APTI ijopp

Comparative Study on the Sensitivity Pattern of Microorganisms

Vidhya D, Sriram S, Manjula Devi A.S, Rajalingam B, Shivashankar S, Chitra B, Rajeswari R

Department of Pharmacy Practice, Sri Ramakrishna Institute of Paramedical Sciences,
Sarojini Naidu Road, Siddhapudur, Coimbatore – 641 044
Address for correspondence: vidhyad18@gmail.com

Abstract

Antimicrobial resistance is an issue of great significance for public health at global level. The purpose of the study is to determine the susceptibility patterns of microorganisms to antibiotics and the prevalence of antibiotic resistance among common pathogens in a tertiary care hospital. The study was conducted in a 500- bedded multi- specialty hospital in South India (for a period of six months from May 2009 to October 2009 in four different phases). A total of 4321 records were analyzed during the retrospective study (May 2006 to April 2009) which revealed that the major organisms isolated were E.coli (33.3%), Klebsiella (21.4%), S.pneumoniae (16%), S. aureus (10.7%), Pseudomonas (8.9%). The sensitivity pattern showed that E.coli, Klebsiella, S.pneumoniae, and Pseudomonas were highly sensitive to Imipenem and Piperacillin/ Tazobactam. S. aureus was sensitive to Linezolid (80%). In the prospective study (May 2009 to October 2009) a total of 956 records were screened which showed that the major organisms isolated were E.coli (37.7%), Klebsiella (24.6%), S.pneumoniae (12%), S. aureus (9.6%), Pseudomonas (7.8%). The sensitivity pattern studies revealed that E.coli was highly sensitive to Piperacillin/ Tazobactam (92.2%), Klebsiella to Cephazolin/ Sulbactam (91.5%), S.pneumoniae to Imipenem (91.3%), and Pseudomonas to Sparfloxacin (90.7%) and S. aureus to Linezolid (91.3%). On comparing the retrospective and prospective data it was seen that S.pneumoniae had developed resistance to Carbenicillin, Klebsiella to Ofloxacin, Citrobacter to Netilmicin, E.coli to Amikacin and S.aureus to Methicillin.

Key words: *Antibiotics, resistance, retrospective, sensitivity pattern*

INTRODUCTION

Antimicrobial resistance is currently the greatest challenge to the effective treatment of infections globally. Resistance adversely affects both the clinical and financial therapeutic outcomes with effects ranging from the failure of an individual patient to respond to therapy and need for expensive alternative drugs to the social costs of higher morbidity and mortality rates, longer duration of hospitalisation, and the need for the changes in the empirical therpay[1]. Multi resistant organisms are diminishing our ability to treat and control the spread of infections. Abuse and misuse of antibiotics have been known to contribute to the development of antibiotic resistance. Clinicians also frequently commence antibiotic therapy before sending samples to the microbiology laboratory for culture sensitivity analysis[2]. Unless antibiotic resistance problems are detected, as they emerge and actions are taken to contain them, the world could be faced with resistant bacterial strains with no known or newer antibiotics available to combat them[3]. Several epidemiological studies have shown that the type and frequency of resistance mechanism varies in regions and even among different hospitals in the same community and such differences have been related to qualitative and quantitative differences in antibiotic use[4]. It is important to regularly monitor the pattern of susceptibility of microorganisms to antiiotics[5]. This will improve the quality of prescribing and may help in overcoming the problems associated with the emergence of resistant bacteria. Hospital antibiograms can be a useful means of guiding empiric therapy and tracking the emergence of bacterial resistance among bacterial isolates and such data will have better day to day application[6]. Thus the purpose of the study is to conduct a detailed retrospective and prospective study about the prevalence of microorganisms and their sensitivity pattern against

Indian Journal of Pharmacy Practice
Received on 25/01/2010
Accepted on 29/01/2010

antibiotics which helps the health care professionals to decrease the irrational antibiotic therapy and also to minimize the development of resistant strains[7].

MATERIALS AND METHODS

Study site

The study was in a 500 bedded multi specialty tertiary care teaching and one of the largest hospitals in Coimbatore.

Study Period

The study was carried out fro a period of six months from May 2009 to October 2009.

Study design

Retrospective – Prospective study.

