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EDITORIAL

The Visual Stethoscope: Redefining Thoracic Care with POCUS

Sharmin Sultana

[Chest & Heart J. 2025; 49(2) : 47-48]

The landscape of chest diagnostics is shifting from "listen and wait" to "see and treat."As Point-of-Care Ultrasound (POCUS) becomes an extension of the physical exam, we are witnessing a paradigm shift in how we approach the thoracic cavity[1].

The Shift in Perspective

For decades, the physical exam and the chest X-ray (CXR) were the dual pillars of pulmonary assessment, despite the subjectivity and limitations of percussion and auscultation. Bedside ultrasound now bridges this gap[2]. Chest POCUS provides real-time, dynamic, radiation-free evaluation of thoracic pathology and has evolved from a luxury to an essential skill for the modern clinician[3].

Why POCUS?

Chest POCUS is indicated in a wide spectrum of clinical scenarios, including undifferentiated dyspnea, hypoxemia, chest trauma, suspected pneumonia, pleural effusion, pneumothorax, pulmonary edema, and monitoring of critically ill or ventilated patientst . Also, it is particularly valuable in emergency, ICU, paediatric, and resource-limited settingsv .

The key advantages of chest POCUS include bedside availability, absence of ionizing radiation, rapid diagnosis, cost-effectiveness, and repeatability for monitoring disease progression or response to treatment[2]. It enhances clinical decision-making and reduces dependence on delayed or less accessible imaging modalities such as chest X-ray or CT scan[3].

Precision in Differentiation

Chest POCUS allows differentiation of various thoracic pathologies through characteristic sonographic signsu ,[7,8]

- Pleural effusion: Anechoic or complex fluid with lung flapping (jellyfish sign)
- Pneumothorax: Absent lung sliding, barcode sign in M-mode, lung point
- Pneumonia: Subpleural hepatization (shred sign) and dynamic air bronchogram
- Pulmonary edema: Diffuse bilateral B-lines ("lung rockets")
- Atelectasis: Tissue-like lung with volume loss, static air bronchogram

These patterns enable rapid and accurate bedside differentiation of common chest diseasesu .

Impact on Early Management

The true power of POCUS lies in early intervention. By integrating ultrasound into the initial assessment, clinicians canv :

- Guide Procedures: Perform thoracentesis with millimetric precision, drastically reducing complication rates[2].
- Narrow the Differential: Rule out life-threatening causes (like tension pneumothorax or tamponade) within seconds.
- Monitor Therapy: Track the resolution of B-lines in heart failure or the re-expansion of lungs in real-time[3].

Its use significantly improves patient outcomes by shortening diagnostic time, optimizing treatment strategies, and reducing unnecessary investigations[3].

Conclusion

As we move forward, the "visual stethoscope" is poised to become a standard of care. This issue highlights the latest evidence and techniques that

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establish chest POCUS as an indispensable ally in the evaluation of thoracic diseases[1]. No longer an adjunct, chest POCUS has evolved into a core clinical tool in respiratory medicine[2]. With proper training and integration into routine practice, it has the potential to redefine early diagnosis, targeted management, and overall patient care in chest diseases[3].

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ORIGINAL ARTICLE

Association of COPD Assessment Test Scores in the Evaluation of Functionality and Severity of Bronchiectasis

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Abstract:

Background: *Bronchiectasis is a chronic respiratory condition characterized by irreversible dilatation of the bronchi, leading to recurrent infections and impaired pulmonary function. Assessing the severity of bronchiectasis is crucial for effective disease management and treatment optimization and reduce mortality. Traditional assessments like the Bronchiectasis Severity Index (BSI), FACED, E-FACED are often complex and require specific diagnostic tools, special setting, expert technician. The COPD Assessment Test (CAT) is a simpler questionnaire-based tool designed to assess symptom severity in COPD patients. Its application in bronchiectasis has not been well explored.*

Objectives: This study aims to evaluate the association of CAT scores in assessing the severity of bronchiectasis andascertain whether CAT can serve as a suitable alternative to BSI in clinical situations with limited diagnostic resources.

Materials and Methods: *Between September 2023 and March 2025, a cross-sectional study was carried out at the National Institute of Diseases of the Chest & Hospital in Dhaka. A total of 98 patients diagnosed with bronchiectasis were enrolled. CAT and BSI scores were collected and analysed to assess their correlation and the ability of CAT to predict disease severity and functionality. Statistical Package for Social Science (SPSS) version 30 for Windows was used to analyse the data.*

Results: *A total of 98 cases were analysed, and the results showed a statistically significant positive correlation between the CAT scores and BSI, with a correlation coefficient (r) of 0.74. The study revealed that patients with higher CAT scores consistently presented with more severe symptoms and complications as measured by the BSI.This study also showed that individuals with a BSI score more than 9 and a CAT score greater than 20 were more likely to have severe bronchiectasis, indicating advanced disease and a larger chance of unfavorable outcomes. These findings demonstrate the potential of CAT as a predictive tool for bronchiectasis severity, aligning closely with the more traditionally used yet resource-intensive BSI.*

Conclusion: *The study concludes that the CAT score is a viable, simple, and cost-effective alternative to BSI for assessing bronchiectasis severity in resource limited setting.*

Key word: *CAT (COPD Assessment Test), BSI (Bronchiectasis Severity Index), Bronchiectasis.*

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Introduction:

Bronchiectasis is an abnormal permanent dilatation with suppuration of airways due to the destruction of muscle and elastic tissue of bronchi.[1]It is a varied, long-term inflammatory disorder of the airways that is frequently considered to be among the most underappreciated illnesses in respiratory medicine.[2] Along with asthma and COPD, bronchiectasis is typically classified as an obstructive airway illness. A vicious cycle of bacterial colonization, increased inflammation, and bronchial blockage results from inadequate mucociliary clearance.[1]It is more prevalent in women and can result in serious morbidity as one age.[3]In the US, there were 701 cases of bronchiectasis for every 100,000 people, with a higher prevalence in women and the elderly[4]; in contrast, bronchiectasis was detected in 36.2 instances per 10,000 people in Catalonia, Spain.[5]In China, it was estimated that 1.1% of men and 1.5% of women had bronchiectasis identified by a doctor.[6]Research on the most prevalent aetiology varies. According to one study, post-infection (40.4%) was the most prevalent cause, although idiopathic bronchiectasis was seen in 18.5% of patients.[7]Post-tuberculosis bronchiectasis is the leading aetiology in the Southeast Asiaregion.[8]

Bronchiectasis has four common phenotypes: predominant hemoptysis, indolent, slowly progressive, and rapidly progressive. Patients suffer from persistent cough, sputum production, exhaustion, dyspnoea, pulmonary hypertension, decreasing pulmonary function, and recurring exacerbations, which can be accompanied by hemoptysis, lethargy, pleuritic chest pain, and respiratory failure.[9]

Bronchiectasis is diagnosed by the presence of a dilated airway (broncho-arterial ratio>1), lack of airway tapering, and visible airways within 1 cm of the parietal pleura or touching the mediastinal pleura. Bronchial wall thickening, tree-in-bud changes, mucous plugging, and mosaic perfusion/ airtrappingonexpiratoryCTareindirectsignsofbronchiectasis. Certain metrics, such as BSI, FACED, and E-FACED, are used to evaluate the severity of bronchiectasis. The BSI score is the most reliable method for assessing the severity of bronchiectasis and predicting 5-year death. This score divides the patients into three groups: mild disease (0-4 points), moderate disease (5-8 points), and severe disease (9 or more points).[10]

In contrast, CAT is a brief, eight-question survey given to patients and was created specifically for use with COPD. Higher CAT scores indicate more severe symptoms ranging from 0 to 40[11.] B-CAT(CAT Bangla) ranges from 8 to 40.

Cough, sputum production, chest tightness, exertional dyspnoea, daily life activities, confidence, sleep, and energy are among the symptoms discussed; these are also important elements of bronchiectasis tools specific to the condition.The CAT elements represent the predominant symptoms of bronchiectasis and are not unique to COPD.Although bronchiectasis is an obstructive airway disease like asthma and COPD, there are few studies on the association between CAT scores and BSI in bronchiectasis. There is a Bengali version of CAT that can be utilised as a valuable tool to evaluate the severity and functionality of bronchiectasis. It may be utilised to track the progression of bronchiectasis in places without facilities if a substantial correlation between CAT and BSI scores is discovered.[11]

CAT score can be introduced in the patient's self-management plan. CAT is adaptable for health care providers at any level, from primary to tertiary care in our country. By using the domains of CAT, doctors may evaluate a patient's health and the effects of the disease at baseline, periodically, and when symptoms worsen. This research aims to determine how closely the CAT and BSI scores correlate. In places where test facilities are scarce or nonexistent, the CAT questionnaire can be used to evaluate the functional assessment and severity of bronchiectasis if it is determined that the CAT score outcomes are comparable to the BSI score outcomes and are closely related.

Materials and methods

This was a cross-sectional study and was carried out in the inpatient and outpatient Department of Respiratory Medicine of the National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka during the period from September 2023 to March2025. A total of 98 patients with diagnosed as bronchiectasis were included in the study after screening in according to the inclusion and exclusion criteria. After

properly explaining the study protocol, informed written consent was taken from each participant or their attendants. All the recruited patients were evaluated in detail, including their demographic details, present and past clinical histories, physical examinations, appropriate laboratory tests, and imaging studies.

General objectives:

To investigate the association of COPD Assessment Test scores in the evaluation of functionality and severity of bronchiectasis.

Specific objectives:

- To calculate CAT scores in patients with bronchiectasis.
- To calculate BSI scores in patients with bronchiectasis.
- To determine the association between CAT scores and BSI scores in patients with bronchiectasis.
- To assess the agreement between CAT scores and BSI in the evaluation of functionality and disease severity of bronchiectasis.

Selection criteria:

Inclusion criteria:

- Patients diagnosed as bronchiectasis at outdoor and indoor in NIDCH.

Exclusion criteria:

- Unable to perform spirometryaccordingtoATS/ERS(Milleretal., 2005).
- Patients with communication barriers.

Study procedure:

Before the study commenced, ethical approval was obtained from the Institutional Review Board (IRB) of NIDCH, Mohakhali, Dhaka. Permission to use the CAT score from MapiResearch Trust (MRT), Lyon, France, was obtained via email. The bronchiectasis patient filled out the 'Bengali' version of the CAT questionnaire. CAT scores were calculated manually with a calculator using B-CAT (Bangla Version of the COPD Assessment Test). A score of <10 is classified as low, 10-20 is classified as Medium, 21-30 is classified as High, and 31-40 is classified as Very high. Bronchiectasis severity was calculated from the score of the Bronchiectasis severity index (BSI). The severity of Bronchiectasis is divided into three categories based on the total score. A score of 0 to 4 is classified as mild, 5 to 8 is classified as moderate, and e"9 is classified as severe.Statistical Package for Social Science (SPSS) version 30 for Windows was used to analyse the data.After collection, the data were checked thoroughly for consistency. Then, the collected data were uniformly coded according to standard specifications, verified, edited, reviewed to satisfy quality control standards, and analysed according to the objectives and variables. Data were presented using descriptive and analytic techniques, including mean, SD, frequency distribution, computation of percentage, etc. ANOVA test was used for continuous variables. Pearson correlation coefficient was used to determine the correlation between BSI and CAT scores. Univariate and multivariate logistic regression analyses were done to determine the severity of bronchiectasis. A p-value d"0.05 was considered to be significant. p-value reached from ANOVA test. Kappa value used for measurement of agreement between CAT score and BSI score.

Results

In this study, out of 98 patients, the majority, 40(40.8%) patients, were 41-60 years old with a mean age of 45.2±15.5 years. Male patients were predominantly 52(53.1%), and female was 46(46.9%), with a male-to-female ratio of 1.13:1. More than half (53.1%) of patients were normal BMI with a mean BMI of 20.4±4.0 kg/m^2 (Table-I). Smoker was found in 28(28.6%), ex-smoker was 8(8.1%) and non-smoker was 62(63.3%) (Figure-1). Most of the patients had DM 20(20.4%), followed by HTN 16(16.3%) and IHD 5(5.1%) (Table-II). High (21-30) CAT score was found in 37(37.8%), medium (10-20) was 31(31.6%), low (<10) was 19(19.4%), and very high (31-40) CAT score was 11(11.2%) with the mean CAT score was 19.4±8.0. Mild (BSI 0-4) bronchiectasis was found in 24(24.5%) moderate (BSI 5-8) bronchiectasis was 25(25.5%), and severe (BSI e"9) bronchiectasis was 49(50.0%) with the mean BSI was 8.3±4.2 (Table-III). A high (21-30) CAT score was associated with severe bronchiectasis (69.4%). The mean CAT score was significantly higher in severe bronchiectasis (24.8±5.2) than in mild and moderate bronchiectasis

Table-I

Distribution of the study population by demographic profile (N=98)

Demographic profile	Number of patients	Percentage
Age (years)		
≤20	3	3.1
21-40	39	39.8
41-60	40	40.8
61-80	16	16.3
Mean ±SD	45.2	±15.5
Range (min-max)	20.0	-80.0
Sex		
Male	52	53.1
Female	46	46.9
BMI (kg/m^2)		
<18.5 (Undernutrition)	34	34.7
18.5-24.9 (Normal)	52	53.1
25.0-29.9 (Overweight)	10	10.2
≥30.0 (Obese)	2	2.0
Mean ±SD	20.4	±4.0
Range (min-max)	12.9	-30.4

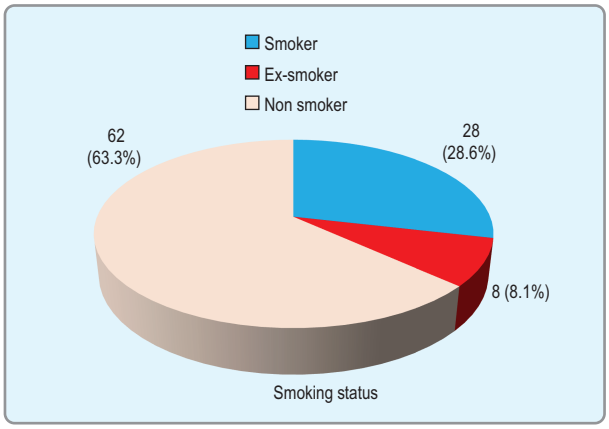

Figure-1: *Pie chart showing distribution of the study population according to smoking status (N=98)*

Table-II

Distribution of the study population according to co-morbidities (N=98)

Co-morbidities	Number of patients	Percentage
DM	20	20.4
HTN	16	16.3
IHD	5	5.1

Table-III

Distribution of the study population according to CAT and BSI score (N=98)

	Number of patients	Percentage
CAT score		
Low (<10)	19	19.4
Medium (10-20)	31	31.6
High (21-30)	37	37.8
Very high (31-40)	11	11.2
Mean ±SD	19.4	±8.0
BSI score		
Mild (0-4)	24	24.5
Moderate (5-8)	25	25.5
Severe (9-26)	49	50.0
Mean ±SD	8.3	±4.2

(9.8±3.1 and 18.0±6.3) (Table-IV). In univariate simple linear regression analysis, DM and CAT score were significantly associated with severe bronchiectasis. However, sex, smoking history, BMI, and a history of taking steroids were not significantly associated with severe bronchiectasis (Table-V). Regarding univariate logistic regression analysis, DM with adjusted OR 1.867, 95% CI (1.098-8.236) and CAT score with adjusted OR 41.620, 95% CI (17.9068-82.123) were significantly associated with severe bronchiectasis. However, sex, smoking history, BMI, and history of taking steroids were not significantly associated with severe bronchiectasis (Table-VI). Regarding multiple linear regression analysis, the CAT score was significantly associated with severe bronchiectasis. However, sex, smoking history, BMI, DM and history of taking steroids were not significantly associated with severe bronchiectasis (Table-VII). Regarding multivariate logistic regression analysis, CAT scorewith adjusted OR 42.427, 95% CI (17.352-94.590) was significantly associated with severe bronchiectasis. However, DM was not significantly associated with severe bronchiectasis (Table-VIII). 49 cases of severe bronchiectasis were evaluated by BSI score, out of which 43 (87.8%) were positive, and 6 (12.2%) were negative for severe bronchiectasis evaluated by CAT Score. 49 cases of non-severe bronchiectasis were evaluated by BSI score, of which 5 (10.2%) were positive, and 44 (89.8%) were negative for non-severe bronchiectasis evaluated by CAT Score.

Table-IV

Comparison between CAT score and BSI score for functionality and severity of bronchiectasis (N=98)

CAT score	BSI score						p-value
	Mild(n=24)		Moderate(n=25)		Severe(n=49)		
	n	%	n	%	n	%	
Low (<10)	17	70.8	2	8.0	0	0.0	
Medium (10-20)	7	29.2	18	72.0	6	12.2	
High (21-30)	0	0.0	3	12.0	34	69.4	
Very high (31-40)	0	0.0	2	8.0	9	18.4	
Mean ±SD	9.8	±3.1	18.0	±6.3	24.8	±5.2	0.001[s]
Range (min-max)	4.0	-19.0	8.0	-32.0	11.0	-34.0	

s= significant; p-value reached from ANOVA test

Table-V

Univariate Simple linear regression analysis for functionality and severity of bronchiectasis (N=98)

	Unstandardized coefficients		Standardized coefficients	t	95% CI		p-value
	B	Std. error	Beta		Lower	Upper	
Sex	-0.006	0.003	-0.196	-1.954	-0.013	0.001	0.054[ns]
Smoking history	0.026	0.057	0.046	0.448	-0.088	0.139	0.655[ns]
BMI (kg/m^2)	0.019	0.013	0.148	1.463	-0.007	0.044	0.147[ns]
DM	0.251	0.124	0.203	2.027	0.005	0.497	0.045[s]
History of taking steroids	0.083	0.146	0.058	0.572	-0.206	0.372	0.572[ns]
CAT score	0.043	0.005	0.685	9.206	0.052	0.034	0.001[s]

s= significant, ns= not significant; p-value reached from simple linear regression analysis

Table-VI

Univariate logistic regression analysisfor functionality and severity of bronchiectasis (N=98)

	Adjusted Odds ratio	95% CI		p-value
		Lower	Upper	
Sex	0.720	0.325	1.596	0.419[ns]
Smoking history	1.091	0.218	5.454	0.916[ns]
BMI (kg/m^2)	1.085	0.971	1.213	0.150[ns]
DM	1.867	1.098	8.236	0.048[s]
History of taking steroids	1.398	0.446	4.380	0.565[ns]
CAT score	41.620	17.9068	82.123	0.001[s]

s= significant, ns= not significant; p-value reached from univariate binary logisticregression analysis

Table-VII

Multivariate linear regression analysis for functionality and severity of bronchiectasis (N=98)

	Unstandardized coefficients		Standardized coefficients	t	95% CI		p-value
	B	Std. error	Beta		Lower	Upper	
Sex	-0.179	0.103	-0.197	-1.727	-0.384	0.026	0.086[ns]
Smoking history	0.059	0.058	0.106	1.027	-0.055	0.174	0.307[ns]
BMI (kg/m^2)	0.013	0.010	0.104	1.338	-0.006	0.033	0.184[ns]
DM	0.161	0.097	0.130	1.659	-0.032	0.355	0.101[ns]
History of taking steroids	0.042	0.113	0.1030	0.376	-0.181	0.266	0.707[ns]
CAT score	0.041	0.005	0.654	8.731	0.051	0.032	0.001[s]

s= significant, ns= not significant; p-value reached from multiple linear regression analysis

Table-VIII

Multivariate logistic regression analysis for functionality and severity of bronchiectasis (N=98)

	Adjusted Odds ratio	95% CI		p- value
		Lower	Upper	
DM	2.725	0.544	13.646	0.223[ns]
CAT score	42.427	17.352	94.590	0.001[s]

s= significant, ns= not significant; p-value reached from multivariate binary logistic regression analysis

Table-IX

Agreement between CAT score and BSI score (N=98)

CAT score	BSI score			
	Severe(n=49)		Non severe(n=49)	
	n	%	n	%
High (n=48)	43	87.8	5	10.2
Without high (n=50)	6	12.2	44	89.8

Measures of agreement Kappa Value =0.776, p-value= 0.001[s]
Observed Agreement = 88.8%; s=significant

Kappa	Interpretation
< 0	Poor agreement
0.0 – 0.20	Slight agreement
0.21 – 0.40	Fair agreement
0.41 – 0.60	Moderate agreement
0.61 – 0.80	Substantial agreement
0.81 – 1.00	Almost perfect agreement

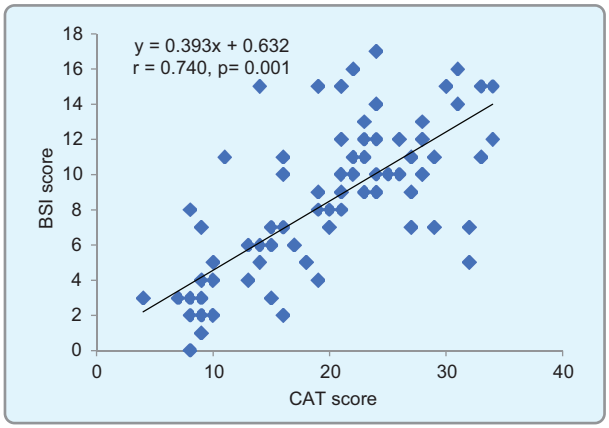

Figure-2:*Scatter diagram showing positive significant correlation between BSI and CAT score*

The results of the two modalities (CAT scoreand BSI score) and severity of bronchiectasis analysis found a Kappa value = 0.776 with a p-value <0.05. This measure of agreement is statistically significant, with substantial agreement between the CAT score and BSI score in evaluating the severity of bronchiectasis (Table-IX). Positive significant correlation (r=0.740; p-value=0.001) between BSI and CAT score (Figure-2).

