The Effect of Taking Bath with Aroma Essence on Cardiac Autonomic Nerve Activity during Sleep

Michikazu SEKINE, Sadanobu KAGAMIMORI

Department of Welfare Promotion and Epidemiology Toyama Medical and Pharmaceutical University Faculty of Medicine

Sakae OHMURA, Takahumi HAYASHI

Yuai Association of Hospitals, Akebi Hot Spring Clinic

芳香温浴が睡眠中の心臓自律神経活動に及ぼす影響

関根道和，鏡森定信

富山医科薬科大学　医学部　保健医学講座

大村栄，林隆文

友愛病院会　明日温泉診療所

抄　録

芳香剤による鎮静作用が，睡眠を改善させるとの報告がある。睡眠と自律神経活動とは密接な関係があることから，今回，芳香浴と夜間睡眠中の心臓自律神経活動との関係を評価した。対象は22—25歳の非喫煙・非肥満の健常大学生6名。就寝前に①入浴しない日，②淡水浴入浴，③アロマバス入浴（ラベンダー）の3種類を1週間おきに無作為に実施した。湯の温度は38－39度に調整し，午後10時から30分間入浴した。アロマバス入浴のときはラベンダーオイル5滴を浴槽に投与して入浴した。入浴後26度前後の静かな部屋にて安楽に過ごし，午後11時に就寝し，約8時間の睡眠をとった。睡眠中の午前0時から午前3時の3時間のRR間隔データについて256秒毎に高速フーリエ変換法を用いて心拍変動スペクトル解析を行った。総パワー（TP; 0.003-0.4Hz），極低周波パワー（VLF; 0.003-0.04Hz），低周波パワー（LF; 0.04-0.15Hz），高周波パワー（HF; 0.15-0.40Hz）を算出した。LF/HF比（LHR），またLF・HFの正規化単位LFnu・HFnuを求めた。統計解析には3群間の各指標の比較をフリードマン検定により行った。多重比較にはウイルコクソン検定を用いた。その結果，TP，VLF，LF，HF，LHRは3群間で有意差を認めなかった。LFnuとHFnuは3群間で有意に異なり，LFnuは非入浴の日に比較し淡水浴の日に有意に低く，HFnuは有意に淡水浴の日は高値であった。アロマ浴の日は無入浴よりLFnuは低く，HFnuは高かったが有意ではなかった。LFnu，HFnuはそれぞれ，相対的な交感神経活動，相対的な副交感神経活動と関連する指標とされることから，入浴による睡眠時の副交感神経活動の亢進と交感神経活動の低下が示唆された。芳香浴の時の自律神経活動は，入浴以上の効果を認めなかった。

Key words : aromatherapy, lavender oil, sleep, heart rate variability, autonomic nerve activity

I INTRODUCTION

Aromatherapy has been increasingly applied to medical treatment as an alternative medicine[1]. It has been considered that essential oils used in aromatherapy are absorbed into the capillary through skin surface, nasal mucosa, and alveoli in the lung[1]. Absorbed material are carried into hypothalamus through blood stream, in which it could play a certain role for the regulation of the autonomic nervous system, endocrine system and immune system[1].

Lavender oil, one of essential oils commonly used in medical aromatherapy, have a sedative property resulting from an increase in alpha wave in electroencephalogram[2,3]. A previous study showed that taking bath was associated with an increase in parasympathetic nerve activity[4] which is considered to be linked to relaxation. Therefore, taking bath with lavender oil could be more effective to maintain the increment in parasympathetic tone, compared to taking plain bath only.

However, there is a lack of data concerning the effects of taking bath with aroma essence on autonomic nerve activity during sleep. Recently, cardiac autonomic nerve activity has been measured noninvasively with power spectral analysis of heart rate variability[5)6)7)]. In this technique, two dominant frequency bands are identified including high frequency band reflecting cardiac parasympathetic nerve activity and low frequency band reflecting combined activity of cardiac sympathetic and parasympathetic nerve activity[5)6)7)].

In this study, we evaluated the effects of taking bath with aroma essence on cardiac autonomic nerve activity during sleep.

