

**Original article:**

## **Bacteriological profile of diabetic foot infections in a tertiary care teaching hospital**

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### **Abstract:**

**Introduction:** India has a diabetic population of about 50.8 million, which is expected to increase to 87 million by 2030. Diabetic foot infections are among the most common bacterial infections encountered in patients with diabetes mellitus. Hence, this study was carried out to determine the frequency of aerobic bacterial isolates from diabetic foot ulcers and their antibiogram.

**Materials and methods:** This was a prospective study conducted on clinical specimens which were taken from 56 patients with diabetic foot infections, over a six months period. The clinical specimens were processed by using the standard microbiological techniques. The anti-microbial susceptibility pattern was studied by the Kirby-Bauer disc diffusion method.

**Results:** Among 56 cases, 33(58.73%) had mono-microbial infections, 16(28.57%) had poly-microbial infections, and 7(12.5%) had sterile culture. Among bacteria isolated, 34(52.31%) were Gram negative and 31(47.69%) were Gram positive. All Gram negative bacilli showed good sensitivity to Imipenem, Piperacillin-Tazobactam and Amikacin. All Gram positive cocci remained 100% sensitive to Vancomycin followed by Amikacin and Clindamycin in a range of 71.4 % to 100%.

**Conclusion:** Gram negative bacilli were predominantly isolated from diabetic foot ulcers. Piperacillin-Tazobactam and Amikacin would be essential for the empirical treatment.

**Key words:** Diabetic foot ulcers, Gram negative bacilli, Antibiogram

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### **Introduction:**

India has a diabetic population of about 50.8 million, which is expected to increase to 87 million by 2030.<sup>1</sup> Among persons with diabetes mellitus, the risk of developing a foot ulcer is estimated to be 15%. Based on recent studies, the annual population based incidence ranges from 1.0% to 4.1% and the

prevalence range from 4% to 10%, suggesting the life time incidence as high as 25%.<sup>2</sup>

The impaired micro-vascular circulation in patients with a diabetic foot limits the access of phagocytes, thus favoring the development of an infection.<sup>3</sup> The local injuries and the improper footwear further compromise the blood supply in the lower extremi

ties.<sup>4</sup> 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.<sup>5</sup> More than half of patients who have undergone lower extremity amputation will have a contralateral amputation within 5 years and half of those who undergo amputation will die within 3 years.<sup>6</sup> E.coli, Klebsiella species, Proteus species, Pseudomonas species, S.aureus, and Enterococcus species are the most frequent pathogens which are cultured from diabetic foot ulcers.

The infections in the diabetic foot are usually polymicrobial due to aerobic bacteria, anaerobes and Candida spp. The severe infections usually yield polymicrobial isolates, whereas the milder infections are generally monomicrobial.<sup>7</sup>The specific organisms found in diabetic footinfections will differ not only from patient to patientand hospital to hospital, but also from one part of thecountry to another.Hence, this study was carried out to determine the frequency of aerobic bacterial isolates from diabeticfoot ulcers and their antibiogram.

#### **Materials and Methods:**

A prospective study was conducted on 56 patients admitted with infected diabetic foot over a period of six months(Jan 2010 to Jun 2010)at PES medical college and hospital, Kuppam. Proforma includes age, sex, history of trauma, habit of bare foot walking, alcohol, smoking,socio-economic status, duration of diabetes, duration of diabetic foot and location of foot ulcer.All ulcers were graded as per Wagner's classification.<sup>8</sup> Diabetic foot ulcers of grade 1-5 were included and grade 0 and patient with limb amputation were excluded from the study.

