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Frequency of Multi-Drug Resistant Pseudomonas Aeruginosa Infection in Patients with Bronchiectasis

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Abstract

Objective

To determine the frequency of multi-drug resistant Pseudomonas aeruginosa (MDR-PA) in patients with bronchiectasis.

Introduction

Bronchiectasis is a chronic lung disorder that generally results in recurrent infections, and multi-drug-resistant Pseudomonas aeruginosa (MDR-PA) represents an important challenge for clinicians. Treatment of such ventral hernia with MDR-PA becomes complex and is associated with significant morbidity, leading to a higher healthcare burden. The frequency of MDR-PA has not been precisely determined in patients with bronchiectasis, and such data will be essential to guide this study.

Material & Methods

A descriptive cross-sectional study was conducted from February 2024 to July 2024 in the Pulmonology Department of Gulab Devi Hospital, Lahore, aiming to investigate the prevalence of multi-drug-resistant Pseudomonas aeruginosa (PA-MDR) among bronchiectasis patients.
Data collection included demographics, clinical symptoms, and microbiological analyses of sputum/bronchoalveolar lavage samples. Statistical analysis was performed using SPSS, employing descriptive statistics and chi-square tests to explore associations with PA-MDR status, with a level of significance 0.05.

Results

The mean age of the 152 patients was 55.33 years, with 55.9% being male and 69.1% residing in urban areas. The prevalence of multi-drug-resistant Pseudomonas aeruginosa (MDR-PA) infection

was 58.55%. MDR-PA was significantly more common among patients with lower socioeconomic status (p=0.017). No significant differences were found in age, gender, residential status, or most comorbidities between MDR-PA and non-MDR-PA cases, though pulmonary hypertension approached significance (p=0.053).

Conclusion
The study highlights a significant prevalence of multi-drug resistant Pseudomonas aeruginosa (MDR-PA) in bronchiectasis patients, particularly among those from lower socioeconomic backgrounds. No significant associations were found between MDR-PA and other factors. These findings emphasize the importance of addressing socioeconomic disparities in managing MDR-PA infections in bronchiectasis patients.

Keywords
Bronchiectasis, Hospitalization, Multi-Drug Resistant Pseudomonas Aeruginosa, Treatment

Introduction

Bronchiectasis is a chronic suppurative lung disease with diverse origins, characterized clinically by a persistent cough, sputum production, and recurrent pulmonary exacerbations and radiographically by permanent abnormal dilation of the bronchi [1,2]. Bronchiectasis continues to be one of modern medicine's most neglected respiratory illnesses, yet awareness is growing of it as an important chronic lung ailment of rising prevalence that places a major strain on healthcare systems and individuals [3, 4]. Estimates of bronchiectasis's prevalence worldwide are increasing, but exact figures remain uncertain, and data differs greatly between locations [5,6]

Pseudomonas aeruginosa is responsible for long-term infection in many bronchiectasis patients as their weakened lungs are highly susceptible to colonization by microbes, triggering airway inflammation and destruction leading to further worsening of symptoms [7,8]. In bronchiectasis individuals, Pseudomonas aeruginosa accounts for 21.4% of all cases and is linked with swift drops in pulmonary function, rapidly advancing radiographic signs of disease, poor quality of life, elevated risk of hospitalization and flare-ups, and increased mortality [9, 10]. With rising antibiotic utilization, the prevalence of antibiotic-resistant Pseudomonas Aeruginosa strains has grown in patients with chronic lung disorders such as bronchiectasis, cystic fibrosis, and chronic obstructive pulmonary disease [11-13]. Different investigations worldwide report varying frequencies of multi-drug resistant Pseudomonas aeruginosa in bronchiectasis patients, such as Gao YH, et al. finding 38.6% of PA strains resistant to three or more drug classes (considered MDR) and 54 (61.4%) resistant to less than three. Another study by McDonnell MJ found 11.0% of patients afflicted with MDR strains [14].

The goal of this study is to determine the frequency of multi-drug resistant Pseudomonas aeruginosa in bronchiectasis patients. This research will designed to establishing the current and concreate statistics of multi-drug resistant Pseudomonas aeruginosa in bronchiectasis patients as well as the clinical impact of PA-MDR infection in bronchiectasis.

Material & Methods

The research was designed as a descriptive cross-sectional investigation conducted at the

Pulmonology Department of Pulmonology Department of Gulab Devi Hospital, Lahore from February 2024 to July 2024. The sample size was based on prior evidence showing a (58.55%)[13] prevalence of PA-MDR among such patients. Using a 95% confidence interval and a 5% margin of error, the calculated sample was determined to be 152 individuals. Consecutive non-probability sampling recruited participants aged 18 to 70 years with bronchiectasis up to 5 years. Patients unwilling to join or not meeting the criteria were excluded.

