



Bacteriological Profile, Serology and Antibiotic Sensitivity Pattern of Micro-organisms from Community Acquired Pneumonia

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Abstract

A study of 233 consecutive patients with pneumonia was done in the Microbiology Department of the Christian Medical College and Hospital, Ludhiana. Laboratory investigations like blood culture, sputum culture and serology were done to establish the diagnosis. Rates of isolation of organisms from blood culture, sputum culture and serology were 21.9%, 32% and 27.1% respectively. *Pseudomonas aeruginosa*, *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, other gram negative organisms, fungi like *Candida albicans* and *Aspergillus fumigatus* were isolated by culture AFB was isolated in 5% of cases. Serology for *Mycoplasma* and *Chlamydia* was positive in 16.5% and 17.6% of the patients respectively. An etiological diagnosis was made in 47.7% cases with a definitive evidence in 31% and presumptive evidence in 16.7%. No etiological diagnosis could be made in 52.3% cases. Best antibiotic sensitivity results for organisms isolated from sputum culture were from third generation cephalosporins followed by fluoroquinolones and aminoglycosides. Blood culture sensitivities also revealed a similar pattern.

Key words

Community Acquired Pneumonia

Introduction

Community Acquired Pneumonia (CAP) remains a common yet serious illness with significant morbidity and mortality despite the availability of potent new antibiotics and other effective therapies. Management of pneumonia remains empiric and challenging because the precise etiology is unknown. Despite progress in diagnostic techniques and laboratory tests, it takes at least a few days to identify causative micro-organisms in blood or sputum samples and etiology of about half of all patients with CAP remains uncertain (1).

CAP is defined as pulmonary infiltration of the lung revealed by radiographic examination at the time of admission, including at least two of the following :

1. Fever (temperature $>37.8^{\circ}\text{C}$)
2. Production of purulent sputum
3. Cough
4. Leucocytosis (WBC count $> 10,000/\text{cu.mm}$)

The most common pathogen isolated from CAP is *Streptococcus pneumoniae*. Other bacteria, uncommon, but include *Haemophilus influenzae* and *Staphylococcus aureus*, particularly in association with influenza virus infection. Viral and atypical pneumonias particularly *Mycoplasma pneumoniae* infection form a sizeable group. A number of new antimicrobial agents have become available for CAP. Thus this study has been conducted to identify the etiological agents of CAP and risk factors involved, so that specific treatment is advocated according to their sensitivity pattern.

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Material and Methods

The study comprised of 233 consecutive samples of sputum and blood of patients over 12 years of age with CAP admitted to the Christian Medical College and Hospital, Ludhiana. Detailed history regarding presence of fever, leucocytosis, cough with expectoration was noted from patients of all walks of life. Patients with congestive heart failure, pulmonary infarction, obstructive pneumonia due to lung cancer, leukemia, AIDS, those receiving immunosuppressive therapy, were excluded from the study.

Laboratory Investigations

Two sets of sputum samples for each of the following were collected on two occasions (6-8 hours apart) and subjected to the following investigations.

1. Gram stained smears were examined to see the character of exudates, number and type of micro-organisms. Culture of sputum was done on blood agar with staphylococcus aureus streak and on MacConkey's agar for pyogenic bacteria in an atmosphere of 5-10% CO₂
2. All the sputum samples were also subjected to Z.N staining and culture on L. J. media by standard techniques.
3. Two samples for blood cultures were drawn from two different sites within a gap of 30 minutes and were processed by the BacT/Alert technology in which bottles have an inbuilt calorimetric CO₂ sensor, which changes from green to yellow in the presence of microbial growth. This process is continuously monitored by a solid-state reflectometer in each bottle/ cell and the slightest colour changes are recorded with advanced algorithms and interpreted in the form of growth curves. Bottles indicating growth were subcultured on Blood agar and MacConkey's agar media for aerobic and anaerobic culture.
4. Serological examination: Paired serum samples in the acute and convalescent periods (7-10 days) after the 1st sample were collected and tested for antibodies of Mycoplasma and Chlamydia using the enzyme linked immunosorbent assay (ELISA) (supplied by OSB diagnostics.)
5. Investigative procedures like bronchoscopic, transtracheal and transthoracic needle aspirations were done where sputum samples were not satisfactory.

