Thi-Qar Medical Journal (TQMJ):Vol.(25),No.(1),2023

Web Site: https://jmed.utq.edu **Email:** utjmed@utq.edu.iq

ISSN (Print):1992-9218, ISSN (Online):1992-9218

The Main Bacterial Isolates Associated with Chronic Obstructive Pulmonary Disease in Thi Qar Province

Jaber Abd Jaber Al-Duraibi Department of Microbiology, Medical Microbiology, College of Medicine, University of Thi-Qar (medmicjj20m5@utq.edu.iq).
Haydar Khamiss Shanan Almaliky Department of Microbiology, College of Veterinary Medicine, University of Thi-Qar (haydar.shan@utq.edu.iq).

Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a well-known, preventable, and curable condition. Frequent respiratory symptoms and a reduction in airflow caused by abnormalities in the airways and/or alveoli are its defining features (1). The prevalence of COPD is 10 % in people over forty years old whereas COPD prevalence in Iraq among adult smokers is 15.1% (2). Infections are the principal source of acute exacerbation of COPD (AECOPD) and these infections are implicated in 40% to 60% of exacerbation cases. Worldwide, a variety of bacteria, such as *Pseudomonas aeruginosa, Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis*, are recognized to cause AECOPD (3).

Aim: The aim of this work was to identify the main bacterial isolates associated with COPD.
Method: This study included 70 patients (46 males and 24 females) suffered from COPD. All these patients were detected through a full medical examination, and chest examination, such as a spirometry. Sputum samples were collected and processed, followed by performing gram staining and culturing. The main isolates were identified using Vitek II systems.

Results: According to results of this study, *Pseudomonas aeruginosa* was found to be the predominant cause of COPD infections, with *Klebsiella pneumonia* following closely in frequency.

Conclusion: In conclusion, *Pseudomonas aeruginosa* and *Klebsiella pneumonia* have been identified as the main bacterial infections associated with COPD.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable respiratory condition, which is characterized by recurrent respiratory symptoms and airflow limitation due to airway and/or alveolar defects. The pathogenesis of COPD is attributed to exposure to noxious particles or gases. Acute exacerbation of COPD (AECOPD) refers to a sudden worsening of respiratory symptoms in COPD patients, requiring additional management (1). One to four COPD exacerbations occur annually in patients, increasing morbidity, mortality, and healthcare costs (4). Infections are the leading source of AECOPD and these infections are implicated in 40% to 60% of exacerbation cases. COPD patients have immunological deficiencies and changes to their lungs' microbiomes that may lead to a chronic bacterial infection, causing acute exacerbations (5). It becomes challenging to treat illnesses brought on by bacteria with medication resistance. The prevalence of these resistant bacteria varies by patient population, facility, antibiotic exposure, and type of intensive care unit (ICU) patients. Worldwide, a variability of bacteria, including *Pseudomonas aeruginosa, Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis*, are known to cause AECOPD. All throughout the world, antibiotic resistance is increasing to alarmingly rising levels, posing a threat to our capacity to manage the infectious diseases (3). In this study, the presence of the main bacterial infections was investigated as these infections are considered the main risk factor for exacerbation.

Subjects and Methods

Subjects: This cross sectional study included 70 patients (46 males and 24 females) suffered from COPD. All patients were recruited from AL Hussein teaching, Al Nassyria teaching hospitals and respiratory centre, from December 2022 to April 2023. Age range was from 31 to 80 years. Inclusion criteria included those who had been diagnosed with COPD. Exclusion criteria included patients who refused to participate in the study, had a bronchiectasis or pneumonia diagnosis on a chest radiograph, were unable to execute a spirometry test, had a reversible airway obstruction, and provided poor quality sputum samples.

History taking and clinical examination: An extensive history taking by specialized physicians for diagnosis of COPD and general examination of body systems was performed.

Detailed chest examination: The Japanese FUKUDa DENSHI Spirosift SP 5000 was used for spirometry. The following criteria were noted: FEV1% percent expected, FVC% percent predicted, FEV1/FVC ratio, and 25%–75% percent predicted (6).

