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Sleep Dysfunctions Influence Decision Making in Undemented Parkinson's Disease Patients: A Study in a Virtual Supermarket

Giovanni ALBANI [1], Simona RASPELLI [2], Laura CARELLI [3]
Lorenzo PRIANO [1], Riccardo PIGNATTI [1], Francesca MORGANTI [3]
Andrea GAGGIOLI [2-4], Patrice L. WEISS [5], Rachel KIZONY [5-6], Noomi KATZ [6]
Alessandro MAURO [1], Giuseppe RIVA [2-4]

[1] *Department of Neurosciences and Neurorehabilitation, Istituto Auxologico Italiano, IRCCS, Piancavallo-Verbania, Italy*
[2] *Applied Technology for Neuro-Psychology Lab, Istituto Auxologico Italiano, IRCCS, Milan, Italy*
[3] *Department of Human Sciences, University of Bergamo, Bergamo, Italy*
[4] *Psychology Department, Catholic University of Milan, Italy*
[5] *Department of Occupational Therapy, University of Haifa, Haifa, Israel*
[6] *Research Institute for the Health & Medical Professions, Ono Academic College, Kiryat Ono, Israel*

Abstract. In the early-middle stages of Parkinson's disease (PD), polysomnographic studies show early alterations of the structure of the sleep, which may explain frequent symptoms reported by patients, such as daytime drowsiness, loss of attention and concentration, feeling of tiredness. The aim of this study was to verify if there is a correlation between the sleep dysfunction and decision making ability. We used a Virtual Reality version of the Multiple Errand Test (VMET), developed using the NeuroVR free software (http://www.neurovr2.org), to evaluate decision-making ability in 12 PD not-demented patients and 14 controls. Five of our not-demented 12 PD patients showed abnormalities in the polysomnographic recordings associated to significant differences in the VMET performance.

Keywords: Virtual Reality, Assessment, Parkinson's disease, NeuroVR, VMET

1. Introduction

In the early-middle stages of Parkinson's disease (PD), polysomnographic studies show early alterations of the structure of the sleep, which may explain frequent symptoms reported by patients, such as daytime drowsiness, loss of attention and concentration, feeling of tiredness.

Apparently these symptoms may involve a deficit in the executive functions, so the goal of this study was to verify the existence of a correlation between the sleep dysfunction and decision making ability in PD not-demented patients.

Specifically, polysomnographic data were associated with the performance obtained by the PD patients in the virtual version of a neuropsychological test, the Multiple Errand Test (MET).

The MET is an assessment of executive functions in daily life originally developed by Shallice and Burgess [1] specifically for high functioning patients and adapted into the simple version and the hospital version. It consists of three tasks that abide by certain rules and is performed in a mall-like setting or shopping centre.

2. Methods

We evaluated 12 PD not-demented patients and 14 controls. In particular, patients who had a severe cognitive impairment (MMSE < 19), a severe motor impairment, auditory language comprehension difficulties (score at the Token Test < 26,5), object recognition impairments (score at the Street Completion Test < 2,25), spatial hemi-inattention and neglect, excessive state and trait anxiety (score at the State and Trait Anxiety Index > 40) and excessive depression state (score at the Beck Depression Inventory > 16) were excluded from the study. A neuropsychological evaluation was conducted on the patients selected according to the above criteria, with the aim to obtain an accurate overview of patients' cognitive functioning. More, the decision making ability was assessed using a virtual version of MET (VMET), which was presented within a virtual supermarket [2-3]. In particular, subjects were invited to buy some items following a defined shopping list and to obtain some information (e.g., the closing time of the supermarket) following specific rules (e.g., you are not allowed to go into the same aisle more than once). While completing the MET procedure, the time of execution, total errors, inefficiencies, rule breaks, strategies, interpretation failures and partial tasks failures (e.g., maintained task objective to completion; maintained sequence of the task; divided attention between components of task and components of other VMET tasks and no evidence of perseveration) were measured.

All patients and controls performed a videopolysonnographyc study within a week after the VMET evaluation.

3. Results

In normal subjects, neuropsychological tests correlated with the findings of VMET. In PD patients, on the other hand, while traditional neuropsychological test were normal, VMET scores showed significant differences between patients and controls (Table 1).

More, five (group A) of our not-demented 12 PD patients of this study showed abnormalities in the videopolysomnographic recordings, such as insomnia, sleep fragmentation and REM behaviour disorders. Concerning VMET analysis, group A in comparison with those patients with normal polysomnographic data (group B), showed significant differences in time of execution (mean $p = 0.05$) and errors ($p = 0.05$).

4. Conclusions

VMET gave us important additional data concerning the cognitive status of PD patients, telling us that also PD not-demented patients may present an underlying unknown cognitive dysfunction.

Moreover, this study also suggested a correlation between dysexecutive syndrome and sleep abnormalities in PD: five of our not-demented 12 PD patients showed abnormalities in the polysomnographic recordings associated to significant differences in the VMET performance.

Table 1. Differences between groups in the VMET performance

	Group	N	Mean	Std. Deviation
Errors	Healthy subjects	14	17,64	3,895
	Patiets	12	25,08	4,757
Searched item in the correct area	Healthy subjects	14	8,86	1,512
	Patiets	12	11,92	2,314
Maintained task objective to completion	Healthy subjects	14	8,86	1,351
	Patients	12	11,83	2,368
Maintained sequence of the task	Healthy subjects	14	8,93	1,328
	Patients	12	12,08	2,234
Divided attention	Healthy subjects	14	9,29	1,437
	Patients	12	12,25	2,379
Organized materials appropriately throughout task	Healthy subjects	14	9,50	1,990
	Patients	12	12,25	2,454
Self corrected upon errors made during the task	Healthy subjects	14	9,86	1,834
	Patients	12	12,50	1,931
No evidence of perseveration	Healthy subjects	14	8,50	1,160
	Patients	12	11,92	2,429
Sustained attention through the sequence of the task	Healthy subjects	14	9,43	1,342
	Patients	12	12,17	2,082
Buying a chocolate bar	Healthy subjects	14	9,29	2,555
	Patients	12	13,25	3,888
Buying toilet paper	Healthy subjects	14	9,07	2,165
	Patients	12	13,33	3,939
Buying a sponge	Healthy subjects	14	9,07	2,556
	Patients	12	13,33	3,939
Buying two products from refrigerated products aisle	Healthy subjects	14	9,64	2,590
	Patients	12	12,83	3,326
Going to the beverage aisle and asking about what to buy	Healthy subjects	14	10,50	2,312
	Patients	12	15,17	1,992
Rule breaks	Healthy subjects	14	28,50	2,378
	Patients	12	24,92	3,423
Strategies	Healthy subjects	14	37,36	8,608
	Patients	12	47,33	3,339

5. References

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