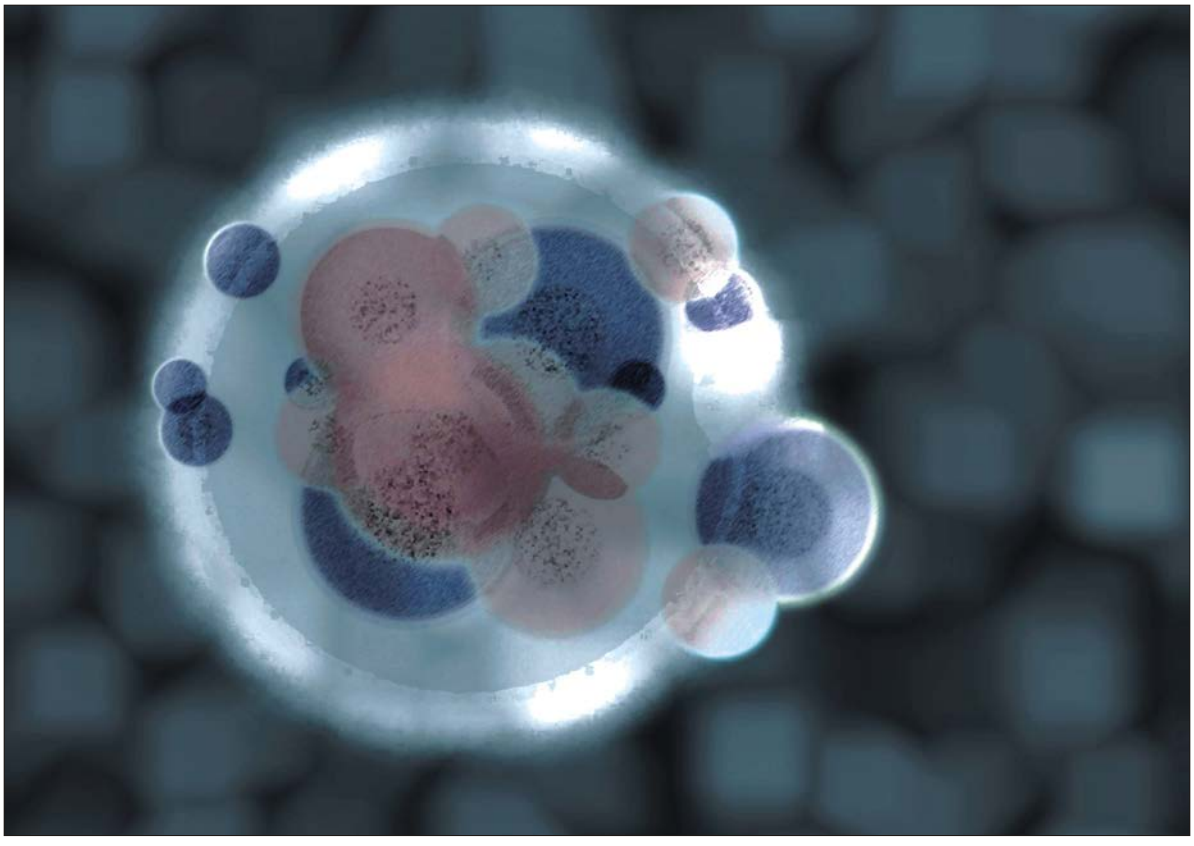

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Bacterial Etiology Associated with Sore Throat and Pneumonia