Discussion

This cross-sectional study included 98 patients with bronchiectasis from indoor and outdoor of NIDCH who met the inclusion and exclusion criteria between September 2023 and March 2025. It was conducted to determine the relationship between COPD Assessment Test scores and BSI in evaluating the functionality and severity of bronchiectasis.

In this study, out of 98 patients, the majority, 40(40.8%) patients, belonged to the age group 41-60 years with a mean age of 45.2±15.5 years.In a study by Lee et al.[12], the mean age was 65.3±9.12 years. Prajapati et al.[13], the mean age was 42±14 years. In this study, most of the patients are young to middle-aged adults. Finch et al.[11], the mean age was 67±7.5 years.Involvement of this productive age group can have profound and far-reaching impacts on socioeconomic status by reducing income, productivity, and overall economic growth.

In this study, male patients were predominantly 52(53.1%) and female 46(46.9%), with a female ratio of 1.13:1.Study conducted by Lee et al.[12], it was found that 19 patients (31.2%) were male. Prajapati et al.[13] found that the population was comprised of 28 (56.0%) males and 22 (44.0%) females. Bulut

et al.[14] demonstrated that males were 84 (78.5%) and females were 23 (21.5%). Georgakopoulou et al.[15] consisted of 80 patients with bronchiectasis exacerbation: 54 (67.5%) males and 26 (32.5%) females. Men often experience a higher prevalence or more severe cases of bronchiectasis compared to women. Higher exposure to smoking,job dangers, and gender-specific social behaviours might account for it.

In this study, high (21-30) CAT score was found in 37(37.8%), medium (10-20) was 31(31.6%), low (<10) was 19(19.4%), and very high (31-40) CAT score was 11(11.2%) with the mean CAT score was 19.4±8.0. Finch et al.[11] mean CAT score was 21.2±7.8.

This study showed the mean BSI was 8.3±4.2, with mild (BSI: 0-4) bronchiectasis identified in 24 (24.5%), moderate (BSI: 5-8) bronchiectasis found in 25 (25.5%), and severe (BSI: e"9) bronchiectasis discovered in 49 (50.0%). Simon Finch et al.[11] reported that the mean BSI for the TRIBE cohort was 6.6±3.2. A study conducted by Prajapati et al.[13] found that five patients (10.0%) had severe BSI, twenty-four patients (48.0%) had low BSI, and twenty-one patients (42.0%) had intermediate BSI. According to Martinez-García et al.[16], the mean BSI was 7.5 ± 4.9. Additionally, Bulut et al.[14] discovered that the average BSI was 9.8 ± 4.7. Sharma et al.[17] found that 45 patients (26%) had mild bronchiectasis (BSI: 1-4), 81 patients (47%) had intermediate bronchiectasis (BSI: 5–8), and 47 patients (27%) had severe bronchiectasis (BSI: 9–12).

This study showed that a high (21-30) CAT score was associated with severe bronchiectasis (69.4%). The mean CAT score was significantly higher in severe bronchiectasis (24.8±5.2) than in mild and moderate bronchiectasis (9.8±3.1 and 18.0±6.3).According to Finch et al.[11], CAT scores and BSI significantly correlated in the TRIBE cohort (r = 0.34, p-value = 0.017). The bronchiectasis severity score and CAT scores were found to have a significant and positive correlation in this study (r=0.740; p=0.001). According to Finch et al.[11], CAT scores were greater for individuals with more severe disease based on BSI (95% CI, 0.73-0.95, p<0.0001).

This study showed that DM and CAT scores were significantly associated with severe bronchiectasis in univariate simple linear regression analysis. However, sex, smoking history, BMI, and a history of taking steroids were not significantly associated with severe bronchiectasis.

This study shows that, regarding univariate logistic regression analysis, DM with adjusted OR 1.867, 95% CI (1.098-8.236) and CAT score with adjusted OR 41.620, 95% CI (17.906-82.123) were significantly associated with severe bronchiectasis. However, sex, smoking history, BMI, and history of taking steroids were not significantly associated with severe bronchiectasis.Regarding multivariate linear regression analysis,this study shows thatCAT scorewas significantly associated with severe bronchiectasis. However, sex, smoking history, BMI, DM, and a history of taking steroids were not significantly associated with severe bronchiectasis.Regarding multivariate logistic regression analysis, CAT scorewith adjusted OR 42.427, 95% CI (17.352-94.590) was significantly associated with severe bronchiectasis. However, DM was not significantly associated with severe bronchiectasis.

This study demonstrates the agreement between the CAT score and BSI score in the evaluation of functionality andseverity of bronchiectasis. Forty-nine cases of severe bronchiectasis were evaluated by BSI score, out of which 43 (87.8%) were positive, and 6 (12.2%) were negative for severe bronchiectasis evaluated by CAT Score. Forty-nine cases of non-severe bronchiectasis were evaluated by BSI score, of which 5 (10.2%) were positive, and 44 (89.8%) were negative for non-severe bronchiectasis evaluated by CAT Score. The results of the two modalities (CAT scoreand BSI score) and severity of bronchiectasis analysis found a Kappa value = 0.776 with a p-value <0.05. This measure of agreement is statistically significant, with substantial agreement between the CAT score and BSI score in the evaluation of functionality andseverity of bronchiectasis.

Conclusion:

There is a significant agreement between CAT scores and BSI in theevaluation of functionality and severity of bronchiectasis.CAT score can be used to monitor bronchiectasis patients as a public health tool after being discussed in expert groups in resource-constrainedsettings.More research on the application of graded severity measures (low, medium, high, and very high), particularly with

regard to CAT scores, is advised in order to evaluate their effects on patient outcomes, healthcare efficiency, and cost-effectiveness in clinical settings.

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ORIGINAL ARTICLE

Impact of Climate Change on Lifestyle and Nutritional Status in Haor Area of Kishoregonj, Bangladesh

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Abstract:

Background:*Climate change is increasingly undermining food system security worldwide.Its impact is one of the major burning issues all over the world where Bangladesh is one of the most affected areas.The climatic events contribute to low crop-yields that result in increases in food prices, malnutrition, starvation and migration.*

Objectives: *To assess the nutritional status and life style in haor area of Kishoregonj, Bangladesh.*

Materials and methods:*A cross sectional study was carried out among 401 respondents ofhaorarea of Kishoreganj. Data were collected by convenient sampling through face to face interview using semi- structured questionnaire. Lifestyle was assessed withdietary pattern, (number of major meal per day, light meal, skipped meal)for last 7 days and dailyhealth-related behaviours and environmental conditions among the respondents. For nutritional assessment, BMI and MUACwas measured.Data were analysed by SPSS 25 software.*

Results:*18.7% of the respondents were underweight, 12% were overweight, and 1.7% had obesity.99.3% respondents had MUAC measurements above 21cm which was normal.Sex and educational status were significantly associated with nutritional status. Respondents who skipped a meal were significantly associated with nutritional status during the flood. But it did not emerge as a significant factor after flood. Daily health-related behaviours like working hours per day and smoking status were statistically significant with nutritional status. Intake of betel leaves and nuts was not statistically significant.*

Conclusions:*The findings of the study may be helpful informing development policies for this region. By understanding the socioeconomic dynamics and nutritional status in haor communities, policymakers can devise targeted interventions to uplift the living conditions and wellbeing of the residents in this region.*

Keywords*: Climate change; Nutritional status; Lifestyle; Health*

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Introduction:

Bangladesh, a densely populated developing country, is home to 166.3 million people, with 20.5% living in poverty and 10.5% facing extreme poverty[1]. While the country has made commendable strides in its overall economic, social, and health indicators, the progress in the haor areas has been less satisfactory. Encompassing approximately 8600 km^2, the haor area constitutes the upper Meghna river basin and heavily relies on agriculture and fisheries as its primary economic activities. Notably, Boro, the main crop cultivated in this region, contributes around 16% (5.3 million tons per year) of the country's total agricultural production[2].

However, the Haor area faces a significant challenge posed by flash floods triggered by intense rainfall in the adjacent mountainous regions of India during the pre-monsoon period. These floods inflict severe damages to paddy fields, occurring right before the harvest, jeopardizing the livelihoods and food security of the local population. Given that the haor region encompasses a substantial portion of the country's land and population, it warrants special attention and targeted development initiatives. The haor in Bangladesh's northeast are vast floodplain depressions with unique hydroecological features, covering approximately 1.99 million hectares (19,998 sq km) and hosting a population of around 19.37 million. These haors are distributed among several districts, namely Sunamganj, Sylhet, Habiganj, Maulvibazar, Netrakona, Kishoreganj, and Brahmanbaria, with 373 haor or wetlands found in each district. A substantial portion, about 43% (over 859,000 hectares), of the entire Haor district area is covered by these 373 haor[3].

Climate change is increasingly undermining food system security worldwide[4,5]. Food security is the ability of every human to consistently have 'physical and economic access to sufficient, safe, and nutritious food'[6]. However, one in nine people worldwide (805 million) faces food shortages[7]. Extreme climatic events, such as increased temperature, salinity intrusion, droughts, cyclones, floods, and prolonged and shortened rainy seasons, significantly contribute to food insecurity by lowing agricultural productivity and threatening rural livelihoods[8,9]. Globally, climate change contributes to a 1%–5% reduction in crop production per decade compared with the baseline situation devoid of climate change[10].

Even if global greenhouse gas (GHG) emissions were halted, it would take more than a millennium to return to preindustrial climatic conditions. A rapid increase in global warming has been observed since 1950. Moreover, Global South countries are the most susceptible to climate-change impacts with minimum adaptation capacity[11].

Bangladesh stands among nations highly susceptible to climate-change impacts worldwide. About 40 million people in the country are food insecure, while an additional 11 million experience acute hunger, plus other risks from climate-change impacts. The Global Climate Risk Index 2019 ranked the nation as the ninth most climate-vulnerable worldwide, having experienced 190 climatic events between 1997 and 2017[12]. Annually, the country receives about 1,073 million acre-feet (MAF) (equivalent to 1.323 trillion m3) of surface water and 203 MAF (equivalent to 0.2503 trillion m3) of rainfall, intensified between July to September. It has the world's longest delta intertwined with approximately 7,000 rivers, canals, and streams totaling about 22,155 km [13,14]. Floods and soil erosion are commonplace in these disaster-prone areas, thereby disrupting the food system, the environment, and other socioeconomic activities[15,16].

Climate change impact is one of the major burning issues all over the world where Bangladesh is one of the most affected areas.The climatic events contribute to low crop-yields that result in increases in food prices, malnutrition, starvation, and migration[17]. About 17% of cultivated land, forest, and aquatic resources could be inundated by only a 1 m sea-level rise, affecting about 17 million people relying on agriculture for livelihoods[18,19].

In southern Bangladesh, 40% of fertile land could be submerged by a 0.65 m sea-level rise [20]. Thus, climatic change has a serious impact on the country's overall agriculture and food security. The agriculture sector contributes 12.1% of Bangladesh's gross domestic product (GDP) and employs 39.71% of its workforce[21]. The sector is

expected to ensure food security according to the government's Vision 2021 [22]. However, climate change threatens food security by actively interacting with the local environment that supports the food systems. The country's adaptive capacity is limited by its low GDP per capita of USD 1,788, adult literacy rate of 72.9%, and life expectancy of 72.3 years. As of 2015, about 31.5% of the total population lives below the poverty line and the population density is over 1,000 persons/ km2 [23]. A study in 2018 reported that nearly 34.2% of children under the age of five were underweight, and 27% of mothers had chronic energy deficiency [24]. Sustaining food production during the moment of the climate crisis is important. Appropriate adaptation actions are required to counteract the increasing challenges of urbanization, land scarcity, and soil degradation[25,26].

Methods:

Study design & setting: This was a cross-sectional study conducted from1st July 2024 to 30 June 2025, among 401 respondents ofhaor area of Kishoreganj.

Study population:

Inclusion criteria:

1. Respondents of age group 16 to 55 years.

2. Willing to participate.

Exclusion criteria:

1. Critically ill respondents.

Data collection and analysis: Data were collected through face-to-face interview using a pre-tested data collection sheet. Before preceding the data collection, the detail of the study was explained to each eligible respondents and written consent from them was obtained. The relevant socio-demographic data along with anthropometric data of the patients were collected and recorded. Computer based statistical analysis were carried out with appropriate techniques and systems. Statistical analysis was performed by using Statistical Packages for Social Sciences (SPSS version 25). Lifestyle was assessed withdietary pattern, (number of major meal per day, light meal, skipped meal)for last 7 days and dailyhealth-related behaviours and environmental conditions among the respondents. For nutritional assessment, BMI was performed. The respondents were assigned a rating of underweight (<18.5), normal (18.5-24.9), overweight (25-29.9), obese (e"30). Anthropometric parameters, such as height (cm), MUAC, weight (kg), BMI (kg/m^2) were recorded. Height was measured with measuring tape and weight was measured with weight machine (CAMRY, Model-EB938). MUAC was measured with MUAC measuring tape for adults.

Ethical considerations:

Ethical clearance of the study was obtained from the Institutional review board of NIPSOM, Bangladesh. Informed written consent were obtained from the respondents after describing the objectives and procedure of the study and ensuring that there was no chance of any physical, mental, social and economic harm to them. Each participant voluntarily took part in the study. Privacy and confidentiality was maintained strictly. Participants had the liberty to refuse to participate at any point of the study. Anonymity of data was maintained and access to data was restricted to the Principal Investigator.

Results:

Table 1 presents the socio-demographic characteristics of the study participants. Most of the respondents (37.4%) were 16 – 25 years old. The minimum and maximum ages were 18 and 51 years, respectively. 85% of the respondents were female, 34.4% had secondary education. Most of the respondents were Muslim (90%), and 83.8% were married. Approximately 80.5% were from nuclear families and 83.8% showed monthly family income (in Taka) between 4000 to 22000.

Table 2 showed that 52.1% of the respondents had a weight ranging from 52 to 72 kg, and 42.1% were between 31 and 51 kg. Majorities (76.3 %) had heights ranging from 156 – 167 cm. 99.3% respondents had MUAC measurements above 21cm which was normal.

*Food and Nutrition Technical Assistance III Projects (FANTA Project): Adopted from WHO: Guideline for Integrated Approach to the National Care of HIV Infected Children (6 months – 14 years), 2008, **Adults include both non-pregnant, pregnant, and postpartum adults.

Table-I

Sociodemographic characteristics of the participants (n = 401)

Characteristics	Frequency	Percentage (%)
Age(years)		
16 – 25	150	37.4
26 – 35	110	27.4
36 – 45	114	28.4
46 – 55	27	6.7
mean (±SD)	30.98 (±9.281)	
Sex		
Male	60	15
Female	341	85
Educational Status		
No school education	117	29.2
Primary	102	25.4
Secondary	138	34.4
College	39	9.7
University	4	1
Others	1	0.2
Religion		
Muslim	361	90
Hindu	40	10
Marital status		
Unmarried	52	13
Married	336	83.8
Divorced	1	0.2
Widow	12	3
Types of family		
Nuclear family	323	80.5
Joint family	73	18.3
Extended family	5	1.2
Monthly family income (in Taka)		
4,000 – 22,000	335	83.5
23,000 – 41,000	62	15.5
42,000 – 60,000	4	1

Table-II

Nutritional status of the participants (n = 401)

Characteristics	Frequency	Percentage
Weight in Kilograms		
31 – 51	178	44.4
52 – 72	209	52.1
73 – 93	14	3.5
Height in centimeters		
120 – 131	2	0.5
132 – 143	-	-
144 – 155	93	23.2
156 – 167	306	76.3
MUAC* in centimeters (Adults**)		
< 18	1	0.2
18 – 21	2	0.5
>21	398	99.3

Figure 1 represented the BMI of the respondents (n = 401). Among them, 18.7% were underweight, 12% were overweight, and 1.7% had obesity.

Lifestyle of the respondents (n = 401)

According to Table 3, 99.3% respondents ate rice 2-3 times per day, 64.3% took pulse, and 62.6% ate egg once a week, and 42.9% ate fish 4 or more times weekly. 50.9% of the respondents ate vegetables 2-3 times per day.

Table 4 showed that 61.1% of the respondents took three major meals per day during the flood, and this increased to 88% after the flood. 4.2% ate snacks between breakfast and lunch and 9.2% ate snacks between lunch and dinner during the flood. After the flood, it increased by 12.7% and 15.5% respectively. 32.9% skipped any major meal during flood, but only 11% skipped any major meal after flood. Most of the respondents (27.4%) skipped breakfast during flood, and it reduced into 6.5% after flood.

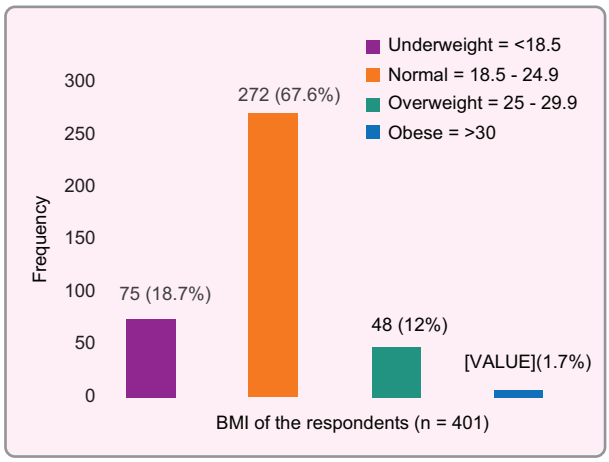

Figure 1: BMI of the participants (n = 401)

Table 5 presents that 75.8% resided in houses with kacha construction, 80.5% had pit latrines, 94.6% used tube-well water for drinking purpose, 51.6% worked 4 – 8 hours daily on average, 59.4% slept 6 – 8 hours daily at night and 69.1% slept 3 -4 hours at daytime. 9% had smoked and 24.4% had a history of betel leaves and nuts intake.

Association of different variables with nutritional status

Table 6 shows the association of different variables with the nutritional status of the participants (n = 401). Sex and educational status were significantly associated with nutritional status (p =0.000*, p = 0.013, respectively). No statistically significant association was observed between family type and nutritional status (p = 0.062). It also observed that respondents who skipped a meal were significantly associated with nutritional status during the flood. But it did not emerge as a significant factor after flood. Daily health-related behaviours like working hours per day and smoking status were statistically significant with nutritional status (p = 0.007*, p = 0.003*, respectively), (p<0.05). Intake of betel leaves and nuts was not statistically significant (p = 0.058).

