Effect of Airway Clearance Techniques on Respiratory Outcomes for Patients with Bronchiectasis Exacerbations

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Abstract

A chronic respiratory disease called bronchiectasis is characterized by aberrant and irreversible bronchial dilatation, a recurring cycle of infection and inflammation, and a reduction in mucociliary clearance. Acute exacerbations are a key feature of bronchiectasis and contribute significantly to its clinical and economic burden. Physiotherapists and nurses should prescribe ACTs as a part of management .**Aim**: Evaluate the effect of airway clearance techniques on respiratory outcomes for patients with bronchiectasis exacerbations. **Design**: A quasi-experimental design was utilized. **Setting**: This study was conducted at Chest Intensive Care Unit at Tanta University Chest Hospital. **Subjects**: A purposive sampling of 120 patients with bronchiectasis exacerbations. The patients were divided into two equal groups, 60 patients in each. **Tools**: **Tool (I):** Bronchiectasis Patient's Assessment. **Tool (II):** Airway Clearance Assessment Tool. **Tool (III):** Modified Borg Dyspnea Scale (MBS). **Result**: statistically significant differences were observed in the daily amount of expectorated sputum between the study and the control group on the 1st and 3rd day where P = (0.000, 0.001) respectively. Also, a difference was observed in the dyspnea level between the study and the control group on 3rd day where P = 0.000. **Conclusion:** Airway clearance techniques had positive effect on improving physiological parameters, respiratory outcome, and daily amount of expectorated sputum and decrease severity of dyspnea for patients' bronchiectasis exacerbation. **Recommendations**: Patients should receive structural health education regarding the importance of airway clearance and are encouraged to practice the technique independently as part of routine care.

Key words: Airway clearance techniques, Bronchiectasis exacerbations, Respiratory outcomes.

Introduction:

A chronic respiratory disease called bronchiectasis is characterized by aberrant and irreversible bronchial dilatation, a recurring cycle of infection, inflammation, and a reduction in mucociliary clearance. **(Chalmers et al., 2023).** Acute exacerbations are a key feature of bronchiectasis and contribute significantly to its clinical and economic burden. Exacerbations have been shown to accelerate lung function decline and increase both hospitalization rates and mortality in patients with bronchiectasis. Effective management of these exacerbations is essential for reducing disease progression, improving patient outcomes, and minimizing healthcare costs. A recent statistical analysis showed that the hospitalization rate for bronchiectasis exacerbations is approximately 16.5 per 100,000 population in the United States (**Serrano, Castaño, de Gracia, & Polverino, 2023).** Furthermore, prevalence estimates in the UK might reach 566 instances per 100,000 persons. In a Belgian prospective cohort study, overall mortality in bronchiectasis patients was 20.4% in a 5-year follow-up. **(De Angelis, Johnson, Sutharsan, & Aliberti, 2024**). Patients with bronchiectasis exacerbations commonly experience hyper secretion of mucus and sputum retention, which contributes to an increased in breathing problems, a high rate of acute exacerbations, a rapid deterioration in lung function, a poor quality of life, and an elevated mortality rate **(Tian& Wen, 2015).** Physiotherapists are advised by national and international recommendations to prescribe ACTs as a part of management for patients who are having an exacerbation **(Polverino et al., 2021).** Moreover, Guidelines from the European Respiratory Society and the British Thoracic Society placed a strong emphasis on active cycle breathing techniques (ACTs) as cornerstone interventions for managing bronchiectasis so that, The frequency and/or length of ACT sessions may need to be increased during exacerbations **(De Angelis et al., 2024).** Autogenic drainage is one of airway clearance technique (ACT). It is a self-directed airway clearance technique that utilizes controlled breathing to mobilize and clear mucus from the lungs. **(Burnham, Stanford, & Stewart, 2021).** Active cycle of breathing technique is another type of airway clearance technique (ACT). Patients engage in this therapeutic practice when they have an excess of secretions in their lungs that need to be expectorated or cleansed. **(Allam, Aysha, Mahmoud, Mohamed, & Weheida, 2023).**

Significance of the study:

Patients with bronchiectasis may experience acute exacerbations of symptoms characterized by acute worsening of dyspnea, cough, and sputum production and activity intolerance **(Meneses-Echavez, Guapo, Loaiza-Betancur, Machado, & Bidonde, 2023).** It was reported that the prevalence of excessive sputum production and dyspnea is about 78% and 62% among patients with bronchiectasis respectively **(Bird & Memon, 2023).** Therefore, the nurse has an important challenge to maintain efficient airway clearance among patients with bronchiectasis. So, the present study aimed to evaluate the effect of airway clearance techniques on respiratory outcomes for patients with bronchiectasis exacerbations.

