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Bacterial infections related to Chronic Obstructive Pulmonary Disease in Baqubah Teaching Hospital in Diyala–Iraq

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Abstract
Background: Respiratory Tract Infections account for the majority of exacerbations of chronic obstructive pulmonary disease (COPD). Determining which individuals have a curable cause of infection and when to proceed with microbiologic testing is a crucial aspect of examination. In Iraq, the prevalence of chronic obstructive pulmonary disease among adult smokers is 15.1%, but the disease affects 10% of those over forty. Infections are the main cause of acute exacerbations of chronic obstructive pulmonary disease, accounting for 40% to 60% of instances of exacerbation. Many bacteria are known to cause acute exacerbations of chronic obstructive pulmonary disease worldwide, including *Moraxella catarrhalis*, *Haemophilus influenza*, *Streptococcus pneumonia*, and *Pseudomonas aeruginosa.*
Aim of the study: The study aims to identify the main bacterial infections related to chronic obstructive pulmonary disease in Baqubah Teaching Hospital Diyala- Iraq.
Patients and Methods: The study was cross-sectional and included 50 patients (33 males and 17 females) who suffered from chronic obstructive pulmonary disease. All patients were recruited from Baqubah Teaching Hospital from 1st October 2023 to 31st January 2024. A comprehensive medical examination and a chest examination, including Spirometry, were used to diagnose each of these individuals. Gram staining and culture were done after sputum samples were collected and processed. Vitek II systems were used to identify the main isolates.
Results: the results of this study showed that 13 (33.3%) of patients were infected with *Pseudomonas aeruginosa*, 11 (28.2%) with *Klebsiella pneumonia,* and low infections were by *Streptococcus pneumonia* 4(10.3%) and *Staphylococcus aureus* 6 (15.4%), while *Proteus spp*. 3(7.7%), *Streptococcus faecalis* 1(2.6%), and Streptococcus viridians 1(2.6%), had the lowest rates of bacterial infection, respectively.
Conclusion: the study concluded, that *pseudomonas aeruginosa* is the primary bacterial infection associated with Chronic Obstructive Pulmonary Disease then *Klebsiella pneumonia* in the Diyala governorate

Keywords: COPD, *Klebsiella pneumonia*, *pseudomonas aeruginosa*

Introduction

Respiratory conditions that are preventable and treatable include chronic obstructive pulmonary disease (COPD), which is typified by recurring respiratory symptoms and airflow restriction brought on by airway and/or alveolar abnormalities. Exposure to toxic particles or gasses is thought to be the etiology of COPD. When a patient's respiratory symptoms suddenly get worse and they require additional treatment, it's called an abrupt exacerbation of Chronic obstructive pulmonary diseases (AECOPD) [1]

Patients experience one to four COPD exacerbations per year, which raises morbidity, mortality, and medical expenses. Infections are the primary cause of AECOPD, accounting for 40–60% of exacerbation cases. Individuals suffering from COPD may experience a recurrent bacterial infection that leads to acute exacerbations because of compromised immune systems and altered lung microbes [2]

Regular exacerbations are linked to a faster rate of lung function decline, less physical activity, a worse standard of living, and a higher death risk [3].

The World Health Organization predicts that by 2030, COPD will rank third globally in terms of causes of death and fifth in terms of economic burden due to its propensity for acute exacerbations [4].

More than half of AECOPD patients are caused by bacterial infections, which make up the microbiological etiology of the disease [5]. *Moraxella catarrhalis, Streptococcus pneumoniae,* and *Haemophilus influenza* are the most frequently isolated bacterial infections in people with COPD exacerbations [6, 7]. Other less frequently isolated pathogens include Staphylococcus aureus, Pseudomonas aeruginosa, and Gram-negative Enterobacteriaceae [7].

Accurate diagnosis and comprehension of prevalent bacterial etiologies and antibiotic resistance patterns would facilitate the creation of a suitable treatment regimen for the management of AECOPD [8].

It becomes more difficult to treat illnesses caused by bacteria that are resistant to drugs. The number of patients in the intensive care unit (ICU), the type of patient, the facility, and the amount of antibiotic exposure all affect the prevalence of these resistant bacteria. AECOPD is known to be caused by a variety of bacteria, including *Pseudomonas aeruginosa*, *Haemophilus influenza, Moraxella catarrhalis, and Streptococcus pneumonia*. Antibiotic resistance is concerning high everywhere in the world, endangering our ability to control infectious diseases [9]

Since these infections are thought to be the primary risk factor for aggravation, the presence of the major bacterial infections was examined in this investigation.

