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Antimicrobial resistance pattern of bacteria isolated from ICU patients with respiratory tract infections: A prospective, observational study

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Abstract
Aim: The aim of this study to analyzed antimicrobial Resistance Pattern of Bacteria Isolated from ICU Patients with Respiratory Tract Infections.
Materials and Methods: This was a prospective, observational study conducted in the Department of Anaesthesiology, Metro Hospital and Cancer Research Center, Jabalpur, Madhya Pradesh, India. A total of 200 samples (Sputum, Pleural fluid, Pus, IT-Tube sample, Bronchial swab, Respiratory swab) of RTI patients were collected from from Respiratory ICU. For identification of different microorganisms selective media were used in this study. Isolate the microorganisms with the help of primary and secondary identification and antibiotic sensitivity were performed.
Results: Majority of the patients was male 62.5% and rest 37.5% was female. Gram negative organisms are detected in (67%), Gram positive organisms detected (22%), and no organism detected (11%) of the swab samples.
Conclusion: Piperacillin-tazobactam was the most common antibiotic prescribed to patients with respiratory infection admitted to ICU. More than half of patients had resistance to the empirical antibiotic used in our ICU, highlighting the need for antibiogram for each ICU. Most of the patient had prior antibiotic use and had mainly gram negative organisms with high resistance to commonly used antibiotics.

Keywords: antibiotic resistance, mortality, pneumonia, respiratory infection

Introduction

Respiratory tract infection (RTI) has been known to be a major health problem for mortility and morbidity since many years. Still now it is one of the major causes of morbidity and mortality in the developing countries including Bangladesh. RTI is defined as any infectious disease of the upper or lower respiratory tract. Upper respiratory tract infection (URTI) includes the common cold, laryngitis, pharyngitis, tonsillitis, rhinitis, rhino sinusitis and otitis media. Lower respiratory tract infection (LRTI) includes acute bronchitis, bronchiolitis, pneumonia and tracheitis. Some of the causative agents of RTI are P. aeruginosa, S. aureus, S. pyogenes and K. pneumonia, E. coli, Citrobacter, H. influenza, M. tuberculosis etc. 1Seven deaths out of ten less than 5 years old children were reported for RTI in the developing countries. National family health survey (NFHS) revealed that two weeks before the survey 6% of under 5 children had symptoms of an RTI (cough, short and rapid breathing). Out of these children, 69% were taken to a health facility or health provider for treatment. An average adult has 2-4 episodes per year and a child has 6-8 episodes of RTI per year [1] Different antibiotics are used to treat RTI like any other infectious diseases. A study record of 150 RTI patients at a Primary Health Complex in Bangladesh from January 2009 to June 2009, showed that, the highest prescribed antibiotic was ceftriaxone (30.19%) followed by cefixime (18.87%), and amoxycillin (16.98%). [2] Antibiotics are commonly prescribed in treating common respiratory tract infections even with viral etiology. As there is difficulty in establishing bacterial etiology at the time of prescription, antibacterial therapy of RTI is usually empirical considering the presence of risk factors and severity of disease [3]. Now a days, the inappropriate or misuse of antibiotics has become a threat worldwide because the number of antibiotic resistant bacteria is increasing day by day. These are not responding to the conventional antimicrobial agents and for that reason, physicians are looking for new antibacterial agents. Critically ill patients admitted in intensive care units (ICUs) are always at a higher risk of developing infections with various antibiotic resistant organisms. The patients in the ICU have a 5 to 7 fold higher risk of a nosocomial infection compared to the average patient and 20–25% of all nosocomial infections develop in ICUs [4]. Antibiotic resistance is emerging as an important public health issue [5, 6] and overuse of antibiotics by physicians has been implicated as contributing to the problem.[7,8] More than one-third of all antibiotics prescribed for respiratory infections are because of sore throat,1 and one in two patients presenting to their general practitioner (GP) with these symptoms receive antibiotics [9, 10].

Meta-analysis of randomized controlled trials of antibiotics for sore throat have shown that they only provide a small reduction in symptom severity and duration (1 day).[11] Survey studies have shown that 1 in 5 patients taking broad-spectrum antibiotics and 1 in 12 taking narrow-spectrum antibiotics suffer side effects such as a rash or gastrointestinal upset [12-16].

As RTI and its outcome are very alarming, the aim of this study was to observe the severity of RTI cases among the adult and child population of our country. This research work was conducted with a view to identify the frequent organisms that are responsible for the RTI and characterize the isolated organism as per their antibiotic sensitivity and resistance pattern. Also, the objective was to find a better treatment of the infections against those organisms which

have already become multidrug resistance.

Materials and methods

Study Design

This was a prospective, observational study conducted in the Department of Anaesthesiology, Metro Hospital and Cancer Research Center, Jabalpur, Madhya Pradesh, India, after taking the approval of the protocol review committee and institutional ethics committee.

Methodology

A total of 200 samples (Sputum, Pleural fluid, Pus, IT-Tube sample, Bronchial swab, Respiratory swab) of RTI patients were collected from Respiratory ICU. The samples were carefully and aseptically transferred to the laboratory for further examinations. The collected samples were cultured in nutrient agar media and stored at 2-8 ◦C for further examinations. For identification of different microorganisms selective media were used in this study. For example, blood agar was used to identify Streptococci sp MacConkey agar for E. coli, Klebsiella sp. and Pseudomonas sp., mannitol salt agar for Staphylococci sp. and Salmonella Shigella agar for Shigella sp.