II SUBJECTS AND METHODS

1.Subjects: Six healthy nonsmoking and nonobese male medical students aged 22 to 25 (mean±SD: 23.2±1.17) voluntarily participated in this study. Anthropometric data including height, weight, and body mass index were 171.2 ±6.77cm (mean±SD), 63.5±6.47kg, and 21.7±1.96kg/m^2, respectively.

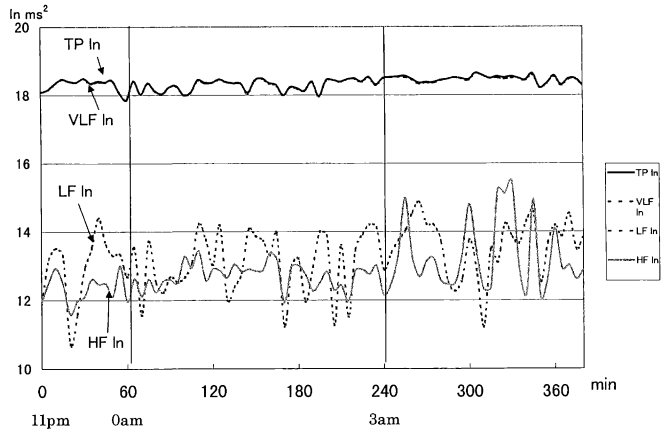
2.Study protocol: Subjects were randomly assigned to experience one of the following three types of interventions for each measurement and repeated to measure three times to experience all of the interventions: ① control day in which subjects went to sleep without taking bath, ② taking warm ordinary bath with plain water, ③ taking bath with aroma essence. In this study, lavender oil was selected as an aroma essence because of the presence of many reports indicating its sedative property[2)3)] and benefit on maintaining sleep quality[2)3)8)]. Each experiment was 1 week apart. On the study day, subjects were prohibited to do heavy exercise and to consume alcohol and beverages containing caffeine. Water temperature in the bath was set approximately at 38-39°C. Subjects started to take bath at 10:00pm and continued for 30 minutes. After taking bath, subjects sat down on a chair in an air-conditioned quiet comfortable room with a temperature of approximately 26°C. After that, a digital Holter electrocardiogram was attached. Subjects went to sleep at 11:00pm and slept for approximately 8 hours.

3.Measurement of heart rate variability: During 8 hours sleep, RR intervals were measured at an accuracy of 1 millisecond and recorded on the IC card in the Holter electrocardiogram. Power spectral data were calculated for each consecutive 256 second RR data. RR interval data were interpolated using a cubic-spline interpolation method and resampled at 2 Hz. The resampled 512-point equidistant data were treated with the Hanning window function and transformed into power spectral data using the Fast Fourier Transform method[7]. Very low frequency power (VLF; 0.003-0.04 Hz), low frequency power (LF; 0.04-0.15 Hz), high frequency power (HF; 0.15-0.40 Hz), and total power (TP; 0.003-0.4 Hz) were calculated and transformed into the natural logarithm(ln). LHR was calculated as LF divided by HF. HF and LF were considered to arise from cardiac parasympathetic nerve activity and combined sympathetic and parasympathetic nerve function, respectively[6][7]. The consensus is that LHR reflects cardiac sympathetic nerve activity[6][7]. In addition, normalized units (nu) of two spectral components were calculated as follows: LFnu=LF/(TP-VLF)x100. HFnu=HF/(TP-VLF)x100(%). Normalized units of HF and LF are thought to highlight sympatho-vagal balance[6]. The estimation of power spectral data lasted for 3 hours between 0:00am and 3:00am. We calculated mean value of spectral data for 3 hours to compare 3 experiments.

4.Statistical analysis: All statistical analyses were performed using SPSS(7.5.1J). Results were expressed as mean± SEM. Friedman test was performed to compare 3 experiments. For significantly different spectral data among 3 experiments, Wilcoxon rank sum test was applied for multiple comparisons. A *P* value of less than 0.05 was considered significant.

Ⅲ RESULTS

Temporal changes in spectral indices obtained from a subject were presented in Fig 1. The results of power spectral analysis of RR interval among 3 measurements were shown



Temporal changes in spectral indices are shown. Power spectral indices were estimated for 3 hours between 0am and 3am and averaged in the analysis.

