DOI Number: 10.37506/v11/i1/2020/ijphrd/193898

Effect of Proprioceptive Neuromuscular Facilitation (PNF) Pattern on Respiratory Parameters in Chronic Bronchitis

Sushma Singh[1], Javid H. Sagar[2], G. Varadharajulu[3]

[1]MPTh (Cardio-pulmonary), [2]Professor/ Unit Head (Cardio-pulmonary), [3]Dean/ Professor/ HOD, Krishna College of Physiotherapy, Krishna Institute of Medical Science Deemed to be University, Karad, Maharashtra, India

Aim: To study the effect of PNF pattern on respiratory parameters in chronic bronchitis.

Objectives: To find the effect of PNF pattern on respiratory parameters and to compare the effects of pursed lip breathing and PNF pattern in chronic bronchitis.

Materials and Method: 60 patients were included according to inclusion and exclusion criteria by consecutive random sampling and were divided into two groups, group A (Conventional-PLB) and group B (D1 & D2 flexion and extension) - with 30 patients in each group. The treatment was given for 2 weeks thrice a day. After 2 weeks effect of interventions were assessed by taking Respiratory Rate (R.R), Oxygen Saturation ($SpO_{2)}$ and FEV_1/FVC.

Results:. There was significant difference in R.R, SpO_2 and FEV_1/FVC seen with PNF pattern exercises. The intra group comparison showed significant improvement in R.R, SpO_2 and FEV_1/FVC. The inter group comparison showed no significant improvement in SpO_2 and FEV_1/FVC except R.R

Conclusion: PNF pattern has shown significant improvement in SpO_2, R.R and FEV_1/FVC

Key words: *Chronic Bronchitis, PNF, PLB, PFT.*

Introduction

Chronic bronchitis is a term that describes inflammation of the bronchial tubes (i.e. bronchi and smaller branches termed bronchioles) that results in excessive secretions of mucus into the tubes, which leads to tissue swelling that can narrow or close off bronchial tubes.

One of the major disease includes COPD, the significance of which is difficult to overestimate. According to the GOLD (2013), guidelines states that chronic bronchitis is a completely independent disease but one which can precede the development of airflow limitation as well as cause or aggravate the persistent airflow limitation. The primary risk factor for majority of patients is smoking. [1]

Chronic bronchitis is defined as a productive cough that lasts for three months for at least two consecutive years. Most people with chronic bronchitis have chronic obstructive pulmonary disease (COPD). [1,2]

The common characteristic of the disease is obstruction to airflow out of the lungs which leads to poor gas exchange and difficulty in breathing. [2]

Symptoms include dyspnea, cough with mucus (sputum) production, wheezing are generally seen. [15] Other features are: constriction in the chest, tachypnoea, tachycardia, adventitial breath sounds, accessory muscles becomes active, thick and stringy mucus.

The other causes are long term exposure to irritating gases or particulate matter, respiratory infection and most often from cigarette smoke.

The pathological foundation for chronic bronchitis is due to the over production of mucus in response to the inflammatory signals, this is known as mucus metaplasia. The overproduction and hypersecretion is due to the presence of goblet cells and reduced elimination of mucus.

The mechanisms responsible for mucus metaplasia is associated with the function of the T cells, this mechanism is still poorly understood but it is believed to

be linked to end production of the cells called as Th2 cells which are inflammatory cells while the cellular response is thought to be attributed to the Th1 inflammatory cells, cytokine substance is produced by both the cells that have an influence on mucus production associated with chronic bronchitis. [2]

Airflow obstruction is caused due to mucus metaplasia through several mechanisms and they causes luminal occlusion, thickening of the epithelial layer which intrudes on the airway lumen and the mucus alters the airway surface tension. [2]

Due to this, the airway has high tendency for collapse and also decreases the capacity for airflow and exchange of gas. [2]

Mucus hypersecretion is one of the risk which is associated with cigarette smoking, viral infections, bacterial infections or inflammatory cell activation.

