

ETIOLOGY OF ACUTE SEVERE LOWER RESPIRATORY TRACT INFECTION IN HOSPITAL-BASED PATIENTS

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Abstract. Acute respiratory infections are common childhood illnesses. Most are mild and self-limiting. Five percent are lower respiratory tract diseases and are potentially serious. A prospective study was conducted to ascertain the etiology of community-acquired severe lower respiratory tract infections (LRTI) in hospital based patients. *Mycoplasma* was the most frequently identified agent (33%). This was followed by viruses (28%) and bacteria (15%). Twenty-four percent of children had no identified causative agent.

INTRODUCTION

Acute respiratory infection was responsible for about 8 percent of total admissions to government hospital in 1988 (Anonymous, 1988). Although lower respiratory tract infections (LRTI) account for only 5% of all community acquired acute respiratory infections (Phelan *et al*, 1982 they were responsible for 35% of all hospital admissions due to acute respiratory infection. In order to determine the etiology of severe LRTI in hospital based patients in Singapore, a prospective study was carried out from November 1988 to October 1989. We also attempted to assess the suitability of a latex agglutination test in the detection of bacterial antigens in patients with pneumonia.

MATERIALS AND METHODS

All children admitted to the Department of Paediatrics, Tan Tock Seng Hospital, Singapore with complaints of cough or fever of less than two weeks (inclusive) duration were eligible. They were included if they had either (i) rapid breathing > 50/minute or chest indrawing, and/or (ii) radiological evidence of pulmonary infiltrates. Children with nosocomial infection, chronic lung disorders, aspiration pneumonia or who were immuno-compromised were excluded.

The following investigations were done :

- 1) Chest x-ray-within 24 hours of admission.
- 2) Hematological investigations - full blood count, erythrocyte sedimentation rate, blood cultures, blood for bacterial antigens (*Pneumococcus*, *Haemophilus*) detection by latex agglutination test and acute and convalescent sera for complement fixation test for *Mycoplasma pneumoniae*.
- 3) Nasopharngeal aspirate for virus detection by immunofluorescence, and for bacterial culture. *Chlamydia* culture was done for children under 6 months.

Statistical analysis was done by calculation of chi-square with Yate's correction or Fisher's Exact Test, where applicable.

RESULTS

Two hundred and forty children satisfied our criteria for acute severe LRTI and were included in the study. Most patients had all the investigations performed, with some exceptions. In some, the specimens sent for investigations were found to be unsuitable and in others blood for convalescent sera for *Mycoplasma* was refused.

The mean age of the children was 3.6 years and ranged from 11 days to 11.8 years. There was a slight male preponderance of 1.2 : 1. Thirty-nine percent of the children were from households where at least one member smoked at home. The households were generally from lower socio-

economic groups, 82% with total income below \$2,000 per month, half of which earned below \$1,000 per month. Twenty-eight percent had received at least one antibiotic before admission. No one had concomitant measles infection.

Clinical features

The 3 most common complaints were cough (97%), fever (89%) and dyspnea (35%). Seventy-three percent of patients were febrile and 47% were tachypneic on admission. There were only 2 patients who had stridor and 4 were cyanosed at presentation. Chest signs were absent in 8% of patients. Of these 8%, half had tachypnea or chest retraction at presentation. All had abnormal chest x-rays. Ninety-two percent had positive chest signs, 86% had crepitations in the lungs and 45% had rhonchi; 5% (11) had rashes at presentation.

Radiological features

All patients had chest x-rays done; 95% had evidence of pulmonary infiltrates, 30% had lobar/segmental consolidation or collapse and 55% had patchy infiltrates, while 3% had pleural effusions.

Etiological agents

Fifty-nine (24%) had no causative agents identified, while 80 (33%) patients had positive mycoplasma serology. Twelve of the patients had concomitant positive bacterial isolates from the nasopharynx but these were not considered as primary respiratory pathogens. The paired sera of these patients showed a four fold increase in titer, indicating recent infection. One patient had positive blood culture for *Escherichia coli* and a four fold rise in *Mycoplasma* titer.

Viral isolates were positive in 66 patients (28%); 95% of these were respiratory syncytial virus (RSV).

Blood culture yielded 12 positive results of which only 4 with single organism were considered to be significant as causative agents: *Haemophilus influenzae* (1), *Klebsiella* (1), β -*Streptococcus* (1) and *Staphylococcus aureus* (1). Thirty-one specimens of sputum culture were significant. There was only one positive *Chlamydia* culture; the overall positive rate for bacterial isolation was 35 (15%).

Latex agglutination did not yield any positive result although there were 8 patients who had positive tests for pneumococcus and *Haemophilus* in blood or sputum. The results are summarized in Table 1.

