ORIGINAL ARTICLE

Effect of aromatherapy on patients with Alzheimer's disease

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Abstract

Objective: Recently, the importance of non-pharmacological therapies for dementia has come to the fore. In the present study, we examined the curative effects of aromatherpay in dementia in 28 elderly people, 17 of whom had Alzheimer's disease (AD).

Methods: After a control period of 28 days, aromatherapy was performed over the following 28 days, with a wash out period of another 28 days. Aromatherapy consisted of the use of rosemary and lemon essential oils in the morning, and lavender and orange in the evening. To determine the effects of aromatherpay, patients were evaluated using the Japanese version of the Gottfries, Brane, Steen scale (GBSS-J), Functional Assessment Staging of Alzheimer's disease (FAST), a revised version of Hasegawa's Dementia Scale (HDS-R), and the Touch Panel-type Dementia Assessment Scale (TDAS) four times: before the control period, after the control period, after aromatherpay, and after the washout period.

Results: All patients showed significant improvement in personal orientation related to cognitive function on both the GBSS-J and TDAS after therapy. In particular, patients with AD showed significant improvement in total TDAS scores. Result of routine laboratory tests showed no significant changes, suggesting that there were no side-effects associated with the use of aromatherapy. Results from Zarit's score showed no significant changes, suggesting that caregivers had no effect on the improved patient scores seen in the other tests.

Conclusions: In conclusion, we found aromatherapy an efficacious non-pharmacological therapy for dementia. Aromatherapy may have some potential for improving cognitive function, especially in AD patients.

INTRODUCTION

Japan, having the highest life expectancy in the world, has seen a remarkable increase in senile dementia in recent years. This has become a big social problem, with Alzheimer's disease (AD) accounting for approximately half the number of cases of dementia.[1,2] Thus, preventive medicine for dementia has become more important.[3] Recently, complementary alternative medicine, which, in addition to using medications, also makes use of various 'non-pharmacological' approaches, has become an attractive alternative in the treatment of senile dementia after the introduction of elderly care insurance. These treatments are performed to complement the effects of pharmacotherapeutics and health care services, such as nursing home, day care etc., for elderly paitents. Aromatherapy is one of the therapies used in complementally alternative medicine.[4,5] In recent years, non-pharmacological intervention has been based on the viewpoint of brain rehabilitation and the possible prevention of senile dementia has also been reported and non-pharmacological treatments other than aromatherapy, such as memory training, music therapy, the recollection method, animal-assisted therapy, and optical treatment, have been studied.[6–8] Aromatherapy experientially classifies the effect of the scent

through the essential oil extracted from the plant, a traditional treatment used according to its effect, and is used in many fields. In the present study, the aromatherapy applied did not include mainstream aroma massage, aroma baths etc. (including touch therapy) because physical problems, such as low-temperature burns, may occur in some cases.[4,5,9–11] The mechanism(s) of action of underlying the effects of aromatherapy are not known for certain. In healthy people, essential oils of rosemary and lavender are commonly used and there is at least one report showing that these oils influence feelings about a person's surroundings.[12] Moreover, lavender oil has been reported to improve sleep disorders.[13,14] It has also been reported that the essential oil of lemon affects the anti-oxidant action of vitamin E and improves the state of blood vessels near the skin.[15] Although there are few reports on aromatherapy in senile dementia, it has been suggested that aromatherapy may bring about some feeling of relief and the ability to act on outside influences such that the obstacle to action in senile dementia can be coped with.[10] However, there are no reports of the effects of aromatherapy on cognitive functional disorder, often seem in cases of dementia and the central feature of senile dementia. Disorders of cognitive function pose considerable problems for both AD patients and care workers.

