

## Research Article

# A bacteriological study of acute exacerbation of chronic obstructive pulmonary disease over a period of one year

Devanath Sosale Narayanagowda\*, Saroj Golia, Jyoti Jaiswal, Suhani Srinivas Manasa

Department of Microbiology, Dr. B R Ambedkar Medical College, Bangalore, Karnataka, India

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### \*Correspondence:

Dr. Devanath Sosale Narayanagowda,  
E-mail: [drdevanath@gmail.com](mailto:drdevanath@gmail.com)

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## ABSTRACT

**Background:** The aim of our study was to analyse the hospital data on AECOPD in patients with special reference in males and female cases, the pathogens involved, antibiotic susceptibility pattern.

**Methods:** 107 patients (72 males, 35 females) aged between 45 and 85 years were included in the study. A detail history was elicited and complete examination was done. The sputum specimen was collected using sterile sputum cups and subjected to Gram's stain, culture and biochemical reactions.

**Results:** Our study shows 44 positive sputum cultures out of total 107 cases. Out of 107 cases 67% were males and 33% were females. The predominant clinical feature observed in our study was cough with expectoration, exertional dyspnoea and production of mucopurulent sputum. The prevalence of Gram negative bacteria was 55% and Gram positive bacteria was 45%. *Klebsiella pneumoniae* was the commonest bacteria isolated (38%) followed by *Staphylococcus aureus* (18%). The drug sensitivity reveals that 79.55% of the isolates were sensitive to amikacin followed by 68.18% sensitive to amoxycyclavulinic acid and 54.55% of the isolates were sensitive to ciprofloxacin.

**Conclusions:** In a developing country like India AECOPD is more common in adults more than 55 years of age due to smoking habits and high indoor pollution. This leads to a major impact on the quality of life of patients with the condition. They are a major cause of hospital admission and health care utilization.

**Keywords:** AECOPD, Aetiology

## INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a spectrum of disorders that results in airflow obstruction. At one end of the spectrum is chronic bronchitis, which is characterized by airway inflammation, mucus hyper secretion and airway reactivity. At the other end of the spectrum is emphysema, characterized by alveolar destruction and small airway abnormalities. Air trapping and hyperinflation are common at both ends of the spectrum. In reality, most COPD patients have features of both.<sup>1</sup>

Acute exacerbation of COPD (AECOPD) is defined as a sustained worsening of the patient's condition, from the stable state and beyond normal day-to-day variations, that is acute in onset and necessitates a change in regular medication in a patient with underlying COPD.<sup>2</sup>

### Staging of AECOPD

The severity of AECOPD without respiratory failure can be classified traditionally according to Winnipeg criteria. The three-stage system is based on three principal symptoms:

1. Increase in sputum volume
2. Increase in sputum purulence
3. Increase in shortness of breath

### **The Winnipeg criteria**

Type of exacerbations:	Criteria:
Type 1	All the 3 symptoms described above.
Type 2	Any 2 of the above symptoms.
Type 3	Any 1 of the above plus at least 1 of the following: Upper respiratory tract infection lasting $\geq 5$ days, fever, increase in wheezes, increase in cough, and increase in heart rate 20%. <sup>3</sup>

Chronic obstructive pulmonary disease (COPD) is the most common respiratory disorder encountered in clinical practice. It constitutes 30% of cases seen in chest clinics and accounts for 1-2.5% admissions in hospitals all over India.<sup>4</sup>

Acute exacerbation of COPD showed a hospital mortality rate of 24% if the patient required ICU admission. This mortality rate increased to 30% if the patient was above 65 years.<sup>5</sup>

It is both a rural and urban health problem, the prevalence varying from 1% in urban nonsmoker to 21% in rural smokers. This increasing prevalence and mortality has led to an extensive research related to these diseases. Much has been learnt about pulmonary response to irritants, particulate antigenic materials and infectious agents.<sup>4</sup>

In COPD, acute exacerbation is the common problem during natural course. The study is about the bacterial etiology in the course of disease. COPD is fourth most common cause of death in countries like USA. Both the prevalence and mortality from this disease has been increasing worldwide.<sup>6</sup>

