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수면 관련 호흡질환 환자의 미각평가

조선대학교 대학원

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배 국 진

수면 관련 호흡질환 환자의 미각평가

Evaluation of Gustatory Function in Patients with Sleep Disordered Breathing

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이 논문을 치의학 석사학위신청 논문으로 제출함

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목 차

표 목 차

도 목 차

초록

수면 관련 호흡질환 환자의 미각평가

배 국 진
지도교수 : 유 지 원
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목적: 이 연구의 목적은 수면 관련 호흡질환 환자의 미각기능을 평가하는 것이다. 수면 관련 호흡질환의 병인은 완전히 규명되지는 않았다. 비록 수면 관련 호흡질환은 근신경과 해부학적으로도 그 병인은 아직 논란이 있는 상태이다. 본 연구에서는 근신경계 요인에 의한 병인론과 연관지어, 미각장애가 있으면 수면 관련 호흡질환의 경향이 있다는 가설을 입증하고자 하였다.

방법: 모든 환자들을 수면다원검사를 통해 수면 관련 호흡질환으로 진단하였다. 수면다원검사 결과를 기준으로, 모든 환자들은 코골이, 혼합, 폐쇄성 수면무호흡의 3개 그룹으로 나누었다. 대조군은 휴대용 수면 모니터링 기기를 통해 정상으로 판명된 건강한 지원자들로 구성되었으며 수면 관련 호흡질환 그룹과 나이를 맞추었다. 환자군과 대조군은 전기미각검사를 통해 미각 기능이 평가되었다. 혀의 전방, 설측 중간, 후방의 양측과 연구개의 양측에서 전기미각역치를 측정하였다.

결과: 수면 관련 호흡질환을 가진 환자들은 우측 설측 중간을 제외한 모든 검사 지점에서 대조군보다 전기미각검사 수치가 높게 나왔고 대조군과 수면 관련 호흡질환의 3개 그룹 각각을 비교 한 결과 통계적 유의성이 있었다. 3개의 수면 관련 호흡질환 중 코골이 그룹은 가장 많은 지점에서 통계적 유의성을 보였으나 코골이, 혼합, 폐쇄성 수면무호흡 그룹 중에는 통계적 유의성

을 보이지 않기도 한다.

결론: 이런 결과들은 수면 관련 질환 환자의 상기도부의 근신경계 이상과 더불어 미각 기능의 변화가 발생할 가능성을 제시한다. 앞으로 이번 연구를 뒷받침할 향후 연구가 필요할 할 것이다.

Keywords: 전기미각검사, 미각 기능, 폐쇄성 수면 무호흡, 수면 관련 호흡질환, 코골이

Ⅰ. Introduction

Sleep disordered breathing(SDB) is a broad term used to describe various distinct or occasionally overlapping respiratory dysfunctions, including primary snoring, obstructive sleep apnea(OSA), central sleep apnea, and hypoventilation.[1] The pathogenesis of SDB has not been fully understood. Anatomic factors, such as obesity, maxillomandibular retrognathia, and enlarged tonsils, compromise the size of the upper airway and are well-known risk factors for SDB. In neurologic aspects, long-standing snoring-induced vibrations cause neurogenic lesions in upper airway tissues, thereby damaging the reflex circuits responsible for keeping the upper airway open during inspiration.[2] In addition, many studies have suggested that neuromuscular alterations also contribute to the pathogenesis of SDB.[3-5] In these studies, several different methods of measuring local sensory neuropathy have been used, such as; two-point discrimination,[4] vibration,[5] and air-pressure pulses,[5] however, there were no attempts to evaluate the gustatory function in the SDB patients. In the studies about SDB, the gustatory dysfunction has been focused on as a side effect after surgical approaches such as uvulopalatopharyngoplasty (UPPP)[6] and radiofrequency tongue base reduction[7] to treat SDB. There was a comment related to the taste disturbance after UPPP that there might have been a pre-existing taste disturbance unrelated to the procedure.[8] The aim of this study is to evaluate the difference between gustatory functions in a sleep disordered breathing (SDB) group and a control group.

Ⅱ. Materials and methods

1. Subjects

This case-controlled study, comprised 60 patients, all of whom were diagnosed with sleep disordered breathing by polysomnography(PSG) in the Department of Neurology at Chosun University Hospital, from March to December 2010. On the basis of PSG results, these patients were divided into 3 groups: snoring, mixed, and obstructive sleep apnea(OSA). The control group comprised 44 healthy volunteers whose age was matched that of the SDB group and whose breathing was verified as normal using a portable sleep monitor device(ApneaLinkTM; ResMed, San Diego, CA, USA) offered by Chosun University Dental Hospital. This study was approved by the institutional review board of Chosun University, Dental Hospital.

2. Methods

The patient group and the control group were evaluated for gustatory functions with an electrogustometry(EG-ⅡB, Nagashima Medical Instrument Co, Tokyo, Japan) with a single, flat, circular stainless-steel stimulus probe (5-mm diameter) (Fig.1).

