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Original Research Article

Efficacy of chest PNF on pulmonary function in patients with Parkinson's diseases: A pilot study

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ABSTRACT

Purpose: 84% of Parkinson disease (PD) patients develop respiratory abnormalities which subsequently becomes the most common cause of death. There is a paucity of research to address this problem. So the main purpose of this study was to evaluate the efficacy of chest PNF on pulmonary function and chest wall mobility in PD.

Materials and Methods: 20 participants recruited for the study were divided into two groups. The conventional group participants received conventional treatment for one week. The experimental group received chest PNF exercise along with conventional treatment for a week. The PFT (FVC, FEV1 & FEV1/FVC) and chest wall expansion at the axillary and xiphi-sternal level were measured for data analysis within and between groups using a paired and unpaired t test respectively.

Results: Within-group analysis showed that the differences were significant between pre and post intervention in both groups for FVC and chest wall expansion (Axilla, xiphi sternum) ($p<0.05$) but not for the other measures. Between-group analysis reveals that PFT parameters were not different ($p>0.05$) whilst chest expansion at the two measured levels were different ($p<0.05$).

Conclusion: The results of this study convey slight additional benefit of chest PNF if added to conventional therapy.

1. Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder which is characterized by tremor, rigidity and bradykinesia. Degeneration of substantia nigra considered as common causative factor. Early symptoms include loss of smell sensation, rapid eye movement and orthostatic hypertension. Later, patients develop postural instability, gait and balance disturbances.[1] Estimated 7-10 million people worldwide are suffering from PD. The average age of onset is 50-60 years. Reported prevalence of PD in India is 328 per 100,000 populations.[1–3]

Every PD patients feel stiffness, which becomes more evident as the disease progresses. Rigidity considered as the main responsible factor for this progressive stiffness appears with the involvement of the proximal muscles, which later affects all muscles.[4] Axial muscles are important for trunk movement and respiratory function. Rigidity of these muscles contributes to postural abnormality and respiratory impairments.[5,6]

Respiratory abnormalities are very common in PD; the incidence rate is as high as 84%.[7] It does not appear in the early course of the disease but is gradually evident in stage 3 to 5 according to Hoehn Yahar scale.[8] Respiratory complications in PD includes dyspnea, decreased lung volume, respiratory muscle weakness, sleep apnea, etc. Anti Parkinsonism drug like L-DOPA which is commonly use to treat PD patients is also known to trigger respiratory abnormalities.[9,10]

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Almost 57% of PD patients develop restrictive lung disease, females more affected than males. Loss of chest wall compliance and bend spine syndrome is pointed out as a common cause of restrictive lung disease. Two-third of PD patients also develops airway obstruction. Existing lung disease, smoking, rigidity of upper airway muscles contributes to developing obstruction.[11]

Early management is indicated for respiratory abnormalities to prevent various chest complications. Airway clearance techniques, postural drainage, incentive spirometry, breathing exercise may be helpful. Chest PNF is an effective treatment tool and has stablished efficacy in respiratory conditions like COPD. It provides proprioceptive feedback to the respiratory muscles, which create reflex respiratory movement responses, and improves rate and depth of breathing.[12] Deep breathing exercise, can reduce the work of breathing by decreasing the respiratory rate and relaxing accessory muscles.[13] Diaphragmatic-breathing helps to ease the diaphragm, which reduces the activity of accessory muscles, hence reduces the breathing difficulties. Apical, costal and basal breathing helps to improve various segments of the lung. As there is a volumetric improvement, lung functions improve.[14]

Respiratory complications in patients with PD is one of the most serious complication and a common cause of death. There exist practical limitations. Researches are limited in checking the efficacy of various chest physiotherapy techniques in PD patients. Hence, the main purpose of the present study was to check the efficacy of chest PNF and breathing exercise on pulmonary functions and chest wall mobility in patients with PD.

2. Materials and Methods

The study design was experimental. Ethics clearance was obtained from the institutional ethics committee and students'projects finalization committee (MMDU/IEC/1111) on 24/3/2018 of Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana. This trial was registered under the Clinical Trial Registry of India (CTRI). The study was conducted in the outpatients department of Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation.

2.1. Study participants

20 participants were chosen based on purposive sampling method. Written consent was taken from each participant. Inclusion criteria of the participants were Grade 3 to grade 5 according to Hoehn Yahar scale, MMSE score >23, Age 50-70 years. Exclusion criteria in this study were previous history of cardiac and pulmonary surgery, flail chest, individuals with neurological disorder other than PD and uncooperative patients.

