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ANTIBIOTIC SENSITIVITY PATTERN AND COST EFFECTIVENESS ANALYSIS OF ANTIBIOTIC THERAPY

Arul B.*, Rangabashyam S. R.[1], Kothai R., Sherin Roy, Sruthy Jose, Swathy Unnithan and Vidhya Lakshmi V.

*Department of Pharmacy Practice, Vinayaka Mission's College of Pharmacy, Vinayaka Missions University, Salem, Tamilnadu.

[1]Department of General Medicine, Vinayaka Missions Kirupanandha Variyar Medical College And Hospitals, Salem, Tamilnadu.

***Corresponding Author: Dr. Arul B.**

Department of Pharmacy Practice, Vinayaka Mission's College of Pharmacy, Vinayaka Missions University, Salem, Tamilnadu.

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ABSTRACT

The present study is aimed to analyse the antibiotic sensitivity pattern of microorganisms, to study the antibiotic usage pattern and to conduct a cost effectiveness analysis for the antibiotics prescribed in a tertiary care teaching hospital. This prospective cross sectional study was conducted in various departments of the hospital for a period of 6 months. The study was conducted in three phases and total of 200 cases were documented and analysed. It was found that *S.aureus* was the major organism isolated in 39% of the isolated specimen, followed by *E.coli* (36%), *Pseudomonas sps* (7%), *Enterococci* (5%), *K.pneumoniae* (5%), *M.tuberculi* (3%), *S.pyogenes* (2%), *MRSA* (2%), *S.typhi* (1%). The sensitivity pattern data of the collected organism revealed that *S.aureus* was highly sensitive to ceftriaxone (41.02%) followed by *E.coli* to cefotaxime (33.33%), *Pseudomonas* to ceftriaxone (42.85%) *Enterococci* to amoxicillin (100%), *K.pneumoniae* to amoxicillin (60%) and *S.Pyogenes* to ceftriaxone (66.67%). The most common disease for which antibiotics were prescribed was fever with 20.5% (41 patients). Amoxicillin (38.5%) was the most commonly prescribed antibiotic followed by cefotaxime (23%), ceftriaxone (20.65%). In the cost effectiveness analysis it revealed that amoxicillin was the most cost effective antibiotic with a low cost effectiveness ratio for various diseases. Continuous surveillance of susceptibility testing is necessary for cost effective customisation of empiric antibiotic therapy. Furthermore reliable statistics on antibiotic resistance and policies should be made available.

KEYWORDS: Antibiotics, cost effectiveness analysis, prescribing pattern, sensitivity.

INTRODUCTION

Antibiotics are chemical substances produced by microorganisms which selectively supress the growth or kill other microorganisms at varying concentrations. However synthetic antibiotics, usually chemically related to natural antibiotics, produce same effects. Antibiotic sensitivity or antibiotic susceptibility is the susceptibility of bacteria to antibiotics and susceptibility can vary even within a species. Antibiotic sensitivity pattern can vary regionally and even among different hospitals within the same community.

Infections are the most common reasons for the patients to seek medical advice and for antibiotics to be prescribed. Inappropriate and indiscriminate use of antibiotics can increase the cost of care by increasing the drug cost, increasing toxicity, increasing resistance and increasing laboratory costs. Prophylactic antibiotic therapy in some hospitals remains a problem.

Antibiotics are prescribed unnecessarily and empirically for complaints where no antibiotics are required or where culture and sensitivity results could be safely awaited. The key action of the clinician should be the provision of a specimen for accurate identification of the offending pathogen by means of culture and sensitivity method.

