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Original research article

A prospective research to determine the antimicrobial resistance trend among ICU patients

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Abstract

Aim: To assess the antibiotic prescription, microbes and its resistance pattern in patients admitted to respiratory ICU.

Methods: This was a prospective, observational study conducted in the Department of Anaesthesia, Vardhman Institute of Medical Science (VIMS), Pawapuri, Nalanda, Bihar, India, for 1 year. A total of 220 samples (Sputum, Pleural fluid, Pus, IT-Tube sample, Bronchial swab, Respiratory swab) of RTI patients were collected 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 63.18% and rest 36.82% was female. Gram negative organisms are detected in (66.82%), Gram positive organisms detected (21.36%), and no organism detected (11.82%) 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 infections are the major cause of morbidity and mortality in the paediatric age group in developed as well as developing countries.[1] In India they are responsible for 20% of the under-five mortality, as compared to only 3% in the developed countries.[2] India has the highest child birth rate as well as child death rate.[2] In the year 2010, the under 5 deaths in the world was about 1.7 million, among which 23% death rate belonged to India.[2] Among this death rate, pneumonia constitutes about 24% of the total under 5 death rate in our country.[2,3] One of the 'Sustainable Development Goals' launched by United Nations in 2016 is to reduce under-five mortality rate to at least 25/1000 live births by the year 2030. It also targets towards decreasing preventable deaths and epidemics of communicable diseases by year 2030.[3] Hence, it is important to try and treat maximum children to decrease their chances of mortality. Respiratory tract infections include wide range of pathological conditions like bronchiolitis, pneumonia, bronchitis, laryngo tracheobronchitis, acute sinusitis, otitis media, rhinitis etc. They can be of viral (adenovirus, rotavirus, rhinovirus etc) or bacterial (H. influenzae, Streptococci, pneumococci, Moraxella catarrhali etc) origin.[4] Treatment modalities include use of antimicrobials (penicillins, erythromycin, cephalosporins etc), respiratory medicines (salbutamol, ipratropium bromide), cough and cold medicines

(nasal decongestants, anti-histaminics etc) or symptomatic management.[4,5] Emergence of newer pathogenic organisms, re-emergence of disease previously controlled, widespread antibiotic resistance and suboptimal immunization coverage even after many innovative efforts are the major factors responsible for high incidence of respiratory tract infections.[3] It therefore becomes the top most priority to prevent and treat these infections. Although the practice guidelines are available for all respiratory infections, the extent of their implementation and effectiveness has not yet been analysed.[6] Also most of the guidelines are based on the etiology, but in most developing countries, including India, the therapy is usually empirical.[7] This can lead to consequences like irrational use of antimicrobials and drug resistance.[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

This was a prospective, observational study conducted in the Department of Anaesthesia, Vardhman Institute of Medical Science(VIMS), Pawapuri, Nalanda, Bihar, India for 1 year.after taking the approval of the protocol review committee and institutional ethics committee.

A total of 220 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: Age and gender distribution of the patients

Gender	N (%)
Male	139 (63.18%)
Female	81 (36.82%)
Age (Years)	
Below -20	45 (20.45%)
20-40	72 (32.73%)
40-60	58 (26.36%)
Above 60	45 (20.45%)
Age (Mean ± SD)	35.82±3.64

Table 2: distribution of infective organisms

Infective organisms	N (%)
Gram Negative (Pseudomonas aeruginosa, Klebsiella pneumonia, Escherichia coli etc.)	147 (66.82%)
Gram Positive (Staphylococcus aureus, Staphylococcus epidermidis etc.)	47 (21.36%)
No Growth detected	26 (11.82%)
Total	220 (100%)

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

Variables	Sensitive	Resistant	Total
Gram Positive			
Benzyl Penicillin	1	39	42
Tetracycline	35	3	40
Gentamicin	35	4	41
Clindamycin	11	26	39
Linezolid	37	0	39
Ciprofloxacin	7	31	40
Gram Negative			
Ampicllin	3	85	92
Tazobactum	101	5	110
Amikacin	101	3	108
Meropenem	106	3	113
Gentamicin	103	4	111
Ciprofloxacin	100	5	109
Amoxyclav	40	62	106

Discussion

Antimicrobial agents (AMs) are among the most commonly used drugs in hospitalized patients. The emergence of AM resistance in ICUs is of great concern as it increases the likelihood of drug interactions/side effects and cost of therapy due to use of newer antibiotics. Resistance may also be responsible for prolonged hospital stays and can affect prognosis. The problem of resistance in a hospital is difficult to understand without the knowledge of AM use pattern.[17] Monitoring the use of AM and review of sensitivity pattern are, therefore, important.

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, tetracycline, 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

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.

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