Drug Resistance in an Organisms of Diabetic Foot Patients attending Tertiary Care Hospital in Kulasekham

K. Greesh and R. Nepolean*

Department of Microbiology, Sree Mookambika Institute of Medical Sciences, Kulesekhram, Tamilnadu, India

*Corresponding author

Abstract

Diabetes mellitus is a metabolic disorder characterised by chronic glycemia. Twenty five percent diabetic patients have a risk of developing foot ulcer and limb amputation was 15-45% higher than non-diabetic ulcer. Aims are to determine the antibiotic resistance pattern of diabetic foot isolates. A total of 75 specimens (pus, swab, aspirated pus, debridement tissue) were collected from diabetic ulcer patients and the specimens processed by manually. Majority of patients (80%) were in the age group of 51 to 70 years. The aerobic pathogens isolated were predominantly gram negative (79) and gram positive (28) bacteria. Of these 107, 70 gram negative bacilli and 20 gram positive cocci were isolated in the age group between 51 to 70 years. Of 70 gram negative bacilli Pseudomonas species was the predominant, among the gram positive cocci Staphylococcus aureus was predominant. In most of the infections in the age group between 51 to 70 years, it was polymicrobial. The antibiogram of the isolates showed that most of the Pseudomonas species was resistant to 3rd generation cephalosporins (74%) and quinolones (76.9%). Klebsiella species 100% resistant to amoxicillin and majority of them also resistant to 3rd generation cephalosporins, E. coli showed high amount of resistance to amoxicillin, cefotaxime, piperacillin. Citrobacter species showed 100% resistant to amoxicillin, cefuroxime, cephalixin. Acinetobacter species showed 100% resistant to amoxicillin, 3rd generation cephalosporins, meropenem, ciprofloxacin, gentamicin. Staphlococcus aureus 100% sensitivity to vancomycin, chloramphenicol, novobiocin.

Keywords

Drug resistance, Diabetic foot patients, Gram negative, cephalosporins

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Introduction

Diabetes mellitus is a metabolic disorder characterised by chronic hyperglycemia and about 150-170 million people are suffering worldwide from this diseases, as per WHO reports the prevalence of diabetes will be double by 2025. Diabetes mellitus is a worldwide phenomenon, type 2 diabetes is the most common form of diabetes in developing countries like India, hence called diabetic capital of the world. In India prevalence of diabetes in rural population is about 2.4%, and in urban population is about 4-11.6%. Complications of diabetes mellitus are peripheral vascular disease, cardiovascular disease, nephropathy, retinopathy, neurological and infections. Uncontrolled
hyperglycemia, atherosclerotic vascular disease, sensory neuropathy are the most important risk factors developing diabetic foot ulcer.\(^1\)

Twenty five percent diabetic patients have a risk of developing foot ulcer and limb amputation was 15-45% higher than non diabetic ulcer.\(^2\)

**Pathogenesis**

For development of diabetic foot ulcer, the most important risk factors are peripheral neuropathy and impaired blood circulation from peripheral vascular disease.\(^3, 4, 5\) In diabetes mellitus patients, one of the major complications is diabetic ulcer. Fifteen percent diabetes mellitus patients develop diabetic foot ulcer and leads to 84% of foot amputation.\(^6\)

**Neuropathy**

Development of neuropathy is as a result of hyperglycemia induced metabolic disorder. The most important one is polyol pathway. Hyperglycemia state will favour aldose reductase and sorbitol dehydrogenase which will convert intracellular glucose to sorbitol and fructose and due to the accumulation of these sugar products leads to decrease in the synthesis of myoinositol, which is needed for normal neuron conduction. The conversion of glucose leads to depletion of nicotinamide adenine dinucleotide phosphate which is required for detoxification of reactive oxygen species and for synthesis of vasodilator nitric oxide. This leads to oxidative stress on nerve cells and increase vasoconstricton leads to ischaemia, which result will nerve cell injury and death. This also contributes to abnormal glycation of nerve cells and leads to inappropriate action of protein kinase C and leads to further nerve damage. In diabetic patients neuropathy develop in motor, sensory, autonomic components of nervous system. Imbalance between flexion and extension due to damage of innervatons of intrinsic foot muscles, leads to foot deformities that create abnormal bony prominence and pressure points, which favour for skin break down and ulceration.

