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Research Article

Respiratory Tract Infection (RTI) and its Treatment

Sheetal Sharma[1*], Preeti Srivastava[2], Anil Kumar[3]
[1]Ph.D Scholar, Department of Microbiology, NIMS Medical College & Hospital, Jaipur (303121), Rajasthan
[2]Associate Professor, Department of Microbiology, NIMS Medical College & Hospital, Jaipur (303121), Rajasthan
[3]Lecturer, Department of Biochemistry, Govt. Medical College & Hospital, Jammu (180001), Jammu & Kashmir

***Corresponding author**
Sheetal Sharma
Email: ssharmabyc@gmail.com

Abstract: The study was carried out to isolate and identify the common bacteria causing Respiratory tract infections (RTIs) among patients attending NIMS Medical College & Hospital, Jaipur between June to October 2015. This study finally carried out the cultural characterization, biochemical test and antibiotic susceptibility testing of the isolated pathogenic bacteria's. Fourty six (46) bacterial pathogens were isolates from 173 sputum specimens. Klebsiella pneumoniae has highest percentage of occurrence (26.2%), followed by Streptococcus pneumoniae (21.7%), Escherichia coli (19.5%) and Staphylococcus aureus (19.5%) respectively. Other organism included Pseudomonas aeruginosa (13.0%) as well. Male patients 27 (58.6%) has highest percentage of infection than Female patients 19 (41.3%). Antimicrobial susceptibility testing by Kirby-Bauer disk diffusion method and result interpreted according to CLSI guidelines. Bacteria were highly sensitive to Meropenem, Imipenem, and Piperacillin with Tazobactum and were highly resistance to Penicillin G, Ampicillin, Cotrimoxazole and Cefepime.
Keywords: Respiratory tract infection, Antimicrobial susceptibility, Bacterial pathogens.

INTRODUCTION

Respiratory tract infection (RTI) refers to any number of infectious diseases involving the respiratory tract. Respiratory tract is the part of human system that plays a vital role in breathing process. In humans, the respiratory tract can be subdivided into an upper respiratory tract and lower respiratory tract based on anatomical features. So the respiratory tract infection are also be subdivided into two categories, a Upper respiratory tract infection (URI) or (URTI) or a Lower respiratory tract infection (LRI) or (LRTI). Lower respiratory infections like pneumonia tend to be in a far more serious condition than upper respiratory infections, such as common cold [1]. Upper respiratory tract includes the nose, sinuses, pharynx, larynx and the lower respiratory tract consists of the trachea, bronchial tubes, the bronchioles and lungs. Lower respiratory tract infections are generally more serious than upper respiratory tract infections. Respiratory tract infections are the most frequently reported of all human infections. Some of these infections are most times mild, transient lasting and sometimes self-limiting. Due to this many infected persons disregard them [2]. However, respiratory infections are common and important cause of morbidity and mortality worldwide. For an instance, in USA alone, over 62 million persons suffer from cold annually [3], while in the United Kingdom, about 8 million persons are infected by some forms of chronic lungs diseases which know kills one in every five persons [4]. In Canada, respiratory disease is accountable for over 16% of deaths and 10% of Hospitalization [5]. Lower respiratory tract infections place a considerable strain on the health budget and more serious than upper respiratory infections. Since 1993 there has been a slightly reduction in the total number of deaths from lower respiratory tract infection. However, in 2002, they were still the leading cause of deaths among all infectious diseases and they accounted for 3.9 million deaths worldwide and 6.9% of all deaths that year (WHO 2004) [6]. Upper respiratory tract infections are mostly caused by viruses. Group A beta hemolytic Streptococci cause 5% to 10% of cases of pharyngitis in adults [7]. Other less common cause of bacterial pharyngitis includes group C beta hemolyticus Streptococci, Coryneabacterium diphtheriae, Neisseria gonorrheae [8]. Streptococcus pneumoniae, Haemophilus influenzae are the most common organisms that cause bacterial super infections of viral acute sinusitis and less than 10% of the cases of acute tracheobronchitis are caused by Bordetella pertusis. The transmissions occur in more commonly in crowded conditions. Respiratory tract infections (RTIs) are usually treated with antibiotics, and in most cases, there is need to start antibiotics treatment before the final lab