2.2. Procedure

2.2.1. Pulmonary function test

All the participants were made to take 30 minutes rest to prevent error in measurements. Participants were then instructed to sit in front of the spirometry machine. (RMS, Helios) The mouthpiece was fitted so that the entire expired air went into the machine. A nose clip was attached to ensure no breathing occurred through the nose. Patients were instructed to take a deep breath and exhale as much they could in the mouthpiece for several seconds. Parameters recorded for the study included FVC, FEV1 and FEV1/FVC in litres.

2.2.2. Chest wall expansion measurement

Both chest circumferences at maximal voluntary inspiration (Inspiration max) and maximal voluntary expiration (Expiration max) were measured in standing position using a tape measure (Shanghai co. China). Measurements were taken at the level of the 4th intercostal space and at the level of the tip of the xiphoid process. Readings were taken by keeping measure tape flat against the subject's skin at the level of the anatomical landmark. Marker pen was used for marking the reference point for tape placement. The test was performed twice for each instruction with the best value used in the analysis.[6]

2.2.3. Treatment procedure

20 participants were randomly selected for this study and allocated into a conventional (conventional treatment) group (n=10) and experimental (conventional and chest PNF) group (n=10) (figure 1). The intervention group treatment was given by the lead researcher who is an expert in chest PNF technique. Chest PNF technique included oblique downward pressure at the sternum, diagonal pressure at lower rib cage in the supine line, caudal medial pressure at side-lying, Caudal pressure over ribcage in prone lying, dorsal and caudal pressure in prone on the elbow. The duration of the treatment was 30 minutes a day for five days.

Control group participants received conventional treatment, which included deep breathing exercise, diaphragmatic breathing exercise, segmental breathing exercise and pursed-lip breathing and incentive spirometer for 30 minutes 5 days for 1 week.

2.2.4. Data collection

Data were collected by a therapist who was blinded about the treatment group (Conventional and experimental). Pre and post treatment data were collectedfor the following parameters, FVC, FEV1, FEV1/FVC, chest wall expansion at the nipple and xiphisternal level.

3. Data analysis

Data analysis was done with SPSS version 16.0. For demographic characteristics, we used independent t-test and Chi-square test. For within group, paired t-test was used to compare pre and post mean values of all variables (FVC, FEV1, FEV1/FVC and chest wall expansion). Independent t-test was used to compare the pre-test and post-test score changes between groups A and B for FVC, FEV1, FEV1/FVC and chest wall expansion. Results were accepted as significant at $p<0.05$.

4. Results

Consent was received from 22 subjects, of which 20 subjects were included based on the inclusion criteria (Figure 1). At baseline, there were no significant differences between the groups for age, gender and all clinical measures (Table 1).

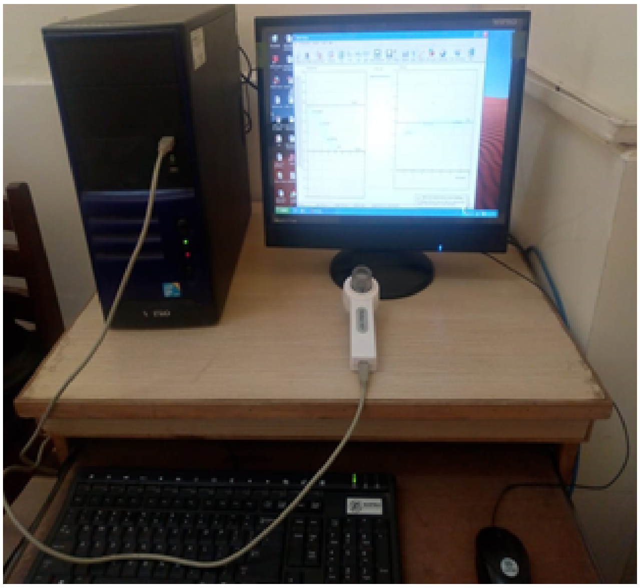

Fig. 1: PFT machine

FVC: FVC measured in litres showed significant improvements in both groups (p=0.02). There was no significant difference between the groups at the post-test level (Table 2).

FEV1: Forced expiratory capacity in one second measured in litres showed a significant improvement in the control group (p=0.01) although significant results were not achieved in the experimental group (p=0.13). There were also no significant differences between the groups at the post-test level (Table 3).

FEV1/FVC: The ratio between FVC and FEV1 parameter failed to reach statistical significance levels in conventional (p=0.63) and experimental (p=0.73) group. There was also no significant difference exist between the groups at the post-test level (Table 4).

