ORIGINAL ARTICLE

A Drug Utilization Study of Antimicrobial agents (AMAs) in the Intensive Care Units (ICUs) at Medical College Hospital of North India

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Abstract

The APACHE (Acute Physiology and Chronic Health Evaluation) is a prognostic scoring system for classifying patients in Intensive Care Unit (ICU) on the basis of physiological scores and chronic health status. The chances of survival increase with a decrease in score. AMAs play a major role in management of such illnesses and dramatically improve patient outcome. This study has been undertaken to study the AMA utilization patterns in ICUs. Data was collected from 49 patients admitted in Surgery and Neurosurgery ICUs after IEC approval. The average number of AMAs used was 3.36 per patient. The highest use of AMAs was 4.3 in group VI of APACHE scoring system. Cephalosporins was the most commonly prescribed AMA group. The preferred route of administration was intravenous route. Feedback from this study would help both the prescribers and institutional authorities to review their prescribing practices and modify if necessary to facilitate better health care delivery.

Key Words

Drug Utilization Studies, APACHE II, Intensive Care Unit

Introduction

Drug utilization research was defined by World Health Organization (WHO) in 1977 as "the marketing, distribution and use of drugs in a society, with special emphasis on the resulting medical, social and economic consequences." A number of other terms or domains like epidemiology, pharmacoepidemiology, pharmacosurveillance and pharmacovigilance have been coined since then. The importance lies in understanding the relationship between the various domains (1) for the effective utilization of this versatile tool.

Epidemiology is the study of populations in order to determine the distribution and determinants of health-related states and events. Pharmacoepidemiology has been defined as "the study of the use and effects/adverse drug effects of drugs in large numbers of people and the application of this study for efficacious drug treatment." The domain of pharmacosurveillance and pharmacovigilance refers to the monitoring of drug safety (1). Drug utilization research is thus an essential part of pharmacoepidemiology. Together, they can provide insights into the various aspects of drug use and drug prescribing like pattern of use, quality of use, determinants of use and outcomes of use (1). Patient data collection can be used as a means of support for clinical audits by which actual use of drugs can be compared to national prescription guidelines or local drug formularies and also, this helps in the quality control (2).

Initially, the studies were conducted for the marketing purposes only (3-5). In view of exponential increase in the number of drugs being marketed, variation in the drug prescriptions, adverse effects of the medicines and the rising concern regarding the cost of drugs have increased the importance of such studies to a great extent (6-9). Hence, it has become a potential tool for the evaluation of health care systems.

Intensive Care Unit (ICU) patients are a heterogeneous group, who often suffer from severe illness, multiple organ dysfunction and coexisting medical disorders. These patients have high mortality and morbidity and require a high level of intensive care (10).The disease severity for

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patients in the ICU and during the hospitalization can be estimated by Acute Physiology and Chronic Health Evaluation, APACHE II prognostic scoring system. It consists of three variables: Acute physiological variables n=12, chronic health status n=2 & age. It is a system for classifying patients in the ICUs. Physiological scores have a strong correlation with severity of illness (11). Among pharmacotherapeutics, antimicrobials have a major impact on the outcome and severity of illness in these patients.

The present study was undertaken to determine the drug utilization pattern and to see the use of antimicrobials in each category of APACHE II scoring system. This was done to get some pointers towards the prescribing of AMAs in ICU setting in our set up.

Material and Methods

This study was conducted in tertiary care teaching institution of North India having 100 ICU beds. The patients in this study were enrolled from Surgery Intensive Care Unit (SICU) and Neurosurgery Intensive Care Unit (NSICU) after taking the approval from Institutional Ethical Committee. APACHE II score was recorded at 24 h of admission to ICUs by resident (AG), department of Pharmacology. The various patient parameters were entered in the standard APACHE II score form. The patients were categorized into six broad groups based on APACHE II score as an indicator of mortality rate in them. (*Table 1*) (12).

In addition, the AMAs prescribed to the patients were entered in a structured performa to look for AMA pattern of use in terms of

a. Average AMA use per patient
b. Commonly prescribed AMAs in ICUs
c. Preferred route of administration
d. Average AMA prescription in different APACHE II score group patients

Table 1. Probability of death in Hospital, based on APACHE II scoring system

Group No.	APACHE II Score	Mortality Rate
I	0-5	2.3%
II	6-10	4.3%
III	11-15	8.6%
IV	16-20	16.4%
V	21-25	28.6%
VI	26-30	56.4%

Results

- Total number of patients enrolled = 49
- Total number of AMAs prescribed = 165
- Average AMA use per patient = 3.36
- Commonly prescribed group of AMAs (Fig 1a&b)
  - Cephalosporins (CS)
  - Fluoroquinolones (FQs)
  - Anti-anaerobic agents (AA)
  - Aminoglycosides (AGs)

The average AMA used in each APACHE II score group ranged from 3.1 to 4.3 (*Table 2*)

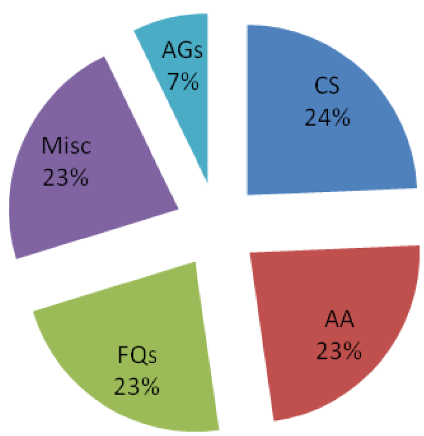
The highest average AMA use in the group VI (APACHE II Score >25) is based on the mortality rate indicator (as table 1) was recorded by us. The preferred route of administration for AMAs was the parenteral route (intravenous route).

