Asian Journal of Pharmaceutical and Health Sciences
www.ajphs.com

Analysis of antibiotic utilization and cost of treatment in hospital acquired pneumonia

Vijayanarayana K[1], Rau NR[2], Anantha Naik N[3], Bhavani Y[1]Girish Thunga[1]*, Sreedharan Nair[1], Rajesh V[1]

1. Dept of Pharmacy Practice, Manipal College of Pharmaceutical Sciences, Manipal University, Manipal, India.
2. Dept. of Medicine, Kasturba Medical College, Manipal University, Manipal, India.
3. Dept of Pharmacy Management, Manipal College of Pharmaceutical Sciences, Manipal University, Manipal, India

ARTICLE HISTORY

Received: 24.12.2013

Accepted: 28.01.2013

Available online: 10.02.2014

Keywords:

Antibiotic utilization, Defined daily dose (DDD), Hospital acquired pneumonia

***Corresponding author:**

Email : girishthunga77@gmail.com

ABSTRACT

A prospective observational study, carried out in a tertiary care teaching hospital. Patients were followed from the day of diagnosis of HAP, till the day of discharge or death. Patient data like demography (age, sex), antimicrobial agent usage details (total number of antibiotics prescribed, generic name, dose, grams per unit dosage, No. of doses per package, No. of packages consumed, duration, and route of administration of the antibiotic), length of hospital stay and clinical outcome were recorded in a predesigned data collection form. The cost of antimicrobial therapy was recorded from the day of admission, till the day of discharge.310 patients were included in the study. Among study population 229 (73.9%) patients were male and mean age was 55.9±18.4 (mean±SD). Out of 310 patients 218 were improved and 55 were expired. Mean length of hospitalization was 9.45±6.75 (mean±SD) days. Total 25 antimicrobial agents or their combinations were used for the treatment of HAP in these patients. Among these antimicrobial agents, consumption (DDD/100 bed days) was highest for Piperacillin/tazobactam (parenteral, 0.12) followed by Ceftriaxone (parenteral, 0.10), Azithromycin (oral, 0.10) and Trimethoprim/sulphamethoxazole (oral, 0.08).Single antimicrobial agent used depending on the sensitivity of the infecting microorganism was the most effective (50%) and also cost-effective (Rs. 2333±1002). Among antimicrobial agent combinations the percentage of treatment success was highest for patients who were treated with Piperacillin/tazobactam+ Azithromycin combination (46%), followed by Cephalosporin+ Azithromycin combination (38%). However the cost of treatment was high for Piperacillin-tazobactam+Azithromycin regimen (Rs.9939±1033) compared to Cephalosporin+ Azithromycin combination (Rs. 5200±1832).

INTRODUCTION

Nosocomial infections are the major causes of mortality, morbidity and personal distress, which also add to a significant economic loss. Hospital acquired pneumonia (HAP) is defined as an inflammatory condition of the lungparenchyma caused by infectious agents not present or incubating at the time of hospital admission; that is, conditionsthat develop more than 48 h after admission. It is still a major cause of death in this millennium accounting for more than 50% of the deaths related to nosocomial infections despite the use of vast spectrum of antimicrobial agents and improved medical care [1].

HAP affects around 0.5-1.7% of patients and is estimated to increase the length of hospitalization by 7-9 days [2]. In majority of patients, mechanical ventilation is a causal factor for HAP, in which case it is termed as ventilator associated pneumonia (VAP). VAP is associated with an increase of 7.6 days of ventilation, an increase of 8.7 days in intensive care and an increase of the total stay of 11.5 days [3,4].Early identification and diagnosis of HAP along with implementation of optimal prevention strategies are the tools for effective management of HAP.VAP and HAP are the major causes of morbidity and mortality with mortality rates

impending to 62% [1].Despite its clinical significance, little is known about the clinical and economic outcomes of HAP and VAP. It is estimated that the prevention of one VAP could result in a minimum cost saving of $14,000 per patient. The number of adult cases of VAP is estimated to be 4,000 per year, resulting in approximately 230 deaths, 17,000 ICU days, and $46 million in healthcare costs [3].The indiscriminate use of antibiotics will lead to the development of antibiotic resistance. One way of improving the clinical effectiveness and economic efficiency is by improving the antibiotic prescribing practices or by limiting the duration of antibiotic therapy. High consumption of antibiotics leads to economic burden causing heavy devastation of economic sources. Effective implementation of these preventive principles can result in significant cost savings for society and reduce hospital mortality and morbidity for individual patients.[2,3]This prospective study was undertaken to determine the antibiotic consumption patternof antibiotic and cost antibiotic treatment in a tertiary hospital.

