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Original Article

Bacterial Spectrum and Antibiotic Sensitivity in Patients with Diabetic Foot Ulcer, A Cross-Sectional Study

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ABSTRACT

Background: Upon doing a comprehensive literature search, the authors were unable to locate any research pertaining to DFI in our demographic. The study has been planned as a result to determine the bacterial spectrum and antibiotic sensitivity in patients with diabetic foot ulcer presenting to tertiary care hospital.

Methodology: This cross-sectional study was carried out at the department of Medicine, Khyber Teaching Hospital, Peshawar from September 2024 till May 2025. 190 male and female patients diagnosed with diabetic foot ulcer were enrolled and evaluated for antibiotic sensitivity pattern.

Results: The mean age of the participants was 49.82±16.10 years. Majority of the participants were aging more than 45 years (n = 101, 53.2%) and 119 (62.6%) participants were male. 170 (89.5%) participants had type 2 diabetes mellitus. Vancomycin was most sensitive was in 163 cases (85.8%) followed by piperacillin plus tazobactum in 160 patients (84.2%). Cotrimoxazole and ampicillin were the least sensitive agents recorded in 86 (45.3%) and 89 (46.8%) patients respectively.

Conclusion: In DFI, isolates were mostly sensitive to vancomycin and piperacillin plus tazobactam and least sensitive were ampicillin and cotrimoxazole.

Keywords: Diabetic Foot Ulcer, Antibiotics, Susceptibility Pattern, Public Health

Introduction

One of the most significant and long-standing chronic not transmissible hormonal disorders, diabetes can have a serious negative impact on one's health by damaging several end organs.[1] It is a serious worldwide public health issue that affects many individuals from many walks of life. There were 435 million diabetics worldwide in 2017, according to the International Diabetes Federation's study.[2]

Diabetic foot infections (DFIs) and their repercussions, including osteomyelitis, are among the major effects of diabetes. These can also result in recurrent hospital stays, unsuccessful treatments, and higher medical costs.[3] According to a prior study, lower limb amputation is used to treat at least 20% of DFIs. DFIs are prevalent, particularly in men and those over 60. Peripheral neuropathy, vascular complications and foot ulcers or compromised host immunity are among the conditions that predispose people to acquire DFI.[4] Nonetheless, a multidisciplinary approach to the best controlling DFIs and DFUs leads to superior results in terms of lower morbidity, mortality, and medical expenses.[5]

DFI's pathogens is frequently polymicrobial, with aerobic bacteria and anaerobes that are both Gram-positive and Gram-negative. Studies on the genesis of DFI have revealed variety of infections and patterns of vulnerability.[6] According to research by Sannathimmappa MB and associates, all Staphylococcus strains were sensitive to trimethoprim-sulfamethoxazole (TMP-SMX), whereas all Gram-positive isolates were responsive to doxycycline. It was discovered that 59% of S. aureus strains were penicillin resistant. Gram-negative organisms were 75% to 100% susceptible to aminoglycosides and penicillins. Gram-negative organisms were shown to exhibit low to high levels of resistance (0–75%) to cephalosporins, ampicillin, amoxicillin-clavulanic acid, and TMP-SMX. It was discovered that 36% of the strains were MDR Gram-negative bacteria.[7] Choosing the right antibiotics depending on the strains' variation in antibiotic susceptibility is essential for the best therapy of DFI. Different countries and regions throughout a country have different types of infecting bacteria and patterns of antibiotic susceptibility. One of the main causes of antibiotic resistance is the careless

use of antibiotics. As a result, regular evaluation of microorganisms and their patterns of antibiotic resistance is required. Effective treatment of DFIs depends on doctors having exact understanding of the organisms and their pattern of antibiotic susceptibility in each area, as well as using antibiotics sparingly. Upon doing a comprehensive literature search, the authors were unable to locate any research pertaining to DFI in our demographic. The study has been planned as a result to determine the bacterial spectrum and antibiotic sensitivity in patients with diabetic foot ulcer presenting to tertiary care hospital.

