www.jmscr.igmpublication.org
Index Copernicus Value: 79.54
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossrefDOI: https://dx.doi.org/10.18535/jmscr/v7i3.204

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

Assessment of Inspiratory Muscle Strength in Patients with Parkinson's Disease

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Abstract
Parkinson's disease (PD) is a chronic, progressive disease of the nervous system. It is characterized by the cardinal features of rigidity, bradykinesia, tremor, and postural instability. Respiratory muscles share structural and functional characteristics with limb muscles and are similarly affected by rigidity in Parkinson's disease. Physiotherapists aim at improving strength, balance and mobility of patients with Parkinson's yet the vital aspect of respiratory muscle strength training is often overlooked. Comparison study was carried out on 30 patients with Parkinson's disease and 30 age and gender match normal individuals with mean age 69.5±7.42 were evaluated by using Inspiratory muscle training device and inspiratory muscle strength was checked. Inspiratory muscle strength in patients with Parkinson's disease was 46±24.30 cm of H_2O compared with age matched normal healthy individuals was 74±9.32 cm of H_2O. p value was <0.05 which showed significant decrease in inspiratory muscle strength in patients with Parkinson's disease. The study concluded that there is decrease in inspiratory muscle strength in Parkinson's patients as compared to healthy individuals.

Keywords: *Parkinson's disease, Inspiratory muscle strength, Inspiratory muscle training (IMT) device.*

Introduction

Parkinson's disease (PD) is a chronic, progressive disease of the nervous system. Characterized by the principal features of rigidity, bradykinesia, tremor, and postural instability[1] PD affects more than 1% of population older than 65 years of age. The incidence and prevalence both increases with age.[1][3]

The Basal Ganglia also plays a major role in some cognitive processes. Depletion of the pigmented dopaminergic neurons in the substantia nigra, hyaline inclusions in nigral cells (Lewybodies) which results in bradykinesia [2]

Patients with Parkinson's disease may have respiratory problems such as reduced maximal inspiratory and expiratory flows, upper airways dysfunction, a restrictive pattern of pulmonary function and diminished strength of the respiratory muscles. [3]

Respiratory conditions in patients with Parkinson's disease can be restrictive or obstructive. Restrictive changes secondary to chest wall rigidity and decrease in lung volume secondary to kyphoscoliosis, upper airway obstacle, irregular ventilatory control, diaphragmatic dyskinesia's and pleuropulmonary complications of medicines [4] [5]

Structures in the pons and the medulla oblongata might be affected by the initial neurodegeneration in the PD. Early alpha synuclein deposition in the nuclei responsible for coordinating ventilation might have harmful impact on respiration.[6]

The respiratory muscles are composed of the diaphragm, external and internal intercostals, parasternal, sternomastoid, scalene, external and internal oblique and abdominal muscles.[7]

Aspiration pneumonia and pulmonary embolism being the main causes of death in Parkinson's patients. Muscle weakness in individuals with PD restricts ability to overcome rigidity and potentially contributes to reduced lung volume and respiratory pressure, reduced strength and coordination of respiratory muscles contribute to low lung volumes. Respiratory muscles being skeletal muscles share structural and functional characteristics with limb muscles and are similarly affected by rigidity in Parkinson's disease. [8]

Muscle weakness in individuals with PD restricts ability to overcome rigidity and potentially contributes to reduced lung volume and respiratory pressure. Such changes are known to cause a negative impact on quality of life in individuals with PD. Adequate respiratory muscle strength is critical to establish the necessary balance between ventilatory requirement and ventilatory capacity.[8]

Patients with restrictive pulmonary dysfunction showed problems in performing activities such as turning in bed, adjusting bedclothes. Airway obstruction was the most frequent pulmonary dysfunction. Patients with airway obstruction showed a decrease performance for daily living activity such as handling utensils, dressing, or hygiene. [9]

Respiratory muscle fatigue resulting from unsuitable antagonistic inspiratory and expiratory muscle activity could also contribute to poor task performance in patients with Parkinson's disease [10]

Inspiratory muscle strength can be used to assess and train inspiratory muscle strength. Inspiratory muscle training (IMT) is a device used for training of inspiratory muscles against resistance. Device has been developed to increase inspiratory strength. The device typically uses basic principles of resistance training. Ventilatory muscles have shown similar adaptations to training as that of the other skeletal muscles by using training principles [11]

Threshold IMT (inspiratory muscle training) device contains, at its end, a valve closed by the positive pressure of a spring. The Threshold IMT has a one-way spring-loaded valve that closes at the time of inspiration and requires that participants breathe in hard enough, to open the valve and let the air enter. This device delivers constant pressure for inspiratory muscle training, irrespective of how quickly or slowly the participants breathe, and the optimal loading pressure can be adjusted, based upon the individual characteristics of the participants. The advantages of threshold IMT are it is easily adjustable and inexpensive.[12]

