ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at: www.ijmacr.com

Volume – 6, Issue – 1, Janaury - 2023, Page No. : 01 - 05

Antibiotic Resistance Patterns and Bacterial Profiles in Clinical Isolates

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How to citation this article: Amitav Mohanty, Shreeja Jajodia, "Antibiotic Resistance Patterns and Bacterial Profiles in Clinical Isolates", IJMACR- January - 2023, Volume – 6, Issue - 1, P. No. 01 – 05.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: Antibiotic efficiency is rapidly declining as a result of bacterial antimicrobial resistance, which is prevalent worldwide (AMR). Due to inadequate treatment options and treatment failures, AMR might result in an increase in mortality and morbidity. This research objective was to assess the AMR profile of several bacterial isolates from hospitals and labs.

Method: 50 clinical isolates were tested for antibiotic susceptibility to 11 multiple drugs: ampicillin, azithromycin, cefamandole, ceftriaxone, ciprofloxacin, nitrofurantoin, clindamycin, erythromycin, ofloxacin, penicillin, and vancomycin. Disk diffusion and microdilution techniques were used to establish antibiotic sensitivities in accordance with the National Committee for Clinical Laboratory Standards (NCCLS).

Result: Vancomycin, ofloxacin, ampicillin, ciprofloxacin, and penicillin were all effective treatments for all isolates. The following clinical isolates, however, showed intermediate or decreased sensitivity to the drugs: 13 (31%) to ciprofloxacin, 8 (16%) to ampicillin, and 8 (15%) to penicillin. Azithromycin and ceftriaxone resistance was found in 30% of the isolates, clindamycin resistance in 18%, cefazolin resistance in 14%, nitrofurantoin 2 (3%) and cefamandole resistance in 12%. Of the clinical isolates examined, 17 (34%) were resistant to five out of the ten examined antibiotics.

Conclusion: Given the relatively high rates of resistance for five of the ten studied antibiotics, it is advised that women colonised with clinical isolates who are penicillin allergic have their isolates antibiotic sensitivities evaluated. The organism's pattern of antibiotic susceptibility should be taken into consideration while choosing the antibiotic for intrapartum chemoprophylaxis. Nitrofurantoin should be administered to patients with ISOLATED BACTERIA bacteriuria.

Keywords: Resistance, Antibiotics, Intrapartum Prophylaxis

Introduction

The expanding global trends in antibiotic resistance in commonly implicated organisms further exacerbate this elevated risk of bacterial infections. This is especially true in the Indian context for organisms belonging to the Enterobacteriaceae group, such as Escherichia coli and Klebsiella pneumoniae, as well as the nonfermenter group, which includes Acinetobacter spp. As evidenced by ESBL (extended spectrum -lactamase) and Amp C producers among the Enterobacteriaceae, there is already widespread resistance to cephalosporins [1]. Unfortunately, widespread usage of antibiotics has resulted in rising carbapenem resistance as well, which is typically brought about by the development of carbapenemase by the organisms [2]. In India, the prevalence of organisms that produce metallo-beta-lactamase (MBL), notably New Delhi MBL-1 (NDM-1), is also increasing [3]. Another issue of worry is the rise of resistance among Gram-positive organisms. One study from North East India found high levels of Methicillin-Resistant Staphylococcus aureus (MRSA) in clinical samples [4]. Similar to this, clinical isolates of enterococci are also becoming more resistant to glycopeptide antibiotics like vancomycin and tiecoplanin [5]. When a clinician lacks sufficient knowledge of the range of microorganisms and the prevalent patterns of antimicrobial susceptibility in that specific setting, empirical treatment of infection in the patient is frequently attempted arbitrarily by administration of broad spectrum or combination antibiotics until culture. These trends could vary from one geographical area to another, and even from one hospital to another.

Method

A total of 50 clinical isolates from strains kept in skim milk at 70°C in the Department of Medicine, Apollo Hospital, Bhubaneswar were analysed. These isolates were gathered in the years 2020 and 2021. 30 non-pregnant women (15 vaginal, 15 rectal) and 5 babies provided the clinical isolates. Each strain was subcultured three times on 5% sheep blood agar plates because they were all stick isolates. The National Committee for Clinical Laboratory Standards (NCCLS) [6] methodology was followed in triplicate for all disc susceptibility procedures. The surface of the inoculated agar plate received eleven discs. 10 µg ampicillin, 15 µg azithromycin, 30 µg cefamandole, 30 µg cefazolin, 30 µg ceftriaxone, 5 µg ciprofloxin, 2 µg clindamycin, 15 µg erythromycin, 5 µg ofloxacin, 30 µg vancomycin, and 10 units of penicillin G were the medications examined. A single disc containing 300 g of nitrofurantoin was applied to the surface of a different small agar plate. All plates were sprayed with isolated bacteria, then incubated for 20 hours at 35°C with 5% CO2 before being read.

Results

Clinical isolates were categorized in gram-positive which consisted of Coagulase negative staphylococcus, Enterococcus spp. streptococci Staphylococcus aureus and gram-negative isolates which consists of Escherichia coli, Klebsiella pneumonia, Pseudomonas aeruginosa, Acinetobacter spp., Stenotrophomonas maltophilia, Shewanella putrefaciens, Klebsiella ozonae, Klebsiella oxytoca, Proteus vulgaris, Proteus mirabilis, Citrobacter spp., Providencia stuartii, Morganella morganii, Pseudomonas spp., Chryseobacterium spp., Serratia marcescens.

Tables 1 and 2 display the findings of the agar disc diffusion and microdilution procedures used to test antibiotic sensitivities.