Fig. 2: Inchtape

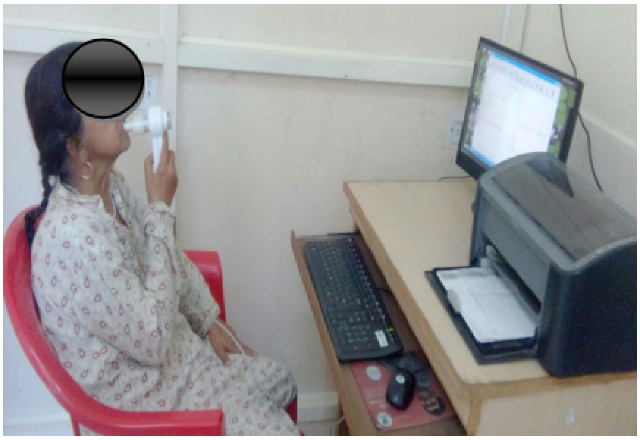

Fig. 3: PFT measurement

Chest wall expansion:Chest wall expansion measured at axillary level showed a significant improvement at pre-test and post-test level in both conventional (p=0.03) and experimental (p=0.001) groups. The experimental group showed more improvement than the conventional group at post-test level (p=0.01). Expansion measured at the xiphisternal level also showed significant improvement in both the groups at pre-test and post-test level ($p<0.05$) as well as between groups (Table 5).

5. Discussion

To the best of our knowledge this is the first study to check efficacy of chest PNF on pulmonary function in PD population. The major findings of this study were that chest

Table 1: Demographic and baseline characteristics of participants

Variable		**Group-A**	**Group- B**	**p-value**
Age [a]		60.50±7.23	62.60±5.66	[c]0.47[e]
Gender	Male % [b]	4 (40)	6 (60)	[d]0.37[e]
	Female % [b]	6 (60)	4 (40)	
FVC [a]		1.23±0.45	1.48±0.37	[c]0.25[e]
FEV1[a]		0.72±0.42	0.85±0.33	[c]0.45[e]
FEV1/FVC [a]		58.31±20.5	57.16±15.9	[c]0.88[e]
Expansion (Axillary)[a]		1.5±0.94	1.7±0.67	[c]0.722[e]
Expansion (Xiphisternum)[a]		1.44±0.77	1.50±0.47	[c]0.893[e]

[e]:p-value ≤ 0.05 considered as significant. [a]: Data are Mean ± SD. [b]: Data are number (%).[c]: Continuous variable (Independent t-test). [d]: Categorical variable (chi-square test). SD: Standard deviation

Table 2: Within and between group comparison of change scores of FVC

			Within group			**Between group**	
Variable	Group	Measure	Mean ± SD (95% C.I)	Mean difference (SEM)	t-value (p-value)	Mean difference (standard error)	t-value (p-value)
FVC (Litre)	Group- A	Pre test	1.23±0.43 (0.96-1.51)	0.24 (0.10)	-2.268* (0.02)	0.08 (0.11)	0.68 (0.49)
		Post test	1.47±0.28 (1.3-1.6)				
	Group- B	Pre test	1.48±0.4 (1.23-1.73)	0.39 (0.14)	2.69* (0.02)		
		Post test	1.87±0.68 (1.45-2.29)				

*: p-value ≤ 0.05 considered as significant.
SD: Standard deviation C.I: Confidence interval, SEM: Standard error mean.

Table 3: Within and between group comparison of change scores of FEV1

			Within group			**Between group**	
Variable	Group	Measure	Mean ± SD (95% C.I)	Mean difference (SEM)	t-value (p-value)	Mean difference (standard error)	t-value (p-value)
FEV1 (litre)	Group- A	Pre test	0.72±0.41 (0.46-0.97)	0.22 (0.20)	3.34* (0.01)	0.03 (0.11)	0.31 (0.74)
		Post test	0.94±0.48 (0.64-1.24)				
	Group- B	Pre test	0.85±0.39 (0.64-1.09)	0.17 (0.11)	2.0 (0.07)		
		Post test	1.02±0.56 (0.67-1.37)				

*: p-value ≤ 0.05 considered as significant.
SD: Standard deviation C.I: Confidence interval, SEM: Standard error mean, FEV1: Forced expiratory volume in 1 seceond.

PNF and conventional physiotherapy programme produced a significant effect at pre-test and post-test in both the groups for FVC and chest expansion at axillary and xiphisternum levels. The remaining parameters of the PFT were not statistically significant at pre-test or post-test in both the groups. Between-group analysis revealed that there were no significant differences in PFT parameters which were our primary outcome measure. As primary outcome measure failed to produce any significant differences between the groups, the null hypothesis is accepted.

