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Impact of Glossopharyngeal Breathing on Expectoration, Airway Clearance and Vital Capacity in Pulmonary Tuberculosis Patients: A Cross-Sectional Study

Urooj Bhatti[1], Sikandar Ali Sangrasi[2], Sadia Effendi[3], Feriha Fatima Khidri[4], Waseem Shaikh[5], Keenjher Rani[6]

[1]M.B.B.S, Ph.D., Assistant Professor Physiology Department Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro, Sindh; [2]Assistant Professor Physiotherapy Institute of Physiotherapy and Rehabilitation Sciences LUMHS, Jamshoro, Sindh; [3]Assistant Professor Anatomy Liaquat University of Medical and Health Sciences Jamshoro, Sindh; [4]Associate Professor, Biochemistry Department Liaquat University of Medical and Health Sciences Jamshoro; [5]Lecturer, Anatomy Department Liaquat University of Medical and Health Sciences Jamshoro; [6]Associate Professor, Physiology Department Liaquat University of Medical and Health Sciences Jamshoro.

ABSTRACT

Introduction: Mycobacterium Tuberculosis is the main agent causing Pulmonary Tuberculosis spread by droplet nuclei that remain airborne for minutes to hours after expectoration via coughing, talking, sneezing or singing. TB is characterized by accumulated mucous in the airway creating a favorable environment for secondary host infections to grow, reduced vital capacity, weakness of respiratory musculature, atelectasis leading to respiratory failure.

Aim: To assess the impact of glossopharyngeal breathing on expectoration, airway clearance and vital capacity in pulmonary tuberculosis patients.

Methodology: Inpatient tuberculosis patients were selected via a simple random sampling technique with a sample size of 197 participants. The application of Glossopharyngeal Breathing (GBP), with the objective of facilitating cough by piston pumping maneuver for exculpating the mucus from lungs hence aims to increase the vital capacity and overall lung compliance. Before and after performing glossopharyngeal breathing, the vital capacity was measured with a spirometer for assessing the outcomes.

Results: The increase in exculpating mucus rate with aid of a different breathing pattern, glossopharyngeal breathing was beneficial in increasing lung compliance and vital capacities (p-value of 0.0001) and also enhancing the strength of the respiratory muscle in patients who are suffering from decreased breathing rate due to accumulation of mucus in the airway.

Conclusion: The experimental study has established data on the effects of GPB on expectoration, VC and chest tightness in pulmonary tuberculosis patients. According to the data collected, the average age affected was adults with weak immunity. Research shows that assistance for physiotherapists and other health care providers in hospitals as it is cost-effective, easy to perform and less time-consuming.

Key Words: Pulmonary tuberculosis, Glossopharyngeal breathing, Adults, Expectoration, Lung compliance and vital capacities, Piston pumping maneuver

INTRODUCTION

In Pakistan tuberculosis is frequently found, as it affects almost a quarter population of the Globe.[1] It is more prevalent because of the increased number of patients infected with human immunodeficiency virus, bacterial resistance to medications, increased international travel and the growing numbers of the homeless and drug abusers.[2] In the absence of treatment, death ensues in 80 percent of cases of tuberculosis. [3] In 2017, World Health Organization(WHO) reported the mortality rate due to tuberculosis was about 1.3 million. [4]

Tuberculosis is the 2nd deadliest infectious disease worldwide and has become a special health concern, especially in Pakistan.[2] Immunological deficient individuals are vulnerable to Tuberculosis caused by the mycobacterium genus complex.[5,1]

Corresponding Author:
Urooj Bhatti (M.B.B.S, Ph.D.), Assistant Professor Physiology Department Liaquat University of Medical and Health Sciences (LUMHS) Jamshoro, Sindh; Email: urooj.bhatti@lumhs.edu.pk

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The Inflammatory condition begins with a simple infection with clinical manifestation of fever, cough, weight loss and resultant sputum production affecting theLungs (Pulmonary TB) and other organs too (Extrapulmonary tuberculosis).[1]

Mycobacterium Tuberculosis is the main agent causing Pulmonary Tuberculosis spread by droplet nuclei that remain airborne for minutes to hours after expectoration via coughing, talking, sneezing or singing.[1,5,2] TB is characterized by accumulated mucous in the airway creating a favorable environment for secondary host infections to grow, reduced vital capacity, weakness of respiratory musculature, atelectasis leading to respiratory failure.[6,7,8]