Autonomic neuropathy leads to suppression of the function of sweat and oil gland. Foot loses natural function of the moisturising the skin and becomes dry which leads breakdown and gradually develop infection.

Sensory neuropathy wounds are unnoticed by the patients which worseness and exacerbates the development of ulcer.

**Vascular disease**

The persistent hyperglycemic state leads to endothelial cell dysfunction and smooth cell abnormalities in peripheral arteries which result in the decreases of endothelium derived vasodilator that leads to vasoconstriction. The diabetes hyperglycemic state leads to increase in thromboxane A2, a vasoconstrictor, platelet aggregation which promote the risk for hypercoagulability, and alteration in the vascular extra cellular matrix leads arterial lumen stenosis. The other factors like smoking, hypertension, hyperlipidemia contribute to the development of peripheral arterial disease.\(^3\)

The present study was carried out to determine the aerobic bacterial isolates cultured from diabetic foot infections and their susceptibility to commonly used antibiotics.

**Materials and Methods**

The study was conducted in a tertiary care hospital at Kulasekharam from June 2014 to August 2015. The study was approved by the Institutional Ethical and Research committee.
A total of 75 specimens (pus, swabs, aspirated pus, debridement tissue) were collected from diabetic ulcer patients. The samples were collected in dressing room for out patients and in wards for inpatient and then immediately transported to the laboratory and the specimens were processed without any delay by manually.

Phenotypic screening of ESBL detection with combination disk method (ceftazidime (30 microgram) /ceftazidime (30 microgram) and clavulonic acid (10 microgram) & cefotaxime (30 microgram)/ cefotaxime (30 microgram) /and clavulonic acid (10 microgram). 2, 11

Inclusion criteria: Patient admitted with clinically diagnosed diabetes mellitus, supported by laboratory findings and presented with ulcer.

Exclusion criteria: Patient with ulcers, who are not diabetic proved by clinical or laboratory investigations & Gestational diabetes mellitus with ulcer.

Results and Discussion

The age group varied from 41 to 90 years. Majority of patients (80%) between 41to 70 years (Table 1). The predominant pathogens isolated were gram negative bacilli constituting 73.8% and gram positive cocci constituting 26, 2%. Among the gram negative bacilli Pseudomonas species was predominant having 36.2% incidence and among the gram positive cocci Staphylococcus aureus were the predominant pathogens accounting 42.8% (Fig. 1). Pseudomonas species shows resistant to cefotaxime (100%), ciprofloxacin (77%), gentamicin (72%), piperacillin (71%), ceftazidime (61%), cefoperazone (61%), meropenem (46%). Sensitivity to piperacillin/tazobactum (68%, netimicin (66%), amikacin (52%) (Table 2). Klebsiella species resistant to amoxicillin (100%), cefoxitin (80%), ceftozidime (80%), cefotaxime (79%), cefuroxime (69%), cotrimoxazole (67%), ciprofloxacin (67%), gentamicin (50%). Sensitivity to meropenem (91%), netilmicin (79%), amikacin (69%), piperacillin (65%) (Table 2). Proteus species shows resistant to cefoxitin (80%), amoxicillin (79%), cotrimoxazole (67%), cefotaxime (62%), cefoperazone (57%). sensitivity to piperacillin/tazobactum (87%), meropenem (85%), piperacillin (64%), netilmicin (64%) (Table 3). E. coli was 89% resistant to amoxicillin, piperacillin, cefotaxime and cefoxitin (78%), cefoperazone (71%), cefuroxime (67%), ciprofloxacin (67%), piperacillin/tazobactum (63%), cotrimoxazole (50%). Sensitivity to netilmicin (86%), amikacin (78%), meropenem (67%), gentamicin (67%) (Table 3). Citrobacter species was 100% resistant to amoxicillin, cefoxitin, cefuroxime and cefotaxime (83%), ceftazidime (83%). sensitivity to netilmicin was (100%), cotrimoxazole (83%), amikacin (80%) meropenem (67%) (Table 4). Enterobacter species shows 100% sensitivity to amoxicillin, piperacillin/tazobactum, netilmicin, gentamicin, ciprofloxacin, cotrimoxazole, cefoxitin, ceftazidime, cefotaxime, cefoperazone, meropenem (Table 4). Acinetobacter species was 100% resistant to amoxicillin, piperacillin/tazobactum, piperacillin, ciprofloxacin, cefoxitin, cefotaxime, cefuroxime, gentamicin, meropenem. Sensitivity to amikacin (40%) (Table 5). Staphylococcus aureus shows 100% sensitivity to vancomycin, novobiocin, chloramphenicol and clindamycin (92%), teicoplanin (90%), cefoxitin (83%), netilmicin (78%). Resistant to penicillin (91%), cotrimoxazole (81%) and erythromycin (69%). CONS was resistant to erythromycin (100%), penicillin (83%), cotrimoxazole (67%), ciprofloxacin (60%) and sensitivity to vancomycin, novobiocin and chloramphenicol.
was 100% respectively, teicoplanin (80%), gentamicin (75%), netilmicin (60%) (Table 6). *Streptococcus pyogenes* shows 100% sensitivity to penicillin, netilmicin, cefuroxime, cefotaxime and amikacin (75%), ciprofloxacin (75%), tetracycline (66%) (Table 7). *Streptococcus* species shows 100% sensitivity to penicillin, amikacin, netilmicin, vancomycin, and 50% resistant to tetracycline, cotrimoxazole, ciprofloxacin.

