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BACTERIOLOGICAL AND CLINICAL PROFILE OF COMMUNITY ACQUIRED PNEUMONIA IN HOSPITALIZED PATIENTS

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ABSTRACT

The aim of our study was to determine the bacteriological and clinical profile of community acquired pneumonia patients requiring hospital admission. CAP was defined as per BTS guidelines. 65/104 cases of study group turned out to be culture positive for definitive bacterial etiology. The Commonest cause for CAP was *Streptococcus pneumoniae* (19/65) followed by, *Klebsiella pneumoniae* (17/65), *Staphylococcus aureus* (13/65), *Pseudomonas aeruginosa* (8/65), *Escherichia coli* (4/65), *Acinetobacter spp.* (3/65). Smoking (52%) and chronic alcoholism (28%) were major risk factors and COPD (23%) and Diabetes mellitus (19%) were major co-morbidities associated with CAP in the study group. The mortality was 8% cases after therapy and *Pseudomonas aeruginosa* was commonest cause of it. Death occurred exclusively in elderly people, all of whom were suffering from co- morbidities and had an initial CURB-65 a score of three. Limitation of our study was the inability to isolate atypical micro organisms. This emphasizes the need for further studies.

KEYWORDS: Sputum culture, Pneumonia, Bacteriological profile, Risk factors, Co-morbidities.



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INTRODUCTION

Lower respiratory tract infections, excluding tuberculosis (TB) are the third most common cause of death worldwide and the most common cause of death in low-income countries¹. Among this community-acquired pneumonia (CAP) is responsible for a large proportion of these deaths despite the availability of potent new anti-microbials. CAP serves as the number one infectious cause and sixth leading cause of death in the United States^{2,3} with an incidence ranging between 3-5 cases per 1000 inhabitants among adults, however, it appears that as many as four million cases of CAP occur annually and as much as 20% of these require hospitalization³. In recent year, both the epidemiology and treatment of pneumonia have undergone changes. Pneumonia is increasingly common among older patients and those with co-morbidity like COPD, diabetes, structural lung disease, cardiac, renal, hepatic failure and other conditions⁴. *Streptococcus pneumoniae* is the most frequent isolate in all geographical areas and in all patient groups with a frequency of approximately 40% of all cases of CAP in adults⁵. Another important Gram-positive cause of pneumonia is *Staphylococcus aureus*. Gram-negative bacteria cause pneumonia less frequently than gram-positive bacteria. "Atypical" bacteria which cause pneumonia include *Chlamydia pneumoniae*, *Mycoplasma pneumoniae*, and *Legionella pneumophila*. The current empirical antibiotic therapy for CAP in adults is based on both general and local microbiology and antibiotic susceptibility patterns⁶, the bacteriological profile is different in different countries and changing with time within the same country, probably due to frequent use of antibiotics, changes in environmental pollution, increased awareness of the disease and changes in life expectancy. For instance, *Pneumococcus* remains the commonest organism in most parts of Europe⁷, United States⁸ and Delhi⁹. The problem is much greater in the developing countries where pneumonia is the most

common cause of hospital attendance in adults¹⁶. In India, also the etiological agent of CAP varies with the geographical distribution. The aim of this present study, conducted in a tertiary referral centre of Maharashtra, with a heterogeneous population representing patients from Western India, is to provide information concerning the bacteriological & the clinical profile of CAP of this region

MATERIALS AND METHODS

The study comprised of 104 patients over 15 years of age admitted with a diagnosis of CAP (as per BTS guideline) in general wards or the Medical ICU due to their disease severity (CURB-65 \geq 2, associated co-morbidity, lack of home support etc.) were included in this study for evaluation after proper screening and ensuring that they satisfy the inclusion criteria. Institute ethics committee approval was taken prior to starting this study. Also written consent was taken from all patients. CAP was defined as per British Thoracic Society (BTS) guidelines²⁵. Patients with evidence of HIV, Leukemia, Lung cancer, Congestive cardiac failure, radiographic evidence of Pulmonary TB, health care-associated pneumonia and on immunosuppressive therapy were excluded from the study. A thorough history was taken from the enrolled patients regarding presence of fever, cough, sputum production and pleuritic chest pain, followed by a detailed clinical examination. After this baseline investigations like complete haemogram, liver function tests, Renal function tests, HIV status, Chest x-rays, Electrocardiogram, Arterial blood gas analysis when indicated was carried out. Sputum collection was done at the time of admission prior to antibiotic administration in as much as cases possible. This was subjected to Gram stain & Ziehl Nelson (ZN) staining and routine aerobic bacterial culture. Sputum containing more than 25 polymorphonuclear cells and less than 10 epithelial cells per low power field was subjected to gram staining. Acid fast