Patients and Methods

Patients: Thirteen male and seventeen female COPD patients made up the 50 participants in this cross-sectional study. The Baqubah Teaching Hospital served as the recruiting site for all patients between 1st October 2023, and 31st January 2024. The patients ranged in age from 31 to 80 years. One of the

inclusion criteria was having a COPD diagnosis. Excluded criteria included Patients who had a chest radiograph diagnosis of pneumonia or bronchiectasis, couldn't do a Spirometry test, had a reversible airway blockage, or were given low-quality sputum samples were among the exclusion criteria. History taking and clinical examination**:** Specialist doctors took a thorough history to diagnose COPD and conduct a general system assessment.

Sputum Processing

The bacteriological investigation was carried out at the Department of Medical Microbiology laboratory after the sputum sample was brought there. Sputa samples were also examined for signs of pulmonary tuberculosis using the Ziehl-Neelsen staining technique; none of them tested positive for *Mycobacterium tuberculosis*.

Laboratory investigation was done before beginning antibiotic treatment, sputum samples were obtained by the suggested protocols. The samples were inspected for physical examination, and a microscopic examination was done to make sure they were suitable for culture. To aid in the isolation of bacteria, the specimens were cultivated on a variety of media, including blood agar, chocolate agar, and MacConkey agar. Numerous methods, including morphological colony investigations, biochemical testing, and gram staining, were used to identify the isolates. Following the manufacturer's instructions, the Vitek II system was used to further confirm the isolates' identities.

Gram Stain

Under a microscope, the specimens were inspected to determine their suitability for cultivation and to evaluate their physical attributes. Gram-stained smears were prepared from the most visually pure sections of the sputum material.

Specimen Culture

Samples were accepted after microscopic examination, sputum was inoculated onto blood agar base, MacConkey agar, and chocolate agar plates for bacterial isolation, while the chocolate agar plate was cultivated in an incubator (5–10% CO2) at 37°C for 24–48 hours, the blood agar and MacConkey agar were incubated in an aerobic environment for 24 hours.

The suspicious colony was subculture on appropriate solid culture media to purify it. After that, additional procedures were processed or conserved on the proper media, and the mixture was kept in a refrigerator (4°C) in case more analysis was required.

Identification of Isolated bacteria

Standard microbiological techniques were used to identify the isolates. A variety of biochemical assays, such as the Oxidase, Catalase, Indol, Citrate Utilization, Urease, Hydrogen Sulfide, Sugar Fermentation, Coagulase, and Optochin Sensitivity tests, were among them, along with Gram staining and morphological colony examinations [10].

Statistical analysis: The Statistical Package for Social Science was used to examine, code, tabulate, and analyze the collected data. The method of analysis was determined by the kind of data that was obtained for every parameter. P-values were classified as statistically significant if they were less than 0.05 and non-significant if they were more than 0.05.

Results

Bacterial Strain Associated with Chronic Obstructive Pulmonary Diseases

Regarding the results of this study listed in Table1 *Pseudomonas aeruginosa* was 13 (33.3%) of isolated bacteria which is the cause of the highest proportion of Chronic Obstructive Pulmonary disease infections, then followed by *Klebsiella pneumonia* was 11(28.2%). While the low infections caused by *Staphylococcus aureus were 6(*15.4%) and *Streptococcus pneumonia* was 4(10.3%) respectively. The results showed that the least bacterial infection was *Proteus spp.* 3(7.7%), Streptococcus viridians 1(2.6%) and *Streptococcus faecalis* 1(2.6%) respectively.

Table 1: The main bacterial isolate, related with COPD

Isolates species	Frequency	Percentage (%)
Pseudomonas Aeruginosa	13	33.3%
Klebsiella Pneumonia	11	28.2%
Staphylococci Aureus	6	15.4%
Streptococcus Pneumonia	4	10.3%
Proteus spp.	3	7.7%
Streptococcus viridians	1	2.6%
Streptococcus. Faecalis	1	2.6%
Total.	39	100 %

Bacterial Infections in COPD According to Age

According to the results of this study, 10 (25.6%) were present in the age group (13 - 39), and 29 (74.4%) were present in the age group (40-85) without significant differences (P= 0.897). As showed in Table 2.

Table 2: Distribution of bacterial isolate in COPD according to age

Age group	Infection with COPD	Without infection	Chi-square
13-39	10(25.6%)	4 (36.4%)	0.897
40-85	29(74.4%)	7(63.6%)	
Total	39(100%)	11(100%)	

Bacterial infections in COPD according to gender

According to the results of this study. A high proportion of isolates were present in males 25 (64.4%), and a low proportion of infections were found in females 14 (35.6%) isolates without significant differences (P= 0.284). As shown in Table.3.