Fig.1 Temporal changes in power spectral indices obtained from a subject

in Table 1. Mean RR interval and standard error of the mean were not different among 3 measurements. There were no significant differences in TP, VLF, LF, HF, and LHR among 3 experiments. For normalized units, LFnu and HFnu were different among 3 measurements. The results of multiple comparisons for statistically significant spectral indices were presented in Fig.2. LFnu was significantly higher in control day than that in ordinary bath. In contrast to LFnu, HFnu was significantly lower in control than that in ordinary bath, LFnu and HFnu in aroma bath gave intermediate levels between those in control and ordinary bath.

Ⅳ DISCUSSION

In this study, we found significant increase in HFnu and decrease in LFnu during sleep after taking ordinary bath, compared to control. Compared to taking ordinary bath, taking bath containing aroma essence was not linked to additional effects on cardiac autonomic nerve activity during sleep.

A previous study showed that increased parasympathetic and decreased sympathetic nerve activity were observed 40-50 minute after taking ordinary bath[4], while taking ordinary bath at a temperature of 38°C could lead to an increase in sympathetic nerve activity and a decrease in parasympathetic nerve activity[9]. This study indicated that increased parasympathetic and decreased sympathetic nerve activity could continue at least during the first half of the night. These results were not inconsistent with previous report.

In contrast to ordinary bath, sympathetic and parasympathetic nerve activity in aroma bath resulted in intermediate levels between those in control and ordinary bath. One reason for that might be allergic skin reaction to lavender oil. A previous study showed that lavender oil could be linked to positive test for allergic skin reaction in subjects with past history of atopic or contact dermatitis[10]. One subject felt mild itching in taking aroma bath, although subjects with past history of allergic skin diseases were not included in this study. We cannot deny the possibility that unexpected allergic skin reaction was associated with lower parasympathetic nerve activity in taking aroma bath, compared to taking ordinary bath. Another reason might be that psychophysiologic changes attributable to aroma essence are different in subjects who like the odor from the changes in subjects who do not like it[2)3)], although subject who did not like the odor of lavender oil was not included in this study.

It should be noted that our study have some limitations in the interpretation of results including small number of data and no simultaneous electroencephalogram recording. A previous study indicated that autonomic nerve activity during sleep could be dependant on sleep stages[11]. Therefore, our results could come from different sleep stages. However, to avoid that, we selected 3 hours of RR interval data in which 2 cycles of sleep stages could be included. Therefore, we could minimize the influence of different sleep stages.

Table 1 Results of power spectral analysis of RR interval among 3 experiments

	Control	Aroma bath	Ordinary bath	Friedman
mean RR [ms]	1123.8±78.2	1090.2±109.4	1159.5±88.2	ns
SEM [ms]	96.9±14.7	91.9±6.14	98.3±11.6	ns
TP ln [ln ms^2]	18.21±0.16	18.13±0.20	18.26±0.16	ns
VLF ln [ln ms^2]	18.20±0.15	18.12±0.20	18.25±0.16	ns
LF ln [ln ms^2]	12.43±0.40	12.15±0.34	12.36±0.33	ns
HF ln [ln ms^2]	12.79±0.27	12.86±0.21	13.12±0.24	ns
LFnu [%]	38.85±4.69	34.83±6.08	31.15±4.90	p<0.05
HFnu [%]	61.15±4.69	65.17±6.08	68.85±4.90	p<0.05
LHR	0.87±0.19	0.74±0.18	0.63±0.13	ns

The comparisons of power spectral data among 3 experiments are shown. Mean RR, SEM, TP In, VLF ln, LF ln, HF ln, and LHR were not different among 3 experiments.
However, LFnu and HFnu were significantly different among 3 experiments.
Date are expressed as mean ± SEM

