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Prospective and observational study of antimicrobial drug utilization in medical intensive care unit in a tertiary care teaching hospital

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Abstract
Objectives: 1) The objective of this study was to assess the prescribing patterns of anti-microbial drugs. 2) Rationality of drug use in the medical ICU of a tertiary care hospital.
Materials and Methods: After taking approval from the Institutional ethical committee, study was undertaken over a period of 6 months. A prospective observational study was conducted to assess the prescription pattern of antibiotic usage in the medical ICU. Standard Proforma was used to collect the information regarding antibiotics, its dose, duration, first line of antibiotics and second line of antibiotics and adverse drug reactions. Data was analysed using descriptive statistics with help of SPSS software.
Results: Total 202 cases were admitted to the ICU during study period. Respiratory conditions (33.2%), febrile illness (15.3%), poisoning (15.3%) and CNS (12.9%) illnesses were commonly reported to ICU. Cephalosporins (81.7%) were commonly prescribed followed by Nitroimidazoles (30.2%) and Penicillin (16.3%). Ceftriaxone (43.1%) and cefixime (38.6%) were commonly used followed by Pipercillin + Tazobactum combination (9.4%). No adverse reactions were reported during the study period.
Conclusion: In conclusion, a wide spectrum of clinical diagnoses and a variety of drugs were utilized from various drug classes. Results showed that Cephalosporins were extensively used in ICU. The number of drugs prescribed by generic names was low in the ICU and effort must be made to encourage prescribing by generic names. Rational usage of antimicrobial agents in ICU should be encouraged by following strict Hospital antimicrobial policy.
Keywords: Prescription analysis, Antimicrobials and ICU.

1. Introduction

Antimicrobials are the most frequently prescribed drugs among hospitalized patients especially in intensive care unit (ICU) department. [1]

Prescription of drugs in a critically ill patient is complicated. The judicious use of medications can be lifesaving. The routine use of conventional drug dosage regimens may expose ICU patients to drug related problems such as treatment failure, drug interactions and high risk of adverse drug reactions. Careful titration and monitoring of dosage regimens becomes imperative to ensure the ideal treatment outcome. [2]

Antimicrobial agents are one of the frequently utilized drug classes in an ICU setting. Patients in ICU were commonly prescribed multiple broad spectrum antibiotics. Patients with critical illnesses are vulnerable and exposed to multiple invasive procedures and are at higher risk of developing nosocomial infections. [3-5] Antimicrobials are the most powerful and useful tools to manage these infections. Extensive and indiscriminate use of antimicrobial agents has been documented in ICUs in previous published reports. [6,7]

Several authors have reported concern about the continuous indiscriminate and excessive use of antimicrobial agents that promote the emergence of antibiotic-resistant organisms. Monitoring of antimicrobial use and knowledge of prescription habits are some of the strategies recommended to contain resistance to antimicrobials in hospitalized patients. [8,9]

Resistance of common hospital-acquired bacteria to antibiotics is a worldwide problem. It can lead to increased morbidity, mortality, length of hospital stay (LOS) and healthcare expenditures. An ICU of a developing country where health costs are borne by the patients and to some extent the hospitals, it is causing a huge economic burden. [10,11]

Knowledge of a ICUs most common bacterial isolates and their antibiotic susceptibility patterns facilitates effective empirical antibiotic therapy and supports decisions to restrict or reduce the clinical availability of certain antibiotics. [12]

Literature on antimicrobial use abroad and in India bears testimony to the widespread concern about the appropriate use of these agents. [13]

Drug utilization study is a component of medical audit that does monitoring and evaluation of the drug prescribing patterns and suggests necessary modifications in prescribing practices to achieve rational therapeutic practice as well as cost effective health care. [14]

The aim of the study is to know about the antibiotic usage in our intensive care unit which helps in rationalising the antibiotic prescription and to avoid emergence of drug resistance and to improve better patient's outcome.

Objective of the study:

1. To assess the prescribing patterns of anti-microbial drugs.
2. Rationality of drug use in the medical ICU of a tertiary care hospital.

2. Materials and methods

Study was initiated after obtaining permission from the Institution Ethical Committee. It was a prospective observational study with case records of patients admitted in the medical intensive care unit (MICU) of tertiary care teaching hospital. All inpatients admitted to the medical ICU during the study period were included as the study population. Patients who got transferred to other specialty ICUs from medical ICU within 24 hours of admission were excluded from the study population.

Standard structured proforma was used and the relevant clinical data was collected from the inpatient medical records.