Table 3: Distribution of bacterial isolate in COPD according to gender

Gender	Infection with COPD	Without infection	Chi-square
Male	25(64.1%)	8(72.7%)	0.284
Female	14(35.9%)	3(27.3%)	
Total	39(100%)	11(100%)	

Bacterial infections in COPD according to smoking.

In this study, the results showed that the most infections in patients with COPD were in smokers 24 (61.5 %), and lower in non-smokers 15 (38.5%). Without significant differences (P= 0.13). as shown in Table.4.

Table 4: Distribution of bacterial isolate in COPD according to smoking

Smokers	Infection with COPD	Without infection	Chi – square
smoker	24(61.5%)	4(36.4%)	0.13
Non-smoker	15(38.5%)	7(63.6%)	
Total	39(100%)	11(100%)	

Discussions

Bacterial infections are usually the primary cause of death, and acute exacerbation of chronic obstructive pulmonary disease is a major source of healthcare utilization, including hospitalizations [11]. In this study, about 22 % of the patients who had their sputum cultured showed no signs of bacterial development, while 78 % had development of harmful bacteria. This suggests that bacterial infections are the etiological cause of COPD in a considerable portion of individuals [12]. The current study is Similar to the study of Abdeen *et al*. (2020) which found there was no bacterial growth in 28% of patients while 72% had bacterial growth of sputum of COPD patients [13]. The results were near to the results of Erekan *et al*., (2008) which reported that 61.3% of patients had a culture of an infectious agent or sputum or serologic test [14]. On the other hand, the study of Moghofei *et al*. (2020) reported that 49.59% of acute exacerbation chronic obstructive pulmonary disease patients were estimated to have bacterial infections [15]. This variation in the incidence of detected bacteria in studies may be due to the patient inclusion criteria and the sputum culture techniques used. When harmful bacterial species were collected from our study patients, gram-negative bacteria prevailed, which were *Pseudomonas. aeruginosa* (33.3%), *Klebsiella. pneumonia* (28.2%), *Staphylococci. aureus* (15.4%) and *Streptococcus. pneumonia* (10.3%). While the lowest bacterial infection was *Proteus.*, *Streptococcus. viridans*, and *Streptococcus. faecalis.* These outcomes Analogous investigations revealing a high concentration of Gram-negative bacteria were documented in Egypt, India, and Tunisia [16, 17, 18]. However, research from several countries showed that the most prevalent strains in AECOPD were *S. pneumoniae, H. influenzae, or M. catarrhalis*, then followed by Gram negative bacteria [19, 20]. In the current study, 10(25.6%) were found in patients between the ages of (13-39), and 29 (74.4%) were reported in the age group of (40-85) that mean the chronic obstructive pulmonary disease infections dominated after the age of 40. The current study was in agreement with Mussemea *et al*. (2022) who reported that the high percent of chronic obstructive pulmonary disease infections was in the age (55−65) years [21]. And similar to another study in Indonesia (55–65 years) [21]. Males had the highest percentage of infections (64.1%), while females had the lowest rate (35.9%). This outcome is consistent with recent research reported by Shimizu *et al*. (2015), who discovered that 86% of infections during AECOPD occurred in men [22, 23]. Another study done by El-Feky et al. (2016) which reported the highest of the patients (93.3%) were in males with age more than forty years [24]. On the other hand, about 61 % of infections were reported among smokers while in nonsmokers were about 39 %, these results agree with a study done by ERS (2012) which found that 73% of smokers have an infection with COPD [25]. This observation may be explained by the fact that smoking and air pollution cause mucociliary clearance to diminish, which in turn increases bacterial colonization, which can worsen airway inflammation and trigger exacerbations [26]. The variation in the illness severity (about 40% of research participants had COPD at its final stage), sample size, and available treatments could be the cause. Furthermore, one of the main risk factors for the development of COPD is tobacco use, which is more widespread in men than in women in our nation. This could account for the male predominance.

Conclusions

In conclusion, COPD and bacterial infections are commonly linked, with males over forty having a higher prevalence of the condition. In most COPD patients, pathogenic bacterial growth was found, with Gram-negative bacteria being the most frequently identified species *Klebsiella pneumonia* and *P. aeruginosa* were the most commonly isolated bacteria.

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Ethical clearance

Ethical approval was obtained from the College of Medicine / University of Diyala ethical committee for this study.

Conflict of interest

The author declares that he has no competing interests.

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