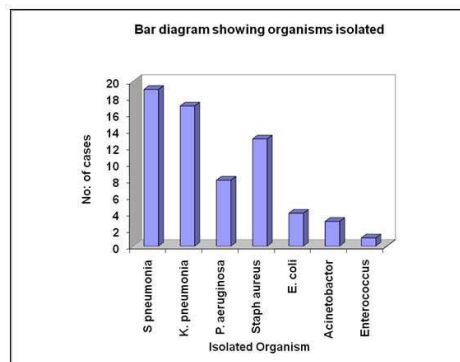
microscopy (direct smear) was done according to ZN technique recommended by the World Health Organization. Sputum was also subjected to aerobic bacterial culture on blood agar and MacConkey agar media. In patients who could not expectorate sputum spontaneously, sputum induction was done by nebulisation with 3% hypertonic saline. Also patients in whom Para-pneumonic effusion was suspected, thoracentesis was done and their respective pleural fluid samples were sent for ZN stain, Gram staining & aerobic bacterial culture. Fiber optic bronchoscopy for broncho-alveolar lavage fluid when indicated was done in selected patients where adequate sputum were not obtained for investigation and bacterial isolation were not possible by other means. This also was subjected to similar investigations mentioned above. Also Blood culture was done in every patient included in this study. Two samples of blood culture were drawn in every possible cases from two different sites (Anticubital veins of both arms in most of the cases) at least 30 mins apart and were inoculated in blood agar & MacConkeys agar media respectively.

RESULTS

Out of the initial 104 CAP suspected patients which were enrolled as per BTS guidelines 65 people (63%) turned out to be culture positive for bacteriological etiology and was included in the study group. Among rest 18 patients (17%)

turned out to be Gram stain Positive, but their respective cultures didn't show any growth and was not included in the study group. The reason for this was well supported by the high percentage (78%) of patients who used prior antibiotics which led to culture negativity. Also the AFB positive patients were not included in the study group. In this series, 47 male patients and 18 female patients were studied. Two-third (68%) of total study population was more than 50 years of age. Largest patient pool was 37% between 50-64 years of age. 31% patients aged more than 65 years. More than half of the study population (52%) was exposed to smoking and 28% was exposed to alcoholism. Addiction was almost exclusively prevalent in male patients. *Streptococcus pneumoniae* (79%) has got strong association with smoking and *Klebsiella pneumoniae* had a strong relationship with alcoholic patients (65%) COPD was the commonest co-morbidity (23%). Followed by Diabetes Mellitus (19%) and Bronchiectasis (6%). Other co-morbidities include Asthma (2%), Congestive heart failure (5%), Chronic Kidney disease (2%), Dementia in (2%). Commonest isolated organism in this series was *Streptococcus pneumoniae* (19/65), followed by *Klebsiella pneumoniae* (17/65), *Staphylococcus aureus* (13/65), *Pseudomonas aeruginosa* (8/65), *Escherichia coli* (4/65), *Acinetobacter spp.* (3/65), *Enterococcus spp.* (1/65) was also isolated. Gram Positive organisms constituted 51% of the isolates and 49% by Gram Negative organisms.

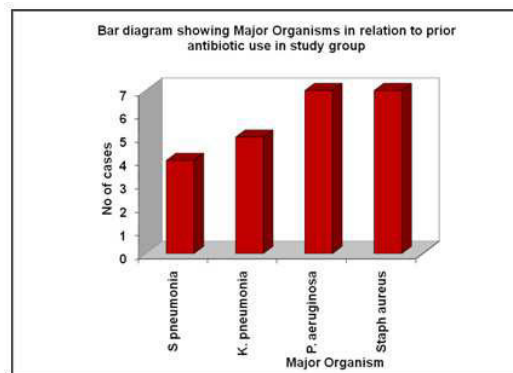
Graph 1
Organisms isolated from sputum, blood, pleural fluid and Broncho-alveolar lavage cultures



Pneumococcus was more common in the older age group > 65 years (40%) in comparison to the younger people (29%), Also a similar trend was seen with *Klebsiella* and other GNB organisms which were commoner in the CAP patients more than 50 years of age. *Pneumococcus* was the commonest isolate in COPD (24%) followed by

Pseudomonas (22%). Diabetics were more prone to *Klebsiella pneumoniae* (54%) followed only by *Pseudomonas* (23%) and *S.aureus* (15%). Incidence of *Pseudomonas aeruginosa* and *S. aureus* was commonest among patients having a prior history of antibiotic intake and history of hospitalization.

