

CORRELATION OF FUNCTIONAL CAPACITY AND BALANCE IN PATIENTS WITH PARKINSON'S DISEASE

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Abstract

Background: Parkinson's disease is characterized by motor symptoms that cause increase in Risk of fall and reduced Functional Capacity.

Objective: To find out the correlation of Functional Capacity and Risk of Fall in patients with Parkinson's disease.

Methods: Thirty-five patients from Parkinson's Mitra Mandal group were approached and were explained about the study amongst which twenty-eight agreed for participation. All individuals were evaluated for balance using BBS and functional capacity using 6MWD. The subjects were included in the study by random sampling. The instruments used were: Berg Balance Scale (BBS), and six-minute walk test. (6MWT).

Result: Amongst 28 patients, 18 males and 10 females with mean age 72.5 and with stage II of PD were 21 patients and with stage III were 7 patients. Mean BBS score was 46 and mean 6MWD was 370m. The scores obtained in the BBS and the 6MWD were positively correlated ($r=0.64$).

Conclusion: There is positive correlation between Functional capacity and Risk of Fall in patients with Parkinson's disease. Further stating that there is significant reduction in Functional Capacity and increase in Risk of Fall progressing from Stage II to Stage III of Parkinson's disease.

Keywords: Parkinson's disease, Balance, Functional capacity, BBS, 6MWT.

INTRODUCTION

Parkinson's disease (PD) is the second most common neurodegenerative disorder and it affects 0.3% of the population at large. It is also characterized by loss of dopaminergic neurons from the substantianigra, pars compacta, causing the reduction of the striatal dopamine levels. Clinically, PD is marked by the presence of tremors at rest, rigidity and bradykinesia. With the PD progression, other impairments occur, such as postural instability and gait dysfunctions. These impairments result in a greater propensity to falls, as well as a reduced capacity to walk and lead to progressive functional restraints.(1)Parkinson's disease develops when dopamine producing cells in the mid brain degenerate and dopamine production decreases.

The basal ganglia are a collection of interconnecting grey matter nuclear masses deep within the brain. The main input structure of Basal ganglia is the striatum. Input is received from all parts of the cerebral cortex via corticosteroid projection. And from substantianigra output is channeled primarily through the Globus pallidus and the substantianigra to the thalamus and back to the cortex, completing the loop. There are direct and indirect pathways facilitates basal ganglia output the thalamus motor area of the cortex while the indirect pathways provide disinhibition of the sub thalamic nucleus and in turn suppression of some move-

ment. Neurons in the basal ganglia discharge before movement begins. The basal ganglia play an important role in the planning and programming of the movement by selecting and inhibiting specific motor synergies. It also plays a role in some cognitive processes, primarily caudate nucleus, including awareness of body orientation in space, ability to adapt behavior as task requirement change, and motivation. Loss of dopamine results in an overactive indirect pathway that is thought to underline akinesia and rigidity and underactive direct pathway is responsible for bradykinesia.(2)

The other basal ganglia disorders produce hyperkinesia characterized by excessive or abnormal movement. These are thought to result from underactive indirect pathways while dyskinesia, dystonia or athetosis are thought to result from an overactive direct pathway. Tremor is viewed as a release phenomenon, representative of loss of inhibitory influences within the basal ganglia. Significant changes in striatal dopamine receptors also occurs, resulting in decrease binding sites for dopamine on basal ganglia. This may explain the loss of clinical effectiveness of L-Dopa during later stage of the disease.(2)Secondary Parkinsonism results from a number of different identifiable causes including virus, toxins, drugs, tumors and so forth.

