

Pneumonia bugs and determinants of their occurrence

Pneumonia can be defined as inflammation of lung parenchyma occurring usually secondary to infection. It is one of the leading causes of morbidity in general population as well as in hospitalized patients. It had been rightly referred to as “Captain of the Men of Death” by Sir William Osler in the past as it is still a common cause of significant mortality in a select group of patients. There are varied spectrums of presentation of pneumonia depending on the setting in which it occurs. Likewise, causative microorganisms may also vary depending on the setting. Community-acquired pneumonia (CAP) is a special subgroup occurring outside health-care facility settings and is caused by typical and atypical pathogens [Table 1].^[1]

This issue of Lung India includes two original studies about the assessment of CAP with a special emphasis on its etiological workup.

Para *et al.* have studied microbial etiology of hospitalized adults with CAP in a tertiary health-care facility in Kashmir.^[2] They have aimed to comprehensively identify both typical and atypical organisms associated with CAP with the help of blood and sputum culture, urinary antigen for pneumococcus and legionella, serology for mycoplasma and chlamydia, and realtime reverse transcriptase-polymerase chain reaction for influenza viruses.

In this study, among typical CAP microbial agents, *Streptococcus pneumoniae* was the most predominant organism. *Klebsiella pneumoniae*, methicillin-resistant *Staphylococcus aureus*, *Pseudomonas aeruginosa*, methicillin-sensitive *S. aureus*, and *Acinetobacter* spp. were recovered in a small subgroup of patients. Among atypical organisms, *Legionella pneumophila* and influenza viruses were most prominent, while *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Mycobacterium tuberculosis*, and mixed pathogens were present in some patients. As far as the study population is concerned, 44% of the participants were smokers with an age range of 18–93 years. Hypertension,

chronic obstructive pulmonary disease (COPD), diabetes, chronic kidney disease, and heart failure were the main comorbid conditions present in the study population. It has been concluded in this study that infections by typical pathogens were more severe with higher CURB65 score at admission and more bilateral radiographic involvement as compared to atypical agents which were characterized by milder form of clinical disease.

In a study by Udawadia *et al.* from Mumbai, *S. pneumoniae*, *C. pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, *P. aeruginosa*, *Staphylococcus*, and *Salmonella typhi* were typical organisms and *M. pneumoniae* and *L. pneumophila* were atypical pathogens isolated in their study population of CAP.^[3]

In different studies across the world, *S. pneumoniae* has been found to be the most common organism identified in CAP, while in hospitalized patients, *S. aureus*, *P. aeruginosa*, and *K. pneumoniae* are commonly found.^[4] *S. aureus* has been shown to complicate CAP in individuals with influenza viral pneumonia. *K. pneumoniae* occurs primarily in individuals with chronic alcoholism. *P. aeruginosa* is found in CAP occurring in patients with bronchiectasis or cystic fibrosis.

Overall, the recovery of microbiological agent in CAP is difficult due to a variety of reasons. Blood culture typically has a low sensitivity. On top of that, most of the patients presenting to health-care facilities are already on antibiotics, making it difficult to grow the organism. In addition, problem in culture of sputum and other respiratory specimens is related mainly to the quality of sample and contamination with mixed bacterial flora.

In another original study being published in this issue of Lung India, Kumar *et al.* from Mysore have tried to identify the etiology of CAP in children between 2 months and 16 years of age for atypical microbial pathogens.^[5] Children not having an etiological diagnosis by conventional culture were subjected to immunofluorescence assay by Pneumoslide IgM test. The most common organism was *M. pneumoniae* which was found more frequently between 5 months and 2 years of age. The most common virus was respiratory syncytial virus. Mixed pathogens were identified in a few children. It could have been more informative for readers if authors would have presented microbiological data of children with CAP having etiological diagnosis of a typical agent by conventional culture.

Various factors including age, comorbid conditions such as COPD, diabetes, smoking, and alcohol use, and seasonality

Table 1: Worldwide etiology of community-acquired pneumonia

Microbiological diagnosis	Percentage
<i>Streptococcus pneumoniae</i>	40-71
<i>Staphylococcus aureus</i>	3-51
<i>Legionella</i> spp.	1-2
<i>Haemophilus influenzae</i>	1-6
<i>Mycoplasma pneumoniae</i>	5-2
<i>Chlamydia</i> spp.	14-24
<i>Pseudomonas</i> spp.	2-23
Other bacteria	2-26
Viruses	10-36

are important in influencing the clinical presentation and etiology of pneumonia.^[1,6]

There are certain age-related differences in the presentation of CAP. In infants and small children, bacterial CAP tends to be the result of a previous viral infection. Sudden worsening of fever and patient's overall condition may occur in these children. It may also manifest as fever of unknown origin without other signs and symptoms of pneumonia, which is characteristic of pneumococcal CAP. In older children, *S. pneumoniae* followed by *Mycoplasma* and *Chlamydial pneumonia* are commonly found. A significant proportion of CAP (up to 40%) is the result of a mixed infection in children.^[7]

Children requiring hospitalization are most likely to have infection caused by pneumococcus, *H. influenzae* or respiratory syncytial virus, and *Mycoplasma*. Worldwide, the use of pneumococcal, *H. influenzae*, and flu vaccines has reduced the frequency of childhood pneumonia. Further reduction possibly requires development of respiratory syncytial virus and *M. pneumoniae* vaccines.^[8] It needs to be emphasized again and again that in developed countries like India, coverage of vaccinations is universally poor.

People in older age group have increased mortality due to CAP as compared to the younger age group and CURB 65 has been found to be less useful in people aged above 65 years. Overall, the microbiological patterns seen in the elderly people with CAP do not differ significantly from those of the younger people and here also *S. pneumoniae* and *H. influenzae* are predominant organisms. It has been convincingly found that COPD is a common predisposing condition for CAP, and besides frequent recovery of usual organisms in this setting, many others have pseudomonas and other more sinister forms of Gram-negative bacilli.^[1]

Risk of severe pneumonia, empyema, and septicemia is linked with comorbidities. For patients with CAP, diabetes mellitus is one of the most common underlying diseases that may be associated with other comorbidities and complications. Initially, diabetic morbidity was linked to altered immune responses, but now it is proposed to be due to worsening of preexisting cardiovascular and kidney diseases. Similarly, alcoholism may be linked to more severe pneumonia which is associated with septicemia and mortality.^[1,9,10]

Season may have a significant influence on occurrence of a particular pathogen. Swine flu has classically been associated with both seasonal and nonseasonal epidemic episodes.^[11-13] In a study by Chen *et al.* using Pneumoslide IgM test in children, *M. pneumoniae*, parainfluenza viruses, and respiratory syncytial virus were found to be associated with seasonality. *M. pneumoniae* was higher in autumn, *L. pneumophila* in August and September,

adenovirus in June, and influenza B virus in March than that in other months.^[14]

From the above-mentioned fact, it can be concluded that overall microbiological etiology of CAP is more or less same throughout the world but may vary depending on the severity, setting, and patient-related factors, especially comorbidity. Therefore, comprehensive etiological workup of cases presenting with severe CAP is important. It should always be stressed upon that pneumonia can be potentially life-threatening, and knowledge of habitual pathogens and their resistance pattern represents the basis for optimal empirical treatment of CAP.

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