Selection criteria

All the inpatients, outpatients and intensive care patients for whom a culture sensitivity test was done were included in both retrospective and prospective analysis.

Study approval

The protocol of the study that includes the objectives and methodology was submitted to the Dean of the study hospital. The authorization from the Dean was procured as per SRH/ DEAN/F.19/2009-2010.

Study material

A specially designed format was used for entering the prevalence and sensitivity pattern of *microorganisms* among the patients during the study period.

METHODOLOGY

The study was carried out in four phases. The first phase involves the retrospective analysis on the sensitivity pattern of *microorganisms* for antibiotics for a period of three years from May 2006 to April 2009.

The second phase pf the study is the prospective study for a period of six months from May 2009 to October 2009.

The third phase involves the comparison of data obtained from retrospective and prospective study to look for changes in the sensitivity pattern of *microorganisms* to antibiotics, since the sensitivity pattern varies from time to time. Sensitivity pattern studies reflect the major organism to be treated and also help to choose the appropriate antibiotics resulting in rational antibiotic therapy[8]. During the final phase of the study antibiotic usage guidelines for the antibiotics prescribed in the hospital were prepared and submitted to the physicians.

RESULTS AND DISCUSSION

The study was conducted in four different phases. During the first phase of the study a retrospective analysis was conducted to check the sensitivity pattern of *microorganisms* for antibiotics during the period May 2006 to April 2009. The necessity of the study was explained to the physician, pathologist and microbiologist of the study hospital. A total of 4321 records were analyzed during the retrospective study. Major organisms isolated were *E.coli* (33.3%), *Klebsiella* (21.4%), *S.pneumoniae* (16%), *S. aureus* (10.7%), Pseudomonas (8.9%) [Table no. 1]. Similar study conducted by Odusanya M D in 2002 revealed that the common organisms isolated were *S. aureus, E.coli, Klebsiella* and *S.pneumoniae.* The retrospective sensitivity pattern studies showed that *E.coli* was more sensitive to Imipenem (96.3%), Piperacillin/ Tazobactam (92.8%) and Amikacin (81.9%) [Fig. no. 1]. *Klebsiella, S.pneumoniae,* and *Pseudomonas* were highly sensitive to Imipenem and Piperacillin/ Tazobactam. *S. aureus* was sensitive to Linezolid (80%) [Table no. 2]. Similar study conducted by Aroma Oberoi[9] et al in the year 2006 in 233 isolates showed that third generation cephalosporins, Fluoroquinolones and Aminoglycosides showed the best sensitivity. The major multiple organisms isolated were *Pseudomonas* and *E.coli,* followed by *Pseudomonas* and *Klebsiella* [Table no. 3]. In the prospective study (May 2009 – October 2009) a total of 956 records were screened which showed that the major organisms isolated were *E.coli* (37.7%), *Klebsiella* (24.6%), *S.pneumoniae* (12%), *S. aureus* (9.6%) and *Pseudomonas* (7.8%) [Fig. no. 2]. The sensitivity pattern studies revealed that *E.coli* was highly sensitive to Piperacillin/ Tazobactam (92.2%), *Klebsiella* to Cephazolin/ Sulbactam (91.5%), *S.pneumoniae* to Imipenem (91.3%), and *Pseudomonas* to Sparfloxacin (90.7%) and *S. aureus* to Linezolid (91.3%) [Fig. no. 3]. From the comparison of the retrospective and prospective data it was seen that *E.coli developed* resistance to Amikacin, *Klebsiella* to Ofloxacin, *S.aureus* to Methicillin and *S.pneumoniae* to Carbenicillin [Table no. 4]. Similar study by Akira[10] (1995) reported strains of Methicillin resistant *S.aureus.* Another study by Ron Dagan revealed that the resistance developed by *S.pneumoniae* varied during the warm and cold months which were 20% and 29% respectively. *E.coli* was present more in urine samples (77%), followed by pus (8%), catheter tip (3.4%), tracheal (3.3%) and semen (2.4%). *Klebsiella* species were present more in urine (50%) and sputum (22.5%). *S.pneumoniae* (63.8%) and *Pseudomonas* (36.3%) were majorly seen in sputum. *S.aureus* was found more in pus cells (47.6%) [Table no. 5].