METHODOLOGY

A prospective observational study, carried outin a tertiary care teaching hospital. The institutional ethics committee's approval was obtained prior to the study (No.UEC/42/2010). Hospital acquired pneumonia (HAP) patients who fulfill the inclusion criteria (e.g., patients admitted to hospital/ICU for more than 72 hours, patients whose diagnosis was confirmed by chest X-ray or by culture as pneumonia and aged above 18 years) were identified during daily visits to the emergency wards & enrolled into the study after taking informed consent. Patients were followed from the day of diagnosis of HAP, till the day of discharge or death. Patient data like demography (age, sex), antimicrobial agent usage details (total number of antibiotics prescribed, generic name, dose, grams per unit dosage, No. of doses per package, No. of packages consumed, duration, and route of administration of the antibiotic), length of hospital stay and clinical outcome were recorded in a predesigned data collection form. The cost of antimicrobial therapy was recorded from the day of admission, till the day of discharge. The antibiotics were classified using the anatomical therapeuticChemical (ATC) Classification System and drug utilization was measured as DDD/100 bed-days using WHO ABC Calc v3.1 [5,6,7]

End points (Out-comes):

The following end points (out-comes) were defined based on the final condition of the patient during discharge: improved and expired.

Length of hospital stay:

For calculating the length ofhospital stay, the date of admission was included, while date of discharge was excluded.

Antibiotic Consumption Pattern:

The antibiotics used for treating HAP were separated from all other prescriptions and their generic name and total numbers of units of each antibiotic were calculated. Total use of antibiotics of whole hospital was calculated as DDD/100 bed daysusing WHO ABC Calc v3.1.

- For calculating DDD/100 bed-days other information like occupancy index data was collected from medical records department.

- The occupancy index of our hospital during the study period was 0.79.

- For calculating the DDD/100 bed days WHO DDD Units of each antibiotic is required. This data was collected from WHO ATC DDD guidelines 31.

$$\text{DDD/100 bed days} = \frac{\text{No. of grams of antibiotic used} \times 100}{\text{WHO DDD Units (g)} \times \text{ No. of bed days}}$$

No. of grams of antibiotic used= strength of unit dosage* (g)×No. of unit doses per package×No. of packages used

No. of bed-days=No. of beds in the hospital×Occupancy index×No. of days (during the study period; 729 days)

Occupancy index= Percentage of beds occupied during study period

Cost calculations:

The daily antibiotic cost per patient was calculated by the multiplication of the cost per unit dosageand the number of doses that were used in each patient. The unit price of each antibiotic used was obtained from the hospital pharmacy data base.

RESULTS

310 patients were included in the study. Among study population 229 (73.9%) patients were male and mean age was 55.9±18.4 (mean±SD). Out of 310 patients 218 were improved, 37 and 55 were expired. Mean length of hospitalization was 9.45±6.75 (mean±SD) days. Total 25 antimicrobial agents or their combinations were used for the treatment of HAPin these patients. Among these antimicrobial agents, consumption (DDD/100 bed days) was highest for Piperacillin/tazobactam (parenteral, 0.12) followed by ceftriaxone (parenteral, 0.10), azithromycin (oral, 0.10) and Trimethoprim-sulphamethoxazole (oral, 0.08) Table.1. Single antimicrobial agent used depending on the sensitivity of the infecting microorganism was the most effective (50%) and also cost-effective (Rs. 2333±1002). Among antimicrobial agent combinations the percentage of treatment success was highest for patients who were treated with Piperacillin/tazobactam+Azithromycin combination (46%), followed by Cephalosporin+Azithromycin combination (38%). However the cost of treatment was high for

Piperacillin-tazobactam+Azithromycin regimen (Rs.9939± 1033) compared to Cephalosporin+Azithromycin combination (Rs. 5200±1832)

DISCUSSION

Antibiotic resistance is one of the major health issues worldwide and needs worldwide concern. This study provides an estimate of quantities of different antimicrobial agents used in the treatment of hospital-acquired pneumonia. Piperacillin-tazobactum (parenteral) was the highest consumed antimicrobial among 25 antimicrobial agents. Single antimicrobial agent used dependingon the sensitivity of the infecting microorganism had highest success rate. Hence use of single agent is encouraged whenever possible, because of their low cost. Similar study conducted by Bairy et.al., also suggested that similar type of usage of Piperacillin/tazobactam combination predominately used in nosocomial pneumonia as an empirical therapy [8]. Among antimicrobial agent combinations, percentage of treatment success wasalmost similar for Piperacillin/tazobactam +Azithromycin combination (46%) and Cephalosporin+ Azithromycin combination (38%). Hence, use of Cephalosporin+ Azithromycin combination is encouraged in susceptible patients considering their lesser cost.

