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Research Article

ANALYSIS OF DRUG RESISTANCE BACTERIA IN RESPIRATORY ICU

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ABSTRACT

Purpose: This study was performed to analyze the drug resistance bacteria in respiratory ICU of the 1st affiliated Hospital of Yangtze University from September 2015 to August 2016.

Background: Bacterial infections are the notorious organism responsible for the mortality of the patient in respiratory ICU. Each year nearly 2 million patient in the United States get an infection in a hospital. About 90,000 die as a result of their infection. More than 70% of the bacteria that cause hospital-acquired infections are resistant to at least one of the drugs. Persons infected with drug-resistant organisms are more likely to have longer hospital stays and require treatment with second- or third-choice drugs that may be less effective, more toxic, and/or more expensive. The study of prevalence and incidence of bacterial infections and their antibiotic-resistance pattern would be a novel idea for their treatment and management in Respiratory ICU.

Materials and Methods: A retrospective cohort study research as performed. Careful reviewing of records of all patients admitted in Respiratory ICU of the first affiliated hospital of Yangtze University of 12 months. Data about nosocomial infections in Respiratory ICU were gathered during September 2015 to August 2016. We analyzed 1500 samples of blood, CSF, BAL, Sputum, pleural and urine from 1000 patients hospitalized in Respiratory ICU of Jingzhou number 1 people's hospital who were admitted for more than 48 hours in the hospital. Depending on the infection sites, different samples were taken from each patient.

Result: Out of all 320 culture positive patients, 220 cases (68.75%) were male and 100 cases (31.25) were female. Out of 320 patients, 78.12% of people were more than 50 years old with mean age of 57 ± 29. The most common sites of nosocomial infection was sputum culture with 118 cases (36.87%),followed by blood culture 92 cases (28.75%), urine culture 58 cases(18.12%), BAL 48 cases(15%), CSF culture 3 cases(0.93%) and the least being pleural fluid culture 1 case (0.3%). The most prevalent organism in our study revealed

that Pseudomonas aeruginosa (29.68%), Klebsiella Pneumonia (21.56%), E. coli (13.43%), Acinetobacter(15.31%), MRSA(6.25%), Staph. Aureus(5.31%), streptococcus Spp(3.75%), Entrococcus Spp(2.81%) & Proteus(1.87%) . Diabetes and Hypertension were the main co morbid factor among the culture positive patients having, diabetes plus HTN combined being the most prevalent with (43.75%), diabetes (25%), HTN (9.375%), CRF (9.375%) and without co morbid condition as (12.5%) shown in table4. The overall culture positive in our RICU revealed (21.33%). The antibiotic-resistance of each bacterium in RICU was assessed and data were categorized. Antibiotic resistance of Gram-positive microorganisms isolated from infections in our ICU shows the Vancomycin having least resistivity percentage and Penicillin being the most resistant antibiotic. Antibiotic resistance Pattern of Gram-negative microorganisms isolated from infections in our ICU revealed the least resistant drug being Amikacin and the highest resistivity was observed in the Piperacillin –Tazobactum.

Conclusion: The resistance of bacteria in this world is increasing day by day and even the novel drugs are unable to treat these resistant bacteria. This study clearly showed that the organisms in the respiratory ICU are mostly resistant to multiple drugs. The prevalence of gram negative bacteria was very high in comparison to the gram positive organisms isolated in RICU. This figure will lead to increase mortality with expenditure of more money and prolong hospital stay. Pseudomonas was the most common drug resistant bacteria overall and it is worthwhile following evidence based guidelines. The random use of antibiotic is leading to the notorious drug resistance; hence, the antibiotics should be used according to rationale even empirically.

It was performed via performing endnote X7, SPSS, T test and The P-Value is < .0005. Where, the result is significant at $p < .05$.

Key words: Antibiotic resistance, nosocomial infection, BAL, Gram Positive, Gram Negative.

