Effects of ergometer exercise in an upright position on autonomic nervous activity in patients with Parkinson's disease

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Abstract: Autonomic disturbances are common non-motor symptoms in patients with Parkinson's disease (PD). Two Japanese men with PD performed three sessions of ergometer exercise each day. The first session involved conventional training the second session involved ergometer exercise in an upright posture, and the third session involved ergometer exercise in a supine posture. We measured the short-term heart rate variability using the R-R interval to evaluate autonomic nervous activity before and after each session. We found that both conventional exercise and lower-limb ergometer exercise effectively improve autonomic nervous system activity.

Keywords: Autonomic disturbances, Parkinson's disease, Conventional training, Ergometer exercise, Upright posture, Supine posture

1. Introduction

Autonomic disturbances are common non-motor symptoms in patients with Parkinson's disease (PD). Orthostatic hypotension and supine hypertension are inter-related in these patients[1]. Previous studies[2-3] have shown that therapeutic exercise with a lower-limb ergometer and some forms of physiotherapy can effectively inhibit sympathetic activity. However, the differences in the effects of ergometer exercise in a sitting versus supine position on autonomous nervous activity remain unclear. This study was performed to compare the short-term effects of ergometer exercise in a sitting versus supine posture.

2. Material and Methods

2.1. Participants and overall Design

Two Japanese men with PD in Table 1(65 and 58 years of age, respectively; Hoehn and Yahr stage 3) performed three sessions of ergometer exercise each day. The first session involved 15 minutes of conventional training according to the European Guidelines for Physiotherapy in Parkinson's Disease[1](con-s), the second session involved 15 minutes of ergometer exercise in a sitting position (sitting-s), and the third session involved 15 minutes of ergometer exercise in a supine posture (supine-s). The Borg scale was used to control the training intensity. We measured the short-term heart rate variability using the R-R interval to evaluate autonomic nervous activity before and after each session.

Table 1. Participants

case	age	gender	Hoehn & Yahr Stage
A	65	male	III
B	58	male	III

2.2. Measurement of heart rate, blood pressure and autonomic nervous system activity

HR, systolic BP (SBP), diastolic BP (DBP) and HRV indices, indicating autonomic nervous system activity, were measured in the orthostatic tolerance test before and after each session. HR was measured by ECG, and BP was measured by upper-arm type automatic sphygmomanometer. HRV indices were measured by the software program “Kiritsu-Meijin” (Crosswell, Yokohama, Japan), which is used for the assessment of automatic reflexes in the orthostatic tolerance test. Electrocardiographic R signals were obtained at 1,000 Hz, and arrhythmias or artifacts were detected and deleted automatically by the software. We checked that all electrographic waves from were saved in the software and confirmed the accuracy of the preprocessed data. HRV indices were obtained from HR using the MemCalc system. The coefficient of variation of the R-R interval (CVRR) was determined by dividing the standard deviation (SD) of the R-R intervals by the mean (M) R-R interval. CVRR is used as an index of overall autonomic nervous system activity[4]. For frequency analysis, HF and LF were extracted[5]. HF is an index of parasympathetic nervous system activity, and the ratio of LF to HF (L/H) is an index of sympathetic nervous system activity[6-8]. We also evaluated the change in the magnitude of autonomic nervous system activity (ΔCVRR) and sympathetic nervous system activity (ΔL/H) when the participants stood up in the orthostatic tolerance test. We calculated a component coefficient of variance HF (CCVHF; √HF/average (RR)×100), a component coefficient of variance LF (CCVLF; √LF/average(RR)×100) and the norm component coefficient of variance HF (normCCVHF; CCVHF/(CCVHF+CCVLF)×100).

3. Results

All autonomic nervous activity with Parkinson disease was lower than normal adults in same age. For parasympathetic activity was increased after the con-s and in the supine-s (Fig 1.) . For sympathetic activity was decreased after the con-s and the supine-s, but not in the sitting-s(Fig 2.). For orthostatic hypotension and supine hypertension were improved in the con-s and in the supine-s, but not in the ssiting-s (Fig 3.).

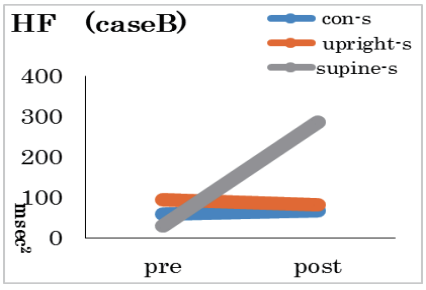

Fig 1. Change of parasympathetic activity

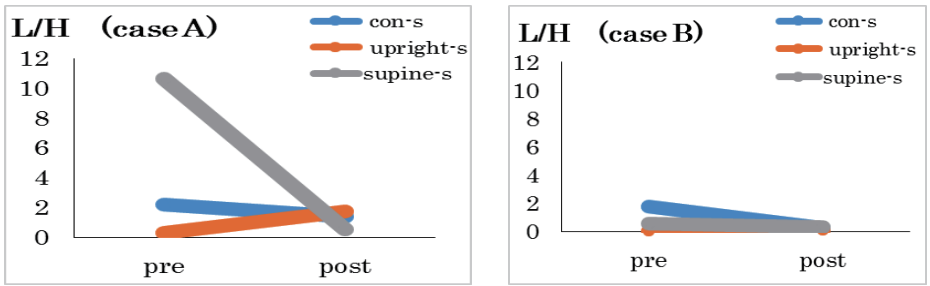

Fig 2. Change of sympathetic activity

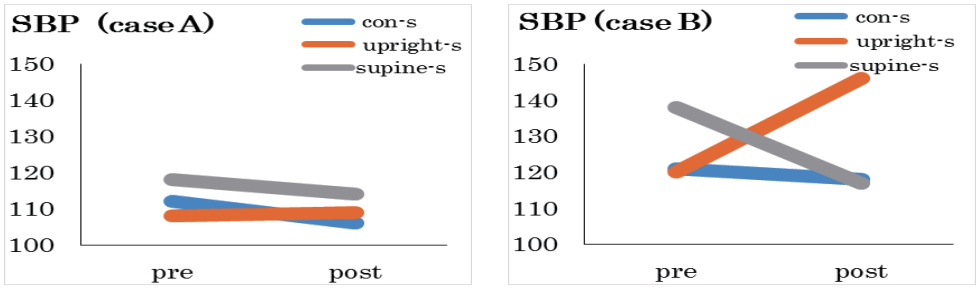

Fig.3 Change of SBP

4. Conclusion

These findings suggest that both conventional exercise and exercise with a lower-limb ergometer effectively improve autonomic nervous system activity. However, the effect of each type of exercise on improvement in autonomic nervous activity depends on the patient's posture.

5. Acknowledgements

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