Breathing exercise is an embracing term for ROM exercises and overall health.[9] Although Physical therapy breathing techniques are useful in many acute and chronic lungs diseases also including neurological conditions which deteriorate the respiratorysystem. [9,10] Glossopharyngeal Breathing (GPB) or Frog Breathing, is a method of independent Breathing and a form of positive pressure insufflation followed by peak expiratory flow passively done by an individual.[11] Though it stretches the rib cage, strengthens the respiratory muscles, mobilizes the mucus, and by activating the cough reflex, increases the vital capacity 5 times than normal breathing. The most beneficial work of this technique is to produce a forceful cough.[12,13,14,15]

GPB has proven to increase the lung volumes above the physiological total lung capacity in muscular dystrophy.[16] Glossopharyngeal breathing significantly increases lung volumes and strengthen the respiratory muscles in such condition as spinal cord injury, multiple sclerosis, poliomyelitis.[9,17,15] In congenital disorders including Muscular Dystrophy and Cystic Fibrosis, Glossopharyngeal breathing seems to be beneficial in respiratory assistance and mucociliary clearance.[6] The effectiveness of glossopharyngeal breathing which is also addressed as frog breathing is highly factual if done properly in deep-sea divers by creating positive pressure in contrast with the atmosphere.[17]

Mechanical insufflation-exsufflation creates a peak and sustained flow high enough to facilitate secretions towards the mouth by providing adequate shear and velocity for suctioning and expectoration. [6] For Airway clearance purposes, cough flows were significantly higher with insufflation via Glossopharyngeal Breathing than with maximum inspiration without glossopharyngeal breathing.[6] In fully ventilator-dependent individuals this maneuver can be used to improve voice and cough efficacy. [8,16] This technique raises threefold Vital capacity even disconnect from ventilation for a prolonged period in patients with upper cervical spine injury.[18] GPB increased the IC from 500 ml to almost 1,400 ml, it is independent of overall lung volume: they generate a uniform inspiratory volume during inflation of the lungs from FRC to approximately 1 liter above FRC. [14]

GPB was chosen as a breathing maneuver for the study to prove the objectives to producean effective cough by creating passive positive expiratory pressure and clearing the accumulated mucous in the tracheobronchial tree thus increasing the vital capacity. [6,10,12.17] Piston pumping action helped the Tuberculosis patients to use their muscle of cheeks, jaw, tongue, pharyngeal muscles allowing them to increase lung compliance, strengthening the chest cavity. [19] As Guyton stated that enforced air prevents chest tightness by working on the elastic property of the lungs, hence supporting the objective to reduce and prevent chest tightness. [20]

GPB was also found to be highly effective on TB patients as well, by encouraging increased VC, expectoration, and decreased dyspnea and chest discomfort as observed. This technique along with pharmacological support shows remarkable results which confront the research objectives.

This study was planned to assess the frequency of expectoration of sputum after GBP in tuberculosis patients, assess the chest tightness in tuberculosis patients after GBP, and determine the association of vital capacity before and after GPB in tuberculosis patients.

Study design: A cross-sectional study

Place and Duration: Tuberculosis Sanatorium hospital, Kotri from January to June 2021

METHODOLOGY

This cross-sectional study was conducted at Sanatorium Chest diseases Hospital Kotri from January to June 2021 with a simple randomization technique. The total sample size calculated by Rao soft came out to be 197 with a set margin of error of 5%, confidence level of 95%, and response distribution of 50%. Participants were of either gender, aged between 18-and 60 years old had pulmonary tuberculosis either drug-sensitive or drug-resistant, and with intact cranial nerves.

Patients with any neurological condition involving cranial nerves, psychologically ill patients, patients on ventilators, any intubations and drains, patients with temporomandibular joint dysfunction, people with tuberculosis of any other region of the body and patients with rib fracture were excluded from the study.Statistical analysis was performed by SPSS version 20 and data is presented in tabular and graphical form. Spirometer, Sputum Container and Questionnaire for ease of cough and sputum clearance were used as a tool.

RESULTS

Table -1 showed the results of eighty samples indoor diagnosed patients with pulmonary tuberculosis were studied.

Comprising of forty-three (53.75%) male patients and thirty-seven (46.25%) female patients. Ages ranging from 18years to 60 years were selected for this study whereas the average age was 41 years. Pulmonary tuberculosis either drug-sensitive or drug resistive were included in this study, twenty-one (26.3%) were drug resistive and the remaining fifty-nine (73.75%) were categorized as drug-sensitive.