Table-III

Frequency of consumption of 15 kinds of foods for the last 7 days (n = 401)

Food name	Never	Once a day	2-3times per day	4 or more per day	Once a week	2-3 times per week	4 or more per week
Rice	-	1(0.2%)	398(99.3%)	-	-	1(0.2%)	1(0.2%)
Roti	245(61.1%)	21(5.2%)	5 (1.2%)	-	68(17%)	61(15.2%)	1(0.2%)
Bread	338(84.3%)	9(2.2%)	1(0.2%)	-	42(10.5%)	11(2.7%)	-
Milk & milk products	107(26.7%)	74(18.5%)	3(0.7%)	-	107(26.7%)	90(22.4%)	20(5%)
Pulses	54(13.5%)	19(4.7%)	3(0.7%)	1(0.2%)	258(64.3%)	65(16.2%)	1(0.2%)
Egg	100(24.9%)	8(2%)	-	-	251(62.6%)	41(10.2%)	1(0.2%)
Chicken	223(55.6%)	4(1%)	1(0.2%)	-	114(28.4%)	58(14.5)	1(0.2%)
Fish	2(0.5%)	116(28.9%)	101(25.2%)	1(0.2%)	3(0.7%)	6(1.5%)	172(42.9)
Mutton	397(99%)	4(1%)	-	-	-	-	-
Beef	392(97.8)	1(0.2%)	-		5(1.2%)	3(0.7%)	-
Fruit	23(5.7%)	37(9.2%)	4(1%)	-	104(25.9%)	204(50.9%)	29(7.2%)
Vegetables	2(0.5%)	13(3.2%)	204(50.9%)	1(0.2%)	1(0.2%)	4(1%)	176(43.9%)
Nuts	266(66.3%)	26(6.5%)	3(0.7%)	-	70(17.5%)	23(5.7%)	13(3.2%)
Sweet foods like sugar, chocolate, bakery, etc.	228(56.9%)	25(6.2%)	9(2.2%)	-	96(23.9%)	21(5.2%)	22(5.5%)
Fatty foods like butter, margarine	5(1.2%)	3(0.7%)	387(96.5%)	4(1%)	1(0.2%)	1(0.2%)	-

Table-IV

Dietary pattern of the respondents during and after the flood (n = 401)

Characteristics	During flood		After flood	
	Frequency	Percentage %	Frequency	Percentage %
Major meal per day				
2 meals	155	38.7	48	12
3 meals	245	61.1	353	88
>3 meals	1	0.2	-	-
Any snacks between breakfast and lunch				
Yes	17	4.2	51	12.7
No	384	95.8	350	87.3
Any snacks between lunch and dinner				
Yes	37	9.2	62	15.5
No	364	90.8	339	84.5
Skipping any meal				
Yes	132	32.9	44	11
No	269	67.1	357	89
Name of skipped meal				
Breakfast	110	27.4	26	6.5
Lunch	13	3.2	13	3.2
Dinner	13	3.2	14	3.5
Never skip a meal	265	66.1	348	86.8%

Table-V

Daily health-related behaviours and environmental conditions among the respondents (n = 401)

Characteristics	Frequency	Percentage%
Household condition		
Kacha	304	75.8
Semi paka	84	20.9
Paka	13	3.2
Types of house latrines		
Sanitary latrines	78	19.5
Pit latrines	323	80.5
Source of drinking water		
Supply water	19	4.7
Tube-well	379	94.6
Both (Pond/water fall, Supply water, Tube-well)	3	0.7
Bathing pattern		
Daily	393	98
Every alternative day	8	2
Physical condition		
Active	397	99
Dependent	4	1
Working hours per day		
1 - 4 hours	159	39.7
4 - 8 hours	207	51.6
8 – 12 hours	32	8
More than 12 hours	3	0.7
Sleeping pattern		
Regular	399	99.5
Irregular	2	0.5
Duration of sleep (in hours) at night		
8 – 12 hours	161	40.1
6 – 8 hours	238	59.4
Less than 6 hours	2	0.5
Duration of sleep (in hours) at daytime		
1 – 2 hours	123	30.7
3 – 4 hours	277	69.1
More than 4 hours	1	0.2
Smoking status		
Yes	36	9
No	365	91
Intake of betel leaves and nuts		
Yes	98	24.4
No	303	75.6

(table continued)

Table-VI

Association of different variables with nutritional status (Chi-square test)

Characteristics	Nutritional status				P value
	Underweight (<18.5)	Normal (18.5-24.9)	Overweight (25-29.9)	Obese (>30)	
Sex					
Male	7	34	17	2	0.000*
Female	68	237	31	5	
Educational Status					
No school education	24	66	22	5	
Primary	22	72	8	0	
Secondary	18	103	15	2	0.013*
College	10	28	1	0	
University	1	1	2	0	
Others	0	1	0	0	
Types of family					
Nuclear family	62	211	44	6	
Joint family	10	58	4	1	0.062
Extended family	3	2	0	0	
Skipping any meal during flood					
Yes	37	80	13	2	0.010*
No	38	191	35	5	
Skipping any meal after flood					
Yes	5	35	4	0	0.299
No	70	236	44	7	
Working hours per day					
1 - 4 hours	23	119	14	3	
4 - 8 hours	49	132	24	2	0.007*
8 – 12 hours	3	18	9	2	
More than 12 hours	0	2	1	0	
Smoking status					
Yes	4	20	10	2	0.003*
No	71	251	38	5	
Intake of battle leaves and nuts					
Yes	22	56	17	3	0.058
No	53	215	31	4	

Discussion:

This cross-sectional study was conducted to assess the Climate change impact on lifestyle and nutritional status in selected haor area of Bangladesh. Among 401 respondents, most of the respondents (37.4%) were 16 – 25 years old. The minimum and maximum ages were 18 and 51 years, respectively. 85% of the respondents were female, 34.4% had secondary education. Most of the respondents were Muslim (90%), and 83.8% were married. Approximately 80.5% were from nuclear families, 83.8% showed monthly family income (in Taka) between 4000 to 22000.

A similar study conducted in 2022 in in the north-eastern region (wetland areas in Sylhet) of Bangladesh found that, the mean age was 62.35 years, with a range of 50–90 years. Most of the participants (59.5 %) were male, with half of the participants (59.8 %) illiterate. A large percentage (72 %) were fishermen, farmers, or daily labours. The average monthly family income was 13,868 Bangladeshi Taka (USD 163). More than half of

them were living in a nuclear family and 10.9 percent were from extended family [27].A study found that mean income of the respondents was 10,346 BDT, 28% are illiterate etc. Agriculture is the main occupation, above 28% are agriculture labour and 56% have secondary occupations [28].

In current study, 52.1% of the respondents had a weight ranging from 52 to 72 kg, and 42.1% were between 31 and 51 kg. Majorities (76.3 %) had heights ranging from 156 – 167 cm. 99.3% respondents had MUAC measurements above 21cm which was normal.

According to BMI, 18.7% were underweight, 12% were overweight, and 1.7% had obesity.

A similar study revealed that, 59.75 percent participants were malnourished, and the following 39.75 % of the participants were at risk of malnutrition [27].

In this study, sex and educational status were significantly associated with nutritional status (p =0.000*, p = 0.013, respectively). No statistically significant association was observed between family type and nutritional status (p = 0.062). It also observed that respondents who skipped a meal were significantly associated with nutritional status during the flood. But it did not emerge as a significant factor after flood. Daily health-related behaviours like working hours per day and smoking status were statistically significant with nutritional status (p = 0.007*, p = 0.003*, respectively). Intake of battle leaves and nuts was not statistically significant (p = 0.058).

A study found age, education, gender, occupation, family type and income as the important influential socio-demographic and economic factors that were significantly associated with the wetland community-dwelling older adults' malnutrition. The prevalence of malnutrition and risk of malnutrition found very high among the wetland community-dwelling older adults where respondent's age, gender, education, occupation and income are significantly associated with malnutrition. Elderly malnutrition also found higher with the advancement of age and female elderly are more vulnerable than male [27].

Conclusions:

The findings of the study may be helpful in forming development policies for this region. By understanding the socioeconomic dynamics and nutritional status in haor communities, policymakers can devise targeted interventions to uplift the living conditions and wellbeing of the residents in this region.

Limitations: Sampling technique was convenient. The sample size was small which may not represent whole population of haor area of Bangladesh.

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ORIGINAL ARTICLE

Operative Risks in Pleural Biopsy: Evaluating Non-Intubated VATS as a Feasible Alternative

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Abstract

Background: *Pleural biopsy is essential for diagnosing undiagnosed pleural effusions. Conventional video-assisted thoracoscopic surgery (VATS) requires general anesthesia with intubation, which carries perioperative risks. Non-intubated VATS (NI-VATS) has emerged as a less invasive alternative.*

Aim of the study*: This study aimed to compare the intraoperative and postoperative outcomes of non-intubated VATS (NI-VATS) versus intubated VATS (I-VATS) in patients with undiagnosed exudative pleural effusion undergoing pleural biopsy, and to assess the feasibility and safety of the NI-VATS approach.*

Methods: *This comparative cross-sectional study was conducted at the National Institute of Diseases of the Chest and Hospital Dhaka from January 2022 to June 2023 in the Department of Thoracic Surgeryincluded 60 patients undergoing pleural biopsy, divided equally into NI-VATS (n=30) and I-VATS (n=30) groups. Baseline demographics, intraoperative variables, postoperative outcomes, and diagnostic yield were compared between groups.*

Result: *Baseline characteristics, including age, BMI, ASA grade, smoking history, and comorbidities, were comparable between groups. NI-VATS demonstrated significantly shorter operative time (37.2±4.5 vs. 66.7±8.0 min, p<0.001), reduced blood loss (34.5±15.1 vs. 41.8±18.7 mL, p=0.02), and decreased hospital stay (5.1±0.8 vs. 7.4±0.7 days, p<0.001). Postoperative pain scores were markedly lower in the NI-VATS group (VAS 1.17±0.50 vs. 5.23±2.05, p<0.001).Diagnostic yield was high and comparable in both groups (93.3% vs. 96.7%, p=0.64). Incidences of complications, ICU admission, 30-day readmission, diagnostic yield, and 30-day mortality were similar between groups.*

Conclusion: *NI-VATS is a safe and feasible alternative to I-VATS for pleural biopsy, offering improved operative efficiency and postoperative recovery without compromising diagnostic yield. Adoption of NI-VATS may enhance recovery pathways in thoracic surgery.*

Keywords: *Non-intubated VATS, pleural biopsy, thoracoscopic surgery, perioperative outcomes, diagnostic yield, enhanced recovery.*

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Introduction

Pleural biopsies are commonly performed for the diagnosis of pleural diseases, including malignancies, infections, and inflammatory conditions. These procedures have been conducted using video-assisted thoracoscopic surgery (VATS), which requires general anesthesia and intubation [1]. Despite its widespread use, VATS is associated with several risks, including anesthesia-related complications, prolonged recovery times, and higher healthcare costs [2]. In recent years, non-intubated video-assisted thoracoscopic surgery (NI-VATS) has emerged as a promising alternative that may mitigate some of these risks [3]. NI-VATS, also known as awake or non-intubated VATS, allows patients to undergo thoracoscopic procedures without the need for endotracheal intubation, relying on local anesthesia and sedation instead [4]. This approach offers potential advantages, such as faster recovery, reduced postoperative pain, and fewer complications related to intubation [5]. With the increasing incidence of pleural diseases globally, the demand for safer, more efficient diagnostic procedures are growing [6]. The prevalence of pleural effusions, a common reason for pleural biopsy, was estimated to affect up to 1.5 million people globally, with an increasing trend noted in many high-risk populations, including the elderly and those with comorbidities such as cardiovascular and respiratory diseases [7]. This highlights the critical need for innovations that reduce operative risks while maintaining diagnostic accuracy. The traditional approach to pleural biopsy using intubated VATS has been well-documented, demonstrating high diagnostic yield, especially for malignancies such as lung cancer and mesothelioma [8]. However, the procedure often comes with significant risks. General anesthesia, particularly in patients with pre-existing pulmonary or cardiovascular conditions, can lead to complications such as ventilator-associated pneumonia, extended ICU stays, and longer recovery periods [9]. Furthermore, the requirement for intubation increases the complexity of the procedure, which can be particularly challenging in elderly or frail patients [10]. As healthcare costs continue to rise globally, minimizing the use of general anesthesia and reducing recovery time have become critical goals for improving patient outcomes and reducing hospital expenses [9]. NI-VATS presents an attractive alternative by eliminating the need for endotracheal intubation [4]. Studies have shown that this technique is not only safe but also associated with fewer complications, reduced postoperative pain, and shorter hospital stays compared to conventional VATS. Moreover, NI-VATS offers an opportunity to treat high-risk patients—those who might otherwise be excluded from undergoing VATS due to concerns about anesthesia risks [12]. The minimal invasiveness of the procedure has led to widespread adoption in various thoracic surgeries, including pleural biopsy, lung resection, and the management of pleural effusions [13]. Furthermore, recent evidence suggests that NI-VATS can be performed with similar diagnostic accuracy to intubated VATS, thus providing a viable alternative for patients requiring pleural biopsy [14]. The aim of this study is to evaluate the feasibility of non-intubated VATS as a safer and more efficient alternative to traditional intubated VATS for pleural biopsy, focusing on reducing operative risks while maintaining diagnostic accuracy.

Materials And Methods

This comparative cross-sectional study was conducted from January 2022 to June 2023 in the Department of Thoracic Surgery at the National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka, Bangladesh. The primary objective was to evaluate the feasibility and safety of non-intubated video-assisted thoracoscopic surgery (NI-VATS) as an alternative to the conventional intubated VATS (I-VATS) approach for pleural biopsy in patients with undiagnosed exudative pleural effusion, specifically focusing on intraoperative risks and postoperative recovery parameters. A total of 60 patients with undiagnosed exudative pleural effusion who met the inclusion criteria were enrolled and categorized into two equal groups using a purposive sampling method:

NI-VATS (n=30): Patients underwent pleural biopsy using the non-intubated VATS approach.

I-VATS (n=30): Patients underwent pleural biopsy using conventional intubated VATS.

Inclusion Criteria

Adult patients (ee18 years) admitted with undiagnosed exudative pleural effusion

Patients deemed surgically fit after preoperative assessment

Exclusion Criteria

Patients with a history of recent myocardial infarction (within 6 months), cardiac arrhythmias, or decompensated coronary artery disease

Patients with hepatic, renal, or heart failure

Pregnant patients

Patients with known HIV, HCV, or HBV infection

Ethical Consideration

This study was approved by the Institutional Review Board (IRB) of the National Institute of Diseases of the Chest and Hospital. All participants provided written informed consent prior to inclusion. Participants retained the right to withdraw at any stage without repercussions.

Surgical Procedure

Preoperative anesthesia evaluations were conducted, and patients with comorbidities received additional specialist consultations. All participants were cleared for potential conversion to general anesthesia if needed.

Figure-1: *Pleural Biopsy Procedure*

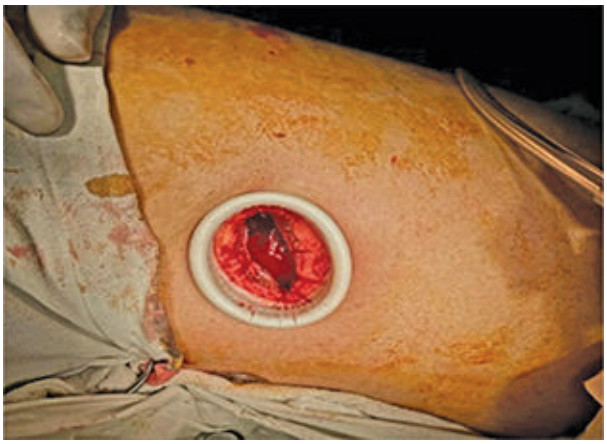

Figure 2: Incision with wound protector

NI-VATS Group: Patients received sedation with pethidine (0.2–0.5 mg/kg) and propofol (0.5 mg/kg), with local anesthesia using 0.5% bupivacaine (2 mg/kg, max 175 mg). Supplemental oxygen was administered by face mask.

I-VATS Group: Patients were intubated using a double-lumen endotracheal tube under general anesthesia.

All patients were placed in the lateral decubitus position. A 3–5 cm incision was made in the 4th or 5th intercostal space. Multiple pleural biopsies (e”3 from visible lesions or 6–8 from various sites if no abnormalities were seen) were obtained using rigid biopsy forceps. A 32Fr chest drain was inserted at the end of the procedure. Post-procedure care, including administration of local anesthetic at the incision site, was standardized for both groups.

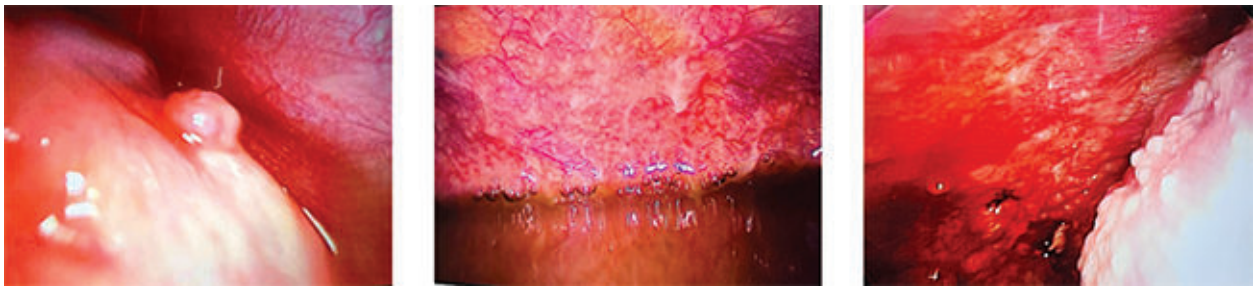

Figure 3: View of some pleural pathology

Data Collection

Data were recorded using a semi-structured, pre-tested checklist. Relevant clinical and surgical information was extracted from patient records, operative notes, and imaging or histopathology reports. Baseline demographic characteristics including age, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status classification, history of smoking, pre-existing pleural disease, and comorbid chronic obstructive pulmonary disease (COPD) were documented. Intraoperative parameters such as total operative time (in minutes), occurrence of oxygen desaturation (defined as SpO, <90%), intraoperative complications, estimated blood loss (in mL), and any need for conversion from non-intubated to intubated anesthesia were recorded in real-time by the surgical and anesthesia teams.Postoperative data included duration of chest tube placement, length of hospital stay (in days), incidence of postoperative nausea and vomiting, need for intensive care unit (ICU) admission, 30-day readmission, diagnostic yield (defined as the proportion of procedures achieving definitive pathological diagnosis), and 30-day mortality. All patients were followed up for a minimum of 30 days postoperatively either through hospital records or telephonic communication to assess late complications and readmissions.

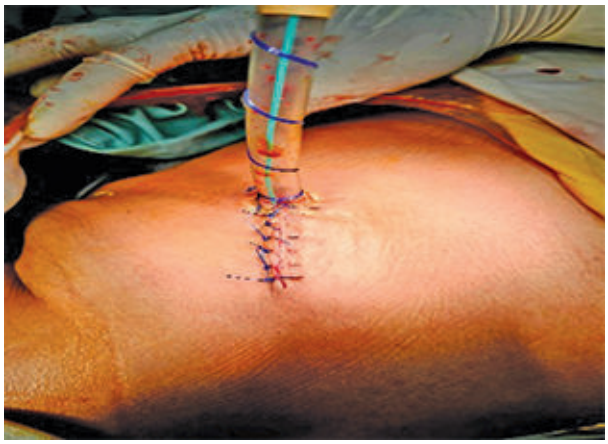

Figure 4: *Post-operative wound with chest drain*

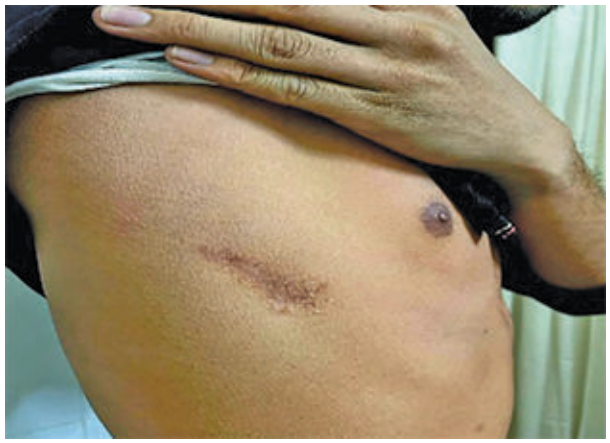

Figure 5: Post-operative scar mark

Statistical Analysis

All data were analyzed using SPSS version 26.0 (SPSS Inc., Chicago, IL, USA). Continuous variables were summarized as means ± standard deviations (SD) and compared using unpaired t-tests. Categorical variables were presented as frequencies and percentages, with group comparisons performed using the Chi-square or Fisher's exact test where appropriate. A multivariate logistic regression model was used to identify independent predictors of shorter hospital stay (de3 days), adjusting for potential confounders. A p-value de0.05 was considered statistically significant.

Result

The mean age of patients in the NI-VATS group was 54.1 ± 13.5 years, compared to 48.0 ± 17.1 years in the I-VATS group (p=0.12). Gender distribution was comparable between the groups, with males comprising 50% of the NI-VATS group and 63.33% of the I-VATS group (p=0.44). The mean body mass index (BMI) was similar in both groups (23.8 ± 3.2 kg/m² in NI-VATS vs. 24.1 ± 3.6 kg/m² in I-VATS; p=0.61). Patients with ASA grade III or IV, were 33.33% in the NI-VATS group and 36.67% in the I-VATS group (p=0.84). Smoking history was more prevalent in the I-VATS group (63.33%) than in the NI-VATS group (43.33%) (p=0.19). Known pleural disease was present in 56.67% of NI-VATS patients and 53.33% of I-VATS patients (p=0.84) (Table I). Regarding comorbidities, diabetes mellitus was observed in 10% of NI-VATS patients and none in the I-VATS group (p=0.24), while hypertension was present in 10% of patients in

both groups (p=0.99). Chronic obstructive pulmonary disease (COPD) was reported in 33.33% of NI-VATS patients and 46.67% of I-VATS patients (p=0.29). Overall, the baseline characteristics of the two groups were comparable, with no statistically significant differences observed across the evaluated variables (Table I). The mean operative time was significantly shorter in the NI-VATS group at 37.2 ± 4.5 minutes compared to 66.7 ± 8.0 minutes in the I-VATS group (p<0.001). Conversion from NI-VATS to intubation was required in 1 patient (3.33%). Intraoperative oxygen desaturation below 90% occurred in 6.7% of NI-VATS patients and 16.7% of I-VATS patients, but this difference was not statistically significant (p=0.43). Mean intraoperative blood loss was lower in the NI-VATS group (34.5 ± 15.1 ml) in comparison of I-VATS group (41.8 ± 18.7 ml), with significant difference (p=0.02). Intraoperative complications were rare, occurring in 3.3% of NI-VATS patients and 6.67% of I-VATS patients (p=0.4) (Table II). The mean Chest tube duration was shorter in NI-VATS (3.8 ± 1.2 days vs. 6.2 ± 1.5 days; p<0.001), as was post-operative hospital stay (5.1 ± 0.8 vs. 7.4 ± 0.7 days; p<0.001). Postoperative nausea/vomiting occurred in 6.67% of NI-VATS patients versus 20% in I-VATS (p=0.04), and pain scores were lower in NI-VATS 1.17 ± 0.50 vs. I-VATS 5.23 ± 2.05; (p<0.001). ICU/HDU admission (3.33% vs. 6.67%; p=0.556), 30-day readmission (3.33% vs. 6.67%; p=0.31), and diagnostic yield (93.33% vs. 96.67%; p=0.64) were almost similar. One patient (3.33%) in NI-VATS died within 30 days, with no deaths in I-VATS (Table III).

