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Antimicrobial Sensitivity Pattern in Surgical PatientsAdmitted to Intensive Care Unit, Northwest Region, Kingdom of Saudi Arabia

Ibrahim Albalawi

Associate Professor of Department of Surgery , Faculty of Medicine, University of Tabuk, P.O.Box:4333-Tabuk 71491 Kingdom of Saudi Arabia

Abstract:-Antimicrobial resistance is challenging for the health care professionals especially in intensive care unit. Most of the hospitals in developing countries yet to understand this phenomenon in order to succeed in antimicrobial therapy among the critically ill patients. The present study aimed to investigate the commonly available bacteria in ICU and antimicrobial sensitivity pattern of those bacteria in King Khalid Hospital, Tabuk, Kingdom of Saudi Arabia. The study has recruited 85 surgical patients admitted to intensive care unit (ICU) and bacterial isolation was carried out from their blood samples. Over all, gram negative bacteria is most common isolated in the study site (54%). However, 42% staphylococcus was isolated from the blood culture of the study population. Gram negative bacteria divided into two categories as *enterobacteriaceae* species and *non-enterobacteriaceae*species. *Staphylococcus* species is the most common isolated bacteria found to have higher sensitive to ceftriaxone, aztreonam, amoxicillin-clavulanic acid, colisitin, amikacin, cefepime, nitrofurantoin;however, high resistance was evident tocarbapenemantimicrobials (meropenem, ertapenem, imipenem) and fluroquinolones.Acinetobacter second common isolated bacteria only sensitive to colistin and sulphamethoxazole + trimethoprim antimicrobials. Antimicrobials sensitivity pattern highly differs between *enterobacteriaceae* and non-*enterobacteriaceae* bacteria's. Hence, the careful selection of antimicrobials is recommended in order to succeed in antimicrobial therapy.

Keywords: *Antimicrobials, sensitivity, resistance*.

I. INTRODUCTION

Antimicrobials resistance is a major worldwide problem especially in the intensive care unit (ICU), including in Saudi Arabia. It has been realized that the spread of drug-resistant organisms in the ICU is treated to the widespread use of antimicrobials. The rate of antimicrobial resistance in the ICU is several folds higher than the general hospital setting. Many surveillance efforts have drawn attention to this phenomenon [1-4].

Worldwide, ICUs are faced with increasingly rapid emergence and spread of AM-resistantbacteria because of frequent use of broad spectrum AMs, crowding of patients with high levels of disease acuity in relatively small, specialized areas of the hospital, shortage ofnursing and other supporting staff due to economic pressures (which increases thelikelihood of person-to-person transmission of microorganisms) and the presence of morechronicallyand acutely ill patients who require prolonged hospitalization [5,6].

Healthcare Associated Infections (HAIs) are an important health problem in terms of morbidities, mortalities and economic consequences, worldwide.The most important risk factors for ICU-acquired infections in our study were an ICU stay of more than 7 days, respiratory failure, sedative medication and operation (before or after admission to ICUs). The patients with respiratory failure were the most at risk for ICU-acquired infections [7].Reports were scarce in regard to antimicrobials sensitivity pattern in ICU in Saudi Arabia especially in Northern Province. Therefore, this study aimed to assess the prevalence of bacteria-causing infections in patients in ICU, as well as their antimicrobial resistant patterns in Northern Province, Tabuk, Kingdom of Saudi Arabia.

II. METHODS

A retrospective study conducted at King Khalid Hospital in Tabuk, Kingdom of Saudi Arabia during the period from January to December 2014, following the ethical guidelines for patient data privacy eighty-five blood cultures of adult surgical patients (>18 years old) admitted to the ICU were reviewed. The research was approved by the ethical committee of the King Khalid Hospital, Tabuk, Kingdom of Saudi Arabia.

Data pertaining to all microbial isolates and their antimicrobials susceptibility data were retrospectively collected and entered into the Microsoft Excel Database. The data were analyzed separately for the predominant Gram-negative isolates including enterobacteriaceae(*Escherichia coli [E. coli], serratia*species*(spp),*enterobacterspp, salmonella spp, proteusspp.*P. aeroginosa,Acinetobacterspp*) andother non-enterobacteriaceae gram-negative bacteria (*Acinetobacterspp, klebsiellaspp, pseudomonas*

spp,achromobacterspp.) and gram positive isolates (*Staphylococcus spp and enterococcus spp*).
Bacterial isolation according to morphology followed according to Benson *et al*., 1994. Antimicrobials sensitivity was ascertained using the standard disc diffusion method according to the National Committee for Clinical Laboratory Standard (NCCLS, 2000). The Vitex 12, Phoenix, and Micro scans were used [8].