When combined with poor ciliary function, distal airway occlusion, ineffective cough, respiratory muscle weakness and reduced peak expiratory flow rate clearing secretions becomes difficult and requires high energy expenditure. [2]

Chronic bronchitis is a condition in which an obstructive ventilation disturbance of the respiratory passages evokes a feeling of shortness of breath. Respiratory rate, oxygen saturation, chest mobility, expiration are all affected. [2]

Furthermore, the amount of air exhaled during initial one second (FEV1) is reduced and is reduced to a greater degree than the entire Forced Vital Capacity and FEV_1/FVC ratio is affected. [10]

PFT is used to measure the lung volumes and capacities which shows decreased FEV_1/FVC ratio . It is an investigation tool for monitoring of patients with respiratory pathology. It also provides information about large and small airways, the pulmonary parenchyma and the size and integrity of the pulmonary capillary bed. [10]

As this is progressive condition and can worsen the quality of life, the physiotherapy plays an important role for promoting good health by reducing breathlessness, improves chest mobility by various breathing exercises.

Breathing exercise and other ventilatory techniques also have a vital role in influencing the rate, depth and distribution of ventilation. [10]

Pursed lip breathing is used as a conventional treatment in chronic bronchitis which showed improvement on respiratory parameters and also in reducing dyspnea. [10]

PNF i.e. D1 and D2 flexion and extension used as an advance technique which has also some improvement.

PNF pattern and methods of treatment were used to obtain the maximum quantity of activity, which can be achieved at each voluntary effort and the maximum possible number of repetition of the activity to facilitate the response.

In the development of PNF techniques, greater emphasis was placed on the application of maximal resistance throughout the range of motion, using many combinations of motion that were related to primitive patterns and the employment of postural and righting reflexes.

In the modern field, the advanced physiotherapy techniques of PNF are being applied as a means of stimulating response and strengthening muscles related to respiration.

PNF mobility exercise aims in improving the pulmonary functions and the mobility of chest wall, trunk and shoulder. [11]

As D1 and D2 flexion extension involves movement of shoulder which improves chest mobility and also shows improvement in chest expansion and mobilizing secretions.

This study is basically done to find the effects of PNF pattern on respiratory parameters and also to compare the effects of PLB and PNF as there are very few literatures available on it. This technique is rarely used in hospital setup so after the study, based on the findings we can prescribe the more effective treatment to the patients for prevention of chronic bronchitis complications and symptoms and thus enhance the patient's recovery which can also improve the quality of life.

Method

Study type: Experimental study

Study design: pre test or post test

Sample size: 60 (30 + 30)

Place of study: Krishna Hospital, Karad

Criterion for Study

Inclusion criteria:

- Both male and female
- Patient diagnosed with chronic bronchitis
- Patients with reduced chest wall movements and reduced air entry
- Haemodynamically stable patients who are willing to participate in the study.

Exclusion criteria

- Any recent thoracic surgeries and abdominal surgeries
- Any musculoskeletal abnormalities limiting the shoulder girdle functions.
- Neuromuscular weakness of upper limb
- Patients with grade IV dyspnea (according to MMRC grading).

Procedure

The subjects who were admitted in wards and those falling in inclusion criteria were selected. Each subject was screened as per inclusion and exclusion criteria and was informed about the study and a written consent was taken from them.

By using consecutive random sampling method the participants were divided into two groups.

Group A and Group B and was named as Conventional and Experimental group. PLB exercise was given as a conventional exercise and PNF was given to the experimental group.

The intervention was given for 2 weeks and thrice a day for both the groups.

Pre test and post test evaluation was taken, which includes: R.R, SpO_2 and FEV_1/FVC

Intervention :

GROUP A : PLB was given in this group. Patient was positioned in semi fowler position with relaxed shoulders and slowed expiration was done by pursing the lips. It was performed 10 times and was given for 2 weeks thrice a day.

GROUP B : In this group, PNF pattern was given: D1 flexion and D1 extension, D2 flexion and D2 extension. It was performed with 10 repetitions for 2 weeks thrice a day. After two weeks of session post test and statistical analysis was done.

Outcome Measure

- SpO_2 / R.R
- PFT: FEV_1/FVC

Results

Table 1: Comparison of pre and post R.R, SpO_2 and FEV_1/FVC within the group

	MEAN ± SD	MEDIAN	P VALUE	t VALUE	df
GROUP A PRE R.R	17.7±3.800	17.000	0.0004	3.096	29
GROUP A POST R.R	19.6±2.527	19.500			
GROUP A PRE SpO2	94.76±2.775	95.000	<0.0001	8.515	29
GROUP A POST SpO2	96.76±2.046	97.000			
GROUP A PRE FEV_1/FVC	75.38±4.457	76.000	<0.0001	13.868	29
GROUP A POST FEV_1/FVC	80.33±4.221	81.000			