Biochemical test

Biochemical test is necessary for specific identification of isolated microorganisms. Under this section, Catalase test, triple sugar ion agar test, citrate utilization tests, optochin susceptibility and bile solubility tests were done.

Antibiotic susceptibility test

Antibiotic susceptibility test of isolates on commonly used antibiotics were performed on Muller-Hinton agar medium by disk diffusion technique according to Clinical Laboratory Standard Institute (CLSI) guidelines (NCCLS 1997). Paper disks were impregnated with antibiotics such as Ciprofloxacin, Amikacin, Piperacillin / tazobactam, Benzyl Penicillin, levofloxacin, Azithromycin and Tetracycline, Amikacin and Meropenem incubated at 37°C for 24 hours. After defined incubation period, the diameter of the zones of inhibition were measured and interpretation of result based on CLSI guideline was performed.

Statistical analysis

The data was entered in the form of a data matrix in Microsoft Excel® and analysed statistically using IBM® SPSS® version 20.0.0. Descriptive statistics were calculated as frequencies for categorical variables and means and standard deviation for continuous variables.

Results

Table 1: demographic profile of the study population

Gender	N (%)
Male	125 (62.5%)
Female	75 (37.5%)
Age (Years)	
Below -20	41 (20.5%)
20-40	68 (34%)
40-60	51 (25.5%)
Above 60	40 (20%)
Age (Mean ± SD)	37.22±3.74

Table 2: distribution of infective organisms

Infective organisms	N (%)
Gram Negative (Pseudomonas aeruginosa, Klebsiella pneumonia, Escherichia coli etc.)	134 (67%)
Gram Positive (Staphylococcus aureus, Staphylococcus epidermidis etc.)	44 (22%)
No Growth detected	22 (11%)
Total	200 (100.0%)

Table 3: drug sensitivity profile of gram positive and negative organisms

Variables	Sensitive	Resistant	Total
Gram Positive			
Benzyl Penicillin	1	39	40
Tetracycline	35	3	38
Gentamicin	35	4	39
Clindamycin	11	26	37
Linezolid	37	0	37
Ciprofloxacin	7	31	38
Gram Negative			
Ampicllin	3	85	88
Tazobactum	101	5	106
Amikacin	101	3	104
Meropenem	106	3	109
Gentamicin	103	4	107
Ciprofloxacin	100	5	105
Amoxyclav	40	62	102

Discussion

Respiratory infections cause significant morbidity and mortality in patients admitted to the ICU worldwide. Admission to ICU has immense economic burden on the patient of which cost for antibiotics forms a major component [17]. Nosocomial infections are very common in patients admitted to ICU. Inappropriate use of antibiotics has led to antimicrobial resistance further increasing the health-care cost and increased mortality. Worldwide incidence rate of antibiotic-resistant pathogen in ICU is 23.7 infection per 1000 patient days [18].

The common infecting organisms isolated in this study were presumptively identified as S. aureus, followed by P. aeruginosa and K. pneumoniae. In another study carried out in Libya, Eldeeb and Khashan found that S. aureus (17.71 %) was the most prevalent organism, followed by S. pyogenes (12.34 %) and K. pneumoniae (11.27 %).[19] P. aeruginosa represented only 6.26 %. This present study did not find S. pyogens. Considering the types of infecting organisms, this study is correlated with the study of Eldeeb and Khashan [19].

Antibiotic resistance is rising to dangerously high levels in all parts of the world. New resistance mechanisms are emerging and spreading globally, threatening our ability to treat common infectious diseases. Respiratory infections are one of the major causes of antibiotic resistance as over the counter use of medications in patients with ear discharge is prevalent in the area of study.

In our study gram positive organisms were resistant to benzyl penicillin or ampicillin, clindamycin, ciprofloxacin or levofloxacin and sensitive to tetracycline, gentamicin, Linezolid. Gram negative organisms were resistant to ampicillin, amoxyclav and sensitive to pipracillin or tazobactum, cefoperazone, amikacin, gentamicin, imipenem,

cefepime, ciprofloxacin.

Similar results were observed in a study by Sridevi et al while studying the prevalence of various microorganisms from throat swab specimens in patients attending a tertiary care hospital at Chinakakani, which shows that the susceptibility patterns varied depending on the drugs [20]. In a similar study Wakode et al studied 305 throat swab reports and found that isolated bacteria in throat swabs were found to be sensitive with cefotaxime, tetracyline, penicillin and gentamicin [21].

A similar study was conducted among 498 admitted patients of different hospitals in Karachi. It showed that, Pseudomonas aeruginosa were isolated from 24% (120/498) of the lower respiratory tract patients. A higher resistance to Pseudomonas aeruginosa isolate was observed with piperacillin/tazobactam and cefipime i.e. 42% and 40% respectively. Amikacin also showed 35% resistance. Imipenem was found to be most effective antibiotic against Pseudomonas aeruginosa (76% sensitivity) but amikacin resistance was continuously increasing [22]. This study result is very close to our findings.

One of the study represent an important target group for efforts aimed at reducing unnecessary antibiotic use, as they receive a significant proportion of the antibiotics prescribed each year [23].

Conclusion

Over the counter availability of antibiotics is also a reason behind this growing resistance. Proper antibacterial guideline and effective plans to manage this over prescribing tendency would be helpful for the coming years.

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