III. RESULTS

Out of 85 isolated blood culture samples at the intensive care unit, King Khalid Hospital, Tabuk, KSA January to December 2014, represents equal gender distribution (Male 43; Female 42). Gram-negative bacteria's commonly present among the isolated samples (n=46) followed by gram-positive bacteria's (n=39). Among the Gram-negative bacteria's, we observed the equal distribution of enterobacteriaceae (n=23) and other than enterobacteriaceae (non-enterobacteriaceae) *spp* (n=23). Enterobacteriaceae*spp* including *E.coli* (8), *serratia* (6), *enterobacter* (6), *salmonella* (2) and *proteus* (1) *spp* were observed in the isolated blood culture. *Acientobacter* (12), *klebsiella* (7), *pseudomonas* (2), *achromobacter* (2) were the non-enterobacteriaceae*spp* observed among the culture. Gram -positive bacteria's including *staphylococcus spp* (n=36) and *enterococcusspp* (n=3) also found in isolated blood culture. (**Table 1**).Sensitivity pattern of antimicrobials was studied among the above said isolated cultures. Ceftriaxone, aztreonam, amoxicillin-clavulanic acid, colisitin, amikacin, cefepime, nitrofurantoin were found to have highly sensitive and the remaining antimicrobialss found to have highly resistant to *staphylococcus spp*. However, Penicillin antimicrobialss (Ampicillin, amoxicillin-clavulanic acid and piperacillin-tazobactum) found to have sensitive and the remaining antimicrobialss found to have resistant to *enterococcus spp*. (**Table 2**)
Table 3 reveals the sensitivity pattern of gram negative enterobacteriaceae*spp* shows that carbapenemantimicrobialss (Ertapenem, imipenem, meropenem) shows high sensitivity and remaining antimicrobialss shows moderate–to-high resistant to all enterbacteriaceae*spp*. Gentamycin and ceftazidime sensitive to *E.coli, serratia, enterobacter* and salmonella *spp*; however, cefoxitin, ceftriaxone, cefepime and amoxicillin-clavulanic acid were sensitive to *proteusspp*.
The present study was attempted to investigate the sensitivity pattern on non-enterobacteriaceae*spp* reveals that colistin and septrin were found to have sensitive to *Acientobacter, pseudomonas* and *achromobacterspp*; however, aminoglycosides and carbapenemantimicrobialss found to have greater sensitivity to *klebsiellaspp*. Cephalosporins, fluroquinolones and pencillin antimicrobials show high resistant to non-enterobacteriaceae*spp*. (**Table 4**)

IV. DISCUSSION

54% of isolated culture formed Gram-negative bacteria in the present study and this finding is substantiated by the various ICU studies reports published previously [9,10,11,12]. Gender was not a risk factor for infection and mortality in the present study, as it was in other studies [12-13].The most common isolate among the blood culture is staphylococci spp, which is approximately 42% of isolates. The result coincides with previous results of Fridkin et al [14] and Nermin KS et al (10). Ceftriaxone, aztreonam, amoxicillin-clavulanic acid, colisitin, amikacin, cefepime, nitrofurantoin were found to have high sensitivity; however, highresistance is observed with carbapenemantimicrobialss and fluroquinolones (50%) which are consistent with the previous report having 68% from Saudi Arabia [15].

Non-enterobacteriaceae bacteria's including *Acientobacter*, *klebsiella*, *pseudomonas*, *achromobacter* found to have higher resistant to all antimicrobialss and this is also consistent with the previous report which indicates a very high rate of multidrug resistance (MDR) in Saudi Arabia [15] and the study carried out inthe USA between 1993 to 2004 [16]. It is emphasized that the increased incidence of MDR among ICU patients may be due to reasons, such as prior antimicrobial use, inadequate antimicrobial therapy, and long antimicrobial exposures that exert antimicrobial pressures that lead to the emergence of resistance in a previously susceptible GN bacterium [15]. Interestingly, colistin and sulphamethoxazole + trimethoprim are found to have moderate to high sensitivity to above said non-enterobacteriaceaegram negative bacteria's. Therefore, the emphasized the physicians to manage the gram negative infection with colistin and sulphamethoxazole + trimethoprim like drugs which also known cost effective.