The aim of this study was to:

Evaluate the effect of airway clearance techniques on respiratory outcomes for patients with bronchiectasis exacerbations.

Research hypothesis:

Patients with bronchiectasis exacerbations who undergo airway clearance techniques are expected to maintain better respiratory outcomes evidenced by an improvement in respiratory indicators, increase amount of daily-expectorated sputum and decrease severity of dyspnea.

Respiratory Outcomes in this study: refer to both objective and subjective measures of pulmonary status. Objective measures include respiratory assessment; amount of secretion and subjective measures include severity of dyspnea that is evaluated by using dyspnea scale.

Subjects and method:

Design: Quasi experimental design.

Study settings: Chest Intensive Care Unit at Tanta University Chest Hospital which affiliated to Tanta University Hospitals.

Study subjects:

A purposive sampling of 120 patients with bronchiectasis exacerbations. Patients were chosen based on the inclusion criteria (Adult patient aged from 21 to 60 of both gender, diagnosed with bronchiectasis exacerbation, able to communicate and willing to participate in the study). While those with recent trauma and have invasive method of ventilation were excluded.

The patients were divided into two equal groups, 60 patients in each group as following:

Control group: consisted of 60 patients with bronchiectasis exacerbations who received routine chest ICU care by critical care nursing staff.

Study group: consisted of 60 patients with bronchiectasis exacerbations who received airway clearance techniques by the researcher in addition to routine chest ICU care.

Data collection tools:

In the present study, three instruments were used.

Tool I: Bronchiectasis Patient's Assessment Tool

The tool was constructed by the researcher based on a thorough review of the related literature to obtain information relevant to the current study **(Allam et al., 2023).** It consisted of three parts as follows:

Part (A): Patient's Demographic Characteristics which include:-

Patient's code, age, gender, marital status, education and occupation.

Part (B): Patient's Clinical Data which include: - patient's chief complain, body mass index, weight, height, past medical history, medication history, frequency of hospitalization and smoking history.

Part (C): Hemodynamic Parameters: to assess systolic blood pressure, diastolic blood pressure, heart rate and respiratory rate, body temperature and oxygen saturation.

Tool II: Airway Clearance Assessment

The tool was constructed by the researcher based on a thorough review of the related literature to obtain information relevant to the current study **(Patterson, Bradley, & Elborn, 2003; Herrero-Cortina et al., 2023)** to assess respiratory indicators and daily amount of expectorated sputum.

Part (A): Respiratory Indicator Assessment Sheet which include: respiratory sounds, respiratory pattern, and respiratory rhythm. The data of this part was described as mean ± SD.

Part (B) Daily amount of Expectorated Sputum: the expectorated sputum measured at the completion of every session. The total quantity of sputum was estimated independently for each subject by using calibrated milliliter cups.

Tool III: Modified Borg Dyspnea Scale (MBS)

This scale was developed by **Wilson & Jones (1989)** and adopted by **Dangers, Montenij, van der Hoeven, & Scheffer (2018).** It represents a numerical rating system of 10 items that measures dyspnea, with each score linked to a descriptive statement.

Scoring system: -

The scores vary between 0 and 10, where 0 represent the absence of breathlessness and 10 denotes extreme dyspnea.

Method

1. Obtaining approval:

After obtaining official permission to collect data from the Faculty of Nursing after deciding on a location for the study, the researcher contacted the appropriate authorities there to get permission to perform the research.

2. Ethical consideration:

A. The scientific research committee of approval was sought and granted with the code number (384-2-2024).
B. No one in the study was ever in danger or discomfort because of the way it was designed.
C. Protect the privacy of patients and their information.

D. Names were replaced with code numbers.

E. The patient was asked to provide their informed consent once the study's purpose was explained. Everyone who took part in the study was informed of its goals and given the option to stop at any moment.

3. Tools development:

Based on a review of relevant literature, the researcher constructed all instruments used in this study except tool III Modified Borg Dyspnea Scale was developed by Wilson & Jones (1989).& Jones (1989).

4. Pilot study:

A pilot study was carried out by the researcher on (10%) of the subjects (twelve patients) for testing the tools for its clarity, applicability and to identify obstacles that may be encountered with the researcher during data collection.

