RESEARCH ARTICLE

ANTIBIOTIC RESISTANCE PATTERNS OF PSEUDOMONAS AERUGINOSA IN A TERTIARY CARE HOSPITAL IN CENTRAL INDIA

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ABSTRACT

Background: Antimicrobial resistance is the major problem of the modern world, thus it needs urgent attention. Pseudomonas aeruginosa has the inherent property of developing the resistance. Hence, it is necessary to know the current resistance pattern for proper use of antipseudomonal agents.

Aims & Objective: (i) To evaluate the antibacterial resistance pattern in Pseudomonas aeruginosa in a tertiary care hospital in Central India; (ii) To provide base for formulating rational antibacterial guidelines to treat the infections caused by pseudomonas aeruginosa.

Material and Methods: The present study was an observational, longitudinal study over a period of three years from April 2007 to March 2010. The necessary data was obtained from Central Microbiology Laboratory of Government Medical College, Nagpur, India. Total 1001 samples were reported the presence of Pseudomonas aeruginosa in all the 11 types of biological sample. Antimicrobial susceptibility testing was performed using disk diffusion method with Pseudomonas species ATCC 27853, as per CLSI guidelines. Appropriate statistical analysis methods were applied to the data to fulfil the objectives of the study with the latest version of Graph pad prism software.

Results: Pus samples showed highest culture positivity for P. aeruginosa followed by sputum. The highest resistance was reported to ciprofloxacin while the lowest resistance to Meropenem.

Conclusion: Wound infection was the most common hospital acquired infection. The use of Meropenem and Amikacin should be restricted to avoid the emergence of resistance against them. Such studies should be performed regularly to recognize the recent trends.

KEY-WORDS: Amikacin; Antibiotic Susceptibility Testing; Antipseudomonal Agents; Ciprofloxacin; Meropenem

Introduction

The discovery and development of antibacterial agents is widely recognized to be one of the most important public health interventions of the last century.[1] Innumerable lives and limbs have been saved by the use of antibacterial agents (ABAs). However, its impact has reduced significantly with the arrival of increase in the antibacterial resistance.[1-4]

According to World Health Organization (WHO) report in June 2010, the worldwide more than 50% isolates of Staphylococcus aureus in hospital settings were Methicillin-resistant.[5,6] With the recent discovery of New Delhi Metallo-β-lactamase 1 (NDM-1) in multidrug-resistance Enterobacteriaceae in India[7], it is time that a national effort is initiated to tackle this problem of antibacterial resistance.[3,4] Recognizing the burden of emerging resistance, WHO prepared 'Antimicrobial Resistance' an organization-wide priority and the focus of World Health Day 2011.[8]

Pseudomonas aeruginosa (P. aeruginosa) is a Gram-negative, aerobic rod. It is an opportunistic pathogen, meaning that it exploits some break in the host defenses to initiate an infection.[9] In fact, P. aeruginosa is an epitome of opportunistic nosocomial pathogen and despite therapy, the mortality to nosocomial pseudomonal pneumonia is approximately 70% in immunocompromised patients. Unfortunately, it demonstrates resistance to multiple antibacterial, thereby jeopardizing the selection of appropriate treatment.[10]

This study underlines the role of local periodic studies in defined patient cohorts for a finite period to determine the local epidemiology of

antibiotic resistance pattern in P. aeruginosa and to evaluate the trend of the resistance pattern in the three consecutive years in a tertiary care hospital setting in Central India.

Materials and Methods

The present study was undertaken in the Government Medical College & Hospital, Nagpur, India from April 2007 to March 2010. The study group included the indoor patients admitted in the tertiary care centre and comprised of 1001 different samples of clinically suspected cases of bacterial infections. Culture was done on McConkey's medium and Nutrient agar by the standard loop technique after the application of screening tests to various samples. Identification of the bacterial isolates was done on the basis of standard recommended procedures.[11]

The various biological samples like urine, pus, sputum, vaginal swab, stool, conjunctival swab, pleural fluid, ascitic fluid, throat swab, cerebrospinal fluid (CSF) etc. of the admitted patients were sent to the clinical microbiology laboratory for antibacterial susceptibility testing (AST). AST was done on Mueller Hinton Agar plates (Hi Media India Ltd., Mumbai) as per the Clinical and Laboratory Standards Institute (CLSI) guidelines.[12] Briefly, Petri dishes containing 20 ml of Mueller-Hinton agar were seeded with a 24 hours old broth culture of the bacterial strains. Filter paper discs impregnated with the antimicrobial agent were applied to the seeded plates. After overnight incubation at 37^{0}C the zone of inhibition around the discs was measured and compared with the standard strains (ATCC Pseudomonas aeruginosa 27853) as recommended by the CLSI manual.[12] The results based on the zone size, as compared with the standard strains, were interpreted as Sensitive or Resistant as per the recommendations of the CLSI manual.[12] The choice of the antimicrobial discs used was dictated by the recommendations of the CLSI manual.[12]

This study was approved by the Institutional Ethics Committee of Government Medical College and Hospital, Nagpur. Since it was an observational study and did not possess any intervention hence the consent part was waived.

Statistics Analysis

The antibacterial resistance was explained in terms of percentage and recorded in tabular form, while to estimate the comparison between resistance patterns from one year to another the Chi-square test was performed with degree of freedom (df) of one with the help of Graph pad prism version 5.01 software. The statistical significance was considered when p value <0.05.

Results

In the three years total 1001 biological samples had shown the growth of Pseudomonas. Out of which Pus samples (35.3%) showed highest culture positivity for P. aeruginosa followed by sputum (20.8%), pleural fluid (15.5%) and urine (13%) as shown in Figure 1.