INTRODUCTION

Healthcare Associated Infections (HAIs) are an important health problem in terms of morbidities, mortalities and economic consequences, world-wide (Meric et al., 2005). They are especially important in intensive care units (ICUs) where they have a five-fold higher incidence rate compared to the general inpatient population (Ewans et al., 1999). This is due to the increased use of medical instruments such as mechanical ventilators, monitoring devices, blood and urine catheters and also high resistance of the microorganisms isolated from ICUs patients to most commonly used antibiotics, which in turn is a result of overt use of broad-spectrum antibacterial agents (Wenzel et al., 1983). Pseudomonas aeruginosa and Enterobacteriaceae species are the major cause of HAIs, associated with significant morbidity and mortality. They are also subjected to multi-drugs resistance (Carmeli et al., 1999). Approximately 2 - 10% of P. aeruginosa are resistant to all available treatments (Carmeli et al., 1999; Babay, 2007). The most common HAIs in ICUs include Urinary Tract Infections (UTIs), bacteremia and pneumonia (Richards et al., 2000), the

latter being the leading cause of death in ICUs patients (Vincent et al., 1995; Eggimann and Pittet, 2001). Because of importance of HAIs, it is critical to conduct surveillance studies to obtain the required data about the prevalence of regional microorganisms and their susceptibility to antibiotics. This study is aimed to provide such information for our clinicians.

MATERIALS AND METHODS

In this cohort study, from September 2015 to August 2016, we collected 1500 specimens from 1000 patients with criteria of HAIs infection, admitted in the intensive care unit of pulmonary department of first affiliated hospital of Yangtze University of China. Clinical specimens included Sputum, blood, urine, CSF and pleural fluid, were collected and cultured on Eosin Methylen Blue (EMB), Blood agar, chocolate agar, thioglycollate and Trypticase Soy broth (TSB) media and incubated at 37°C for 24 - 48 h. Thioglycollate cultures and TSB bottles were reincubated for at least 7 days and sub cultured on EMB and blood agar or chocolate agar plates, as necessary. The pathogenic isolates were identified by Gram staining, biochemical reactions and diagnostic tests included catalase, tubecoagulase and Manitol Salt agar in order to identify Staphylococcus aureus from Coagulase Negative Staphylococci (CoNS). Antibiogram pattern of microorganisms was determined by Kirby Bauer method on Mueller Hinton agar medium (Baily and Scott, 1990). Results were recorded according to the standards provided by National Committee for Clinical Laboratory Standards (NCCLS, 2003) Table 1and graph1. The study protocol was approved by research ethics committee of Jingzhou number 1 people's hospital and each patient's family gave informed consent before enrollment the study. The data was analyzed using Statistical Package for the Social Sciences (SPSS).

Inclusion criteria:

1. All the patients with clinically suspected infections after 48 hours of admission in Respiratory ICU.
2. All the people who were more than 15 years old.

Exclusion criteria:

1. All patients who were admitted in respiratory ICU for less than 48 hours
2. All the patients who were less than 15years old
3. Patients who were discharged or died before 48 hours of admission were excluded from study.

Research methods and tools:

Questionnaire and image interpretation form was established and taken with care and consent.

Statistical Methods and Data analysis:

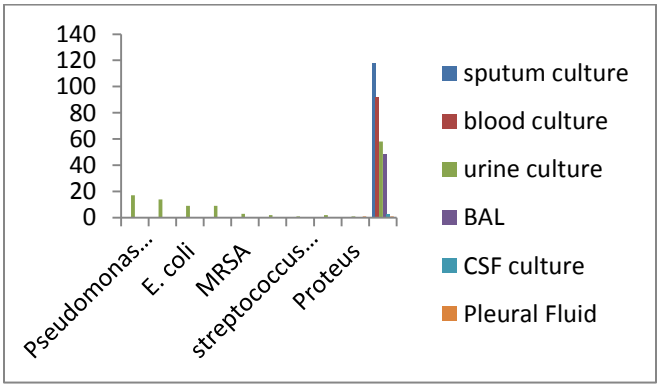
1. Diagnostic evaluation via: Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, T-test and Chi square test.
2. All the data were entered and analyzed through Statistical Package for Social Science [SPSS].
3. References and bibliography were maintained by using Endnote X7