5. Content validity of the tools

All tools were submitted to a jury of five experts in the field of specialty such as Critical Care and Emergency Nursing, physicians to check content validity and clarity of questionnaire, and necessary modification were done.

6. Reliability of tools:

Tool I & tool II are tested for reliability using Cronbach's α coefficient test and it was 0.88 &0.89 respectively.

Tool (III) was tested for reliability using Cronbach's α coefficient test and it was 0.82 **(Glaab, Chhajed, Vogelmeier, Beeh, & Kirsten, 2020).**

7. Duration of data collection:

Data was collected for the current study from the beginning of July 2024 to the end of January 2025.

8. Phases of the study

1. Assessment phase: -

-Assessment was done by the researcher on the first day of admission before starting the routine care for control group and airway clearance techniques for study group using tool I: Part (a) , part (b) and part (c). Also, tool II**:** Part (a) and part (b). Also, tool III: Modified borg dyspnea scale (MBS) used to assess dyspnea for both the control and study groups.

- During this phase, the baseline data was collected from both groups to compare between control and study groups throughout period of the study. This baseline data guided the implementation of this intervention and provided reference points for post intervention evaluation.

2. Planning phase: -

In this phase, the researcher developed a structural intervention program based on a review of recent literature and evidence-based guidelines related to airway clearance technique. The content was carefully designed to meet the study objective and address the identified patient's needs from the base line assessment.

Expected outcomes:

1. Improve respiratory indicators.
2. Increase daily amount of expectorated sputum.

3. Decrease severity of dyspnea.

3. Implementation phase: -

A- Control group:

Patients received their routine ICU nursing care as provided by intensive care nurses which include oxygenation, nebulization sessions, suctioning and pharmacological treatment.

B- Study group:

- Patients received the structured intervention program of airway clearance techniques in addition to routine care, the program was delivered individually to each patient every day.

- Two techniques were used in this study, and each technique lasted about 15 minutes with rest period of 20 minutes in between.

Nursing measures included the following:

- **Preparation (Paul et al., 2023).**
- **Preparation for the nurse:**

1. Wash hands.
2. Wear personal protective equipment.
3. Prepare the essential equipment (papers, pillows, pulse oximeter for oxygen saturation, cardiac monitor for vital signs, suction device and sputum containers are readily available for mucus expectoration.

- **Preparation of patient:**

Positioning:

Ensure that the patient is seated upright or in semi-flower position, with good back support.

Instruct the patient to blow their nose and if required, use a nasal spray or sinus rinse to clear their upper airways.

- **Intervention techniques:-**

I. Autogenic drainage: Phases of autogenic drainage: (Żak, Kowalik, & Grabczak, 2023).

1. **Unsticking phase:** In order to achieve a deep expiration, the patient is instructed to breathe slightly less than the tidal volume and then tense their abdominal muscles to do so.
2. **Collecting phase:** In order to move a larger volume of air, the patient was instructed to forcefully expire after inspiring within the tidal volume but not beyond his maximal inspiratory capacity.
3. **Evacuation phase:** The patient was instructed to inhale as much as he could, using his full inspiratory capacity.

11. Active Cycle of breathing techniques (Allam et al., 2023)

1. **Breathing control phase:** the researcher encourage patient to breathe in through their nose to humidify and warm then between five and seven gradual expirations.
2. **Thoracic expansion exercises:** the researcher encourage patient to relax their upper chest. Without utilizing your auxiliary muscle, take deep, calm breaths through your nose. Do the preceding steps three or four times.
3. **Forced expiration technique (huffing):** the researcher encourage patient to place their hands over their

chest to support it. They huffed two or three times and coughed twice as often.

4. **Evaluation** was done by the researcher for all patients in both groups throughout the two consecutive days (2nd and 3rd days) of intervention and the comparison between control and study group was done according to the baseline data on the first day.

Results:

Table (1) Shows distribution of the studied patients with bronchiectasis exacerbations regarding their socio-demographic characteristics. This table revealed that the majority (83.33% and 86.67) of patients in the control and study groups respectively were in the age group (≥50) years with mean ± SD (57.62±10.200 and 59.10±9.442) respectively. **In relation to gender,** 58.33 and 55.00% of patients in the control and study groups respectively were female. Also, the majority (86.67%) of patients in the control group and 78.33% of patients in the study group were married.

Concerning education, 40.0% of patients in the control group were read and write while 38.33 % of patients in study group were illiterate.