Table-I

Baseline characteristics of study participants (N=60)

Variables	NI-VATS (n=30)		I-VATS (n=30)		P-value
	n	%	n	%	
Age (years)					
Mean ± SD	54.1 ± 13.5		48.0 ± 17.1		0.12
Gender					
Male	15	50.00	19	63.33	0.44
Female	15	50.00	11	36.67	
BMI (kg/m²)					
Mean ± SD	23.8 ± 3.2		24.1 ± 3.6		0.61
ASA Grade III or IV	10	33.33	11	36.67	0.84
Smoking history	13	43.33	19	63.33	0.19
Known pleural disease	17	56.67	16	53.33	0.84
Co-morbidity					
DM	3	10.00	0	0.00	0.24
HTN	3	10.00	3	10.00	0.99
COPD	10	33.33	14	46.67	0.29

Table-II

Intraoperative and postoperative parameters among patients (N=60)

Variables	NI-VATS (n=30)		I-VATS (n=30)		P-value
	n	%	n	%	
Operative time (minutes), Mean ± SD	37.2 ± 4.5		66.7 ±8.0		<0.001
Conversion to intubation	1	3.33	N/A	N/A	N/A
Intraoperative oxygen desaturation (<90%)	2	6.7	5	16.7	0.43
Blood loss (ml), Mean ± SD	34.5 ± 15.1		41.8 ± 18.7		0.02
Intraoperative complications	1	3.30	2	6.67	0.4

Table-III

Postoperative outcomes among study population (N=60)

Outcome	NI-VATS (n=30)		I-VATS (n=30)		P-value
	n	%	n	%	
Chest tube duration (days)					
Mean ± SD	3.8 ± 1.2		6.2 ± 1.5		<0.001
Length of post-operative hospital stay(days)					
Mean ± SD	5.1 ± 0.8	7.4 ± 0.7	<0.001		
Postoperative nausea/vomiting	2	6.67	6	20.00	0.04
Postoperative ICU/HDU Admission	1	3.33	2	6.67	0.556
Postoperative Pain (VAS)					
Mean ± SD	1.17 ± 0.50		5.23 ± 2.05		<0.001
30-day readmission	1	3.33	2	6.67	0.31
Diagnostic yield	28	93.33	29	96.67	0.64
30-Day Mortality	1	3.33	0	0.00	NS

Discussion

Pleural biopsy remains a critical procedure in the diagnostic algorithm of unexplained pleural effusions, particularly when malignancy or tuberculosis is suspected. The growing adoption of non-intubated video-assisted thoracoscopic surgery (NI-VATS) has opened avenues for reducing perioperative morbidity without compromising diagnostic accuracy [15,16]. Our prospective comparative analysis provides robust evidence that NI-VATS is not only feasible but also associated with superior perioperative outcomes compared to the conventional intubated VATS (I-VATS) approach.In our study population (N=60), baseline demographic and clinical characteristics were well matched between groups. No statistically significant differences were found in age, BMI, ASA grade, smoking history, prevalence of known pleural disease, and co-morbidity. This ensures that outcome disparities are less likely due to baseline imbalances, thus reinforcing the internal validity of our comparisons [17].The most compelling intraoperative advantage of NI-VATS was the significantly shorter operative time (37.2 ± 4.5 vs. 66.7 ± 8.0 minutes, p<0.001), operative time referring to the duration from the initial skin incision to the completion of the surgical procedure, including pleural biopsy and chest tube placement. The reduced duration is explained by avoiding endotracheal intubation, mechanical ventilation setup, and complex anesthetic induction and reversal[18,16]. Spontaneous ventilation allows faster procedural initiation and smoother workflow, confirming the efficiency of avoiding general anesthesia and airway instrumentation[19].Similar trends were reported by Longo et al., who observed reduced operative durations and improved workflow with NI-VATS in undiagnosed pleural effusion management [19].Blood loss was also significantly lower in the NI-VATS group (34.5 ± 15.1 mL vs. 41.8 ± 18.7 mL, p=0.02), likely attributable to minimized hemodynamic fluctuation during spontaneous ventilation. Intraoperative oxygen desaturation occurred in 6.7% of NI-VATS patients compared to 16.7% in I-VATS (p=0.43), though not statistically significant. One patient (3.30%) in the NI-VATS group required conversion to intubation—a rate consistent with conversion figures (2–5%) from prior large-scale studies by Pathonsamit et al. [20].Intraoperative complications remained infrequent and comparable across groups. Postoperatively, NI-VATS significantly outperformed I-VATS in multiple parameters. The mean chest tube duration was 3.8 ± 1.2 days in NI-VATS versus 6.2 ± 1.5 days in I-VATS (p<0.001), while the length of hospital stay was notably reduced in NI-VATS (5.1 ± 0.8 vs. 7.4 ± 0.7 days, p<0.001). These findings are in line with

Shi et al., who highlighted enhanced recovery and shorter hospitalizations likely resulting from reduced physiological stress, preservation of spontaneous respiratory mechanics, and avoidance of complications related to endotracheal intubation and mechanical ventilation. The hypothesis supporting this relationship is that maintenance of natural respiratory dynamics and reduced anesthetic exposure contribute to faster postoperative recovery and earlier mobilization in NI-VATS patients, following non-intubated thoracoscopic interventions [21]. Postoperative nausea and vomiting—a frequent sequela of general anesthesia—were significantly lower in the NI-VATS group (6.67% vs. 20.00%, p=0.04), reinforcing the anesthesia-sparing benefits of the technique.While ICU/HDU admission was required in one NI-VATS case (3.33%) and two I-VATS cases (6.67%), the difference was not statistically significant (p=0.49). The ICU/HDU admission in these cases was primarily related to the need for closer postoperative monitoring due to transient respiratory compromise, advanced age, or underlying cardiopulmonary comorbidities, rather than procedure-related complications[18]. Importantly, both groups demonstrated excellent diagnostic yield (93.33% vs. 96.67%, p=0.556), affirming the diagnostic integrity of NI-VATS. A similar yield was reported by Zhang et al. in a matched cohort study assessing non-intubated thoracoscopic biopsies [22].Thirty-day mortality was observed in only one patient (3.33%) within the NI-VATS group, and this event was unrelated to the surgical procedure, as the patient had significant pre-existing systemic illness that progressed during the postoperative period, suggesting that mortality was more likely associated with underlying disease severity rather than the operative intervention itself. Additionally, readmission rates were low and showed no significant difference between the NI-VATS and I-VATS groups (3.33% vs. 6.67%, p=0.31)[16]. These findings are consistent with previously reported mortality rates for patients undergoing non-intubated thoracic procedures, which typically range from 1.5% to 4.7%, with deaths often attributed to exacerbations of underlying comorbidities rather than direct surgical complications. This observation is further supported by the study of Cherchi et al., which demonstrated no significant difference in readmission rates between non-intubated and intubated thoracoscopic lung biopsy patients, underscoring the safety and feasibility of the non-intubated approach [14].

Limitations of the study:

This study has certain inherent limitations. First, despite meticulous matching of baseline variables, unmeasured confounders such as variations in anesthetic depth, surgical expertise, or intraoperative ventilation dynamics could influence outcomes. Additionally, the reliance on clinical records for postoperative variables may introduce reporting bias. While diagnostic yield was comparable, subtle differences in tissue adequacy or pathologist interpretation were not assessed. Moreover, conversion criteria to intubation were not standardized across all cases, which may affect reproducibility. These factors warrant cautious interpretation and highlight the need for further validation in broader settings.

Conclusion

The present study demonstrates that non-intubated video-assisted thoracoscopic surgery (NI-VATS) is a safe, effective, and feasible alternative to conventional intubated VATS for pleural biopsy. NI-VATS was associated with significantly reduced operative time, blood loss, chest tube duration, and hospital stay, without compromising diagnostic yield or increasing complications. These findings support the integration of NI-VATS into enhanced recovery pathways, particularly in selected patients with preserved respiratory function. Further large-scale, multicenter trials are warranted to validate these outcomes and refine patient selection criteria, ultimately promoting minimally invasive, anesthesia-sparing strategies in thoracic surgical practice.

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ORIGINAL ARTICLE

Determination of Clinical Predictive Indices For Differentiating Asthma COPD Overlap Syndrome (ACO) From COPD: A Cross Sectional Study

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Abstract:

Background: *Many older peoples with a history of smoking and asthma develop clinical features of both asthma and COPD, an entity sometimes called Asthma-COPD overlap (ACO). Patients with ACO may be at higher risk of poor health outcomes than those with asthma or COPD alone. However, understanding of ACO is limited in the primary care setting and more information is needed to better patient management and thus to reduce exacerbation, morbidity and mortality of ACO patients.*

Objective: : *The aim of the study was to differentiate the clinical characteristics between ACO and COPD patients.*

Methods: *This cross-sectional observational study conducted at the Department of Respiratory Medicine in National Institute of Diseases of the Chest and Hospital from October 2019 to September 2020 in collaboration with the Department of Pathology, Radiology and Respiratory Laboratory. Statistical analyses of the results were obtained by using window based computer software devised with Statistical Packages for Social Sciences (SPSS-23).*

Results: : *Out of 96 patients with ACO and COPD, 29 patients had ACO and 67 had COPD. Mean age was 58.0±11.2 years in ACO group and 62.3±10.6 years in COPD group. Age and sex differences were not significant ($p>0.05$) between two groups. Regarding BMI, mean BMI was found 22.0±1.9 kg/m^2 in ACO group and 19.6±2.2 kg/m^2 in COPD group, which was statistically significant ($p<0.05$) between two groups. Smoking status, smoking of the pack year, symptoms of atopy, wheeze ,diurnal variation of symptoms, exacerbation number per year, hospital visit number per year, number of emergency room visit (life time), and number of hospitalization (life time) and requirement of NIV were significant ($p<0.05$) between two groups. Diabetes mellitus was found significantly more frequent in ACO group than COPD group. Mean eosinophil count and total circulatory eosinophil count was significantly higher in ACO group than COPD group. Mean level of FeNO was found 31±5.2 ppb in ACO group and 24.1±3.1 ppb in COPD group and mean total serum IgE was found 310±35 IU/L in*

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ACO group and 168±27 IU/L in COPD group. The differences were statistically significant ($p<0.05$) between two groups. Mean post bronchodilator FEV_1/FVC & reversibility of FEV_1 were significantly higher in ACO group than COPD group. Whereas, emphysema was significantly higher in COPD group than ACO group. In multivariate analysis, diurnal variation of symptoms subjects was 5.614 (95% CI 2.173 to 14.506) times increase in odds of having ACO.

Conclusion: *ACO patients have more diurnal variation of symptoms, frequent emergency room visit but less hospitalization due to exacerbation and also have frequent diabetes mellitus than COPD. Relatively high post bronchodilator FEV_1/FVC, reversibility of FEV_1 >200ml and/or >12% and FeNO level >25 ppb are likely to be ACO patients.*

Keywords: *ACO,COPD,clinical predictor*

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Introduction

Asthma and chronic obstructive pulmonary disease (COPD) are chronic respiratory diseases involving the major and small airways and manifest with wheeze, shortness of breath, chest tightness and cough. Asthma is characterized by chronic airway inflammation and airway hyper-responsiveness to a variety of stimuli with symptoms varying over time and intensity associated with variable expiratory airflow limitation. COPD is characterized by persistent airflow limitation that is usually progressive and is associated with a chronic inflammatory response in the airways to noxious particles and gases.[1,2] COPD should be considered in any patient who has dyspnoea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease. Spirometry is required to make the diagnosis; the presence of a post-bronchodilator FEV_1/FVC<0.70 confirms the presence of persistent airflow limitation and thus COPD.[1]

A subset of patients with COPD with clinical implication has been identified: in addition to having chronic airflow limitation (post-bronchodilator FEV_1/FVC<0.70 they also demonstrate variability in symptoms along with significant post-bronchodilator reversibility. These patient have clinical features of both asthma and COPD and hence are diagnosed to have asthma COPD overlap (ACO).[2]

A joint project of Global Initiative for Asthma (GINA) and Global Initiative for Chronic Obstructive Lung Disease (GOLD) provides a clinical description of ACO as follows: ACO is characterized by persistent airflow limitation with several features usually associated with asthma and several features usually associated with COPD. ACO is therefore identified by the features that it shares with both asthma and COPD.[3]

Furthermore, many studies use the term Asthma-COPD overlap syndrome (ACOS), but based on the recent change recommended by the GINA and GOLD in 2017, we will use 'ACO' as a term for this condition. From the time it was identified the notion of overlap has generated considerable debate,and some issues, particularly surrounding concept and diagnosis, remain unclear. Despite the rapprochement of opinion between asthma and COPD experts, no uniform criteria available to define ACO in patients with a previous diagnosis of asthma or COPD.Thus ACO might be defined as an evolving process for which new scientific evidences is still needed to reach definite conclusions.

Materials and methods

This cross sectional observational study was conducted at department of Respiratory Medicine of National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka from May 2019 to October 2020.

Inclusion criteria

- Patients of COPD was diagnosed by following GOLD criteria (All needed)
    1) Age > 40 years
    2) H/O exposure to risk factor for COPD such as tobacco smoking or other environmental exposures (biomass fuel/ air pollution).
    3) H/O dyspnoea /cough /sputum production

4) Post-bronchodilator $FEV_1/FVC < 0.70$

5) Post-bronchodilator reversibility <200 ml and <12% in FEV_1.

- Patients of ACO was diagnosed by following criteria .All criteria must be fulfilled.[10]

1) Age >40 year.

2) H/O exposure to risk factor for COPD such as tobacco smoking or other environmental exposures (biomass fuel/ air pollution).

3) H/O dyspnoea /cough /sputum production

4) Post-bronchodilator $FEV_1/FVC < 0.70$

5) Post-bronchodilator reversibility e" 200 ml in FEV_1.

- Patient willing to be part of the study.
- Both stable and exaggerated patients were included in this study.

Exclusion criteria

- Patients with other co-morbidity (smear positive pulmonary tuberculosis, lung cancer, end stage renal disease, left ventricular failure-EF < 30%).
- Patients who are not able to perform spirometry.
- Patients age less than 40 years

Study procedure

This study was conducted in the Respiratory Medicine, National Institute of Diseases of the Chest and Hospital, Mohakhali, Dhaka. Patients were selected according to the inclusion and exclusion criteria. Following informed written consent, a detailed clinical history including age, sex, height, weight, BMI ,socioeconomic status, level of education, smoking status, age at the onset of disease, duration of the disease, symptoms of atopy (rhinitis, dermatitis, conjunctivitis, articaria), dyspnoea (mMRC dyspnea scale), wheeze, cough, sputum production, diurnal variation of symptoms (by compatible history and by peak flow meter chart), ankle oedema, family history of wheeze, history of tuberculosis, co-morbidity such as OSA (e"3 points in STOP-BANG Questionnaire), diabetes mellitus, systemic hypertension, ischemic heart disease, muscle wasting, anxiety, depression, dyslipidemia, stroke, osteoporosis (screening by x-ray of lumbo-sacral spine) and hospital visits including number of emergency room (ER) visits, hospitalization, requirement for non-invasive (NIV), invasive mechanical ventilation (IMV) and long term oxygen therapy (LTOT) was taken from all patients and consent was obtained from each of the patient or patient's attended. Patients attending OPD or admitted in the IPD of COPD during study period, spirometry was done as a routine test. Patient was encouraged to perform the test to ensure optimum result as per the American Thoracic Society-European Respiratory Society (ATS-ERS) guideline in force since 2005.[11] Reversibility test was done after administration of 400 microgram of salbutamol by pressurized metered dose inhaler along with spacer as 4 actuation of 100 micrograms each every 15s.[12] Blood samples were taken for measuring hemoglobin value,haematocrit, ESR, eosinophil level and serum IgE. FeNO test was done as a marker of eosinophilic inflammation and also for ABG. Chest x-ray P/A view was done to see emphysema (hyperinflation of the lungs) and cardiomegaly. Hyperinflation of lungs was detected by counting more than 10 ribs posteriorly above diaphragm and cardiomegaly was detected when cardiac shadow will be more than half of intrathoracic diameter.[13] Colour Doppler echocardiogram was also done to measure pulmonary artery systolic pressure. The subjects were divided in the following groups of ACO and COPD. Clinical variables between groups were compared using Chi-square test. A p-value of less than 0.05 is considered as statistically significant.

Observations and results

This cross-sectional descriptive type of observational study was carried out in the Department of Respiratory Medicine, NIDCH, Dhaka from May 2019 to October 2020. Total ninety six patients were included in this study based on inclusion and exclusion criteria. Among them 29 patients were selected as ACO and 67 patients were selected as COPD on the basis of clinical feature and investigation profile. All the

information was collected by face to face interview of the patients. All the data were analyzed with SPSS version 23.0. The data were presented through different tables and graphs. Table I shows that most ACO patients were aged 41–50 years (31.0%), while most COPD patients were aged 61–70 years (34.3%). The mean age was 58.0±11.2 years in the ACO group and 62.3±10.6 years in the COPD group, with no significant difference ($p>0.05$). Males predominated in both groups (86.2% in ACO and 94.0% in COPD), without significant difference ($p>0.05$). However, mean BMI was significantly higher in the ACO group (22.0±1.9 kg/m²) compared to the COPD group (19.6±2.2 kg/m²) ($p<0.05$). Table II shows that smoking was more prevalent in the COPD group (97.0%) compared to the ACO group (79.3%), with higher pack-years in COPD, while atopy, wheeze, and diurnal variation were more common in the ACO group.ACO patients had higher mean exacerbations, hospital visits, and emergency visits per year than COPD patients.Conversely, COPD patients had higher lifetime hospitalizations and NIV requirements, with all differences being statistically significant ($p<0.05$). Table III shows that diabetes mellitus was significantly more common in the ACO group (44.8%) than in the COPD group (13.4%) ($p<0.05$). Other comorbidities, including OSA, hypertension, IHD, muscle wasting, anxiety, depression, dyslipidemia, stroke, and osteoporosis, showed no significant differences between the groups ($p>0.05$). Tables IV–V show that ACO patients had significantly higher eosinophil percentage and absolute eosinophil count compared to COPD patients ($p<0.05$). Additionally, mean FeNO levels and total serum IgE were also significantly higher in the ACO group than in the COPD group ($p<0.05$).

Tables VI and VII shows that mean post BD FEV_1/FVC was found 63.5±4.1 percent in ACO group and 52.5±8.0 percent in COPD group. he mean reversibility of FEV_1(ml) was found 461.4±40.7 ml in ACO group and 88.5±59.1 ml in COPD group. The mean reversibility of FEV_1(%) was found 35.5±6.7 percent in ACO group and 11.4±7.9 percent in COPD group. The difference were statistically significant ($p<0.05$) between two group. Table VII show that emphysema was significantly more common in the COPD group (65.7%) than in the ACO group (27.6%) ($p<0.05$).In contrast, cardiomegaly and elevated PASP (>40 mmHg) were comparable between ACO and COPD groups, with no statistically significant differences ($p>0.05$).

Table VIII and IX logistic regression analysis shows that diurnal variation of symptoms, diabetes mellitus, higher reversibility of FEV• (>200 ml and >12%), and FeNO (>25 ppb) were significant predictors ($p<0.05$). Additionally, emergency room visits, hospitalization (>2 times), and lower post-BD FEV•/FVC (<70%) were significantly associated with the outcome ($p<0.05$).Other variables, including BMI, smoking status, atopy, wheeze, exacerbation frequency, hospital visits, NIV requirement, eosinophil count, TCE, post-BD FEV, FVC, emphysema, and total serum IgE, were not statistically significant ($p>0.05$)

Multivariate regression analysis was performed to identify independent predictors of ACO. Variables with $p < 0.05$ were considered statistically significant. Diurnal variation of symptoms (OR 5.61, p=0.001), diabetes mellitus (OR 5.24, p=0.001), post-bronchodilator FEV•/FVC <70% (OR 0.04, p=0.001), reversibility of FEV• >200 ml (OR 7.11, p=0.003), reversibility of FEV• >12% (p=0.005), emergency room visit (lifetime) (OR 0.78, p=0.016), hospitalization >2 times (OR 0.15, p=0.020), and FeNO >25 ppb (OR 0.65, p=0.001) were independently associated with ACO. Among these, diurnal variation, diabetes, and bronchodilator reversibility showed strong positive associations, whereas lower FEV•/FVC, frequent hospitalization, emergency visits, and lower FeNO showed inverse associations. Other variables, including BMI, smoking, atopy, wheeze, exacerbation frequency, eosinophilia, IgE, and emphysema, were not statistically significant after adjustment.These findings suggest that asthma-like features (symptom variability and bronchodilator reversibility) favor ACO diagnosis, whereas markers of more severe or fixed airflow limitation and healthcare utilization are more associated with COPD.

