ORIGINAL ARTICLE

An Audit for Microbiological Surveillance and Antimicrobial Susceptibility in the Intensive Care Unit

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ABSTRACT

Objectives: To document the prevalence of microorganisms and their susceptibility to different antimicrobial drugs in our ICU over a period of one year.

Methodology: 570 samples for culture and sensitivity were sent to laboratory from 6 sites; blood, central venous catheter (CVC) tip, cerebrospinal fluid (CSF), wound tissue, tracheobronchial secretions and urine.

Results: 238 out of 570 culture reports were positive; 9 organisms were tested positive; Escherichia coli (110), Pseudomonas (42), Staph aureus (32), Methicillin Resistant Staphylococcus Aureus [MRSA] (20), Klebsiella (10), Proteus (10), Candida (6), Acinatobacter (5) and Beta-hemolytic streptococci (3). Meropenem, Imipenem, Cefoperazone/Sulbactam, Piperacillin/Tazobactam, Amikacin, Ceftriaxone/Ceftazidime and Ciprofloxacin in descending order were found to be the antimicrobials with broadest spectrum.

Conclusions: Microbiological surveillance in the ICU facilitates the monitoring of changes of dominant microorganisms and antibiotic susceptibilities in the unit helping in the decision of empirical treatment regimes and, as a result, selecting the right antibiotics.

Key words: Microbiological Surveillance, Antimicrobial Susceptibility, ICU Antimicrobial therapy

INTRODUCTION

Intensive care units (ICUs) are the areas with the highest rate of nosocomial infections thus increasing duration of hospital stay[1]. Several studies have reported higher rates of antimicrobial resistance among isolates from ICUs than isolates from general patient-care areas[2]. Hospital infections are important contributors in increasing risk of mortality and morbidity as well as the economic burden[3]. Antimicrobial resistance among pathogens causing hospital-acquired infections is a major worldwide issue, which must be dealt with continuously. Moreover, infectious agents in the ICU are commonly resistant types, and the requirement for treatment with more toxic and expensive medications becomes a problem increasing length of stay and mortality[4].

Obtaining microbiological information of Intensive Care Units ensures that the local epidemiologic database is kept up to date, without which logical antimicrobial prescription is difficult. There are substantial differences among intensive care units in the microbial ecology. A major issue confronting organized health care today is that of controlling the increase in antimicrobial resistance. Surveillance programmes are valuable tools in preventing antimicrobial resistance[5]. Consequently, proper surveillance programmes focused on specific patient-care areas have become a focal point in combating the development of resistant organisms. However, surveillance programmes are limited in their ability to address all relevant clinical and microbiological outcome issues. Thus, efforts must be made to better understand bacterial resistance trends and to refine clinical decision tools locally.

OBJECTIVES

To document the prevalence of microorganisms and their susceptibility to different antimicrobial drugs in our ICU over a period of one year.

MATERIAL AND METHODS

This study was carried out in Intensive Care Unit of National Hospital and Medical centre. It is a 10 bedded ICU with 1:1 nursing care facility. The ICU has an input of around 350- 400 patients a year. The team managing the patients consists of 4 consultant anaesthetists, a cardiologist, a pulmonologist, a physician, an infectious diseases consultant and a neurosurgeon.

The study was started after approval from hospital ethical committee and consent from the family of the patients. A total of 450 patients were admitted in ICU during the year 2007. In 2007 we developed a protocol of sending blood and urine culture on admission and wound tissue, tracheal

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aspirate, CVC & CSF cultures as indicated. The purpose was to document the prevalence of microorganisms and their susceptibility to different antimicrobial drugs in order to develop prophylactic antibiotic administration policy. The program was designed with Microsoft Visual Basic 6.0 at front-end, as a data project having two screens. One screen was designed for data entry into a 78-field Microsoft Access Database (2005 format) at back-end while the other screen analysed the data entered into the aforementioned database. The database had the provision of entering upto 3 isolates in a specimen (a very rare occurrence) and a maximum of 21 antibiotics names entry for each isolate's sensitivity list. The data entry screen contained dropdown lists for organism, specimen and antibiotic types from which the entry could be selected. Only the positive cultures were entered. The program was able to analyse the general data regarding total isolate types, specimen types, antibiotics type, total mixed cultures and calendar span of cultures from database. The specific analysis was also programmed to count the number of times an organism was isolated from any specific specimen and then percentage of total count the number of any specific isolate that was sensitive to an antibiotic to measure sensitivity. The counts and percentages were taken from analysis screen and plotted on excel sheet for graphical presentation.