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Abstract: This study was designed to ascertain the bacterial etiology associated with acute respiratory tract infections (ARIs) among patients visiting the National Institute of Health (NIH) and Pakistan Institute of Medical Sciences (PIMS), Islamabad. These patients presented symptoms of sore throat and pneumonia. Clinical samples (throat, pharyngeal swabs and sputum) were obtained from a total of 225 patients (125 sore throat, 100 pneumonia) and were subjected to a series of microbiological and biochemical tests to identify the bacterial pathogens associated with such infections. Of the 125 sore throat samples, 15% were found to be of bacterial etiology. Among the bacterial isolates, *S. aureus* was found to be the most common (16.8%), followed by *S. pyogenes* (7.2%), *H. influenzae* and other β-hemoloytic *Streptococci* (5%). *H. influenzae* was found predominantly in children under the age of 5 years (75%), while *S. pyogenes* was most common pathogen among children of school going age (44.4%). Among the adult patients, *K. pneumoniae* and *S. aureus* were the common isolates (38.5 and 83.3%, respectively). As for the 100 pneumonia patients, the study revealed that 47% of the cases were attributable to other than viral pathogens, of which 2% were associated with the fungal pathogen *C. albicans* and the rest to bacterial sources. *K. pneumoniae* was reported in 16%, *S. pneumoniae* in 10%, *H. influenzae* in 9%, *S. aureus* in 7% and *P. aeruginosa* in 3% of the pneumonia patients. *H. influenzae* was most common among children under the age of 5 years (53.8%), followed by *S. pneumoniae* (38.5%) within the same age bracket. Among adults, *K. pneumoniae* and *S. aureus* were found to be most common, with 100% incidence of *K. pneumoniae* in the 46-55 year age group and 40% *S. aureus* among the 36-45 year age bracket. The findings of the study indicate that clinicians and parents alike need to take particular care in identifying the etiological agent responsible for ARIs, to ensure the most appropriate and effective therapy. Also, in case of *H. influenzae* there is need to promote childhood immunization (Hib) to prevent complications, like meningitis, arising from primary ARIs caused by this particular fastidious bacteria.

Key words: Bacterial etiology, sore throat, pneumonia infections

INTRODUCTION

Upper respiratory tract infection is usually involved in general and localized infections involving mouth, oropharynx, nose, nasopharynx, larynx, trachea and lungs and the complications associated with acute upper respiratory infections are commonly encountered in children all over the world, particularly so in developing countries. These infections are the major cause of morbidity and mortality reported from all parts of the world[1,2].

In Pakistan, each year about 250,000 child deaths are attributed to acute respiratory infections in which pneumonia accounts for 28.5%[3]. These cases are usually associated with certain risk factors like low birth weight, malnutrition, overcrowding, chilling, poor indoor ventilation, environmental pollution and poverty[4].

These infections are caused by wide varieties of bacteria and viruses. Bacterial infections are most often due to potential pathogens residing in upper respiratory tract like *Streptococcus* sp., *Haemophilus* sp. and *Staphylococcus* sp.[1,2].

Among these pathogens of the *Streptococci* sp. are capable of causing a variety of suppurative and non-suppurative diseases in humans, of which *Streptococcus pyogenes* and *Streptococcus pneumoniae* are major etiological agents. In United States, each year about 10 million cases of septic sore throat, due to Group A *Streptococci* and 500,000 cases of pneumonia caused by *S. pneumoniae* have been reported[5].

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These infections are common among people of all age groups, beginning with neonates. Among infants and small children, sore throat occurs as sub-acute nasopharyngitis resulting in slight fever and leads to the enlargement of cervical lymph nodes. In older children and adults the disease is more acute and is characterized by tonsillitis[6]. Apart from streptococcal species other sore throat causing microorganisms are *Haemophilus* sp., *Staphylococcus* sp., *Corynebacterium* sp. and *Klebsiella* sp.[7-9].

Although majority of lower respiratory infections like pneumonia, characterized by onset of fever, productive cough and pleuritic chest pain is caused by *S. pneumoniae*, other pathogens may include *Klebsiella pneumoniae, Haemophilus influenza, Staphylococcus aureus, Legiollena pneumoniae, Mycoplasma pneumoniae, Pseudomonas* sp. and *Candida* sp.[10-13].

Researchers have documented that in the majority of cases of Acute Respiratory Infection (ARI) in Pakistan are associated with mismanagement by clinicians and patients alike as well as the unjustified and often indiscriminate use of antibiotics in the treatment of Upper Respiratory Infection (URI). In addition the late diagnosis of pneumonia in Lower Acute Respiratory Infection (LARI) has also been deemed as a contributing factor in the rise of the mortality rate associated with LARI, especially among infants and children[13-18].