Graph 2
Major Organisms in relation to prior Antibiotic use in study group



Organism isolation was done in about half of the patients (44%) from sputum and in 30% patients from blood. BAL fluid (6%) and pleural fluid (14%) were another major source. Most of the patients had initial CURB-65 score of either 2 (48%) or 3 (35%). Mean duration of recovery in culture positive study group (65 patients) was 11.20 days, whereas mean duration in culture negative group (18 patients) was 7.94 days. Difference in mean recovery period between these two groups of patients was significant with P value < 0.001. The mortality was 8% cases after therapy. Four out of five deaths were infected with *Pseudomonas*. Death occurred exclusively in elderly people, all of whom were suffering from co- morbidities and had an initial CURB-65 a score of three. Multi Organ failures were the ultimate causes of death.

STATISTICAL ANALYSIS

Data was analyzed using the following statistical model Software 11 by Chi- Square and Z test and was represented by Pie chart and composite Bar diagram.

DISCUSSIONS

Despite the use of conventional methods & invasive procedures microbiological diagnosis of CAP could be confirmed only in among 63% of bacteriologically diagnosed patients. Out of this 32% belong to < 50 years of age group and rest 68% were ≥ 50 years of age, among this 37% of the total population aged between 50-64 years; they constitute the largest patient pool. 20 patients (31%) were aged more than 65 years. This is in accordance with the earlier studies, like community based studies done in Finland in the year of 2000, which showed that the rate of CAP increased for each year of age over 50 years¹⁰. Our study group consists predominately of male patients (72%) and only (28%) patients were females. Male & female ratio is maintained for all the age groups (2:1) in this population. In a nationwide hospital based study of community-acquired pneumonia in the elderly in Pittsburgh, included a total number of 623,718 cases of hospitalized elderly CAP patients as the study cohort¹¹. They found that although there were more women in the study

cohort, the incident rate of CAP was higher in men (19.4 versus 15.6 cases per 1000 population, ($p < 0.001$)). The higher incidence of CAP persisted across all age groups. There are still controversies whether the incidence of CAP is more common among men than women, researchers observed that men who come to the hospital with pneumonia generally are sicker than women and have a higher risk of dying over the next year, despite aggressive medical care. They found significant difference between men and women in the level of TNF, IL-6, IL-10, AT-III, factor IX, plasminogen activator inhibitor-1 and D-dimer and concluded this might be linked to difference in immune response¹¹. Even after adjusting several social and demographic characteristics, it is shown that men have a 30 percent higher risk of death¹². This further explain the genetic and immunological role. Among 65 patients 52% were smokers and 28% were using alcohol. In a study conducted in North-India revealed that smoking as the most

common risk factor for CAP (as high as 65%)¹³. In our study we observed that COPD (23%) was the most common associated co-morbidity associated with CAP patients. The Second largest group was suffering from Diabetes Mellitus (19%). This was followed by Bronchiectasis (6%) and Congestive Heart Failure (5%), Cerebro vascular disease (4%), Seizure disorder (4%), Bronchial Asthma (2%), Dementia (2%), Interstitial Lung Disease (2%), Chronic Kidney Disease (1%). Studies done in the past two decades have shown that the majority of patients with severe CAP had co morbidities. Studies in the west showed that the most common co morbidity was COPD, present in one-third to one-half of patients, followed by alcoholism, chronic heart disease and diabetes mellitus¹⁹. Similar studies were also done in different parts of India and they showed that there is no difference in identified risk factors in India and West^{14, 15}.