Enterococcus species shows 100% sensitive to ciprofloxacin, cefotaxime, cefuroxime, vancomycin and 50% resistant to tetracycline, amikacin, netilmicin, cotrimoxazole (Table 8). Among the gram negative bacilli 67% of *E.coli*, 47% of *Klebsiella*, 17% of *Citrobacter* species, 15% of *Pseudomonas* species, 13% of *Proteus* species were ESBL producers (Table 9 and Fig. 2).

This study presents clinical and microbiological profile of Diabetic foot ulcers. About 150 to 170 million populations are suffering from diabetes mellitus worldwide. In India nearly 40 million people are diabetics and their socioeconomic status is poor.

Diabetic foot infections are seen in 20% of the patients and hence are the most commonly faced clinical problem. Ulcers treated inappropriately may lead to amputation or disarticulation in varying levels at least once in such patients’ life time. This study was carried out at SMIMS, Kulasekharam from June 2014 to August 2015. Samples (swabs, aspirated pus, debrided tissue) from 75 patients of diabetic foot ulcer was collected after receiving written consent from the patient. Majority of patients (80%) were in the age group of 51 to 70 years. The aerobic pathogens isolated were predominantly gram negative (79) followed by gram positive (28) bacteria (Fig. 1). Of these 107, 70 gram negative bacilli and 20 gram positive cocci were isolated in the age group between 51 to 70 years.

Of 70 gram negative bacilli isolated in the age group of 51 to 70 years, *Pseudomonas* species was the predominant isolate followed by *Klebsiella* species, *Proteus* species, *E.coli*, *Citrobacter* species, *Acinetobacter* species and *Enterobacter* species.

Among the gram positive cocci organisms isolated in this age group (51 to 70years), *Staphylococcus aureus* was the predominant pathogen followed by coagulase negative *Staphylococci*, *Streptococci* pyogenes, other beta hemolytic *Streptococci*, *Streptococcus* species and only one *Enterococcus* species was isolated in this age group. A evidenced by Shanmugam P et al., Pappu K et al., also have shown the similar findings.

In most of the infections in the age group between 51 to 70 years it was polymicrobial (31 cases), whereas monomicrobial etiology was seen in 27 cases. As also reported by Chopdekar et al., 2011. There was no growth in two clinical samples this could be due to the prior antibiotic therapy before coming to the hospital or could be anaerobic organisms the isolation of which was not attempted in the study.

