Original Article

Antibiotic susceptibility pattern in an intensive care unit of a tertiary care hospital of Pakistan

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Objective: To determine the most common microorganisms in the body secretions of patients admitted in an intensive care unit (ICU) of a tertiary care hospital and estimate antibiotic sensitivities to those organisms.

Methodology: In this cross-sectional study performed in the medical ICU of Jinnah Postgraduate Medical Center, Karachi, from January to February 2019, 95 specimens were collected from blood, endotracheal secretions, central catheter tips, and urine. Antibiotic sensitivity was tested by the disk diffusion method.

Results: Out of 95 patients, 69.5% were males and mean age was 27.37±10 years. All patients had positive bacterial cultures except one that was of Candida albicans. Bacteria were mostly gram-negative (85.3%, n=81) and the most frequently encountered were Pseudomonas aeruginosa (34.7%). Pseudomonas aeruginosa was most sensitive to polymixin-B (17.8%, n=17). For Acinetobacter baumannii, colistin (10.5%, n=10) followed by cefoperazone/sulbactam (5.2%, n=5); for Klebsiella pneumoniae, amikacin and imipenem had equally highest sensitivity (8.4%, n=8). For Staphylococcus aureus, amikacin sensitivity was found in the majority (7.3%, n=7).

Conclusion: Microorganisms with multidrug-resistance especially gram-negative ones are increasing day by day. A high percentage of resistance to the frequently used antibiotics (cephalosporins, quinolones, and carbapenems) was found. The antibiotics prescribed empirically should be according to regularly updated antibiogram. (Rawal Med J 202;45:17-21).

Keywords: Culture, antibiotic resistance, multidrug-resistance, antibiogram, intensive care units.

INTRODUCTION

Antibiotic resistance is an emerging problem globally resulting in widespread public health issues. Lack of therapeutic agents to cope up with this increasing resistance is another big challenge for physicians.[1] The use of antibiotics is pivotal in a critical care setting.[2] A combination is used empirically to cover various microorganisms in intensive care units (ICU) particularly for critically ill patients.[3] The incidence of antibiotic resistance is around seven times higher in ICU than in general hospitals.[4] A large proportion of infections are contributed by resistant species of Staphylococci, Acinetobacter, Pseudomonas, and Candida. The global incidence rate is 23.7 infections per 1000 patient days.[5]

Failure of antibiotic therapy can be due to a number of factors such as empiric therapy not specific to the organism, inadequate source control, severity of illness, immunocompromised patients, susceptibility to nosocomial infections, cross-transmission of pathogens, breach of skin and membranes due to use of invasive devices, increased patient and healthcare personnel contact, and most importantly frequent and widespread use of prophylactic and therapeutic antimicrobial.[4,5] This calls for prompt preventive measures to be observed in all healthcare facilities, particularly ICUs, such as maintaining hand hygiene, decolonization of skin using antiseptics and proper screening for multidrug-resistant microorganisms.[6] To make sure that effective antibiotic treatment is initiated, choice of empirical treatment should be optimized using the pharmacokinetic-pharmacodynamics (PK-PD) characteristics of the drugs and minimizing the frequency of patients treated unnecessarily. Furthermore, shortening the duration of therapy and de-escalating once the culture reports are available, can help to optimize and rationalize antibiotic therapy in the ICU.[2] The aim of

this study was to determine the most common microorganisms in the body secretions of patients admitted in our ICU and to estimate antibiotic sensitivities to those organisms.

METHODOLOGY

This cross-sectional observational study was performed at the medical ICU of Jinnah Postgraduate Medical Center, Karachi, from January to February 2019 after approval from the ethical review board. An informed consent was taken from all patients. All patients admitted to the ICU were included via non-probability sampling. Pediatric patients were excluded. Specimens were collected from blood (22.1%), endotracheal secretions (63.2%, n=60), central catheter tips (10.5%, n=10), and urine (4.2%, n=4). Inoculation and incubation were done for 24-48 hours and gram staining was done.

