattern for the first line and second-line agents are being maintained in the Microbiology laboratory analysis of grading of ulcers, risk factors and outcome of patients will be done from the records maintained in Medical Records Department. The results are represented in percentages.

RESULTS

In this study among 137 patients with DFI, 108 were male and 29 were female, the mean age distribution is 61-70 years. Total growth constituted 131(95%) monomicrobial growth was 107 (78%) and polymicrobial growth was 24(17.5%). The distribution of bacterial isolates according to Wagner's grades were 10.3% in I, 14.4% in II, 25.7% in III, 24.7% in IV and 24.7% in V (Table 1, Fig 1). In our study, Gram-negative isolates were 77 (79%) with *Pseudomonas spp* being the most predominant. Most of the Gram-negative bacteria were found to be sensitive to amikacin (56.9%), imipenem (66.6%) and piperacillin-tazobactam (47.1%) (Fig 2,3). Gram-positive isolates were 11 (11.3%) with *Staphylococcus aureus* being the most predominant. MRSA being 5.1%. In our study Gram-positive isolates were sensitive to erythromycin (81.8%), ciprofloxacin (81.8%) and cotrimoxazole (54.5%) (Fig 4). 100% sensitivity was observed with linezolid, teicoplanin and vancomycin. A total of 21 (27.3%) patients who presented with gangrene were amputated. The level of amputation ranged from toes (n=16) to below-knee (n=5). Empirical antibiotics used in these patients were third-generation cephalosporins.

DISCUSSION

In this study, males were more predominant than females, with the mean age distribution being 61-70 years which corresponds to a retrospective study in DFI patients conducted by McDonald et al.³

In the present study among 137 patients with DFI, monomicrobial growth was 107(78%) and polymicrobial growth was

24(17.5%), which is similar to the study conducted by Hadadi.⁴

Mohd Zubai,⁵Anandi,⁶Ramakant,⁷ Pappu K,⁸ and Citron,⁹ have reported 56.6%, 19%, 23 %, 92% and 16.2 % monomicrobial infections and 33%, 67%, 66%, 7.7% and 83 % of polymicrobial infections respectively.

The distribution of bacterial isolates according to Wagner's grades were 10.3% in I, 14.4% in II, 25.7% in III, 24.7% in IV and 24.7% in V, which coincides with the study conducted by Mahmoud B. Ahmed where bacterial growth was predominant in grade IV and V.¹⁰

In our study, Gram-negative isolates were 77(79%) with *Pseudomonas spp* being the most predominant (26.8%), followed by *Escherichia coli* (12.3%), which is in concordance with findings of Bansal and Jayashree Kona which is 76% and 72.36% respectively with *Pseudomonas aeruginosa* being predominant.^{11,12} Zubair and Hadadi reported *Escherichia coli* (26.6%) and 28% which is lower in the present study.^{5,4} Goh et al and Hadadi reported *Pseudomonas* 18% and 8%.^{13,4}

Gram-negative bacteria were found to be sensitive to amikacin (56.9%), imipenem (66.6%) and piperacillin-tazobactam (47.1%). Bansal observed 100% sensitivity to imipenem, 96% to piperacillin-tazobactam and 90% to Amikacin similarly Mahmoud B. Ahmed observed sensitivity of 98.3% to imipenem and 89.8% to amikacin which is much higher when compared to the present study.^{11,10}

Gram-positive isolates were 21% with *Staphylococcus aureus* (11.3%) being the most predominant whereas MRSA being 5.1%. This is similar to the study conducted by Bansal.¹¹ Alavi reported a single microorganism, mainly *Staphylococcus aureus*, as the most frequently isolated bacteria from diabetic foot patients.¹⁴ Whereas Macdonald et al also reported higher distribution of *Staphylococcus aureus* (32.5%) among Gram-positive organisms.³ Global prevalence of MRSA is found to be 15-30% but in our study, it is much lower.^{16,17} In our study Gram-positive isolates were sensitive to erythromycin (81.8%), ciprofloxacin (81.8%) and cotrimoxazole (54.5%).³ Alva observed cotrimoxazole to be 53.8% and ciprofloxacin to be 58.3% which is similar to the present study.¹⁸ 100 % sensitivity was observed with vancomycin, teicoplanin and linezolid which is similar to studies by M.B Girish and Jayashree Konar.^{15,12}

A total of 21 (27.3%) patients who presented with gangrene were amputated. The level of amputation ranged from toes (n=16) to below-knee (n=5). Hadadi and Alva reported 45.5% and 34.4% amputations in their studies.^{4,1} Empirical antibiotics used in these patients were third-generation cephalosporins. Treatment initiation with broad-spectrum antimicrobials including carbapenems and piperacillin-tazobactam for more extensive chronic moderate and severe infections is

a safety measure as suggested by a study.¹⁹ However definitive treatment should be initiated following antibiogram and clinical correlation. In deeper infections surgical as well as medical intervention is necessary management of DFIs.