Discussion

Antibiotics are one of the most common pharmacotherapies administered in the ICU setting (13). Since the prescription of antibiotics in the hospital setting is often empiric, particularly in the critically ill (14), this study was planned to analyze the use of antibiotic agents in the patients of neurosurgery ICU and surgery ICU. These ICUs were selected in view of their prolonged stay as compared to medical ICU patients.

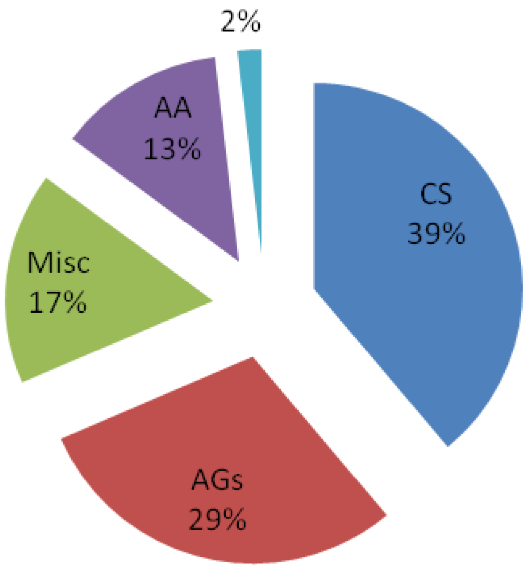
The pattern of antibiotic use was collaborated with APACHE scoring to predict hospital mortality risk for critically ill hospitalized patients. Critically ill patients admitted to ICUs frequently develop nosocomial blood stream infections (BSI) which is a leading cause of death in such patients (15,16). These patients are predisposed to life threatening BSIs by debilitated condition of the patient due to underlying diseases, various invasive diagnostics and therapeutic procedures. The problem gets

Fig. 1a SICU- AMA Encounters (%)



Total AMAs Prescribed=54

Fig. 1b NICU- AMA Encounters (%)



Total AMAs Prescribed=111

further compounded by contaminated life support equipment (15,17). Hence, antimicrobial therapy plays a definite role in saving the lives of these BSI vulnerable patients.

In our study, average AMA use was 3.36 per patient, which is high but in view of the above mentioned risk, the definitive and prophylactic treatment mandates the high use of AMAs. A large number of antibiotics were prescribed to these patients. Amongst these, the order of commonly used AMA groups was Cephalosporins, Fluroquionolones, Anti-anaerobic agents and Aminogycosides. Among the Cephalosporins group Piperacillin-tazobactum, Cefoperazone-sulbactum, Ceftazidime were the most commonly prescribed drugs. These drugs are effective against the common nosocomial pathogenic microorganisms like Pseudomonas aerugenosa, Klebsiella spp., Salmonella typhii, B. fragilis etc (18).

Drugs prescribed from the Fluoroquinolones group were mainly Ofloxacin, Levofloxacin, and Ciprofloxacin. The antimicrobial spectrum of these agents includes E. coli, Salmonella, Shigella, Enterobacter, Pseudomonas etc (19).

Amongst the Aminogycosides, the drugs commonly prescribed were Amikacin and Gentamicin. Their effectiveness has been reported against Pseudomonas, Proteus, E. coli, Klebseilla, Enterobacter, Serratia (20). Other than these AMAs, Metronidazole was another

Table 2. Average use of AMA in each APACHE Score Group

Group No.	Average AMA use/Group
I	4.0
II	3.2
III	3.3
IV	3.1
V	3.7
VI	4.3

commonly prescribed drug. It was given in combination with other antimicrobial agents to treat polymicrobial infections with aerobic and anaerobic bacteria (21). Apart from the above mentioned groups of drugs, the AMAs prescribed included Vancomycin, Tigecycline, Teicoplanin, Clindamycin and antifungals like Amphotericin B, Fluconazole.

There has been variability in the pathogens associated with BSI, along different antibiotic susceptibility profiles, among the various hospitals (22). In a study conducted in the ICUs of a tertiary care centre in northern India, the commonly isolated pathogens were Pseudomonas, Staph. aureus, Klebsiella and E. coli (23). Our study has also shown the commonly prescribed AMAs to be effective against all these pathogens. The current antibiograms also collaborates with the sensitivity patterns of microorganisms cultured from these ICUs and hence justify the selection of used AMAs in this study.

The data so obtained was discussed with the departments of Neurosurgery and department of General Surgery individually and with the hospital infection control committee. Further studies are being planned from other areas to determine the baseline AMA use. This baseline data will help in designing AMAs cycling. Results of this intervention will be appreciated in the subsequent plan studies. The aim of this project was not to correlate the mortality rates with AMA use rather to study the AMA prescribing pattern.

Study of the prescribing pattern is helpful in developing antibiotic administration guidelines/protocols locally or by national societies to avoid unnecessary antibiotic administration and also helps in increasing therapeutic effectiveness (24). Even the concept of antibiotic class cycling has been advocated as a potential strategy for reducing the emergence of antimicrobial resistance (25)

However, limited clinical data is currently available that has examined the issue of antibiotic class changes or cycling (26). Changing temporal patterns of pathogens and antimicrobial susceptibility over time have been described (27, 28). This suggests that hospitals may need to develop systems for reporting antimicrobial susceptibility patterns of bacterial pathogens for individual hospital areas or units on a regular basis because of the potential existence of intrahospital variations. Using such data can improve the efficacy of antimicrobial therapy by increasing the likelihood for adequate initial treatment of infections (29).

Conclusion

Clinicians practicing in the ICUs must develop standard operating procedures (SOPs) for more effective antimicrobial therapy. They should promote infection control practices and rational antibiotic utilization aimed at minimization of antibiotic resistance.

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