The pharmacist can provide information at the point of care regarding antibiotic susceptibility and individual patient factors to improve antibiotic prescribing. The pharmacist can play a significant role in recommending the prescriber about the necessary changes to be made in the patient regimen, dose and duration of action of antibiotic therapy.[1]

Testing for antibiotic sensitivity is often done by the Kirby-Bauer method. Small wafers containing antibiotics are placed onto a plate upon which bacteria are growing. If the bacteria are sensitive to the antibiotic, a clear ring or zone of inhibition is seen around the wafer indicating poor growth. Other methods to test antimicrobial susceptibility include the stocks method, E test (also based on antibiotic diffusion) and agar and broth dilution methods for minimum inhibitory concentration (MIC) determination. The results of the test are reported on the antibiogram.[2]

Cost effectiveness analysis (CEA) measures outcome in natural units (eg., mmHg, cholesterol levels, symptom free days[SFDS], years of life saved, etc). The main advantage of this approach is that the outcomes are easier to quantify when compared with a CUA or a CBA and clinicians are familiar with measuring this types of outcomes because these outcomes are routinely collected in clinical trials and in clinical practice. Thus the purpose of this study is to conduct a detailed study on the sensitivity pattern of microorganisms, to analyse the antibiotic usage pattern and to conduct a CEA for the antibiotics prescribed.[3]

MATERIALS AND METHODS

This prospective cross-sectional study was carried out in a tertiary care hospital in South India for a period of 6 months. 200 patients were selected for this study. All patients under the age of 18-60 and prescribed with atleast one antibiotic were included in the study. Special populations were excluded in this study. A specially designed format was used for entering the datas collected from the patients during the study period. This data entry form included the needed data for analysing the sensitivity pattern and pattern of antibiotic usage.

The study included three phases, in which the first phase involves a prospective analysis to check the sensitivity pattern of microorganisms to various antibiotics for a 6 month period. The documented data were reviewed and necessary information such as specimen collected, organism isolated and their sensitivity pattern were noted down. During the second phase, information on the pattern of antibiotics prescribed in the hospital and also their cost were analysed in detail.

A CEA was conducted by calculating the cost per failure avoided to find out the most cost effective antibiotic prescribed in the hospital. Cost effectiveness ratio (CER) for different antibiotics were found out which were prescribed for different diseases in the hospital. CER was found out using the therapeutic effect of antibiotic against infection and the anticipated therapeutic cost per patient, the cost effectiveness ratio (CER) was calculated. The antibiotic with the lowest CER was found to be the most cost-effective antibiotic.

RESULTS

A total of 200 cases were analysed in the first phase and in that 100 patients performed sensitivity testing and 100 patients did not perform sensitivity testing. In the 100 patients who performed sensitivity testing, *Staphylococcus aureus* (39%) was the most common organism isolated, followed by *Escherichia coli* (36%), *Pseudomonas sps* (7%), *Klebseilla pneumonia* (5%), *Entercocci (*5%), *Mycobacterium tuberculi* (3%), *MRSA (*2%), *Streptococcus pyogenes* (2%), *Salmonella typhi* (1%) [Table 1]. Urine (36%), sputum (35%), blood (17%) and pus (6%) were the most commonly collected specimens. *S.auerus* was most commonly found in sputum (68.52%) and *E.coli* in urine (97.22%) and stool (100%). *Pseudomonas* was mostly present in pus (50%) and *Enterococci* in blood (29.41%). The results were depicted in Fig. 1.

The prospective data revealed that almost all the organism isolated were highly sensitive to Amoxicillin. It was found that amoxicillin showed the best sensitivity in *Enterococci* (100%), followed by *K.Pneumoniae* (60%). *S.pyogenes* showed high sensitivity towards ceftriaxone (66.67%). The results were depicted in Fig. 2.

Phase two of the study was to collect information on the antibiotic prescribing pattern along with the cost of antibiotics for the 6 months period. Fever (20.5%) was the major disease for which the antibiotics were prescribed. Amoxicillin (38.5%) was the most commonly prescribed antibiotic followed by cefotaxime (23%) and ceftriaxone (20.65%).

In the third phase, the CEA of the antibiotics prescribed was conducted. For analysing the CEA, CER for various antibiotics prescribed for different diseases were found out. It was found that patients in whom the antibiotic sensitivity testing was done to be more cost efficient than those who did not perform antibiotic sensitivity testing. The drug with the lowest CER was found to be the most cost efficient drug. In this study, amoxicillin has the lowest CER when compared to other drugs for various diseases.

