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Prospective Study on Prevalence of Bacterial Exacerbation of Copd and Sensitivity Patterns of Antibiotics in a Tertiarycare Hospital

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ABSTRACT

Background: acute exacerbations are common in people with chronic obstructive pulmonary disease (COPD), a condition that significantly impacts the course of the disease. Infections are a major cause of acute exacerbation of chronic obstructive pulmonary disease (AECOPD), which has a high morbidity and mortality rate. Many previous studies have concluded that bacteria are the primary cause of these exacerbations. As a result, we carried out a prospective study to investigate the bacteriological profile and the pattern of antibiotic sensitivity of bacteria isolated from sputum samples. Method: the study involved 150 hospitalised patients of both genders diagnosed with AECOPD. Sputum samples from all the patients were collected and subjected to gram staining, bacterial culture, and antibiotic sensitivity. Results: culture was found to be positive in 101 (67.33%) of the patients. Gram-negative bacteria outnumbered gram-positive bacteria 78% to 22%. Klebsiella pneumonia was the most common pathogen isolated (15.33%), followed by Pseudomonas aeruginosa (12.67%). E. Coli (3.33%), Haemophilus influenza (6.67%), and Acinetobacter (6.0%).Amikacinand Gentamycin are effective treatments for the majority of gram-negative bacteria, while Vancomycin ,Cefazolin and Linezolid are effective treatments for gram-positive bacteria. Conclusion: gram-negative organisms accounted for the majority of exacerbations in our area; therefore, these aetiologies with sensitivity patterns should be taken into account before starting a patient on empirical antibiotic therapy.

KEYWORDS: Chronic obstructive pulmonary disease, acute exacerbation, Antibiotics, Sensitivity pattern

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a lung disease that is becoming a major global health concern. It was the third leading cause of death worldwide in 2019, and experts predict it will become the leading cause within 15 years (1).Between 2007 and 2017, there was a 15.6% increase in COPD cases, especially in older people, but it decreased by 10.1% in men (2). Chronic Obstructive Pulmonary Disease (COPD) is a highly prevalent, preventable, and treatable medical condition characterized by persistent respiratory symptoms and the restriction of airflow. These clinical manifestations typically result from structural abnormalities within the airways or alveoli, predominantly attributed to significant exposure to noxious particles or gases. A defining hallmark of COPD exacerbation is the sudden exacerbation of respiratory symptoms, necessitating immediate additional medical intervention. (5)

Exacerbation can be triggered by various risk factors, including passive or active tobacco exposure, contact with dust, fumes, or chemical gases, indoor or outdoor air pollution, as well as infection by bacteria or viruses.(3)

Acute Exacerbations of Chronic Obstructive Pulmonary Disease (AECOPD) can be precipitated by three distinct classes of pathogens, namely respiratory viruses, atypical bacteria, and aerobic gram-positive and gram-negative bacteria(3).Numerous research studies have provided substantiated evidence regarding the coexistence of viral and bacterial infections.The causative agents for the majority of bacterial infections are Haemophilus influenza, Moraxella catarrhalis, Streptococcus pneumoniae, and Staphylococcus aureus. (4)

Antibiotics are used to treat more than 90% of AECOPD patients, although many of these medications may not be as effective as they once

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were due to the introduction of resistance strains in the majority of common respiratory bacteria. Based on the local bacterial resistance pattern, antibiotic selection should be made (Global Initiative for Chronic Obstructive Lung Disease [GOLD], 2015).Despite the fact that culture studies are now crucial for choosing antibiotics correctly, most primary and secondary care institutions lack them due to their time- consuming nature. (6)

The emergence of antimicrobial resistance has considerably increased the effect of infectious diseases, increased the number of infections, and raised healthcare expenses. Even while we have a very wide range of antimicrobial drugs to choose from for potential infection therapy, there is proven antimicrobial resistance to all of these, and this resistance develops soon after a new antibiotic is given the go-ahead for use. These worries motivated the WHO to develop a Global Action Plan on Antimicrobial Resistance in 2015. (7)

To minimise disease progression and consequences related to AECOPD in patients, it is therefore preferable to have knowledge of the pattern of bacterial flora and their antibiotic susceptibility in a specific geographic location. (6). This prospective study aims to determine the prevalence of COPD exacerbations caused by bacteria, the bacteria that cause COPD, and the sensitivity of the causative bacteria to antimicrobials.