Comparison of the sensitivity pattern for *E. coli* in our study shows carbapenemantimicrobialss (Ertapenem, imipenem, meropenem), amikacin, gentamicin, ceftazidimeand amoxicillin-clavulanic acid found to have higher sensitivity and the remaining antimicrobialss had moderate sensitivity in the present study. On the other hand, colistin is the only antimicrobials shows 100% resistance to E.coli, which is consistent with the result of the previous study [17]. *Enterobacter* is sensitive to carbapenemantimicrobialss (Ertapenem, imipenem, meropenem), amikacin, gentamicin, ceftazidime, piperacillin-tazobactum, septrin, nitrofurantoin, ciprofloxacin etc. *Serratia* is highly sensitive to most of the antimicrobialss except cephalothin, cefuroxime, cefoxitin, ampicillin, amoxicillin-clavulanic acid, colistin. Nitrofurantoin etc. On the contrary, serratia has 100% sensitivity to ceftriaxone in our study and resistance has reported in the previous study [18].

We present this data as an observation of the trends in antimicrobial susceptibility patterns over twelve months period in the ICU of our study site. We hope that this data will be useful to healthcare professionals in order to decide and/or update the antimicrobials policy in the concerned hospital and region. We believe the continuous surveillance is needed to achieve successful antimicrobial therapy in ICU.

V. LIMITATIONS OF THE STUDY

Antimicrobials disc sensitivity test results may vary withthe hospital setting, while infection rate in a hospital may depend on the hospital environment, antimicrobials use and other infection control practices. All these would limit the applicability of the findings of this study to other hospital settings.

VI. CONCLUSION

Staphylococcus spp is the commonly isolated bacteria found to have higher resistance to carbapenemantimicrobialss (meropenem, ertapenem, imipenem) and fluroquinolones.Acinetobacter second common isolated bacteria only sensitive to colistin and sulphamethoxazole + trimethoprim antimicrobials. Antimicrobials sensitivity pattern highly differs between enterobacteriaceae and non-enterobacteriaceae bacteria's. Hence, the careful selection of antimicrobials is recommended in order to succeed in antimicrobial therapy.

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Table 1 Distribution of gram-positive and gram-negative bacteria's among the isolated blood culture

Bacteria type	No. of isolated blood culture
Gram Positive	
Staphyloccus	36
Enterococuus	3
Gram Negative	
Enterobatericea	
E.Coli	8
Enterobacter	6
Serratia	6
Salmonella	2
Proteus	1
Non-Enterobatericea	
Acinobacter	12
Klebsiella	7
Pseudomonas	2
Acromobacter	2

Table 2 Antibiotic sensitivity pattern of gram-positive *spp*

Antibiotic	*Staphyloccus*			*Enterococuus*		
	S	**I**	**R**	**S**	**I**	**R**
Amikacin	27	3	6	0	0	3
Gentamicin	1	32	3	0	0	3
Ertapenem	8	27	1	0	0	3
Imepenem	13	20	3	0	0	3
Meropenem	17	1	18	0	1	2
Cephalothin	16	13	7	0	2	1
Cefuroxime	12	20	4	0	2	1
Cefoxitin	11	24	1	0	3	0
Ceftazidime	15	16	5	1	2	0
Ceftriaxone	29	2	5	1	0	2
Cefepime	27	2	7	1	2	0
Aztreonam	29	3	4	0	3	0
Ampicillin	17	16	3	3	0	0
Amoxicillin-clavulanic acid	29	4	3	2	0	1
Piperacillin-tazobactum	20	12	4	2	1	0
Colistin	28	0	8	0	2	1
Septrin	10	19	7	1	0	2
Nitrofurantoin	27	0	9	0	0	3
Ciprofloxacin	5	5	26	1	0	2
Levofloxacin	22	12	2	0	3	0

S- Sensitive; I – Intermediate resistant; R- Resistant.