report are available. But of recent, empiric treatment has been complicated by the emergency of the antimicrobial resistance among the principal pathogens and a definitive bacteriological diagnosis and susceptibility testing would, therefore, be required for effective management [9]. In developing countries, most respiratory tract infections are treated empirically, possibly because of higher coast of laboratory services where available. The emergency of antimicrobial resistance in the management of respiratory tract infections is a serious public health issue, particularly the developing world apart from high level of poverty, ignorance and poor hygienic practices. There is also high prevalence of fake and spurious drugs of questionable quality in circulation. Antibiotics resistance often leads to therapeutic failure of empirical therapy, which is why knowledge of etiological agents' respiratory tract infections and their sensitivities to available drugs is of immense importance to the selection and use of antimicrobial agents [10].

This study was conducted to determine the microbial agents of human respiratory tract infections (RTIs) and antimicrobial susceptibility pattern of isolated pathogens.

EXPERIMENTAL SECTION

Sample Collection & transportation

A total 173 early morning Sputum specimens "before eating" were collected in sterile plastic container from the patients which attending NIMS Medical College & Hospital, Jaipur with all aseptic precautions. All samples were properly labeled including the source, date/time of collection, age and sex of the patients. These samples were then transported to the microbiology laboratory for analysis.

Sample Processing

All the specimens was inoculated on the surface of Blood agar, MacConkey agar and Chocolate agar by picking the sample using sterilize wire loop and then swabbing on the surface of the agar. The blood agar & MacConkey agar plates incubated aerobically in an incubator at 35^0 C for 18 – 24 hrs while the chocolate agar plates were incubated in a carbon dioxide enriched environment using anaerobic jar at 35^0C also for 18-24 hrs. After incubation, the plates were observed for following morphological characteristics: growth of the pathogens, size and shape of colony, pigmentation, heamolysis, swarming, odour, elevation. Gram reaction was carried out in order to differentiate the bacteria into gram positive and gram negative and also identify the shape of the organism.

Identification of Bacteria

In order to identify the microorganisms, the isolates were subjected to various biochemical tests. Peptone broth medium was used to detect motility and indole test. Catalase test was carried out to differentiate between Staphylococcus and streptococcus species. Other biochemical test such as Voges-proskauer (VP), methyl red (MR), triple sugar iron agar (TSI), Oxidase, Coagulase, urease test were used to identify and differentiate the organisms.

Sensitivity Screening

Antimicrobial susceptibility testing was performed using the Kirby Bauer disc diffusion testing [11] and result interpreted according to CLSI guidelines [12]. Briefly, for each isolate, a small inoculum was emulsified in 3ml sterile normal saline. The density was then compared with 0.5 McFarland standard. A sterile cotton swab was dipped into the standardized solution of bacterial cultures and used for evenly inoculating Mueller-Hinton agar plates and were allow to dry. Then using sterile forcep, standard antibiotics were placed on the surface of the inoculated agar plates. These plates were incubated at 37^0 C for 24 hrs. After 24 hrs, the plates were observed for the zones of inhibition. Sensitivity of the isolates were determined by measuring the diameter of each zone of inhibition around each disc and the values obtained were compared with the standard chart provided by the manufactured company.

RESULT

A total of 173 individuals (94 males & 79 females) sputum specimens were tested for bacterial infection. The bacteria isolated from the samples included Klebsiella pneumoniae 12 (26.2%), Streptococcus pneumoniae 10 (21.7%), E.coli 9 (19.5%), Staphylococcus aureus 9 (19.5%), Pseudomonas aeruginosa 6 (13.0%) in order of ranking (Table 1). The susceptibility pattern of the isolates to various routinely prescribed antibiotics is shown in table 3 & 4. Klebsiella pneumoniae was the most prevalent bacteria with a susceptibility of 91.6% to Imipenem, 83.4% Cefoperazone with sulbactam, 81% Meropenem, 75% Piperacillin +Tazobactum, 75% Amikacin, 66.5% Ciprofloxacin & 58.4% Gentamicin.