Figure (1) Shows percentage of the studied patients with bronchiectasis exacerbations regarding their occupation. 46.67% in control group were hospitalized twice compared to 48.33% of study group were hospitalized more than twice.

Table (2) Shows distribution of the studied patients with bronchiectasis exacerbations regarding their clinical data.

As for smoking status, the results showed that 60.00% and 65.00% in the control and study group were smokers respectively. **Also,** 41.67% and 46.67% of patients in the control and study groups respectively were overweight (25–<30) respectively.

Table (3) Shows distribution of the studied patients with bronchiectasis exacerbations regarding their diagnosis, chief complaint and past medical history. In this table, 75% of patients in the control group and 78.33% of patients in the study group were diagnosed with COPD. **Regarding the chief complaint,** 100% of patients in the control and study groups complained from shortness of breath. **Also**, 95% and 98.33% of patients in control and study groups respectively experienced productive cough.

Table (4) Shows hemodynamic parameters of the studied patients with bronchiectasis exacerbations throughout days of study.in this table, significance differences were observed among control and study groups regarding heart rate, respiratory rate, temperature and Spo_2 where P=0.000.

Table (5) shows the daily amount of expectorated sputum of the studied patients with bronchiectasis exacerbations throughout days of study. There were statistically significant differences within each group regarding amount of sputum, where P = 0.000.

Table (6) Illustrates dyspnea level of the studied patients with bronchiectasis exacerbations throughout days of study. Statistically significant difference regarding level of dyspnea were observed within each group where P = 0.000.

Table (7): Shows the relation between daily amount of expectorated sputum of the studied patients with bronchiectasis exacerbations and their dyspnea, medication frequency and diagnosis at 3rd day of study. There was a significant relationship between daily amount of expectorated sputum and dyspnea level in both groups where P= 0.000 and 0.003 respectively, bronchodilator frequency in the study group where P=0.000 and mucolytic drugs frequency where P= (0.013, 0.001 respectively.

Table (1): Distribution of the studied patients with bronchiectasis exacerbations regarding their socio-demographic characteristics.

Demographic Characteristics	The studied patients (n=120)				χ^2 P
	Control group (n=60)		Study group (n=60)		
	N	%	N	%	
Age (in years)					
1. (21-<30)	1	1.67	1	1.67	
2. (30-<40)	2	3.33	1	1.67	0.456
3. (40-<50)	7	11.67	6	10.00	0.928
4. (50-<60)	50	83.33	52	86.67	
Range	**(29-85)**		**(29-78)**		t=0.683
Mean ± SD	**57.62±10.200**		**59.10±9.442**		P=0.410
Gender					
5. Male	25	41.67	27	45.00	FE
6. Female	35	58.33	33	55.00	0.854
Marital status					
7. Single	1	1.67	3	5.00	
8. Married	52	86.67	47	78.33	1.834
9. Widowed	7	11.67	10	16.67	0.400
Education					
10. Illiterate	19	31.67	23	38.33	
11. Read and write	24	40.00	18	30.00	1.353
12. Secondary/Diploma	17	28.33	19	31.67	0.508