Several potential contributions of bacterial infection to the etiology, pathogenesis and clinical course of COPD can be identified. Three classes of pathogens have been implicated as causing acute exacerbation of COPD by infecting the lower respiratory tract: respiratory viruses, atypical bacteria, and aerobic Gram-positive and Gram-negative bacteria. The relative contributions of these three different classes of pathogens may change depending on the severity of the underlying obstructive airway disease. Such changes may also happen within a class, especially for bacterial pathogens.<sup>7</sup>

However the precise role of bacterial infection in COPD has been a source of controversy for several decades. Opinion regarding the contribution of bacteria to the pathogenesis of COPD has ranged from the idea that has

a preeminent role (along with hyper secretions) as embodied in the British hypothesis in the 1950 and 1960's to the idea that it is a mere epiphenomenon in the 1970 and 1980's.<sup>7</sup>

In the last decade with the increasing use of fiber optic bronchoscopy, newer sampling methods like Trachea Bronchial Aspirated Sample (TBAS), Broncho Alveolar Lavage Fluid (BALF), and Protected Specimen Brushing (PSB) have emerged.<sup>8</sup>

This has renewed interest in the area of bacteria and COPD, and this should lead to a precise delineation of the contribution of bacterial infection to the disease.<sup>9</sup>

### **Aims and objectives**

1. To find out the incidence of acute exacerbation of chronic obstructive pulmonary disease in the cases admitted to Dr. B.R. Ambedkar Medical College, Bangalore.
2. To study the type of bacterial infections in acute exacerbations of chronic obstructive pulmonary disease.
3. To study the antibiotic sensitivity patterns of isolated organisms.

## **METHODS**

### **Source of DATA**

All the patients of acute exacerbation of chronic obstructive pulmonary disease admitted in medicine ward, chest and tuberculosis ward in Dr. B.R. Ambedkar Medical College and Hospital, Bangalore.

One hundred and seven patients clinically diagnosed case of acute exacerbation of chronic obstructive pulmonary disease were included in the study.

Variables included for the study were age, sex, smoking, signs and symptoms of the patient. The information regarding these variables was collected by using a pretested questionnaire.

Period of study: cross sectional study over a period of one year. (1<sup>st</sup> July 2014 to 31<sup>st</sup> June 2015)

### **Inclusion criteria for the case**

All clinically diagnosed Acute Exacerbation of Chronic Obstructive Pulmonary disease cases admitted in Dr B.R. Ambedkar Medical College and Hospital, Bangalore.

### **Exclusion criteria for the case**

- Bronchial asthma/lung abscesses/lung cancer
- Subjects who were recently started on antibiotic therapy

- Known case of pulmonary Koch's
- Ischaemic heart disease.

### **Sputum culture**

After collection and assessing the sputum, sample was sub cultured on following culture plates.

- 1) Blood agar - 5% sheep blood agar for isolation of hemolytic organisms.
- 2) Chocolate agar - For Haemophilus and Neisseria species.
- 3) MacConkey's agar - for isolation and differentiation of Gram negative bacilli.

These inoculated plates were then incubated for a period of 24 hours after which they were examined for evidence of bacterial growth. In case of bacterial growth on the medium, the bacteria were further identified using standard tests.

In case of no growth occurring on plates, a report of no organisms grown on culture after 24 hours of incubation was dispatched to the respective units.

The following tests were performed according to standard methods:

- Grams staining
- Hanging drop
- Catalase test
- Oxidase test
- Indole
- Methyl red test
- Voges proskauer test
- Citrate utilisation test
- Urease production
- Hydrogen sulfide production
- Sugar fermentation test
- Nitrate reduction test
- Coagulase production (for Staphylococci)
- Bile solubility test (for Streptococcus pneumoniae)
- Blood agar - Bacitracin (for  $\beta$ -haemolytic Streptococci) and optochin sensitivity (for Pneumococci)

### **Antibiogram**

Antibiotic sensitivity test of the isolates were performed on Mueller-Hinton agar plates by the disc diffusion method of Kirby-Bauer. Before using, the plates were dried for 10-30 minutes at 37°C by placing them in an upright position in the incubator or with lids tilted.

After the plates were dried broth suspension of the organisms was made and adjusted to McFarland's opacity

factor 0.5. A lawn culture was made over the surface of the media using a sterile swab, then appropriate antibiotics disc were placed and incubated at 37°C for 24 hours after which reading were taken. The zone of inhibition was measured and reported.

Sensitivity was performed using control strains of Klebsiella pneumoniae ATCC 700603, Staphylococcus aureus ATCC 25923, E. coli ATCC 25922, and Pseudomonas ATCC 27853.