The action of aromatherapy begins from a smell molecule combined with an acceptor peculiar to each specific odor. The smell molecule passes along the nasal cavity and adheres to the olfactory epithelium. The stimulus is transmitted to the hippocampus or cerebral limbic system and amygdaloid body through the olfactory nerve system currently concentrated on the olfactory epithelium. Although this process is deeply related to cognitive function, the odor is recognized and the stimulus sends information to the hypothalamus on which it was projected by the cerebral limbic system, which then adjusts the autonomic nervous system and the internal secretory system, guiding a series of vital reactions in the hippocampus or amygdaloid body, such as the discharge of neurotransmitters. In brief, aromatherapy is the result of the vital reaction that occurs through the smell molecule.

Although some reports have proposed that the sense of smell is decreased in AD patients, nerve rebirth through smell is possible.[16,17] We also sus-

pected that patients' cognitive function could be improved by stimulation through the sense of smell.

The aromatherapy treatment used in the present study is is physically safer and easier to apply than mainstream treatments, such as massage and baths, so the operator feels no limitation because he or she can work through purely aromatic means.

Initially, the level of congnitive function was assessed using the Gottfries, Brane, Steen (GBSS-J) and Touch-panel type Dementia Assessment Scale (TDAS). Aromatherapy was applied to AD patients using a combination of a lavender oil–orange oil solution, which activates the parasympathetic nervous system, with a rosemary oil–lemon oil solution used to relieve depression and heighten concentration. In this preliminary phase of the investigation, the possibility that the cognitive function could improve in AD patients following aromatherapy was discovered and the validity of using aromatherapy in AD patients was examine further.

METHODS
Patients

In total, 28 elderly people (mean age 86.1 ± 6.9 years) were involved in the study. Seventeen patients had AD (two men, 15 women; mean age 86.3 ± 6.4 years), three had vascular dementia (VaD; all women; mean age 89.7 ± 5.5 years), and eight had other diagnoses, including, among others, a mixed case of AD and cerebrovascular lesions (CVL; all women; mean age 84.5 ± 8.3 years). We provided patients and their families with detailed information regarding the methods and purpose of the study (Table 1) and informed consent was obtained. Patients with AD were diagnosed by the DSM-IV[18] and NINCDS-ADRDA,[19] whereas patients with CVL were diagnosed using DSM-IV and NINCDS-AIREN.[20]

Methodology

The examine the effect of mixed aromas, a crossover method was used in the present study. To evaluate the persistence of any effect of the aromatherapy, a washout period of 28 days was included after the 28 days of aromatherapy. Furthermore, to examine in detail how the aromatherapy influenced cognitive function in dementia patients, the TDAS was applied as a highly sensitive test with little influence from the investigator.

Table 1 Distribution of subjects according to Functional Assessment Staging of Alzheimer's disease (FAST) assessment

	FAST3-5	FAST6-7	Total	Mean (±SD) age (years)
AD	5 (0/5)	12 (2/10)	17 (2/15)	86.3 ± 6.4
VaD	1 (0/1)	2 (0/2)	3 (0/3)	89.7 ± 5.5
Others	3 (0/3)	5 (0/5)	8 (0/8)	84.5 ± 8.3
Total	9 (0/9)	19 (2/17)	28 (2/26)	86.1 ± 6.9
Mean (±SD) age (years)	83 ± 6.9	87 ± 6.2	86.1 ± 6.9	

Data show the number of patients in each group, with the number of men/women given in parentheses.
FAST3-5, mild to moderate Alzheimer's disease (AD); FAST6-7, severe AD; AD, Alzheimer's disease; VaD, cerebrovascular dementia; Others, mixed dementia and other dementia.