The antibiogram of the isolates showed that most of the *Pseudomonas* species was resistant to 3rd generation Cephalosporins (74%) followed by Quinolones (76.9%) (Table 2). Twenty five (68.4%) isolates were sensitive to Piperacillin/Tazobactam followed by Netilmicin (65.8%) and Meropenem (53.8%) Gentamicin (74%). Shanmugam et al., (2013) in their study also have shown, *Pseudomonas* being 50% resistant to Gentamicin and Quinolones, 61% resistant to 3rd generation Cephalosporin but 100% resistant to Meropenem. But in our study resistant to Meropenem was 46.2%.
Table 1 Distribution of age

| Age       | Patients | Percentage |
|-----------|----------|------------|
| 41 to 50  | 8        | 11         |
| 51 to 60  | 30       | 40         |
| 61 to 70  | 30       | 40         |
| 71 to 80  | 6        | 8          |
| 81 to 90  | 1        | 1          |

The age group varied from 41 to 90 years (Table 1)

Table 2 Antiibiogram

|                          | PSEUDOMONAS SP | KLEBSIELLA SP |
|--------------------------|----------------|--------------|
|                          | Sensitive      | Intermediate | Resistant    |
| PENICILLIN               | -              | -            | -            |
| AMOXICILLIN              | -              | -            | -            |
| TETRACYCLINE             |                |              |              |
| AMIKACIN                 | 52.17%         | 8.69%        | 39.13%       |
| PIPERACILLIN/TAZOB ACTUM| 68.42%         | 0.00%        | 31.58%       |
| NETILMICIN               | 65.83%         | 15.38%       | 19.23%       |
| PIPERACILLIN             | 28.57%         | 0.00%        | 71.43%       |
| CIPROFLOXACIN            | 23.07%         | 0.00%        | 76.92%       |
| COTRIMOXAZOLE            |                |              |              |
| MEROPENEM                | 53.85%         | 0.00%        | 46.15%       |
| GENTAMICYN               | 24%            | 4%           | 72%          |
| VANCOMYCIN               |                |              |              |
| CEFOLIXIN                |                |              |              |
| CEFUROXIME               |                |              |              |
| CEFOTOXIME               | 0.00%          | 0.00%        | 100.00%      |
| CEFOPERAZONE             | 30.7%          | 7.69%        | 61.5%        |
| CEFTAZIDIME              | 33.33%         | 5.56%        | 61.11%       |

Seventy four percent of Pseudomonas species was resistant to 3rd generation Cephalosporins. (Table 2)
Table.3 Antibiogram

|                  | PROTEUS SPECIES | E.COLI |                  |                  |
|------------------|-----------------|--------|------------------|------------------|
|                  | Sensitive | Intermediate | Resistant | Sensitive | Intermediate | Resistant |
| PENICILLIN       | -        | -              | -         | -        | -              | -         |
| AMOXICILLIN      | 21.42%   | 0.00%           | 78.57%    | 11%      | 0.00%           | 89.00%    |
| TEICOPLANIN      | -        | -              | -         | -        | -              | -         |
| CLINDAMYCIN      | -        | -              | -         | -        | -              | -         |
| ERYTHROMYCIN     | -        | -              | -         | -        | -              | -         |
| TETRACYCLINE     | -        | -              | -         | -        | -              | -         |
| AMIKACIN         | 64.28%   | 0.00%           | 35.71%    | 78%      | 0.00%           | 22%       |
| PIPERACILLIN/TAZOBACTAM | 86.66% | 13.33%         | 0.00%     | 37.50%   | 0.00%           | 62.50%    |
| NETILMICIN       | 63.63%   | 0.00%           | 36.36%    | 86%      | 0.00%           | 14%       |
| PIPERACILLIN     | 63.64%   | 0.00%           | 36.36%    | 11%      | 0.00%           | 89%       |
| CIPROFLOXACIN    | 40%      | 13%             | 47.00%    | 33%      | 0.00%           | 67%       |
| COTRIMOXAZOLE    | 33%      | 0.00%           | 67%       | 50%      | -               | 50%       |
| MEROPENEM        | 84.62%   | 7.69%           | 7.69%     | 67%      | 11%             | 22%       |
| GENTAMICIN       | 53%      | 0.00%           | 47%       | 67%      | 0.00%           | 33%       |
| VANCOMYCIN       | -        | -              | -         | -        | -              | -         |
| CEFOTOXIMIN      | 20%      | 0.00%           | 80%       | 22%      | 0.00%           | 78%       |
| CEFUROXIME       | 27%      | 0.00%           | 73%       | 33%      | 0.00%           | 67%       |
| CEFOTETOXIMIN    | 30.77%   | 7.69%           | 61.54%    | 11%      | 0.00%           | 89%       |
| CEFOPERAZONE     | 35.71%   | 7.14%           | 57.14%    | 29%      | 0.00%           | 71%       |
| CEFTAZIDIME      | 53%      | 13.33%          | 33%       | 33%      | 0.00%           | 67%       |