Table I

Distribution of demographic characteristics of the study patients(n=96)

Demographic characteristics	ACO(n=29)		COPD(n=67)		χ^2 or t value	value P
	n	%	n	%		
Age (years)						
41-50	9	31.0	13	19.4		
51-60	8	27.6	17	25.4		
61-70	7	24.1	23	34.3		
71-80	5	17.2	12	17.9		
>80	0	0.0	2	3.0		
Mean±SD	58.0 ±11.2		62.3 ±10.6		1.79	[a]0.078[ns]
Range (min-max)	41.0 -76.0		43.0 -83.0			
Sex						
Female	4	13.8	4	6.0	1.62	[b]0.189[ns]
Male	25	86.2	63	94.0		
BMI (kg/m^2)						
<18.5 (Underweight)	0	0.0	17	25.4		
18.5-24.9 (Normal)	28	96.6	50	74.6		
≥25.0 (Overweight)	1	3.4	0	9.0		
Mean±SD	22.0±1.9		19.6±2.2		4.98	[a]0.001[s]
Range (min-max)	18.8-26.2		12.9-24.6			

(s= significant, ns= not significant, [a]P value reached from unpaired t-test, df=1; [b]P value reached from chi square test, df=1)

18.5-24.9 (Normal) 28 96.6 50 74.6

Table II

Distribution of clinical profile of the study patients (n=96)

Clinical profile	ACO(n=29)		COPD(n=67)		×^{2} or t value	P value
	n	%	n	%		
Smoking status						
Yes	23	79.3	65	97.0	8.31	[a]0.009[s]
No	6	20.7	2	3.0		
Smoking of the pack year	10.2	±4.5	24.1	±7.2	9.60	[b]0.001[s]
Age at the onset of disease (years)	48.3	±10.4	52.4	±9.5	1.89	[b]0.080[ns]
Duration of disease (years)	10.9	±7.6	9.8	±5.0	0.84	[b]0.411[ns]
Dyspnoea :mMRC scale	2.38±0.62		2.42±0.66		0.28	[b]0.788[ns]
Symptoms of atopy	21	72.4	18	26.9	17.41	[a]0.001[s]
Wheeze	23	79.3	22	32.8	17.55	[a]0.001[s]
Cough	29	100.0	67	100.0	-	-
Sputum production	26	89.7	57	85.1	0.36	[a]0.403[ns]
Diurnal variation of symptoms	20	69.0	19	28.4	13.84	[a]0.001[s]
Ankle edema	9	31.0	16	23.9	0.54	[a]0.463[ns]
H/O tuberculosis	2	6.9	4	6.0	0.03	[a]0.590[ns]
Exacerbation number per year	3.34±1.42		2.28±0.98		4.22	[b]0.001[s]
Hospital visit number per year	2.10±1.23		1.64±0.75		2.25	[b]0.027[s]
Number of emergency room visit (life time)	4.52±1.76		3.24±2.44		2.55	[b]0.013[s]
Number of hospitalization (life time)	1.34±0.61		1.90±1.37		2.11	[b]0.043[s]
Requirement of NIV	0.07±0.26		0.36±0.57		2.62	[b]0.010[s]
Requirement of LTOT	5	17.2	13	19.4	0.06	[a]0.803[ns]

(s= significant, ns= not significant, [a]P value reached from unpaired t-test;df=1; [b]P value reached from chi square test,df=1)

Table III

Distribution of co-morbidities of the study patients (n=96)

Co-morbidities	ACO(n=29)		COPD(n=67)		$\times^2$ value	P value
	n	%	n	%		
OSA Diabetes mellitus	1313	44.844.8	279	40.313.4	0.1711.29	$0.679^{ns}0.001^{s}$
Hypertension	9	31.0	19	28.4	0.07	0.791^{ns}
IHD	8	27.6	17	25.3	0.05	0.821^{ns}
Muscle wasting	9	31.0	24	35.8	0.24	0.321^{ns}
AnxietyDepression	1210	41.434.5	3121	46.331.3	0.220.08	$0.294^{ns}0.904$
Dyslipidemia	10	34.5	19	28.4	0.36	0.548^{ns}
Stroke	2	6.8	5	7.5	0.01	0.645^{ns}
Osteoporosis	14	48.3	36	53.7	0.24	0.321^{ns}

(s= significant, ns= not significant, P value reached from chi square test, df=1)

Table IV

Distribution of hematological investigation results of the study patients (n=96)

Investigation	ACO(n=29) Mean±SD	COPD (n=67) Mean±SD	t value	P value
Haematocrit (%)				
Male	42.3±3.5	44.0±4.2	1.79	0.077^{ns}
Female	41.1±3.2	43.0±3.9	0.79	0.480^{ns}
Eosinophil count (%)	4.3±1.3	2.7±0.7	7.82	0.001^{s}
Total circulatory eosinophil (cells/cubic mm)	334.2±54.5	207.7±57.5	10.05	0.001^{s}

(s= significant, ns= not significant , P value reached from unpaired t-test, df=1)

Table V

Distribution of inflammatory biomarker results of the study patients (n=96)

Inflammatory biomarker	ACO(n=29) Mean±SD	COPD(n=67) Mean±SD	t value	P value
FeNO (ppb)	31.0±5.2	24.1±3.1	8.07	0.001^{s}
Total serum IgE (IU/L)	310.0±35	168.0±27	21.56	0.001^{s}

(s= significant, P value reached from unpaired t-test, df=1)

Table VI

Distribution Of Spirometry Results Of The Study Patients (N=96)

Spirometry	ACO(n=29) Mean±SD	COPD(n=67) Mean±SD	t value	P value
Post bronchodilator FEV_1/FVC (%)	63.5±4.1	52.5±8.0	6.95	0.001^{s}
Reversibility of FEV_1 (ml)	461.4±40.7	88.5±59.1	30.92	0.001^{s}
Reversibility of FEV_1 (%)	35.5±6.7	11.4±7.9	14.36	0.001^{s}

(s= significant, P value reached from unpaired t-test, df=1)

Table VII

Distribution Of Chest X-Ray And Echocardiogram Findings Of The Study Patients (N=96)

	ACO (n=29)		COPD (n=67)		$\times^2$	P value
	n	%	n	%		
Chest x-ray						
Emphysema	8	27.6	44	65.7	11.83	0.001[s]
Cardiomegaly	10	34.5	21	31.3	0.09	0.763[ns]
Echocardiogram						
PASP(mm of Hg)						
≤40	18	62.1	41	61.2	0.01	0.936[ns]
>40	11	37.9	26	38.8	0.01	0.936[ns]

(s= significant, ns= not significant, P value reached from chi square test,df=1)

Table VIII

Multivariate Regression Analysis for ACO

Parameter	Regression coefficient (β)	Odds Ratio	95% CI	P value
e"25.0 kg/m^2 (Overweight)	0.044	1.047	0.013-8.973	0.967[ns]
Smoker	0.351	1.421	0.222-1.653	0.207[ns]
Symptoms of atopy	1.202	3.326	0.956-11.576	0.059[ns]
Wheeze	1.269	3.557	0.957-13.215	0.058[ns]
Diurnal variation of symptoms	1.725	5.614	2.173-14.506	0.001[s]
Requirement of NIV	-0.736	0.479	0.150-1.531	0.214[ns]
Exaggeration (>2 time)	1.494	4.456	0.788-25.209	0.091[ns]
Hospital visit (e"2 time)	-0.203	1.226	0.375-4.009	0.737[ns]
Emergency room visit (Life time)	0.244	1.784	1.634-1.955	0.016[s]
Hospitalization (>2 time)	-1.894	0.150	0.030-0.745	0.020[s]
Diabetes mellitus	1.656	5.236	1.899-14.437	0.001[s]
Eosinophil count (>3%)	23.532	1.193	0.247-8.431	0.998[ns]
TCE (>250 cells/cubic mm)	3.334	1.055	0.730-65.512	0.063[ns]
Post bronchodilator FEV_1/FVC (<70%)	-3.185	0.041	0.013-0.134	0.001[s]
Reversibility of FEV_1 (>200 ml)	1.962	7.111	1.986-25.465	0.003[s]
Reversibility of FEV_1 (>12%)	1.351	1.873	1.59-1.980	0.005[s]
Emphysema	-1.160	0.313	0.073-1.339	0.117[ns]
FeNO (>25 ppb)	0.426	1.653	1.530-1.804	0.001[s]
Total serum IgE (>170 IU/L)	1.359	0.279	0.257-1.506	0.132[ns]

(s= significant, ns= not significant, P-value reached from multivariate analysis by binary logistic regression analysis, df=1)

Table IX

Predictive Indices For Differentiating ACO From COPD Obtained Through Multivariate Regression

Parameter	Odds ratio	95% CI	P value
Diurnal variation of symptoms	5.614	2.173-14.506	0.001[s]
Emergency room visit (Life time)	1.784	1.634-1.955	0.016[s]
Hospitalization(>2 times)	0.150	0.030-0.745	0.020[s]
Diabetes mellitus	5.236	1.899-14.437	0.001[s]
Post bronchodilator FEV_1/FVC (<70%)	0.041	0.013-0.134	0.001[s]
Reversibility of FEV_1(>200 ml)	7.111	1.986-25.465	0.003[s]
Reversibility of FEV_1(>12%)	1.873	1.159-1.980	0.005[s]
FeNO (>25 ppb)	1.653	1.530-1.804	0.001[s]

(s= significant)

Discussion

This cross-sectional descriptive type of observational study was carried out with an aim to study the physical profile of ACO and COPD patients, to study the clinical profile of ACO and COPD patients and to study the laboratory investigation profile of ACO and COPD patients.

A total of 96 patients with ACO and COPD were enrolled in this study. Among them 29 patients had ACO and 67 patients had COPD. They were attending OPD or admitted in IPD of Respiratory Medicine in National Institute of Diseases of the Chest and Hospital (NIDCH), Mohakhali, Dhaka during the period from October 2019 to September 2020 according to inclusion and exclusion criteria.

In this study it was observed that in ACO group majority 9(31.0%) patients belonged to age group 41-50 years whereas in COPD group 23(34.3%) patients belonged to age group 61-70 years. The mean age was found 58.0±11.2 years in ACO group and 62.3±10.6 years in COPD group. The difference was not significant ($p>0.05, x^2=1.79, df=1$) between two groups. Similarly, Izbicki [10] reported that mean age was 64.1±11.5 years in ACO group and 64.8±10.6 years in COPD along group, that was not significant (p=0.73) between two groups. Duong-Quy[14] showed mean age was 52±14 years in ACO group and 59±13 years in COPD group, that was not significant (p>0.05) between two groups.

Regarding sex distribution in this study it was observed that male patients were predominant in both groups, whereas 25(86.2%) in ACO group and 63(94.0%) in COPD group. The difference was not significant ($p>0.05, x^2=1.62, df=1$) between two groups. Similarly, Ayub et al.,[6] had found male patients were predominant in both groups, whereas 39(86.7%) in ACO group and 47(85.5%) in non ACO COPD group, that was not significant (p=0.36) between two groups.

In this present study it was observed that mean BMI was found 22.0±1.9 kg/m^2 in ACO group and 19.6±2.2 kg/m^2 in COPD group, which was statistically significant (p<0.05) between two group. Ayub et al.,[6] had observed that mean BMI was 22.6±6.0 kg/m^2 in ACO group and 21.9±4.3 kg/m^2 in non ACO group, which was not significant (p=0.45) between two group.

In this study it was observed that 23(79.3%) patients were found smoker in ACO group and 65(97.0%) in COPD group. Mean smoking of the pack year was found 10.2±4.5 in ACO group and 24.1±7.2 in COPD group. The difference was significant (p<0.05) between two groups. In a study of Izbicki et al.,[10] where they found smoker was 37(61.7%) in ACO group and 118(57.8%) in COPD alone group, that was not significant (p=0.61) between two groups. Almost similar study observed by Toledo-Pons et al.,[11] reported that mean smoking pack per year was 18.40 ± 21.50 in ACO group and 16.12 ± 18.89 in COPD group. The difference was not significant (p=0.230) between

two groups. . Ayub et al.,[6] consisted that history of smoking was 31(68.9%) in ACO group and 34(65.4%) in non ACO- COPD group, that was significant (p<0.01) between two groups. History of smoking was significantly higher in the ACO group. This may be a selection bias, as the ACO group is a selective subset within the COPD cohort and hence, there will be a concentration of cases within this subset. The SI was significantly lower (SI <200) in the ACO group, similar to previously published literature.[9,7] The Non-ACO group smoking index was significantly higher than that of ACO group, it had been recognized that tobacco smoke was one of the causes of lung function damage.[15]

In this current study it was observed 21 (72.4%) patients had symptoms of atopy in ACO group and 18(26.9%) in COPD group. Twenty three (79.3%) patients had wheeze in ACO group and 22(32.8%) in COPD group. Twenty (69.0%) patients had diurnal variation of symptoms in ACO group and 19(28.4%) in COPD group. The mean exaggeration number per year was found 3.34±1.42 in ACO group and 2.28±0.98 in COPD group. The mean hospital visit number per year was found 2.10±1.23 in ACO group and 1.64±0.75 in COPD group. The mean number of emergency room visit was found 4.52±1.76 life time in ACO group and 3.24±2.44 life time in COPD group. The mean number of hospitalization was found 1.34±0.61 life time in ACO group and 1.90±1.37 life time in COPD group. The mean requirement of NIV was found 0.07±0.26 in ACO group and 0.36±0.57 in COPD group. Which were statistically significant (p<0.05) between two group. In a study of Duong-Quy et al.,[14] where they had observed in COPD and ACO groups, the main respiratory symptoms were cough and sputum production, and dyspnoea on excretion (90.5% and 84.7%; 82.4% and 91.5%). The percentage of subjects with dyspnea on excretion in the ACO group was significantly higher than that in the COPD group (P<0.05).

Ayub et al.,[6] consisted that mean duration of symptoms was 15.5±10.3 years and 12.6±11.5 years in ACO and non ACO group respectively, the difference was not significant (p=0.206). Atopy was 29 (64.4%) in ACO group and 36 (67.9%) in non ACO group. Wheeze was 43(95.6%) in ACO group and 42(79.2%) in non ACO group. Cough was 43(95.6%) and 52(98.1%) in ACO and non ACO group respectively. Sputum was 39 (86.7%) in ACO group and 47(88.7%) in non ACO group. Ankle edema was 17 (37.8%) and 17 (32.1%) in non ACO group respectively. History of tuberculosis was 11 (24.4%) and 14 (26.4%) in ACO and non ACO group respectively. Both groups had similar presenting complaints. However, the ACO group reported to perceive wheeze as more troublesome when compared to the non ACO group. Their study believed that in the ACO group, there is a consistent variability in the wheeze attributed to the "reversible" element in airflow limitation. This probably makes the patient often recognize the wheeze as its intensity frequently changes with time. However, in the non ACO patient, there is persistent and slowly progressive airflow limitation with no sudden variability.

Regarding co-morbidity, in this study it was observed that 13(44.8%) patients were found diabetes mellitus in ACO group and 9(13.4%) in COPD group. The difference was statistically significant (p<0.05) between two group. OSA(44.8% vs 40.3%), hypertension(31.0% vs 28.4%), IHD(27.6% vs 25.3%), muscle wasting(31.0% vs 35.8%), anxiety(41.4% vs 46.3%), depression(34.5% vs 31.3%), dyslipidemia(34.5% vs 28.4%), stroke (6.8% vs 7.5%) and osteoporosis (48.3% vs 53%) were not significant (p>0.05) between ACO and COPD groups . Ayub et al.,[13] reported that no significant difference was identified in co-morbid illnesses such as OSA and diabetes mellitus. Izbicki et al.,[10] found no statistically significant difference in the number of comorbidities. In a subgroup analysis of the ECLIPSE study.[16] (Wurst 2016), it was found that the proportions of co-morbidities were higher in ACO patients (66%), compared with COPD patients (43%). However, both groups had similar prevalence of cardiovascular diseases. There were no significant differences between ACO and COPD in comorbidities other than rhinitis in an analysis of the British Optimum Patient Care Research Database.[17] (Krishnan 2019).

Regarding haematological investigation, there were no significant differences of haematocrit

between ACO and COPD group. Eosinophil count and TCE (Total Circulatory Eosinophil) were observed 4.3±1.3% and 334.2±54.5 cells/cubic mm in ACO and 2.7±0.7% and 207.7±57.5 cells/cubic mm in COPD group respectively, both of them are significantly different($p<0.05$) between two groups. Inoue et al.,[5] found higher eosinophlia in peripheral blood. Blood eosinophil count >400/ microliter is more common in ACO patients than pure COPD patients.[16] (Llonos 2018).

Regarding inflammatory biomarkers, mean level of FeNO was found 31±5.2 ppb in ACO group and 24.1±3.1 ppb in COPD group. The mean total serum IgE was found 310±35 IU/L in ACO group and 168±27 IU/L in COPD group. The differences were statistically significant ($p<0.05$) between two groups. Kobayashi et al.,[9] found total serum IgE was significantly higher in patients with ACOS (2989 IU/L) than those without ACOS (451 IU/L). Inoue et al.,[5] found mean FeNO level was 33.7±15.3 ppb in ACO group and 26.9±21.6 ppb in non-ACO group which was not significant differences between two group.

In this study it was observed that mean post bronchodilator FEV_1/FVC was found 63.5±4.1 percent in ACO group and 52.5±8.0 percent in COPD group. The mean reversibility of FEV_1 was found 461.4±40.7 ml in ACO group and 88.5±59.1 ml in COPD group. The mean reversibility of FEV_1 was found 35.5±6.7 percent in ACO group and 11.4±7.9 percent in COPD group. The difference were statistically significant ($p<0.05$) between two group. Izbicki et al.,[10] reported that FEV_1/FVC was 0.57 (±0.09) in ACO group and 0.57 (±0.12) in COPD group.

Ayub et al.,[6] consisted that mean FEV_1/FVC was 57.8±7.9 in ACO group and 59.3±7.2 in non ACO group. The difference was not significant ($p=0.33$). Mean reversibility of FEV_1 was 351.6±168.4 ml in ACO group and 38.5±103.3 ml in non ACO group. Mean reversibility of FEV_1 was 23.6±13.3 percentage and 2±7.7 percentage in ACO and non ACO group respectively, that was statistically significant ($p<0.001$) between two groups.

Ayub et al.,[6] defined ACO in patients having significant bronchodilator reversibility in the background of persistent postbronchodilator airflow limitation (FEV1/FVC <70%) (Diagnosis of Diseases with Chronic Airflow Limitation 2017). Other studies have used exhaustive criteria (such as younger age, presence of asthma, atopy, significant smoking, high reversibility on spirometry to identify this group of patients.[18,19]

Regarding radiological investigations, it was observed that emphysema was significantly higher in COPD group than ACO group (65.7% vs 27.6%). Cardiomegaly was not significant ($p>0.05$) between two groups. PASP (>40 mm of Hg) was found 38% in ACO group and 39% in COPD group which was not also significant ($p>0.05$) between two groups. Ayub et al.,[6] found pulmonary hypertension significantly higher in non-ACOS COPD group than ACOS group.

In multivariable analysis, diurnal variation of symptoms subjects was 5.614 (95% CI 2.173 to 14.506) times increase in odds of having ACO. Emergency room visit (Life time) subjects was 1.784 (95% CI 1.634 to 1.955) times increase in odds of having ACO. Hospitalization (>2 time) subjects was 0.150 (95% CI 0.030 to 0.745) times increase in odds of having ACO. Diabetes mellitus subject was 5.236 (95% CI 1.899 to 14.437) times increase in odds of having ACO. Post bronchodilator FEV_1/FVC (<70%) subjects was 0.041 (95% CI 0.013 to 0.134) times increase in odds of having ACO. Reversibility of FEV_1 (>200 ml) subjects was 7.111 (95% CI 1.986 to 25.465) times increase in odds of having ACO. Reversibility of FEV_1 (>12%) subjects was 1.873 (95% CI 1.159 to 1.980) times increase in odds of having ACO. FeNO (>25 ppb) subjects was 1.653 (95% CI 1.530 to 1.804) times increase in odds of having ACO. Which were found to be significantly ($p<0.05$) associated with ACO patients but others findings were not found to be significantly ($p>0.05$) associated with ACO patients.

