Section: Pharmacology

Original Research Article

A RETROSPECTIVE STUDY OF ANTIBIOTIC RESISTANCE IN PATIENTS ATTENDING OUTPATIENT AND INPATIENT DEPARTMENT OF RURAL TERTIARY CARE HOSPITAL

Sagar A Gavankar[1], Rakesh R Jadhav[2], J.B Jaju[3], Mahadeo Sawant[4]

[1]Pharmacology Resident 3rd Year, Swami Ramanand Teerth Rural Government Medical College, Ambajogai, Maharashtra, India
[2]Associate Professor, Department of Pharmacology, Swami Ramanand Teerth Rural Government Medical College, Ambajogai, Maharashtra, India
[3]Professor and Head, Department of Pharmacology, Swami Ramanand Teerth Rural Government Medical College, Ambajogai, Maharashtra, India
[4]Assistant Professor, Department of Pharmacology, Swami Ramanand Teerth Rural Government Medical College, Ambajogai, Maharashtra, India

Received : 28/02/2024
Received in revised form : 30/03/2024
Accepted : 18/04/2024

Keywords: Antibiotics, Culture, Drug Resistance and Sensitivity

Corresponding Author:
Dr. Mahadeo Sawant,
Email: devsrtr@gmail.com

DOI: 10.47009/jamp.2024.6.2.182

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (2); 887-891

Abstract

Background: Antibiotics are the cornerstone of modern medicine. As per World Health Organization (WHO) the emergence of antibiotic resistance is a global public health problem and a threat to humanity. India has the highest infectious disease burden in the world and recent reports have shown that inappropriate and irrational use of antimicrobials against disease has led to an increase in the emergence of antimicrobial resistance. The Aim is to study the Antibiotic Resistance in patients attending Outpatient and Inpatient department of a Rural Tertiary Care Hospital. **Materials and Methods:** Retrospective observational study was done on samples received in Microbiology department for culture sensitivity testing. **Result:** During the study period, a total of 1874 samples were received. A total of 1148 samples shown growth of organisms, remaining 726 cases no growth was seen. Out of total samples, 35.6% were culture positive. Gram-negative accounted for 42.26 %, gram-positive 18.99 % and no growth was seen in 38.74%.E. coli was the most common organism isolated and was most sensitive to Meropenem. Pseudomonas species showed a high resistance to cefepime (13.37%) as compared to Escherichia coli (9.12%) and Klebsiella species (10%). However, resistance to cefotaximewas lower (2.78%) than that among Escherichia coli and Klebsiella species. This study indicates that majority of the gram-negative isolates were more sensitive to meropenem and amikacin as compared to the other antibiotics tested and therefore these may be considered the drugs of choice for the treatment of hospital acquired infections at our tertiary care hospitals. **Conclusion:** The study identified both gram positive and gram-negative bacteria were responsible for blood stream infections and most of them were multi drug resistant. Therefore, patterns of antibiotic susceptibility and resistance need to be identified in a timely manner to initiate empiric antibiotic administration for medical and surgical diseases.

INTRODUCTION

Antibiotics are the foundation of modern medicine.[1] The re-emergence of antibiotic resistance is a global public health problem and a threat to mankind. India has the highest burden of infectious diseases in the world and recent reports have shown the inappropriate and irrational use of antimicrobial agents leading to increase in the incidence of antimicrobial resistance. Besides poor financial conditions, inadequate infrastructure, high burden of disease, and unregulated sales of cheap antibiotics have amplified the crisis of antimicrobial resistance in India.[2] The World Health Organization (WHO) and the European Commission (EC) recognize the importance of studying the emergence and determinants of resistance and developing strategies to combat it.[3] Illnesses associated with bloodstream infections range from self-limited infections to life-threatening sepsis and demand prompt and aggressive antimicrobialtherapy. Bacterial drug resistance is presently an important issue, but since there is wide variation in bacterial drug resistance, the results of investigation and reports from one region