CONCLUSION

There was an increase in the prevalence of bacteria as the Wagner's grade increased with Gram-negative growth being more predominant. Frequent surveillance of antibiotic resistance patterns would be useful in deciding empiric antibiotic therapy.

Further, the findings of this study emphasize the need to select the antimicrobial treatment which should be guided by proven culture results and antimicrobial sensitivity patterns exhibited by isolates.

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Authors' Contribution

Dr . Dhanaleha P: Clinical Study

Dr Jayapradha.S: Study Design, Literature Review

Dr Aparna V: Manuscript preparation
Dr Anand M.R: Manuscript editing

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Table 1: Distribution of bacterial isolates from various grades of diabetic foot infections.

Organism	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Total	%%
Gram negative bacilli						77	79
E.coli		2	3	3	4	12	12.3
Klebsiella spp	1	2	2	4	2	11	11.3
Enterobacter				2	2	4	4.1
Proteus spp		4	2	3	4	13	13.4
Pseudomonas spp	6	4	5	2	9	26	26.8
NFGNB	1	1	2		2	6	6.2
Acinetobacter spp			5			5	5.1
Gram-positive cocci						20	21
Staphylococcus aureus	2		3	5	1	11	11.3
MRSA		1	1	3		5	5.1
Streptococcus spp			1	2		3	3.1
Enterococcus spp			1			1	1
	10	14	25	24	24	97	100

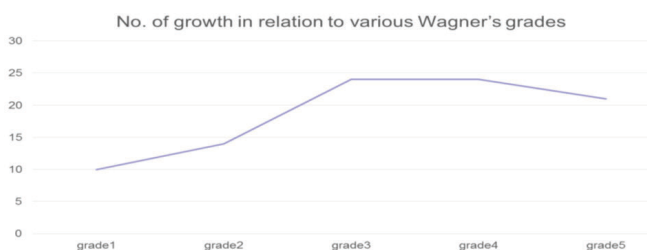


Figure 1

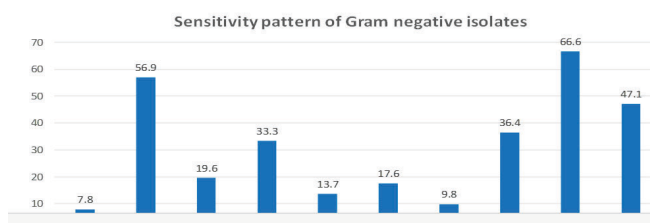


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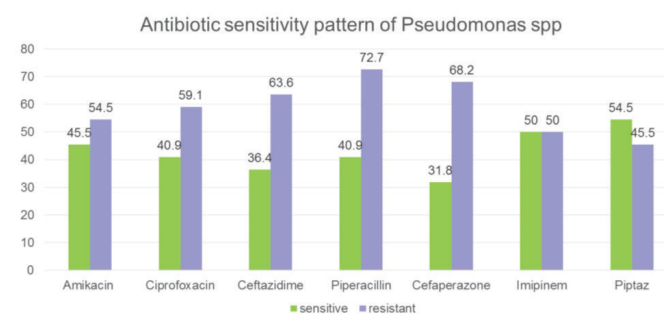


Figure 2

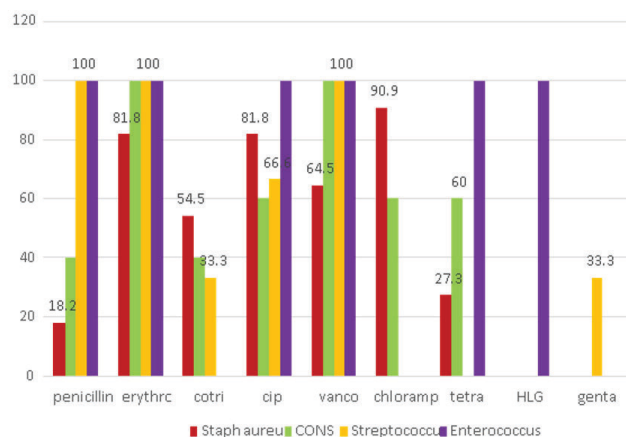


Figure 4: Sensitivity Pattern of Gram-positive cocci.