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Verification of Therapeutic Effects When an Occupational Therapist Walks with a Patient with Moderate Alzheimer's-Type Dementia: A Case Report—Validity of Clinical Observational Perspective Verified by Changes in Autonomic Nervous System Responses: A Preliminary Study

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Abstract

Background: In actual clinical settings, an occupational therapist (OT) encounters a patient with moderate Alzheimer's disease (AD) walking with an anxious expression on the ward. The OT walks with the patient and encourages them to look at the symbol tree in the center of the ward. Additionally, when the patient talks to the OT, the OT empathizes with them and responds appropriately. As a result, many patients feel less anxious and become calmer. Therefore, in this study, the OT walked with an elderly female patient in her 80s with moderate AD and measured the patient's autonomic nervous system responses. The study aimed to verify to what extent the results matched the OT's clinical observational perspective. **Methods:** An OT with over 10 years of experience and a good relationship with the patient conducted one-on-one walking sessions with the patient. We divided the sessions into five-time periods: when the patient and OT were sitting on a sofa, and when they were walking. We implemented the same approach to the patient as usual. Therefore, we prompted the patient to look at the symbol tree during the walking session. Additionally, when the patient talked to the OT, the OT empathized and gave appropriate responses. We checked the changes in the patient's au-

tonomic nervous system responses in each time period. **Results:** This study showed that when walking with an OT, patient with moderate AD had a significant increase in parasympathetic nervous system (PNS) activity. Therefore, it is suggested that the involvement of professionals such as the environment and the OT during walking training for Alzheimer's patients may lead to improved mental stability. **Conclusion:** This study suggests that walking together with an OT may have a positive effect on the PNS of female patient with AD. The study also suggests that there is a potential agreement between clinical observation by the OT and evaluation results based on autonomous nervous system reactions. However, due to the limited number of patients, further studies involving a larger number of patients and multidimensional evaluations are needed.

Keywords

Alzheimer's Disease, Autonomic Nervous Response, Clinical Observational Perspective, Therapeutic Effect, Walking

1. Introduction

Dementia is a devastating condition that is most commonly seen in older adults and places a significant burden on the individual, their family, and the healthcare system. To enable more successful preventative interventions, it is important to identify pathways to dementia or factors associated with the onset of dementia [1]. One of the factors that have been attracting attention and studied in relation to dementia is the association with walking.

Specifically, several studies have reported that slow walking speed is associated with an increased risk of developing dementia. Walking speed has been proposed as a potential marker for cognitive decline and dementia risk in older adults. Slower walking speed may reflect underlying neurological or vascular impairments that are also related to the development of cognitive decline and dementia. Therefore, identifying and addressing walking impairments may be an important strategy for reducing the risk of cognitive decline and dementia [2] [3] [4] [5]. And in other studies, it has been shown that walking is beneficial in improving symptoms of sundowning syndrome [6] [7].

These studies have gradually revealed the impact of walking on cognitive function, as well as its effects on communication and sundowning syndrome.

In a clinical setting at an actual psychiatric hospital, an occupational therapist (OT) worked with moderately advanced Alzheimer's disease (AD) patients who walked around the ward with anxious expressions. During this walking, the therapist walked alongside the patients and encouraged them to look at the symbol tree in the center of the ward. When the patients spoke to the therapist, the therapist empathized with them and responded with nods. As a result, many patients felt less anxious and calmer. Therefore, we searched for literature that showed the physiological effects of reducing patient anxiety and calming them

through occupational therapists walking with a patient. However, we could not find any such reports.

Thus, in this study, we examined whether the results from the observational perspective of the OT could be confirmed by measuring the autonomic nervous system responses of moderately advanced Alzheimer's patients walking together with occupational therapists.

2. Methods

2.1. Characteristic Information of the Patient

Table 1 shows the characteristic information of the patient.

2.2. Equipment Used

Heart rate variability, one of the indicators of status changes such as anxiety, was used [8].

In this study, an ECG monitor (BSM-0805, Nihon Kohden Corporation) was used, and ECG analog signals were analyzed using MemCalc/Tarawa, PC software that can also measure ECG fluctuations. By utilizing the installed wireless transmitter to read the electrocardiograph information with the measuring pc, the load on the patient during walking was reduced as much as possible.