Table.3 shows Proteus species 87% sensitivity to Piperacillin/Tazobactam, 85% to Meropenem and E.coli shows 89% resistant to Amoxicillin, Piperacillin, Cefotoxime

Table.4 Antibiogram

|                  | CITROBACTER SPECIES | ENTEROBACTER SPECIES |                  |                  |
|------------------|---------------------|----------------------|------------------|------------------|
|                  | Sensitive | Intermediate | Resistant | Sensitive | Intermediate | Resistant |
| AMOXICILLIN      | 0.00%   | 0.00%         | 100.00% | 100.00% |
| TETRACYCLINE     |          |               |          |          |
| AMIKACIN         | 80%     | 0.00%         | 20%       | 20% |
| PIPERACILLIN/TAZOBACTAM | 17% | 17%         | 67%       | 100.00% |
| NETILMICIN       | 100%    | 0.00%         | 0.00%    | 100.00% |
| PIPERACILLIN     | 20.00%  | 13%           | 67%       | 100.00% |
| CIPROFLOXACIN    | 50%     | 0.00%         | 50.00%    | 100.00% |
| COTRIMOXAZOLE    | 83%     | 0.00%         | 17%       | 100.00% |
| MEROPENEM        | 67%     | 0.00%         | 33%       | 100.00% |
| GENTAMICIN       | 25.00%  | 25.00%        | 50.00%    | 100.00% |
| CEFOLIXEM        | 0.00%   | 0.00%         | 100.00%   | 100.00% |
| CEFUROXIME       | 0.00%   | 0.00%         | 100.00%   | 100.00% |
| CEFOTETOXIMEN    | 0.00%   | 17%           | 83.00%    | 100.00% |
| CEFOPERAZONE     | 17%     | 17%           | 67%       | 100.00% |
| CEFTAZIDIME      | 17%     | 0.00%         | 83%       | 100.00% |

Table.4 shows Citrobacter and Enterobacter species shows 100% sensitivity to Netilmicin
### Table 5: Antibiogram for Acinetobacter species

| Antibiotic                  | Sensitive | Intermediate | Resistant |
|-----------------------------|-----------|--------------|-----------|
| **Acinetobacter SP**        |           |              |           |
| PENICILLIN                  | 0.00%     | 0.00%        | 100.00%   |
| AMOXICILLIN                 |           |              |           |
| TEICOPLANIN                 |           |              |           |
| CLINDAMYCIN                 |           |              |           |
| ERYTHROMYCIN                |           |              |           |
| TETRACYCLINE                |           |              |           |
| AMIKACIN                    | 40.00%    | 0.00%        | 60.00%    |
| PIPERACILLIN/TAZOBACTAM    | 0.00%     | 0.00%        | 100.00%   |
| NETILMICIN                  | 40.00%    | 0.00%        | 60.00%    |
| PIPERACILLIN                | 0.00%     | 0.00%        | 100.00%   |
| CIPROFLOXACIN               | 0.00%     | 0.00%        | 100.00%   |
| COTRIMOXAZOLE               | 20.00%    | 40.00%       | 40.00%    |
| MEROPENEM                   | 0.00%     | 0.00%        | 100.00%   |
| GENTAMICIN                  | 0.00%     | 0.00%        | 100.00%   |
| CEFOLEXIN                   | 0.00%     | 0.00%        | 100.00%   |
| CEFUROXIME                  | 0.00%     | 0.00%        | 100.00%   |
| CEFOTOXIME                  | 0.00%     | 0.00%        | 100.00%   |
| CEFOPERAZONE                | 0.00%     | 0.00%        | 100.00%   |
| CEFTAZIDIME                 | 0.00%     | 0.00%        | 100.00%   |