Conclusion:

In conclusion, this study highlights how the ACO phenotype may clinically differ from their counterparts elsewhere, making it a clinical challenge to identify them in Bangladesh. The present study highlights the importance of detailed clinical history and physical examination and

performing spirometry for accurate diagnosis of ACO and COPD patients in primary care.

Limitations of the study

1. The present study was conducted at a short period of time.
2. Small sample size was also a limitation of this study. Therefore, in future further studies may be under taken with large sample size.
3. The sample was taken purposively, so there may be chance due to bias which can influence the result.

Recommendation

Further studies can be undertaken by including large number of patients in different centers.

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ORIGINAL ARTICLE

A Prospective Analysis of Antimicrobial Susceptibility in Klebsiella pneumoniae and Pseudomonas aeruginosa Isolated from Sputum at a Tertiary Respiratory Care Center in Bangladesh

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Abstract

Background: *The escalating burden of antimicrobial resistance (AMR) among respiratory pathogens poses a critical threat to public health. Data on local epidemiology and resistance profiles from culture-confirmed cases are essential for guiding effective empirical therapy and stewardship in high-burden settings.*

Objective: *To prospectively analyze the prevalence and antimicrobial susceptibility patterns of Klebsiella pneumoniae and Pseudomonas aeruginosa isolated from sputum samples at a tertiary respiratory care center in Bangladesh, with the aim of informing local empirical treatment guidelines and antimicrobial resistance surveillance.*

Methods: *A prospective, laboratory-based analysis was conducted over a 6-month period. A total of 146 culture-positive sputum samples from patients with diagnosed lower respiratory tract infections were included. All isolates were identified using standard microbiological techniques. Antimicrobial susceptibility testing for Klebsiella pneumoniae and Pseudomonas aeruginosa was performed using the Kirby-Bauer disk diffusion method, and results were interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines.*

Results: *Among 146 culture-positive samples, gram-negative bacilli predominated (84.2%), led by Klebsiella pneumoniae (56, 38.4%), Pseudomonas aeruginosa (39, 26.4%), and Enterobacter spp. (25, 17.2%). MRSA accounted for 2.6% (4) of isolates. For K. pneumoniae, resistance was extreme to cefixime (100%), levofloxacin (88.4%), and azithromycin (91.8%), with 68.7% resistant to ceftriaxone, suggesting a high prevalence of ESBL producers. Meropenem remained highly active (93.2% susceptible). In contrast, P. aeruginosa showed preserved susceptibility to key agents: ceftazidime (94.1%), cefepime (95.0%), piperacillin-tazobactam (88.1%), and carbapenems (82–83%).*

Conclusion: *This analysis of culture-confirmed respiratory infections at a tertiary chest hospital reveals a striking predominance of Gram-negative pathogens, with Klebsiella pneumoniae showing alarming resistance to most first-line agents except carbapenems. Pseudomonas aeruginosa remains broadly susceptible. The findings mandate a revision of empirical antibiotic guidelines at NIDCH, favoring carbapenems or piperacillin-tazobactam for severe Gram-negative infections, and highlighting ceftazidime/cefepime as cornerstone therapies for suspected Pseudomonas infections.*

Keywords: A*ntimicrobial resistance, Bacteriology, Sputum culture, Klebsiella pneumoniae, Pseudomonas aeruginosa.*

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Introduction

Respiratory tract infections (RTIs) are a formidable global health challenge, a leading cause of morbidity, mortality, and healthcare expenditure worldwide.[1] Their impact is especially severe in low- and middle-income countries (LMICs), where systemic constraints exacerbate poor outcomes.[2] Among RTIs, lower respiratory tract infections (LRTIs) are particularly devastating.[3] Effective clinical management depends on timely antimicrobial therapy, yet the relentless rise of antimicrobial resistance (AMR) is eroding standard regimens.t South Asia, including Bangladesh, is an epicenter of multidrug-resistant (MDR) Gram-negative bacteria.[5] These pathogens often harbor enzymes such as ESBLs and carbapenemases that defeat last-line antibiotics.[6]

In Bangladesh, the respiratory disease burden is immense, driven by high rates of tuberculosis, COPD, and related conditions.[7,8] The National Institute of Diseases of the Chest and Hospital (NIDCH) is the nation's premier respiratory referral center, which inherently concentrates patients at the highest risk for MDR infections.[9] Despite this, there is a critical paucity of contemporary, systematic data on local bacteriology and AMR patterns from this institution.[10,11] This lack of evidence forces clinicians to rely on potentially outdated protocols, risking inappropriate therapy that can lead to clinical failure, increased mortality, and further selection of resistance.[12]

Empirical antibiotic selection depends on local pathogen and susceptibility profiles. Recent reports from tertiary centers in neighboring countries indicate a disturbing shift toward Gram-negative rod dominance, with alarmingly high rates of resistance.[13,14,] Even low levels of carbapenem-resistant pathogens are an urgent warning.[15,16] For pathogens such as Pseudomonas aeruginosa, susceptibility varies significantly across institutions, making local data essential for guiding therapy and preventing carbapenem overuse.[17, 18]

Generating precise, local-level evidence is therefore a fundamental prerequisite for effective antimicrobial stewardship (AMS) and improved patient outcomes, as AMS programs rely on facility-specific data. [19, 20]. This study addresses this critical gap at NIDCH through a prospective analysis of sputum cultures. It aims to characterize the contemporary bacteriological profile and detailed antimicrobial susceptibility patterns, with a focus on key pathogens. The findings will provide an essential evidence base to update local guidelines, inform national policy, and strengthen AMS in Bangladesh.

Materials and Methods

Study Design

Cross-sectional observational study.

Place of study

Department of Respiratory Medicine, National Institute of Diseases of the Chest and Hospital, Mohakhali, Dhaka-1212

Study Period

From 1st January 2025 to 30th June 2025 (Total 6 months).

Study Population

Adult patients 18 years and older attending the inpatient ward of the Department of Respiratory Medicine at the National Institute of Diseases of the Chest and Hospital, Mohakhali, Dhaka-1212

Sampling technique

A non-probability consecutive sampling technique was employed, enrolling all eligible patients who met the inclusion criteria during the study period.

Sample size: 146 patients.

Inclusion Criteria:

- Adult patients aged e"18 years attending the inpatient department of NIDCH, Bangladesh
- Presence of clinical symptoms suggestive of a lower respiratory tract infection (LRTI) or an infective exacerbation of chronic lung disease
- Provision of a good-quality, purulent sputum sample meeting standard microbiological criteria: >25 polymorphonuclear leukocytes (PMNs) and <10 squamous epithelial cells per low-power field
- Primary, significant bacterial isolate identified as either *Klebsiella pneumoniae* or *Pseudomonas aeruginosa* (for final comparative analysis)

Exclusion Criteria:

- Received effective systemic antibiotic therapy for >48 hours prior to sputum sample collection
- Unable to provide a good-quality sputum specimen (failing the microbiological criteria of >25 PMNs and <10 epithelial cells/low-power field)
- Cultures yielding only commensal flora, contaminants, or a significant pathogen other than *K. pneumoniae* or *P. aeruginosa*
- Duplicate sample submitted for the same infectious episode (only the first isolate was retained)
- Incomplete demographic or antimicrobial susceptibility data for the core antibiotic panel
- Patients with cultures yielding other pathogens (*Enterobacter* spp., *S. pneumoniae*, *A. baumannii*, MRSA, or polymicrobial infections) were excluded from the comparative analysis (n=51)

Ethical Issue:

The study received approval from the NIDCH scientific committee. Before participating, all patients provided written informed consent following a complete explanation of the study's purpose and procedures. Since all tests were non-invasive and posed no harm, there were no ethical concerns.

Results:

Based on the analysis of 146 sputum samples from patients with respiratory infections at NIDCH, the cohort was predominantly male (66.6%) with a mean age of 46.65 years and high rates of smoking (60.1%) and COPD (49.3%). *Klebsiella pneumoniae* (38.4%) was the most common pathogen, followed by *Pseudomonas aeruginosa* (26.4%), with Gram-negative bacilli accounting for 84.2% of isolates. Of these 146 culture-positive samples, 95 patients (56 with *K. pneumoniae* and 39 with *P. aeruginosa*) met the final inclusion criteria for the comparative resistance analysis; the remaining 51 patients with other pathogens (*Enterobacter* spp., *S. pneumoniae*, *A. baumannii*, MRSA, or polymicrobial infections) were excluded. Antimicrobial resistance was alarming, particularly for *K. pneumoniae*, which showed complete resistance to cefixime and high resistance to levofloxacin (88.4%) and ceftriaxone (68.7%), though meropenem remained highly susceptible (93.2%). In contrast, *P. aeruginosa* isolates demonstrated preserved susceptibility to first-line anti-pseudomonal agents, with cefepime (95.0%) and ceftazidime (94.1%) being the most effective. These distinct resistance profiles necessitate pathogen-directed empirical therapy, favoring carbapenems for suspected *Klebsiella* infections and anti-pseudomonal cephalosporins for suspected *Pseudomonas* infections in this setting.

Table-I

Demographic Characteristics of Study Participants (N=146)

Characteristic	Category	Number (n)	Percentage (%)
Sex	Male	97	66.6
	Female	49	33.4
Age Group (Years)	18–30	11	7.6
	31–40	21	14.4
	41–50	64	44.1
	51–60	38	26.1
	>60	12	7.8
Total	146	100.0	

Table 1 shows that 146 patients with respiratory infections were enrolled, from whom sputum-derived bacterial isolates were obtained. Most participants were male (97, 66.6%). The largest age group was 41-50 years (64, 44.1%), followed by 51-60 years (38, 26.1%). The mean age was 46.65 years.

Table-II

Clinical Risk Factors and Comorbidities of the Study Cohort (N=146)

Risk Factor / Comorbidity	Number (n)	Percentage
Current or Former Smoker	88	60.1
Chronic Obstructive Pulmonary Disease (COPD)	72	49.3
Asthma	34	23.2
Post-Tuberculosis Lung Disease	17	11.7
Bronchiectasis	17	11.7
Lung Cancer	6	3.9
Undernutrition (BMI <18.5 kg/m²)	14	9.6
Diabetes Mellitus (DM)	47	31.9

Table II shows that the predominant risk factors in the cohort were smoking (88, 60.1%) and COPD (72, 49.3%). A considerable proportion of patients had diabetes mellitus (47, 31.9%), while undernutrition (BMI <18.5 kg/m²) was observed in 14 patients (9.6%).

Table-III

Distribution of Bacterial Pathogens Isolated from Sputum Samples (N=146 Isolates)

Pathogen	Number of Isolates (n)	Percentage (%)
Klebsiella pneumoniae	56	38.4
Pseudomonas aeruginosa	39	26.4
Enterobacter spp.	25	17.2
Streptococcus pneumoniae	14	9.4
Acinetobacter baumannii	3	1.8
MRSA	4	2.6
Polymicrobial Infections	5	3.42
Total	146	100.0

Table-IV

Antimicrobial Susceptibility Profile of Klebsiella pneumoniae Isolates (n=56)

Antimicrobial	Tested (n)	Resistant n (%)	Sensitive n (%)
Cefixime	56	56 (100.0)	0 (0.0)
Levofloxacin	56	49 (88.4)	7 (11.6)
Azithromycin	56	51 (91.8)	5 (8.2)
Cefuroxime	56	47 (84.4)	9 (15.6)
Ciprofloxacin	56	43 (77.6)	13 (22.4)
Ceftriaxone	56	38 (68.7)	18 (31.3)
Amoxicillin-Clavulanate	56	37 (66.7)	19 (33.3)
Piperacillin-Tazobactam	56	14 (24.1)	42 (75.9)
Meropenem	56	4 (6.8)	52 (93.2)

Table-V

Antimicrobial Susceptibility Profile of Pseudomonas aeruginosa Isolates (n=39)

Antimicrobial	Tested (n)	Resistant n (%)	Sensitive n (%)
Cefixime	39	39 (100.0)	0 (0.0)
Azithromycin	39	37 (94.1)	2 (5.9)
Ceftriaxone	39	29 (74.3)	10 (25.7)
Amoxicillin-Clavulanate	39	27 (68.3)	12 (31.7)
Ciprofloxacin	39	15 (38.6)	24 (61.4)
Levofloxacin	39	11 (27.7)	28 (72.3)
Meropenem	39	7 (17.8)	32 (82.2)
Imipenem	39	7 (16.8)	32 (83.2)
Piperacillin-Tazobactam	39	5 (11.9)	34 (88.1)
Ceftazidime	39	2 (5.9)	37 (94.1)
Cefepime	39	2 (5.0)	37 (95.0)

Table-VI

Baseline Characteristics of Patients with K. pneumoniae vs. P. aeruginosa Infections (n=95)

Characteristic	*K. pneumoniae* (n=56)	*P. aeruginosa* (n=39)	p-value
Male sex, n (%)	37 (66.1)	26 (66.7)	0.95†
Mean age (years) ± SD	46.2 ± 10.5	47.3 ± 11.2	0.62‡
Smoking, n (%)	34 (60.7)	24 (61.5)	0.94†
COPD, n (%)	28 (50.0)	19 (48.7)	0.90†
Diabetes mellitus, n (%)	18 (32.1)	13 (33.3)	0.90†
Undernutrition (BMI <18.5), n (%)	6 (10.7)	4 (10.3)	0.95†

† Chi-square test; ‡ Independent t-test ($p > 0.05$ for all, no significant differences)

Table-VII

Comparative Resistance Rates between K. pneumoniae (n=56) and P. aeruginosa (n=39).

Antimicrobial Agent	*K. pneumoniae* Resistance (n=56)	*P. aeruginosa* Resistance (n=39)	p-value†
Levofloxacin	88.4% (49)	27.7% (11)	<0.0001
Ciprofloxacin	77.6% (43)	38.6% (15)	<0.0001
Ceftriaxone	68.7% (38)	74.3% (29)	0.55
Meropenem	6.8% (4)	17.8% (7)	0.10
Piperacillin-Tazobactam	24.1% (14)	11.9% (5)	0.14
Amoxicillin-Clavulanate	66.7% (37)	68.3% (27)	0.87

"P-values: Chi-square or Fisher's exact test; 95% CIs: Clopper-Pearson method."

Table-VIII

Comparative Resistance Profiles of Klebsiella pneumoniae and Pseudomonas aeruginosa: Implications for Empirical Therapy

Antimicrobial Agent	*K. pneumoniae* Resistance (n=56)	*P. aeruginosa* Resistance (n=39)	Recommendation
Meropenem	6.8%	17.8%	Recommended for both
Piperacillin-Tazobactam	24.1%	11.9%	Recommended for both
Cefepime	Not tested	5.0%	Recommended for *P. aeruginosa* only
Ceftazidime	Not tested	5.9%	Recommended for *P. aeruginosa* only
Levofloxacin	88.4%	27.7%	Avoid for *K. pneumoniae*
Cefixime	100.0%	100.0%	Avoid for both
Ceftriaxone	68.7%	74.3%	Avoid for both

Table III shows that the most frequently isolated pathogen was *Klebsiella pneumoniae* (56, 38.4%), followed by *Pseudomonas aeruginosa* (39, 26.4%) and *Enterobacter* spp. (25, 17.2%). Collectively, Gram-negative bacilli accounted for 84.2% of all significant isolates. MRSA was isolated in only 2.6% of cases (4 isolates).

Table IV shows that among 56 *Klebsiella pneumoniae* isolates, resistance was complete to cefixime (100%), and exceptionally high to levofloxacin (88.4%), ciprofloxacin (77.6%), and ceftriaxone (68.7%), suggesting a high burden of ESBL producers. In contrast, meropenem retained excellent activity (93.2% susceptible), and piperacillin-tazobactam showed moderate activity (75.9% susceptible).

Table V shows that among 39 *Pseudomonas aeruginosa* isolates, susceptibility to first-line anti-pseudomonal agents was well-preserved. Ceftazidime (94.1%) and cefepime (95.0%) were the most effective agents, followed by piperacillin-tazobactam (88.1%), imipenem (83.2%), meropenem (82.2%), and levofloxacin (72.3%). Ciprofloxacin showed higher resistance (38.6%). These findings establish anti-pseudomonal cephalosporins as the preferred empirical therapy for suspected *P. aeruginosa* infections at NIDCH.

Table VI shows that patients with *K. pneumoniae* (n=56) and *P. aeruginosa* (n=39) infections were well-matched, with no significant differences in sex (66.1% vs. 66.7% male, p=0.95), mean age (46.2 vs. 47.3 years, p=0.62), smoking (60.7% vs. 61.5%, p=0.94), COPD (50.0% vs. 48.7%, p=0.90), diabetes mellitus (32.1% vs. 33.3%, p=0.90), or undernutrition (10.7% vs. 10.3%, p=0.95).

Table VII compares resistance rates between *K. pneumoniae* (n=56) and *P. aeruginosa* (n=39). *K. pneumoniae* showed significantly higher resistance to levofloxacin (88.4% vs. 27.7%, $p < 0.0001$) and ciprofloxacin (77.6% vs. 38.6%, $p < 0.0001$). For

meropenem, resistance was 6.8% in *K. pneumoniae* vs. 17.8% in *P. aeruginosa* (p = 0.10), and for piperacillin-tazobactam, resistance was 24.1% in *K. pneumoniae* vs. 11.9% in *P. aeruginosa* (p = 0.14); these differences were not statistically significant. No significant differences were observed for ceftriaxone (p = 0.55) or amoxicillin-clavulanate (p = 0.87).

Table 8 compares resistance profiles of *K. pneumoniae* (n=56) and *P. aeruginosa* (n=39) to guide empirical therapy. Meropenem and piperacillin-tazobactam are effective options for both pathogens, though meropenem is more reliable for *K. pneumoniae* (6.8% vs. 17.8% resistance) and piperacillin-tazobactam for *P. aeruginosa* (11.9% vs. 24.1% resistance). For suspected *Pseudomonas* infections, cefepime and ceftazidime are highly effective (H"95% susceptibility). Fluoroquinolones should be avoided for *K. pneumoniae* (77–88% resistance) but remain moderately active against *P. aeruginosa* (27–38% resistance). Cefixime is completely ineffective against both pathogens (100% resistance), emphasizing the need for antibiotic stewardship.

Discussion:

This study provides a crucial, institution-specific overview of antimicrobial resistance among the principal Gram-negative pathogens in sputum at NIDCH. It documents a substantial disease burden from Klebsiella pneumoniae and Pseudomonas aeruginosa, with critically high resistance in K. pneumoniae, in sharp contrast to the maintained susceptibility in P. aeruginosa. These findings have direct implications for initial treatment, stewardship, and infection prevention at this referral hospital. [21]

The high-risk patient cohort at NIDCH, defined by chronic lung conditions such as COPD (49.3%), smoking (60.1%), and prior healthcare contact, is predisposed to infection with multidrug-resistant Gram-negative bacteria, which accounted for 84.2% of isolates.[22],[23] This aligns with regional trends in tertiary care in South Asia, where chronic lung disease and healthcare exposure are well-established risk factors for colonization and infection with resistant organisms.[2]t ,[2]u

The resistance profile of K. pneumoniae is profoundly alarming. The extreme resistance to cephalosporins (100% to cefixime, 68.7% to ceftriaxone) and fluoroquinolones (88.4% to levofloxacin, 77.6% to ciprofloxacin) strongly suggests widespread extended-spectrum beta-lactamase (ESBL)-producing strains.[2]v This pattern aligns with surveillance data from neighboring countries, where CTX-M-type ESBLs predominate in K. pneumoniae isolates from respiratory specimens.[2]w ,[2]x The high susceptibility to meropenem (93.2%) confirms carbapenems as the current last resort, but the 6.8% carbapenem resistance observed in this study is a serious early warning of emerging carbapenem-resistant Enterobacteriaceae (CRE).[2]y ,[3]p CRE infections are associated with significantly higher mortality (up to 40-50%) than carbapenem-susceptible strains, underscoring the urgent need for containment strategies.[31],[32]

Conversely, P. aeruginosa exhibits a more manageable susceptibility pattern. The outstanding efficacy of ceftazidime (94.1% susceptible) and cefepime (95.0%) is a key finding that challenges reflexive carbapenem use and positions these antipseudomonal cephalosporins as first-line agents for Pseudomonas at NIDCH, thereby conserving carbapenems.[33] This strategy aligns with global stewardship recommendations that advocate the use of narrower-spectrum agents when susceptibility is assured.[3]t ,[3]u Piperacillin-tazobactam (88.1% susceptible) and carbapenems (imipenem 83.2%, meropenem 82.2%) remain effective alternatives, though their higher resistance rates compared with ceftazidime and cefepime suggest they should be reserved for second-line or directed therapy.[3]v

The comparative data from this study revealed statistically significant differences that mandate a pathogen-guided empirical approach. K. pneumoniae showed significantly higher resistance to levofloxacin (88.4% vs. 27.7%, p < 0.0001) and ciprofloxacin (77.6% vs. 38.6%, p < 0.0001) than P. aeruginosa.[3]w This divergence likely reflects distinct resistance mechanisms: plasmid-mediated quinolone resistance (PMQR) and ESBL co-production are common in K. pneumoniae, whereas P. aeruginosa more often develops resistance through chromosomal mutations in efflux pumps and target enzymes.[3]x ,[3]y Conversely, P. aeruginosa showed higher

resistance to meropenem (17.8% vs. 6.8%, p = 0.10) and piperacillin-tazobactam (11.9% vs. 24.1%, p = 0.14), reflecting P. aeruginosa's intrinsic ability to upregulate AmpC beta-lactamases and efflux systems.t p No significant differences were observed for ceftriaxone or amoxicillin-clavulanate, both of which showed poor activity against both pathogens.t [1]

For suspected Klebsiella infection, a carbapenem is warranted given the 93.2% susceptibility rate observed in this study.t [2] For suspected Pseudomonas infection, ceftazidime or cefepime should be initiated as first-line therapy, with piperacillin-tazobactam as an alternative.t [3] High resistance renders empirical use of fluoroquinolones or ceftriaxone ineffective for both pathogens.t t This precise, pathogen-directed strategy is central to antimicrobial stewardship, optimizing clinical outcomes while reducing further selection of resistance.t u

Limitations

This study has several limitations. Firstly, it was conducted at a single tertiary referral center, limiting generalizability to primary or secondary care settings. Secondly, ESBL production was inferred from phenotypic resistance patterns without confirmatory testing (e.g., combined disk test, PCR for *bla*CTX-M, *bla*TEM, *bla*SHV). Thirdly, the Kirby-Bauer disk diffusion method provides qualitative results; MIC determination by E-test or broth microdilution would offer more precise quantitative data. Fourthly, the sample size (n=95 for comparative analysis) may limit statistical power for detecting smaller but clinically meaningful differences. Finally, clinical outcome data (e.g., treatment failure, mortality, length of stay) were not analyzed, representing an important area for future research.