Keeping in consideration the hazards caused by these infections this study was designed to determine the various pathogens associated with respiratory tract infection and their correlation with age. The results of this study may be of immense use to the medical profession in determining the common cause of respiratory infections and thereby assisting them in rapid diagnosis as well as in the prescription of a more proficient therapy to reduce the mortality rates associated with Respiratory Tract Infections (RTI). Furthermore, such studies are also aimed at generating mass awareness campaigns among the population at large, to enable them to practice better preventive measures to reduce the incidence of RTIs.

MATERIALS AND METHODS

This study spanned over a one year period, August 2001 till July 2002, during which a total of 225 clinical samples of throat, nasopharyngeal swabs and sputum were collected from suspected patients of sore throat and pneumonia visiting at the National Institute of Health (NIH) and Pakistan Institute of Medical Sciences (PIMS), Islamabad. After collection, these samples were processed further for bacteriological isolation and characterization at the Bacteriology Laboratory, Public Health Division of the NIH.

Patients, of all ages, presenting symptoms of sore throat and pneumonia infections were included in this study. Throat swabs were collected from the patients of sore throat, whereas nasopharyngeal swabs were collected from children up to 10 years with pneumonia and sputum from pneumonic patients above 10 years of age.

Clinical samples were inoculated on blood, chocolate and MacConkey agar. Inoculated plates were incubated at 37°C for 24 h. Colonies of bacterial pathogens were identified on the basis of their morphological and color pattern characteristics. Following preliminary identification the samples were subjected to different biochemical confirmatory tests. These included catalase, bacitracin sensitivity, optochin sensitivity, bile solubility, coagulase, satellitism, oxidase, indole, citrate, urease, motility, triple sugar iron and germ tube tests.

RESULTS AND DISCUSSION

The results of present study indicated the prevalence of different bacterial pathogens among patients of ARIs. Although these infections were predominantly a pediatric problem, yet there is sufficient evidence to suggest that ARIs may be a significant, even disabling diseases among adults, particularly geriatric patients residing in close quarters under adverse environmental and hygienic conditions.

According to this study the overall bacterial etiology was defined in 32% of the patients suffering from sore throat infections, whereas, the remaining were thought to be viral in origin. Among these bacterial pathogens, incidence of Group A *Streptococcus* was comparatively low (7.2%), with *S. aureus* reported to be highest (16.8%) and other *beta* hemolytic *Streptococci* and *H. influenzae* were found in 4% patients (Table 1). These findings are similar to those reported by other researchers both in Pakistan and in other developing countries[11,13,16,19]. However, some researchers have reported higher prevalence rates of Group A *Streptococcus* (GAS) among patients suffering from respiratory tract infections[20,21].

Among pneumonic patients, isolation rate of bacterial pathogens was 47%, whereas no cause was shown in 53% patients and they were thought to have viral origin. The incidence of *S. pneumoniae* as the sole pathogen was observed in 10% of these patients in this study (Table 2). Previous studies in Pakistan like, Lahore[22] and in Bahawalpur[16], have also indicated higher incidence rates (33.9, 25.9%, respectively). Similarly, other researchers have reported *S. pneumoniae* as

Table 1: Pathogens isolated from patients with sore throat infection (n=125)

Pathogens	No. (%)
Staphylococcus aureus	21 (16.8)
Streptococcus pyogenes	9 (7.2)
Other β hemolytic *Streptococci*	5 (4)
Haemophilus influenza	5 (4)
Others (viral, etc.)	85 (68)

Table 2: Pathogens isolated from patients with pneumonia (n=100)

Pathogens	No. (%)
Klebsiella pneumoniae	16 (16)
Streptococcus pneumoniae	10 (10)
Haemophilus influenza	9 (9)
Staphylococcus aureus	7 (7)
Pseudomonas aeruginosa	3 (3)
Candida albicans	2 (2)
Others (viral, etc.)	53 (53)

the etiological agents in 25% of neonatal pneumonia in developing countries[23,24].

One possible reason of this low incidence rate reported in this study may be attributable to the possible use of antibiotics prior to sampling. Numerous patients use previously prescribed antibiotics in self-medicating themselves to combat ARIs. Antibiotics are easily available in the market in Pakistan and are often sold without a doctor's prescription[25-27]. Researchers have documented that culture isolation rate may become significantly lower if the patient had received antimicrobial agents 48 h before sampling[23].

