

Bacteriological study of upper respiratory tract infection in pediatric patients

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Background: The study was conducted with aims to identify the causative bacterial agents of upper respiratory tract infection (URTI) among pediatric patients and to reveal the antibiotic susceptibility pattern of the major pathogen during November 2001 to October 2002.

Methods: The throat swab samples from 192 children suspected of URTI were obtained from the outpatient department of Kanti Children's Hospital and inoculated in the culture medium. The bacterial infection was confirmed only in 152 patients. The organisms isolated on medium were identified by their cultural, morphological and biochemical characteristics.

Results: The infections were found to be due to *S.pyogenes*, *S. aureus* and *S. pneumoniae*. Most of the infections were due to *S.pyogenes*. The information obtained during sample collection showed that the high rate of infection was found to be in male patients, in infants and in urban children. Antibiotic susceptibility pattern for the isolated organisms revealed that Amoxycillin and Cephalexin, Erythromycin and Cephalexin were the most effective for *S.pyogenes* and *S. aureus* respectively whereas both Amoxycillin and Cephalexin were equally and the most effective for *S. pneumoniae*. The effective antibiotic for overall URTI was found to be Amoxycillin

Conclusion: The study concluded that despite the existence of so many pathogens, and the susceptible antibiotics, Amoxycillin has been found to be the most effective against the pathogens causing URTI among pediatric population.

Key words: antibiotic, susceptible, resistant, acute respiratory infection

Introduction

Infections of the respiratory tract are the most common human ailment. While they are a substantial cause of morbidity in young children and the elderly¹. Every year, acute respiratory infection (ARI) in young children is responsible for an estimated 4.1 million deaths worldwide. It is estimated that Bangladesh, India, Indonesia and Nepal together account for 40% of the global ARI, which are bacterial in origin¹. ARI is considered the topmost killer, not only in Nepal but also all over the world. Every year, about 5 million people mostly children less than five years of age affect with high mortality of ARI and most of these deaths occur in developing countries².

Out of total acute respiratory diseases, about 30% of the morbidity is accounted for upper respiratory tract infection, while 20-40% of deaths are due to lower respiratory tract infection (LRTI)³. The incidence of URTI in developing

countries has been difficult to determine accurately due to problem in defining discrete episodes in children who may have chronic infection and symptoms. However, it is clear that URTIs are the commonest illnesses in early childhood with incidence rates equivalent to those found in industrialized countries⁴.

An early diagnosis of infection, proper identification of causative organisms and their antibiotic susceptibility pattern are essential for the treatment of infection. The purpose of antimicrobial susceptibility testing URTI is to provide *in vitro* information to assist clinicians in selecting an antimicrobial effective in inhibiting the growth of infecting microorganisms.

Considering the above problems, the study on the upper respiratory tract infection in pediatric patients had been conducted with the objectives to identify the possible causative bacterial agents involved in the URTI and to

Bacteriological study of upper respiratory tract

determine the antibiotic susceptibility pattern of the pathogens.

Material and Methods

The throat swab samples of 192 children suspected of upper respiratory tract infection attending the out patient department (OPD) of Kanti Children's Hospital was taken after obtaining informed consent from their parents. In order to obtain good specimen, throat swabs were taken by vigorous rubbing of sterile cotton tipped wooden applicator over both tonsils and oropharynx. The collected samples were immediately transported to the Health Research Laboratory of Institute of Medicine, Tribhuvan University Teaching Hospital. The swabs were streaked onto sheep blood agar, chocolate agar and Mac-conkey agar and incubated at 37°C for 24 hours for the isolation of all the possible pathogens present in the swab. The isolated organisms were identified with their cultural, morphological and biochemical characteristics^{5,6,7}. After identification of the isolates, antibiotic susceptibility test for the major pathogens isolated was performed using modified Kirby-Bauer Disc Diffusion technique⁷. The primary data in relation to age, sex and locality were analyzed and the correlation with the rate of infection was statistically verified using statistical tool chi-square (X^2) test. The result with P-value < 0.05 was considered to be significant.

Results

Out of total 192 samples collected only 152 (79.2%) samples were found to have bacterial infection.

Among 152 infected patients, 59.9% were males and 40.1% were females. The rate of infection in males was higher than in females and was statistically significant ($P < 0.05$, $X^2 = 5.92$). The infection was found to be highest in infants (39.4%), followed by 2-5 years (23.6%), 1-2 years (20.4%) and then above 5 years (16.4%) ($P < 0.01$, $X^2 = 18.58$). In this study, the higher number of infected children were from urban region (62.5%) than from rural region (37.5%) ($P < 0.01$, $X^2 = 9.5$) Fig.1.