II. MATERIAL AND METHOD

The study was conducted within a 700-bedded tertiary care teaching hospital, specifically in the inpatient pulmonology department, from January 11, 2022, to May 31, 2023, spanning a period of 6 months. This study enrolled 150 patients randomly selected from the pulmonology inpatient department, following confirmation of their eligibility based on inclusion and exclusion criteria. The hospital-based prospective observational study focused on patients with clinical symptoms indicative of COPD such as progressive dyspnoea, chronic cough, and chronic sputum production, along with a relevant history of risk factor exposure or a family history of COPD. Patients meeting the criteria for acute exacerbation of COPD (AECOPD) were enrolled based on the presence of at least two of the following symptoms: worsening dyspnoea, increased cough, and increased sputum production. Ethical approval was obtained from the institutional ethics committee, and informed consent was obtained from all study subjects. Data collected from each subject included age, gender, presenting symptoms, history of smoking, duration of smoking, and past medical history. Routine investigations, chest radiographs, and ECG's were conducted for all patients, while a CT scan of the thorax was performed in selected cases. Additionally, sputum samples were collected and sent for sputum culture and sensitivity testing.
The SPSS software program was utilized to input and analyse all the data. Categorical variables will be presented as percentages in the report.

III. RESULT AND DISCUSSION:

PREVALENCE OF BACTERIAL EXACERBATION OF COPD:

Table 1

Sl No	BACTERIOLOGICAL PROFILE	FREQUENCY	PERCENTAGE
1	PATHOGENIC	101	67.33 %
2	NON PATHOGENIC	49	32.67%

A prospective observational study enrolled 150 patients admitted to the pulmonary department diagnosed with exacerbations of COPD. Out of 150 patients, 101 (67.33%) were diagnosed with bacterial pathogenic exacerbations, and 49 (32.67%) were diagnosed with non-bacterial causes, which include viruses, fungi, and environmental factors.

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GENDER WISE DISTRIBUTION:

Table 2

Sl No.	GENDER	FREQUENCY	PERCENTAGE
1	Male	103	69%
2	Female	47	31%
3	Total	150	100%

This table reveals that, based on gender-wise distribution, 69% of males who are either smokers or non-smokers are more prevalent to have infective exacerbation COPD than females (31%). After this study, we found out that infective exacerbation of COPD was more prevalent in males (69%) than females (31%).

SMOKING CHARACTERISTICS

Table 3

Sl .NO.	SMOKING PATTEREN	NUMBER	PERCENTAGE
1	ACTIVE SMOKER	71	47.3%
2	EX-SMOKER	34	22.67%
3	NON SMOKER	45	30%
4	TOTAL	150	100%

By observing the above table, smoking is one of the most common causes of COPD. In our study, the majority of enrolled patients are current smokers (47.3%), while 30% are non-smokers, and the majority of them have been exposed to biomass fuel since their younger age. 22.67% of the study population were ex-smokers.

Table 4

Sl.No	AGE	MALE	FEMALE	PERCENTAGE
1	18-35	0	0	0%
2	36-45	2	0	1.33%
3	46-55	21	11	21.33%
4	56-65	29	15	29.33%
5	66-75	30	9	26%
6	76-85	21	12	22 %
7	Total	103	47	100%

Based on age-wise distribution, out of 150 patients, 43 in in age group of 56 to 65 were more prevalent; of these, 29 were males and 15 were females.

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OCCUPATIONAL RISK-BASED CATEGORISATION:

Table 5

Sl.No	OCCUPATION	FREQUENCY	PERCENTAGE
1	HOUSE WIFE	43	29 %
2	BLACK SMITH	18	12 %
3	CONSTRUCTION	21	14 %
4	MINNING	30	20 %
5	FLOUR MILL	10	6 %
6	OTHERS	28	19 %
7	Total	150	100%

The majority of enrolled patients are at occupational risk of developing AECOPD. According to Table No. 5, the highest-risk occupation was housewives (29%); they were exposed to biomass fuel from a younger age; 20% are mining labourers; and 14% are construction labourers.