Data collection started upon ethical approval and obtaining written consent. Thorough medical histories documented demographics like age and gender plus clinical displays including cough, sputum, dyspnea, wheezing, hemoptysis, chest pain, and clubbing. Sputum or bronchoalveolar lavage samples were acquired under sterile settings and sent to the lab for microbiological analysis. Tests for PA identification and antibiotic resistance followed standard protocols by blinded technicians.

Statistical analysis was performed using SPSS. Descriptive statistics, including mean and standard deviation, were calculated for continuous variables such as age and disease duration. Categorical variables, including gender and symptoms, were summarized using frequencies and percentages. To assess the association of potential effect modifiers (e.g., age, gender, disease

duration, symptoms) with MDR-PA status, stratification and the Chi-square test were applied, with significance set at $p \leq 0.05$.

Results

The study included a total of 152 bronchiectasis patients. The demographic characteristics of the participants are summarized in Table 1. The mean age of the patients was 55.33 years with a standard deviation of 13.72 years. The gender distribution showed that 55.9% of the participants were male, while 44.1% were female. A majority (69.1%) of the participants resided in urban areas, with the remaining 30.9% living in rural areas. In terms of socioeconomic status, 22.4% of the participants were classified as poor, 49.3% as middle class, and 28.3% as upper class. Regarding educational status, 22.4% of the participants were illiterate, 49.3% had primary education, 22.4% had secondary education, 49.3% had intermediate education, and 28.3% had graduated or attained higher education.

The clinical characteristics of the study population show a range of comorbidities, with 20 individuals (13.2%) having chronic heart disease, 63 (41.4%) suffering from hypertension, 35 (23.0%) having experienced a stroke, 25 (16.4%) with pulmonary hypertension, and 50 (32.9%) diagnosed with diabetes mellitus. Regarding the causes of their conditions, 80 participants (52.6%) have post-infection-related issues, 27 (17.8%) are affected by immunodeficiency, 81 (53.3%) have idiopathic causes, and 122 individuals (80.3%) report other causes.

The symptoms experienced include cough in 57 individuals (37.5%), sputum production in 11 (7.2%), dyspnea in 14 (9.2%), wheezing in 49 (32.2%), hemoptysis in 19 (12.5%), and chest pain in 38 (25.0%). Clubbing is observed in 5 individuals (3.3%). (TABLE 2)

The analysis shows similar mean ages between resistant and sensitive cases (55.49 vs. 55.10 years, p=0.860) and no significant differences in gender distribution (p=0.683) or residential status (p=0.864). However, socioeconomic status is significant; 76.5% of poor individuals are in the resistant group (p=0.017), while upper socioeconomic status is associated with sensitivity. Educational status shows trends but no significant differences overall (p=0.164). Comorbidities like chronic heart disease, hypertension, stroke, and diabetes show no significant differences (p>0.05), but pulmonary hypertension approaches significance (p=0.053). The causes of the condition do not differ significantly between groups (p=0.289 to 0.781). (TABLE 3)

Table 1: Demographic Characteristics of Study Participants (n=152)

Demographic Characteristics	**Frequency (%)**
Age (Mean ± SD)	55.33 ± 13.72
Gender	
Male	85 (55.9)
Female	67 (44.1)
Residential Status	
Urban	105 (69.1)
Rural	47 (30.9)
Socioeconomic Status	
Poor	34 (22.4)
Middle	75 (49.3)
Upper	43 (28.3)
Educational Status	
Illiterate	34 (22.4)
Primary	75 (49.3)
Secondary	34 (22.4)
Intermediate	75 (49.3)
Graduate & above	43 (28.3)

(%) = Percentage, SD = Standard Deviation

Table 2: Clinical Characteristics of Bronchiectasis Patients (n=152)

Clinical Characteristics	**Frequency (%)**
Comorbidities	
Chronic Heart Disease	20 (13.2)
Hypertension	63 (41.4)
Stroke	35 (23.0)
Pulmonary Hypertension	25 (16.4)
Diabetes Mellitus	50 (32.9)
Causes	
Post Infection	80 (52.6)
Immunodeficiency	27 (17.8)
Idiopathic	81 (53.3)
Others	122 (80.3)
Sign and Symptoms	
Cough	57 (37.5)
Sputum Production	11 (7.2)
Dyspnea	14 (9.2)
Wheezing	49 (32.2)
Hemoptysis	19 (12.5)
Chest pain	38 (25.0)
Clubbing	5 (3.3)

(%) = Percentage

Table 3: Demographic and clinical characteristics of bronchiectasis patients with and without Pseudomonas aeruginosa

