Effect of Chest PNF and Breathing Exercises on Blood Pressure in Female Smokers

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ABSTRACT

Background: Nicotine, one of the many dangerous chemicals included in cigarettes, causes atherosclerosis, chronic obstructive pulmonary disease (COPD), and other respiratory and cardiovascular conditions. Wheezing, frequent coughing, with or without phlegm, increased dyspnea, and decreased respiratory muscle endurance might result from this. The study's primary goal is to determine how breathing exercises and chest proprioceptive neuromuscular facilitation affect female smoker's blood pressure.

Method: According to the study's criteria, 20 subjects were included in this comparative analysis, For two weeks, participants underwent breathing exercises and a chest proprioceptive neuromuscular facilitation approach. Five minutes after treatment on Day 1 and Day 14 blood pressure readings were taken. The data was analyzed using the ANOVA (single factor).

Conclusion: Significant improvement in terms of blood pressure was observed in participants who received chest proprioceptive neuromuscular facilitation and breathing exercises.

Keywords: Blood pressure, chest PNF, breathing exercises, smoking.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common and treatable disease characterized by progressive airflow limitation and tissue destruction. It is associated with structural lung changes due to chronic inflammation from prolonged exposure to noxious particles or gases most commonly cigarette smoke. Chronic inflammation causes airway narrowing and decreased lung recoil.[1] The disease often presents with symptoms of cough, dyspnea, and sputum production. COPD is an inflammatory condition involving the airways, lung parenchyma, and pulmonary vasculature. The process is thought to involve oxidative stress and protease-antiprotease imbalances. Emphysema describes one of the structural changes seen in COPD where there is the destruction of the alveolar air sacs (gas-exchanging surfaces of the lungs) leading to obstructive physiology. In emphysema, an irritant (e.g., smoking) causes an inflammatory response. Neutrophils and macrophages are recruited and release multiple inflammatory mediators. Oxidants and excess proteases leading to the destruction of the air sacs. The protease-mediated destruction of elastin leads to a loss of elastic recoil and results in airway collapse during exhalation.[1,2] Symptoms can range from being asymptomatic to respiratory failure. An estimated 4 million people died from tobacco use in 1999, and by the 2030s, that number is predicted to rise to 10 million fatalities annually. Smoking usually starts in teens or early adulthood. Smoking produces pleasurable feelings because the chemicals inhaled cause chemical interactions in the brain's nerve endings that resemble those of endorphins and dopamine, which are found naturally. obstructive pulmonary disease), atherosclerosis, and other respiratory and cardiopulmonary disease. Smokers and people over 40 are more likely to have COPD. It is currently the third most prevalent cause of illness and mortality globally, and prevalence rises with age. Around 3.2 million people died from COPD globally in 2015, while the prevalence of the disease was 174 million. However, because COPD is underdiagnosed, the prevalence is probably underestimated. This may lead to wheezing, frequent coughing with or without sputum, increased breathlessness, reduced endurance and strength of respiratory muscles, and tightness in the chest. Even the early stage of smoking might affect the respiratory function of young adults due to acute alterations in the lungs. The thoracic capacity, which is dictated by the respiratory muscles' intensity, the skeletal muscles' mobility, and the flexibility of the surrounding soft tissues, influences the lungs' ability to expand and contract. The maximum effort put forth by the muscles used for chest expansion while breathing determines the strength of the respiratory muscles. Additionally, several studies have discovered that young people who smoke have smaller chest circumferences, particularly at the axillary level, which is linked to smaller AP and ML diameters of the upper chest expansion. Dyspnea could result from reduced chest expansion since it would impair breathing function and effort.

MATERIALS AND METHODS

An experimental study was conducted which included 20 patients that visited the outpatient department of Jyotirao Phule Subharti College of Physiotherapy, SVSU, Meerut. The patients included in the study were assessed Five minutes after treatment on Day 1 and Day 14 blood pressure readings were taken. The subjects were selected according to the inclusion and exclusion criteria. The purpose and procedure of the study were explained in detail to the subject or and consent was obtained. The sample size was calculated by G-Power software, using the power of study 0.95 and probability error 0.05.

PATIENT ENROLMENT

Inclusion Criteria: Only female patients were included. Patients who were hemodynamically stable. Patients aged between 30-40 years. Having a history of smoking for 5 years or more. Informed consent from the patient. All the subjects had a body mass index (BMI) in the range of 18.5–23 kg/m2.
Exclusion Criteria: Subjects who had a history of any presence of systemic, respiratory, cardiovascular diseases or any orthopedic disease and subjects with any psychological disorder were excluded from the study.
Before the study began, all participants were given a thorough explanation of the entire process, and their written informed permission was obtained. Twenty females were incorporated into the study based on the inclusion and exclusion criteria. All subjects engaged in exercise for two weeks for 30-minute sessions three days a week.

TREATMENT PROTOCOL: All subjects underwent the treatment in two phases: 1 and 2.
Phase 1 (chest PNF): Participants were given chest PNF while prone, side-lying, and in a supine posture. Oblique downward pressure at the sternum, diagonal pressure at the lower rib cage in the supine position, caudal medial pressure at side-lying, caudal pressure over the rib cage in the prone position, and dorsal and caudal pressure on the elbow in the prone position were all part of the chest PNF technique. For two weeks, the treatment lasted for thirty minutes each day, three days a week.