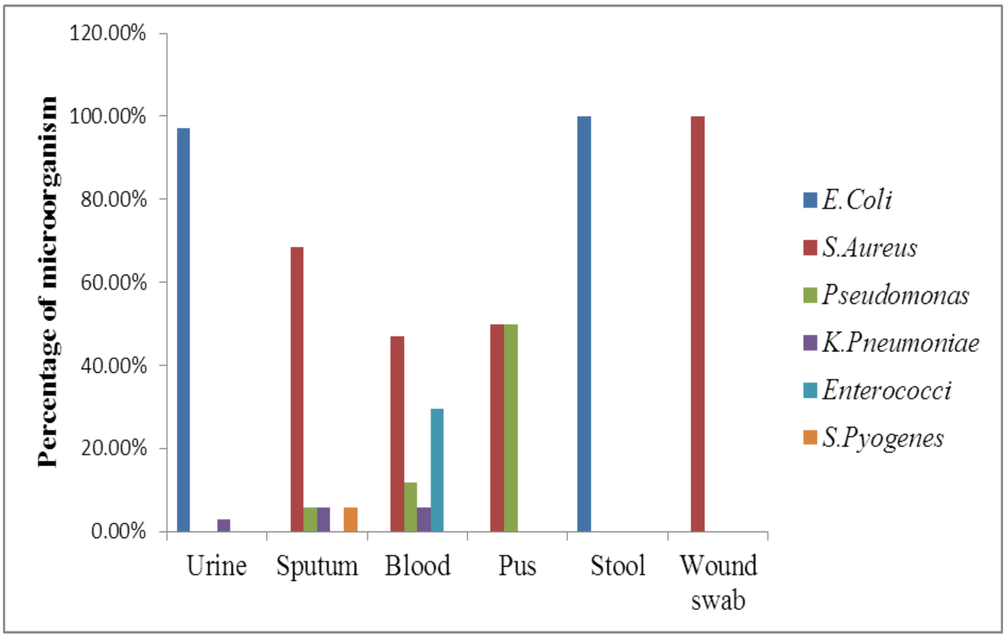

Fig. 1 Percentage of microorganisms found in different patient specimens.

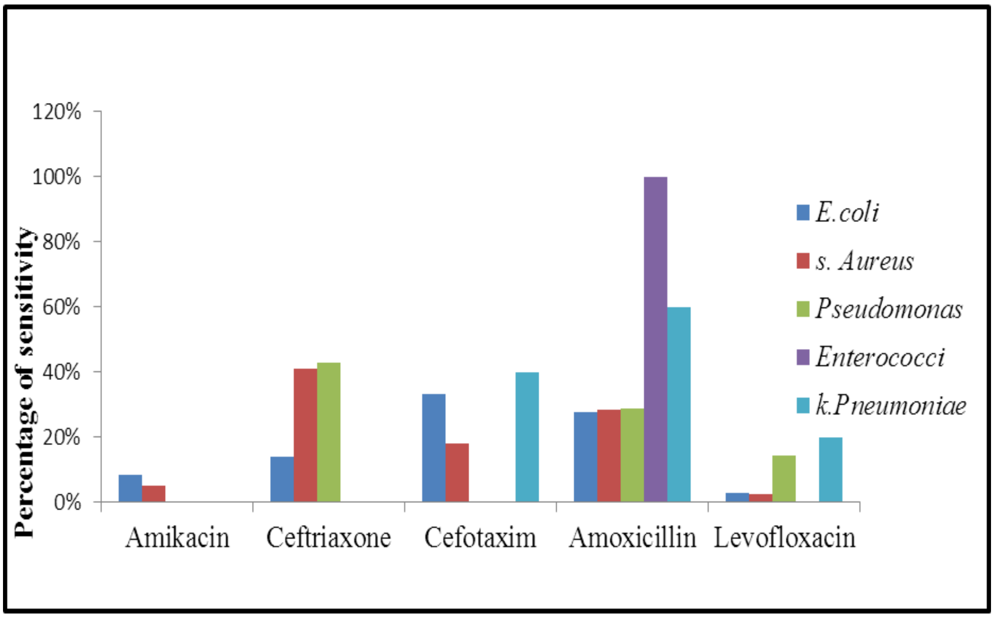

Fig. 2: Percentage of microorganisms sensitivity to different antibiotics.