Criteria for Determination of Microbial Etiology :

The etiology of pneumonia was classified as "definitive", presumptive or unknown according to definitions established previously by Fang and colleagues (2).

A. Definitive : If bacteria considered to be causative agent was isolated from blood culture, transthoracic needle aspiration or thoracocentesis or on serology four fold increase in antibody titre between paired sera or an elevated single titre > 256 x.

B. Presumptive : If bacteria considered to be causative agent showed heavy growth (>10⁷ colony-forming units/ml) on culture or a moderate or light growth (10⁶ or 10⁵) colony forming units/ml and the Gram's stain test was compatible with culture results.

C. Unknown : If bacteria considered to be causative agent doesn't fall in any of above two groups.

Results

Mean age group suffering from CAP was 40 years with maximum number of cases (47 out of 233-20.17%) identified were in the more than 70 years age group. Male predominance was found in the study with 60.5% males and 39.5% females. Male to female ratio was 1.5:1. Fever was the prominent symptom in 92% of patients. The most common risk factor identified was smoking (26.6%) followed by chronic alcoholism (23%), COPD (14%) and diabetes mellitus (13.7%). Maximum number of cases (75.6%) occurred during the monsoon and winter months. Rates of isolation of organisms from Blood culture, Sputum culture were 21.9%, 32% respectively. Serology was positive in 27.1% of cases. AFB were isolated 5.1% of cases. Using the above investigations an etiological diagnosis was made in 47.6% cases (definitive 30.9%, presumptive 16.7%).

The most common organism isolated from blood culture was *Pseudomonas aeruginosa* followed by *Staphylococcus aureus* and *Streptococcus pneumoniae* and those from the sputum culture were *Streptococcus pneumoniae* followed by *Pseudomonas aeruginosa*. Antibodies for *Mycoplasma* were found in 16.5% of cases and for *Chlamydia* in 17.6% of cases as shown in Table-1. Cephalosporins were found to be most effective drug as shown in Table 2.

**Table 1 Distribution of Organisms Isolated from Blood Culture, Sputum Culture and Serology.**

	No	Percentage
Organisms from Blood Culture		
<i>Pseudomonas aeruginosa</i>	10	24.3
<i>Staphylococcus aureus</i>	8	19.5
<i>Streptococcus Pneumoniae</i>	6	14.6
<i>Klebsiella pneumoniae</i>	4	9.7
<i>E-coli</i>	4	9.7
<i>Acinetobacter</i>	4	9.7
<i>Enterobacter</i>	2	4.8
<i>Enterococcus faecalis</i>	2	4.8
<i>Salmonella typhi</i>	1	2.4
Organisms from Sputum Culture		
<i>Streptococcus pneumoniae</i>	22	32.8
<i>Pseudomonas aeruginosa</i>	21	30.9
<i>E.coli</i>	8	11.7
<i>Klebsiella pneumoniae</i>	7	10.2
<i>Acinetobacter</i>	4	5.9
<i>Candida albicans</i>	3	4.4
<i>Aspergillus fumigatus</i>	1	1.4
<i>Staphylococcus aureus</i>	1	1.4
Organisms from Serology		
<i>Chlamydia</i>	...	17.6
<i>Mycoplasma</i>	...	16.5

Table 2 Antibiogram of various Organisms isolated

Antibiotic	Sputum (%)	Blood (%)
Cotrimoxazole	6.9	5.2
Piperacillin	11.2	5.6
Ciprofloxacin	18.5	11.7
Sparfloxacin	14.6	8.6
Cephalaxin	11.6	5.2
Pefloxacin	16.7	8.2
Cefuroxime	15.9	9.4
Cefotaxime	23.2	13.3
Gentamycin	14.2	4.3
Amoxycillin	22.7	10.7
Netromycin	21.0	11.2
Tobramycin	9.9	4.7
Sisomycin	5.2	1.3
Lincomycin	5.2	0.4
Erythromycin	11.2	4.7
Ampicillin	11.2	4.7
Vancomycin	7.3	3.9
Ofloxacin	22.3	10.3
Ceftaxidime	23.2	13.7
Augmentin	11.6	6.4
Cloxacillin	11.2	5.6
Tetracycline	8.2	6.9
Ceftriazone	23.6	13.3
Cefaperazone	23.3	13.3
Cefadroxyyl	23.3	13.3

Discussion

Maximum number of cases (20.17%) of CAP were in the more than 70 years age group. This is in accordance to the earlier studies and in community based studies in Finland,

the rate of CAP increased for each year of age over 50 years (3). The most common risk factor identified was smoking (26.6%), followed by chronic alcoholism (23%), COPD (14%) and Diabetes Mellitus (13.7%). This is no different from the identified risk factors in India and the west (4-5).