Phase 2 (Breathing exercises): For two weeks, subjects engaged in deep breathing exercises for thirty minutes each day, three days a week, which included segmental, diaphragmatic, and pursed-lip breathing.

OUTCOME MEASURES

To evaluate the outcome of the study, the systolic blood pressure and diastolic blood pressure of the patients were noted 5 minutes after the sessions ended on Day 1 and Day 14.

STATISTICAL ANALYSES

All analyses were obtained using Microsoft Excel 2007 Demographic data of the patients including age and gender were summarized. Statistical analysis was performed using EZR Software Version 1.55. The dependent variables for the statistical analysis were SBP and DBP. The analyzed BP was measured noninvasively and collected by using a mercury sphygmomanometer and a stethoscope, 5 minutes after the physiotherapy session. A level of o.o5 was used to determine the statistical significance.

RESULTS

During the study period (August 2024-September 2024), a total of 20 patients were enrolled in the study, and was completed within 28 days. All the patients underwent six sessions of chest PNF and breathing exercises.

Results were analyzed using the ANOVA test (Single Factor) by using EZR Software Version 1.55.

Summary of Data for SBP						
	Treatments					
	1	2	3	4	5	Total
N	20	20				40
∑X	2977	2445				5422
Mean	148.85	122.25				135.55
$\sum X^2$	455315	300559				755874
Std.Dev.	25.3279	9.3408				23.1616
Result Details						
Source	***SS***	***df***	***MS***			
Between-treatments	7075.6	1	7075.6	***F* = 19.41839**		
Within-treatments	13846.3	38	364.3763			
Total	20921.9	39				
The *f*-ratio value is 19.41839. The *p*-value is .000083. The result is significant at *p* < .05.						

Summary of Data for DBP						
	Treatments					
	1	2	3	4	5	Total
N	20	20				40
∑X	1838	1534				3372
Mean	91.9	76.7				84.3
$\sum X^2$	176314	118860				295174
Std.Dev.	19.7375	7.9545				16.7289
Result Details						
Source	***SS***	***df***	***MS***			
Between-treatments	2310.4	1	2310.4	***F* = 10.204**		
Within-treatments	8604	38	226.4211			
Total	10914.4	39				
The *f*-ratio value is 10.204. The *p*-value is .002816. The result is significant at $p < .05$.						

DISCUSSION

The purpose of this study was to provide evidence that chest PNF shows effective results upon being applied to patients. The findings of this study revealed that chest PNF is effective in improving systolic and diastolic blood pressure. The basic respiratory muscles get a proprioceptive signal from the chest PNF, increasing the movement of the chest wall. It also contracts the abdominal and diaphragmatic muscles, as was previously mentioned. Through autogenic inhibition, the stiff muscles of the chest wall can be weakened, allowing the chest wall to move more freely. Additionally, PNF causes the muscles of the chest wall to relax under stress, increasing chest wall mobility. A prior study by Saha et al. showed that breathing exercises and chest PNF improved the assessment of chest expansion in Parkinsonism patients.

Reduced maximal expiratory flow and sluggish forced lung emptying are hallmarks of COPD. In certain instances, the clinical manifestation may be irreversible, and there may be a decrease in tolerance and endurance. The fourth most common cause of mortality is COPD. Women are typically affected more than males. It is currently seen as a systemic illness that impacts not just the lungs but also several the peripheral muscular system, among other organs. These anomalies in the function of peripheral muscles are linked to reduced oxygen delivery, the impact of inflammatory mediators on illness, malnourishment, drugs and comorbidities, which have been demonstrated to have a negative correlation with overall survival health condition. The effects of breathing exercises on chest expansion in older adults with inspiratory muscle weakness were demonstrated in a study by Kim et al. As Important elements influencing air flow during inspiration and expiration include the rib cage's mechanical characteristics and muscle tension. The skeletal muscles' mobility, the soft tissues' flexibility, and the respiratory muscles' intensity all influence the thorax's capacity, which in turn affects the lungs' ability to expand and contract.

According to Felter et al., sensory muscle spindles are present in intercostal muscles as well as in diaphragm that respond to elongation. Muscle fibers recruited when signal is sent via spinal cord and anterior horn cell and thus increase the strength. Stretch reflex is activated by stretching ribs and diaphragm which helps to take deep breaths.[7]

Chest PNF efficiently stimulates the diaphragm and the intercostals thereby increasing the chest mobility. It also invigorates the abdominal muscles thereby causing them to contract.

The theory of Laplace's law suggests that the length of muscle relates to the maximal force of either diaphragm or intercostal muscles, which affect ventilation in the lung. So, due to ventilatory movement strategies all the muscles of ventilation are facilitated to work at optimal length which further results in increase in the recruitment of fibers and also in the increased strength and endurance of the muscles of ventilation.[8] Chest PNF should thus be appended in ICU management of such patients.

The biggest limitation of the study was a small sample size and cursory duration. For future studies, an extended time duration with a sizeable sample can be taken. Also, additionally the duration for which the treatment is cogent should also be researched.

RECOMMENDATIONS

It is recommended that chest PNF can be incorporated and must be frequently used as a physiotherapeutic method of intervention in smokers as it shows promising results.

CONCLUSION

In summary, systolic and diastolic blood pressures were clinically significantly improved by the training regimen namely chest PNF and breathing exercises. These result supports the use of breathing exercises and chest PNF as an adjuvant to pulmonary rehabilitation program in the treatment of female smokers since they are clinically useful.

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