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Structured Rehabilitation Exercise Program in Parkinson's Disease

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Abstract

Title of the article: A Study of structured rehabilitation exercise program in Parkinson's disease

Context: There is a growing need to address rehabilitation issues to supplement medical therapy.

Aims: To assess the impact of rehabilitation intervention in the functional status and quality of life in patients with Parkinson's disease.

Settings and Design: Prospective follow-up study in a teaching hospital

Materials and Methods: Twenty-eight cases with Parkinson's Disease on a stable pharmacological regimen and moderately disabled participated in this study. All patients were given the same set of exercises. During the first month, patients performed exercises under supervision at the hospital and rest of the days at home. In the second and third month, patients continued the same exercises at home. During the fourth month, patients maintained their usual level of physical activity but discontinued the exercises. All patients were evaluated at 0, 1, 2, 3 and 4 months. Outcome measures used were Unified Parkinson's Disease Rating Scale (UPDRS) version 3.0, Webster step seconds product, and Parkinson's Disease Quality of Life Questionnaire (PDQL)

Results: Significant improvements were observed in UPDRS section 1 (Mentation, behavior and mood), sections 2 and 6 (Activities of Daily Living), PDQL subscales (parkinsonian symptoms, systemic symptoms and social functioning), and Webster step-seconds product.

Conclusions: Systematic program of physical therapy is beneficial in patients suffering from moderately disabled Parkinson's disease. Activities of daily living like dressing, turning in bed and walking respond favorably to exercises. Quality of life improves considerably following exercises leading to increased social participation

Key Words: Activities of Daily Living, Exercise therapy, Parkinson Disease, Quality of life, Rehabilitation.

Introduction

An estimated seven million Indians are affected with Parkinson's disease (PD), a progressive neurological disorder. As the life expectancy of the general population increases, there is a large pool of at risk population and with better medications, patients with PD have increased life expectancy.[1] Hence the patient pool of PD is bound to increase and there is a growing need to address their rehabilitation issues to supplement medical therapy.[2] The strategies that are developed in rehabilitation are directed toward assisting patients with PD to manage activities of daily living (ADL), to remain as much independent as possible in home environment and to improve quality of life.[3] As early as in 1956, Bilowit[4] reported improvement in range and initiation of motion following exercise. Scientific studies to substantiate these issues are lacking in India and this study was initiated to fill this gap and gather preliminary observations which will be helpful in planning future studies.

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Material and Methods

Patients of any age and either gender diagnosed with PD by the UKPD Society Brain Bank Criteria, on a stable pharmacological regimen during period of study and for six months before entry into study and able to ambulate and function independently were included in the study. Patients having Hoehn and Yahr (HY) Stage 4/5 PD, dyskinesia, Parkinsonism variants, neurosurgical intervention, cognitive deterioration, psychiatric disturbances, head trauma, other neurological diseases and medical contraindications to exercise were excluded from the study. The procedures followed were in accordance with the ethical standards of the institutional committee. The program was of a 4-month period. All patients were taught the same set of exercises as described below for a period of 45 minutes to 1 hour.

Supine: Five repetitions of passive range of motion and stretching exercises for each major joint.

Sitting: 1.Neck exercises: Five repetitions each of flexion, extension, rotation and lateral flexion. 2. Breathing exercises.3. Stretching of the thigh muscles: Patients instructed to place one foot at a time on a chair in front and hold the knee with hands for a count of 10. Exercise to be repeated three times for each leg. 4. Knee extension: Sitting on chair, patient instructed to extend knees one at a time and hold at full extension for a count of 10. Exercise to be repeated five times for each leg.

Standing: 1. Stretching exercises: Standing with back up against a wall, making sure heels, shoulders and back of head all touch the wall for 1 minute, repeated five times in the morning. Standing facing the wall, raising both hands and placing the palms of hands on the wall. Slowly the hands are pushed up the wall as far as they can reach. The stretch force should be maintained for at least 15 to 30 seconds. This exercise is repeated 5 times in the morning. 2. Five repetitions of active flexion-extension of hip, knee and ankle joints holding a rail. 3.Balance training: In self induced responses, the patient displaces his or her own center of gravity outside the base of support by reaching upward and outward in various directions, focusing on counter-balancing motions of the upper and lower extremities and on protective responses. In externally induced balance responses, the therapist or care-giver gradually shifts the patient's center of gravity while eliciting normal righting responses. Exercise to be practiced for 5 minutes. 4. Rotation of trunk: Standing with feet slightly apart, arms are put out at shoulder level, then swung to the left and then to the right for 5 times. 5. Marching in place with swinging of the arms for 5 minutes.