Functional capacity is assessed by 6MWT. The 6MWT is conductive

to such an assessment because it generally combines numerous turns and straight line walking within 6 minute. A 6MWT typically involves walking back and forth down a corridor and quantifies walking capacity as the distance traversed in 6 minutes. The reliability of this test in subjects with PD is ICC=.95, ICC=.96.(3)

Among people with Parkinson's disease acts as many as 65% of fallers will experience an injury secondary to their fall. 33% will suffer fracture and 75% of fall will lead to use a healthy care service. Fall and related fractures are the most common secondary reason that people with Parkinson's disease are admitted to hospital. These falls have devastating consequences and are accompanied by pain, reduced mobility and an unacceptable high levels of care givers stress. Fear of falling is also greater in community dwelling people with Parkinson's disease then healthy controls. This results in restriction of activities compromising quality of life and predisposing to secondary reduction in muscle strength and cardiovascular fitness. (4)

Parkinson's specific impairments such as slowness of movement. Poor balance, freezing of gait and cognitive impairment as well as age related impairments such as reduced lower limb muscle strength. After adjusting for past falls, it was found that freezing of gait, poor balance and lower limb muscle weakness were independent predictor of falls.

As the disease progresses, abnormal and inflexible postural responses along with increased body sway are seen. Narrowing of the base of support or competing attentional demands increases postural instability. Patient also experiences increase in difficulty during dynamic destabilizing activity such as self-initiated movements and perform poorly under conditions of perturbate balance. The response to instability is an abnormal pattern of coactivation, resulting in a rigid body and inability to utilize normal postural synergies to recover balance. Extensor muscles of the trunk demonstrate greater weakness than flexor muscles, contributing to the adoption of a flexed, stoop posture with increased flexion of the neck, trunk, hip and knees. This results in a significant change in the center of alignment position, positioning the individual at the forward limits of stability.(2)

The BBS was designed to measure changes in functional standing balance over time. It is a 14 itemscale that rates each function from 0 (worst) to 4 (best) along a dependence-independence continuum. The summative scale measures balance abilities seen during tasks involving sitting, standing, and positional changes. Total scores are indicative of overall balance abilities. The BBS relatively safe and simple to administer. It uses the quantitative scale format that has strong internal consistency and good inter and intra rater reliability with

different patient population including brain injury, stroke and geriatric population. (7)

MATERIAL AND METHODOLOGY:

PARTICIPANTS

28 subjects (n = 28; mean age 72.5), were invited from Parkinson's Mitra Mandal Pune, India. Out of which there were 18 males and 10 females.

INCLUSION CRITERIA

- a) Individuals diagnosed with Parkinson's disease.
- b) Males and Females
- c) Stage II & III of HY scale.

EXCLUSION CRITERIA

- a) Any lower limb musculoskeletal pain.
- b) Other associated neurological deficits.
- c) Stage I, IV & V of HY scale
- d) Any known cardiovascular and respiratory disorder.
- e) Those who could not complete 6MWT.

PROCEDURE: The study was approved by the Institutional Ethical Committee at Tilak Maharashtra Vidyapeeth, Pune. Parkinson's Mitra Mandal group of Pune was approached and patients undergoing treatment were invited to participate in this study. Individuals with dementia, history of previous neurological procedures, history of a heart condition, any musculoskeletal pain were excluded. All participants signed a written consent form prior to data collection. A demographic questionnaire

and other clinical assessments were completed on the same day. All patients using levodopa were retested during the "on" period i.e. under the effect of drug.

6 Minute Walk Test

The 6MWT was used to determine the functional capacity by measuring the maximum distance that an individual covered within six minutes using standardized procedure. Participants were instructed to walk as far as they could and were provided with standardized encouragement every minute on the minute, such as "You are doing well", or "You have 3 minutes to go". They were also advised to slow down or rest if needed.