Methodology

This cross-sectional study was carried out at the department of Medicine, Khyber Teaching Hospital, Peshawar from September 2024 till May 2025. Male and female patients diagnosed with diabetic foot ulcer were enrolled. Patients with history of antibiotic intake in the last 15 days, immunocompromised patients, prethrombotic conditions and statis ulcer were excluded. Diabetic foot ulcer was defined clinically by the presence of an ulcer on the foot with pustular or serosanguinous discharge and pus for culture and sensitivity revealed growth of pathogens. Antibiotic panel studied included aminoglycosides, fluoroquinolones, sulfonamides, penicillin's and cephalosporins. Antibiotic sensitivity was defined as the ability of an antibiotic to inhibit the growth of microbes in pus culture with routine systemic concentration and failure to do so was called antibiotic resistance. The sample size was 190, calculated using WHO sample size calculator taking anticipated frequency of penicillin resistance as 59.0%,[7] 7% margin of error and 95% confidence level. Sampling technique was nonprobability consecutive sampling.

Patients who meet the requirements for enrollment were recruited from the hospital's inpatient division of medicine after receiving approval from the study regulatory board. Every participant in the study were asked for their informed permission, which guaranteed anonymity and the absence of any risks associated with participating in the research. Baseline data such as age (years), gender, BMI (kg/m2), foot laterality, type of diabetes (I/II), and length of illness (years) was recorded. To prevent the pathogen from being isolated instead of typical skin normal flora, the wound's surface was thoroughly cleansed with saline. The specimen was obtained by aspirating the pus and necrotic tissue following a thorough washing. These samples underwent Gram staining to use the Q score to distinguish between colonization and infection. Specimens were plated on Blood and MacConkey agar and then incubated at 37°C at room temperature. Antibiotic sensitivity was towards sulfonamides, aminoglycosides, fluroquinolone's, cephalosporins and penicillin's was determined using CLSI criteria.

IBM SPSS version 25 was used to analyze the data. For qualitative information such as gender, diabetes kinds, foot laterality, and antibiotic sensitivity and resistance, frequencies and percentages will be calculated. For quantitative information such as age, BMI, and length of illness, means ± SD was calculated. Age, gender, diabetes type, foot laterality, and length of illness was taken into consideration when stratifying antibiotic resistance and sensitivity. At the 5% level of significance, the post-stratification chi square test was used. Statistical significance was defined as a p value of less than 0.05.

Results

The mean age of the participants was 49.82±16.10 years, mean BMI was 23.091±2.739kg/m^2 and mean disease duration was 9.56±3.461 years. Majority of the participants were aging more than 45 years (n = 101, 53.2%) and 119 (62.6%) participants were male. 170 (89.5%) participants had type 2 diabetes mellitus as shown in table 1

Table I. Baseline characteristics of study participants (n = 190)

Parameters	Subgroups	Frequency	Percent
Age (years)	45 or below	89	46.8
	Above 45	101	53.2
BMI (kg/m^2)	24.0 or below	105	55.3
	More than 24.0	85	44.7
Gender	Male	119	62.6
	Female	71	37.4
Diabetes	T1DM	20	10.5
	T2DM	170	89.5
Diabetes duration (years)	10 or below	53	27.9
	More than 10	137	72.1
Laterality of foot	Right	101	53.2
	Left	89	46.8

Table II. Antibiotic susceptibility pattern among the studied participants (n = 190)			
Antibiotic	Susceptibility	Frequency	Percent
Ampicillin	Sensitive	89	46.8
	Resistant	101	53.2
Co-amoxiclav	Sensitive	124	65.3
	Resistant	66	34.7
Ceftriaxone	Sensitive	132	69.5
	Resistant	58	30.5
Cefotaxime	Sensitive	117	61.6
	Resistant	73	38.4
Cotrimoxazole	Sensitive	86	45.3
	Resistant	104	54.7
Cefuroxime	Sensitive	96	50.5
	Resistant	94	49.5
Ceftazidime	Sensitive	124	65.3
	Resistant	66	34.7
Piperacillin tazobactam	Sensitive	160	84.2
	Resistant	30	15.8
Moxifloxacin	Sensitive	110	57.9
	Resistant	80	42.1
Ciprofloxacin	Sensitive	90	47.4
	Resistant	100	52.6
Vancomycin	Sensitive	163	85.8
	Resistant	27	14.2