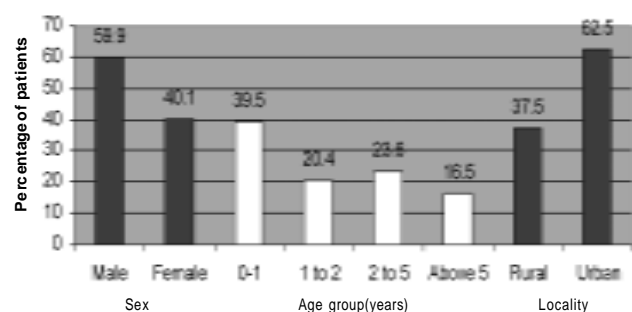
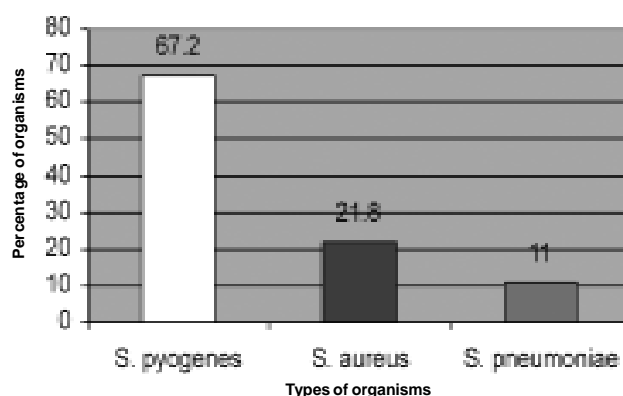


Fig.1. Distribution of patients according to age, sex, and locality

Altogether 174 isolates were obtained from 152 samples and all the isolates were found to be gram-positive cocci. Out of total isolates, 67.2% represented *S. pyogenes*, 21.8% represented *S. aureus* and 11% represented *S. pneumoniae*. The incidence of β -hemolytic streptococcal was significantly higher than other infections (37.5%) ($P < 0.01$, $X^2 = 20.68$) Fig.2.



The culture of all the samples revealed that 85.5% of the bacterial infected samples contained a single type of pathogen and 14.5% contained mixed pathogens. Among the monomicrobial infections, the highest number was found to be due to *S. pyogenes* (69.2%), followed by *S. aureus* (15.4%) and then *S. pneumoniae* (8.4%). Among the polymicrobial infections, the co-infection of *S. pyogenes* and *S. aureus* was found to be the highest i.e. 63.2%. The co-infections of *S. pneumoniae* with *S. aureus* and *S. pyogenes* were found to be equal Table.1.

Table. 1. Pattern of bacterial infection

Type of infection	Organisms isolated	Number	Percentage
Monomicrobial infection (85.53%)	<i>S. pyogenes</i>	99	69.23
	<i>S. aureus</i>	20	15.38
	<i>S. pneumoniae</i>	11	8.46
	Total	130	100
Polymicrobial infection (14.47%)	<i>S. pyogenes</i> and <i>S. aureus</i>	14	63.64
	<i>S. aureus</i> and <i>S. pneumoniae</i>	4	18.18
	<i>S. pyogenes</i> and <i>S. pneumoniae</i>	4	18.18
	Total	22	100

Five antibiotics were used for the susceptibility study against the isolated organisms. Amoxycillin was 83.3%, Cephalexin was 68.4%, Co-trimoxazole was 67.8%, Erythromycin was 63.8% and Penicillin was 62% effective against total bacterial isolates.

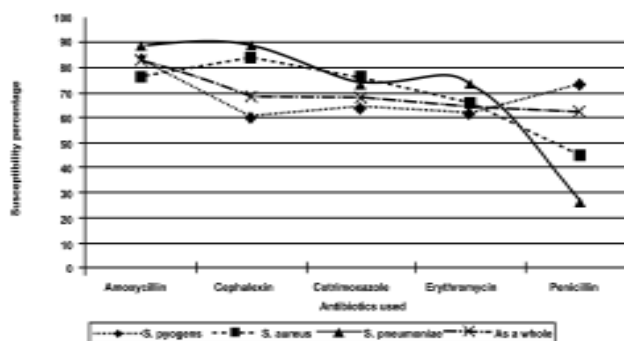


Fig. 3. Drug susceptibility pattern of bacterial isolates

Drug susceptibility pattern of *S. pyogenes* showed that Amoxycillin was the most effective (84.6%), followed by Penicillin (73.5%), Co-trimoxazole (64.1%), Erythromycin (61.5%) and Cephalixin (59.8%). For *S. aureus*, Amoxycillin and Co-trimoxazole were equally and highly effective (76.3%), Erythromycin was 65.8% effective and only 44.7% *S. aureus* were sensitive to Penicillin. Out of total pneumococcal isolates, 89.5% were sensitive to both Amoxycillin and Cephalixin, 73.7% were sensitive to Co-trimoxazole and Erythromycin while only 26.3% were sensitive to Penicillin Fig. 3. Thus, Amoxycillin was found to be the best antibiotic against the bacterial pathogens of URTI in pediatric patients

Discussion

It was found that the higher percentage of males acquire URTI than females and was statistically significant. Shrestha et.al presented high prevalence of streptococcal infection among male, comparable to the findings of similar studies conducted in different parts of the world⁸. Another similar study showed that the male patients outnumbered the females⁹.