After a control period of 28 days, aromatherapy was performed over the following 28 days, followed by a 28-day wash out period. During the control and wash out periods, patients did not receive any treatment. During the 28 days of aromatherapy, patients were exposed to the aroma of 0.04 mL lemon and 0.08 mL rosemary essential oil in the morning from 0900 to 1100 hours and to 0.08 mL lavender and 0.04 mL orange essential oils in the evening from 1930 to 2100 hours. The oils were placed on a piece of gauze in diffusers with an electric fan. (All essential oils and diffusers used in the present study were produced by the Peace of Mind Company (Tokyo, Japan).) Two diffusers were set up in each room where patients had been moved. The essential oils (rosemary and lemon; lavender and orange) were then mixed as described above. The lemon and rosemary mix activates the sympathetic nervous system to strengthen concentration and memory, whereas the lavender and orange fragrance activates the parasympathetic nervous system to calm patients' nerves. The mixtures used in the mornings and evenings were changed because this method is known, through experience, to synchronize the autonomic nervous system to the circadian rhythm: the sympathetic nerve system works predominantly after stimulation by rosemary–lemon oil in the morning, whereas the parasympathetic nerve system works predominantly after activation by the lavender–orange oil at night. Patients were evaluated at four time points throughout the study: 'Before 1', consisting of 7 days of tests, followed by the 28-day control period; 'Before 2', tests for 7 days, followed by aromatherapy for the next 28 days; 'After 1', tests for the 7 days, followed by 28 days wash out; and 'After 2', tests for 7 days after the 28-day wash out period (Table 2).

Tests were administered to patients according to the schedule given in Table 3. The GBSS-J scale (the

Table 2 Study schedule

Before 1	1 week
Control period	4 weeks
Before 2	1 week
Aromatherapy period	4 weeks
After 1	1 week
Wash out period	4 weeks
After 2	1 week

To evaluate the effects of aromatherapy, tests were performed up to four times throughout the schedule.

Table 3 Tests used in the present study

	Before 1	Before 2	After 1	After 2
HDS-R	✓	✓	✓	✓
GBS	✓	✓	✓	✓
FAST	✓	✓	✓	✓
CT	✓	✕	✕	✕
Blood Examination	✓	✕	✓	✕
Biochemical Examination	✓	✕	✓	✕
TDAS	✓	✓	✓	✓
Zarit	✓	✓	✓	✓

✓, test performed; ✕, test not performed; FAST, Functional Assessment Staging of Alzheimer's disease; HDS-R, revised version of Hasegawa's Dementia Scale; GBSS-J, Japanese version of the Gottfries, Brane, Steen scale; CT, computed tomography; TDAS, Touch Panel-type Dementia Assessment Scale.

Japanese version of the Gottfries, Brane, Steen (GBS) Scale)[21] was used to determine the effect of medical treatment because this test is currently used in the evaluation of pateints with AD. The GBSS-J consists of five items: GBSS-J-A (cognitive function), GBSS-J-B (spontaneity), GBSS-J-C (feeling function), GBSS-J-D (other moral condition), and GBSS-J-E (movement function).

The degree of AD was determined in patients using the Functional Assessment Staging of Alzheimer's disease (FAST).[22] This test is based on observation of patients with AD and classifies the level of dementia into seven stages. To apply the FAST, the evaluator

Table 4 Test results in dementia patients that did not exhibit significant changes after aromatherapy

	Befere 1	Before 2	After 1	After 2	*P* value
FAST	5.64 ± 1.32	5.58 ± 1.37	5.53 ± 1.07	5.76 ± 0.97	0.573
HDS-R	11.06 ± 7.72	10.61 ± 7.49	10.27 ± 7.72	10.56 ± 7.83	0.833
GBSS-J-B	10.65 ± 7.24	9.88 ± 7.05	11.06 ± 8.3	11.35 ± 7.31	0.174
GBSS-J-C	10.29 ± 7.54	9.76 ± 7.05	11.2 ± 7.09	11.65 ± 7.48	0.463
GBSS-J-D	7.24 ± 7.44	8.71 ± 5.97	7.18 ± 4.64	8.47 ± 6.74	0.499
GBSS-J-E	15.65 ± 8.98	15.18 ± 8.91	15.88 ± 9.55	17.59 ± 8.74	0.071

FAST, Functional Assessment Staging of Alzheimer's disease; HDS-R, revised version of Hasegawa's Dementia Scale; GBSS-J, Japanese version of the Gottfries, Brane, Steen scale.