RESULTS

From the total 1500 specimens obtained, Out of all 320 culture positive patients, 220 cases (68.75%) were male and 100 cases (31.25%) were female. Out of 320 patients, 78.12% of people were more than 50 years old with mean age of 57 ± 29. The most common sites of nosocomial infection was sputum culture with 118 cases (36.87%), followed by blood culture 92 cases (28.75%), urine culture 58 cases(18.12%), BAL 48 cases(15%), CSF culture 3 cases(0.93%) and the least being pleural fluid culture 1 case (0.3%) as shown in table1 & graph1. The most frequent microorganisms derived from samples included P. aeruginosa (29.68%), Klebsiella spp (21.56%), Acinetobacter spp (15.32%), Escherichia coli (13.43%), MRSA (5.6%), S. aureus (5.31%)), Streptococcus (3.75%) and Entrococcus Spp(2.81%) & Proteus (1.87%). Diabetes and Hypertension were the main co morbid factor among the culture positive patients having, diabetes plus HTN combined being the most prevalent with (43.75%), diabetes (25%), HTN (9.375%), CRF (9.375%) and without co morbid condition as (12.5%) as shown in table 4. The overall culture positive in our ICU revealed (21.33%). The antibiotic-resistance of each bacterium in ICU ward was assessed and data were categorized. Antibiotic resistance of Gram-positive microorganisms isolated from infections in our ICU shows the Vancomycin having least resistivity percentage and Penicillin being the most resistant antibiotic. Antibiotic resistance Pattern of Gram-negative microorganisms isolated from infections in our ICU revealed the least resistant drug being Amikacin and the highest resistivity was observed in the Piperacillin –Tazobactum shown in Table 2 and table 3.

Microorganism	sputum culture	blood culture	urine culture	BAL	CSF culture	Pleural Fluid	
Pseudomonas aeruginosa	35	28	17	14	1	0	
Klebsiella Pneumonia	25	20	14	10	0	0	
E. coli	16	10	9	7	1	0	
Acinetobacter	18	14	9	8	0	0	
MRSA	8	6	3	3	0	0	
Staph. Aureus	6	6	2	3	0	0	
streptococcus Spp	5	4	1	2	0	0	
Entrococcus Spp	3	2	2	1	1	0	
Proteus	2	2	1	0	0	1	
Total	118(36.87%)	92(28.75%)	58(18.12%)	48(15%)	3(0.93%)	1(0.3%)	

Table1: Distribution of different organisms in different samples.



Graph 1: Showing the distribution of different organisms in different samples.

Organism	MRSA	Staph aureus	Streptococcus pneumonia	enterococci	Total
vancomycin	6%	10%	12%	30%	14.5%
– nitrofurantoin	98%	98%	99%	100%	98.7%
co-trimoxazole	100%	98%	89%	99%	96.5%
amikacin	89%	92%	91%	94%	91.5%
tetracycline	93%	90%	94%	92%	92.25%
ciprofloxacin	100%	99%	98%	99%	99%
meropenem	80%	87%	86%	90%	85.75%
cefotaxime	100%	97%	98%	98%	98.25%
cefepime	100%	100%	98%	99%	99.25%
cephalexin	100%	99%	99%	100%	99.5%
clindamycin	80%	89%	85%	83%	84.25%
Tigecycline	45%	50%	70%	75%	60%
Ceftriaxone	100%	100%	99%	99%	99.5%
Moxifloxacin	89%	92%	98%	90%	92.25%
imipenem	70%	76%	75%	78%	74.75%
Linezolid	40%	34%	38%	50%	40.5%
Penicillin	100%	100%	100%	99.9%	99.97%
Erythromycin	100%	100%	99%	99%	99.5%
Chloramphenicol	98%	96%	97%	100%	97.75%