Table.1: Percentage Prevalence of Microorganism- A Comparison

ORGANISM	RETROSPECTIVE (May 2006 – April 2009) (n= 4321)		PROSPECTIVE (May 2009 – October 2009) (n= 956)	
	NO. OF PATIENTS INFECTED	PERCENTAGE (%)	NO. OF PATIENTS INFECTED	PERCENTAGE (%)
E.coli	1440	33.3	360	37.7
Klebsiella	924	21.4	235	24.6
S.pneumoniae	693	16	115	12
Pseudomonas	386	8.9	75	7.8
S.aureus	464	10.7	92	9.6
S.pyogenes	052	1.2	8	0.8
S.epidermidis	102	2.4	-	-
Proteus	108	2.5	30	3.1
Enterobacter	068	1.6	12	1.4
Actinobacter	066	1.5	16	1.7
Citrobacter	006	0.1	9	0.9
α-*Hemolytic streptococci*	010	0.2	-	-
Salmonella	002	0.05	4	0.4

Table.2: Sensitivity pattern of microorganisms

ORGANISM	RETROSPECTIVE (n= 4321)	PROSPECTIVE (n= 956)
E.coli	Imipenem – 1387 (96.3%)	Piperacillin/ Tazobactam – 332 (92.2%)
Klebsiella	Imipenem – 848 (91.8%)	Ceftriaxone/ Sulbactam – 215 (91.5%)
S.pneumoniae	Imipenem – 631 (91.1%)	Imipenem – 105 (90.7%)
S.aureus	Imipenem – 414 (89.1%)	Sparfloxacin – 68 (90.7%)
Pseudomonas	Imipenem – 428 (92.2%)	Linezolid – 84 (91.3%)

Table.3: Multiple Organisms Isolated

ORGANISMS	RETROSPECTIVE (n= 26)	PROSPECTIVE (n=14)
Pseudomonas + E.coli	6	1
Pseudomonas + Klebsiella	4	2
Pseudomonas + S. aureus	3	1
S.pneumoniae + Klebsiella	3	3
S.pneumoniae + S. aureus	3	1
Klebsiella + E.coli	2	1
Klebsiella + S. aureus	1	2
S. aureus + S.pyogenes	1	1
S. aureus + E.coli	3	2

Table.4: Emergence of Resistance

ORGANISM	ANTIBIOTIC	DEVELOPMENT OF RESISTANCE	
		RETROSPECTIVE (%)	PROSPECTIVE (%)
E.coli	Amikacin	18.1	41
Klebsiella	Ofloxacin	49	70
S.pneumoniae	Carbenicillin	52	84
S.aureus	Methicillin	70.3	98.7
Citrobacter	Netilmicin	50	88.9

Table.5: Specimen vs. Organism – Retrospective

ORGANISM	URINE	TRACHEAL	PUS CELLS	THROAT SWAB	WOUND	SPUTUM
E.coli	71.1	5.8	6.4	21.1	3.9	2.5
Klebsiella	80	5.1	6.4	4.7	0.4	1.7
S.pneumoniae	1.7	2.6	1.7	10.4	-	77.4
S.aureus	13	3.3	53.3	2.2	5.4	4.3
Pseudomonas	20	14.7	14.7	18.7	-	29.3

Fig.1: Shows the percentage sensitivity pattern of microorganisms retrospectively (from May 2006 to April 2009). A total of 4321 records are studied and this shows that all the organisms were highly sensitive to Imipenem i.e., E.coli (96.3%), Klebsiella (91.8%), S.pneumoniae (91.8%), and Pseudomonas (89.1%) and S. aureus (92.2%). The other antibiotics which show better sensitivity are Piperacillin/ Tazobactam and Amikacin.

