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Original Article

Antibiotic Susceptibility and Resistance of Clinical Isolates against Various Antibiotics

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ABSTRACT

Antibiotics are essential for treating bacterial infections, but their overuse and misuse have led to the development of antibiotic resistance. **Objective:** To evaluate the antibiotic susceptibility and resistance of clinical isolates against various antibiotics. **Methods:** A total of 1000 clinical isolates were collected from patients at the Fatima Memorial Hospital in Lahore, Pakistan. Identification of bacteria was performed using conventional culture and biochemical tests. Antibiotic susceptibility was assessed using the Kirby-Bauer disc diffusion method with 26 commercial antibiotic discs, including amikacin, amoxycillin, ampicillin, and others. **Results:** The study found that the most common Gram-positive isolates were *Staphylococcus aureus* (40.0%) and Streptococcus pyogenes (5.0%). The most effective antibiotics against these isolates were amikacin, cefotaxime, and meropenem. In contrast, high levels of resistance were observed against commonly prescribed antibiotics, including amoxicillin, ampicillin, and cefixime. **Conclusion:** These findings highlight the need to promote appropriate antibiotic use and to monitor antibiotic resistance patterns to combat the rise of antibiotic-resistant infections.

INTRODUCTION

The antibiotics are an essential group of therapeutic drugs used to kill bacteria on various levels in the human body. These antibiotics had played a significant role for the treatment as well as the prevention of bacterial infections. The effectiveness of antibiotics against bacterial infections cannot be denied. Anti-microbial or antibiotic resistance is an international public health issue, greatly dominant in the developing countries. Antimicrobial resistance is a microbial adaptation that permits microorganisms to survive even when antibiotics are present. Antibiotic resistance is a significant risk to human health and is being seen as a global environmental and economic risk. The relationship between bacterial resistance and misuse of antibiotics had been well documented and was considered to be a major public health problem [1]. Mortality due to bacterial infections represents one-fifth of global deaths. The effectiveness of antibiotics against diseases caused by bacteria was a great success in the latest medicine. However, bacteria were developing resistance and becoming less reactive to antibiotics when it was really needed. In order to preserve the effectiveness of antibiotics, antibiotic usage might be regulated to stop the spread of germs that are resistant to them[2]. Antibiotic resistance poses a significant threat to public health, as it limits the effectiveness of antibiotics and makes it harder to treat bacterial infections. The overuse and misuse of antibiotics are major factors that contribute to the development of antibiotic resistance. When antibiotics are used too frequently or unnecessarily, bacteria are exposed to them more frequently, which

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increases the likelihood that they will develop resistance [3]. A major public health problem is the rise of antibiotic resistance in bacteria and infections from resistant bacteria are becoming ever more difficult and expensive to treat [4]. Antibiotic resistance has become a global health problem as a result of the extensive use of broad-spectrum antibiotics in hospitals and the population. Antibiotic resistance may evolve in bacteria in order for them to escape [5, 6]. Excessive use of antibiotics had led to emergence of bacteria that can escape themselves from antibiotics, the so called antibiotic resistant bacteria (ARB) which commonly appeared in developing countries where antibiotics were frequently used. Antibiotic resistance is a natural adaptation and represents an evolutionary response to the strong selective pressure as a result of antibiotic exposure [7]. Morbidity and mortality due to bacterial infections by resistant microorganisms are increasing in Pakistan. Most common cause of severe illness in individuals receiving medical treatment was nosocomial infections. The nosocomial infections, often known as healthcare-associated illnesses, can arise due prolong stay in hospital. The increase in antimicrobial resistance (AMR) nationwide is suffocating all attempts to reduce hospital-acquired infections [8]. Antibiotic efficacy is becoming a concern due to the emergence of novel antibiotic-resistant bacterium strains. Despite an ever-increasing demand for novel antimicrobial medications, antibiotic advancement and development appears to be at a deadlock in recent years [9, 10]. Antibiotic resistance has now become a health problem worldwide. Every year, approximately 7 billion causalities throughout the world are as a result of infections that have developed resistance to the antibiotics used to treat them [11-13]. Resistance is a common occurrence in nature. Only a few germs survive being exposed to pharmaceuticals that are supposed to kill them, and these microbes pass on their drug resistance to others. In view of the findings that overdo and misuse of antibiotics, as well as inadequate disease control, is hastening antibiotic resistance, this issue has gained prominence [14, 15].