Table 1: Resistance pattern of clinical isolates

Antibiotic	Susceptible	Intermediate	Resistant
Ampicillin	42 (62.6%)	8 (17.2%)	-
Azithromycin	32 (66.4%)	2 (4.3%)	15 (30.7%)
Cefamandole	44 (68.4%)	1 (1.8%)	6 (13.4%)
Ceftriaxone	25 (49%)	1 (1.8%)	7 (15.3%)
Ciprofloxacin	29 (68.1%)	13 (31.7%)	-
Clindamycin	41 (80.7%)	1 (1.8%)	9 (19.1%)
Erythromycin	33 (65.3%)	5 (9.5%)	12 (24%)
Nitrofurantoin	50 (98.0%)	2 (4.3%)	-
Ofloxacin	25 (99%)	1 (1.8%)	-
Penicillin	43 (84.5%)	7 (15.3%)	-
Vancomycin	51 (99%)	1 (1.8%)	-

Table 2: Analyses of isolates microdilution susceptibilities that were identified as intermediate or resistant by the disc diffusion method

Disc Diffusion	Micro-dilution		
	Susceptible	Intermediate	Resistant
Penicillin G Intermediate	1/11 (20.1%)	7/11 (80.1%)	-
Ampicillin Intermediate	11/18 (52.5%)	8/18 (47.3%)	-
Clindamycin resistant	-	-	11/11 (100%)

The response to ampicillin was the only difference in susceptibility between the two techniques. The microdilution approach confirmed the susceptibility of around half of the isolates categorized as intermediate-susceptible to ampicillin by disc diffusion. However, the microdilution approach revealed that 7 of 11 bacteria identified as intermediately susceptible to penicillin G by the agar disc diffusion method continued to exhibit this reduced level of sensitivity. Six isolates out of them showed intermediate sensitivity to ampicillin**.** According to the microdilution approach, all 11 isolates that had been found to be resistant to clindamycin by disc diffusion were also resistant, with an MIC90 of > 6 µg/ml. The disc diffusion method can be used to screen isolates for antibiotic resistance because there were no differences between it and the microdilution technique. With and without 5% sheep blood, Mueller-Hinton agar measurements of inhibitory zones showed only ciprofloxacin to significantly vary ($p < 0.018$) from the control.

Discussion

Since the Center for Disease Control (CDC) established guidelines in 1996 and then updated guidelines in 2002 [7], the use of intrapartum antibiotics to avoid perinatal vertical transmission of clinical isolates and early-onset neonatal sepsis has greatly increased. An estimated 1 million women will be at risk for isolated colonization and may need intrapartum antibiotic prophylaxis due to the anticipated 4 million deliveries that take place annually in the United States. Penicillin G or ampicillin is the recommended antibiotics. The most recent CDC recommendations advise giving penicillin or ampicillin to people who are not allergic to the drug. Cefazolin should be administered to those with a slight penicillin allergy, and clindamycin or vancomycin should be administered to people with a major allergy (rash or a history of breathing difficulties), if the isolate is known to be resistant to clindamycin. Vancomycin, however, has not been demonstrated to pass the placenta and reach enough amounts in amniotic fluid and foetal blood. It is possible that the local vaginal microflora will develop resistant strains as a result of the extensive use of -lactam antibiotics and exposure to them for other reasons. Escherichia coli has shown signs of developing resistance, particularly to ampicillin [8]. However, as shown in numerous studies, clinical isolate is universally

susceptible to penicillins, making it the best antibiotic to use for intrapartum prophylaxis [2]. Clinical isolates that were resistant to penicillin were not discovered in this investigation or any previous studies. However, when tested for antibiotic sensitivity using the disc diffusion and micro-tube dilution procedures, the isolates showed an intermediate sensitivity to penicillin G in 16% of instances and to ampicillin in 14% of instances. Actually, the disc diffusion method showed that 35% of the isolates had an intermediate sensitivity to ampicillin and that 18% of the isolates had an intermediate sensitivity to penicillin. According to Rouse et al findings, 10% and 8%, respectively, of the isolates they examined showed intermediate susceptibility to penicillin and ampicillin [9]. 2% of clinical isolates, according to Betriu et al., displayed intermediate susceptibility to penicillin [10]. 15% of the examined clinical isolates, according to Liu et al., were intermediately susceptible to penicillin [11]. The discovery of penicillin G and ampicillin-resistant bacteria does not indicate that these antibiotics should not be utilised. However, this information does suggest that isolates should be followed up on yearly to see if a reduction in sensitivity or development of resistance occurs. Resistance will develop if -lactams are used often, as it did with Streptococcus pneumoniae. Additionally, it has been hypothesised that the large decline in the prevalence of sepsis may be accompanied by an increase in the prevalence of newborn sepsis caused by Gram-negative bacteria. Incidence of Gram-negative newborn sepsis was compared before and after the CDC recommendations by Levine et al. They discovered that throughout the same time period, the incidence of Gram-negative newborn sepsis increased 4.5 fold whereas the incidence of clinical sepsis considerably decreased. Another significant finding was that all neonatal sepsis deaths involved intrapartum ampicillin prophylaxis administered to women, and the bacteria isolated from the neonates were ampicillin-resistant [2]. These results were consistent with recent reports of unfavorable foetal outcomes caused by resistant Enterobacteriaceae following the use of antibiotics for an early membrane rupture [12].

Conclusion

In conclusion, it is unknown whether the clinical importance of the antibiotic resistance found in vitro exists in vivo. In order to prevent perinatal vertical transmission and infection with clinical isolates, future clinical trials are required to find safe and effective penicillin substitutes. Antibiotic susceptibilities likely vary significantly by area, particularly for second antibiotics. As a result, the laboratory should be asked to perform antibiotic sensitivities on the clinical isolate in the penicillin-allergic patient. The doctor will then be able to select an acceptable penicillin substitute thanks to this.

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