Fig.1: Percentage sensitivity pattern of microorganisms - Retrospective

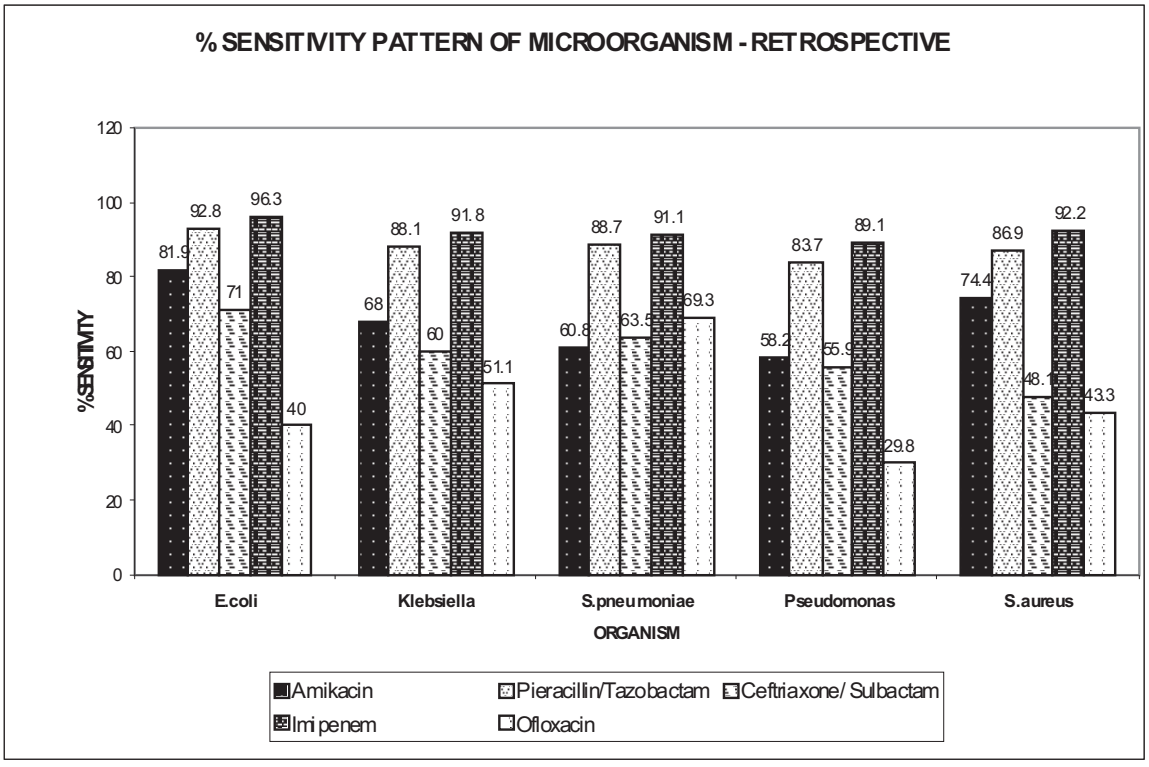


Fig.2: shows the comparative prevalence (retrospective and prospective) of organisms in the study hospital. It may be seen both in the retrospective and prospective study that E.coli is the most commonly found organism, ie 33.3% and 37.7% respectively, followed by Klebsiella 21.4% and 24.6%. The other organisms commonly prevailing are S.pneumoniae, and Pseudomonas and S. aureus.

Fig.2: Retrospective vs Prospective organism prevalence (%)