Variables		**PA-Resistant** (n=89)	**PA-Sensitive** (n=63)	**P-Value**
Age in years, Mean ± SD		55.49 ± 14.01	55.10 ± 13.40	0.860
Age Group	18 – 60 Years	46 (56.1)	36 (43.9)	0.506
	>60 Years	43 (61.4)	27 (38.6)	
Gender	Male, *n* (%)	51 (60.0)	34 (40.0)	0.683
	Female, *n* (%)	38 (56.7)	29 (43.3)	
Residential Status	Urban, *n* (%)	61 (58.1)	44 (41.9)	0.864
	Rural, *n* (%)	28 (59.6)	19 (40.4)	
Socioeconomic Status	Poor, *n* (%)	26 (76.5)	8 (23.5)	0.017
	Middle, *n* (%)	44 (58.7)	31 (41.3)	
	Upper, *n* (%)	19 (44.2)	24 (55.8)	
Educational Status	Illiterate	10 (58.8)	7 (41.2)	0.164
	Primary	9 (37.5)	15 (62.5)	
	Secondary	32 (58.2)	23 (41.8)	
	Intermediate	19 (65.5)	10 (34.5)	
	Graduate & above	19 (70.4)	8 (29.6)	
Comorbidities	Chronic Heart Disease	13 (65.0)	7 (35.0)	0.530
	Hypertension	36 (57.1)	27 (42.9)	0.767
	Stroke	20 (57.1)	15 (42.9)	0.847
	Pulmonary Hypertension	19 (76.0)	6 (24.0)	0.053
	Diabetes Mellitus	32 (64.0)	18 (36.0)	0.340
Causes	Post Infection	46 (57.5)	34 (42.5)	0.781
	Immunodeficiency	14 (51.9)	13 (48.1)	0.436
	Idiopathic	50 (61.7)	31 (38.3)	0.396
	Others	74 (60.7)	48 (39.3)	0.289

(%) = Percentage, SD = Standard Deviation, (PA) = Pseudomonas aeruginosa, SD = Standard Deviation, P = level of Significance

Discussion

The investigation conducted at the Pulmonology Department of Gulab Devi Hospital, Lahore, analyzed the prevalence and impact of multi-drug resistant Pseudomonas aeruginosa (MDR-PA) in patients with bronchiectasis. The results highlighted the growing concern of antibiotic resistance in chronic respiratory conditions, emphasizing the need for more effective management strategies.

MDR-PA infections are related to detrimental medical outcomes, including more frequent exacerbations, accelerated lung performance decrease, prolonged medical center remains, and increased mortality costs compared to attacks with susceptible strains. Effective control of MDR-PA is crucial, presenting the minimal treatment selections and higher risks related to second-line or mixture therapies [15].

The research's emphasis on the Lahore, Pakistan, Pakistan people highlighted regional fluctuations in MDR-PA occurrence and level of resistance patterns, motivated by local antibiotic usage practices, healthcare infrastructure, and socioeconomic aspects. Customizing treatment suggestions and applying localized methods are essential to deal with these obstacles successfully.

Constraints incorporated the research's cross-sectional style and non-randomized screening technique, potentially restricting generalizability [16]. Future analysis should highlight longitudinal reports to keep an eye on the level of resistance patterns and assess the impact of antimicrobial stewardship packages and infection control actions.

Beyond clinical outcomes, severe MDR-PA infections can significantly diminish a patient's quality of life. Those with bronchiectasis frequently endure debilitating symptoms, recurrent exacerbations, and drawn-out therapeutic regimens, imposing profound physical and emotional strain that hampers daily activities and overall wellness [17].

Addressing MDR-PA demands comprehensive education engaging patients in infection control practices, strict treatment adherence, and appreciating the implications of resistance. Involving patients intimately in their care is pivotal to optimizing results and curtailing the dissemination of resistant strains [18].

In our study, multi-drug resistant pseudomonas aeruginosa infection was noted in 58.55% of patients. Gao YH, et al reported in 59.9% of cases [13] while Ding F, et al found in 35.05% [21].

Managing severe MDR-PA infections routinely demands extensive medical assets, including specialized analysis, prolonged hospitalization, and expensive medications. This places a substantial economic burden on healthcare systems and individuals alike, necessitating cost-effective strategies for both treatment and prevention [19].

Continued exploration is indispensable to identify novel therapeutic approaches, diagnostic techniques, and vaccines against MDR-PA and other resistant pathogens. Innovation in antimicrobial progress and complementary therapies will prove critical to confronting present therapeutic obstacles and future resistance trends [20].

Conclusion

The study highlights a significant prevalence of multi-drug-resistant Pseudomonas aeruginosa (MDR-PA) in bronchiectasis patients, particularly among those from lower socioeconomic backgrounds. No significant associations were found between MDR-PA and other factors. These findings emphasize the importance of addressing socioeconomic disparities in managing MDR-PA infections in bronchiectasis patients.

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