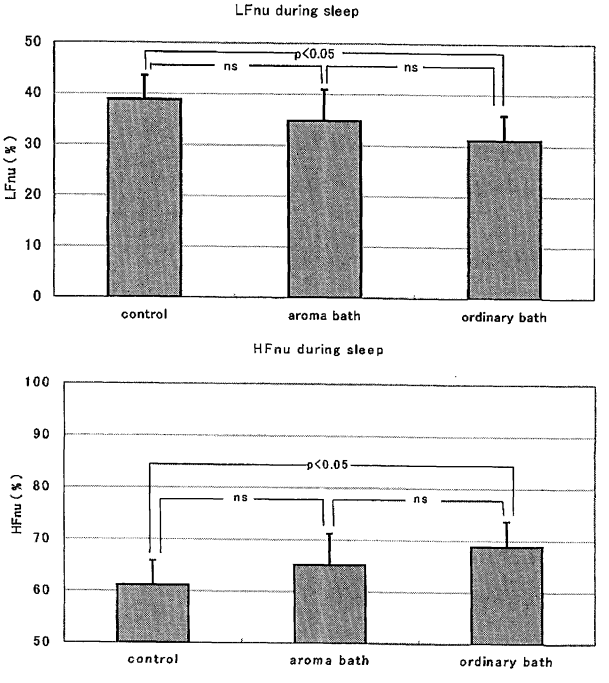


Fig. 2 Multiple comparisons for significantly differnt spectral data among 3 groups
The results of multiple comparisons for significantly spectral data are shown.
LFnu in control was higher than that in ordinary bath.HFnu gave an opposite result.
LFnu and HFnu in aroma bath showed intermediate levels between those in control and ordinary bath.

In conclusion, additional effect of taking bath with aroma essence on cardiac autonomic nerve activity during sleep was not found in this study, while taking ordinary bath could cause significant increase in parasympathetic and decrease in sympathetic nerve activity during sleep. Further studies with different way of the use of aroma essence during taking bath will be needed to clarify the accurate effects of taking aroma essence on human sleep.

This study was presented in the 65th Congress in Japanese Association of Physical Medicine, Balneology and Climatology held in Ishikawa prefecture, Japan.

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References

1) Kawabata K. Medical aromatherapy. Perinatal Care 17:55-61, 1998.

2) Koga Y. Aromatherapy: an application for patients with sleeplessness. Journal of Therapy 81:1137-1140, 1999.

3) Koga Y. Physiological evaluation of effect of aromatherapy. Clinic All-round 47:2017-2019, 1998.

4) Osaki N, Ochiai R, Tokumitsu I. Effect of artificial CO_2 bathing on autonomic nervous system. J Jpn Assoc Phys Med Baln Clim 63:91-96, 2000.

5) Akselrod S, Gordon D, Ubel FA, et al. Power spectral analysis of heart rate fluctuation: a quantitative probe of beat-to-beat cardiovascular control. Science 213:220-222, 1981.

6) Pagani M, Lombardi F, Guzzetti S, el al. Power spectral analysis of heart rate and arterial pressure variabilities as a marker of sympatho-vagal interaction in man and conscious dog. Circ Res 59:1178-1193, 1986.

7) Hayano J. Sakakibara Y, Yamada A, et al. Accuracy of assessment of cardiac vagal tone by heart rate variability in normal subjects. Am J Cardiol 67:199-204, 1991.

8) Kotsubaki I, Sakai Y, Omoto M, Okamoto C. The influence of using aromatherapy on sleep in patients in HCU: the results of practicing aroma bathing with lavender oil. Med J Hiroshima Pref Hosp 31:161-166, 1999.

9) Kishino T, Nagahama A, Sasagawa K, Matsuda M. Heart rate variability during the bathing in still water and flowing water. J Jpn Assoc Phys Med Baln Clim 59:175-183, 1996.

10) Nagareda T, Sugai T, Shoji A, et al. Incidence of positive reaction to cosmetic products and their ingredients in patch tests and representative cases with cosmetic dermatitis in 1992. Skin Research 35(suppl16):55-64, 1993.

11) Baharav A, Kotagal V, Gibbons BK, et al. Fluctuation in autonomic nervous system during sleep displayed by power spectral analysis of heart rate variability. Neurology 45:1183-1187, 1995.

連絡先：〒930-0194 富山市杉谷2630（Tel 076-434-2281, Fax 076-434-5022,
E-mail: ）
富山医科薬科大学医学部保健医学講座 関根 道和