Table 1
Distribution of CAP cases according to
Co-morbid illnesses

Co-morbidity	No. of cases	Percentage (%)
COPD	17	23
Diabetes Mellitus	13	19
Congestive Heart Failure	4	5
Bronchiectasis	4	6
Cerebrovascular Disease	2	4
Seizure disorder	2	4
Bronchial Asthma	2	2
Dementia	1	2
Interstitial Lung Disease	2	2
Chronic Kidney Disease	1	1
Carcinoma Pancreas	1	1
No Co-morbid Illness	20	34

The Majority of the isolated micro organisms were isolated from sputum gram stain and routine aerobic bacterial culture (43%). This observation supports the recommendations of IDSA and Canadian Thoracic Society (CTS) for routine sputum analysis in all inpatients suffering from CAP^{20, 21}. Blood culture showed growth of 30%. The most common isolated organism was *Streptococcus pneumoniae* (19/65) patients in study group when all age groups were considered followed by *Klebsiella pneumoniae* (17/65), *Staphylococcus aureus*

(13/65), *Pseudomonas aeruginosa* (8/65), *E. coli* (4/65), *Acinetobacter spp.* (3/65) and *Enterococcus* (1/65). It was also noted that gram negative organisms constitute more than 50% of the isolated organisms in >50 years age group patients, among which *Klebsiella pneumoniae* alone constitute 25% (in the age group 50-64 years) and 35% (in age group > 65 years). Also it was noted that *Streptococcus Pneumoniae* was the predominant organism (40%) causing CAP in patients > 65 years of age. *Streptococcus pneumonias* have been

identified as the commonest organism causing CAP in hospital and non-hospitalized patients all over the world^{9, 16-17}. *Streptococcus pneumoniae* has also got strong association with smokers, which was seen among 79% of the total cases isolated. There are various studies which support our observation that *S. pneumoniae* is predominant among smokers¹⁹. *Klebsiella* was showing a strong association with alcohol. 65% of cases were associated with alcoholism, which is highly significant. Alcohol consumption increases the relative risk for CAP with a dose response relationship¹⁸. *Streptococcus pneumoniae* is found more frequently in patients with alcohol abuse¹⁸. Increased prevalence of *Klebsiella* in alcohol users is also been reported¹⁸. CAP is also observed to be more severe in alcoholics, but mortality is not different¹⁸. But several other studies, have reported higher incidence of gram negative organisms among culture positive pneumonias and most of the patients from whom gram negative bacteria was isolated were over 50 years of age, smokers and had COPD²⁴. It has been reported that old age, smoking and COPD impair pulmonary defenses and pre-dispose to CAP caused by Gram negative bacteria. Similar types of findings were also reported from Indian studies²². A major pitfall of our study was that we could not identify any atypical microorganisms as the causative agent of CAP. This was due to the lack of resources to perform serological tests for atypical pathogens and also anaerobic bacterial culture. The Mortality rate in our study was 8% despite therapy. In various hospitals based studies mortality rate was variable, being 5.7% in a British Thoracic Society multi centric study²⁶ and other studies noted a higher mortality rate²⁷. *Pseudomonas aeruginosa* was the commonest organism isolated among mortality group and *S. aureus* infection was also noted. An article published in 2008 by the Asian Network for surveillance of resistant pathogens comparing the outcome of CAP caused by GNB with those of patients with non-GNB pneumonia showed

that mortality was significantly higher in the GNB group than non-GNB group²³. Other contributing factors of death in our study group were age (>65 yrs) of the patients, CURB-65 (>3 score) at the time of admission and the presence of one or more co-morbidities. Multiple organ dysfunctions were the cause of death in all CAP patients in our study group. In our study etiology of CAP was determined in 63% of patients compared with other Indian studies which showed 75.6% in Shimla²⁸, 47.7% in Chandigarh²⁹. In 37% of our patient's causative agent was could not identified. This emphasizes the need for further investigations in CAP suspects to establish the etiological agent, which can help in reducing mortality associated with it.

CONCLUSION

Gram negative bacteria predominate among the bacteriological profile of CAP especially in the elderly population. The most predominant organism responsible for CAP was *Streptococcus pneumoniae* in our study. The high prevalence of *Klebsiella pneumoniae*, *Staphylococcus aureus* and *Pseudomonas aeruginosa* in our study can be explained by the presence of risk factors and co-morbidities among the patients, we received by a wide range of disease severity in our tertiary care hospital. Like other studies of CAP even our study also shows that smoking, alcohol intake are major risk factors and COPD, DM are major co-morbidities. Our attempt was to collect local data on CAP pathogens which will help to establishing own local prescribing policies and can lead to improvement in morbidity, mortality and also cost effectiveness of treatment of hospitalized CAP patients. Though this is not a true population based study with some limitations like the inability to isolate atypical organisms, results of this study would guide and encourage other researchers to do more work on CAP in this region.

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