Table 2: Consumption pattern of various antibiotics & antimicrobial agents (DDD/100 bed days) in HAP patients.

Antimicrobial agent	ATC Code	Route	WHO DDD (g)	DDD/100 bed days
Piperacillin/tazobactam	J01CR05	Parenteral	14	0.120
Azithromycin	J01FA10	Oral	0.3	0.100
Ceftriaxone	J01DD04	Parenteral	2	0.100
Sulphmethoxazole/trimethoprim	J01EE01	Oral	1.92	0.080
Cefixime	J01DD08	Oral	0.4	0.055
Amoxicillin/clavulanate	J01CR02	Oral	1	0.052
	J01CR02	Parenteral	3	0.024
Doxycycline	J01AA02	Oral	0.1	0.050
Meropenem	J01DH02	Parenteral	2	0.050
Teicoplanin	J01XA02	Parenteral	0.4	0.023
Linezolid	J01XX08	Parenteral	1.2	0.020
Amikacin	J01GB06	Parenteral	1	0.015
Ampicillin	J01CA01	Parenteral	2	0.008
Cefditoren	J01DD16	Oral	0.4	0.01
Cefpodoxime	J01DD13	Oral	0.4	0.007
Cftazidime	J01DD02	Parenteral	4	0.003
Cefotaxime	J01DD01	Parenteral	4	0.001
Cefuroxime	J01DC02	Parenteral	3	0.0006
	J01DC02	Oral	0.5	0.02
Ciprpfloxacin	J01MA02	Parenteral	0.5	0.006
Clarithromycin	J01FA09	Oral	0.5	0.003
Clindamycin	J01FF01	Oral	1.2	0.005
	J01FF01	Parenteral	1.8	0.011
Levofloxacin	J01MA12	Oral	0.5	0.023
	J01MA12	Parenteral	0.5	0.01
Metronidazole	J01XD01	Parenteral	1.5	0.01
	J01XD01	Oral	2	0.01
Netilmicin	J01GB07	Parenteral	0.35	0.002
Streptomycin	J01GA01	Parenteral	1	0.0003
Vancomycin	J01XA01	Parenteral	2	0.0002

Table 2: Cost of antimicrobial agent therapy in HAP patients:

Antimicrobial agent	Antibiotic cost/patient in Rs (Mean±SD)	Mean Length of hospital stay in day	% improvement
Piperacillin/tazobactam + Cephalosoprins + Azithromycin + One other antibiotic	29599±10533	14.7	36
Cephalosporins+ Azithromycin	5200±1832	10.4	38
Piperacillin/tazobactam + Azithromycin	9939±1033	8.7	46
Piperacillin/tazobactam + Cephalosoprins	20134±11156	12.6	14
Single antibiotic	2333±1002	5.8	50
Two antibiotic combinations	7380±4023	7.8	34

CONCLUSION

Usage of single effective antibiotic provide better efficacy with lower cost. Prevention of antibiotic resistance can be minimized by adhering the local antibiotic polices. The use of Cephalosporins should be encouraged according to sensitivity pattern of microbes and can be used in combination with macrolides effectively with lower cost.

REFERENCES

1. Anatomical Therapeutic Chemical (ATC) classification index with Defined Daily Doses (DDDs). Oslo (Norway): WHO Collaborating Center for Drug Statistics Methodology;2006.
2. McEachern R, Campbell GD Jr. Hospital-acquired pneumonia: Epidemiology, etiology, and treatment. Infect Dis Clin North Am. 1998, 12: 761-779.
3. Muscedere J., Day A., HeylandD.K. Clinical Infectious Diseases 2010. 51 Suppl1:S120- 5.
4. Safdar N, Dezfulian C, Collard HR, Saint S. Crit Care Med. 2005; 33:2 184-93.
5. Monnet DL, ABC Calc-Antibiotic consumption calculator [Microsoft® Excel application]. Version 3.1. Copenhagen (Denmark): Statens Serum Institute; 2006.
6. Aparna W, Ashu SM, Atul SP. Antibiotic prescription patterns at admission into a tertiary level intensive care unit in Northern India. Journal of Pharmacy and Bioallied Sciences. 2011;3(4):531-36.
7. Shankar PR, Shenoy NK, EasowJM, Brahmadathan KN. 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. Annals of Clinical Microbiology and Antimicrobials. 2003;2(7):1-9.
8. Bairy KL, Bhat BV , Sudha V, Bairy Indira.A retrospective comparative study of empirical antibiotic treatment of hospital-acquired pneumonia at a tertiary care hospital in South India. RJPBCS.2010;1(4):