BACTERIOLOGICAL PROFILE:

Table 6

SL No	BACTERIA ISOLATED	No. OF CASES	PERCENTAGE
1	KLEBSIELLA PNEUMONIAE	23	15.33%
2	PSEUDOMONAS AERUGINOSA	19	12.67%
3	ACINETOBACTER	9	6.00%
4	HEAMOPHILUS INFLUENZA	10	6.67%
5	STREPTOCOCCUS PNEUMONIAE	9	6.00%
6	ESCHERICHIA COLI	5	3.33%
7	STAPHYLOCOCCUS AUREUS	19	12.67%
8	MORAXELLA CATARRHALIS	7	4.67%
9	NORMAL FLORA	49	32.67%

Culture and sensitivity studies were conducted on sputum samples from 150 patients. Among the samples collected, 32.67% were identified as having normal flora. The most commonly isolated pathogens included Klebsiella pneumoniae (15.33%), Pseudomonas aeruginosa (12.67%), Staphylococcus aureus (12.67%), Heamophilus influenza (6.67%), streptococcus pneumoniae (6.00%), Acinetobacter (6.00%), Moraxella catarrhalis (4.67%), and Escherichia coli (3.33%), respectively.

ANTIBIOTICS SENSITIVITY OF ISOLATED BACTERIA:

The table no. 7 reveals that, Staphylococcus aureus (12.67%) and Streptococcus pneumoniae (6%) were identified as two different types of gram positive organisms throughout the culture and sensitivity testing. Vancomycin is more sensitive against S. aureus (84.21%), while Azithromycin and Levofloxacin are completely resistant .Vancomycin is more sensitive to S.

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pneumonia (77.78%), whereas Ciprofloxacin and Gentamycin are completely resistant to it.

However, during culture sensitivity we discovered six distinct gram negative bacterias.

Moraxella catarrhalis is highly sensitive to Cotrimoxazole at 42.85% and exhibits significant resistance to Ciprofloxacin at 100%. Escherichia coli is 100% sensitive to Amikacin and displays greater sensitivity to Meropenam (80%), Piperacillin + Tazobactam (80%), and Imipenam (80%). Pseudomonas aeruginosa is more sensitive to Amikacin at 84.21% and shows greater resistance to Imipenam (63.15%) and Cefuroxime (63.15%). H. influenzae demonstrates higher sensitivity to Ciprofloxacin at 80% but greater resistance to Meropenam at 80%. Klebsiella pneumoniae exhibits higher sensitivity to Amikacin at 86.9% but more resistance to Piperacillin + Tazobactam at 86.95%. Acinetobacter is more sensitive to Amikacin at 77.78% but shows more resistance to Gentamycin (77.7%), Imipenam (77.7%), and Cefepime (77.7%).

Table 7:

ANTIBIOTIC SENSITIVITY PATTERN – GRAM NEGATIVE BACTERIA (n=73)																								
H.INFLUENZA (n=10)					KLEBSIELLA PNEUMONIAE(n=23)				E. COLI (n=5)				ACINETOBACTER (n=9)				P.AERUGINOSA (n=19)				MORAXELLA (n=7)			
	RESISTANT		SENSITIVE		RESISTANT		SENSITIVE		RESISTANT		SENSITIVE		RESISTANT		SENSITIVE		RESISTANT		SENSITIVE		RESISTANT		SENSITIVE	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
MEROPENEM	8	80%	2	20%	7	30.43 %	16	69.56 %	4	80%	1	20%	3	33.33 %	6	66.67 %	5	26.3 3%	14	73.6 8%	5	71.4 2%	2	28.57 %
PIPERACILLIN+TAZOBACTUM	7	70%	3	30%	20	86.95 %	3	13.04 %	4	80%	1	20%	6	66.66 %	3	33.33 %	4	21.0 5%	15	78.9 4%	5	71.4 2%	2	28.57 %
AMIKACIN	6	60%	4	40%	3	13.04 %	20	86.95 %	0	0%	5	100%	2	22.22 %	7	77.77 %	3	15.7 8%	16	84.2 1%	6	85.7 1%	1	14.28 %
GENTAMYCIN	5	50%	5	50%	3	13.04 %	20	86.95 %	1	20%	4	80%	7	77.77 %	2	22.22 %	4	21.0 5%	15	78.9 4%	6	85.7 1%	1	14.28 %
CIPROFLOXACIN	2	20%	8	80%	8	34.78 %	15	65.21 %	2	40%	3	60%	6	66.67 %	3	33.33 %	4	21.0 5%	15	78.9 4%	7	100 %	0	0%
CEFTRIAXONE	5	50%	5	50%	14	60.86 %	9	39.13 %	2	40%	3	60%	5	55.55 %	4	44.44 %	11	57.8 9%	8	42.1 0%	6	85.7 1%	1	14.28 %
IMIPENAM	6	60%	4	40%	17	73.91 %	6	26.08 %	4	80%	1	20%	7	77.77 %	2	22.22 %	12	63.1 5%	7	36.8 4%	5	71.4 2%	2	28.57 %
CEFUROXIME	3	30%	7	70%	4	17.39 %	19	82.60 %	2	40%	3	60%	6	66.67 %	3	33.33 %	12	63.1 5%	7	36.8 4%	6	85.7 1%	1	14.28 %
COTRIMOXAZOLE	7	70%	3	30%	7	30.43 %	16	69.56 %	2	40%	3	60%	5	55.55 %	4	44.44 %	10	52.6 3%	9	47.3 6%	4	57.1 4%	3	42.85 %
CEFEPIME	3	30%	7	70%	11	47.82 %	12	52.17 %	3	60%	2	40%	7	77.77 %	2	22.22 %	10	52.6 3%	9	47.3 6%	6	85.7 1%	1	14.28 %