Walking: Patient instructed to walk for 5 minutes with long steps, broad base of support and arm swing.

During the first month, patients performed exercises under supervision twice a week at the hospital and rest of the days at home. In the second and third month, patients continued the same exercises at home. During the fourth month, patients maintained their usual level of physical activity but discontinued the exercises. All patients were evaluated at 0, 1, 2, 3 and 4 months. During follow-up, the patients were evaluated at about the same time of the day and about the same duration after drug intake to decrease clinical fluctuations that may hamper evaluation. All patients were evaluated with UPDRS version 3.0 and a timed activity test described by Webster[5]. In the timed activity test patient was required to rise from a chair, walk 15 feet, turn around, and return to the chair. This time was multiplied by the number of steps taken with the right foot to provide a "step seconds" product. Additionally, the patients were evaluated with PDQL questionnaire at 0 and 3 months.[6] It has 37 items in four sub-scales: parkinsonian symptoms, systemic symptoms, social functioning and emotional functioning.

Results

Twenty eight patients (23 males and 5 females) with mean (±SD) age of 55.18 (±11.47) years satisfying the inclusion criteria participated in the study. Of the 28 patients enrolled into the study, only 20 completed the 4-month follow-up. The reasons for drop-out were change in medications (2), difficulty in transport (2), loss of health due to other causes (1) and loss of interest (1). Two cases were lost to follow-up and could not be contacted. Descriptive statistics including mean and standard deviation distribution were found out for each quantitative variable. To compare each of the quantitative parameters (UPDRS section 1) over a period of time, two way analysis of variance / Friedman's test was used. In case of significant result, multiple comparison test (Post hoc test / Bonferroni) was carried out to identify pairs of time-points when the parameters [UPDRS section 2, UPDRS section 3, UPDRS total (of sections 1, 2, & 3), UPDRS section 6 and Webster step seconds] had significantly different levels. A result was considered significant at 5% level of significance, that is, $P<0.05$. Results are tabulated in table 1. Significant improvement was observed in the first month and this was maintained through the rest of the study in UPDRS section 1 (mentation, mood and behavior), section 2 (activities of daily living), section 6 (Schwab and England activities of daily living scale) and Webster step-seconds product. No significant improvement was observed in section 3 of UPDRS (motor examination).

To compare scores related to quality of life between baseline and 3 months, paired t-test was used. Significant improvement was observed in three subscales of PDQL

			Baseline	1 month	2 month	3 month	4 month
UPDRS Section 1 (Mentation)	Mean		2.80	2.30	2.30	2.30	2.30
	SD		1.58	1.22	1.22	1.22	1.22
	P			*	*	*	*
UPDRS Section 2 (ADL)	Mean		10.30	7.55	7.55	7.55	7.55
	SD		3.15	2.67	2.67	2.67	2.67
	SE		0.70	0.59	0.59	0.59	0.59
	95% CI	Lower	8.83	6.3	6.3	6.3	6.3
		Upper	11.77	8.79	8.79	8.79	8.79
	P			*	*	*	*
UPDRS Section 3 (Motor)	Mean		22.35	21.60	21.60	21.60	21.70
	SD		8.79	8.66	8.66	8.66	8.66
	SE		1.96	1.94	1.94	1.94	1.94
	95% CI	Lower	18.24	17.55	17.55	17.55	17.65
		Upper	26.46	25.65	25.65	25.65	25.76
	P			†	†	†	†
UPDRS Section 6 (Schwab & England ADL)	Mean		80.00	86.00	86.00	85.50	84.50
	SD		3.24	5.98	5.98	6.05	6.05
	SE		0.72	1.34	1.34	1.35	1.35
	95% CI	Lower	78.48	83.20	83.20	82.67	81.67
		Upper	81.52	88.80	88.80	88.33	87.33
	P			*	*	*	*
Webster step seconds	Mean		153.28	135.57	136.62	136.52	139.30
	SD		41.58	38.06	37.73	38.79	41.10
	SE		9.29	8.51	8.44	8.68	9.19
	95% CI	Lower	133.82	117.76	118.96	118.36	120.06
		Upper	172.74	153.38	154.27	154.67	158.54
	P			*	*	*	*

Table 1: UPDRS Sections 1, 2, 3 & 6 and Webster step seconds (N=20). (N-number of cases, SD-Standard deviation SE-Standard error, CI-Confidence interval, *- Significant at 5% interval between baseline and the corresponding month, †- Not significant at 5% interval between baseline and the corresponding month)