Conclusions and Recommendations

In conclusion, this study documents a critical dichotomy in the AMR landscape at NIDCH: an escalating crisis involving Klebsiella pneumoniae, marked by high rates of ESBL and emerging carbapenem resistance, juxtaposed with a more controllable scenario involving Pseudomonas aeruginosa. These findings provide an urgent, evidence-based mandate for action. We recommend:

1. Immediate Revision of Empirical Therapy Guidelines: Formally recommend carbapenems for suspected ESBL-producing Gram-negative infections and prioritize ceftazidime/cefepime for suspected *Pseudomonas*.
2. Enhanced Antimicrobial Stewardship: Implement pre-authorization for carbapenems and continuous education based on this local data to deter the inappropriate use of cephalosporins and fluoroquinolones.
3. Strengthened Laboratory Capacity: Introduce routine phenotypic confirmation of ESBL and carbapenemase production to guide infection control and therapy.
4. Infection Control Reinforcement: Strict adherence to contact precautions, particularly for patients infected or colonized with carbapenem-resistant isolates, is non-negotiable to prevent outbreaks.

By translating this microbiological surveillance into concrete policy, NIDCH can lead a more effective fight against antimicrobial resistance, ultimately safeguarding patient lives and preserving the efficacy of last-resort antibiotics for Bangladesh.

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REVIEW ARTICLE

Air Pollution and Lung Cancer: A Growing Global Health Crisis

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Abstract

Lung cancer remains the leading cause of cancer-related mortality worldwide. Although tobacco smoking is the predominant risk factor, a growing proportion of cases now occur in never-smokers, highlighting the importance of environmental exposures such as air pollution. Fine particulate matter (PM2.5) has been classified as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC).[1] Epidemiological and mechanistic evidence suggest that air pollution significantly contributes to the global lung cancer burden through oxidative stress, chronic inflammation, and DNA damage.[2,3] This systematic narrative review synthesizes current global and regional evidence on the association between air pollution and lung cancer, integrating epidemiological, mechanistic, and translational insights, with a particular focus on high-exposure settings such as South Asia.

Keywords: *Lung cancer, air pollution, PM2.5, particulate matter, environmental carcinogenesis*

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Introduction

Despite major advances in screening, diagnosis, and treatment, lung cancer continues to account for the highest number of cancer-related deaths worldwide. Lung cancer in individuals who have never smoked is currently the seventh leading cause of cancer deaths in both sexes worldwide, suggesting an important role for environmental exposures.[2,3] Ambient air pollution has emerged as a dominant environmental determinant of this shift. Fine particulate matter (PM2.5), now classified as a Group 1 carcinogen, represents a key exposure with global relevance.[1] Air pollution, particularly PM2.5, is now recognised as a major environmental carcinogen. Large-scale analyses, including the Global Burden of Disease (GBD) study, confirm that air pollution contributes substantially to lung cancer mortality worldwide, particularly in low- and middle-income countries.[4,5]

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Table I

Global Burden of Disease 2017 Risk Factor Collaborators' Estimates of Global Lung Cancer Mortality Attributable to Selected Risk Factors in 2017

Exposure	Rank	Number in 1000s	95% Uncertainty Interval
Smoking	1	1190	1150-1230
Ambient particulate matter pollution	2	265	183-351
Household air pollution from solid fuels		85	60-113
Occupational exposure to asbestos	3	191	137-247
Occupational exposure to silica		49	22-77
Occupational exposure to diesel engine exhaust		18	16-20
Occupational exposure to arsenic		9	2-16
Occupational exposure to nickel		9	1-23
Occupational exposure to polycyclic aromatic hydrocarbons		5	4-6
Occupational exposure to cadmium		1	1-1
Occupational exposure to chromium		1	1-2
Diet low in fruits	4	185	77-320
Secondhand smoke	5	100	57-149
Residential radon	6	88	50-139

Fig.-1: Global lung cancer mortality attributable to selected risk factors in 2017(This table has been constructed from data fromInternational Agency for Research on Cancer, 2016)

Methods (PRISMA-Informed Narrative Approach)

This review follows a PRISMA-informed narrative synthesis approach. A comprehensive literature search was conducted across PubMed, Scopus, Web of Science, and Google Scholar for studies published up to June, 2025. Keywords included "air pollution," "PM2.5," "lung cancer," "adeno-carcinoma," "environmental carcinogenesis," and "Bangladesh."

Eligible studies included cohort studies, case-control analyses, mechanistic investigations, and global burden assessments. Priority was given to high-impact journals such as The Lancet, Nature, British Journal of Cancer, and Environmental Health Perspectives.

Global burden estimates and policy data were supplemented by reports from the World Health Organization,v Health Effects Institute,[7] and World Bank.[8]

Sources and Types of Air Pollution

Air pollution constitutes a complex mixture of particulate and gaseous pollutants originating from traffic emissions, industrial activities, biomass burning, and household fuel use. Among these, particulate matter (PM) with an aerodynamic diameter less than 2.5 microns (PM2.5) is most relevant to lung cancer due to its ability to penetrate deep into the alveolar regions of the lungs.[3] These particles contain carcinogenic compounds such as polycyclic aromatic hydrocarbons (PAHs), transition metals, and organic carbon fractions.[4,5] Owing to their small size and physicochemical properties, PM2.5 particles can remain suspended in the atmosphere for prolonged periods, reach the distal airways, and deposit within the alveoli. They may also enter systemic circulation, contributing to systemic effects. These particles contain polycyclic aromatic hydrocarbons, heavy metals, sulfates, and organic carbon compounds.[4]

Indoor air pollution from solid fuel combustion in low- and middle-income countries further contributes significantly to exposure burden.[10]

Global Burden of Disease

Air pollution is one of the largest environmental health risks globally. Air pollution is responsible for millions of premature deaths annually, with a substantial proportion attributable to lung cancer.[6,7]Approximately 14% of global lung cancer deaths are linked to PM2.5 exposure, with higher proportions observed in Asia.[4]

In 2017, about 14% of lung cancer deaths worldwide were linked to PM2.5 air pollution, with national levels varying from 4.7% in the United States to 20.5% in China. This indicates that air pollution is a major contributor to lung cancer alongside smoking and radon exposure.[4] Higher burden is observed in rapidly industrializing regions and densely populated urban areas.[4,5]

Epidemiological Evidence

A strong and consistent body of epidemiological evidence demonstrates a positive association between long-term air pollution exposure and lung cancer risk.[9,11] Cohort studies show that higher PM2.5 exposure is associated with increased lung cancer incidence and mortality. Latency analyses suggest a delay of 15–20 years between exposure and disease manifestation.[2] Importantly, the association persists after adjustment for smoking and is also observed in never-smokers, confirming an independent carcinogenic effect.[9] Dose–response relationships further strengthen causality between PM2.5 exposure and lung cancer risk.[9] Air pollution exposure after lung cancer diagnosis is also associated with poorer survival, particularly in adenocarcinoma and early-stage disease.[2]

Histological Subtypes

Air pollution is associated with all major lung cancer subtypes, including adenocarcinoma, squamous cell carcinoma, and small cell lung cancer. However, stronger associations are consistently observed for adenocarcinoma.[12]

The global increase in adenocarcinoma incidence may be partly influenced by environmental exposures such as air pollution.[12] Emerging molecular evidence indicates that PM2.5 exposure is linked to EGFR-mutant lung cancer, particularly among never-smokers.[2]

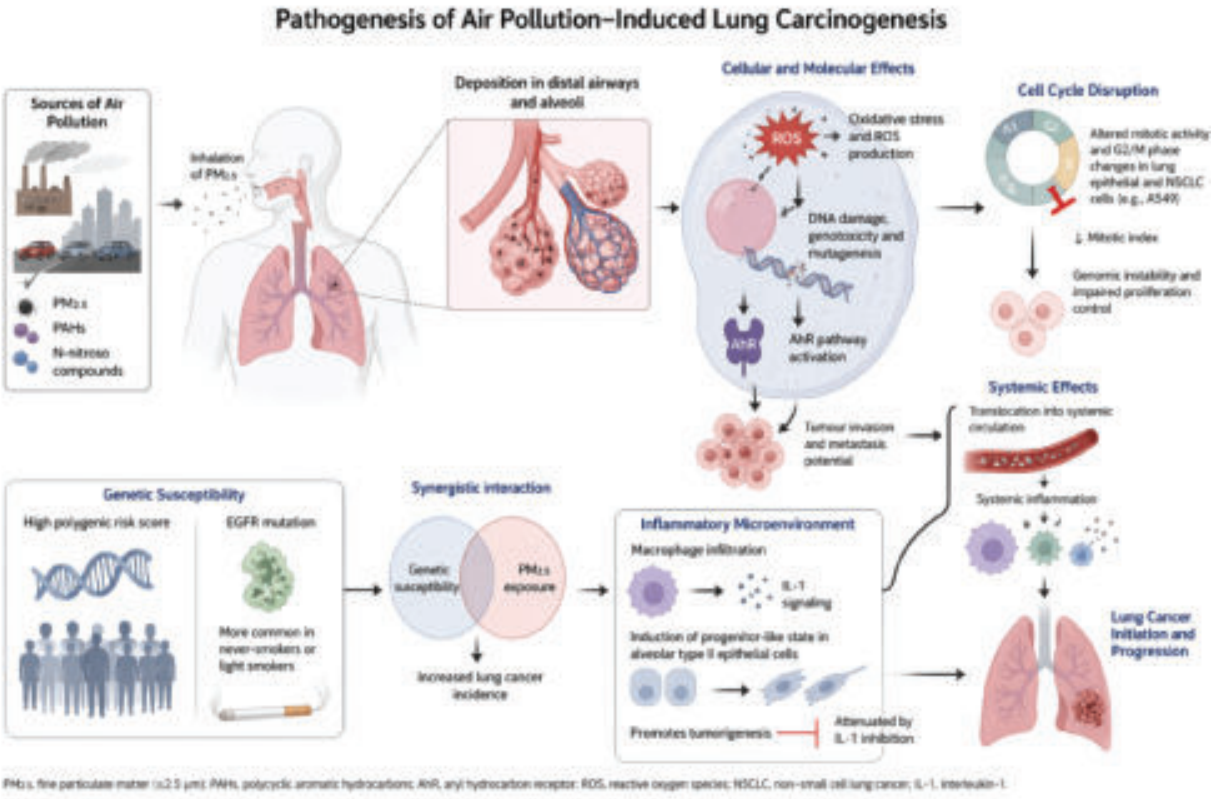

Fig.-2: *Pathogenesis of air pollution induced lung carcinogenesis*

Biological Mechanisms

The carcinogenic effects of air pollution are mediated through multiple biological pathways. PM2.5 induces oxidative stress, chronic inflammation, and reactive oxygen species (ROS) production, leading to DNA damage and mutagenesis.[3] It also activates the aryl hydrocarbon receptor (AhR) pathway, promoting tumor invasion and metastatic potential.[2] Genetic susceptibility modifies risk, with interactions between polygenic risk scores and PM2.5 exposure increasing lung cancer susceptibility.[3] EGFR-mutant lung cancer, more common in never-smokers or light smokers, is significantly associated with PM2.5 exposure.[2] Experimental studies show macrophage infiltration and interleukin-1–mediated signalling leading to progenitor-like transformation of alveolar type II cells, promoting tumorigenesis.[2]

Interaction with Smoking

Air pollution and tobacco smoking act synergistically in increasing lung cancer risk. Individuals exposed to both factors have a significantly higher risk compared with those exposed to either alone.[2]

Bangladesh Perspective: A High- Exposure, High-Vulnerability Setting

Bangladesh represents one of the most severely affected regions globally, with PM2.5 concentrations consistently exceeding WHO guidelines.[6,7] Major sources include vehicular emissions, brick kilns, industrial activity, and biomass fuel use. Seasonal peaks during winter exacerbate exposure levels.[12,13]

Both ambient and household air pollution contribute significantly to disease burden, with women and non-smokers disproportionately affected.[10,13] The presence of toxic constituents such as PAHs and heavy metals further enhances carcinogenic risk[9]. Despite policy initiatives, enforcement gaps persist, limiting effective mitigation.[8]

Prevention and Control

Reducing exposure to air pollution is essential for lung cancer prevention. The most effective strategy is reduction at source through emission control, clean energy transition, and improved urban air quality policies.[4]

Individual-level strategies include monitoring air quality (PM2.5/PM10), using protective respirators during high pollution episodes, reducing traffic exposure, and adopting cleaner transport options. Indoor exposure can be reduced through clean fuels, ventilation improvement, and air purification systems.[4]

Preventive strategies should account for exposure intensity, duration, and population susceptibility while ensuring equitable implementation.[4]

Future Directions

Future research should focus on improving exposure assessment using high-resolution environmental data and personal monitoring technologies.[14]

Further studies are needed to clarify molecular mechanisms and identify high-risk populations. Integration of environmental exposure data into lung cancer screening programmes may improve early detection and prevention strategies.[15]

Conclusion

Air pollution, particularly PM2.5, is a well-established environmental carcinogen contributing significantly to the global burden of lung cancer. Epidemiological and mechanistic evidence consistently supports its role in lung carcinogenesis, especially in adenocarcinoma and among never-smokers. Reducing air pollution exposure remains a critical global public health priority.[2,4]

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CASE REPORT

Granulomatosis with Polyangiitis Complicated by Non-Tuberculous Mycobacterial Infection in a Patient with Diabetes Mellitus

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Abstract

Granulomatosis with polyangiitis (GPA) is a rare systemic necrotizing vasculitis affecting small- to medium-sized vessels, often presenting with pulmonary and upper respiratory tract involvement. Its clinical and radiological manifestations frequently mimic pulmonary tuberculosis (TB) and poses a diagnostic difficulty; especially in high TB-burden countries. We report the case of a 42-year-old diabetic woman who presented with chronic cough, fever, recurrent hemoptysis, and nasal ulceration. Radiological imaging revealed bilateral cavitary lesions, raising suspicion of pulmonary TB. However, repeated sputum AFB and GeneXpert were negative. Further immunological testing showed strongly positive c-ANCA, and fiberoptic bronchoscopy with BAL detected non-tuberculous mycobacteria (NTM). She was ultimately diagnosed with granulomatosis with polyangiitis complicated by NTM infection in the setting of uncontrolled diabetes mellitus. She was treated with immunosuppressive therapy (cyclophosphamide, dexamethasone) along withantibiotics and insulin therapy. This case highlights the need to consider vasculitis in patients with cavitary lung disease andemphasizes the importance ofinvestigating for potential co-infections, such asnon-tuberculous mycobacteria (NTM);particularly in immunocompromised individuals.

Key words: *Granulomatosis with Polyangiitis, Non-tuberculous Mycobacteria, Diabetes Mellitus, Cavitary Lung Disease, c-ANCA.*

[Chest & Heart J. 2025; 49(2) : 100-103]

Case Presentation

Ms. X, a 42-year-old normotensive, non-smoker housewife from Chandpur, was admitted to institute with complaints of cough and low-grade fever with evening rise of temperature for three months and recurrent hemoptysis for one month. The cough was predominantly dry with occasional mucoid sputum, not related to diurnal variation or environmental exposure. She also reported anorexia, fatigue, and a single episode of epistaxis two months earlier. She had uncontrolled diabetes mellitus and for four months she was taking both short- and long-acting insulin.

On examination, she was alert, cooperative, mildly anemic, and vitals were stable. Notable findings included nasal mucosal ulceration. No clubbing, lymphadenopathy, or organomegaly was detected. Respiratory, cardiovascular, gastrointestinal, and musculoskeletal system examinations were unremarkable.

Baseline biochemical analysis shows persistently raised ESR and high blood sugar along with glycosuria.

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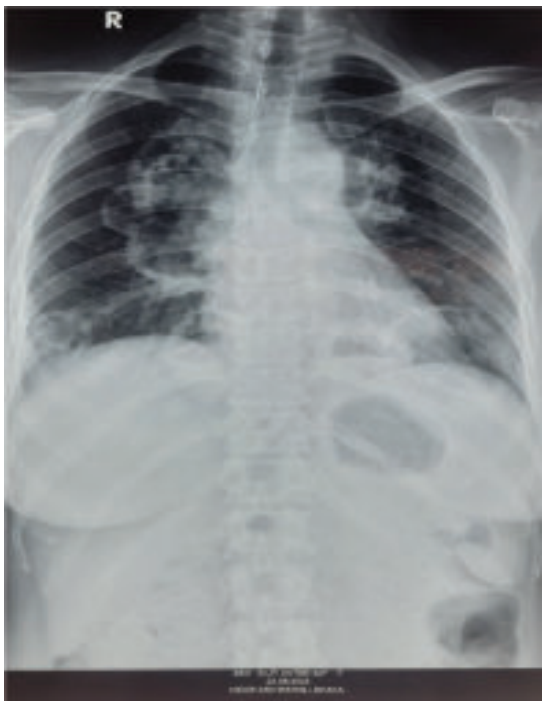

Figure1: Chest X-ray (PA View) showingBilateral Cavitary lesions

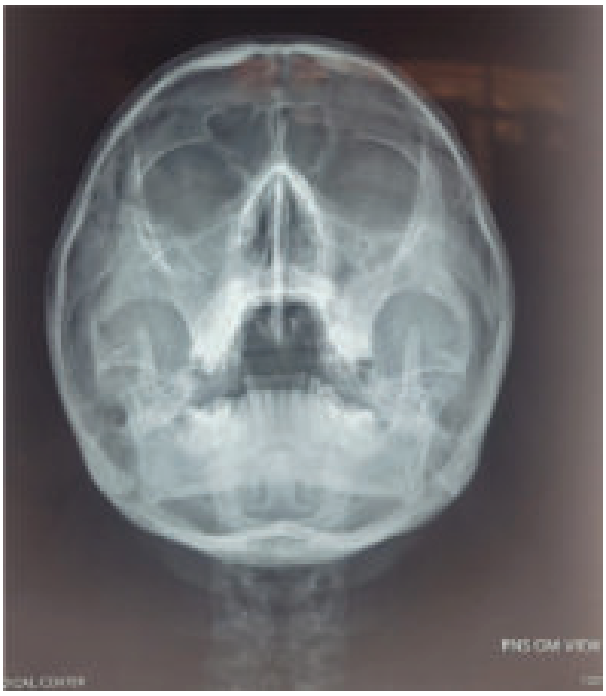

Figure 2:X-ray PNS (OM View): Chronic Maxillary Sinusitis

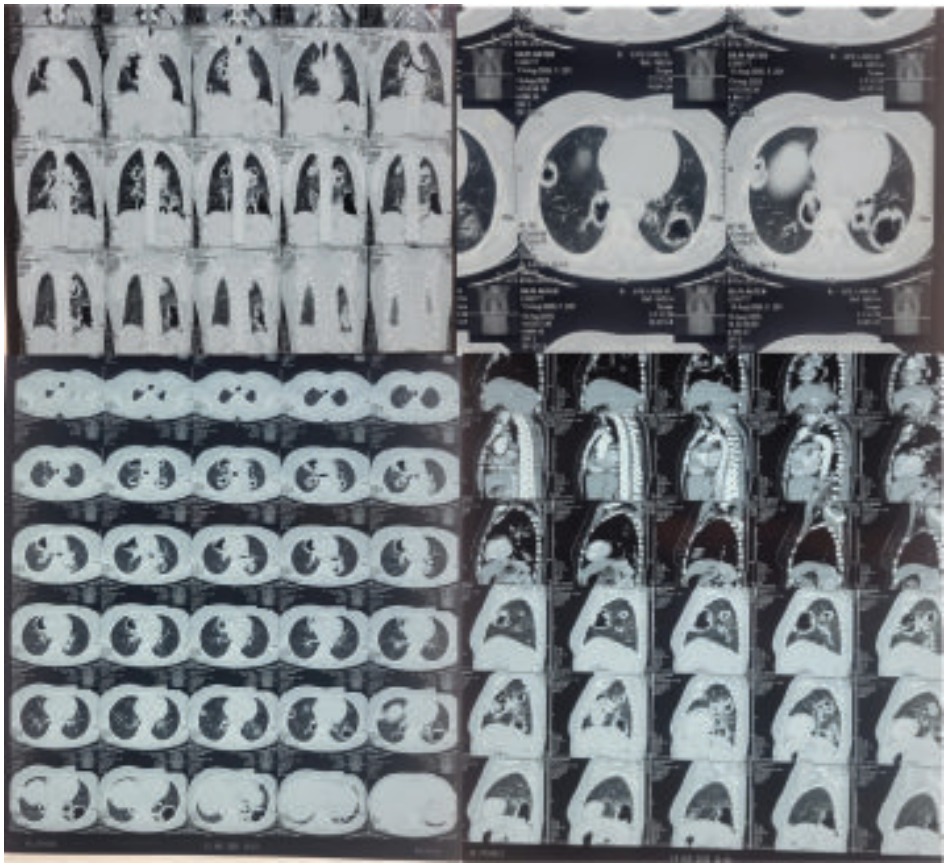

Figure3:HRCT Scan of Chest: Bilateral Cavitary lung lesions

c-ANCA: >400 AU/ml (17 times raised) and repeat sample showed 19 times higher titer.

p-ANCA was (negative) and ANA, RA, Anti-CCP, ENA profile was negative.