Material and Methods

Study design: Comparative study

Selection of subjects: The participants selected for the study were diagnosed with Parkinson's disease with age above 50 years according to inclusion and exclusion criteria. Inclusion criteria were medically diagnosed patients with Parkinson's disease including all the grades of Hoehn –yahr classification of disability. The exclusion criteria were patients with Parkinson's plus syndrome, patients with any respiratory abnormalities and impaired cognitive functions. 30 patients with Parkinson's disease and 30 age and gender match normal individuals were included in the study and inspiratory muscle

strength was assessed using IMT device. Written consent was taken from the participants.

Material: Inspiratory muscle training device was used to assess inspiratory muscle strength.

Procedure

Ethical clearance was taken from the Institutional Ethical Committee. Participations were selected according to inclusion and exclusion criteria. The aim, objectives and method of study was explained to the participants. Written consent was taken from the participants. The inspiratory muscle strength was checked using IMT device.

IMT Device procedure:

IMT device was used to check the inspiratory muscle strength in patients with Parkinson's. The individuals were explained about the IMT device and the use of the device. A nose clip was given to the individuals and asked to close the nose with that clip. Then the individuals were asked to put the mouth piece of IMT device in mouth and asked to do inspiration and the resistance was increased till the individual had difficulty to breathe with increased resistance. Inspiratory muscle strength was noted on the recording sheet.

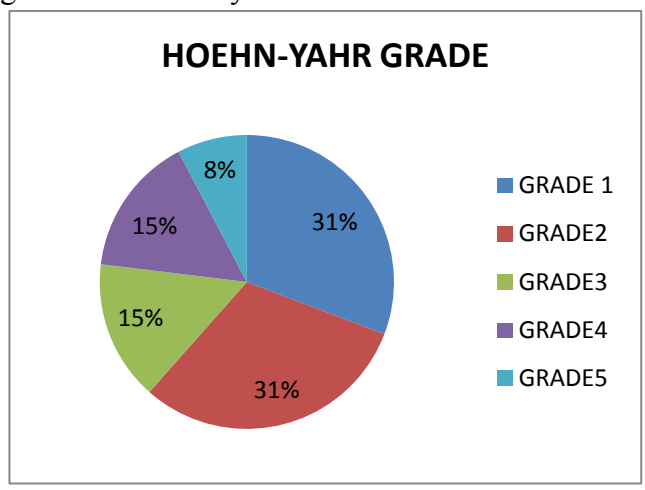
Results

Table 1: Age wise distribution of inspiratory muscle strength in both the groups

Age group	No.of patients with PD	Mean±SD (Inspiratory muscle strength)	No. of healthy individuals	Mean±SD (Inspiratory muscle strength)
50-59	4	40±18.25	4	70±8.16
60-69	12	58.33±24.43	12	70.83±9.96
70-79	11	31.81±21.36	11	76.36±8.09
80-90	3	56.6±15.2	3	83.33±5.72

Interpretation: Table 1 shows age wise distribution of inspiratory muscle strength in both the groups. In age group 50-59 the mean in PD is (40±18.25), age group 60-69 (58.33±24.43), age group 70-79(31.81±21.36) and in age group 80-90(56.6±15.2). The mean in healthy individuals of age group 50-59(70±8.16), age group 60-69 (70.83±9.96), age group 70-79 (76.36±8.09), age group 80-90(83.33±5.72) respectively.

Graph 1: Frequency distribution of Hoehn-yahr grades of disability of Parkinson's disease.

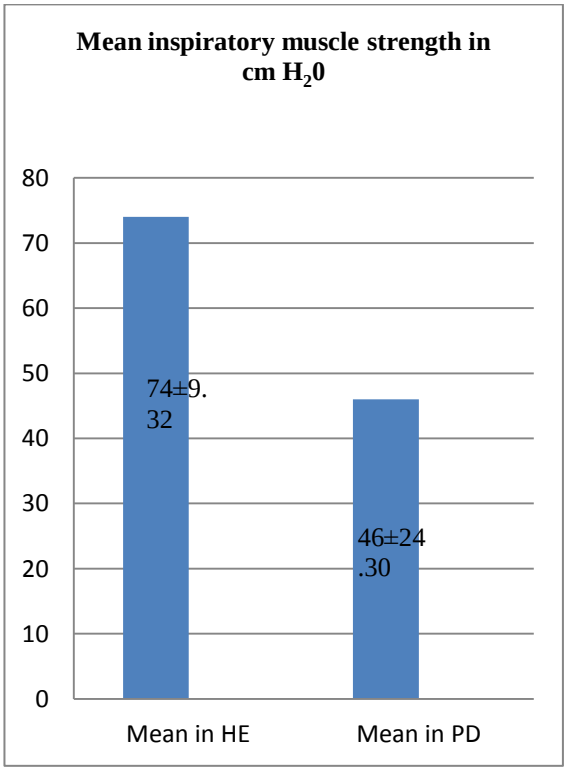


Interpretation: - Graph 1 shows frequency distribution of Hoehn–Yahr classification of disability in Parkinson's disease, grade 1 (31%), grade-2 (31%), grade-3 (15), grade-4 (15%), grade-5 (8%) respectively.