ISSN (O): 2687-5365; ISSN (P): 2753-6556

or another may not necessarily be applicable to other regions or areas.[4]Rational and appropriate use of these agents requires understanding of common pathogenic organisms and drug resistance patterns in this specific region. Bacterial infections are a common cause of hospitalization globally, the emergence of antibiotic resistance and the limited treatment options available globally represent a growing challenge in the treatment of bacterial infections.[5] The increased risk of infection is related to the severity of the patient's illness and the duration of exposure to the invasive device or procedure increased contacts between patients and medical staff, and longer hospital stays.[6] Recently the incidence of gram-negative bacterial infections in hospital setup has increased, and the lack of available treatment options against some multi-drug-resistant strains is alarming.[7]Infections caused by multi-drug-resistant gram-negative organisms are associated with high morbidity and mortality.[8]Hence, careful adherence to infection control and treatment guidelines can help improve patient outcomes and reduce economical suffering of patients and in turn of nation.[9] To overcome these challenges and improve outcomes of serious infections, we need to watch resistance patterns within everyhospital.[10]In this study, we analysed the pattern of antibiotic sensitivity and resistance based on the results of various culture and sensitivity test done on samples receivedin microbiology department.[11]

Aim & Objectives: To study the antibiotic resistance and sensitivity pattern in patients attending outpatient and inpatient department of a rural tertiary care hospital.

MATERIALS AND METHODS

Study Design: Retrospective observational study.
Study Site: Microbiology department of rural tertiary care hospital
Study Period: 6 months
Study Population: samples received in Microbiology department for culture sensitivity testing
Study Sample: All samples received in Microbiology department for culture sensitivity testing and satisfying according to inclusion exclusion criteria.

Inclusion Criteria

- Patients of all age groups and both sexes are included in the study.
- Both In patient department and Out Patient Department patient's data.
- All gram culture samples collected from Microbiology department over a period of 6 months.

Exclusion Criteria

- Patients on antibiotics treatment.
- Repeat samples from the same patients.
- **Data Collection and Analysis**: Data is collected from bacteriology section of microbiology. The results obtained were analyzed using descriptive statistics.

RESULTS

During the study period, a total of 1874 samples were received. A total of 1148 samples had shown growth of organisms, which were tested for sensitivity pattern by standard laboratory methods, remaining 726 samples showed no growth. Out of total samples, 356 (19%) were gram positive and 792 (42.26 %) samples were gram negative. No growth was seen in 726 (38.74%) of the samples [Chart 1].

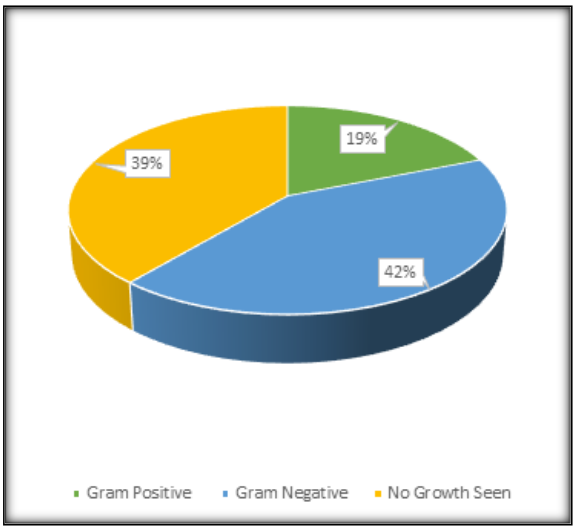

Chart 1: Specimens Organism Data

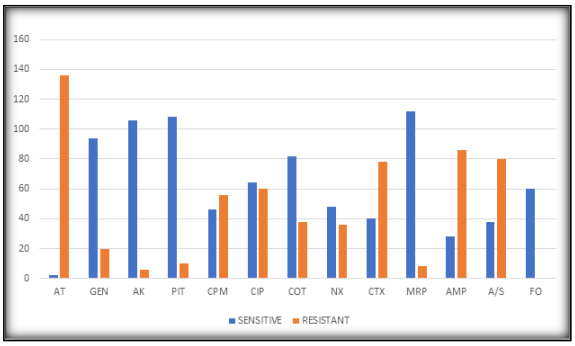

Figure 1: Escherichia coli-sensitivity and resistance pattern.