2.1 Data collection:

The demographic and clinical treatment data of patients are collected in the following format:

1. Patient's name, age, sex, date of admission (DOA) and date of discharge (DOD) or death.
2. Previous drug allergy.
3. Diagnosis.
4. Percentage of antimicrobial agents (AMAs) prescribed in the order of preference.
5. Dose of the drug, dosage form, route of administration, frequency of administration.
6. Antibiotics prescribed at the time of discharge.

2.2 Rationality [15]

A. The therapy is considered rational if the antimicrobial use and its route of administration, dose, frequency and duration of use were considered appropriate for infection.

B. Therapy is considered irrational if the antimicrobial was used without indication, prophylaxis under circumstances of unproven efficacy or by clearly inappropriate route, dose or preparation for that indication.

C. Therapy is considered questionable when insufficient clinical or laboratory data was present to enable the therapy to be classified as clearly rational or irrational e.g. patients of congestive heart failure having cough but do not know that cough is due to CHF or infection then treatment with antimicrobial agent considered questionable.

2.3 Statistical Analysis

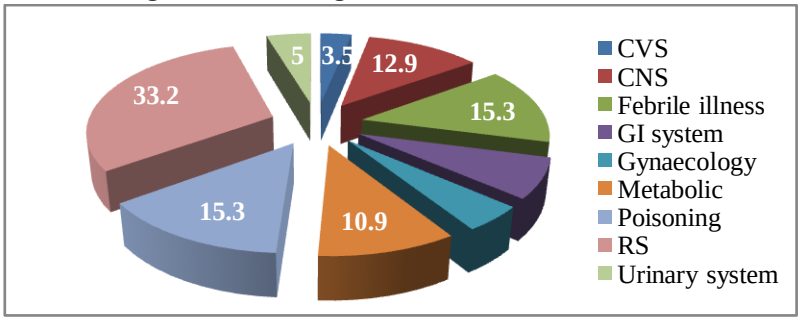
The collected data were entered in Excel sheet and analysed with Proportions, Chi-Square using SPSS software version 20, 2015.

3. Results

Total of 202 cases were admitted in the ICU over a period of 6months. Out of which 110 were male and remaining were female.

There were variety of cases admitted in the ICU among which respiratory tract infection (RTI) was most common (33.2%) followed by febrile illness (15.3%), poisoning (15.3%), central nervous system (CNS) (12.9%), metabolic (10.9%) and less percentage of cases were seen in GI system and Urinary system infections. (Figure 1)

Figure 1: Percentage of diseases admitted in ICU



Ceftriaxone (43.1%) and cefixime (38.6%) were the most commonly prescribed antibiotics as first line drugs in the ICU. Other antibiotics like Pipercillin+tazobactum (9.4%), amoxicillin + sulbactum (5.9%), amoxicillin, ampicillin and ciprofloxacin (0.5%) were also used but very less compared to the above two drugs.

Metronidazole was the other drug given along with the first line drugs constituting about (30.2%). Levofloxacin (1%) and amikacin (3.5%) were the other two drugs used along with first line drugs. (Table 1)

Table 1: Antimicrobials prescribed as first line drugs and drugs given along with first line drugs

First line AMAs	Frequency	Percentage
Ceftriaxone	87	43.1
Cefixime	78	38.6
Pipercillin + tazobactum	19	9.4
Amoxicillin + sulbactum	12	5.9
Levofloxacin	3	1.5
Ampicillin	1	0.5
Amoxicillin	1	0.5
Ciprofloxacin	1	0.5
Total	202	100
AMSs given with first line drugs	**Frequency**	**Percentage**
Metronidazole	61	87.1
Amikacin	7	10
Levofloxacin	2	2.8
Total	70	100

Pipercillin + tazobactum (5.4%) used as second line antibiotic followed by levofloxacin (2.5%) and metronidazole (2%). Other antibiotic drug utilization was very minimal. (Table 2)

Table 2: Antimicrobials prescribed as second line drugs

Second line AMAs	Frequency	Percentage
Pipercillin + tazobactum	11	40.7
Levofloxacin	5	18.5
Metronidazole	4	14.8
Cefixime	2	7.4
Azithromycin	2	7.4
Ciprofloxacin	1	3.7
Doxycycline	1	3.7
Amoxicillin + sulbactum	1	3.7
Total	27	100

Among all the antimicrobials, cephalosporin (81.7%) and penicillin (16.3%) group drugs were extensively used as first line drug along with nitroimidazole (30.2%) group. Penicillin (5.9%) group were the most commonly used second line drugs. (Table 3)