So initially all patients whose stay was longer than 48 hours were included in the study. Patients staying for less than 48 hours were excluded. 65% of the patients were post surgical while remaining 35 % were referred from medical unit. A total of 570 samples from these patients were sent to laboratory for microbiological screening of blood, CVP tip, CSF, pus tissue, suction catheter tip, tracheobronchial secretions and urine.

RESULTS

Out of 570 samples sent 238 tested positive for microorganism. Figure 1 shows the percentage of sample sites that were used. Nine micro-organisms were found in the culture reports; Escherichia coli (20), Klebsiella (10), Proteus (10), Candida (6), (110), Pseudomonas (42), Staph aureus (32), Methicillin Resistant Staphylococcus Aureus [MRSA] Acinatobacter (5) and Beta-hemolytic streptococci (3) as shown in table 1.

Fig. 1: Sample sites

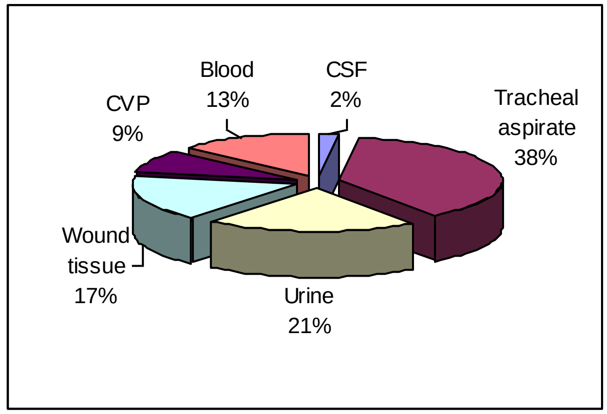

Table 1: Organisms testing positive (n=238)

Organism	=n	%age
E.coli	110	47
Psuedomonas	42	18
S. Aureus	32	13
MRSA	20	8
Klebsiella	10	4
Proteus	10	4
Candida	6	3
Acinatobacter	5	2
B-Hemolytic Streptococci	3	1

E.coli was the most predominant organism found in every sample (Table 2). In 10 patients two organisms were isolated. In all those incidences the organism isolated were E.coli and pseudomonas.

Percentage sensitivity was taken as the fraction of the organism that was reported sensitive to a particular antibiotic for e.g., in case of E. coli 66 times out of 110, positive sensitivity was shown to meropenem so percentage sensitivity of the organism to that antibiotic was taken as 60%. Percentage sensitivity of the above organisms against various antibiotics is shown in table 3.

Table 2: Site/ organism relationship

Organism	Blood	Tracheal Aspirate	CVC Tip	Urine	Wound Tissue	CSF
E.coli	48%	51%	35%	52%	37%	25%
Psuedomonas	21%	22%	20%	9%	15%	25%
S. Aureus	10%	8%	5%	11%	33%	25%
MRSA	14%	8%	30%	2%	5%	-
Klebsiella	-	2%	-	13%	-	25%
Proteus	-	4%	10%	2%	5%	-
Candida	-	1%	-	11%	-	-
Acinatobacter	7%	3%	-	-	-	-
B-Hemolytic Streptococci	-	1%	-	-	5%	-

Table 3: Percentage sensitivity of organisms to antibiotics

Organism	Tazocin	Sulzone	Amikacin	Ceftriaxone	Imepenem	Meropenem	Vanco-mycin	Ciprofloxacin
E.coli	66	33	44	6	60	60	1	9
Psuedomonas	90	38	70	20	80	80	-	30
S. Aureus	35	70	-	78	92	92	78	78
MRSA	10	-	-	-	10	10	90	-
Klebsiella	80	100	80	20	100	100	-	20
Proteus	70	20	40	1	70	100	-	20
Candida	-	-	-	-	-	-	-	-
Acinatobacter	-	20	40	-	-	40	-	-
B-Hemolytic Streptococci	100	-	-	100	100	100	50	100

DISCUSSION

In order to start the right empirical antibiotic regime in a particular ICU setup it is important that we should have the knowledge of microbiological pattern of that setup. Starting empirical treatment without microbiological investigations and surveillance studies is recognized as a mistake[6]. Keeping the above considerations in mind 570 bacteriologic samples were sent to laboratory during the year 2007. Microbiological surveillance studies are performed all over the world to monitor the organisms responsible for site specific infection rates (pneumonia, blood stream infections, urinary tract infections, surgical site infections) and to guide infection management and antibiotic prophylaxis[7].