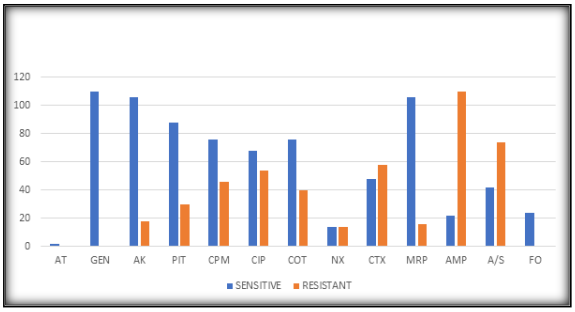

Figure 2: Klebsiella-sensitivity and resistance pattern.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

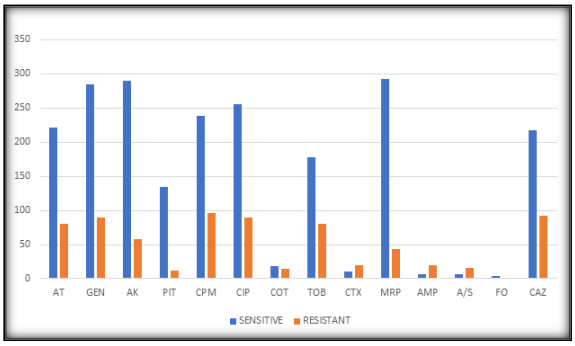

Figure 3: Pseudomonas-sensitivity and resistance pattern.

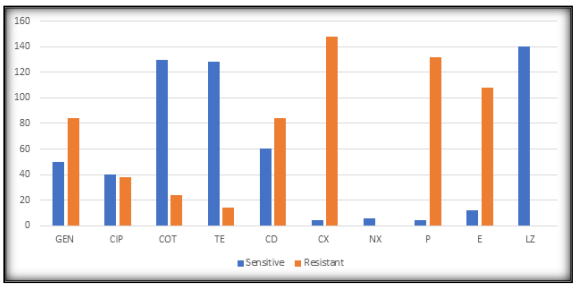

Figure 4: MRSA-Sensitivity and Resitant pattern(Methicillin resistant staphylococcus aureus)

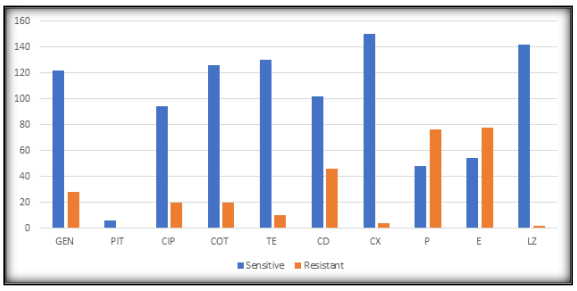

Figure 5: MSSA-Sensitivity and Resitant pattern(Methicillin resistant staphylococcus aureus)

The positive isolates are obtained from the following samples: pus (n = 499), urine (n = 295), blood (n = 72), sputum (n = 21), CSF (n = 19), blood bags (n = 10), pleural effusion (n = 4), throat swab (n = 4), vaginal swabs (n = 2), endotracheal probe (n = 1), and stool sample (n = 1) [Table 1]. Methicillin sensitive and resistant staphylococcus aureus is the most common isolate from gram positive blood culture. Pseudomonas, klebsiella and e. Coli were the most common gram-negativeisolates from blood culture. Most common gram-negative organisms like e. Coli (27.65%) followed by klebsiella (08.51%), pseudomonas (05.31%), and proteus (01.59%) were found in 295 urine samples and pseudomonas (39.17%) from 499 pus samples. Among the gram-positive organisms, methicillin resistance staphylococcus (13.78%) andmethicillin sensitive staphylococcus (13.96%) were the most common organism isolated from urineand pus samples. E. Coli was most sensitive to meropenem (12.61%) followed by piperacillin-tazobactam(12.16%), amikacin (11.93%), gentamycin (10.58%), and cotrimoxazole (9.32%) and most resistant to aztreonam (22.14%), ampicillin (14%), ampicillin-sulbactam (13.02%), cefotaxime (12.70%)cefepime (9.12%) and ciprofloxacin (09.77%) out of all drugs. [Figure 1].