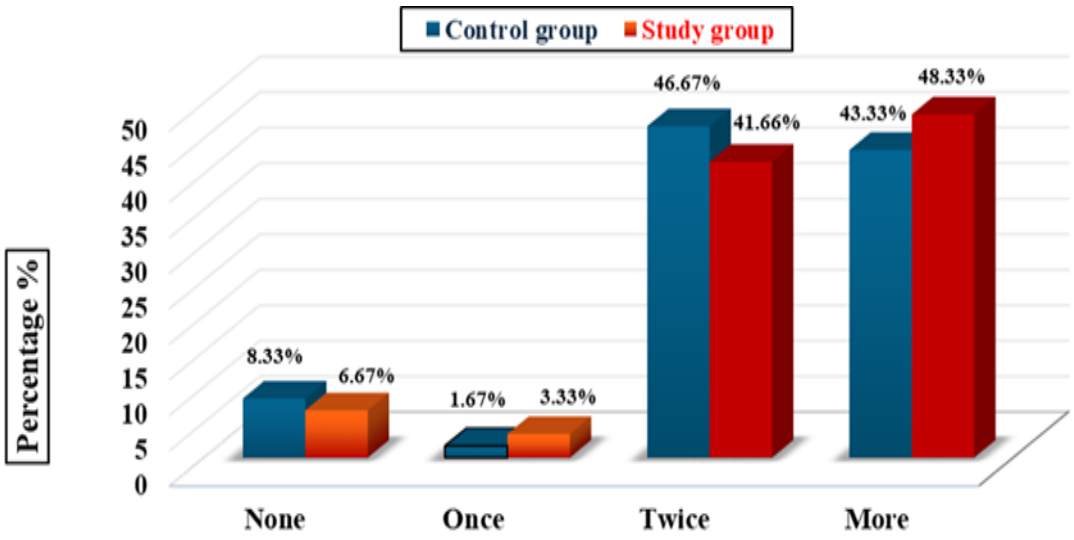

Figure (1): Percentage of the studied patients with bronchiectasis exacerbations regarding their frequency of hospitalization.

Table (2) Distribution of the studied patients regarding their clinical data.

Clinical data	The studied patients (n=120)				χ^2 P
	Control group (n=60)		Study group (n=60)		
	N	%	N	%	
Smoking history					
13. Yes	36	60.00	39	65.00	FE
14. No	24	40.00	21	35.00	0.706
Weight (in Kg)					
Range	(55-110)		(60-110)		0.646
Mean ± SD	80.62±10.759		82.15±10.124		0.423
Height (in cm)					
Range	(1.53-1.80)		(1.50-1.81)		0.007
Mean ± SD	1.66±0.065		1.66±0.064		0.933
Body mass index					
15. Normal weight (18.5–<25)	11	18.33	4	6.67	
16. Overweight (25–<30)	25	41.67	28	46.67	5.566
17. Obese (30–<35)	20	33.33	19	31.67	0.135
18. Extreme obese (≥35)	4	6.67	9	15.00	
Range	(21.22-42.44)		(19.59-38.28)		t=0.558
Mean ± SD	29.22±4.402		29.79±3.961		P=0.457

Table (3) Distribution of the studied patients with bronchiectasis exacerbations regarding their diagnosis, chief complain and past medical history.

Clinical data	The studied patients (n=120)				χ^2 P
	Control group (n=60)		Study group (n=60)		
	N	%	N	%	
# Clinical Diagnosis					
19. COPD	45	75.00	47	78. 33	0.829
20. Asthma	15	25.00	13	21.67	0.414
# Chief complain					
21. Non-productive cough	3	5.00	1	1.67	
22. Productive cough	57	95.00	59	98.33	
23. chest pain	36	60.00	37	61.67	1.081
24. Fatigue	35	58.33	35	58.33	0.298
25. Shortness of breath	60	100.00	60	100.00	
# Past medical history					
26. Cardiovascular disorder	27	45.00	26	43.33	
27. Respiratory diseases	60	100.00	60	100.00	
28. Neurological disorders	1	1.67	1	1.67	0.034
29. Gastrointestinal disorders	5	8.34	6	10.01	0.854
30. Endocrine disease	13	21.67	11	18.33	

Table (4): Assessment of hemodynamic parameters of the studied patients with bronchiectasis exacerbations among the studied groups throughout days of implementation.

Hemodynamic parameters	The studied patients (n=120) Range Mean ± SD							
	Control group (n=60)			F P	Study group (n=60)			F P
	1st day	2nd day	3rd day		1st day	2nd day	3rd day	
1. Blood pressure								
Systolic	(80-170) 121.22±24.428	(85-155) 122.37±15.772	(100-160) 121.42±13.343	0.066 0.936	(80-160) 129.83±24.111	(90-160) 122.17±16.984	(100-150) 119.50±10.958	**5.233 0.006***
Diastolic	(50-100) 76.75±14.609	(60-100) 79.25±8.821	(60-90) 76.83±7.247	1.056 0.350	(60-100) 80.83±14.763	(60-100) 77.50±10.189	(60-100) 76.33±7.584	2.588 0.078
2. Heart rate	(95-132) 111.13±9.554	(87-120) 100.65±10.472	(72-111) 91.27±10.599	**56.755 0.000***	(94-128) 109.85±9.275	(82-120) 95.12±10.187	(69-112) 85.35±10.198	**93.201 0.000***
3. Respiratory rate	(19-31) 25.63±3.723	(18-28) 21.93±2.755	(17-24) 19.97±1.832	**60.067 0.000***	(20-30) 24.78±3.098	(19-26) 20.68±1.751	(16-23) 18.27±1.364	**134.505 0.000***
4. Temperature	(36.6-39) 37.70±0.705	(36.7-38.2) 37.32±0.416	(36.5-37.9) 37.11±0.289	**21.400 0.000***	(36.5-39.0) 37.42±0.641	(36.7-37.5) 37.08±0.137	(36.5-37.5) 37.00±0.146	**20.018 0.000***
5. SPO2	(90-96) 92.98±1.557	(92-97) 94.57±1.294	(94-98) 96.05±1.523	**65.980 0.000***	(88-96) 92.72±1.984	(92-97) 94.87±1.512	(93-99) 96.82±1.097	**101.954 0.000***

Table (5): Assessment of daily amount of expectorated sputum of the studied patients with bronchiectasis exacerbations throughout days of study.