Table -2 reports regarding the frequency of cough prior to GPB, 4 (5.0%) participants mentioned constant coughing, 18 (22.5%) participants reported frequent fits of coughing, 24 (30.0%) participants reported occasional coughing, 19 (23.8%) participants reported rare coughing and 15 (18.8%) participants reported unaware of coughing. Regarding the frequency of cough after the maneuver a total of 2 (2.5%) participants reported constant cough, 16 (20%) participants reported frequent coughing, 21 (26.3%) participants reported occasional cough, 18 (22.5%) participants reported rare coughing and 23 (28.8%) individuals were unaware of cough.

All participants reported GPB as a feasible exercise regimen and were willing to continue its practice. According to the objective, outcomes were highly significant, showing the marked statistical difference in vital capacity before and after the GPB maneuver, Paired T-test shows a p-value of 0.0001, as shown in table no.3. This study found that there is an impact of GPB the on expectoration of sputum, airway clearance and vital capacity in pulmonary tuberculosis patients value of less than 0.05. (As shown in diagram No 1)

DISCUSSION

Patients diagnosed with pulmonary tuberculosis admitted at the institute of chest diseases hospital, Kotri, Sindh were recruited for this study. The subjects with hemoptysis, chest intubations, temporomandibular dysfunction, rib fractures, neurological or psychologically unstable patients were excluded, while patients aged between 18 to 60 years were selected for this study.

The previous studies show an increase in vital capacity after GPB due to the ingestion of air bolus with subsequent strokes passing through the larynx into lower airways mobilizing the tract helping in the stimulation of receptors, stretching the chest cavity, and excreting the phlegm out of the tract with the forceful cough production thus increasing the Capacities of involved Volumes. The difference in vital capacity pre and post-GPB shows a mean value greater than 430.625 and a standard deviation of 326.510, statistical analysis shows a significant outcome with the p-value of less than 0.05 revealed in table no.8, which confers the substantial increase in vital capacity in a patient with pulmonary TB.

Similarly in a pilot study of Ankylosing spondylitis, the maximal vital capacity was increased to 5 % in 3 patients using Glossopharyngeal insufflation.[21] In a study conducted on 7 chronic poliomyelitis respirator patients, 11 to 50 % of mean vital capacity showed an increase.[11] According to a case report in 2019, a DMD Patient of 33 years old showed an increase in lung volumes after attempting GPB several times.[16] GPB showed a substantial increase in Lung volumes in 7 breath-hold divers aged 33 years.[22] Tetraplegia patient on ventilation shows an increase in vital capacity three-folds after GPB and adaptation of this exercise has assisted patient without ventilation.[14] In high spinal cord injuries, GPB had proved to increase VC and expiratory flow rates.[9] Healthy women, elite swimmers, people with cervical spinal cord injury (CSCI) and children with spinal muscular atrophy (SMA) had an increase in their vital capacity (VC) by 23% and increase their chest expansion.[23] The increase in vital capacity in 7 chronic poliomyelitis patients showed good chest and lung stretching and this maneuver was experienced to be pleasant.[24]

The expectoration of sputum improves after GPB in tuberculosis patients. The method of GPB causes mobilization of phlegm depending on the number and amount of air engulfed with each swallow, the more the number of air bolus swallowed causing the chest expansion the more will be air accumulation increasing the recoiling of the lungs, the pressure difference between the outside and inside of intrathoracic airways causes the dynamic compression and narrowing which cause the expulsion of air stream with the outcome of expelling the secretion with great force. The results of question no 3 supported the objective of the study by showing ease in coughing up sputum in the majority of the population, displayed in Table no 6 and figure no.5. In Patients with neuromuscular diseases, mechanical insufflation and exsufflation have helped in maintaining peak cough and avoiding the retention of secretions.[6] Glossopharyngeal breathing has been shown to increase vital capacity and expiratory flow rates and is a treatment option for patients with high spinal cord injury.[9]

Big breaths during the process help us to gulp air and hold it in our lungs using an intermittent positive pressure increasing the air impulsion into the lungs stretching the chest wall preventing the chest stiffness and thus decreasing the chest tightness. A relative question was interviewed on the last day of follow-up that reported mild discomfort in the majority of participants and participants reviewed comfort and abated pain. Quadriplegic patients because of weak or paralyzed muscles report chest rigidity with shallow breath GPB increases the air influx which stretches the lung capacity and ribcage as well.[20]

The correlation and association of question no.1 and 2 from the questionnaire conclude decrease in cough frequency in TB patients after GPB. The results initially show GPB increases cough frequency as it fills the resistive lung capacity that stimulates cough receptors, the weak musculature of chest is stretched and cough became easier day by day and the frequency was slightly decreased on third day of follow-up indicate the effectiveness of GPB on cough frequency.