Klebsiella was most sensitive to meropenem and amikacin (13.15%), followed by piperacillin-tazobactam (10.91%), cotrimoxazole (09.42%) and was most resistant to ampicillin (23.91%), ampicillin-sulbactam (16.08%), cefotaxime (12.60%) and ciprofloxacin (11.73%), cefepime (10%) out of all drugs. [Figure 2].

Pseudomonas showed sensitivity to meropenem (6.70%), amikacin (6.65%) and gentamycin (6.51%) and resistant to cefepime (13.37%), ceftazidime (6.40%), ciprofloxacin (6.26%)out of all drugs. [Figure 3].

MRSA shows sensitivity to linezolid (24.39%), cotrimoxazole (22.64%) and resistant to cefoxitin (23.41%), erythromycin (17.08%), gentamycin and clindamycin (13.29%). [Figure 4].

MSSA shows sensitivity to piperacillin tazobactam (15.12%), linezolid (14.31%) and tetracycline (13.10%) and resistant to penicillin g (27%) and clindamycin (15.97%). [Figure 5].

Table 1: Most common isolates from following samples

	Methicillin Resistant Staphylococcus Aureus (n=158)	Methicillin Sensitive Staphylococcus Aureus (n=160)	E. coli (n=134)	Klebsiella (n=140)	Pseudomonas (n=376)
Pus	130	130	30	98	344
Blood	18	12	0	0	12
Urine	0	10	104	32	20
Pleural fluid	0	0	0	0	0
CSF	0	0	0	0	0
Sputum	6	2	0	10	0
Throat sample	4	6	0	0	0

DISCUSSION

The discovery of antibiotics revolutionised the management of infectious diseases. The microbial pathogens, as well as their antibiotic sensitivity patterns may change from time to time and place to place. In India, variation might be due to the fact that most of the patients are given antibiotics empirically before they come to the tertiary care hospital and other reason is that in most of the cases self-medication is very common as the medicines are available at the counter. Hospital antibiograms are commonly used to help guide empirical antimicrobial treatment and are an important component of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