Among other bacterial etiological agents associated with ARIs, this study revealed *K. pneumoniae* as the sole pathogen in 16% of the cases, H. *influenza* in 9%, *S. aureus* in 7%, *P. aeruginosa* in 3%, while the lone fungal pathogen *C. albicans* was found in 2% of patients investigated in this study (Table 2). Researchers have reported slightly higher incidence rates of these etiological agents in general, however, in terms of regarding the particular agents, such as *H. influenzae,* researchers have reported an active role of this particular pathogen in cases of severe community acquired pneumonia[28].

The wide range of carriage among these pathogens, globally, reflects the variation in study populations with respect to age, socioeconomic conditions, level of personal and environmental hygiene, literacy and awareness levels and differences in sampling and isolation techniques. Comparable low incidence of these pathogens in this study may be due to the fact that only suspected patients of pharyngitis/sore throat infection and pneumonia were selected. This selection was done on the basis of presenting symptoms and no clinical tests were performed for the confirmation of these infections, which decreased the overall prevalence. In addition some of the reports mentioned in this study were from incidences among neonates, whereas for this study there was a wider age range consisting of only a few neonates were selected in the sample.

Age has been reported to be an important factor in microbiological etiology of ARIs[26]. In this study the incidence of *S. pyogenes*, as the pathogen deemed responsible for the upper respiratory tract infection, was reported to be highest (44.4%) among school going children aged 6-15 years (Table 3). Other researchers have reported similar findings, particularly in this age group, but not in neonates or adults, where the commonly identified etiological agent differed from *Strep. pyogenes*[20,24,29,30]. The occurrence of peak incidence of this pathogen at 5-15 year age group may be due to the fact that at this age children are school going adding to the risk of exposure to infection from different strains of *Streptococci.*

Among the other bacterial pathogens associated with the cases of sore throat, prevalence of *S. aureus* was found to be more common in adults (76.2%) of the 21 positive cases of bacterial etiology reported in this study among patients older than 26 years, whereas other β hemolytic streptococci was predominant among children of school going age (22.2%) in school going children i.e. in age group of 6-15 years. In contrast, *H. influenzae* was reported as the causative agent in 75% of childhood (< 5 years) cases of sore throat infection (Table 3).

As for the pneumonia cases, *S. pneumoniae* was identified as the etiological agent in 38.5% cases of childhood pneumonia; 38.5% among neonates and 7.7% among those under 5 years of age (Table 4). This is in agreement with numerous researchers who have reported

Table 3: Age-wise distribution pattern of bacterial pathogens isolated from patients with sore throat infection (n=125)

Age groups (years)	Positive cases No. (%)	Positive cases of bacterial etiology No. (%)	*Staphylococcus aureus* No. (%)	*Streptococcus pyogenes* No. (%)	Other β hemolytic *Streptococci* No. (%)	*Haemophilus inflnenza* No. (%)
<5	9 (7.2)	4 (44.4)		1 (25)		3 (75)
6-15	24 (19.2)	9 (37.5)	2 (22.2)	4 (44.4)	2 (22.2)	1 (11.1)
16-25	20 (16)	6 (30)	3 (50)	2 (33.3)	1 (1.7)	
26-35	19 (15.2)	5 (26.3)	4 (80)	1 (20)		
36-45	13 (10.4)	5 (38.5)	3 (60)	1 (20)		1 (20)
46-55	18 (14.4)	5 (27.8)	4 (80)		1 (20)	
>55	22 (17.6)	6 (27.3)	5(83.3)		1 (16.7)	
Total	125	40 (32)	21 (52.5)	9 (22.5)	9 (12.5)	5 (12.5)

Table 4: Age-wise distribution pattern of bacterial pathogens isolated from patients with pneumonia (n=100)