Daily amount of sputum (in ml)	The studied patients (n=120)													
	Control group (n=60)						χ2 P	Study group (n=60)						χ2 P
	1st day		2nd day		3rd day			1st day		2nd day		3rd day		
	N	%	N	%	N	%		N	%	N	%	N	%	
(<50)	11	18.33	21	35.00	36	60.00		8	13.33	33	55.00	51	85.00	
(50-100)	27	45.00	26	43.33	19	31.77	27.408	7	11.77	16	36.77	9	15.00	**106.801**
(>100)	22	36.67	13	21.77	5	8.33	0.000*	45	75.00	11	18.33	0	0.00	**0.000***
Range Mean ± SD	(30-140) 86.42±33.269		(30-120) 70.67±22.671		(20-120) 56.83±30.49		15.463 0.000*	(30-160) 113.50±21.674		(40-130) 77.17±16.374		(10-90) 41.33±17.989		**220.793 0.000***
Control Vs **Study** t P	**21.094 0.000***		**5.260 0.072**		**13.182 0.001***									

Table (6): Assessment of dyspnea level of the studied patients with bronchiectasis exacerbations throughout days of study.

Dyspnea level	The studied patients (n=120)													
	Control group (n=60)						χ2 P	Study group (n=60)						χ2 P
	1st day		2nd day		3rd day			1st day		2nd day		3rd day		
	N	%	N	%	N	%		N	%	N	%	N	%	
No breathlessness	0	0.00	0	0.00	24	40.00		0	0.00	1	1.67	43	71.67	
Very slight	0	0.00	4	6.67	11	18.33		0	0.00	5	8.33	12	20.00	
Slight breathlessness	1	1.67	21	35.00	8	13.33	**161.120 0.000***	2	3.33	25	41.67	3	5.00	**250.230 0.000***
Moderate	12	20.00	21	35.00	15	25.00		12	20.00	26	43.33	2	3.33	
Somewhat severe	19	31.67	12	20.00	2	3.33		21	35.00	3	5.00	0	0.00	
Severe breathlessness	28	46.67	2	3.33	0	0.00		25	41.67	0	0.00	0	0.00	
Control Vs Study χ2 P	**2.134 0.711**		**10.934 0.053**		**21.889 0.000***									

Table (7): Relation between daily amount of expectorated sputum of the studied patients with bronchiectasis exacerbations and their dyspnea, medication frequency and diagnosis at 3rd day of study.

	The studied patients (n=120) Daily amount of expectorated sputum			
	Control group (n=60)	F/t P	Study group (n=60)	F/t P
Dyspnea level				
31. No breathlessness	40.00±23.729		38.60±14.733	
32. Very slight	55.45±25.832	**6.168**	42.50±17.123	**5.321**
33. Slight breathlessness	57.50±27.124	**0.000***	46.67±35.119	**0.003***
34. Moderate	75.00±35.355		**85.00±7.071**	
35. Somewhat severe	**82.00±29.081**		-	
36. Medication frequency				
Bronchodilator				
37. Every/12 hrs.	41.07±20.772		38.93±14.742	
38. Every/8 hrs.	41.47±24.094	**8.775**	40.00±21.602	0.544
39. Every/6 hrs.	58.57±25.448	**0.000***	-	0.583
40. 5 times/day	**78.18±29.703**		**43.93±20.609**	
Mucolytic drugs				
41. Every/24 hrs.	40.59±20.378		37.92±13.507	
42. Every/12 hrs.	60.00±32.016	**4.700**	40.00±17.227	**6.352**
43. Every/8 hrs.	**74.00±29.136**	**0.013***	**60.00±28.284**	**0.001***
Diagnosis				
44. COPD	**61.11±31.477**	3.706	**43.85±18.046**	0.320
45. Asthma	44.00±23.845	0.059	40.64±18.106	0.574

Discussion

A chronic respiratory disease called bronchiectasis is characterized by aberrant and irreversible bronchial dilatation, a recurring cycle of infection and inflammation, and a reduction in mucociliary clearance. **(Choi and Chalmers, 2023).**

Hence, the present study had the aim to investigate the impact of airway clearance techniques on respiratory outcomes for patients with bronchiectasis exacerbations. This section was represented in the following parts:

Part I: Socio-demographic characteristics, clinical data, chief complaints and past medical history.