It was found that the infection predominated in the children below one year (39.47%), followed by 2-5 years (23.68%), 1-2 years (20.39%) and lastly above 5 years. The result was statistically significant at 95% confidence level. Age is considered as an important factor in the respiratory infection in children. The prevalence of infection is generally higher in the young children and infants and decreases with the increasing age, probably due to the susceptibility to the infection in younger children and no resistance to the infection. The resistance against disease and infection goes on increasing with the exposure to the agents along with their age. The maximum incidence of ARI had been recorded in children less than one year in age, and the incidence decreases with advancing age, presumably due to the immunity acquired after repeated exposures³. This result is supported by Cotran et. Al that the infection is seen in

infants and children who have not developed any protective immunity to such agents¹⁰.

The children of urban area were found to be affected highly than the rural ones and the result was statistically significant. The polluted air of particular area directly affects the respiratory health of the people but its effect is more to the children. The small particles in the polluted air enter respiratory organs causing ARI. Air pollution is present more in urban than the rural areas. So, the occurrence of URTI may be more common in children of urban area.

Altogether 174 isolates were obtained from 152 samples. The highest number was represented by *S. pyogenes*, followed by *S. aureus* and then *S. pneumoniae*. It was found that the incidence of beta-hemolytic streptococcal infection significantly higher than the other infections. Beta-hemolytic streptococcus was considered to be a major etiological agent of upper respiratory tract infection in children^{7,10,11,12,13,14}. All the organisms isolated as pathogens were found to be gram-positive organisms. The respiratory tract infection is caused by air borne pathogens that survive under dry conditions for long period of time. According to Madigan gram-positive bacteria are more resistant to drying than gram-negative bacteria because of their thicker, more rigid cell wall; and also the human pathogens (*Staphylococcus*, *Streptococcus*) survive under dry conditions fairly well and remain alive in dust for longer periods of time¹⁵.

Amoxycillin was found to be the most effective drug in the URTI as a whole. The same drug was also found to be the most effective against *S. pyogenes* followed by Penicillin, Co-trimoxazole, Erythromycin and lastly Cephalixin. Penicillin was found to be the most effective antibiotic against *S. pyogenes*^{6,16}. Gillespie states that penicillin has long been regarded as the treatment of choice in streptococcal tonsillitis and had a high *in-vitro* activity against *S. pyogenes*, but treatment failures of *S.pyogenes* infections have always been recognized¹⁷. An analysis of therapeutic studies for streptococcal pharyngotonsillitis showed that the bacteriological treatment failure rate remained at around 12% from 1953-1993 and the failure rate of Penicillin against *S. pyogenes* ranged widely from 2% to 38%¹⁸.

The drug susceptibility pattern of *Staphylococcus aureus* showed that Cephalixin was the most effective drug while Penicillin was the least sensitive. The present practice of using erythromycin for these infections often leads to the delayed resolution¹⁹. Many children often complain of abdominal pain and vomiting. Cephalixin could be used as a first line drug to treat *Staphylococcus aureus* infections in children. Amoxycillin and Co-trimoxazole were equally

Bacteriological study of upper respiratory tract

effective and erythromycin was less sensitive than those two. Easmon and Goodfellow say that *Staphylococcus* is often resistant to Penicillin and Erythromycin.

The drug sensitivity pattern of *S. pneumoniae* showed that Amoxycillin and Cephalexin were more and equally effective (89.5%) followed by Co-trimoxazole and Erythromycin (73.7%) and the most resistant was Penicillin (26.3%). The present guidelines of Integrated Management of Childhood Illness support the use of Co-trimoxazole and Amoxycillin as the first line of drug to treat pneumonia at the community level²¹. This study supports its use based on the present sensitivity pattern of the *S. pneumoniae*. Various researchers had supported this result that *S. pneumoniae* is mostly resistant to Penicillin. Pneumococci with diminished susceptibility to Penicillin were more common¹⁶. Study by Perez et al showed 35.9% were resistant to Penicillin and 32.7% were intermediately resistant, 79.2% were sensitive to co-trimoxazole and most of the strains were sensitive to erythromycin.

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