Table2: Antibiotic resistance pattern of gram-positive microorganisms isolated from infections in RICU (N =64)

Organism	Pseudomonas	Klebsiella	Acinetobacter	E. coli	Proteus	Total
vancomycin	30%	40%	80%	88%	78%	63.2%
nitrofurantoin	92%	95%	98%	99%	98%	96.4%
co-trimoxazole	91%	56%	89%	99%	98%	86.6%
amikacin	70%	40%	60%	70%	72%	62.4%
tetracycline	95%	60%	90%	92%	99%	87.2%
ciprofloxacin	100%	90%	95%	98%	99%	96.4%
Meropenem	92%	70%	80%	90%	96%	85.6%
cefotaxime	97%	76%	90%	98%	97%	91.6%
cefepime	92%	70%	90%	89%	92%	86.6%
cephalexin	91%	75%	89%	94%	90%	87.8%
clindamycin	91%	65%	95%	97%	87%	87%
Tigecycline	60%	60%	86%	88%	86%	76%
Ceftriaxone	91%	71%	94%	98%	99%	90.6%
Moxifloxacin	95%	71%	90%	90%	96%	88.4%
imipenem	70%	40%	50%	70%	89%	63.8%
piperacillin-tazobactam	100%	100%	99.6%	100%	99.7%	99.86%
nalidixic acid	100%	100%	99%	100%	99%	99.6%
ampicillin	95%	89%	90%	96%	98%	93.6%
metrondiazole	98%	98%	98%	99%	98%	98.2%
ceftazidime	100%	98%	99%	95%	97%	97.8%
Chloramphenicol	100%	99%	97%	96%	99%	98.2%

Table 3: Antibiotic resistance Pattern of Gram-negative microorganisms isolated from infections in RICU (N=256)

Disease	Diabetes plus Hypertension (43.75%) N=140	HTN(9.375%), n=30	CRF (9.375%) n=30	diabetes(25%) n=80	without co morbid(12.5%) n=40
Pseudomonas	41	10	10	23	11
Klebsiella	30	6	6	17	10
Acinetobacter	21	4	4	14	6
E.coli	19	4	4	11	5
Proteus	3	1	1	1	0
Staph aureus	7	2	2	4	2
Streptococcus	5	1	1	3	2
Enterococci	4	1	1	2	1
MRSA	10	1	1	5	3
Total	140	30	30	80	40

Table 4: Prevalence of organism according to co morbid condition

DISCUSSION

This study provides an analysis of epidemiology of the hospital acquired infections in the ICU patients of a Respiratory department of Jingzhou number 1 hospital in China. Consistent with other studies, Respiratory cause was the leading form of infection in the subjects of our study. Pseudomonas spp is the number one cause of HAI based on samples gathered from the Sputum and BAL and shows 100% resistance to Piperacillin-Tazobactum and nalidixic acid. Several studies have investigated the risk factors of hospital acquired pneumonia (HAP). These include age, gender and a history of prior hospitalization, chronic obstructive pulmonary disease, reintubation, coma, steroid treatment, intra-aortic balloon counter pulsation, prior antibiotics and intermittent positive-pressure ventilation hours (Pawar et al., 2003; Erbay et al., 2004). A recent study suggested that further advancements in development of risk models for HAP are required (Wolkewitz et al., 2008). From amongst the 320 culture positive patients that were in our study, 51.87 percent were related to the respiratory system which was consistent with the results of Jamshidi et al.'s (2007) study (respiratory tract 54.2%) and the which is similar to the study (Dasgupta, et al,2015) a public tertiary teaching hospital of Eastern India which shows Pneumonia was the most frequently detected infection (62.07%). Gram negative drug resistance bacteria(80%) were common in comparison to the gram positive bacteria(20%) in our ICU which is similar to the study conducted in a tertiary hospital of India((Ghanshani, et al.2015) where Gram positive organisms were 28% and the gram negative bacteria was 72%). Antibiotic resistance of Gram-positive microorganisms isolated from infections in our ICU shows the Vancomycin having least resistivity percentage and Penicillin being the most resistant antibiotic. Antibiotic