ANTIBIOTIC SENSITIVITY PATTERN - GRAM POSITIVE BACTERIA (n=28)								
	S.AUREUS(n=19)				S.PNEUMONIA(n=9)			
	RESISTANT		SENSITIVE		RESISTANT		SENSITIVE	
	No.	%	No.	%	No.	%	No.	%
LINEZOLID	5	26.32%	14	73.68%	3	33.33%	6	66.67%
CEFAZOLIN	4	21.05%	15	78.68%	3	33.33%	6	66.67%
AZITHROMYCIN	19	100%	0	0%	2	22.22%	7	77.77%
LEVOFLOXACIN	19	100%	0	0%	8	88.88%	1	11.11%
CIPROFLOXACIN	12	63.15%	7	36.84%	9	100%	0	0%
GENTAMYCIN	15	78.68%	4	21.05%	9	100%	0	0%
AMIKACIN	0	0%	19	100%	4	44.44%	5	55.55%
COTRIMOXAZOLE	15	78.68%	4	21.05%	8	88.89%	1	11.11%
VANCOMYCIN	3	15.79%	16	84.21%	2	22.22%	7	77.77%

IV. CONCLUSION:

A prospective observational study was conducted to identify the prevalence of bacterial exacerbation COPD and antibiotic sensitivity patterns of isolated organism in the patients who were admitted to pulmonology department.

After starting empirical therapy, Sputum was collected and cultured toidentify the pathogens. Here we identified bacterial pathogens including gram negative and gram Positive, Normal flora.

Exacerbation of COPD is characterized by presence of purulent sputum and other respiratory symptoms such as increased sputum volume and dyspnea.Before final diagnosis, evaluate the blood samples for infection markers like WBC, ESR and CRP. Later culture sensitivity test was done which helped us to identify the organism and whether to decide to comply on current therapy or to switch to another antibiotic. This culture sensitivity study helped to prevent super infection and reduce the medical cost.

Exacerbation of COPD is more prevalent in smoking individuals. In our study 47.3 % patient are current smoker and 22.67 % ex smoker, 30 % non-smoker, who were females, those are exposed to biomass fuels. By conducting culture sensitivity test, we identified that. 67.33 % were bacteria and 32.67 % were normal flora. Culture sensitivity test was done by collecting sputum samples from patients.

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After sputum analysis 48.67 % gram negative and 18.67 % gram positive Organism where found respectively. By evaluating the bacterial aetiology we identified Klebsiella pneumoniae, Pseudomonas aeruginosa, Acinetobacter, Heamophilus influenza, Streptococcus pneumoniae, E coli, Staphylococcus aureus, Moraxella cattarhalis organisms.

After identification of organisms the next step is to identify sensitivity of antibiotic towards specific Organism.where Staphylococcus aureus is completely sensitive towards amikacin and streptococcus pneumoniae shows more sensitivity towards amikacin and vancomycin

Most of gram negative organisms such as E coli, Pseudomonas aeruginosa, Klebsiella Pneumoniae, Acinetobacter are sensitive towards amikacin. Moraxella cattarhalis is more sensitive towards co-trimoxazole and Heamophilus influenza is more sensitive towards ciprofloxacin.

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