Table 1: Bacterial Pathogens isolated from the respiratory tract of patients

Pathogens isolated	**No. of isolates**	**% of Occurrence**
Klebsiella pneumoniae	12	26.2%
Streptococcus pneumoniae	10	21.7%
Escherichia coli	9	19.5%
Staphylococcus aureus	9	19.5%
Pseudomonas aeruginosa	6	13.0%
Total	**46**	**100%**

Table 2: Occurrence of Bacterial Pathogens isolated from patients in relation to sex

Sex	**Examined**	**Patients with pathogens**	**Percentage %**
Male	94	27	58.6%
Female	79	19	41.3%
Total	**173**	**46**	**26.5%**

Table 3: Sensitivity patterns of the Gram positive bacterial isolates of the respiratory tract infection

Pathogens	**Streptococcus pneumoniae**			**Staphylococcus aureus**		
Antimicrobials	**T**	**S (%)**	**R (%)**	**T**	**S (%)**	**R (%)**
Penicillin G	10	30%	70%	9	33.3%	66.6%
Ampicillin	10	60%	40%	9	77.7%	22.3%
Cefotaxime	10	70%	30%	9	44.4%	55.6%
Cefepime	10	30%	70%	9	33.3%	66.6%
Cotrimoxazole	10	40%	60%	9	55.6%	44.4%
Ciprofloxacin	10	80%	20%	9	66.6%	33.3%
Gentamicin	10	50%	50%	9	77.7%	22.3%
Amikacin	10	30%	70%	9	88.8%	11.2%
Tetracycline	10	70%	30%	9	77.7%	22.2%
Amox. + Clau.	10	80%	20%	9	88.8%	11.2%
Imipenem*	10	100%	00	-	-	-
Meropenem*	10	100%	00	-	-	-

T- Number of isolates tested against each antimicrobial agents, **S (%)** – Percent of isolates susceptible to antimicrobial agents, **R (%)** – Percent of isolates resistant to antimicrobial agents, **Amox + Clau** – Amoxycillin + Clavulanic acid, *Imipenem & Meropenem are not used for Staphylococcus aureus isolates.

Table-4: Sensitivity pattern of the Gram negative bacterial isolates of the respiratory tract infection

Pathogens	**Klebsiella pneumoniae**			**Escherichia coli**			**Pseudomonas aeruginosa**		
Antimicrobials	**T**	**S (%)**	**R (%)**	**T**	**S (%)**	**R (%)**	**T**	**S (%)**	**R (%)**
Ampicillin	12	16.6%	83.3%	9	22.2%	77.8%	6	16.6%	83.3%
Cefotaxime	12	25.0%	75.0%	9	22.2%	77.8%	6	33.3%	66.7%
Cefepime	12	33.3%	66.7%	9	33.4%	66.6%	6	33.3%	66.7%
Cotrimoxazole	12	33.3%	66.7%	9	22.2%	77.8%	6	16.6%	83.3%
Ciprofloxacin	12	66.5%	33.5%	9	44.4%	55.5%	6	66.7%	33.3%
Gentamicin	12	58.4%	41.6%	9	55.5%	44.4%	6	66.7%	33.3%
Amikacin	12	75.0%	25.0%	9	77.8%	22.2%	6	83.3%	16.4%
Tetracycline	12	41.6%	58.4%	9	55.5%	44.4%	6	50.0%	50.0%
Amox + Clau.	12	16.6%	83.4%	9	22.2%	77.8%	6	16.6%	83.3%
Cef. + Sulb.	12	83.4%	16.6%	9	66.6%	33.4%	6	83.3%	16.4%
Pipe. + Tazo.	12	75.0%	25.0%	9	77.8%	22.2%	6	83.3%	16.4%
Imipenem	12	91.6%	8.4%	9	88.7%	11.2%	6	83.3%	16.4%
Meropenem	12	83.4%	16.6%	9	77.8%	22.2%	6	83.3%	16.4%