**Specimen collection:** Wound beds were prepared before specimen collection, where the wound immediate surface exudates and contaminants were cleansed off with moistened sterile gauze and sterile normal saline solution. Dressed wounds were cleansed with non bacteriostatic sterile normal saline after removing the dressing. Aseptically the end of a sterile cotton-tipped applicator was rotated over 1 cm<sup>2</sup> area for 5 seconds with sufficient pressure to express fluid and bacteria to surface from within the wound tissue.Two swabs were collected from each patient,One swab was used for Gram staining and the other was used for culture. The specimens were inoculated on blood, chocolate and MacConkey agar plates and incubated aerobically for 24 to 48 hours at 37°C. Bacteriological culture and examination was done following standard microbiological techniques.<sup>9</sup>

#### *Antibiotic sensitivity testing:*

Antimicrobial susceptibility of the isolates was determined against the following antibacterial agents by Kirby Bauer disk diffusion method on Muller Hinton agar plates according to Clinical and Laboratory Standard Institute (CLSI) guidelines.<sup>10</sup> Amikacin, Ceftazidime ,Cefotaxime, Ciprofloxacin, Cotrimoxazole, Gentamycin, Piperacillin-Tazobactam, Imipenem, Clindamycin, Erythromycin, Vancomycin, Cotrimaxazole, Amoxy-Clav, Ceftriaxone(Hi Media, Mumbai).

#### **Results:**

Among 56 patients with diabetic foot ulcers,41 were male and 15 were female and the age ranged from 35 – 72 with mean age being 53 years.

**TABLE 1** Characteristics of diabetic foot specimens

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Total Patients examined 56  
 Patients with microbial growth 49(87.5%)  
 No growth 7(12.5%)  
 Monomicrobial 33(58.73%)  
 Polymicrobial 16(28.57%)  
 Gram Negative Isolates 34(52.31%)  
 Gram Positive Isolates 31(47.69%)

**TABLE 2** Bacteria isolated from diabetic foot infections

S.NO	Name of the isolate	Number of isolates(n=65)
1	Staphylococcus aureus	21(32.31%)
2	Klebsiella pneumoniae	10(15.38%)
3	Pseudomonas aeruginosa	8 (12.31%)
4	Proteus mirabilis	6 (9.23%)
5	Proteus vulgaris	4(6.15%)
6	Enterococcus species	4(6.15%)
7	Coagulase negative staphylococci	4(6.15%)
8	Escherichia coli	3(4.62%)
9	Streptococcus pyogenes	2(3.08%)
10	Providencia species	2(3.08%)
11	Morganella morganii	1(1.54%)

TABLE 3

Antimicrobial sensitivity pattern of Gram positive cocci.

ANTIBIOTIC	Stahylococcus aureus n=21	Enterococcus species n=4	Coagulase negative staphylococci n=4	Streptococcus pyogenes n=2
Gentamicin	8(38.1%)	1(25%)	2(50%)	1(50%)
Amikacin	18(85.7%)	3(75%)	4(100%)	1(50%)
Vancomycin	21(100%)	4(100%)	4(100%)	2(100%)
Erythromycin	9(42.8%)	2(50%)	3(75%)	2(100%)
Clindamycin	15(71.4%)	3(75%)	4(100%)	2(100%)
Amoxy-Clav	12(57.1%)	2(50%)	3(75%)	2(100%)
Ciprofloxacin	13(61.9%)	0(0%)	2(50%)	1(50%)
Ceftriaxone	5(23.8%)	1(25%)	2(50%)	1(50%)
Cefotaxime	7(33.3%)	1(25%)	1(25%)	1(50%)