Chest PNF and conventional exercises both produced significant improvement in FVC at post-intervention. Between group analysis revealed that there was no significant difference at post-intervention (p=0.50) with an small effect size of 0.3. Both groups also failed to reach the MCID value of FVC, which is minimum 3%.[15] Both FEV1 And FVC/ FEV1 fails to reach significance level and also does not meet the desired MCID value.[16]

One important finding of this study is a significant improvement in chest expansion in both the groups at pre-

Table 4: Within and between group comparison of change scores of FEV1/FVC

Variable	Group	Measure	Mean ± SD (95% C.I)	Within group: Mean difference (SEM)	Within group: t-value (p-value)	Between group: Mean difference (standard error)	Between group: t-value (p-value)
FEV1/FVC (% Ratio)	Group- A	Pre test	58.31±24.38 (40.8-75.8)	1.73 (6.7)	0.48 (0.63)	7.9 (4.22)	1.88 (0.07)
		Post test	60.04±23.98 (45.1-74.9)				
	Group- B	Pre test	57.16±15.77 (47.4-66.9)	3.9 (3.3)	0.35 (0.73)		
		Post test	61.08±15.64 (51.4-70.8)				

*: p-value ≤ 0.05 considered as significant.
SD: Standard deviation C.I: Confidence interval, SEM: Standard error mean.

Table 5: Within and between group comparison of changes cores of chest expansion at axillary level

Variable	Group	Measure	Within group: Mean ± SD (95% C.I)	Mean difference (SEM)	t-value (p-value)	Between group: Mean difference (standard error)	Between group: t-value (p-value)
Expansion (Axillary) (Inch)	Group- A	Pre test	1.5±0.94 (0.91-2.08)	0.6 (0.14)	4.12* (0.003)	0.70 (0.25)	2.7* (0.01)
		Post test	2.1±1.1 (1.42-2.78)				
	Group- B	Pre test	1.7±0.67 (1.28-2.11)	1.3 (0.21)	6.0* (0.00)		
		Post test	3.0±0.94 (2.4-3.5)				

*: p-value ≤ 0.05 considered as significant.
SD: Standard deviation C.I: Confidence interval, SEM: Standard error mean.

Table 6: Within and between group comparison of change in pre to post scores of chest wall expansion atxphisternum level

Variable	Group	Measure	Within group: Mean ± SD (95% C.I)	Mean difference (SEM)	t-value (p-value)	Between group: Mean difference (standard error)	Between group: t-value (p-value)
Expansion (xiphisternum) (Inch)	Group- A	Pre test	1.4±0.77 (0.92-1.88)	0.6 (0.16)	3.6* (0.005)	0.6 (0.24)	2.42* (0.02)
		Post test	2.0±0.78 (1.52-2.48)				
	Group- B	Pre test	1.5±0.47 (1.21-1.79)	1.2 (0.18)	6.4* (0.00)		
		Post test	2.7±0.58 (2.34-3.06)				

*: p-value ≤ 0.05 considered as significant.
SD: Standard deviation C.I: Confidence interval, SEM: Standard error mean.

test and post-test. The improvement in the experimental group was superior to the control group. The possible explanation for this may was chest PNF provides proprioceptive stimulus to the primary respiratory muscles, which leads to improving their function and increases chest wall mobility. It also increases the activity of the diaphragm and abdominal muscles. The rigid chest wall muscles may be get inhibited through autogenic inhibition and promotes mobility to the chest wall. PNF also increases stress relaxation to the chest wall muscles which promotes chest wall mobility.[17]

A previous study done by Khatri et al demonstrated a positive effect of chest PNF on respiratory functions. Their results do not support our study results. This is most probably because they used different outcome measures to record respiratory parameters.[18] Research by Ganesh et al on the effect of chest PNF on lung function in normal individuals found similar result like our study.[19]

Fig. 4: Breathing in supine position, sternal pressure

Fig. 6: Breathing in sidelying

Fig. 5: Breathing in supine position, lower rib pressure

Fig. 7: Breathing in prone

The result of this study was not significant between the groups on PFT parameters but there is a trend of improvement both the groups. This is maybe due to the short duration of the intervention (5 days) and the difficulty of the PD patients to understand PFT. Tremors in the tongue and facial muscles may produce a barrier to record PFT parameters.

Breathing exercise used as conventional treatment in this study produced a beneficial effect on FVC and chest wall expansion. The possible physiology behind this improvement could be the ability of patients to achieve some breathing control with these kind of exercises and reduce the respiratory muscle tension which can be better utilised during respiration. It also produces a calming effect, which can reduce the breathing effort.[20]

6. Limitation and Future Suggestion

The major limitation of the study was a small sample size, a small period of intervention. So future studies are needed with a large sample and a longer period of intervention.

7. Conclusion

This study fails to show any improvement of chest PNF on pulmonary functions in patients with PD. Future studies with large sample size and long treatment duration are needed.

8. Source of Funding

None.

9. Conflict of Interest

None.

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