The current study, revealed that majority of both groups were more than fifty years old with **mean ± SD 57.62±10.200 & 59.10±9.442.** The findings of this study were aligned with those of **González-Barcala et al., (2023)** who reported that the mean age of bronchiectasis patients across most included studies was 73.4 years. On the other hand, this finding was contradicted by **Capsiello, Rossi & Chetta, (2000),** who conducted a study about **"Prevalence, age distribution and etiology of bronchiectasis",** and found that approximately more than two third of the patients participating within the age groups of less than fifty years old.

On observation of gender, more than half of patients in both groups were female. This might be explained by the relationship between infection, inflammation, and immune function is complicated by sex steroid hormones, especially estrogens. **(Fuseini & Newcomb, 2018).** The results were congruent with **Chalmers et al., (2023)** who showed that two third of participants were female. On the other hand, according to **Fong, Low, & Yii, (2022),** reported that more than half were male in the study group.

Concerning marital status and educational level, most patients in both groups were married. This may be justified by stress related to family and social responsibilities which may increase the vulnerability to respiratory conditions **(Cohen, 2020). Also,** the results showed that less than half of patients in the control group were read and write while more than one third of patients in study group were illiterate. **(Wang, Chen, Zhang, Li, & Ma, 2023).** This outcome was consistent with **Lim et al., (2020),** who stated that low educational level was more common in subjects with bronchiectasis.

Regarding frequency of hospitalization, less than half of both groups were hospitalized more than twice **(Chalmers et al., 2023).** As highlighted by **Fan et al., (2024),** who reported that nearly half of patients were readmitted within one year following an acute exacerbation, with significant predictors including older age, low BMI, colonization by Pseudomonas aeruginosa, and extensive radiologic involvement. Also, the result was in the line with **Choi & Chalmers, (2022)** who showed that nearly half of patients have ≥2 exacerbations/year, and ~33% require ≥1 hospitalization/year.

In reference to smoking history, less than two-thirds of patients in both groups were smokers. Smoking impairs mucociliary clearance, compromises airway epithelial integrity, and enhances neutrophilic inflammation in bronchiectasis patients lead to precipitate more frequent and severe exacerbations **(De la Rosa-Carrillo et al., 2024).** The results were aligned with **Hegazy, Youssef, Elgharbawy, & Farghaly, (2022),** who reported that those with bronchiectasis had significantly higher current cigarette smoking. On the other hand, this finding was contradicted by **Gomes et al., (2023)** who reported that most subjects in their study had never smoked.

Concerning body mass index, less than half of patients in both groups were overweight. These findings were aligned with those of **Gashynova, Suska, & Dmytrychenko, (2020),** who reported that half of studied patient is BMI ≥ 25 kg/m. On the other hand, this finding was contradicted by **Yang et al., (2021)** who reported that underweight status significantly increases the risk of incident non–cystic fibrosis bronchiectasis.

Regarding diagnosis, almost three quarters of patients in the control group and more than three quarters of patients in the study group diagnosed with COPD. The findings were aligned with those of **Wang, Lin, & Kao, (2018)** who showed that individuals with bronchiectasis–COPD overlap experienced significantly higher rates of acute respiratory events compared to those with COPD alone.

In relation to chief complaints, almost all of patients in both groups complained of shortness of breath and most of them experienced productive cough, and less than two thirds of them complained of chest pain, as exacerbations in bronchiectasis are driven by acute bacterial infection superimposed on chronic airway inflammation. **(Polverino, Dimakou, Aliberti, de Soyza, & Chalmers, 2022).**These findings were supported by **Hosseinzadeh, Aslani, Khoramian, & Nikoofal-Sahlabadi, (2021)** who revealed that Patients with non-cystic fibrosis bronchiectasis commonly present with chronic productive cough, daily sputum production, dyspnea.

Regarding past medical history, almost all patients had respiratory disease and less than half of them had cardiovascular disorders. The findings were aligned with those of **Hosseinzadeh et al., 2021),** who reported that one fifth of patients had cardiovascular comorbidities and hypertension.