Table 2: Comparison of inspiratory muscle strength between patients with Parkinson's disease and healthy individuals.

Mean±SD in Parkinson's Disease	Mean±SD in Healthy individuals	Un-paired t test p value
46±24.30	74±9.32	P<0.0001

Graph 2:



Interpretation: Table 2 and graph 2 shows comparison of inspiratory muscle strength between Parkinson's patients and healthy individuals. The mean is 46±24.30 and 74±9.32 respectively with p value < 0.05 showing statistically significant difference in inspiratory muscle strength between both the groups.

Discussion

Parkinson's disease (PD) is a progressive neurologic disorder results from degeneration of dopaminergic neurons in the basal ganglia. The cardinal features include rigidity, tremor, bradykinesia and impaired postural control. Morbidity and mortality are frequently associated with pulmonary dysfunction in PD.[1][6]

In the study the participants selected were diagnosed with Parkinson's disease with age above 50 years according to inclusion and exclusion criteria. The data was collected and then statistical analysis was done. Descriptive data analysis for age and Hoehn-yahr grades of disability of Parkinson's disease was done. Comparison of inspiratory muscle strength between parkinson's patients and healthy individuals was done using unpaired t test. Level of significance was set as 0.05.

Total 40 males and 20 females were included. A comparison study was carried out on 30 patients with Parkinson's disease and 30 age and gender match normal individuals with mean age 69.5±7.42 and were evaluated by using inspiratory muscle training device and inspiratory muscle strength was assessed. Graph 1 shows frequency distribution of subjects according to Hoehn-yahr grades of disability of Parkinson's disease.

Table 1 shows age wise distribution of inspiratory muscle strength in both the groups**.** This is supported by a study done on respiratory muscle strength in physically active elderly which says advancing age is associated with a decline in the strength of skeletal muscles including those of respiration.[13]

Table No.2 and graph No2. shows inspiratory muscle strength in patients with Parkinson's disease which was 46±24.30 cm of H_2O compared with age matched healthy individuals was 74±9.32 cm of H_2O. p value was <0.05 which showed significant decrease in inspiratory muscle strength in patients with Parkinson's disease. This is supported by Guillaume baille et al who studied early occurrence of inspiratory muscle weakness in parkinson's disease and concluded that inspiratory muscle strength appears to be impaired in very early stage of parkinson's disease and levodopa shows positive effect on inspiratory muscle strength.[6]

The study was done by Michelle Ramsay that maximum Inspiratory pressure (Pi max) can provide a simple rapid method to check the Inspiratory muscle strength. Reduction in maximum Inspiratory pressure is influenced due to the elastic recoil of the chest wall.[14]

Similar study was done by Rivka Inzel berg, Nana Peleg et al on Inspiratory muscle training and the perception of dyspnea in Parkinson's disease. Pulmonary and respiratory muscle function impairment are common in patients with Parkinson's disease (PD). Inspiratory muscle training may improve strength, dyspnea and functional capacity in healthy subjects and in those with chronic obstructive pulmonary disease. There was a close correlation between the increase in the inspiratory muscle performance and the decrease in the Perception of Dyspnea.[3]

Respiratory muscles being skeletal muscles share structural and functional characteristics with limb muscles and are similarly affected by rigidity in Parkinson's disease. Respiratory muscles respond to training in a similar manner as limb muscles when appropriate physiological load is applied. It is necessary to identify the symptoms before the condition gets worsen. After the diagnosis the intervention can be done to improve the Inspiratory muscle strength by improving the maximum Inspiratory pressure by 30% of the PI max and trained up to the 60% of PImax.

A similar study done by Dr. Pournima Pawar which states that the effect of inspiratory muscle training on functional mobility in Parkinson's

patients where the aim was to find out effect of inspiratory muscle training on functional mobility in Parkinson's patients using lindop Parkinson's scale. They concluded that inspiratory training improves the functional mobility in Parkinson's patients.[15]

Conclusion

The study concluded that there is decrease in inspiratory muscle strength in Parkinson's patients as compared to healthy individuals.

Limitation of Study

Postural abnormalities are not considered and drug on off period was not considered.

Acknowledgement

I thank to all the participants who participated in the study.

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