		Mean	SD	SE	P value
Parkinsonian symptoms	Baseline	50.09	5.49	1.17	.000*
	3 month	53.59	5.23	1.12	
Systemic symptoms	Baseline	25.55	2.84	0.61	.000*
	3 month	28.36	2.49	0.53	
Social functioning	Baseline	21.05	5.55	1.18	.000*
	3 month	22.68	5.47	1.17	
Emotional functioning	Baseline	35.68	3.34	0.71	.104†
	3 month	35.86	3.33	0.71	
PDQL total	Baseline	132.32	14.20	3.03	.000*
	3 month	140.63	13.62	2.90	

Table 2: PDQL (Parkinson's disease quality of life) (N=22). (N-number of cases, SD-Standard deviation, SE-Standard error, *-Significant between baseline and 3 month, †- Not significant between baseline and 3 month.)

namely, in parkinsonian symptoms, systemic symptoms and social functioning. Emotional functioning subscale however showed no significant improvement. Results are tabulated in table 2.

Discussion

The results of our study show that moderately disabled PD patients (HY stages 1 to 3) show objective improvement following regular physical exercise, the improvement being significant in many of the standardized measures of PD severity. Exercise programme was kept to the minimum taking into consideration the fact that strenuous exercises may induce muscle stiffness which in turn may lead to deterioration of function.[7] The benefits of exercise were helpful in overcoming some physical limitations, which may be due to the disease or due to the inactivity and disuse following the disease. The improvements following exercise may not be considered as improvement in neurological condition but may be improved residual potencies left in the parkinsonian patient. However, animal experiments by Sutoo[8] et al found that exercise increases the dopamine level in brain.

Significant improvement in mentation subscale (section 1) of the UPDRS was observed as due to the improvement in motivation section. Improvement in motivation could be due to the self-realization of the patients about their exercise and mobility potential. There were no improvements in intellectual impairment, thought disorder, and depression sections of this sub-scale. Absence of use of separate depression scores (like Geriatric depression scale or Beck's depression inventory) may have been a drawback in this study. In normal persons, physical activity ameliorates mood which in turn improves motor performance.[9] Psychological factors are likely to influence motor performances in parkinsonian patients.[10,11] It is not possible to exclude the placebo effect of exercise but the insignificant outcome in the emotional functioning subscale of PDQL adds credence to the non-psychological benefits of exercise.

Improvements in ADL section of UPDRS (sections 2 and 6) were significant in spite of insignificant improvement in motor section (UPDRS section 3). Nieuwboer[12] et al found improvement in the UPDRS ADL section, but not in the motor examination, similar to our study. However, Comella[13] et al found that there was significant improvement in the UPDRS ADL and motor scores. Ellis[14] and Formisano[10] have reported similar improvements in ADL. Most of the improvements in our study were observed in dressing, hygiene, turning in bed and walking. Speech, swallowing, handwriting and tremor showed poor or no improvement. This could be due to the structure of exercise programme where occupational therapy and speech therapy were not incorporated. This could become the scope of future studies.

In this study there was no significant improvement in motor scores (section 3), but there was some improvement from baseline. Most of these improvements were observed in leg agility, arising from chair, gait and postural stability. Very little or no improvements were noticed in tremor, rigidity, speech, and bradykinesia. The reason for improved symptoms in lower limb when compared with upper limb may be due to the exercise program, which was more focused on lower limb mobility. Poor response of rigidity[7] and tremor[15] to exercise has already been recorded. Comella[13] et al reported significant changes in bradykinesia and rigidity, but they were short-lived and lost at follow-up. In this section of UPDRS, impairments where changes are seen following exercises are given less importance. It gives more importance to tremor and rigidity (48 points out of 108) which might be the reason for insignificant outcome reported in this study. The limited benefit may also be because of the fact that the patients were already well managed (since they were recruited from specialist neurology clinic) and hence a limited scope for further improvement. Maybe this sub-scale could have reached levels of significance if more patients had been studied.

Absence of change in modified HY staging (UPDRS section 5) is not surprising. This staging is accepted as a rough estimate of disease severity and may not be sensitive enough to detect changes in symptoms. Similarly much attention was not paid to section 4 of UPDRS since it evaluates complications of drug therapy, which was immaterial to the purpose of our study. However no new onset of complications or worsening of persisting complications was observed during the course of the study.

Improvement in gait was assessed through Webster step-seconds product. The improvement could have been due to increase in stride length or speed or both. More objective studies using sophisticated gait analysis machines may throw some light in this field. Similar improvements in gait have been reported by Fisher[16], Palmer[7] and others.[14,17,18] Though significant improvement was noted, the assessment was conducted at level ground in controlled environment and hence may lose significance when generalized to an external environment like a house or street where the grounds may not be leveled and several impediments in the form of steps, crowd or furniture may be present.