## **RESULTS**

A total of one hundred seven (107) patients, clinically diagnosed as cases of acute exacerbation of chronic obstructive pulmonary disease, admitted to the Tuberculosis and chest ward & Medicine ward of Dr. B.R Ambedkar Medical College and Hospital were studied. A sputum samples from hundred (100) normal patients were included as a controls in the study.

Bacterial infections of AECOPD were analyzed. The individual bacterial isolates and their sensitive pattern to various antibiotics were also recorded.

### ***Incidence of acute exacerbation of chronic obstructive pulmonary disease***

Out of three thousand four hundred and ninety (3490) patients admitted in the Tuberculosis and chest ward & Medicine ward of Dr. B.R Ambedkar Medical College and Hospital from (1<sup>st</sup> July 2014 to 31<sup>st</sup> June 2015) AECOPD was diagnosed in one hundred and seven (107) patients. Incidence of AECOPD was 3%.

### ***Age distribution***

The age group of the patient in the study, ranged from forty five to eighty five years. Out of one hundred and seven (107) patients, the most common age group was fifty five to sixty five years (40.19%). The next common age group was sixty five to seventy five years (32.71%). (Table 1).

**Table 1: Showing age distribution among 107 AECOPD patients.**

Age	Number	Percentage
45	13	12.15%
55	43	40.19%
65	35	32.71%
75	13	12.15%
>75	3	2.80%

### ***Sex distribution among AECOPD cases***

Out of one hundred and seven (107) patients, clinically diagnosed as Acute exacerbation of chronic obstructive pulmonary disease, seventy two (72) (67%) were males

and thirty five (35) (33%) were females. The ratio between male and female is 2.06:1 (Table 2).

**Table 2: Showing sex distribution among the 107 sputum samples.**

Sex	Number	Percentage
Males	72	67.29%
Females	35	32.71%

### Smoking index

Out of one hundred and seven (107) patients, seventy two (72) were male patients. Out of seventy two (72) 45 (62.5%) were smokers and twenty seven (27) (37.5%) were non-smokers (Table 3).

**Table 3: Showing the smoking pattern in males.**

Smoking/Non-smoking	Number	Percentage
Smoking	45	62.5%
Non-smoking	27	37.5%

### Bacteriological profile

One hundred and seven (107) sputum samples were subjected to culture study. Out of which forty four (44) (41%) were positive for pathogenic bacteria and sixty three (63) (59%) were non-pathogenic (Table 4).

Out of forty four (44) pathogenic bacteria isolated, thirty nine (39) had single microbial infections and five (5) had polymicrobial infections (Table 4).

**Table 4: Showing the growth pattern in 107 sputum samples.**

Growth	Number	Percentage
Single isolates	39	36.45%
Multiple isolates	5	4.67%
Non pathogenic	63	58.88%

Among thirty nine (39) single pathogenic microbial growth twenty seven (27) (55%) were Gram-negative bacteria and twenty two (22) (45%) were Gram-positive bacteria.

Out of thirty nine (39) single pathogenic bacteria, *Klebsiella pneumoniae* was the commonest bacteria isolated, in fifteen (15) cases, followed by *Staphylococcus aureus* isolated in seven (7) cases. *Streptococcus pneumoniae* was isolated in six (6) cases. Other common organisms isolate were *Pseudomonas aeruginosa* in four (4) cases, *Streptococcus pyogenes* in three (3) cases.

*Escherichia coli*, Methicillin Resistant *Staphylococcus aureus* (MRSA) were isolated as two (2) and two (2) cases respectively.

**Table 5: Showing organism isolated from sputum culture.**

Name of the organism	Number	Percentage
<i>K. pneumoniae</i>	15	38.46%
<i>S. aureus</i>	7	17.95%
<i>S. pneumoniae</i>	6	15.38%
<i>P. aeruginosa</i>	4	10.26%
<i>S. pyogenes</i>	3	7.69%
<i>E. coli</i>	2	5.13%
MRSA	2	5.13%
<b>Total</b>	39	

### Antibiotic sensitivity patterns of the isolates

- *Klebsiella pneumoniae*, which was the most common isolate, was sensitive to amikacin, ciprofloxacin and netilmicin.
- *Staphylococcus aureus*, which was the next common isolate, was sensitive to amoxycyclavulinate, penicillin, erythromycin, gentamicin amikacin, netilmicin, and co-trimoxazole. 28.5% of *Staphylococcus aureus* were methicillin resistant (MRSA).
- *Streptococcus pneumoniae* was sensitive to ampicillin, gentamicin, amikacin co-trimoxazole, penicillin, and erythromycin.
- *Pseudomonas aeruginosa* was mainly sensitive to piperacillin, amikacin and gentamicin.
- *Strep. pyogenes* was sensitive to ciprofloxacin and gentamicin, penicillin.