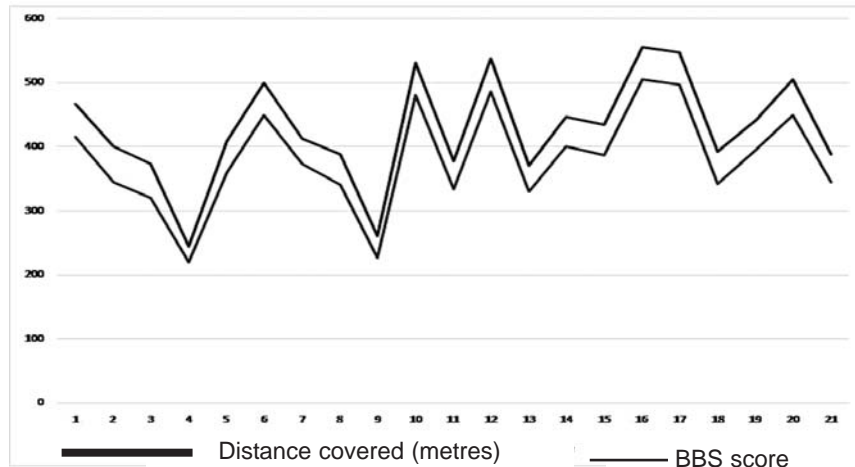
Berg Balance Scale

The BBS consists of 14 items assessing the risk of fall that is scaled from 0 (worst) to 4 (best) with the summation of these items indicative of overall balance ability. This summed score was recorded for each subject. The BBS scores obtained were correlated with the distance walked by the subjects.(10)

The participants were made clear that the information gathered would remain confidential and would be only used for research purpose.

STATISTICAL ANALYSIS:

Statistical analysis was performed using InStat software. Data are expressed as mean \pm SD. Correlation coefficients between Berg Balance Scale and 6MWT were calculated. Pearson Correlation coefficient was



used($r=0.64$). Statistical significance was assumed extremely significant at p less than 0.0001.

RESULTS:

Out of the 40 individuals initially invited for the study, 5 subjects did not meet the inclusion criteria, 3 subjects had cardiovascular disease, 2 subject could not complete the 6MWT and 2 subjects withdrew consent. A total of 28 subjects completed the entire procedure. There were 18 males and 10 females in the group. The average age was 72.5.

1) Mean score of BBS and 6MWT in Stage II and Stage III- The table shows that Stage II individuals had better BBS score than Stage III. And Stage II individuals walked more distance than Stage III.

| | BBS | 6MWD |
|----------|------|----------------|
| | Mean | Mean |
| Stage I | 47 | Stage I 378.91 |
| Stage II | 45 | Stage II 337.5 |

Table 1- Mean score of BBS and 6MWD in Stage I and Stage II patients

2) Correlation of Functional Capacity and Risk of Fall- As per the graph 1, the scores obtained in the BBS and the distance walked in the 6MWT were positively correlated. ($r=0.64$, $p<0$).

DISCUSSION:

The purpose of this study was to find the correlation between balance and risk of fall in patients with Parkinson's disease. Parkinson's Mitra Mandal Society, Pune was approached for the sample collection. During this research work it was found that male individuals were more as compared to females individuals.

The British medical journal published an article in the year 2004 saying that men are more likely to develop Parkinson's disease than women. They conducted this study so as to cover populations in the U.S., China,

Poland, Italy, Spain and Finland. Their results showed that men were 1.5 times more likely to develop PD than women. The authors speculate that male gender itself could be a risk factor or it may simply be a marker for other risk factors such as greater exposure to toxic chemicals and higher rates of head injury, both of which are associated with the disease. Other possible explanations lie in the potential protective effect of the female hormone oestrogen on the nervous system and a genetic susceptibility to parkinson's disease linked to X (male) chromosome.(5)

We found that BBS score of stage II was higher than that of Stage III. In the second stage of PD, the person's symptoms are bilateral, affecting both limbs and both sides of the body. The person usually encounters problems walking or maintaining balance, and the inability to complete normal physical tasks become more apparent. Among the individuals we observed, more belonged to Stage II than Stage III. According to Hoehn and Yahr staging scale(11) there is bilateral or mid line involvement without impairment of balance in Stage II. Bilateral disease: mild to moderate disability with impaired postural reflexes; physically independent.(2) According to impairments of Stage II and Stage III, Stage II are comparatively independent than Stage III and as the samples were collected from Parkinson's Mitramandal Pune, some of the individuals came with assistance and oth-

ers came without or minimal assistance. As we did not include any hospitalized, healthcare centres, old age homes, we had more number of Stage II individuals.