Significant improvements were noted in PDQL total and PDQL subscales (parkinsonian symptoms, systemic symptoms and social functioning). Improvement in quality of life following exercise therapy is evidently

documented.[19,20] The improvement in parkinsonian symptoms was observed as due to improvements in walking, getting up from chair and turning in bed. The improvement in systemic symptoms was observed as due to improved feeling of well-being and lessened feeling of exhaustion. The patients were better able to participate in social functions and recreational activities leading to significant outcome in social functioning subscale. However they still scored poorly in the question related to difficulties with transport which was possibly due to poor access for the disabled provided by the public transport system in the city. Insecurity, embarrassment, depression, concentration and memory were not improved by exercise programme and hence the insignificant outcome in emotional functioning subscale. The patients' acceptance of the fact that they suffer from an incurable progressive disease with uncertain course could be a reason for this. The effects of exercise program were specifically perceived by the patients as improvement in the quality of life in the domain of physical mobility leading to increased participation in their social roles. This confirms the specificity of the exercise program and the need to incorporate additional rehabilitative protocols to improve the quality of life in other domains like speech, swallowing and handwriting. The improvement in PDQL could also mean that the benefits of exercise programme are not limited to controlled environments (improvement in UPDRS), but can be extended to community dwelling patients.

In almost all parameters studied, there was no significant improvement after the first month, though the levels of performance were significantly better when compared with the baseline. Although patients received instructions to continue exercises regularly, some of them missed their regularity which might explain the mild loss of benefit in the second and third months. Failure to exercise in spite of preserved higher motivational status (UPDRS section 1) during the second and third months is but unexplainable. More loss was recorded in the fourth month when the patients stopped exercising as instructed. However the scores reflecting patients' performance at the end of the fourth month were still significant when compared with the baseline. This means that there is some carry over effect of the benefits of exercise over a period of one month. The duration of this extended benefit needs further study; probably a long term follow-up at 6, 9 and 12 months may be helpful in answering this question. Previous studies indicate loss of improvement around sixth month.[13]

Since no significant improvement occurred beyond the first month, it is advisable to limit the duration of treatment to this period. Exercise regimens are not easily integrated into a patient's lifestyle and hence regular follow-up visits may have to be arranged, preferably every 4 months as deterioration start setting at around this time as seen in our study. The disease being chronic and progressive, and the patients' being old and forgetful, it is imperative that follow-ups are stringent. Regular weekly exercises were sufficient to maintain fitness levels in parkinsonian patients comparable with age matched controls.[21] Need based house visits and community based programmes could be strengthened to cover a wider range of patients who may find it difficult to travel long distances and attend tertiary health care centers. Context (hospital / home) and content (physical therapy / occupational therapy / speech therapy) specificity of the rehabilitative interventions should be further studied. Cost-effectiveness of treatment strategies (group therapy / individualized / home-based / hospital-based) must also be studied in future.

Conclusions

Systematic program of physical therapy is beneficial in patients suffering from moderately disabled Parkinson's disease (HY stage 1 to 3). Activities of daily living like dressing, turning in bed and walking respond favorably to exercises. Improvement in gait is the most successful outcome observed in this study, though the generalization of this outcome in community dwelling PD patients is done with caution. Quality of life improves considerably following exercises leading to increased social participation. Further studies are needed to evaluate individual components of physical therapy (benefits of strengthening, balance training, etc.), speech therapy (for speech, swallowing, and drooling), occupational therapy (for handwriting), to quantify improvements in gait in terms of speed, stride length and other parameters using sophisticated gait analysis machines, to examine the cost-effectiveness of different treatment modalities or strategies, to evaluate the efficacy of exercises in delaying the initiation of drug therapy in early PD, and the benefit of exercises in slowing the progression of PD.

What we learn from this article

A minimum of one month of individualized exercise sessions conducted twice a week (under supervision) is necessary to have outcome oriented benefits in most of the co-operative and cognitively unimpaired PD patients. Exercise regimen done daily in the first month and at least thrice a week for the next two months provides benefits which are carried over another one month period, at the end of which some deterioration starts setting in. Follow-up every 4 month is recommended. Activities of daily living like speech, swallowing, and handwriting do not have favorable response from exercises. Occupational therapy and speech therapy may have to be incorporated in the rehabilitation intervention to have favorable

outcome in these areas. There is only a limited scope for improvement from exercises in motor symptoms of PD, like tremor, rigidity, and bradykinesia.

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