needs to observe the patient objectively and obtain information from the nurse or care giver. As a screening tool, the revised version of Hasegawa's dementia scale (HDS-R) was used.[23] Finally, a simple touch panel was used to identify possible dementia (the Touch Panel-type Dementia Assessment Scale; TDAS). One part of the TDAS is a modification of the Alzheimer disease Assessment Scale (ADAS),[24] a method used to evaluate cognitive function. The TDAS clarifies the level of cognitive dysfunction by using problems involving word recognition, vocal orders, figure recognition, understanding the concept of mail, understanding knowledge items, money calculation, recall of names and dates, the use of tools and being able to tell the time on a clock. An experienced TDAS investigator can easily inspect these data in approximately 20 min per subject, but even in the absence of an experienced investigator, the test only takes approximately 40 min. In the TDAS, decreasing scores indicate cognitive improvement. The four dementia assessment scales (i.e. TDAS, GBSS-J, FAST, and HDS-R) were applied by nurses and/or care workers.

In addition, head computed tomography (CT) scans were performed for all patients. A patient with a low-density area on the CT scan without history of stroke was considered as having CVL. Routine laboratory tests, such as blood analysis and biochemical examination, were performed before and after aromatherapy.

Finally, two questions were added to the care burden evaluation scale (Zarit)[25] for 21 care workers. Originally, the Zarit scale was designed to evaluate a family's care load so, in the present study, the questions 'Do you think the patient's excreta is unpleasant?' and 'Do you think that you unknowingly present an unpleasant face to the patient?' were added to help judge the nursing staff's care load more appro-

priately. In total, this questionnaire consists of 24 items about a care worker's mental and economic burden.

All results were compared by repeated-measures ANOVA and Scheffé's post hoc test using the Statview software for analysis.

RESULTS

There were no significant differences between patients with dementia for most items, except for those evaluating actual function, such as GBSS-J-B (spontaneity), GBSS-J-C (feeling function), and GBSS-J-D (other psychotic manifestations), before and after aromatherapy (Table 4). However, a significant improvement was seen in GBSS-J-A-13 (abstract function) in the FAST3-5 AD (mild–moderate AD) group ($P < 0.05$; Fig. 1).

There were no significant difference in HDS-R, in the transition of the FAST score or in the results of routine laboratory tests.

Although there were no significant changes on the TDAS for each of the individual items described above (i.e. word recognition, vocal orders etc.), some improvement was seen in the overall score for the TDAS in all patient groups ($P < 0.05$; Fig. 2). Some significant improvement was noted in concept understanding ($P < 0.05$; Fig. 3). The overall total points for TDAS in the AD patient group were improved after aromatherpay ($P < 0.01$; Fig. 2).

Finally, there were no significant differences differences in any items on the Zarit scale before and after aromatherapy (Fig. 4).