detecting and monitoring trends in antimicrobial resistance. In this present study the most common micro-organisms isolated were Escherichia coli (27.65%), staphylococcus aureus (15%), klebsiella species (08.51%), and pseudomonas species (39.17%). Escherichia coli was commonest gram-negative organisms isolated from urine specimens. It showed a high-level resistance aztreonam (22.14%), ampicillin (14%), ampicillin-sulbactam (13.02%), cefotaxime (12.70%) and ciprofloxacin (09.77%). In Asian countries including India, most of the isolates obtained are gram-negative organisms such as E. coli, klebsiella, and pseudomonas followed by gram-positive organisms like staphylococcus comparable to our study.[12,13] E. Coli was the most common organism isolated from urine, i.e., (27.65%) followed by klebsiella and pseudomonas, this is comparable to studies done by javeedet al,[14]rajeevan et al,[9] and shrestha et al.[15] In other studies, such as bajaj et al,[16] klebsiella showed marked resistance to these antibiotics— ampicillin (23.91%), ampicillin-sulbactam (16.08%), cefotaxime (12.60%). This data shows that more than 85% of these isolates were resistant to these drugs. Similarly, pseudomonas shows resistant to cefepime (13.37%), ceftazidime (6.40%), ciprofloxacin (6.26%) i.e. Cephalosporin class of drugs as compared to Escherichia coli (9.12%) and klebsiella species (10%) as also reported by chakravartiet al.[17] However, resistance to cefotaxime i.e. third generation cephalosporin class of drugs was lower in pseudomonas (2.78%) than that among Escherichia coli (13%) and klebsiella species (12%). Similar findings regarding drug resistance patterns of klebsiella, Escherichia coli, pseudomonas and other gram-negative bacteria have been observed by hsu et al,[18]oteoet al.[19] Our study showed a high ampicillin resistance in klebsiella species and Escherichia coli (23.91%and 14% respectively); ampicillin-sulbactam resistance amongst these two isolates was also found to be high (10.91%and 13.02%). Klebsiella showed high resistance to ampicillin (23.91%), ampicillin-sulbactam (16.08%), cefotaxime (12.60%) and ciprofloxacin (11.73%), cefepime (10%). The resistance of klebsiella to cephalosporins was also observed in other studies by javeedet al.[14] In our study the most common organisms isolated were gram-negative isolates such as enterococcus which showed highest resistance to aztreonam (22.14%), ampicillin (14%), ampicillin-sulbactam (13.02%), cefotaxime (12.70%), cefepime (9.12%) this was identical to the study by hsu et al,[18]oteo et al.[19] Antibiotics which retained their usefulness and showed less resistance and more sensitivity for these three-gram negative isolates in our study, were amikacin (13.15%, 11.93%, 6.65%) and meropenem (13.15%, 12.61%, 6.7%) against klebsiella, Escherichia coli and pseudomonas species respectively. According to a study conducted by chent et al,[20] cefotaxime were the antibiotics still effective against gram – negative isolates. Meropenem was the most effective drug against gram negative bacterial strains.[12] In 2019 sanjaym et al,[21]from Nepal reported that most of the gram – negative bacteria isolated in their study were resistant to ampicillin, chloramphenicol and amoxicillin, results which are comparable to our study. Methicillin resistant staphylococcus aureus (MRSA) is a global phenomenon with a prevalence rate of 26.4%. MRSA infections can be responsible for fatal sepsis, pneumonia, and higher rates of myocardial infarction and heart failure in patients with bacteraemia.[22] In the present study, staphylococcus aureus was the most common gram-positive organism isolated from pus and urine samples.[23] However, all were sensitive to piperacillin tazobactam (15.12%) and linezolid (14.31%). A comparable prevalence rate of 31% to 38.56% have been reported from saikial et al. Study.[24] The results of the present study highlighted the alarming resistance to the drugs with the exception of a few included in this study. In developing countries, antibiotics are prescribed for 44%-97% of patients in hospital inappropriately10. Antibiotic resistance is becoming a big problem for the public health which threatens the lives of hospitalized patients as well as those with chronic conditions. This also adds considerably to health care cost. Therefore, it is an important issue which has to be addressed by the policy makers in order to formulate strict antibiotic prescription policy in our country. Reasons for irrational antibiotic prescribing are: perceived patient expectation; time constraints; lack of knowledge; lack of diagnostics; pressure, incentives and advertising from industry.[25] Moreover, this study indicates that majority of the gram-negative isolates were more sensitive to meropenem and amikacin as compared to the other antibiotics tested and therefore these may be considered the drugs of choice for the treatment of nosocomial infections at tertiary care hospitals. Most important in this is the use of broad-spectrum empirical antimicrobials with an aggressive de-escalation strategy to minimize collateral damage to current and future patients.

CONCLUSION

Antibiotic resistance is a major new problem in today's clinical practice. The study identified both gram positive and gram-negative bacteria were responsible for blood stream infections and most of them were multi drug resistant. Therefore, patterns of antibiotic susceptibility and resistance need to be identified in a timely manner to initiate empiric antibiotic administration for medical and surgical diseases. Better use of available medicines will lead to better preservation of supplies for future generations. Emphasis should also be laid on the use of sterile techniques while inserting devices, hand hygiene and use of gowns and gloves in hospital setup to prevent infections and better patient response and clinical outcome. The rate of emergence of antimicrobial resistance is much higher than the rate of new antibiotic discovery, which is an alarming

ISSN (O): 2687-5365; ISSN (P): 2753-6556

situation. Therefore, empiric use of antibiotics without proper knowledge of susceptibility should always be reconsidered before using them.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556