Age groups (years)	Positive cases No. (%)	Positive cases of bacterial etiology No. (%)	*Klebsiella pneumoniae* No. (%)	*Streptococcus pneumoniae* No. (%)	*Haemophilus inflnenza* No. (%)	*Staphylococcus aureus* No. (%)	*Pseudomonas aeruginosa* No. (%)	*Candida albicans* No. (%)
<5	31	13 (41.9)	1 (7.7)	5 (38.5)	7 (53.8)			
6-15	12	6 (50)	2 (33.33)	1 (16.7)	2 (33.3)	1 (16.7)		
16-25	9	4 (44.4)	2 (50.)	1 (25)		1 (25)		
26-35	13	7 (53.8)	3 (42.9)	1 (14.3)		2 (28.6)	1 (14.3)	1
36-45	12	5 (41.7)	1 (20)			2 (40)	2 (40)	1
46-55	10	3 (33.3)	3 (100)					
>55	13	7 (53.8)	4 (51.1)	2 (28.6)		1 (14.3)		
Total	100	46	16	10	9	7	3	2

S. pneumoniae as the etiological agent in 22-45% cases of neonatal pneumonia[31], as the sole causative agent in 69% of childhood cases of pneumonia and in 60% of pneumonia cases among school going children[32].

This high incidence of *S. pneumoniae* in childhood cases may be associated with an under-developed immune system, while in children of school going age, their poor response to the polysaccharide capsular antigen may contribute to the increased an incidence reported in this age group[33]. In contrast among adults this pathogen was not reported in this study, however, 2 cases were recorded among the elderly-above age of 55 (Table 4). These findings are in accordance with those reported[34].

Interestingly, among the pneumonia patients in the age group (<5 years) the predominant etiological agent isolated in this study was *H. influenzae*, in 53.8% of the 13 positive cases of bacterial pneumonia (Table 4). This was also reflected in the cases of soar throat infection among the age group. This gram-negative bacteria (type b) is also associated with childhood meningitis among children aged 6-24 months[33,35,36]. Such findings strengthen the argument for early childhood vaccination against *H. influenzea* (type b), Hib vaccine, as prescribed by numerous researchers and pediatricians to prevent childhood meningitis - a complication of pneumonia cased by this particular etiological agent[33,35].

Among the adult cases of pneumonia, this study did not document any incidence of *H. influenzea* as the causative agent, instead revealed *K. pneumoniae* as the predominant pathogen among patients older than 26 years. Of the 22 pneumonia positive cases of bacterial etiology, 11 (50%) were reported to have been caused by *K. pneumoniae*. In contrast, *H. influenza* was not isolated from any of the adults cases above the age 16 years. Incidence of *S. aureus* was high (28.6%) between ages of 26-45 years and even higher among the 36-45 years category (40%). *P. aeruginosa* were also common in adults over the age of 26 years (Table 4).

These findings in large are similar to those reported by other researchers[36,37], yet others have identified *H. influenzae* as the predominant etiological agent responsible for cases of pneumonia in the elderly[38]. Actually several host factors are associated with increased risk of infection, which include extremes of age, immunological deficiency, metabolic abnormalities and chronic respiratory diseases[39].

In the light of present study it may be concluded that although percentage of prevalence of streptococcal pathogens has decreased, but still it is prevalent in the population of Rawalpindi/Islamabad.

S. pyogenes and *S. pneumoniae* along with other pathogens play an extremely important role as causative agent of upper and lower respiratory infections. Favorable conditions for spread and maintenance of these pathogenic microorganisms include geographical locations, hygienic conditions, pollution levels, socioeconomic conditions/poverty associated with over population and confined quarters persist in many developing countries, particularly in Pakistan. With the added reduction of immunity linked with tobacco and narcotics smoking a population becomes more prone to infections of this nature. Therefore, clinicians, related government departments and civil society at large must play an active role in addressing the mitigating circumstances to reduce the spread of such infections and play an vital role in the prevention of the disease rather than the cure which would be more expensive and an added burden on the poor. In addition, the findings of the study indicate that clinicians and parents alike need to take particular care in identifying the etiological agent responsible for ARIs, to ensure the most appropriate and effective therapy. Also, in case of *H. influenzae*, there is need to ensure childhood immunization (Hib) to prevent complications, like meningitis, arising from primary ARIs caused by this particular fastidious bacterium.

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