**Table 5 Acinetobacter species** 100% resistant to Amoxicillin, PIPERACILLIN/TAZOBACTAM, PIPERACILLIN, CIPROFLOXACIN, MEROPENEM, CEFOTOXIME, CEFUROXIME, CEFOLEXIN, GENTAMICIN.

### Table 6: Antibiogram for Staphylococcus aureus

| Antibiotic                  | S. aureus | CONS |
|-----------------------------|-----------|------|
| **S. aureus**               |           |      |
| PENICILLIN                  | 9.00%     | 0.00%| 91.00%| 0.00%| 17.00%| 83.00%|
| AMOXICILLIN                 | 0.00%     | 0.00%| 100.00%| 0.00%| 17.00%| 83.00%|
| TEICOPLANIN                 | 90.00%    | 10.00%| 0.00%| 80.00%| 0.00%| 20.00%|
| CLINDAMYCIN                 | 91.67%    | 0.00%| 8.33%| 60.00%| 0.00%| 40.00%|
| ERYTHROMYCIN                | 15.38%    | 15.38%| 69.23%| 0.00%| 0.00%| 100.00%|
| TETRACYCLINE                | 58.00%    | 17.00%| 25.00%| 50.00%| 0.00%| 50.00%|
| AMIKACIN                    | 63%       | 25%  | 12.5%| 50.00%| 16.67%| 33.33%|
| PIPERACILLIN/TAZOBACTAM    | 37%       | 32%  | 31% | 50.00%| 16.67%| 33.33%|
| NETILMICIN                  | 78%       | 0.00%| 22% | 60.00%| 0.00%| 40.00%|
| PIPERACILLIN                | 100.00%   | 0.00%| 0.00%| 100.00%| 0.00%| 100.00%|
| CIPROFLOXACIN               | 33%       | 0.00%| 67% | 40.00%| 0.00%| 60.00%|
| COTRIMOXAZOLE               | 19.00%    | 0.00%| 81.00%| 33.33%| 0.00%| 66.67%|
| MEROPENEM                   | 40.00%    | 20.00%| 40.00%| 75.00%| 0.00%| 25.00%|
| GENTAMICIN                  | 100.00%   | 0.00%| 0.00%| 100.00%| 0.00%| 100.00%|
| VANCOMYCIN                  | 100.00%   | 0.00%| 0.00%| 100.00%| 0.00%| 100.00%|
| NOVOBIOCIN                  | 100.00%   | 0.00%| 0.00%| 100.00%| 0.00%| 100.00%|
| CHOLORAMPHENICOL            | 100.00%   | 0.00%| 0.00%| 100.00%| 0.00%| 100.00%|
| CEFOTAXIM                   | 83.33%    | 0.00%| 16.67%| 50.00%| 0.00%| 50.00%|
| CEFOPERAZONE                |           |      |      |      |      |      |
| CEFTAZIDIME                 |           |      |      |      |      |      |