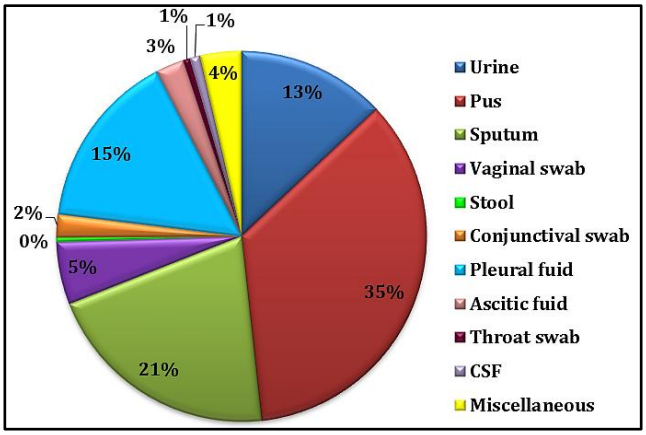

Figure-1: Distribution of Culture Positive Biological Samples for P. aeruginosa in the Three Years

Table 1 shows the comparison of resistance pattern in Pseudomonas aeruginosa in the three years. There were 328, 348 and 275 biological samples found P. aeruginosa as the isolated organism in year 2007-08, 2008-09 and 2009-10 respectively.

In all the years, the highest resistance was reported to ciprofloxacin (48-59%) while the lowest resistance to Meropenem (8-11%). When resistance in 2008-09 was compared with the 2007-08, it showed statistical significant increase in resistance to Ciprofloxacin (χ^2= 3.99, df=1, p<0.05). While when resistance in 2009-10 was compared with 2007-08, it showed statistical significant decrease in resistance to Gentamicin (χ^2= 4.37, df=1, p<0.05) and increase in resistance to Ciprofloxacin (χ^2= 6.50, df=1, p<0.05).

Table-1: Comparison of Resistance Patterns in Pseudomonas Aeruginosa in the Three Financial Years

Antibacterial Group	ABA Ψ	ATC# Code	2007-08 (n=328)			2008-09 (n=348)			2009-10 (n=275)		
			Total Tested	Resistant		Total Tested	Resistant		Total Tested	Resistant	
				No.	%		No.	%		No.	%
Ureidopenicillin	**Pc**	J01CR05	323	125	**38.69**	319	143	**44.82**	252	96	**38.09**
Carbapenem	**Mp**	J01DH02	324	25	**7.71**	314	34	**10.82**	221	22	**09.95**
Aminoglycoside	**G**	J01GB03	355	181	**50.98**	336	160	**47.61**	268	114	**42.53***
	Ak	J01GB06	335	71	**21.19**	314	76	**24.20**	244	54	**22.13**
Fluoroquinolone	**Cf**	J01MA02	323	155	**47.98**	313	175	**55.91***	245	144	**58.77***

Chi square test applied, df=1, p value <0.05 (significant); * p value<0.05 (When compared with the 2007-08 resistance data); Ψ (ABA= Antibacterial agent; Pc= Piperacillin; Mp= Meropenem; G= Gentamicin; Ak= Amikacin,;Cf=Ciprofloxacin); # ATC= Anatomical Therapeutic Chemical Classification

Discussion

The majority of biological samples from which bacterium was isolated were consisted of pus (35.3%), sputum (20.8%), pleural fluid (15.5%) and urine (13%), indicating that, wound infection, lower respiratory tract infection (LRTI) and urinary tract infection (UTI) are the common causes of morbidity in the local population and hospital visits. Javiya VA et al[10] stated similar findings in their study.

The resistance pattern in Pseudomonas aeruginosa showed high resistance rates in Ureidopenicillin (45%), Aminoglycoside (Gentamicin: 51%, Amikacin: 24%) and Fluoroquinolone (58%) groups with a statistically significant ($p<0.05$) rise in resistance to Ciprofloxacin; while lowest resistance was seen to Carbapenem (Meropenem: 10%) group. These findings were supported by the studies done by Javiya VA et al[10] and WHO report in June 2010[5]. Amikacin and Meropenem being 'reserved antibacterial agents', their consumption in hospital was very low, this had some beneficial effect, since when used, the efficacy of these antibacterial was preserved, and bacterial resistance to them.

As the AST reports are not available for the initial 48 hours, the empirical therapy is often needed to treat the life threatening infections. In the empirical therapy, the broad spectrum bactericidal ABAs like Aminopenicillin and Fluoroquinolones are generally preferred by the treating physicians. Hence, the consumption and percentage share in the total budget of these ABAs is rising. The repeated exposure of these ABAs causes step-wise development of resistance in bacteria; which lead to loss of their cost-effectiveness. The rational use of antibacterials can only be expected if the prescriber is aware of the local antibacterial guideline which generally based on the knowledge of commonest bacteria and the possible susceptible antibacterial agent in that local setting. Thus, our observations can help to improve the rational use of ABAs in indoor patients and also to curtail the economic burden of our tertiary care hospital. Hence, we expect that such type of studies should be done in every hospital to provide a base for formulating the local antibacterial guideline.

Conclusion

From the present study, we conclude that the pseudomonal infection was the most commonly in the wound infection at the hospital. Among all antibacterial, Meropenem & Amikacin demonstrated minimum resistance against the Pseudomonas species. Therefore, use of these agents should be restricted to severe nosocomial infections, in order to avoid rapid emergence of resistant strains. Periodic AST should be carried over a period of two to three years, to detect the resistance trends. Also, a rational strategy on the limited and prudent use of antipseudomonal agents is urgently required.

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