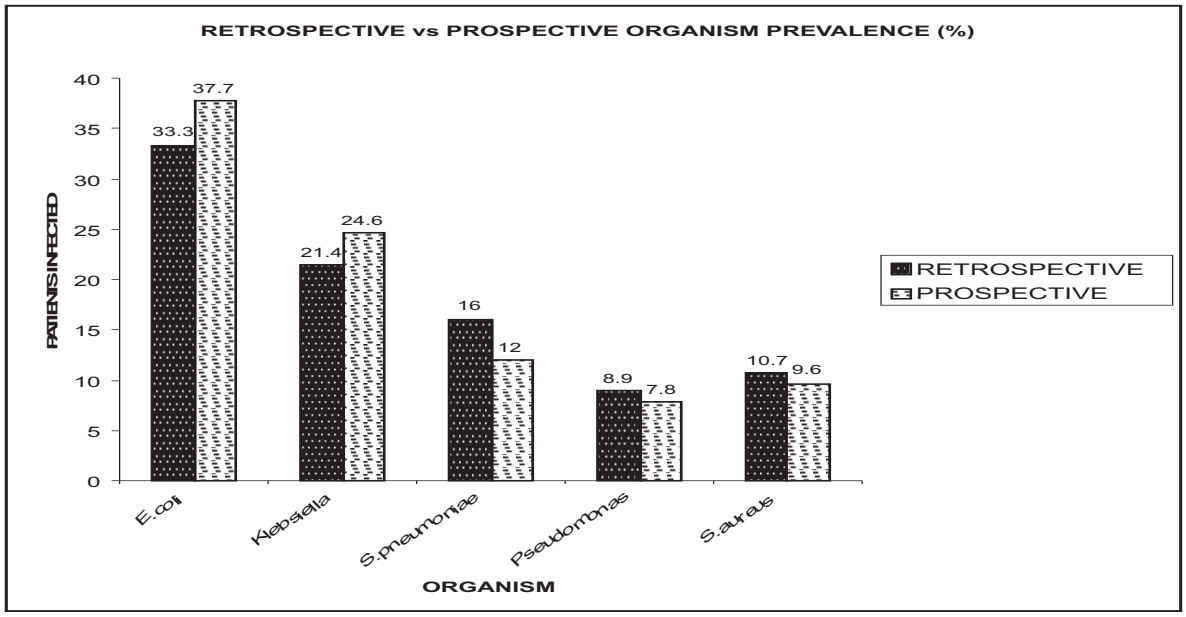
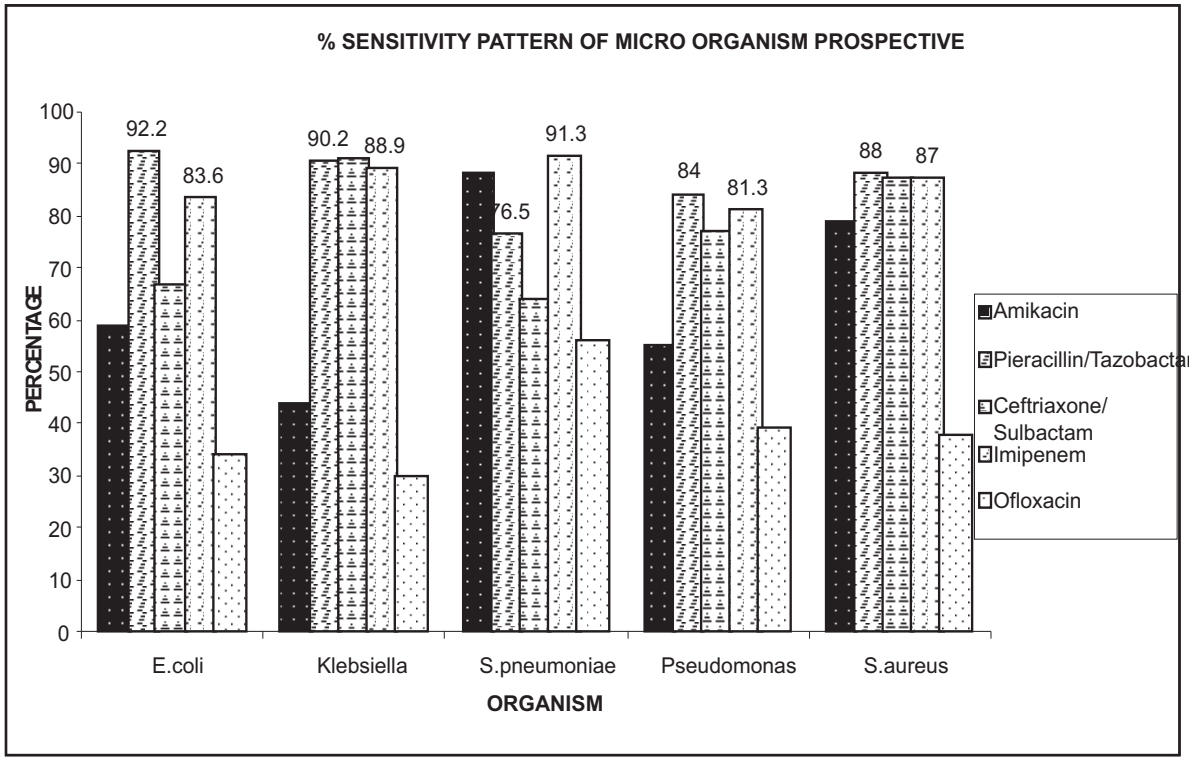


Fig.3: Shows the percentage sensitivity pattern of microorganisms prospectively fir a six month period (May 2009 to October 2009). A total of 956 records are studied and this shows that all the organisms are highly sensitive to Imipenem, Ceftriaxone, Piperacillin/ Tazobactam and Amikacin.