Laboratory investigation: Sputum samples were collected following the recommended guidelines before initiating antibiotic treatment. The samples were examined for their physical characteristics and microscopic evaluation was conducted to ensure their suitability for culture. The

specimens were cultured on various media such as MacConkey agar, blood agar, and chocolate agar to facilitate bacterial isolation. Isolates were identified using various techniques such as gram staining, morphological colony studies, and biochemical tests. The identification of isolates was further confirmed using the Vitek II system as per the manufacturer's instructions.

Statistical analysis: The obtained data was reviewed, coded, tabulated, and analyzed using the Statistical Package for Social Science (IBM Corp. 2015. IBM SPSS Statistics for Windows, Version 23.0). The analysis approach was based on the type of data received for each parameter. A P-value of less than 0.05 was considered statistically significant, while a P-value of greater than 0.05 was deemed non-significant.

Results

The main bacterial agents, associated with COPD

According to Table 1, Pseudomonas aeruginosa, which accounted for 20 (56.7%) of the isolated strains, caused the highest proportion of COPD infections, followed by Klebsiella pneumonia, which accounted for 16 (27.1%) isolates The percentage of infections caused by Staphylococci aureus and Streptococcus pneumonia were 15.2 and 10.1 respectively. The least bacterial isolates were Proteus, Streptococcus viridians and Streptococcus faecalis.

Table (1): The main bacterial agents, associated with COPD:

Isolated Species	Frequency	Percentage (%)
Pseudomonas Aeruginosa	**20**	**33.8**
Klebsiella Pneumoniae	**16**	**27.1**
Staphylococci Aureus	**9**	**15.2**
Streptococcus Pneumoniae	**6**	**10.1**
Proteus Spp.	**5**	**8.4**
Streptococcus Viridans	**2**	**3.3**
Streptococcus Faecalis	**1**	**1.69**
Total	**59**	**(100)%**

Distribution of COPD infections according to age

As shown in table (2), 15 isolates (25.4%) were found in patients between the ages of 13 and 39, and 44 isolates (74.6%) were found in patients between the ages of 40 and 85.

Table (2): Distribution of COPD infections according to gender and age:

Variables	Infection With COPD	Without Infection	Chi2 With P-Value
Age	**%**	**%**	**0.01659** **0.8975** **(Not Significant)**
13-39	**15 (25.4) %**	**3 (27.3) %**	
40-85	**44 (74.6) %**	**8 (72.7) %**	
Total	**59 (100)%**	**11(100)%**	

Distribution of COPD infections according to gender

In the current study, a high percentage of infections were found in males with COPD, where 38 (64.4%) isolates were found, and a lower percentage in females with COPD, where 21 (35.6%) isolates were found (table 3).

Table (3): Distribution of COPD infections according to gender :

Variables	Infection With COPI	Without Infection	Chi2 With P-Value
Gender	**%**	**%**	**0.2849** **0.5935** **(Not Significant)**
Male	**38 (64.4)%**	**8 (72.7)%**	
Female	**21 (35.6)%**	**3 (27.3)%**	
Total	**59 (100)%**	**11 (100)%**	

Percentage of COPD infections by smoking.

It was found that the proportion of infection with COPD in smokers was 36 (61%), and during this study the proportion of infections in non-smokers was 23 (39%) (table 4).

Table (4): Percentage of COPD by smoking:

Variables	Infection With COPD	Without Infection	Chi2 With P-Value
Smoker	**36 (61) %**	**4 (36.4) %**	**2.301** **0.1293** **(Not Significant)**
Non- Smoker	**23 (39) %**	**7 (63.6) %**	
Total	**59 (100)%**	**11(100)%**	

Discussion :