The main AGNB are Klebsiella, Proteus, Morganella, Citrobacter, Enterobacter, Acinetobacter, Serratia and Pseudomonas species[8]. Out of these we found 9 species to be present in our population including Escherichia coli (110), Pseudomonas (42), Staph aureus (32), Methicillin Resistant Staphylococcus Aureus [MRSA] (20), Klebsiella (10), Proteus (10), Candida (6), Acinatobacter (5) and Beta-hemolytic streptococci (3).

Escherichia coli was the most dominant microorganism (47%) followed by Psuedomonas (18%) and Staphylococcus aureus (13%). MRSA was present in 8% of the sample. Even while considering different samples site it was found that Escherichia coli was the most dominant microorganism followed by Psuedomonas and Staphylococcus. Other studies have shown the rank order of pathogens recovered as Staphylococcus aureus (24.1%), Pseudomonas aeruginosa (12.2%), Escherichia coli (10.1%), Klebsiella spp. (8.9%), Enterococcus spp. (7.2%), coagulase-negative staphylococci (7.0%) and Enterobacter spp. (7.0%) [9]. Escherichia coli rate was very high as compared with the international findings while other patogens rates were comparable. This may be due to lack of strict implementation of nursing barrier techniques in our ICU. Handwashing has been the cornerstone of traditional policies for the prevention of nosocomial infections in the ICU. The present view is that handwashing remains the single most important prevention strategy to reduce the risk of healthcare workers transmitting microorganisms from one patient to another[10]. In view of these recommendations and our findings we are trying to implement a strict protocol of nonantibiotic prophylaxis for prevention of infections by pathogens like Escherichia coli that include manoeuvres like handwashing by sterilium for everyone who is in contact with the patient, repeated suction of supraglottic secretions and nursing in the semirecumbent position.

Antibiotic susceptibility rates of various microorganisms have also been reported internationally. Caio Mendes[11] et al reported Pseudomonas aeruginosa susceptibility rates of 64% to meropenem, 63.8% to piperacillin/tazobactam, 63.4% to amikacin, and 58.7% to imipenem. Acitenobacter baumannii susceptibility rates to meropenem of 97.1%, and 73% to tobramycin were also reported in the same study. They also found that Escherichia coli and Klebsiella pneumoniae were highly susceptible to both carbapenems.

In our study the commonest microorganism Escherichia coli had susceptibility rates of 66% to Tazocin, 60% to Imepenem/Meropenem, 33% with sulzone and 44% with Amikacin. These susceptibility rates are much lesser than the internationally reported rates. These results regarding Escherichia coli may signify emergence of resistant strains of this micro-organism. Psuedomonas had susceptibility rates of 90% with Tazocin, 80% with Imepenem/ Meropenem, 38% with sulzone and 70% with Amikacin. These rates are a bit higher than internationally reported rates. Staph Aureus had susceptibility rates of 35% with Tazocin, 92% with Imepenem/ Meropenem and 70% with sulzone. MRSA apart from Vancomycin (90% susceptibility rate) was resistant to most of the antibiotics used. Proteus and Klebsiella species also showed excellent susceptibility rates to Tazocin and carbapenems. So considering the above results and keeping in mind our microbiology pattern we made a protocol of empirically starting with Tazocin or Carbapenems, after sending the appropriate cultures, thereby covering around 90% of the microorganisms present in our ICU. These were reviewed after obtaining the culture reports.

One of the limitations of the initial programme designed for this purpose was that it did not show the relevance of the disease state of patient with the microorganisms found in their samples. This was incorporated in the latest versions of the programme and we are in the process of determining the specific organisms being isolated in various disease states in our ICU.

Furthermore initially all patients were included irrespective of their stay and disease state. Patients whose stay was prolonged more than 48 hours were included while rest were excluded. No allocation of the patients was done in subpopulations according to their stay and disease. Both these provisions and their analysis have been incorporated in the latest version as well.

CONCLUSION

Microbiological surveillance in the ICU facilitates the monitoring of changes of dominant microorganisms and antibiotic susceptibilities in the ICU. This helps in the decision of empirical treatment regimes and, as a result, selecting the right antibiotics.

In the light of the above results we are in the process of developing protocols for our ICU especially stressing on the need for developing an antibiotic policy and proper training of the nursing staff.

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