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MULTIPLE ANTIBIOTIC RESISTANCE (MAR) INDEX AND EFFICACY RATIO OF BACTERIA ISOLATED FROM DIABETIC WOUND ULCER

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ABSTRACT Bacteria show increased resistance and more virulence factors. They are found to be most dominant isolates in diabetic wounds. They can also cause Healthcare Associated infections. They are easily isolated from individuals with compromised immune systems. The overall goal of the study is to estimate the Multiple antibiotic resistance (MAR) index & effective ratio of the antibiotic against bacteria isolated from diabetic wounds. Wound swab specimens from diabetic wound ulcer received to Clinical Microbiology laboratory were included. Out of 129 specimen, 49 (38%) yielded Proteus species. MIC breakpoint of antibiotics showed highest resistance to carbapenems (100%) and more susceptible to aminoglycosides and beta lactamase inhibitors (88%). Efficacy ratio showed that amikacin (against 65% of isolates) to be effective drug against Proteus species isolated from Diabetic foot ulcer. MAR index showed 98% were above 0.2 (i.e MDR isolates). As multidrug infections pose major problem and the Diabetic patients have to spend twice the medical expenses when compared with the non diabetic, which directly have impact of our Socio economic status, alternative or combined therapy is needed effectively as topical therapy for life threatening Proteus infections in Diabetic wound infections.

KEYWORDS : Proteus species, Diabetic wound, Multiple antibiotic resistance index, Effective ratio

INTRODUCTION:

The emergence of multidrug resistant strains and pan drug resistant strains of bacterial strains can even cause a sudden outbreak of infection in a clinical unit. High prevalence of multidrug resistance indicates a serious need for surveillance and planning of effective interventions to reduce multidrug resistance in such pathogens [1]. Multiple antibiotic resistance (MAR) indexing has been shown to be a cost-effective and valid method of bacteria source tracking [2]. MAR in bacteria is most commonly associated with plasmids that contain one or more resistance genes, each encoding a single antibiotic resistance phenotype [3]. MAR index is calculated as the ratio of a number of antibiotics to which organism is resistant to total number of antibiotics to which organism is exposed. MAR index values >0.2 indicate high-risk source of contamination where antibiotics are often used [2]. The emergence of MAR pathogenic strains of bacteria causing Diabetic Foot ulcer will indicate the possible nosocomial infection in the hospital environment also [4]. As per NIH (National Institute of Health) evolution of comorbidities in people living with HIV are high. Among which Type II Diabetes is also identified [5]. As estimated 15% of patients with diabetes have diabetic foot ulcers. Of which 80% develops infections. The most prevalent organisms causing Diabetic foot ulcers are Staphylococcus aureus, Proteus species Pseudomonas aeruginosa, Escherichia coli, etc., Hence, it is important for the clinicians to remain updated with the current susceptibility profile and MAR index of the microbes, which will help in proper usage of antibiotics and even in preventing nosocomial infections. Aim of the study is to know the prevalence, MAR index of isolated microbes and to determine the efficacy ratio of the antibiotics used against those microbes.

MATERIALS AND METHODS

This is a cross sectional study. Wound swab specimens from Diabetic foot ulcer received to Clinical Microbiology laboratory were included with Institutional Review Board clearance. Study period was from January 2022 to August 2022. Samples yielding bacterial isolates were included. No growth were excluded. Culture, identification and antibacterial susceptibility testing was done by Conventional method [2]. Minimum Inhibitory Concentration (MIC) data was obtained from automated identification system. MAR index was obtained based on the ratio of no. of antibiotics shown resistance to the total no. of antibiotics that was tested [2]. Efficacy ratio was calculated as the ratio between standard MIC breakpoint to the obtained MIC value of the isolate.

RESULTS

129 clinical samples yielded 95 (74%) bacterial growth. Out of which, 49 (52%) were identified as Proteus species, 37 (39%) were Escherichia coli spp and 9 (9%) were identified as Staphylococcus aureus. 93 (98%) of Bacterial isolates were found to have MAR index greater than 0.2. MAR index distribution among the strains were shown in Table 1. Among these organisms, Proteus species exhibits 45%, Escherichia coli 16% and Staphylococcus aureus 39% of MAR index >0.2. This was explained in Table 2.