Mycoplasma pneumoniae infection was present in 50 of 76 children above 5 years of age. Below 5 years of age, only 30 of 164 had positive serology ($p < 0.001$). Chest x-ray evidence of lobar/segmental consolidation was seen more frequently in children with positive *Mycoplasma* serology. Thirty-four of the 80 patients with positive *Mycoplasma* had lobar/segmental consolidation compared to 10 of 66 with viral isolates ($p < 0.01$) and 7 out of 35 with positive bacterial isolates ($p < 0.05$). Eighty percent (9) of patients with rashes had *M. pneumoniae* ($p < 0.001$).

Table 1

Summary of etiological agents.

Etiological agents	Number positive	Organism
Viral isolates	66	RSV 95% Parainfluenzae, influenzae A, Adenovirus
Bacterial isolates	35	<i>Haemophilus influenzae</i> (1)
Blood culture	4	<i>Staphylococcus aureus</i> (1) <i>Streptococcus</i> (1)
Sputum culture	31	<i>H. influenzae</i> (5) <i>Klebsiella</i> (5) <i>Escherichia coli</i> (2) <i>S. aureus</i> (4) <i>S. pneumoniae</i> (2) <i>Chlamydia</i> (1) Others 12
<i>Mycoplasma pneumoniae</i>	80	
Total	181	

The children with viral isolates were younger. Of the 69 patients below one year of age, 31 were positive for viruses. Only 35 out of 171 children above the age 1 year had viral etiology ($p < 0.05$). The children with viral isolates were more likely to wheeze. Fifty-five percent of the 66 patients with positive viral isolates had wheezing. Only 37% of other 115 patients with bacterial of *Mycoplasma* infection had wheezing ($p < 0.05$).

DISCUSSION

Our study revealed that among hospital based patients with acute severe LRTI, the commonest etiological agent was *M. pneumoniae* (33%). The incidence increased to 66% in children above age of 5 years. Forty-three percent of patients with *Mycoplasma pneumoniae* had lobar/segmental consolidation. Those with *Mycoplasma* infection were also more likely to present with rashes.

Viral etiology ranked next, at 28% of all children below 12 years of age but constitute 45% of the children below 1 year of age. Children with viral etiology were less likely to have pulmonary infiltrates but they were more likely to have wheezing.

Only 15% of children were diagnosed to have bacterial LRTI. Although bacterial infection was uncommon in our study, we must bear in mind that 28% of our patients had been treated with antibiotics before admission. This may be responsible for the low yield in bacterial culture.

Latex agglutination for bacterial antigen detection was disappointing in this study. Co-agglutination test had been reported to be useful in the detection of *Haemophilus* and pneumococcal infections in central nervous system and respiratory tract infections (Lehtomaki *et al*, 1988; Chowdhury *et al*, 1990). Although, in our study, we had 1 positive blood culture (*H. influenzae*) and 7 positive sputum isolates for *H. influenzae* and pneumococcus, there was no single positive for bacterial antigens. Technical problems cannot be excluded here and further evaluation will be necessary.

A similar study was conducted in Metro Manila. Tupasi *et al* (1990) found that 70.6% of 258 patients had viral infection as a cause of LRTI.

This difference from our study was probably because their investigation did not include children above 5 years. In older children *Mycoplasma* infection was expected to be more common (Ali *et al*, 1986). In the Manila study, bacteria were noted in 13.4% of children and they were mostly associated with measles infection (Tupasi *et al*, 1990). Because of the successful measles immunization program in Singapore we did not have a single case of measles.

The high incidence of smoking (39%) in households of these children should be of concern. With improvement in nutritional status of our children, the risk of passive smoking will become more important as a risk factor causing severe LRTI in young children (Wright *et al*, 1991).

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REFERENCES

- Ali NJ, Sillis M, Andrews BE, Jenkins PF, Harrison BDW. The clinical spectrum and diagnosis of *Mycoplasma pneumoniae* infection. *QJ Med* 1986; 58 : 241-51.
- Anonymous. Statistics on hospital admission by disease and age 1988. Research and Evaluation Department, Ministry of Health, Singapore 1988.
- Chowdhury ZU, Rahman KM, Miah RA, Hussain T, Asna ZH, Khan WA. Evaluation of co-agglutination (COA) counter immunoelectrophoresis (CIE) culture and direct microscopic (Du) examination of cerebrospinal fluid (CSF) for detection of meningitis caused by common bacterial pathogens. *Bangladesh Med Res Counc Bull* 1990; 16 : 34-41.
- Lehtomaki K, Leinonen M, Takala A, Hooi T, Hervi E, Koskela M. Etiological diagnosis of pneumonia in military conscripts by combined use of bacterial culture and serological method. *Eur J Clin Microbiol Infect Dis* 1988; 7 : 348-54.

Phelan PD, Landau LI, Olinsky A. Respiratory illness in children. City Blackwell Scientific Publications 1982.

Tupasi TE, *et al.* Etiology of acute lower respiratory tract infection in children from Alabany, Metro Manila. *Rev Infect Dis* 1990; 12 (Supp 18);

929-39.

Wright AL, Holberg C, Fernando DM, Tassig LM. Relationship of parental smoking to wheezing and non-wheezing lower respiratory tract illness in infancy. *J Pediatr* 1991; 118 : 207-14.