Antibiotic sensitivity was tested by disk diffusion method based on the guidelines of National Committee for Clinical Laboratory Standards.[7] The antibiotics used were penicillins with and without β-lactamase inhibitors (ampicillin, cloxacillin, amoxicillin/clavulanic acid), aztreonam. Aminoglycosides (amikacin, gentamicin, and tobramycin), cephalosporins (ceftazidime, cefixime, cefepime, ceftriaxone, cephradine, cefaclor, cefoperazone/sulbactam), quinolones (ciprofloxacin, levofloxacin, and norfloxacin), carbapenems (imipenem and meropenem), tetracyclines (tetracycline, doxycycline, minocycline), piperacillin/tazobactam, polymixins (polymixin-B and colistin), tigecycline, fosfomycin, co-trimoxazole, chloramphenicol, clindamycin, linezolid, fusidic acid, nalidixic acid, pipemidic acid, nitrofurantoin, erythromycin, and vancomycin. The interpretation was done as susceptible, resistant, or intermediate. The testing technique randomly gave these results and a single patient sample was not tested for all antibiotics.

95 patients were gathered in the assigned duration. Limited information was collected i.e. their age, gender, and the parameters of their culture and sensitivity report

Statistical analysis: Data were analyzed using SPSS version 23.0. Mean and standard deviations were recorded for age, while frequency and percentages for categorical variables including isolated organisms, site of collection, and sensitivity distribution.

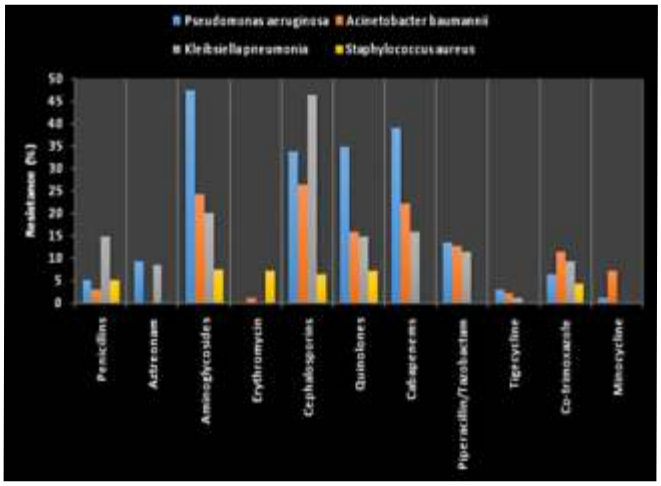
RESULTS

Out of the total of 95 patients, 66 (69.5%) were males and 29 (30.5%) were females. The mean age was 27.37±10 years. Out of 95 cultures, 94 were bacterial and one was of Candida albicans. Bacteria were mostly gram-negative (85.3%, n=81) and the most frequently encountered bacteria were Pseudomonas aeruginosa (34.7%, n=33), Klebsiella pneumoniae (16.8%, n=16), Acinetobacter baumannii (16.8%, n=16), and Staphylococcus aureus (10.5%, n=10), while the less common ones (Table).

Table. Sources of cultured sample and organisms.

Organisms	Total Sample (n=95)	Tracheal secretions (n=60)	Blood (n=21)	Urine (n=4)	Catheter tip (n=10)
Pseudomonas aeruginosa	33 (34.7%)	28	4	0	1
Proteus mirabilis	1 (1.1%)	0	1	0	0
Klebsiella pneumoniae	16 (16.8%)	13	3	0	0
Acinetobacter baumannii	16 (16.8%)	13	3	0	0
Serratia marcescens	1 (1.1%)	0	1	0	0
Candida albicans	1 (1.1%)	0	0	1	0
Staphylococcus aureus	10 (10.52%)	4	3	0	3
Escherichia coli	6 (6.3%)	1	0	3	2
Enterobacter species	5 (5.2%)	0	2	0	3
Morganella morganii	1 (1.1%)	1	0	0	0
Stenotrophonas maltophilia	1 (1.1%)	0	1	0	0
Micrococcus species	1 (1.1%)	0	1	0	0
Corynebacterium diphtheria	2 (2.1%)	0	1	0	1
Streptococcus pneumoniae	1 (1.1%)	0	1	0	0

Figure. Sensitivity to commonly seen organisms.



Pseudomonas aeruginosa was most sensitive to polymixin-B (17.8% sensitive, n=17), followed by piperacillin/tazobactam (15.7% sensitive, 15), amikacin (14.7% sensitive, n=14), and ceftazidime (13.6% sensitive, n=16). Acinetobacter baumannii, colistin (10.5%, n=10) followed by cefoperazone/sulbactam (5.2%, n=5); for Klebsiella pneumoniae, Amikacin and Imipenem had equal sensitivity frequencies (8.4%, n=8), while similar sensitivities were found for cefoperazone/sulbactam and tigecycline (7.3%, n=7). For Staphylococcus aureus, amikacin sensitivity was found in seven patients (7.3%) while five patients (5.2%) were found susceptible each for vancomycin, chloramphenicol, clindamycin, and co-trimoxazole (Figure).