DISCUSSION

In the present study, aromatherapy was performed on dementia patients and was found to improve the ability to form abstract ideas. In addition, some improvement in movement was noted. Furthermore,
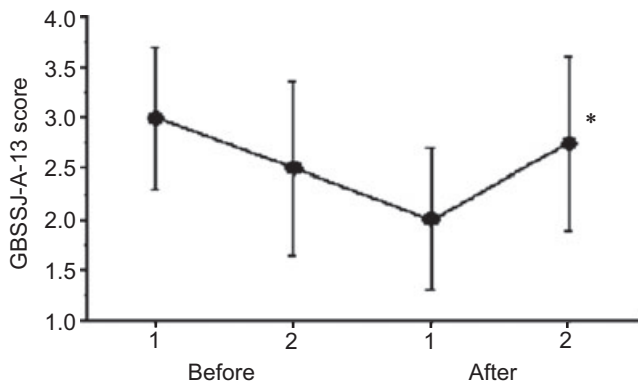
Figure 1 Changes in scores for item A-13 (abstract function) of the the Japanese version of the Gottfries, Brane, Steen scale (GBSS-J) in patients identifed as 3-5 on the Functional Assessment Staging of Alzheimer's disease (FAST), before the control period (Before 1), after the control period (Before 2), after aromatherpay (After 1), and after the washout period (After 2). Significant improvement in cognitive function was observed after aromatherapy. Data are the mena ± SEM. *$P < 0.05$ (repeated-measures ANOVA).
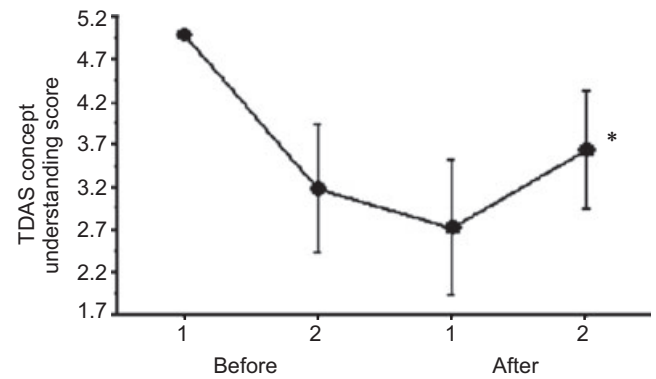
Figure 3 Change in Touch Panel-type Dementia Assessment Scale (TDAS; concept understanding) scores before the control period (Before 1), after the control period (Before 2), after aromatherpay (After 1), and after the washout period (After 2). Significant improvement in ideational praxis function after aromatherapy was observed. Data are the mena ± SEM. *$P < 0.05$ (repeated-measures ANOVA).
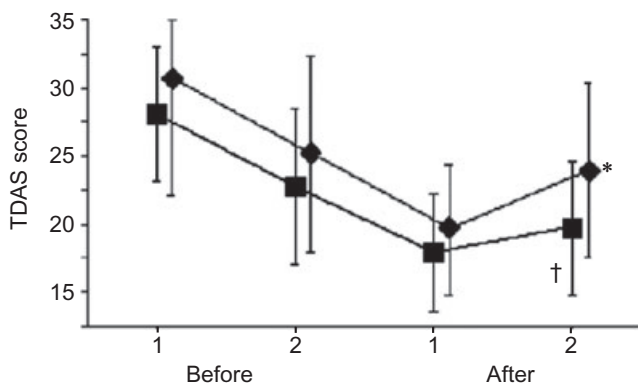

Figure 2 Change in Touch Panel-type Dementia Assessment Scale (TDAS) scores in all subjects (◆) and in patients with Alzheimer's disease (AD; ■), before the control period (Before 1), after the control period (Before 2), after aromatherpay (After 1), and after the washout period (After 2). All subjects showed significant improvement in cognitive function after aromatherapy, as did patients with AD. Data are the mena ± SEM. *$P < 0.05$, †$P < 0.01$ (repeated-measures ANOVA).
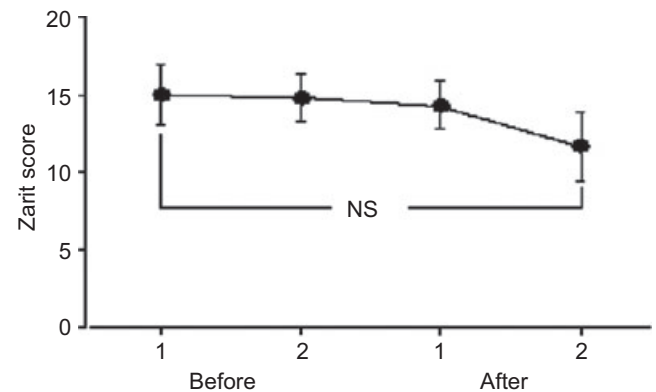

Figure 4 Change in Zarit's score before the control period (Before 1), after the control period (Before 2), after aromatherpay (After 1), and after the washout period (After 2). There was no significant change in Zarit's score after aromatherapy.

using the TDAS, improvements in cognitive function were noted for the entire group, with some improvement in conceptual understanding. Although no significant differences were seen in other disease groups, slight improvement in cognitive function was found in patients with moderate AD. Consequently, we believe that aromatherapy effectively improves cognitive function and may be particularly effective for patients with moderate AD. We did not observe any

significant changes on the HDS-R after aromatherapy. Some studies of the effects of aromatherapy have used scales evaluating behavioral and psychological symptoms of dementia (BPSD).[6–8] However, on the basis of the results of the present study, our view is that the most important effect of aromatherapy in dementia is on cognitive function. Thus, the main aim of the present study was to determine whether aromatherapy can improve cognitive disorders.