Table. 1: Sensitivity pattern studies of antibiotics.

Organism	Total % of patients infected	Ceftriaxone	Cefotaxime	Amikacin	Amoxycillin	Levoflo Xacin
E.coli	36%	5	12	3	10	1
S.aureus	39%	16	7	-	11	1
Pseudomonas	7%	3	-	-	2	1
Enterococci	5%	-	-	-	5	-
S.pyogenes	2%	2	-	-	-	-
K.pneumoniae	5%	-	2	2	3	1
MRSA	2%	1	1	1	-	-
M.tuberculi	3%	1	1	1	-	-

DISCUSSION

As resistance is an emerging hazard in present day prescriptions in hospital, hospital antibiograms can be a useful means for guiding empiric therapy and tracking the emergence of resistance among bacterial isolates. In the other study conducted by Goswami *et al*[4]., describes antibioitic sensitivity profile of bacterial pathogens in postoperative wound infections at a tertiary care hospital in Gujarat, India. In that study also, out of 183 organisms, 126 (68.85%) isolated organisms were gram negative and the *Staphylococcus aureus*, 48 (26.23%) was the predominant organism. There is an alarming increase of infections caused by antibiotic-resistant bacteria, particularly in the emergence of VRSA/VISA, meropenam and third generation cephalosporin resistant *Pseudomonas aeruginosa*.

Similar study was conducted by Maksum *et al*[5]., about Antibiotic sensitivity pattern of bacterial pathogens in the intensive care unit of Fatmavati Hospital, Indonesia. The most predominant isolate was *P.aeruginosa* (26.5%) followed by *K.pneumoniae* (15.3%) and Amikacin was the most cost effective (84.4%) antibiotic against *P.aeruginosa* followed by imipenam (81.2%) and meropenam (75%). Most bacteria isolated from ICU of fatmavati hospital Jakarta, Indonesia were resistant to the third generation cephalosporins and quinolone antibiotics. Gayathri *et al.*[6] studied antibiotic susceptibility pattern of rapidly growing mycobacteria. The antibiotic susceptibility testing was performed following CLSI method for the drugs Amikacin, Azithromycin, Tobramycin, Ceftazidime, Cephotaxime, Cefuroxime, Cefaperazone, Ceftriaxone, Ciprofloxacin, Ofloxacin, Norfloxacin, Gatifloxacin and Moxifloxacin. Out of the 148 RGM isolates 146 (98%) were susceptible to amikacin, 138 (91%) to gatifloxacin, 132 (87%) to moxifloxacin, 122 (76%) to ciprofloxacin and 116 (74%) to norfloxacin. Majority of the RGM were resistant to tobramycin. The invitro antibiotic susceptibilty testing by disc diffusion method showed that majority of the RGM were sensitive to Amikacin followed by Gatifloxacin, Moxifloxacin and Ciprofloxacin.

The present study also analysed the data obtained for any changes in the sensitivity pattern of antibiotic use in the study department. This phase involves the CEA on the antibiotics prescribed. Amoxicillin was the most cost effective alternative to cefotaxime and ceftriaxone.

Similar study was conducted by Lavoie *et al*[7] about cost effectiveness analysis of antibiotic therapy in macrolide-resistant community-acquired pneumonia. A total of 3,610 episodes of LRTIs were studied. Azithromycin, which is widely prescribed antibiotic, appears to be the most cost-effective treatment strategy for lower respiratory tract infections.

CONCLUSION

From the above study, it may be concluded that susceptibility testing is necessary for cost-effective customisation of empiric antibiotic therapy and it should be done continuously. Furthermore, reliable statistics on antibiotic resistance and policies that are mandatory to control spread of resistant pathogen should be made available. Clinical pharmacists play a significant role in promoting optimal antibiotic prescribing practice among physicians, during their routine visit toward.

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