Table 2: Comparison of pre and post R.R, SpO_2 and FEV_1/FVC within the group

	MEAN ± SD	MEDIAN	P VALUE	t VALUE	df
GROUP B PRE R.R	16.9±2.528	14.000	<0.0001	14.715	29
GROUP B POST R.R	17.46±2.374	18.000			
GROUP B PRE SpO_2	94.73±2.559	95.000	<0.0001	7.909	29
GROUP B POST SpO_2	96.96±1.86	96.500			
GROUP B PRE FEV_1/FVC	75.63±4.214	78.000	<0.0001	10.912	29
GROUP B POST FEV_1/FVC	81.5±3.288	81.500			

Table 3: Comparison of pre and post R.R, SpO_2 between the group

	GROUP A & GROUP B	MEAN ± SD	MEDIAN	P VALUE	t VALUE	df
R.R	PRE	17.7 ± 3.800	17.000	0.931	4.160	58
	PRE	15.4 ± 2.528	14.000			
R.R	POST	19.6±2.527	19.500	0.0013	3.370	58
	POST	17.46±2.374	18.000			
SpO2	PRE	94.76±2.775	95.000	0.9616	0.0483	58
	PRE	94.73±2.559	95.000			
SpO2	POST	96.76±2.046	97.000	0.693	0.395	58
	POST	96.96±1.866	96.500			

Table 4: Comparison of pre and post FEV_1/FVC between the group

FEV1/FVC	PRE	75±4.457	76.00	0.573	0.565	58
	PRE	75.63±4.214	78.00			
FEV1/FVC	POST	80.33±4.221	81.00	0.237	1.194	58
	POST	81.5±3.288	81.50			

Statistics

The outcomes were assessed at the 1st day prior to treatment and at the end of 2nd week post treatment. Inter group analysis was done by unpaired 't' test and intra group analysis was done by using paired 't' test. The inter and intra group analysis was done by using Instat 3.

Discussion

Chronic Bronchitis is common but a variable phenomenon on COPD with numerous clinical consequences and reduced lung function with increase in airflow obstruction[1]

The therapeutic role of PNF pattern based on stretch-reflex theory in altering pulmonary functions. E.Dean, Donna Frownfelter stated that ventilation has been improved, chest wall muscles are being maximally stretched and ribs are naturally opening up in butterfly technique where the inspiration with trunk extension, shoulder flexion, abduction and external rotation (D2 flexion) and the expiration with trunk flexion, shoulder extension, adduction and internal rotation (D2 extension) . [4]

Vanessa Resqueti stated that pursed lip breathing is used conventionally which has been showed in reducing the dyspnoea and has greater effect on improving pulmonary function. [10]

The main objective of the study was to find the effect of PNF on improving the pulmonary function in chronic bronchitis.

In the present study, the sample size was 60 and they were divided into two groups: group A (conventional group) and group B (experimental group) which consisted of 30 participants in each group. The participants were selected on the basis of inclusion and exclusion criteria.

In this, the efficacy of D1 and D2 flexion and extension pattern on respiratory rate, oxygen saturation and FEV_1/FVC were investigated. They were investigated using Pulmonary Function Test. The intervention was given for 2 weeks thrice a day.

After the intervention statistical analysis was done where; Respiratory Rate, SpO_2 and FEV_1/FVC ratio of pre and post were compared by paired 't' test of within the groups. Whereas, the comparison between the groups were also done by comparing pre and post R.R, SpO_2, FEV_1/FVC of group A with group B by unpaired 't' test.

Post intervention it was found that there was significant improvement within the group A and group B and in comparison of both the groups there was no significant improvement may be because the shoulder movement didn't had effect on improving lung volumes and capacity and thus FEV_1/FVC ratio and oxygen saturation was not improved.

And also, during intervention patient had difficulty in performing shoulder flexion and extension repeatedly due to dyspnoea where some of the participants were performing trick movements.

Therefore, various dyspnoea relieving techniques were given to the patient like pursed lip breathing, forward leaning position and rest which helped in relieving dyspnea.

It was difficult to treat dyspnoea in grade 3 patients, as some patients were non –co-operative and some didn't do exercises independently once the therapist is taught how to do the exercise and instructed to do number of times in a day, which hampered the results of the study

and recovery in the patients.