*Escherichia coli* were sensitive to amikacin, ciprofloxacin, ceftriaxone and cefotaxime (Table 6).

**Table 6: Antibigram (Sensitivity).**

Antibiotics	No. of isolates	Percentage
Amikacin	35	79.55%
Ampicillin	13	29.55%
Amoxy-clavulinic acid	30	68.18%
Cefotaxime	18	40.91%
Ceftriaxone	26	59.09%
Ciprofloxacin	24	54.55%
Co-trimoxazole	12	27.27%
Gentamicin	12	27.27%
Netilmicin	14	31.82%
Pipercillin	3	6.82%
Vancomycin	7	15.91%
Oxacillin	9	20.45%

Sputum samples studied from hundred cases as control group showed non-pathogenic growth (commensals) in all the cases.



## DISCUSSION

AECOPD have a major impact on the quality of life of patients with the condition. They are a major cause of hospital admission and health care utilization.

In our study it was observed that AECOPD was prevalent in 45-85 year age group. However among them, 55-65 year age constituted 40.19%. Thus AECOPD was common above 55 years. This observation corresponds to other similar studies. This is because it was more commonly seen in patients with advanced lung disease as an expression of deterioration in host defenses at the bronchial mucosal level.<sup>10</sup> Out of one hundred and seven (107) patients, clinically diagnosed as Acute exacerbation of chronic obstructive pulmonary disease, seventy two (72) (67%) were males and thirty five (35) (33%) were females. The ratio between male and female is 2.06:1, which is similar to study conducted in April 2014 by Wipa Reechaipichitkul<sup>11</sup> which showed out of 183 patients male to female ratio is 170:13. In our study AECOPD was more common among smokers 62.5% than non-smokers 37.5% which was similar to other studies.<sup>4,6</sup>

The prevalence of Gram negative isolates was 55%, as compared to 45% of gram positive. The Gram negative organisms were more common in the patients with the most severe lung dysfunction, whereas the Gram positive bacteria predominated in the exacerbations of the patients with the mildest degree of lung function abnormalities.<sup>12</sup> which matched with study conducted by Rakesh et al.<sup>13</sup> who found among the thirty seven single pathogenic microbial growth 19 (51.35%) were Gram negative bacteria and 18 (48.64%) were Gram positive bacteria.

Among the Gram negative isolates, K. pneumonia was the predominant organism isolated 38.46%, Staphylococcus aureus 17.95%, S. pneumoniae 15.38%, P. aeruginosa 10.26%, S. pyogenes 7.69%, E coli 5.13%, MRSA 5.13%. H influenzae was not isolated whereas study conducted by Alexandra et al.<sup>14</sup> in 2014 H influenza predominates with 23.9% followed by Pseudomonas aeruginosa with 14.1%. Study conducted by Patel et al.<sup>15</sup> in Dec 2014 showed Streptococcus pneumonia to be the major cause with 32% followed by S. pyogenes (16%) and Pseudomonas (12%).

The drug sensitivity reveals that 79.55% of the isolates were sensitive to amikacin followed by 68.18% sensitive to amoxycloxacillin and 54.55% of the isolates were sensitive to Ciprofloxacin which is similar to study conducted by Chawla et al.<sup>16</sup> in 2008 who found quinolones to be most effective whereas Patel et al.<sup>15</sup> showed piptaz more effective than quinolones.

## CONCLUSION

Sputum culture is a good and simple tool to study the aetiology & complications due to bacteria in AECOPD. If done well, it can replace the costlier diagnostic methods

like immunodiffusion. Antibigram helps in the correct treatment protocol during management of AECOPD. It also helps in screening resistant pathogens and better drug for treatment, thereby helping to decrease the mortality and morbidity. To conclude, in addition to the host genetic factors, smoking behaviour, accessibility to health care and presence of co-morbid conditions contribute to morbidity and mortality due to AECOPD.

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