**Table 6** Eight one percentage of *Staphylococcus aureus* was resistant to cotrimaxozole in our study followed by Erythromycin (69%), Ciprofloxacin (67%), Gentamicin (40%).
Table 7: Antibiogram

|                      | Streptococcus pyogenes | BETA - HEMOLYTIC Streptococcus |
|----------------------|------------------------|--------------------------------|
|                      | Sensitive | Intermediate | Resistant | Sensitive | Intermediate | Resistant |
| PENICILLIN           | 100.00%    | 0.00%        | 0.00%     | 100.00%    | 0.00%        | 0.00%    |
| AMOXYCILLIN          | -          | -            | -         | -          | -            | -        |
| TEICOPLANIN          | -          | -            | -         | -          | -            | -        |
| CLINDAMYCIN         | -          | -            | -         | -          | -            | -        |
| ERYTHROMYCIN        | -          | -            | -         | -          | -            | -        |
| TETRACYCLINE        | 66.67%     | 0.00%        | 33.33%    | 50.00%     | 0.00%        | 50.00%   |
| AMIKACIN            | 75.00%     | 0.00%        | 25.00%    | 100.00%    | 0.00%        | 0.00%    |
| PIPERACILLIN/TAZOBACTUM NETILMICIN | 100.00% | 0.00% | 0.00% | 100.00% | 0.00% | 0.00% |
| PIPERACILLIN        | -          | -            | -         | -          | -            | -        |
| CIPROFLOXACIN       | 75.00%     | 0.00%        | 25.00%    | 50.00%     | 0.00%        | 50.00%   |
| COTRIMOXAZOLE       | -          | -            | -         | -          | -            | -        |
| MEROPENEM           | -          | -            | -         | -          | -            | -        |
| GENTAMYCIN          | -          | -            | -         | -          | -            | -        |
| CEFUROXIME          | 100.00%    | 0.00%        | 0.00%     | 100.00%    | 0.00%        | 0.00%    |
| CEFOTOXIME          | 100.00%    | 0.00%        | 0.00%     | 100.00%    | 0.00%        | 0.00%    |

Streptococcus pyogenes and other beta hemolytic streptococci were 100% sensitive to penicillin (100%). However, Streptococcus pyogenes was also sensitive to Netilmicin, Cefotaxime and Cefuroxime (100%) as showed in Table 7.

Table 8: Antibiogram

|                      | Enterococcus sp | Streptococcus SP |
|----------------------|-----------------|------------------|
|                      | Sensitive | Intermediate | Resistant | Sensitive | Intermediate | Resistant |
| PENICILLIN           | -         | -           | -         | -         | -           | -         |
| AMOXYCILLIN          | -         | -           | -         | -         | -           | -         |
| TEICOPLANIN          | -         | -           | -         | -         | -           | -         |
| CLINDAMYCIN         | -         | -           | -         | -         | -           | -         |
| ERYTHROMYCIN        | -         | -           | -         | -         | -           | -         |
| TETRACYCLINE        | 50.00%    | 0.00%       | 50.00%    | 50.00%    | 50.00%      | 50.00%    |
| AMIKACIN            | 50.00%    | 0.00%       | 50.00%    | 100.00%   | 0.00%       | 0.00%     |
| PIPERACILLIN/TAZOBACTUM NETILMICIN | 50.00% | 0.00% | 50.00% | 100.00% | 0.00% | 0.00% |
| PIPERACILLIN        | -         | -           | -         | -         | -           | -         |
| CIPROFLOXACIN       | 100.00%   | 0.00%       | 0.00%     | 50.00%    | 0.00%       | 50.00%    |
| COTRIMOXAZOLE       | 50.00%    | 0.00%       | 50.00%    | 50.00%    | 0.00%       | 50.00%    |
| MEROPENEM           | -         | -           | -         | -         | -           | -         |
| GENTAMYCIN          | -         | -           | -         | -         | -           | -         |
| VANCOMYCIN          | 100.00%   | 0.00%       | 0.00%     | 100.00%   | 0.00%       | 0.00%     |
| CEFUROXIME          | 100.00%   | 0.00%       | 0.00%     | 100.00%   | 0.00%       | 0.00%     |
| CEFOTOXIME          | 100.00%   | 0.00%       | 0.00%     | 100.00%   | 0.00%       | 0.00%     |

Table 8 shows Enterococcus species 100% sensitive to ciprofloxacin, cefotaxime, cefuroxime and Vancomycin.
Table.9 shows *E. coli* was the dominant ESBL producer (67%).