But there was significant improvement in respiratory rate post intervention may be due to chest wall muscles are being maximally stretched and the inspiration with trunk extension, shoulder flexion, abduction and external rotation (D2 flexion) and the expiration with trunk flexion, shoulder extension, adduction and internal rotation (D2 extension).

As the intercostals muscle and diaphragm contains sensory muscle spindles that respond to elongation. A signal is sent to spinal cord and anterior horn cells. These neurons signal make more muscle fibers to contract (recruitment) and thus increase the strength. Stretching the ribs and diaphragm activate the stretch reflex and help the patients to take a deep breath which helps in improving the quality of breathing and thus improves the respiratory rate.

Few studies like D.Anandhi, P.Deekshitha - PNF shows an immediate improvement in FVC and IC thus shows an enhanced lung function among collegiate students.

Leandro Ferracini - concluded that pursed lip breathing reduces dynamic hyperinflation and improves exercise tolerance, breathing pattern and arterial oxygenation at submaximal intensity exercise.

Gopi Parth Mehta - shows significant improvement in chest expansion and pulmonary function test such as forced expiratory volume and forced vital capacity than only active assisted exercise program for elderly subjects.

After comparing with the above study, PNF exercise has important role on pulmonary function as the therapeutic role of PNF pattern is based on stretch reflex theory in altering pulmonary functions with D1 and D2 extension it showed improvement in oxygen saturation, respiratory rate and FEV_1/FVC ratio.

But in comparison it had no significant improvement except respiratory rate which may be due to short intervention duration and small sample size may be responsible for the baseline differences that appeared to exist in the groups for PLB and PNF.

Conclusion

Based on the statistical presentation, analysis and interpretation it can be concluded that Proprioceptive Neuromuscular Facilitation pattern has shown significant improvement in SpO_2, R.R and FEV_1/FVC.

The present study provided the evidence to support that both the techniques are effective on SpO_2, R.R and FEV_1/FVC individually in chronic bronchitis patients.

However, the techniques when compared with each other were equally effective and there were no significant difference between each other but had shown significant improvement in R.R.is study

Conflict of interest: Short intervention duration as patients did not stay in wards for more than 2 weeks.

Funding: This study was funded by Krishna Institute of Medical Science Deemed to be University, Karad.

Ethical Clearance: The study was approved by the institutional ethics committee of KIMSDU.

References

1. Victor kim etal “Concise clinical review of chronic bronchitis and chronic obstructive pulmonary disease” Am J Crit Care Med. 2013 Feb; 187(3): 228-237.
2. Galina L. Ignatova etal “Features of chronic bronchitis in different age groups” International journal of biomedicine 2014;4(1): 15-18
3. Seo K,etal “The effects on the pulmonary function of normal adults proprioceptive neuromuscular facilitation respiration pattern exercise” Journal of physical therapy science. 2014;26(10):1579-82
4. Frownfelter DL, Ed Dean EW “Principles and practice of cardiopulmonary physical therapy” Mosby incorporated; 1996.
5. Marek SM, etal “ Acute effects of static and proprioceptive neuromuscular facilitation stretching on the muscle strength and power output” J Athl Train. 2005, Apr-Jun; 40(2): 94-103.
6. Bernard – Narbonne F etal “effectiveness of chest physiotherapy in ventilated children with acute bronchiolitis” Arch Pediatr. 2003:10:1043-1047.
7. Mackenzie CFal et “Cardio respiratory function before and after chest physiotherapy in mechanically ventilated patients with posttraumatic respiratory failure” Crit Care Med. 1985:13:483-6
8. Schmidt RW “The effect of airflow and oral pressure on the mechanics of breathing in patients

with asthma and emphysema." Am Rev Respir Dis 1964;90:564-71

9. Breslin EH etal "Abdominal muscle recritment during pursed lips breathing in COPD" Am J Respir Crit Care Med 1996;153:A128
10. Leandro Ferracini Cabral, etal "Pursed lip breathing improves exercise tolerance in COPD: A randomized crossover study" Eur J Phys Rehabil Med 2015; 51(1): 79-88.
11. D.Anandhi, P etal "Immediate effect of proprioceptive neuromuscular facilitation(PNF) of respiratory muscles on pulmonary function ig collegiate students" International Journal of Pharma Bio Sci 2017 october; 8(4): (B) 508-512
12. Seemungal TAetal." Time course and recover of exacerbations in patients with chronic obsturctive pulmonary disease" Am J Respir Crit Care Med 2000;161:1608-1613