Table 3 Antibiotic sensitivity pattern of gram-negative enterobacteriaceae*spp*

Antibiotic	*E.Coli*			*Serratia*			*Enterobacter*			*Salmonella*			*Proteus*		
	S	**I**	**R**	**S**	**I**	**R**	**S**	**I**	**R**	**S**	**I**	**R**	**S**	**I**	**R**
Amikacin	6	1	1	6	0	0	6	0	0	0	1	1	0	1	0
Gentamicin	6	1	1	6	0	0	6	0	0	1	1	0	0	1	0
Ertapenem	4	3	1	6	0	0	6	0	0	2	0	0	1	0	0
Imepenem	7	0	1	6	0	0	6	0	0	2	0	0	1	0	0
Meropenem	7	1	0	6	0	0	6	0	0	2	0	0	1	0	0
Cephalothin	2	5	1	0	6	0	0	0	6	1	0	0	0	1	0
Cefuroxime	3	5	0	0	6	0	0	0	6	1	0	0	0	1	0
Cefoxitin	6	1	1	0	6	0	0	0	6	2	0	0	1	0	0
Ceftazidime	7	1	0	6	0	0	6	0	0	2	0	0	0	0	1
Ceftriaxone	3	4	1	6	0	0	0	0	6	2	0	0	1	0	0
Cefepime	4	4	0	6	0	0	6	0	0	2	0	0	1	0	0
Aztreonam	4	3	1	6	0	0	0	0	6	2	0	0	0	1	0
Ampicillin	3	4	1	0	6	0	0	2	4	2	0	0	0	1	0
Amoxicillin-clavulanic acid	7	0	1	0	6	0	0	6	0	1	0	1	1	0	0
Piperacillin-tazobactum	6	0	2	6	0	0	4	2	0	0	1	1	0	1	0
Colistin	0	2	6	0	6	0	0	0	6	1	0	1	0	1	0
Septrin	3	4	1	6	0	0	6	0	0	1	0	1	0	1	0
Nitrofurantoin	4	2	2	0	6	0	4	0	2	0	1	0	0	1	0
Ciprofloxacin	3	4	1	6	0	0	6	0	0	0	1	0	0	0	1
Levofloxacin	4	2	2	6	0	0	0	0	6	0	1	0	0	1	0

S- Sensitive; I – Intermediate resistant; R- Resistant.

Table 4 Antibiotic sensitivity pattern of gram-negative non-enterobacteriaceae*spp*

Antibiotic	*Acinetobacter*			*Klebsiella*			*Pseudomonas*			*Acromobacter*		
	S	**I**	**R**	**S**	**I**	**R**	**S**	**I**	**R**	**S**	**I**	**R**
Amikacin	0	10	2	7	0	0	2	0	0	0	0	2
Gentamicin	2	9	1	3	4	0	1	0	1	0	2	0
Ertapenem	0	7	5	7	0	0	0	0	2	0	0	2
Imepenem	0	1	11	7	0	0	0	1	1	2	0	0
Meropenem	0	9	3	7	0	0	1	0	0	2	0	0
Cephalothin	1	5	6	0	7	0	0	0	2	0	0	2
Cefuroxime	0	5	7	0	7	0	0	0	2	0	0	2
Cefoxitin	1	5	6	4	3	0	1	1	0	0	0	2
Ceftazidime	0	11	1	2	4	1	0	0	2	2	0	0
Ceftriaxone	0	5	7	1	6	0	1	0	1	0	2	0
Cefepime	0	10	2	0	5	2	2	0	0	0	2	0
Aztreonam	1	5	6	0	5	2	0	2	0	0	2	0
Ampicillin	0	11	1	0	7	0	0	1	1	0	0	2
Amoxicillin-clavulanic acid	1	10	1	1	5	0	1	0	1	0	2	0
Piperacillin-tazobactum	1	7	4	4	2	1	2	0	0	2	0	0
Colistin	9	1	2	1	0	6	1	1	0	2	0	0
Septrin	9	3	0	1	6	0	1	1	0	2	0	0
Nitrofurantoin	1	11	0	1	4	2	2	0	0	0	2	0
Ciprofloxacin	0	12	0	1	4	2	1	0	1	0	2	0
Levofloxacin	0	4	8	2	5	0	0	0	2	0	0	2

S- Sensitive; I – Intermediate resistant; R- Resistant.