CRP was 14.17 mg/L and MT was negative.

Bronchoscopy and BAL Analysis:

- Bilateral inflammatory lesions
- AFB: Negative
- GeneXpert: Negative
- Fungal Stain: Negative
- MTB Complex DNA: Not Detected
- Non-Tuberculous Mycobacteria DNA: Detected

Final Diagnosis

Granulomatosis with Polyangiitis with Non-Tuberculous Mycobacterial (NTM) Infection with Diabetes Mellitus

Discussion

The diagnosis of Granulomatosis with Polyangiitis (GPA) in this patient was established based on the **2022 ACR/EULAR Classification Criteria** for GPA [6]. According to these criteria, a patient can be classified as having GPA if they achieve a cumulative score of e" 5 points [6]. Our patient fulfilled several high-weight parameters:

- **Nasal involvement:** The presence of nasal mucosal ulceration and epistaxis.
- **Cartilaginous/Bone involvement:** Chronic maxillary sinusitis evidenced on X-ray PNS.
- **Radiological findings:** HRCT and Chest X-ray demonstrating bilateral cavitary lung lesions.
- **Immunological markers:** Strongly positive c-ANCA (PR3-ANCA) titers, which were 17 to 19 times the normal limit.

The clinical triad of upper airway involvement, pulmonary cavitation, and high-titer c-ANCA provided a definitive diagnosis for this patient.

Granulomatosis with polyangiitis (GPA), formerly known as Wegener's granulomatosis, is a systemic necrotizing vasculitis primarily affecting the respiratory tract and kidneys, with a prevalence of 3 cases per 100,000 population worldwide.[1] Pulmonary involvement occurs in ~85% of patients, commonly manifesting as nodules, cavitary lesions, or alveolar hemorrhage[2]. The triad of upper airway involvement (sinusitis, nasal ulceration), pulmonary cavitation, and positive c-ANCA strongly supports the diagnosis in this patient.

In TB-endemic countries, GPA is often misdiagnosed as pulmonary tuberculosis because both conditions can present with chronic cough, fever, hemoptysis, and cavitary lung lesions[3]. Our patient's negative sputum AFB and GeneXpert, combined with fluctuating but persistently abnormal c-ANCA titers, pointed away from TB and toward GPA.

Complicating the diagnosis, her BAL fluid grew non-tuberculous mycobacteria (NTM). Patients with GPA are predisposed to secondary infections due to mucosal damage and immunosuppression, while diabetes mellitus further increases susceptibility to opportunistic infections[4]. Differentiating between active NTM disease and colonization is challenging, but the presence of cavitary lesions and positive molecular detection supported NTM lung disease in this case.

The management of GPA involves immuno-suppressive therapy. Current guidelines recommend glucocorticoids plus either cyclophosphamide or rituximab for induction of remission[5]. However, concomitant NTM infection necessitates careful balance between immunosuppression and antimicrobial therapy. Our patient received cyclophosphamide and dexamethasone for vasculitis control alongside antibiotics and supportive diabetic management.

Conclusion

This case underscores the diagnostic challenge of differentiating GPA from pulmonary tuberculosis in endemic settings. The coexistence of NTM infection and uncontrolled diabetes further complicated the clinical picture. A multidisciplinary approach integrating microbiology, radiology, and immunology is essential for accurate diagnosis and optimal management of such patients.

Declarations:

- **Funding:** This study received no specific grant from any funding agency.
- **Conflict of Interest:** The authors declare no conflicts of interest.

- **Patient Consent:** Informed written consent was obtained from the patient for the publication of this case report and associated images.

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CASE REPORT

Catamenial Haemoptysis: A Rare Presentation of Thoracic Endometriosis in a Middle-Aged Woman

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Abstract

Background:*Catamenial haemoptysis is a rare manifestation of thoracic endometriosis syndrome (TES), often misdiagnosed due to its cyclical nature and uncommon occurrence.*

Case presentation: *We report the case of a 45-year-old woman, Mrs. Bilkis presenting with recurrent episodes of haemoptysis coinciding exclusively with her menstrual cycles for the past 6 years. She had no significant comorbidities and no history of smoking. Her symptoms worsened in frequency and volume over the last 4 months.*

Outcome: *Initial hormonal therapy provided transient benefit, but due to progressive deterioration, she was referred for thoracic evaluation and further management. Upon admission to National Institute of Diseases of the Chest and Hospital (NIDCH), clinical evaluation revealed she appeared ill but cooperative, pale, non-cyanotic, and non-icteric. Vitals were stable (BP 120/80 mmHg, pulse 84 b/min, RR 16br/min). Respiratory and other systemic examinations were unremarkable.Radiological imaging studies confirmed the presence of adenomyosis, supports underlying endometriosis spectrum disease, which strengthens the suspicion of thoracic endometriosis in this patient.*

Conclusion: *Catamenial haemoptysis should be considered in women of reproductive age presenting with cyclical haemoptysis, as early recognition can prevent delay in management.*

Keywords: *Catamenial haemoptysis, Thoracic Endometriosis Syndrome (TES), Adenomyosis, OCP (oral contraceptive pill), VATS (Video Assisted Thoracic Surgery). Bronchial artery embolisation (BAE).*

[Chest & Heart J. 2025; 49(2) : 104-108]

Background

Thoracic endometriosis syndrome (TES) refers to the presence of functional endometrial-like tissue in the thoracic cavity, with or without pelvic endometriosis; which may involve the pleura, lung parenchyma, airways, and diaphragm.[1,2] TES can manifest through several distinct clinical presentations, including catamenial pneumothorax, catamenial haemothorax, catamenial haemoptysis, or pulmonary nodules.[1,2]

Catamenial haemoptysis is the rarest form, accounting for roughly 7–10% of TES cases.[3] It is caused by cyclical bleeding from ectopic endometrial implants in the bronchial tree or pulmonary parenchyma, triggered by hormonal changes during menstruation.[4] Clinically, patients present with cyclical haemoptysis during menstruation.

Due to its rarity, the diagnosis is often delayed, with many patients being treated for tuberculosis, bronchiectasis, or malignancy before the correct diagnosis is established.[5] This highlights the importance of careful history taking, especially the precise correlation of haemoptysis with the menstrual cycle.

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Case presentation

Mrs. Bilkis, a 45-year-old housewife, non-smoker, non-diabetic, and normotensive, presented to the National Institute of Diseases of the Chest and Hospital (NIDCH), Dhaka, with recurrent haemoptysis exclusively occurring during her menstrual periods for the last 6 years.

She reported coughing up about half a tablespoon of bright red blood during each menstrual cycle, which spontaneously resolved once menstruation ceased. Symptoms worsened in the last 4 months, with increased frequency and volume. She had undergone menstrual regulation 5 years earlier. There was no history of chest pain, shortness of breath, fever, or systemic illness. She was married with four children, all healthy.

On examination, she appeared ill but cooperative, pale, non-cyanotic, and non-icteric. Vitals were stable (BP 120/80 mmHg, pulse 84/min, RR 16/min). Respiratory and other systemic examinations were unremarkable.In our patient, the long history of cyclical haemoptysis, lack of infectious or neoplastic features, and worsening symptoms strongly suggest thoracic endometriosis.

Investigations

A. Routine blood tests were within normal limits except for mild anaemia.

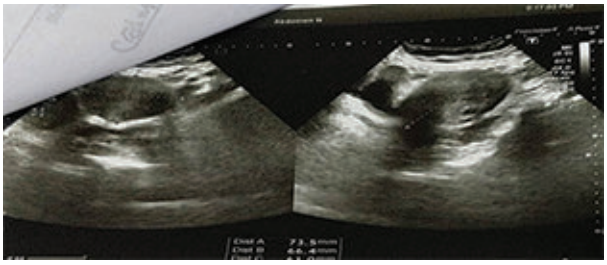

Fig.- 1: *Ultrasonography of the lower abdomen showing a bulky uterus with heterogeneous myometrial echotexture, suggestive of adenomyosis.*

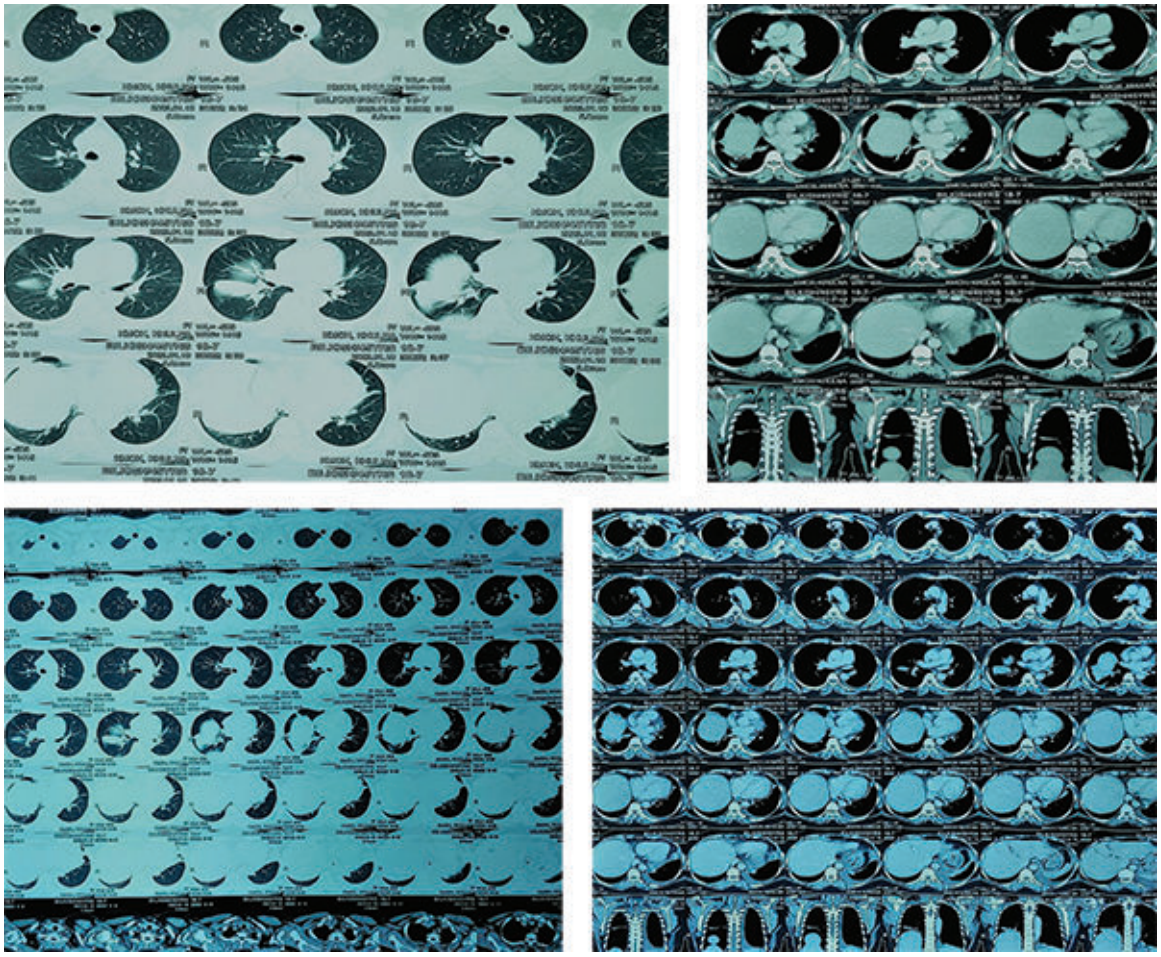

Figure 2: CT scan of the chest showing multiple sections with subtle parenchymal changes, with mild pleural collection/ effusion, suggestive of alveolar haemorrhage.

B. Ultrasonography of lower abdomen

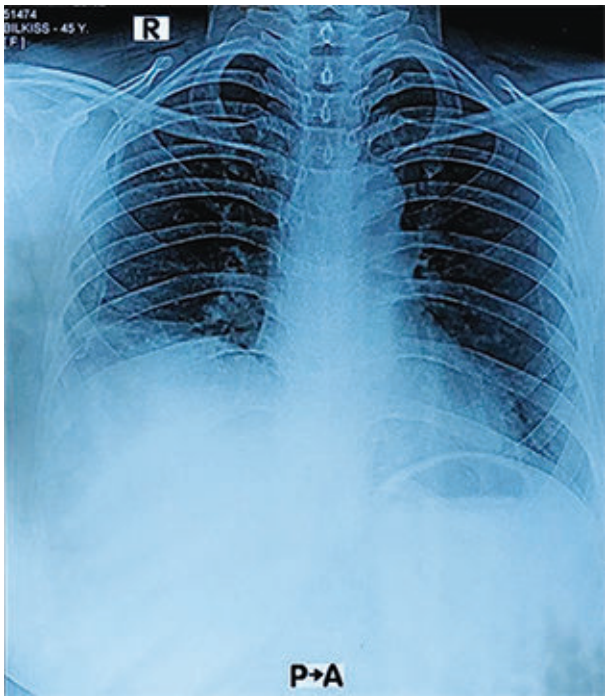

Figure 3: *Chest X-ray*

Clinical relevance: The presence of adenomyosis supports underlying endometriosis spectrum disease, which strengthens the suspicion of thoracic endometriosis in this patient.

C. CT Scan of Chest

D. CHEST X-RAY

Differential diagnosis

- Pulmonary tuberculosis
- Bronchiectasis
- Endobronchial tumour
- Pulmonary embolism
- Thoracic endometriosis (catamenial haemoptysis)
- Arteriovenous malformations,
- Anomalous vessels.

Treatment

- Management is not universally standardized and is tailored to the patient's reproductive desires and extent of the disease.
- She was initially treated with hormonal therapy (oral contraceptive pills) prescribed by her gynaecologist, which provided transient improvement. As symptoms worsened, she was referred to thoracic surgery for further evaluation, with surgical interventions like VATS (video-assisted thoracoscopic surgery) may be an alternative.
- The patient was managed conservatively, resulting in a favorable clinical response characterized by the spontaneous resolution of symptoms. Following a period of stability, she was discharged with instructions for routine outpatient follow-up to monitor her long-term progress.

Discussion

Epidemiology & Natural History

TES is an uncommon condition; in a recent systematic review of 592 patients, the median age was found to be approximately 34 years[1]. Catamenial pneumothorax is the most frequent presentation (around 65–72%), followed by haemothorax (~10–15%) and haemoptysis (~7–10%), with lung nodules being exceedingly rare [3]. Right-sided involvement predominates for pleural and diaphragmatic implants, whereas bilateral cases are much less frequent[4].

Clinically, patients present with cyclical haemoptysis during menstruation. The bleeding is often mild to moderate, but recurrent and distressing[8]. Misdiagnosis is common, particularly in tuberculosis-endemic regions[9].

Pathophysiology

Several theories or hypothesis have been proposed to explain how endometrial-like tissue arrives and behaves in the thorax:

1. **Retrograde menstruation and transdiaphragmatic passage:** Menstrual blood or endometrial cells may pass through diaphragmatic defects or via lymphatic/peritoneal routes to reach the pleural space[4].
2. **Coelomic metaplasia:** Pleural or possibly pulmonary mesothelial cells transform into endometrial-type tissue[5].
3. **Haematogenous or lymphatic spread:** Particularly favoring spread to the pulmonary parenchyma or yielding lung nodules[6].
4. **Stem cell theory:** Recent studies suggest that bone-marrow-derived or circulating stem cells give rise to ectopic endometrial tissue[7].

Once implanted, the ectopic tissue responds to cyclical hormonal changes similarly to uterine endometrium, causing bleeding during menstruation. If located in the lung parenchyma

or bronchioles, this manifests as haemoptysis.

Clinical Features Relevant to Catamenial haemoptysis:

- Haemoptysis in TES is usually mild to moderate and strictly cyclical. Massive, life-threatening bleeding is very rare[8].
- Diagnostic delays are common because imaging performed outside of menstruation may yield normal results.
- Imaging (CT, sometimes MRI) performed during menstruation may reveal ground-glass opacities, nodules, thin-walled cavities, or alveolar haemorrhage that often vanish outside of menstrual cycle[10], contributing to diagnostic delays.
- Bronchoscopy may sometimes identify an active bleeding source if performed during menstruation, though many lesions are peripheral or parenchymal and may be missed[12].

Diagnostic workup

Given its rarity, diagnosis requires a high index of suspicion. Key diagnostic tools include:

- **Detailed menstrual history:** Establishing the cyclical fashion of respiratory symptoms is paramount.
- **Imaging:** Chest X-ray, USG of abdomen, HRCT chest, and MRI (especially if diaphragmatic or pleural involvement is suspected), ideally timed during menstruation[10,11]. CT scans may show ground-glass opacities, nodules, or alveolar haemorrhage that disappear outside menstruation.[10]
- **Bronchoscopy:**Ideally during active bleeding; bronchial washings, cytology may help but often negative, though tissue biopsy via bronchoscopy, transthoracic needle, or thoracoscopy provides a more definitive histopathological diagnosis[12].
- **VATS:** Video-assisted thoracoscopic surgery (VATS)may stands as a both diagnostic and therapeutic tool[13]. In pleural or diaphragmatic disease, VATS allows visualization of implants, repair of diaphragmatic defects, resection, or ablation.

Treatment

Management is not universally standardized and is tailored to the patient's reproductive desires and extent of the disease:

- **Hormonal therapy:** Combined oral contraceptives (COCs), progestins, gonadotropin-releasing hormone(GnRH) analogues, and danazol are first-line to suppress cyclic stimulation, especially when disease is mild and surgery is undesirable. However, recurrence rates are non-negligible upon discontinuation[14].
- **Surgical management:** VATS resection or ablation of endometrial implants, repair of diaphragmatic defects; resection of lung nodules if present. In pulmonary parenchymal disease manifesting as hemoptysis, resection may be considered. Combined with hormonal therapy may yields the best long-term outcomes[15].
- **Adjunctive therapies:** Bronchial artery embolisation (BAE) is reserved as a temporary measure for significant or uncontrollable bleeding.[16]

Prognosis and Relevance to Current Case

- Recurrence remains a known challenge, occurring in roughly 10% of cases post-treatment.
- In our patient, the 6-year history of cyclical haemoptysis without other respiratory signs(such as pneumothorax or pleuritic pain)suggests a limited or small distribution, likely confined to the lung parenchyma.
- Investigation during menstruation (bronchoscopy, imaging) is particularly important.
- Given the chronicity and failure of standard medical therapy, VATS resection may be an alternative;especially if symptoms become severe or medical therapy fails.

Learning points

- Catamenial haemoptysis is a rare but important cause of cyclical haemoptysis in reproductive-aged women.
- Better awareness is critical among pulmonologists, gynaecologists, and thoracic

surgeons to reduce the years of diagnostic delay.

- Imaging and intervention should be actively timed during menstrual cycle to increase diagnostic yields.
- Combined medical and surgical therapy may sometimes reduce recurrence compared to either approach alone.
- Reproductive goals of the patient must inform the treatment strategy, as many hormonal therapies suppress fertility.

Funding Statement

- The study didn't receive any funding.

Ethical Approval

- The study is exempt from ethical approval in our institution.

Consent

- Written informed consent was obtained from the patient or the publication of this case report and the accompanying images.

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