We also found that BBS score of stage II was higher than that of Stage III. In the second stage of PD, the person's symptoms are bilateral, affecting both limbs and both sides of the body. The person usually encounters problems walking or maintaining balance, and the inability to complete normal physical tasks become more apparent. Paula Luciana Scalzo et al stated that patients with severe balance dysfunctions assess by the BBS and who scored lower distances in the 6MWT had worst QoL. In the course of the disease progression, changes in posture may arise, leading to postural instability, gait disturbance and a predisposition to falls. As the ability to keep balance deteriorates, PD patients are susceptible to falls, which in turn commonly causes them to develop a fear of falling. This anxiety maybe protective if it interferes only with hazardous activities or if it increases the level of alertness during the performance of all other daily living tasks, leading to further deconditioning. (1)

A study done by Yeole UL et al on Effectiveness of Tai-Chi on Balance in Elderly which stated that with age, the task of maintaining balance becomes increasingly difficult, as evidenced by the high frequency of falling in older adults. Motor coordi-

nation and balance are abilities that decline during the aging process, partially, by the deterioration of proprioception. A single fall often results in a fear of falling, which may lead to a loss of confidence in one's ability to perform routine tasks, restriction in activities, social isolation, and increased dependence on others. So according to this we can say that the functional independence of the patients with parkinson's disease is much lesser than in elderly population.. As the age advances, balance deteriorates. (6)

Collen G Canning did a study walking capacity in mild to moderate Parkinson's disease in which they discussed about the impairments contribute to walking capacity in PD. Hypokinesia walking, hypokinesia turning, and strength combined accounted for 94% of the variance seen in the 6MWD, with hypokinesia walking making a significant independent contribution to the variance in 6MWD.(8)

The average 6MWD for our sample was 370m, which is in agreement with previous literature reporting a range of 6MWD values from 315 to 560m. This variability in distances may be caused by disease severity and physical activity. Previous investigators have likened PD to accelerated aging, we anticipated that age and disease severity would account for a significant amount of variance in 6MWD.(3) Canning et al for the inclusion of exercise therapy to improve

walking capacity in subjects with PD. In summary, Lilian T.B Gobbi said that both exercise interventions were effective in improving functional balance and mobility in people with PD. Therefore, people with PD can benefit from such exercises, since they can help facilitate and prolong the performance of ADL, and, consequently, quality of life.(9)

The pathogenesis of PD-related balance disorders and postural instability is likely multifactorial: dystonia, rigidity, proprioceptive and sensorimotor disintegration, and peripheral degenerative processes have been proposed as causative factors. Therefore, it is possible that lesions in non-dopaminergic systems can play a role in the pathophysiology of postural instability in PD. (7) That the attentional demands required to sustain faster walking speeds are considerably greater for people with PD than for healthy participants. More than 90% of the variance in walking capacity is explained by hypokinemia during walking in the Parkinson's group. This finding highlights the impact that slowness of movement has on walking capacity. Although slowness in turning also contributes in these mild to moderately affected people, the velocity of walking is the largest and only independent contributor to walking capacity. If people with PD routinely use lower walking velocities to walk longer distances, this is likely to result in deconditioning over time. Pearson product

moment correlation analysis showed that the amount of regular physical activity correlated significantly with 6MWD in the PD group ($r=0.64$, $p<0.001$). These findings suggest that the reduced walking capacity in the Parkinson's group is associated with increased Risk of Fall.

CONCLUSION

There is reduction in Functional Capacity and increase in Risk of Fall which progresses from Stage II to Stage III in individuals with Parkinson's disease. Also, there is positive correlation between Functional Capacity and Risk of Fall in individuals with Parkinson's disease.

FUTURE SCOPE:

Intervention study can be done to improve the functional capacity of the individuals with Parkinson's disease so as to reduce risk of fall ultimately aiming to improve Balance.

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