Vancomycin was most sensitive antibiotic among panel of medications. The sensitivity was observed 163 cases (85.8%) followed by piperacillin plus tazobactam in 160 patients (84.2%). Cotrimoxazole and ampicillin were the least sensitive agents recorded in 86 (45.3%) and 89 (46.8%) patients respectively. (Table II)

Discussion

Some of the primary manifestations of morbidity and impairment in diabetics is diabetic foot infections, which can result in amputation and need meticulous care throughout treatment.[8] However, by identifying the causing bacteria and their usual course of antibiotic sensitivity, doctors can play a more significant role in rational and successful care.[9] DFIs amongst people with diabetes were evaluated in the present study, and we discovered that males had greater DFIs than females. This may be explained by the fact that men are more likely to be exposed to hard labor in the outside world.[10]

Furthermore, considering complications from diabetes are closely correlated with the length of course of diabetes mellitus, the majority of DFIs patients were aging more than 45 years and had had the disease for more than ten years.[1] The findings are comparable to those of previous researches.[11,12] However, due because of the prohibitive price of antibiotics , the majority of research participants had poor to intermediate socioeconomic level, which could lead to the growth of antibiotic-resistant bacteria. As a result, many of them may neglect to finish the antibiotic course.[13]

Over eighty per cent of individuals had type 2 diabetes, which may be because most people with this sort of metabolic disorder have troubles already, especially neuropathies and vasculopathies by the time they get diagnosed because the majority of these individuals remain undetected for a long time.[14] Additionally, 87.2% of patients had HgbA1c values above 7%, which suggests inadequate blood glucose management. It is well recognized that high blood sugar makes harmful bacteria more virulent and can lead to serious infections, immune system dysfunction, and resistance to antibiotics.[15]

Surprisingly, all examined specimens, absolute resistance to a single antibiotic was not observed to any antibiotic when it came to sensitivity to various antibacterial medications. However, antibiotic resistance was recorded to significant proportion of cases. The over usage of these antibiotics may be the cause of this. The findings of pathogens isolates are somewhat consistent with a previous study which found that over half of various strains were resistant to cephalosporins, gentamicin, and quinolones.[16] Additionally, a different research found that imipenem works better for these infections.[17] Our results are in conflict with a research that found absolute sensitivity to co-amoxiclav but 95% sensitivity to imipenem and 89% sensitivity to meropenem.[18]

The increasing prevalence of antimicrobial resistance in nosocomial and non-nosocomial acquired illnesses in underdeveloped nations may cause ongoing shifts in the empirical approach selection process.[19] Additionally, the quantity of resistant varieties that develop is directly correlated with the entire quantity of one specific antibiotic administered in a certain hospital over a given time period.[20] The excessive usage of antibiotics may be the cause of elevated resistance percentages. Furthermore, some patients with DFIs may choose to forego culture and sensitivity testing, turn to less expensive medicines, or even undergo the test but never finish the antibiotic course due to the low cost and accessibility of antibiotics in

community pharmacies without restrictive restrictions.[21] Management of DFIs necessitates separating and recognizing of the bacterial flora, suitable treatment with antibiotics based on sensitivity patterns, precise choice and recognition of long-term challenges, and logical surgical treatment for complications, despite the fact that no ideal antibiotic therapy has been developed as of yet.[22]

Conclusion

Bacterial isolates were more frequently identified from DFIs examined samples. Proteus species and Escherichia coli were the most often isolated organisms. All isolates were shown to be extremely sensitive to vancomycin, piperacillin plus tazobactams and majority of the cases were resistant to ampicillin and cotrimoxazole. Antibiotic policy should be developed in the medical facility, and antibiotic-resistant bacteria surveillance is essential.

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