COPD exacerbations increase the disease burden leading to augmented morbidity or mortality (7). The AECOPD's bacterial ecology is constantly changing, and antibiotic choice depends on the local predominance of bacteria and their resistance patterns (8). 15.8% of the patients in our study who underwent sputum culturing had no bacterial growth, while 84.2% had pathogenic bacterial growth. This indicates that a significant fraction of COPD patients have bacterial infections as its etiological cause. Similarly, Abden et al.(2020) stated that no growth was found in 28% of patients while 72% of COPD patients had positive sputum cultures (9). According to Erkan et al.,(2008) 61.3% of patients had an infectious agent found either sputum culture or serology (10). Moghoofei et al. (2020) showed that 49.59% of AECOPD patients were estimated to have bacterial infections (11). The inclusion criteria for patients and the methods employed for sputum culture may be to blame for this difference in the prevalence of identified bacteria in studies. Gram-negative bacteria predominated among pathogenic bacterial species that were recovered from our study patients in descending order were *Pseudomonas aeruginosa* (56.7%), *Klebsiella pneumonia* (27.1%), *Staphylococci aureus* (15.2%) and *Streptococcus pneumonia* (10.1%). The least bacterial isolates were *Proteus, Streptococcus viridans and Streptococcus faecalis*. Similar studies with a prevalence of Gram-negative bacteria were reported in Egypt and India, with *K. pneumonia, P. aeruginosa,* and *Acinetobacter* being the most prevalent strains, followed by *S. aureus* (12,13). In contrast, Studies conducted in several nations revealed that *S. pneumoniae, H. influenzae or M. catarrhalis* were the most common strains in AECOPD, followed by Gram-negative bacteria (14,15).

In this study, 15 isolates (25.4%) were found in patients between the ages of 13 and 39, and 44 isolates (74.6%) were found in patients between the ages of 40 and 85 which mean that COPD infections predominated after the age of forty. This study was in concordant with Mussema et al. (2022) who found that the highest percentage of COPD infections was in the age range 55−65 years (16). The highest percentage of infections was found among males with percentage 64.4 % and the female percentage was 35.6%. This finding is compatible with other studies described from Shimizu et al.(2015) who found that most of the infections during AECOPD occurred in man (86%) (17). Another study by ElFeky et al.(2016) found that the majority of the patients (93.3%) were males with patients age above 40 (18).

Also 61 % of infections were found among smokers whereas infections in nonsmokers account 39 %. Badaran et al.(2012) also found that 73% of male smokers have a COPD infection (19). This observation might be because smoking is responsible for a decrease in mucociliary clearance which leads to increased bacterial colonization and this can lead to rise in inflammations and exacerbations. As well as, male predominance may be tobacco-smoking habits which are common among males.

The main advantage of this work is that only high quality sputum was cultured and semi-quantitative cultures was performed, which tackles the significant issue that contamination by oral discharges, that are thought to harbour organisms, is a major worry in sputa cultures. However, it is important to note that this study has some limitations. First off, evaluating viral and atypical microorganisms were prohibited by technical and economic barriers in the current investigation.

Second, there was only one center in Iraq where the study was conducted. Finally, this small sample size prevented a detailed analysis of particular organism-specific factors.

Conclusion:

In conclusion, bacterial infections are frequently associated with COPD, with predominance in males over the age of forty. Pathogenic bacterial growth was detected in 84.2% of COPD patients, with Gram-negative bacteria being the most commonly isolated organisms. The most frequently isolated microorganisms were *Klebsiella pneumonia* and *P. aeruginosa*.

References:

1. GOLD. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease. www.goldcopd.org. 2022.

2. Wang K, Mamidipalli A, Retson T, Bahrami N, Hasenstab K, Blansit K, et al. Automated CT and MRI Liver Segmentation and Biometry Using a Generalized Convolutional Neural Network. Radiol Artif Intell. 2019 Mar;1(2).

3. Ayobami O, Willrich N, Suwono B, Eckmanns T, Markwart R. The epidemiology of carbapenem-non-susceptible Acinetobacter species in Europe: analysis of EARS-Net data from 2013 to 2017. Antimicrob Resist Infect Control. 2020 Dec;9(1):89. Available from: https://aricjournal.biomedcentral.com/articles/10.1186/s13756-020-00750-5

4. SEEMUNGAL TAR, DONALDSON GC, BHOWMIK A, JEFFRIES DJ, WEDZICHA JA. Time Course and Recovery of Exacerbations in Patients with Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2000 May;161(5):1608–13. Available from: https://www.atsjournals.org/doi/10.1164/ajrccm.161.5.9908022

5. Sethi S. Bacteria in Exacerbations of Chronic Obstructive Pulmonary Disease: Phenomenon or Epiphenomenon? Proc Am Thorac Soc. 2004 Apr;1(2):109–14. Available from: http://pats.atsjournals.org/cgi/doi/10.1513/pats.2306029

6. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, Coates A, et al. Standardisation of spirometry. Eur Respir J. 2005 Aug;26(2):319–38. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16055882

7. Talatam A, K. Reddy P, Pragati Rao D, Vineela S, Yamuna K. Bacteriological profile of acute exacerbations of chronic obstructive pulmonary disease. IP Indian J Immunol Respir Med. 2020 Dec 28;3(3):98–102. Available from: https://ijirm.org/article-details/7449

8. Sharma P, Narula S, Sharma K, Kumar N, Lohchab K, Kumar N. Sputum bacteriology and antibiotic sensitivity pattern in COPD exacerbation in India. Egypt J Chest Dis Tuberc. 2017 Oct;66(4):593–7. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0422763817301747

9. Abden H, Hafez M, Eltrawy H. Sputum bacterial profile and antibiotics sensitivity pattern in acute exacerbation of chronic obstructive pulmonary disease. J Recent Adv Med. 2020 Dec 29;0–0.

Available from: https://jram.journals.ekb.eg/article_133603.html

10. Erkan L, Uzun O, Findik S, Katar D, Sanic A, Atici AG. Role of bacteria in acute exacerbations of chronic obstructive pulmonary disease. Int J Chron Obstruct Pulmon Dis. 2008;3(3):463–7. Available from: http://www.ncbi.nlm.nih.gov/pubmed/18990975

11. Moghoofei M, Azimzadeh Jamalkandi S, Moein M, Salimian J, Ahmadi A. Bacterial infections in acute exacerbation of chronic obstructive pulmonary disease: a systematic review and meta-analysis. Infection. 2020 Feb;48(1):19–35. Available from: http://www.ncbi.nlm.nih.gov/pubmed/31482316

12. Sobhy KE, Abd El-Hafeez AM, Shoukry FA, Refaai ES. Pattern of sputum bacteriology in acute exacerbations of chronic obstructive pulmonary disease. Egypt J Bronchol. 2015 Aug 4;9(2):170–7. Available from: https://ejb.springeropen.com/articles/10.4103/1687-8426.158065

13. Basu S, Mukherjee S, Samanta A. Epidemiological study of bacterial microbiology in AECOPD patients of Kolkata, India. Asian J Pharm Clin Res. 2013;6(1):112–6.

14. Rakesh G, Kasturi T, Yuvarajan S. Bacterial agents causing acute exacerbations in Chronic Obstructive Pulmonary Disease (COPD) patients, their antibiograms to Extended Spectrum Beta-Lactamases (ESBL) production in a tertiary care hospital, India. Int J Curr Microbiol Appl Sci. 2013;2(11):273–82.

15. Ma X, Cui J, Wang J, Chang Y, Fang Q, Bai C, et al. Multicentre investigation of pathogenic bacteria and antibiotic resistance genes in Chinese patients with acute exacerbation of chronic obstructive pulmonary disease. J Int Med Res. 2015 Oct;43(5):699–710. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26152913

16. Mussema A, Beyene G, Gashaw M. Bacterial Isolates and Antibacterial Resistance Patterns in a Patient with Acute Exacerbation of Chronic Obstructive Pulmonary Disease in a Tertiary Teaching Hospital, Southwest Ethiopia. De Francesco M, editor. Can J Infect Dis Med Microbiol. 2022 Aug 31;2022:1–11. Available from: https://www.hindawi.com/journals/cjidmm/2022/9709253/

17. Shimizu K, Yoshii Y, Morozumi M, Chiba N, Ubukata K, Uruga H, et al. Pathogens in COPD exacerbations identified by comprehensive real-time PCR plus older methods. Int J Chron Obstruct Pulmon Dis. 2015 Sep;4(1):2009. Available from: https://www.dovepress.com/pathogens-in-copd-exacerbations-identified-by-comprehensive-real-time--peer-reviewed-article-COPD

18. ElFeky DS, Elmandory HM, Galal M, AbdelHakim M. Sputum Bacteriology in Patients with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. Int J Curr Microbiol Appl Sci. 2016 Jan 10;5(1):289–305. Available from: http://www.ijcmas.com/abstractview.php?ID=28&vol=5-1-2016&SNo=28

19. European Respiratory Society Annual Congress 2012. 2012;(14):7–8.