The measurement items were heart rate, entropy (every 8 beats), and heart rate variability (CVRR) averaged every 10 s. MemCalc/Tarawa analyzes the frequency intensity of heart rate variability in the R-R interval from the ECG heart rate waveform and the fluctuation component of the ECG R-R interval in a power spectrum analysis, defined by Pagani *et al.* [9]. The low-frequency component (LF: 0.04 - 0.15 Hz) reflects sympathetic nervous system (SNS) function and some parasympathetic nervous system (PNS) function, while the high-frequency component (HF: 0.15 - 0.4 Hz) is related to respiratory heart rate variability and mostly reflects PNS function [10]. Therefore, the LF/HF ratio was used as an index of SNS.

2.3. Implementation Environment and Measurement Method

The weather was sunny with 25.0˚C temperature and 54% humidity. An OT with over 10 years of experience and a good relationship with the patient conducted one-on-one walking sessions with the patient.

Eguchi *et al.*'s method [11] was used as reference for directions and measurement points, with the route set shown in Figure 1 and divided into five time periods: (i) to (v).

We asked the ward staff to cooperate as follows during the assessment:

The environment was set in such a way that other patients would not talk to the patient. In addition, we eliminated noise and visual distractions in the ward that affected autonomic nervous system responses. As for the measurements, only a three-point sensor was attached to the patient, thus reducing the burden on the patient as much as possible.

Table 1. Characteristic information of the patient.

Diagnosis	Alzheimer's disease
Age	80s
Sex	Woman
Various Evaluation Results	Mini Mental State Examination (MMSE): 10
	Clinical Dementia Rating (CDR): 2
	Behavioral rating scale for the mental states (NM Scale): 21
	New clinical scale for rating of activities of daily living of the elderly (N-ADL): 33
	Dementia Behavior Disturbance Scale (DBD): 34

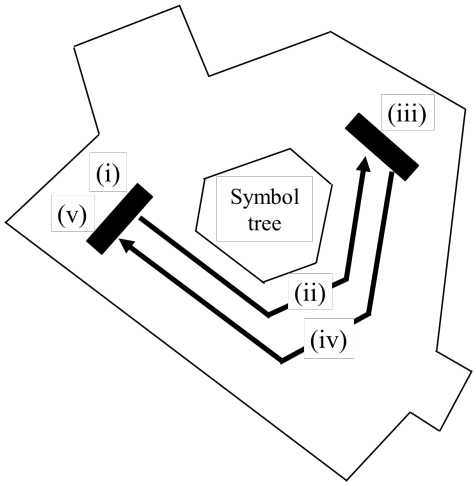

Figure 1. Walking directions of the patient and OT and the five time periods. (i) When the patient and OT are sitting on the sofa before walking (3 min). (ii) When the patient and OT are walking together to another sofa (approximately 30 m, 2 min). (iii) When the patient and OT are resting on the sofa (5 min). (iv) When the patient and OT are walking to return to the first sofa (approximately 30 m, 2 min). (v) When the patient and OT are sitting on the first sofa (3 min).

Moreover, when the patient spoke to the OT, the OT empathized and provided a back-channeling. In addition, at (ii) and (iv), the OT encouraged the patient to look at the symbol tree in the center of the ward only once.

This study did not use a method to directly assess changes in calmness, reducing patient anxiety before and after the study. On the other hand, heart rate variable HF is considered relaxed when parasympathetic activity is predominant [12]. Therefore, we defined that when the patient and OT are walking together, an increase in the patient's PNS indicates that anxiety is reduced and calm.

3. Ethical Consideration

This study was conducted in accordance with the ethical standards established by the Declaration of Helsinki. Additionally, the study protocol was approved by the author's university ethics review board (Approval No. 22-016). Informed

consent was obtained verbal and written consent from patient with AD and her family prior to participation in this study.

4. Results

Figure 2 shows the changes in the patient's PNS and SNS. In addition, the patient's facial expressions and conversations at each time period were as follows:

During the period (i), the patient and OT were sitting on the sofa. The patient talked to the OT, asking questions like "Where did you go today?" At that time, both the PNS and the SNS were slightly elevated.

During the period (ii), the patient and OT stood up from the sofa and walked together. The OT prompted the patient to look at the symbol tree in the center of the ward, and the patient looked at it. Then, the patient smiled and talked to the OT, saying, "It's nice weather today" or "The sunlight filtering through the trees is beautiful." During this period, a significant increase in the patient's PNS was observed.

During the period (iii), when the patient and OT sat on the sofa, the patient remained looking down without looking at the scenery, and during that time, the PNS decreased while the SNS increased significantly.

During the period (iv), when the patient and OT stood up from the sofa and walked, the patient's expression gradually became calm, and the patient behaved, expressed and spoke in the same way as in (ii). At that time, the PNS was significantly increased.

During the period (v), when the patient sat on the sofa again, the patient looked down again. At that time, both the parasympathetic and sympathetic nervous systems were decreased.