The rate of isolation of organism from sputum culture and blood culture was 32% and 22% respectively. Serology was positive in 34% of cases. Indian studies showed sputum culture positivity in 10-33% of patients (6-8). Decreased sputum positivity is due to (a) inability of patients to expectorate due to altered sensorium because of severe disease (b) prior administration of antibiotics (c) 10-30% of patients have non productive cough. Blood cultures are valuable when positive but negative results are more common even in severe pneumonia (7). Positive results were observed in only 10-24% of patients with pneumonia (9-10). Acid fast bacilli were identified in 5% (p value > 0.0005) of cases reflecting that tuberculosis could masquerade as a cause of acute pneumonia. A high prevalence of tuberculosis has been noted in Asian countries. A 3 years prospective study from Japan revealed 5 patients with caseous pneumonia (11). The most common organism isolated from blood culture was *Pseudomonas aeruginosa* followed by *Staphylococcus aureus* and *Streptococcus pneumoniae* and those from sputum culture was *Streptococcus pneumoniae* followed by *Pseudomonas aeruginosa*. The other organisms isolated were *Klebsiella* and gram negative organisms. Fungi like *Candida albicans* and *Aspergillus fumigatus* were identified in very few patients. Atypical pneumonia was found in 34% of cases, with *Mycoplasma* causing 16.5% of infections and *Chlamydia* in 17.6% cases. Though *Streptococcus pneumoniae* have been reported as the commonest organisms causing community acquired pneumonia (1). Indian studies over the last three decades have reported higher incidence of gram negative organisms among culture positive pneumonia (12-15).

In the present study the most common organism cultured from sputum was *Streptococcus pneumoniae* followed by *Pseudomonas aeruginosa*. Barrett Conner (16) *et al* have reported that only in 18.75% patients organism isolated from sputum culture were consistent with those isolated from blood culture indicating that the practice of performing routine sputum culture to diagnose acute bacterial pneumonia may be a sacred cow.



In our study a high incidence of atypical pneumonia (34%) was detected. Mycoplasma pneumoniae was the most common organism against which antibodies were detected, in our patients with CAP (13-37% of all episodes) when serological testing was performed followed by Chlamydia pneumoniae in 17% of patients. In an Indian study at AIIMS Delhi, prevalence of Mycoplasma in CAP was found to be 35% (17). Higher incidence in India might be due to low socioeconomic condition and crowding. In 52% of cases no etiological diagnosis was made. This could be due to prior administration of antibiotics, viral and other atypical pneumonias.

The antibiotics which showed best sensitivity were third generation cephalosporins, fluoroquinolones and aminoglycosides. This is because of the higher incidence of gram negative pneumonia. The largest experience to date for treatment of Pseudomonas aeruginosa pneumonia have been with combination of a broad spectrum beta lactam antibiotic with an aminoglycoside such as gentamycin. The study revealed that CAP can be caused by different bacteriological agents with preponderance of gram negative over gram positive organisms in isolation from the blood but from sputum culture higher number of Streptococcus pneumoniae were isolated from maximum number of cases. If the antibiotic according to the sensitivity pattern is administered to these patients at an early stage of the disease, morbidity and mortality due to CAP can be minimized.

Undiagnosed cases of CAP can be diagnosed by applying serological methods if available so that appropriate treatment can be given to reduce the morbidity in these patients. Management of CAP in community differs from what actually found in antibiogram because patients always start with newer and costly drugs although in CAP Macrolides, and Sulphamethoxazole/Trimethoprim combinations are also effective. In the study of David J. *et al* (18) 2004, out of total of 1043 macrolides resistant streptococcus pneumoniae 91.3% were resistant to tetracyclines, 82.6% were resistant to Trimethoprim - Sulphamethoxazole one isolate was fluoroquinolone resistant. This study was conducted to identify the etiology of CAP as far as possible in relation to various riskfactors and also the antibiogram of these pathogenic organisms as a number of new antimicrobial agents have become available for CAP and the organisms have also evolved different resistance mechanisms against these.

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