The TDAS results suggest an improvement in recognition after aromatherapy. Nevertheless, total scores for abstract thinking and motor function on the GBSS-J remained the same. During preliminary

investigations, we noted some improvement in the total score for GBSS-J-A (cognitive function) and GBSS-J-B (spontaneity) with less aromatherapy oil than that used in the present study. Moreover, based on results of our preliminary investigations, the effects observed depend on the amount of aromatherapy oil used. Thus, a stronger effect may be obtained by increasing the amount of the oil used. Conversely, although we did not see any significant effect on HDS-R, this doesn't mean that aromatherapy is not effective. The HDS-R is simply a scale used for screening test for patients with dementia and, perhaps, we were not able to demonstrate any any cognitive improvement on screening because the HDS-R is a screening test with low sensitivity.

One of the limitations of the present study is the low patient numbers. In future studies, a greater number of patients may need to be evaluated to clearly demonstrate the effect of aromatherapy in cognitive disorders. Stimulation of the sense of smell is projected to the cerebral limbic system. Very important areas, such as the hippocampus and the amygdaloid body, are part of the cerebral limbic system. These are strongly related to the cognitive impairment that is the central symptom of dementia. Moreover, neurofibrillary tangles (NFT) are observed in the early stages of AD in the entorhinal cortex, hippocampus, amygdaloid body, and thalamus, which receive stimulation from the cerebral limbic system.[26,27] On the basis of these observations, it has been suggested that the olfactory area is closely related to AD and the development of dysosmia in early AD may support this hypothesis. Neuropoiesis in the human hippocampal dentate gyrus and subventricular zone is controlled by various environmental agents, but continues throughout life.[28] One hypothesis states that stimulation by smell promotes neuropoiesis in the human hippocampal dentate.[17] There is also a report that indicates a positive effect of pleasant surroundings of levels of senile plaques.[29]

In brief, it is thought that neuropoesis, reinforced by stimulation from smell projected to the cerebral limbic system, plays an important role in improving cognitive function. However, aromatherapy has positive effects on care givers in addition to the possibility of improving a patient's actual function. To investigate these factors, we evaluated Zarit's score to determine the care load level. However, there appeared to be no significant change in Zarit's score after aromatherapy; thus, the nursing load did not change and could not have impacted on the improvements in cognitive function seen or on general results of patient evaluation.

Complementary alternative medicines need to be safe. To confirm the safety of the aromatherapy used in the present study, we performed routine laboratory tests, such as blood analysis and biochemical examinations, before and after the treatment. There were no significant differences in any of the parameters evaluated, indicating no deleterious side-effects from the aromatherapy. Based on these results, we believe that cognitive dysfunction, the cental symptom of AD, improves after aromatherapy. As far as we know, the present study is the first to investigate the possibility of improved cognitive function with simulatneous improvemenmts in other symptoms of AD using aromatherapy. We confirmed that aromatherapy using pure aromas is safe. Anyone can understand how easy it is to perform this type of treatment, which appears to be an effective complement to conventional therapy. Moreover, aromatherapy can be used not only a treatment, but also as a preventive measure because it influences neuropoiesis.

Now that adult day care, brain rehabilitation, and dementia syndrome prevention classrooms are becoming more and more necessary, it is thought that aromatherapy may be very profitable as one type of program in the near future. It will be necessary to verify the effect of this treatment, as well as the underlying mechanism of action, from both a clinical and biological perspective in order to establish a clear methodology for the use of aromatherapy in the future. We are currently examining these issues by investigating the effects of aromatherapy on cell differentiation.

ACKNOWLEDGMENTS

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