Table 3: Antimicrobial groups prescribed as first line and second line drugs

First line AMAs groups	Frequency	Percentage
Cephalosporins	165	60.6
Nitroimidazole	61	22.4
Penicillin	33	12.1
Aminoglycoside	7	2.5
Fluoroquinolones	6	2.2
Total	272	100
Second line AMAs group	**Frequency**	**Percentage**
Penicillin derivatives	12	44.4
Fluroquinolones	6	22.2
Nitroimidazole	4	14.8
Cephalosporin	2	7.4
Macrolides	2	7.4
Tetracycline	1	3.7
Total	27	100

4. Discussion

Antimicrobials are the most frequently prescribed drugs among hospitalized patients especially in medical intensive care unit. The present study was a prospective observational study to monitor the antibiotic usage in the medical intensive care unit.

Total 202 patients were admitted in the ICU during the study period. Among them 110 were male and 92 were female. Which was similar to the other studies where male preponderance was seen? [16].

Medical ICU is the place where highly fatal, complicated and variety of cases are seen. Respiratory system related admissions were common in ICU and in the present study it showed that 33.2% of the reported cases belong to RS system. Similar result were seen in other study done by Krivoy *et al*. [17]

Antimicrobials were extensively used in ICU to treat the complicated cases, irrational prescription and polypharmacy of antimicrobial leads to emergence of drug resistance and therapy failure and increase the patient mortality and morbidity. Among all the prescribed drugs Cephalosporins (60.6%) were extensively prescribed in the ICU compared to the other group of antibiotics followed by penicillin and fluoroquinolones. Study done by John *et al* showed the similar results. [18]

Among the cephalosporins, majority of the physicians prescribed ceftriaxone (43.1%) and cefixime (38.6%) as the first line antibiotics, the reason for prescribing cephalosporins is that it is cost-effective as well as covers majority of bacteria's. A similar result was shown in study done by Badar *et al.* [19]

Metronidazole was prescribed along with cephalosporin's in majority of the prescription (22.4%) as the first line drug. The rationale behind prescribing metronidazole is that it covers the anaerobic infection which is quite common in hospital acquired infections. Earlier studies have also showed similar use of metronidazole given along with the cephalosporins.[19]

Among second line antimicrobials, penicillin derivative pipercillin+tazobactum combination was prescribed. Reason for choosing the above drug is that it's wide has a variety of antimicrobial activity and is active against the organisms which have shown resistance to cephalosporin's.

Among the total prescribed antimicrobials, ceftriaxone was mainly prescribed in conditions related to RS and CNS diseases. Cefixime was prescribed for conditions like febrile illness, poisoning cases and RS diseases. Metabolic conditions like sepsis and multi organ dysfunctions (MODS) were treated with pipercillin+tazobactum combination which covers the majority of organisms. Metronidazole was prescribed to most of the ICU patients along with ceftriaxone, cefixime, pippercillin+tazobactum and other antibiotics to cover the anaerobic organisms.

Irrational prescription of antimicrobials is the major health care problem and burden to the society, which leads to development of resistance and increase in health care cost. Previous study has shown that antibiotics were prescribed for non-infectious conditions. Similar results were also seen in our study, that antimicrobials were prescribed for conditions where the antimicrobial utilization is not required. [20]

The combinations of antimicrobials (ceftriaxone+metronidazole, cefixime+metronidazole and pipercillin-tazobactum+metronidazole) used in our study were rationale as it covered gram positive, gram negative, aerobic and anaerobic organisms. As compared to other studies, our study showed better outcome in antibiotic usage. [18,19,21]

A total of 298 antimicrobials prescribed for 202 patients, more than half of the antimicrobials (52.8%) prescribed were by brand name which was similar to study done by Pandiamunian *et al.* [16]

Most of the antimicrobials prescribed were from the National list of essential medicine [NLEM] compared to the study done by Adhikari *et al* where 45.1% of prescribed drugs were from NLEM. It proves that the prescribers are adherent to the antibiotic prescription policy made by national regulatory bodies. [22]

5. Conclusion

A wide spectrum of clinical diagnoses and a variety of drugs were utilized from various drug classes. Results showed that Cephalosporin's were extensively used in ICU. Among cephalosporin's ceftriaxone and cefixime was most commonly prescribed. Pipercillin+tazobactum combination was prescribed as second line drug and metronidazole was given along with first and second line drug in majority of the patients. The number of drugs prescribed by generic names was low in the ICU and effort must be made to encourage prescribing by generic names. Rational usage of antimicrobial agents in ICU should be encouraged by following strict Hospital antimicrobial policy.

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