resistance Pattern of Gram-negative microorganisms isolated from infections in our ICU revealed the least resistant drug being Amikacin and the highest resistivity was observed in the Piperacillin –Tazobactum. The length of stay will increase in drug resistance bacteria with high expenditure. Thus, drug resistant bacteria needs to be treated with evidence based guidelines and following the preventive guidelines to prevent drug resistance. Diabetes plus Hypertension was the main co morbid factor, hence, it should be taken care closely. Pseudomonas was the main drug resistance bacteria, however, most of the recent articles had shown the main drug resistant bacteria in ICU as Acinetobacter. So, the further study on this topic adds the value. This figure will lead to increase mortality with expenditure of more money and prolong hospital stay. Since, the infection is only disease that can be cured but unfortunately due to resistance of these drugs, the outcome of treatment will be hampered and will lead to increase morbidity and mortality. Moreover, according to the results, the respiratory system more than other organs is prone to nosocomial infections caused by resistant bacteria. Therefore, attention to methods which control the respiratory infections in the RICU may help prevent the spread of nosocomial infections. The studies indicated that Amikacin and Tobramycin is the most effective antibiotic in positive- gram bacteria and Methicillin is the most effective antibiotics when it comes to negative-gram bacteria. It is therefore a wise idea to use these antibiotics for controlling and fighting these drug resistance bacteria. On the other hand, taking into consideration the possibility that the resistant genes may transfer to other bacteria, also high resistance levels which were observed in the present study, the health authorities must pay more attention to planning and carefully supervising control over the nosocomial infections and utilizing accurate and effective treatment protocols for the purposes of eliminating the drug-resistant microorganisms.

CONCLUSION

The resistance of bacteria in this world is increasing day by day and even the novel drugs are unable to treat these resistant bacteria. This study clearly showed that the organisms in the respiratory ICU are mostly resistant to multiple drugs. The prevalence of gram negative bacteria is very high in comparison to the gram positive organisms isolated in RICU. This figure will lead to increase mortality with expenditure of more money and prolong hospital stay. Since, the infection is only disease that can be cured but unfortunately due to resistance of these drugs, the outcome of treatment will be hampered and will lead to increase morbidity and mortality. According to the examinations carried out in the present study, the male patients and also the group aged over 50 years of age are the most vulnerable groups among the patients hospitalized in the Respiratory ICU. Pseudomonas being the main culprit and the drug resistant had taught us for the use of rationale antibiotics. Overall, the study favors to follow the evidence based guidelines as well as it strongly suggest us against the random use of antibiotics. Who knows later on there will be a scarcity of antibiotics and Infectious disease could turns out to be a killer disease in the world. According to the examinations carried out in the present study, the male patients and also the group aged over 50 years of age are the most vulnerable groups among the patients hospitalized in the RICU. The nosocomial infections caused by resistant

bacteria is greater in the summer in ICUs rather than in other seasons, which must be further studied. The present research indicates that Pseudomonas aeruginosa is the most common pathogen which is resistant to multiple drugs and is, in fact, very important when it comes to the spread of nosocomial infections. This important matter must therefore be noted when treating infections that are caused by it so that this process will decrease to the minimum. It is also mandatory to prescribe antibiotics according to evidence based guidelines, to which bacteria have multiple and high resistance. This study revealed the prevalence of drug resistance bacteria is rising and it is especially very notorious along with co morbid condition. The gram negative bacteria being the number one cause i.e. Pseudomonas aeruginosa. Cultures are the backbone to decrease the drug resistance as it can lead towards the accurate treatment. This study will help the Physician to choose the right path to prevent the disaster called drug resistance and help the patient by providing the suitable antibiotic.

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