Part II: Assessment of hemodynamic parameters, daily amount of expectorated sputum and dyspnea level of the studied patients with bronchiectasis exacerbations.

In relation to physiological parameters, there is a significant improvement in the physiological parameter including reduction in heart rate, respiratory rate and body temperature and increase in oxygen saturation among study group than control group patients throughout periods of intervention. As autogenic Drainage

helps to mobilize secretions by controlled breathing at different lung volumes, leading to improved ventilation **(Lee, Burge, & Holland2015; McIlwaine, Bradley, Elborn, 2020).** This result was supported by **Zisi et al., (2022)** who found that the active cycle of breathing technique in patients with bronchiectasis and COPD, verifying a higher, beneficial short-term effect on expectorated sputum, physiological parameters **Chandrika, Apparao, Chintada, & Jyothi, (2021)** who reported highly significant improvement of pulse rate of Autogenic Drainage technique from pre-test to post-test within the groups.

Also, the current study demonstrated a statistically significant reduction in the daily amount of expectorated sputum among patients in the study group throughout the three days of interventions. This reduction reflects the effectiveness of the applied airway clearance technique in mobilizing and eliminating mucus **(Alwekhyan, Alshraideh, Yousef, & Hayajneh, 2022).** These findings were consistent with **Zisi et al., (2022),** who revealed that the active cycle of breathing technique led to a measurable decrease in sputum production after one week. On the other hand, this finding was contradicted by **Zisi et al., (2022)** who showed that active cycle of breathing techniques is effective in increasing the expectorated sputum volume.

As regards dyspnea level, on the 1st day in the control group, less than half of patients had severe breathlessness while less than half of patients in study group had severe breathlessness compared to on the 3rd day. Also, there were statistically significant differences within each group due to the effect of ACTs in increasing the expectorated sputum volume, reducing viscoelasticity of the secretion and in relieving symptoms such as dyspnea **(Zisi et al., 2022).** This result was in the same line with **Kavitha, & Srihari (2023)** who revealed that there was statistically significant improvement in group A (ACBT + postural drainage) compared to group B (conventional chest physiotherapy). On the other hand, this finding was disagreed with **Olivier, McDonnell, O'Neill, & Bradley (2022)** who reported that no significant changes in dyspnea after airway clearance techniques such as ACBT or Flutter over one week.

Part III: Relation between daily amount of expectorated sputum of the studied patients with bronchiectasis exacerbations and their dyspnea, medication frequency and diagnosis at 3rd day of study. The highest mean score of expectorated sputum was reported in moderate dyspnea level. This is justified that mucus plugging is a key contributor to airflow limitation and increased work of breathing **(Polverino et al., 2022).** This result was congruent with **Fan et al., (2024)** who mentioned that excess sputum production is a key contributor to dyspnea and impaired quality of life in patients with chronic airway diseases.

Concerning the relation between daily amount of expectorated sputum of and medication frequency, the highest mean score of expectorated sputum were

reported when patient consumed bronchodilator 5 times/day and the mucolytic drug Every/8 hrs, the reason for this Symptoms such as productive cough, dyspnea, and chest tightness often prompt patients to increase their use of inhaled bronchodilators and mucolytic agents in an attempt to alleviate mucus burden **(Polverino et al., 2022).** This result was supported with **Lee, Kim, Park, Rhee& Yoo, (2023)** revealed that frequent sputum production is linked to increased inhaler use and exacerbation-driven antibiotic prescriptions. Conversely, this result disagreed with **Martínez-García et al., (2023),** who found that not all patients with daily sputum production use more medications.

Conclusions:

Airway clearance techniques had positive effect on improving physiological parameters, respiratory outcome, and daily amount of expectorated sputum and decrease severity of dyspnea level for patients' bronchiectasis exacerbation.

Recommendations:

1. Nurses working in respiratory intensive care units should be trained and encouraged to apply airway clearance techniques, particularly ACBT and Autogenic Drainage, to improve respiratory outcomes and reduce dyspnea.
1. Implementation of airway clearance techniques (ACTs) during routine nursing care for patients with bronchiectasis.

Limitation of the study: -

2. Short follow-up period restricted the ability to assess the long-term effectiveness and sustainability of airway clearance techniques.
3. The study conducted at one Chest Intensive Care Unit at Tanta University Chest Hospital may restrict the external validity of the findings.

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