METHODS

The Pathology Department at Fatima Memorial Hospital in Lahore, Pakistan, conducted this cross-sectional research. Almost all sorts of samples, including blood, pus, swabs, sputum, urine, fluids, and semen, were included in the collection of the 1000 total samples (sputum, swabs, blood, urine, pus, etc.). In a sterile container, each sample was taken. Within an hour of collection, the sample container was labelled with the source, date, and time of collection and sent to the lab for analysis. Patients of either gender who had any kind of illness and had not previously received therapy were included; patients receiving antibiotic treatment, children, pregnant women, and those who had no signs or symptoms of infection were excluded. Samples from the sample container were grown on specific medium plates. The plates were then kept in an incubator for 24 hours at 37°C. After incubation, isolated colonies were inspected, and cfu/ml was measured for a few of the plates, with a few exhibiting significant growth. To establish pure cultures that could be preserved, the colonies were then streaked across agar plates. Clinical isolates were identified by their colonial morphology on Blood agar. Colony features had been studied using isolated colonies. For the identification of these species, standard identification and susceptibility procedures were used. Staphylococcus species developed hemolytic and non-hemolytic creamy-colored smooth colonies on blood agar. In the case of streptococci, on blood agar, hemolytic pinpoint colonies were also found. Gram positive bacteria appeared as dark purple color organisms.

RESULTS

Antibacterial activity was assessed by sensitivity profile of different antibiotics against clinical isolates. The Resistance pattern of Gram Positive clinical isolates revealed that the majority of the clinical isolates were resistant to several antibiotics. Antibiotic sensitivity pattern of clinical isolates had been shown. 26 antibiotics were used to test antibacterial activity. Table 1 showed sensitivity in percentage (80%) by *Staphylococcus aureus* was 100% to Levofloxacin, 100% to Nalidixic acid, 99% to Linezolid, 99% to Ceftriaxone, 99% to Cefotaxime, 96% to Nitrofurantoin, and 91% to Amikacin, 90% to Gentamycin 88% to Cefixime, 84% to Ciprofloxacin, 83% to Ceftazidime, and 80% to Vancomycin. Sensitivity shown by *Streptococcus pyogenes* was 100% to Levofloxacin, 100% to Nalidixic acid, 100% to Cefixime, 99% to Linezolid, 99% to Ceftriaxone. Other antibiotics which retained their efficacy were Ampycillin (98%), Cefoxitin (96%), Clindamycin (92%), Cephalothin (88%), Cefipime (86.8%), and Rifampicin (82%).

Antibacterial agent	Symbol	*Staphylococcus aureus* (400)	
		Sensitive	Resistance
Amikacin	AMK	364(91)	36(9)
Ampicillin	AMP	88(22)	312(78)
Augmetin	AUG	48(12)	352(88)
Cefazolin	CFZ	252(63)	148(37)
Cefepime	CPM	168(42)	232(58)
Cefixime	CFM	352(88)	48(12)
Cefotaxime	CTX	388(97)	12(3)
Cefoxitin	CFN	0(0)	0(0)
Ceftriaxone	CTR	396(99)	4(1)
Ceftazidime	CFD	332(83)	68(17)
Cephalothin	CEP	0(0)	0(0)

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Ciprofloxacin	CIP	336(84)	64(16)
Clindamycin	CLD	308(77)	92(23)
Gentamycin	GEN	360(90)	40(10)
Imipenem	IPM	156(39)	244(61)
Levofloxacin	LEX	400(100)	0(0)
Linezolid	LNZ	396(99)	4(1)
Meropenem	MRP	4(1)	396(99)
Nalidixic Acid	NA	400(100)	0(0)
Nitrofurantoin	NIT	384(96)	16(4)
Norfloxacin	NOF	284(71)	116(29)
Rifampicin	RMP	220(55)	180(45)
Vancomycin	VNX	320(80)	80(20)

Table 1: Antibacterial activities against *Staphylococcus aureus*

Table 2 showed antibacterial activity of *Streptococcus pyogenes* against different antibiotics.