Table-1 Distribution of MAR index among NFGNB

S.No	Name of the organism	Total No. of isolates	MAR index										
			0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
1.	Proteus species	49	1	Nil	11	3	7	nil	6	6	7	1	7
2.	Escherichia coli	37	1	Nil	1	11	2	nil	9	4	3	1	5
3.	Staphylococcus aureus	9	Nil	nil	Nil	Nil	2	nil	2	1	3	Nil	1

MAR: Multiple antibiotic resistance

Table 2: Percentage of NFGNB with MAR index > 0.2

S.No	Name of the organism	MAR index									Total	Percentage
		0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1		
1.	Proteus species	11	3	7	nil	6	6	7	1	7	48	51%

2.	Escherichia coli	1	11	2	nil	9	4	3	1	5	36	39%
3.	Staphylococcus aureus	Nil	Nil	2	nil	2	1	3	Nil	1	9	10%
Total											93	100%

MAR: Multiple antibiotic resistance

75(81%) was from in-patient department. 73(62%) were hospitalized for more than 3 days, 44 (38%) was from surgery department. 95 (85%) were MDR isolates. The anti -microbial susceptibility pattern of bacterial strains with MAR index >0.2 was shown in Table 5.

Table 5: Antimicrobial resistance (R) pattern (in percentage) of bacterial strains with MAR index >0.2

Antibiotics	Proteus species (R%)	Escherichia coli (R%)	Staphylococcus aureus (R%)
Amikacin	28	16	26
Gentamicin	48	27	18
Cefuroxime	54	56	NA
Cefepime	39	36	NA
Ciprofloxacin	46	44	39
Ofloxacin	43	39	32
Piperacillin tazobactum	29	26	NA
Imipenem	100	95	NA
Meropenem	100	86	NA
Cefoxitin	NA	NA	43
Penicillin	NA	NA	56
Cotrimoxazole	60	38	32
Vancomycin	NA	NA	5
Linezolid	NA	NA	0

The isolates were highly susceptible to amikacin (72%). Proteus species isolated from Diabetic foot ulcer.

Efficacy ratio of >1 was showed by Amikacin (against 65% of isolates). This can be an effective drug against DISCUSSION: Though the bacterial infections being the life threatening pathogens, the proper surveillance and treatment will help to manage those organisms. In this study, the overall prevalence rate of bacteria in Diabetic foot ulcer was 74%. This contradicts with the prevalence rate of 10.5%with Olayinka et al. This may be due to the difference in the study population. In this study, Proteus species was the predominant organism followed by Escherichia coli and Staphylococcus aureus. But in a study done by Arora, Acinetobacter spp. (62%) was the most common followed by Proteus species (18%). The MAR index of >0.2 was seen more with Proteus species, In this study, >0.2 MAR index was isolated more from surgical unit (38%). In this study 100% were sensitive to Carbapenem, 69% were sensitive to Amikacin. But 98.1% were sensitive to Amikacin in the study done by Olayinka et al., Being the first line drug, in our study Amikacin exhibited only 69% susceptibility. Compared with the study done at the Lagos University teaching hospital, only 12.5% exhibited resistance to imipenem. But in our study 30% had shown resistance to imipenem. Likewise Olayinka et al also had reported more than 80% sensitivity to imipenem in her study. In this study, 95 isolates exhibited Multidrug resistance mechanism. Out of which 19 were pan drug resistant. Susceptibility profile of MDR isolates revealed that the resistance pattern is equally distributed and Staphylococcus aureus alone is 100 % susceptible to a Linezolid. Whereas in a study conducted by Olayinka et al, 100% MDR strains were sensitive to imipenem and 16 out of 18 were resistant to Gentamicin. It has been said that there is generally an excess of resistance among isolates from hospitalized patients compared with those from out patients (Livermore, 2004). This has been correlated well with this study, were 81% (98) were in patient and 62% of which have been hospitalized for more than 3 days. MAR index higher than 0.2 has been said to be an indication of isolates originating from an environment where antibiotics were often used (Krumpernam, 1983; Paul et al.,

1997). Analysis of the MAR index of the Pseudomonas strains in a study done by Olayinka et al, showed that 60.9% had MAR index of 0.3 and above.

CONCLUSION
Resistance development worsens the infections to diabetic foot ulcers and impede the therapeutic treatment towards favoring surgical interventions. Hence, it is essential to develop new strategies to guarantee an effective treatment by antibiotics against microbes causing Diabetic foot ulcer. Drug resistance pose a major problem. Future studies are needed for complete multicentric analysis of overall bacterial isolates that shows drug resistance. Especially with isolates that affect immunocompromised patients.

This can be controlled by proper management and surveillance. The isolates were more from surgery department. This shows that the chance of contamination of MDR isolates will be more in these units, which has to be taken for consideration. In this study, 98% were MDR isolates. 62% were hospitalised for more than 3 days which indicates that these organisms may be the probable source for nosocomial infection in future that need to be treated immediately. When strains have multiple antibiotic resistance, the choice of therapy is limited and difficult. Thus, it is important to have antibiotic policies and surveillance programs. Moreover, it is desirable to periodically monitor the susceptibility pattern of NFGNB as they were the common pathogens causing nosocomial infections worldwide. This will help to administer an effective therapeutic agent whenever there is a need to so do.

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