All the patients found this technique of frog breathing feasible and easy to perform and everyone (100 %) were willing to continue this technique and agreed to include this exercise in their regime by observing the wide differences and improvement in their expectoration, power of cough and overall quality of life.

CONCLUSION

This experimental study has established data on the effects of GPB on expectoration, VC and chest tightness in pulmonary tuberculosis patients. According to the data collected, the average age affected was adults with weak immunity. Research shows that assistance for physiotherapists and other health care providers in hospitals as it is cost-effective, easy to perform and less time-consuming.

The study would help them to evict via non-pharmacological physical therapy maneuver which not only decreases the time of stay at the hospital and also provides lifelong prevention from a respiratory problem by improving the overall state of health.

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Table 1: Baseline Characteristics of Studied Samples (n= 80)

Characteristics		n	%
Gender	Male	43	53.8
	Female	37	46.3
Age (Years)	Mean (±SD)	40.51	±14.25
Drug	Resistant	21	26.3
	Sensitive	59	73.8

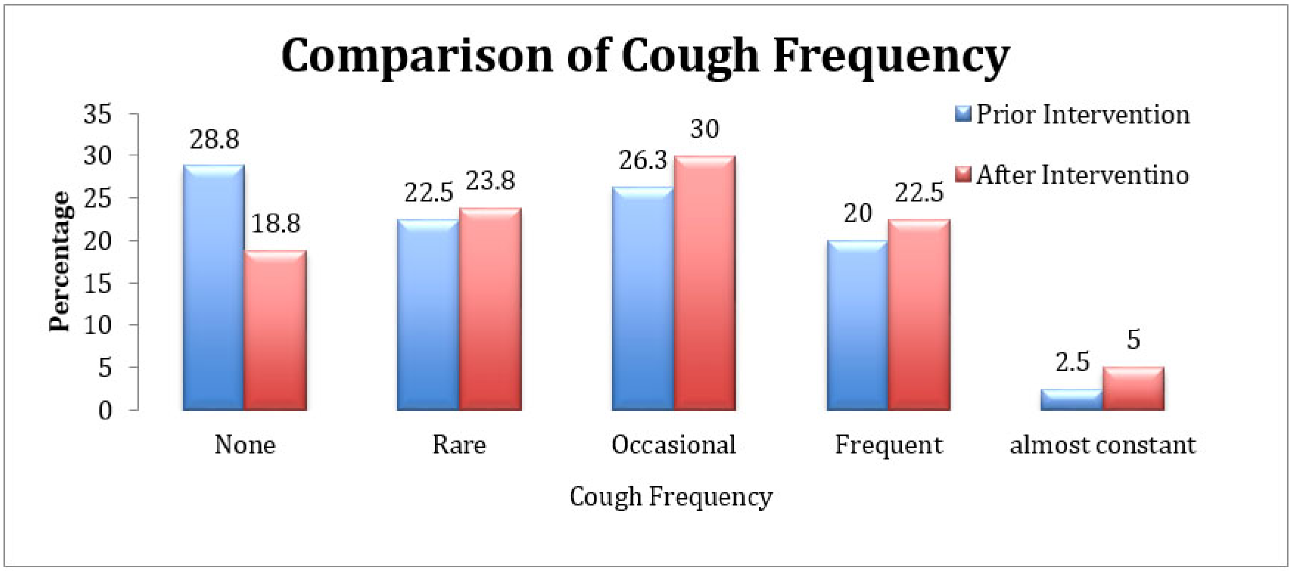
Table 2: Outcomes on Cough frequency, Sputum, and Tightness

Variables		n	%
Cough Frequency After Intervention	None	23	28.8
	Rare	18	22.5
	Occasional	21	26.3
	Frequent	16	20.0
	almost constant	2	2.5
Cough Frequency Prior Intervention	None	15	18.8
	Rare	19	23.8
	Occasional	24	30.0
	Frequent	18	22.5
	almost constant	4	5.0
Cough Out Sputum	None	13	16.3
	Easy	45	56.3
	Somewhat difficult	18	22.5
	Very difficult	4	5.0
Chest tightness	None	19	23.8
	Mild	34	42.5
	Moderate	24	30.0
	Severe	3	3.8

Table 3: Mean Comparison of Vital Capacity before and after GPB

Parameter	Mean Difference	SD	t-value	DF	p-value
Vital capacity before GPB vs. Vital capacity after GPB	-430.625	326.510	-11.796	79	<0.01*

*p<0.05 was considered statistically significant using paired sample t-test



Bar Diagram 1