Antibacterial agent	Symbol	*Streptococcus pyogenes* (50)	
		Sensitive	Resistance
Amikacin	AMK	31(61.5)	19(38.5)
Ampicillin	AMP	49(98)	1(2)
Augmetin	AUG	33(33)	17(34)
Cefazolin	CFZ	0(0)	0(0)
Cefepime	CPM	43(86.8)	7(13.2)
Cefixime	CFM	50(100)	0(0)
Cefotaxime	CTX	0(0)	0(0)
Cefoxitin	CFN	48(96)	2(4)
Ceftriaxone	CTR	49(99)	1(0)
Ceftazidime	CFD	1(2.8)	36(72)
Cephalothin	CEP	44(88)	6(12)
Ciprofloxacin	CIP	38(76)	12(24)
Clindamycin	CLD	46(92)	4(8)
Gentamycin	GEN	15(30)	35(70)
Imipenem	IPM	38(76)	12(24)
Levofloxacin	LEX	50(100)	0(0)
Linezolid	LNZ	49(99)	1(0)
Meropenem	MRP	0(0)	50(100)
Nalidixic Acid	NA	50(100)	0(0)
Nitrofurantoin	NIT	37(74)	13(26)
Norfloxacin	NOF	33(66)	17(34)
Rifampicin	RMP	41(82)	9(18)
Vancomycin	VNX	10(20)	40(80)

Table 2: Antibacterial activities against *Streptococcus pyogenes*

DISCUSSION

Antibiotics are important to treat and manage bacterial infections more efficiently and timely. There is a well-known saying "Every invention and discovery has its own downside" the pathogens are becoming resistant to those. Due to misuse and overuse of antibiotics in the community, bacteria are developing resistance and becoming unmanageable and troublemaker for treatment. The facts and results about sensitivity and resistance pattern of clinical isolates against antibiotics in this study were appealing. 1,000 clinical isolates out of 1,400 biological samples were obtained with an infection rates 71.4%. This was relatively higher compared to infection rate in other study by Mehta *et al.*, which showed an infection rate of 20% [4]. Gender wise distribution of biological samples showed that number of samples obtained from the male patients 770 (55%) were more than the female patients 630 (45%). Similar results were observed in 2014 in a study conducted in Peshawar, males (58%) had a higher percentage of clinical isolates than females (42%) [6]. According to gram category, among 1,000 clinical isolates, 450 (45%) were Gram Positive. Similar results were found in research done in 2007 [16, 17]. Baddour *et al.*, observed in Riyadh, Saudi Arabia, that (64.4%) gram negative isolates had a higher percentage than (35.6%) gram negative isolates [18]. On analyzing sensitivity pattern in this study, it was found that *Staphylococcus aureus* was showing sensitivity with various degrees to Nalidixic acid (100%), Levofloxacin (100%), Linezolid (99%), Ceftriaxone (99%), Cefotaxime (97%) and Nitrofurantoin (96%). Similarly, *streptococcus pyogenes* were 100% sensitive to Nalidixic acid, Levofloxacin Cefixime and 99% to Linezolid, and Ceftriaxone. This type of sensitivity pattern of Gram-positive bacteria to different antibiotics was also observed in previous study by Vanitha *et al.*, with similar findings [19]. Similar sensitivity pattern was also noted by Shrestha *et al.*, in Kathmandu University [20].

CONCLUSIONS

With very few exceptions among the antibiotics employed in this investigation, the findings of the current study clearly show that there is a worrying rise in resistance to almost all antibiotics.

Conflicts of Interest

The authors declare no conflict of interest

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