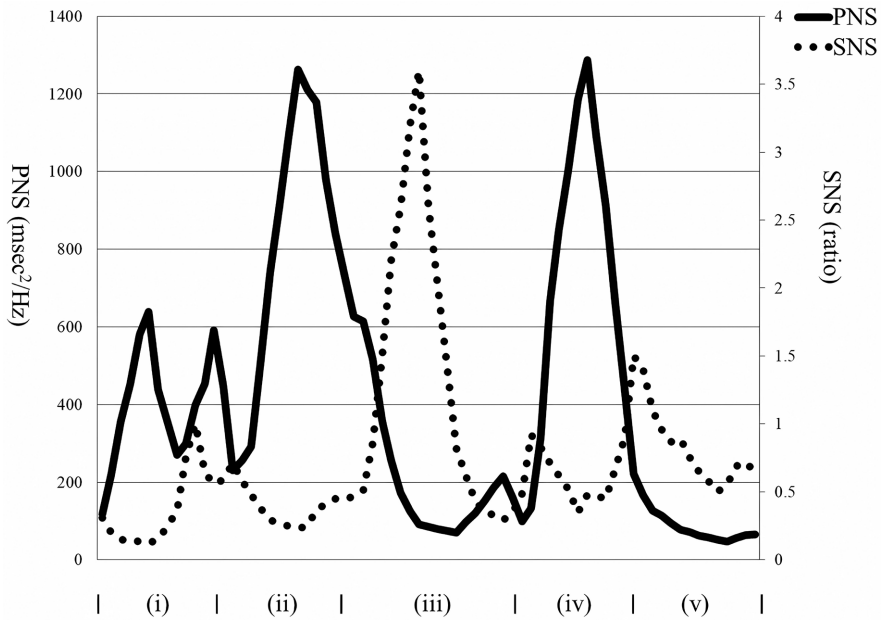

Figure 2. Changes in the patient's PNS and SNS in each time periods. PNS, parasympathetic nervous system; SNS, sympathetic nervous system.

5. Discussion

In this study, we walked with a moderate Alzheimer's patient together as an OT. We then investigated whether there is a match between the clinical observational perspective of the OT and the patient's autonomic nervous system response. As a result, a significant increase in the patient's PNS was observed during walking. Therefore, we judged that there was a match between the clinical observational perspective and the autonomic nervous system response.

According to Karibe *et al.*, results suggest that the values of the PNS in simulated space using Komorebi tend to be higher than those of the PNS in unassimilated space [13]. Although the present study involved actual sunlight filtering through trees, it is possible that the PNS was activated by a similar effect. Additionally, if PNS activity becomes dominant over SNS activity, pupil contraction occurs [14]. Thus, it is also possible that the difference in light intensity between sunlight filtering through trees, and indoor lighting caused the patient's pupils to contract, leading to a significant PNS response.

The walking in this study was at a pace of approximately 30 meters in about 2 minutes, which can be considered short in terms of both distance and time for walking training in rehabilitation. On the other hand, in the study by Eguchi *et al.*'s [11], the patients were in their 80s, but there were no significant changes in heart rate during walking. Then, even with short distances and times, moderate exercise may have led to activation of the PNS.

In addition, when the patient spoke to the OT, the OT responded with empathy and nodding. Ono *et al.* reported that empathetic reactions from the listener (a state of "accompanying empathy") are an important factor in reducing stress [15]. Therefore, we speculated that the OT's empathetic response to the patient's speech may have led to activation of the PNS.

Therefore, it is possible that the complex elements during walking in this study had a positive effect on the activation of the patient's PNS.

6. Conclusions

In this study, it was suggested that the complex elements during walking, such as the amount of sunlight, walking time and distance, and the OT's empathetic responses, may have had a positive effect on the activation of the patient's PNS.

Therefore, there is a possibility that the observational perspective of the OT in clinical practice and the evaluation results based on autonomic nervous system responses may be consistent.

Research Limitations

This study was conducted with consideration for the stress that the patient may experience during the examination and was completed in a single verification.

In addition, the OT who participated in this study had more than 10 years of experience and was the one who normally provided occupational therapy to the patient. Therefore, it was not possible to confirm whether the evaluation results

would be consistent when different OT with different years of experience were involved.

Therefore, in the future, it will be necessary to verify whether the same results can be obtained even when OT with different years of experience walk with patients. It will also be necessary to investigate whether the same results can be obtained even when the severity of the patients' condition varies. Furthermore, even if the number of patients is increased, it will be necessary to perform more detailed settings to verify whether the evaluation results are consistent.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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