TABLE 4

Antimicrobial sensitivity pattern of Gram negative bacilli

Antibiotic	Klebsiella pneumonia n=10	Pseudomonas aeruginosa n=8	Proteus species n=10	Escherichia coli n=3	Providencia species n=2	Morganellamorganii n=1
Gentamicin	5(50%)	3(37.5%)	6(60%)	1(33.3%)	1(50%)	1(100%)
Amikacin	7(70%)	5(62.5%)	8(80%)	3(100%)	2(100%)	1(100%)
Amoxy-Clav	7(70%)	6(75%)	9(90%)	3(100%)	2(100%)	1(100%)
Ciprofloxacin	6(60%)	3(37.5%)	5(50%)	2(66.6%)	2(100%)	1(100%)
Cotrimaxazole	4(40%)	3(37.5%)	4(40%)	1(33.3%)	2(100%)	1(100%)
Imipenem	10(100%)	6(75%)	10(100%)	3(100%)	2(100%)	1(100%)
Ceftriaxone	3(30%)	2(25%)	5(50%)	2(66.6%)	1(50%)	0(0%)
Piperacillin/Tazobactam	9(90%)	6(75%)	9(90%)	3(100%)	2(100%)	1(100%)
Ceftazidime	4(40%)	3(37.5%)	4(40%)	1(33.3%)	2(100%)	0(0%)
Cefotaxime	3(30%)	3(37.5%)	5(50%)	2(66.6%)	1(50%)	1(100%)

### **Discussion:**

Diabetic foot ulcer is one of the most common complication requiring hospitalization among diabetic patients. A diabetic foot infection is defined as any inframalleolar infection in a diabetic.

These include paronychia, cellulitis, myositis, abscesses, necrotizing fasciitis, septic arthritis, tendinitis, and osteomyelitis. The most common and classical lesion, however, is the infected diabetic "mal-perforans" foot ulcer.<sup>11</sup> Males were predominant in the study population 41 (73.21%). This is in agreement with the study conducted by Gadepalli. B et al.<sup>12</sup> In the present study the maximum number of patients with infected diabetic foot ulcers belonged to Wagner grade 3. Diabetic foot is known for poly-microbial infections.<sup>13, 14</sup> But in our study, monomicrobial infections were predominated. This is in agreement with the study conducted by Dhanasekaran et al.<sup>15</sup>

In our study, Gram negative bacilli 34 (52.31%) were more prevalent than gram positive cocci 31 (47.69%). In previous reports, researchers have shown the predominance of Gram-positive infections.<sup>13</sup> However, if individual isolate is concerned, *Staphylococcus aureus* 21 (32.31%) was predominated, which was in accordance with the others findings.<sup>16, 17</sup> Second most prevalent pathogen was *Klebsiella pneumoniae* 10 (15.38%) followed by *Pseudomonas aeruginosa* 8 (12.31%). But other studies have demonstrated gram negative bacteria as the predominant pathogen.<sup>18, 19</sup> These discrepancies could be partly due to the differences in the causative organisms which occurred over time and the geographical variation or the types and the severity of the infections which were included in the studies.

Most of the Gram positive cocci were found to be highly resistant to cephalosporins, gentamicin, and erythromycin. But they showed good sensitivity to amikacin and clindamycin. All Gram positive cocci remained sensitive to Vancomycin. Most of the Gram negative bacilli were highly resistance to gentamicin, cotrimaxazole, ciproflaxacin and cephalosporins. All gram negative bacilli showed good response towards imipenem, amikacin and piperacillin/tazobactam. This is in agreement with the study conducted by Ozer B et al.<sup>19</sup>

The emergence of resistant strains represents a compounding problem standing against the efforts to prevent amputation as infection is the single most common cause of amputation. Even if the microorganism is sensitive to one particular antimicrobial, the drug is unlikely to attain therapeutic concentration at the site of infection because of virulence factors, such as hemolysins, proteases, and collagenases, as well as short-chain fatty acids, that cause inflammation, impede wound healing, and contribute to the chronicity of the infection.<sup>20, 21</sup>

### **Conclusion:**

In our study, Gram negative bacilli predominantly caused diabetic foot infections.

But, if individual isolate is concerned, *Staphylococcus aureus* was predominated. Piperacillin- Tazobactam, and Amikacin would be essential for the empirical treatment. Patterns of microbial infections are not consistent in patients with diabetic foot infections and therefore repeated evaluation of microbial characteristics and their antibiotic sensitivity is necessary for selection of appropriate antibiotics.

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