Fig.3: Sensitivity pattern of microorganism prospective



CONCLUSION

As there is increasing international concern regarding the escalating antibiotic resistance, periodical study on the control of antibiotic resistance is necessary[12]. This can be achieved only when proper sensitivity pattern data are available. The pharmacist's role in advising prescribers on antibiotic prescribing issues gained more importance in adhering to rational drug therapy and complete patient care[13]. The study revealed that clinical pharmacists play an important role in promoting optimal antibiotic prescribing practice among physicians, during their routine daily visit to wards[14].

REFERENCES

1. Essack SY, Connolly C, Strum AW. Antibiotic use and resistance in public sector hospitals KwaZulu – Natal. S Afr Med J 2005;95:865-870.
2. Odusanya OO. Antibiotic susceptibility of microorganisms at a general hospital in Nigeria. J Natl Med Assoc 2007;94:994-998.
3. Lakshmi V. Need for National/ Regional guidelines and policies in India to combat antibiotic resistance. Ind J Med Microbiol 2009;26(2):105-107.
4. Jacobs Michael, Flemingham David, Appelbaum Peter C, Gruneberg Reuben N. Susceptibility to pathogens isolated from CARTI to commonly used antimicrobial agents. J of Antimicrobial chemotherapy 2003;52:229-246.
5. Ozumba Uchenna Chinedu. Antimicrobial resistance problem in a University hospital. J Natl Med Assoc 2005;97:1714-1718.
6. Shoba KL, Rao PS, Thomas J. Survey of Staphylococcus isolates among hospital personnel, environment and their antibiogram with special emphasis on methicillin resistance. Ind J Med Microbiol [serial online] 2005 [cited 2009 Oct 30];23:186-88. Available from URL:http://www.ijmm.org/text.asp?2009/23/3/186/ 16592.
7. Agalar C, Aydin S, Yaris F, Ozcakir A. Most common infections and antibiotic prescribing habits of residents: experience of three university hospitals. Turk J Med Sci 2005;35:169-173.
8. Serena P, Akhilesh CJ. A study of antibiotics used in adult respiratory disorders in Kathmandu and Bhaktapur. J Nepal Med Assoc 2008;43:31-35.
9. Oberoi Aroma, Agarwal Aruna. Bacteriological profile, serology and antibiotic sensitivity pattern of microorganisms from community acquired pneumonia. JK Science 2006;8:79-82.
10. Akira W, Kotaro O, Kazuhiro M, Takeshi N, Masakichi M, Toshihiro N. Antibiotic susceptibility of the sputum pathogens and throat swab pathogens isolated from the patients undergoing treatment in twenty-one private clinics in Japan. Tohoku J Exp Med 1995;175:235-247.
11. Ron D, Galia B, Noga G, Amir ZS, Daniel V, Ted C, et. al. Seasonality of antibiotic resistant S.pneumoniae that causes acute otitis media: A clue for an antibiotic restriction policy. J Infect Diseas 2008;197(8):1094-1102.
12. Ravi PS, Praveen P, Nagesh KS, Joshy M, Narayanan K. Prescribing patterns of antibiotics and sensitivity patterns of common microorganisms in the internal medicine ward of a teaching hospital in Western Nepal: a prospective study. Ann Clin Microbiol Antimicrob [serial online] 2008 [cited 2007 Feb 1];16:2-7. Available from: URL:http://www.ann-clinmicrob.com/content/2/1/7
13. Shlaes DM, Gerding DN, John JF. Optimizing antibiotic use in hospitals: Methods of data collection and analysis. Pharmacotherapy [serial online] 2008 [cited 2008 Oct 5];23(12):152-157. Available from: URL:http://www. pharmacother.org.
14. Cole O. Combating resistance to antibiotics. Hosp Pharmacist 2002;9(1):21-22.