**Table.9 ESBL**

| Organism          | Percentage |
|-------------------|------------|
| KLEBSIELLA SP     | 47%        |
| E.COLI            | 67%        |
| PSEUDOMONAS SP    | 15%        |
| PROTEUS SP        | 13%        |
| CITROBACTER SP    | 17%        |

**Fig.1** List of organisms: The predominant pathogens isolated were gram negative bacilli constituting 73.8% and gram positive cocci constituting 26.2%. Among the gram negative bacilli *Pseudomonas* species was predominant having 36.2% incidence and among the gram positive cocci *Staphylococcus aureus* were the predominant pathogens accounting 42.8%.

**Fig.2** List of organisms Producing ESBL
It is surprising to note that high amount resistant to Meropenem which could be probably due to use of Carbapenems prescribed by general practitioners which must have resulted in developing resistance to Mereopenem before coming to our hospital.

*Klebsiella* isolates were 100% resistant to Amoxicillin. Majority of them were also resistant to 3rd generation Cephalosporin but 91% of the isolates were sensitive to Meropenem followed by Netilmicin (78.5%), Amikacin (69.2%), Gentamycin (50%). Majority of *Proteus* species showed sensitivity to Piperacillin/Tazabactam (86.7%) followed by Meropenem (84.6%). *E.coli* showed high amount of resistance to Amoxicillin, Cefotoxime, Piperacillin. However majoritiy of organisms were sensitive to Netilmicin (86%), Amikacin (78%) followed by Gentamicin and Meropenem (67% each).

*Citrobacter* species showed 100% resistant to Amoxicillin, Cefuroxime, Cephalexin. However they were 100% sensitive to Amikacin and Netilmicin.

*Enterobacter* species showed 100% sensitivity to most of the antibiotic used.

*Acinetobacter* species showed 100% resistant to Amoxicillin, all the 3rd generation Cephalosporins and Meropenem, Ciprofloxacin and Gentamicin. Only Amikacin and Netilmicin showed 40% sensitivity.

Among gram positive organisms *Staphylococcus aureus* was the predominant pathogen and the antiobriogram showed 100% sensitivity to Vancomycin, Choloramphenicol and Novabiocin followed by Clindamycin (91.7%) and Teicoplanin (90%). Of the total 18 *Staphylococcus aureus*, 2 were MRSA. Kaur.N *et al.*, 2014, also showed less sensitivity to Clindamycin is contrast to our study.

CONS showed a similar pattern of sensitivity to Vancomycin, Novobiocin, Choloramphenicol as *Staphylococcus aureus*. However they were less sensitive to Clindamycin (Table 6). One Coagulase negative Staphylococcus was resistant to Methicillin. Paul.S *et al.*, 2009, found that 8.7% of Methicillin Resistant in their study.

All the *Streptococcus* pyogens were sensitive to Penicillin, they were also 100% sensitive to Netilmicin, Cefotoxime and Cefuroxime (Table 7) Enterococcus showed 100% sensitivity to Vancomycin, Cefuroxime, Cefotoxime. Ciprofloxacin seems to be good antibiotic for treating infections with Enterococcus species, since they showed 100% sensitivity in our study.

Extended spectrum beta lactamase producing organisms were mainly seen in *E.coli* (67%), *Klebsiella* (47%). However ESBL was not a major problem in *Pseudomonas* species, *Proteus* species, *Citrobacter* species. However AmpC, MBL were not looked for in our study (Table 9).

In conclusion,
- Diabetic foot ulcer infection should be treated according to culture and sensitivity report.
- To avoid unnecessary usage of antibiotic which may result in development of Multi Drug Resistant strains.
- Empirical treatment should be based on recent report of articles of same geographical region.
- Sensitivity pattern varies from place to place. This study could help clinician to know the sensitivity pattern of organism.
- Diabetic foot ulcer treatment should be based on multidisciplinary approach.
It is health providers responsibility to enlighten the foot care in diabetes and consequences of foot infection and use of Proper foot wear which could decrease development of foot ulcer.

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