DISCUSSION

In this study, most of the microorganisms were gram-negative and the four most frequently encountered organisms were Pseudomonas aeruginosa, Klebsiella pneumoniae, Acinetobacter baumannii, and Staphylococcus aureus. It is a worldwide practice to use an antibiogram for determining an appropriate empirical antibiotic against a suspected microorganism. However, in developing countries like Pakistan, no good local data is available and antibiotics are prescribed inappropriately in up to 90% patients in the hospital.[8]

Although gram-positive infections are increasing, their higher prevalence in a hospital environment and their increasing resistance to antibiotics is a well-known fact.[9] The most commonly found gram-negative organisms in our ICU were Pseudomonas aeruginosa, Klebsiella pneumoniae, and Acinetobacter baumannii. Similar results were obtained by Radji et al[4] and Al-Jawady et al[9] while Al-Ahmadey et al[10] showed that to be Escherichia Coli (E.coli). In samples collected from trachea and blood in our study, Pseudomonas aeruginosa was the predominant organism. While in other studies, Acinetobacter baumannii and Klebsiella pneumoniae were the most frequent organisms in respiratory tract secretions.[11,12] In urine, E. coli dominated, similar to what other authors.[11,13]

Cephalosporins are amongst the most widely used antibiotics globally.[14] Moreover, there is an extensive usage of cephalosporins and quinolones in our hospital and throughout Pakistan, which might be one reason why there is an increasing resistance to these drugs. The same applies to carbapenems, which is alarming. We found Pseudomonas aeruginosa showed highest resistance to ciprofloxacin (26.3%) and gentamicin (22.1%), while Polymixin-B was considered as the most sensitive antibiotic. Qadeer et al concluded colistin as the most sensitive antibiotic and carbapenems and cefoperazone/sulbactam as the most resistant ones for Pseudomonas aeruginosa.[3] A study reported amikacin as the most sensitive and ceftriaxone as the most resistant antibiotic for this microbe.[4]

The second most common gram-negative organisms in our study i.e. Klebsiella pneumoniae showed highest resistance to 3rd generation cephalosporins and ciprofloxacin (each 14.7%) while amikacin and imipenem had the highest sensitivity. Qadeer et al and Gunjal et al showed high resistance to carbapenems and aminoglycosides.[3,15] Rajan et al,[11] Al-lawati et al[16] and Sheth et al[17] on the other hand, found high sensitivities to carbapenems in their studies. Radji et al had observations similar to our study about cephalosporins and quinolones.[4]

Acinetobacter baumannii, the third important organism in our study was found to be highly resistant to ciprofloxacin (12.6%), carbapenems (12.6% for meropenem and 9.4% for imipenem), and piperacillin/tazobactam (12.6%), while the most sensitive one was colistin. A similar resistance profile was found for carbapenems and ciprofloxacin in previous studies with Acinetobacter baumannii being highly resistant to both.[3,11,18] Tigecycline was the most sensitive antibiotic reported by Hasan et al.[19] High frequency of Acinetobacter baumannii isolated in our setup compared with those of developed countries is because Acinetobacter baumannii is commonly found in water supply of our hospitals and it is a common practice to use this water for flushing and washing hospital equipment.[20]

Our study results cannot be generalized since it's a short sample study conducted in a single tertiary care setup in a short time period. The comorbidities were not taken into account which might be causing the difference in resistance. Other potential confounding factors like age was also not considered. Since this was a cross-sectional study, there was no follow-up of patients affected by different drug-resistant organisms and their outcomes. We did not analyze and compare the organisms with resistance to multiple antibiotics and lack of resistance genotyping is also one of our limitations. A prospective cohort study with larger sample size is required in our setup to have further conclusions.

CONCLUSION

Microorganisms with multidrug-resistance especially gram-negative ones are increasing day by day. A high percentage of resistance to the frequently used antibiotics (cephalosporins, quinolones, and carbapenems) was found in this study. It is inferred that antibiotics prescribed empirically should be according to the locally made and regularly updated antibiogram.

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