Cef. + Sulb.: Cefoperazone + Sulbactam**, Pipe. + Tazo:** Piperacillin + Tazobactam

DISCUSSION

Out of 173 samples analyzed, in 46 samples various bacteria were isolated giving a prevalence rate of 26.5%. This consisted of 58.6% from male patients and 41.3% from female patients (Table 2). The result shows that respiratory tract infections were more prevalent in males than females. According to Doddann-navar in 1985 as reported by Gauchan at al.[13], the reason for high risk in males of respiratory tract infection is attributable to decreased local immunity in the respiratory tract due to smoking, use of tobacco, alcohol consumption etc. Among the bacteria isolates, Klebsiella pneumoniae 26.2% was the most common isolate followed by Streptococcus pneumoniae 21.7%, Escherichia coli 19.5%, Staphylococcus aureus 19.5%, and Pseudomonas aeruginosa 13.0%. Staphylococcus aureus and Streptococcus pneumoniae are the only two gram positive isolates obtained in this study whereas Klebsiella pneumoniae was predominant of gram negative isolates. In another study of Taura D.W *et al*. also reported Klebsiella pneumoniae as the predominant in gram negative isolates [14]. All the isolates displayed variable sensitivity to different antibiotics tested as detailed in table 3 & 4. The most effective antimicrobials for Klebsiella pneumoniae was 91.6% to Imipenem, 83.4% Cefoperazone with sulbactam, 81% Meropenem, 75% Piperacillin +Tazobactum, 75% Amikacin, 66.5% Ciprofloxacin & 58.4% Gentamicin. Least effective drug for K. pneumoniae was Ampicillin 16.6%. Streptococcus pneumoniae was more sensitive to Imipenem and Meropenem 100% followed by Amox + Clau. 80%. Ciprofloxacin 80%. Escherichia coli was more sensitive to Imipenem 88.7%, Meropenem 77.8%, Pipe. + Tazo 77.8%, Amikacin 77.8%. Staph. aureus was more sensitive to Amox. + Clau 88.8%, Amikacin 88.8% and Pseudomonas aeruginosa was more sensitive to Imipenem, Meropenem, and Pipe. + Tazo, Cef. +Sulb. 83.3%. The results of the sensitivity tests indicates that isolates showed highest sensitivity to Imipenem, Meropenem, Piperacillin + Tazobactam, Cefoperazone + Sulbactam, Amikacin, Amoxycillin + Clavulanic acid, ciprofloxacin. High resistance recorded for antimicrobials such as Ampicillin, Cefotaxime, cotrimoxazole, Cefepime. The pattern of the antimicrobial sensitivity recorded in this study among Klebsiella, Pseudomonas aeruginosa, E.coli isolates is consistent with result obtained from other developing countries [15]. Resistance to Ampicillin by respiratory tract pathogens in this study is of concern. High microbial resistance to Ampicillin & penicillin has also been reported in Iran by Imani *et al*. [16]. Data presented in this study indicate that some of the antibiotics commonly used to treat respiratory tract infections in the referral Hospitals are still effective. The result showed relatively low antibiotic resistance in the locality of NIMS Medical College & Hospital, Jaipur compared with other countries and regions throughout the world as determined the global surveillance studies conducted by Morrissey *et al*. [17]. But, it is still important to periodically monitor the prevalence and antimicrobial sensitivity pattern before empirical therapy is initiated in hospitals.

CONCLUSION

The level of antibiotics resistance observed in this study is a serious public health problem and hence, brings to light the need for timely and proper diagnosis of the major microbial causes of the respiratory infections, in order to administer the appropriate therapy based on antibiotics susceptibility testing of the causative agents. The reason for the resistance may be due to indiscriminate and inappropriate use and abuse of drugs, adulteration of drugs and mutation of microorganisms and lack of infection control strategies. Surveillance of bacterial infections and monitoring their antimicrobial susceptibility pattern must be carried out, from time to time, not only in tertiary hospitals but, also in small hospital settings.

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