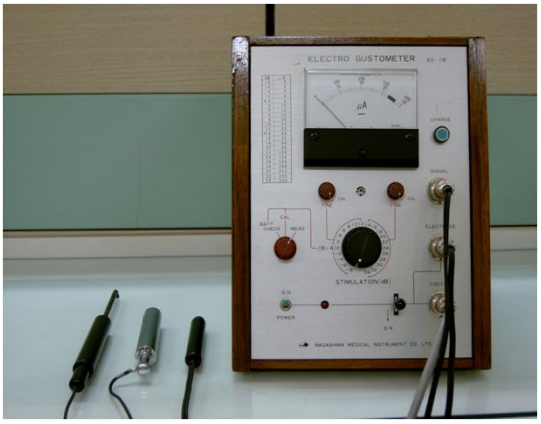

Fig. 1. Electrogustometery(EG-ⅡB, Nagashima Medical Instrument Co, Tokyo, Japan).

The test was carried out in a comfortable room, free from noise and distraction. Subjects were asked not to eat or drink anything except water 1 hour before testing. The electrical taste thresholds were measured at 8 different sites in the oral cavity : left anterior 1/3 of the tongue[LA], left midlateral of the tongue [LM], left posterior 1/3 of the tongue (circumvallate papillae) [LP], left soft palate [LS], right anterior 1/3 of the tongue [RA], right midlateral of the tongue [RM], right posterior 1/3 of the tongue (circumvallate papillae) [RP], and right soft palate [RS](Fig.2). After gargling with 5 mL of distilled water for approximately 10 seconds, the subject rested for 3 minutes. Then, the negative electrode was applied to the subject's right hand, the buzzer to the left hand, and the positive electrode to the recording sites. An electrical stimulus of 1 second was given to the patients, with the current intensity initiated at -8dB and subsequently increased by 2dB each time until a taste was evoked. The taste threshold was defined as the lowest detected level of sour, bitter, or metallic taste. The electrical taste thresholds of subjects who did not respond at 34dB were regarded as 34dB.

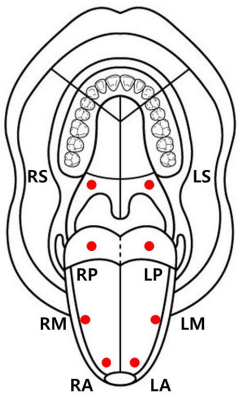

Fig. 2. Measured sites in oral cavity by Electrogustometery. LA, left tongue tip; RA, right tongue tip; LM, left middle 1/3 of the tongue; RM, right middle 1/3 of the tongue; LP, left posterior 1/3 of the tongue; RP, right posterior 1/3 of the tongue; LS, left soft palate; RS, right soft palate.

3. Statistical Analysis

All statistical analyses were performed using SPSS for windows (SPSS, Chicago, Illinois, version 20.0). To find out the difference in EGM scores, statistical analysis was performed using the Kruskal-Wallis and Mann-Whitney U test. Statistical significance was defined as $p<0.05$, with a 95% confidence interval.

Ⅲ. Results

There were 19 patients in the snoring group, 22 patients in the mixed group, and 19 patients in the OSA group. The average patient ages and the male: female ratio (M:F) in each group are listed in Table 1.

Table 1. Comparison of Age, Male:Female(M:F) ratio among groups.

	Control(n=44)	Patient(n=60)		
		Snoring(n=19)	Mixed(n=22)	OSA(n=19)
Age	42.0±4.6	44.73±10.5	44.6±11.5	46.7±11.3
M:F ratio	40:4	16:3	20:2	14:5

OSA, Obstructive Sleep Apnea; M, male; F, female

In the first analysis, comparison between the control group and all SDB patients, patients with SDB had higher EGM scores than the control group at all spots tested, except for the RM ($p<0.05$)(Table 2.). In the comparison between the control groups and divided SDB groups using the Kruskal Wallis Test, there was a statistically significant difference in the five tested sites (LA, RP, LP, RS, LS) (Table. 3), and there was a statistical significance in the comparison between the control group and divided SDB groups, respectively($p<0.05$).

Table 2. Comparison of EGM scores between control and Sleep Disordered Breathing group. (unit: dB)

	Location							
	LA	RA	LM	RM	LP	RP	LS	RS
Control (n=44)	5.68 ±7.40	4.73 ±7.60	13.64 ±8.98	14.05 ±9.66	12.55 ±7.97	12.23 ±7.93	9.32 ±7.57	11.50 ±8.70
SDB (n=60)	11.50 ±11.03	9.70 ±11.81	18.02 ±11.45	17.13 ±11.61	20.10 ±11.72	18.30 ±12.02	19.80 ±12.97	17.87 ±11.44
P-value	.010*	.035*	.041*	.119	.001*	.008*	.000*	.004*

LA, left tongue tip; RA, right tongue tip; LM, left middle 1/3 of the tongue; RM, right middle 1/3 of the tongue; LP, left posterior 1/3 of the tongue; RP, right posterior 1/3 of the tongue; LS, left soft palate; RS, right soft palate

Data expressed as the mean of the individual scores.

* ; $p < 0.05$(P-value by Mann-whitney U test)

Table 3. Comparison of EGM scores between control and divided Sleep Disordered Breathing group. (unit: dB)

	Location							
	LA	RA	LM	RM	LP	RP	LS	RS
Control	5.68 ±7.40	4.73 ±7.60	13.64 ±8.98	14.05 ±9.66	12.55 ±7.97	12.23 ±7.93	9.32 ±7.57	11.50 ±8.70
Snoring	10.63 ±8.85	9.89 ±10.21	16.84 ±9.92	20.00 ±10.52	21.16 ±11.34	19.58 ±12.08	19.80 ±12.97	17.87 ±11.44
Mixed	13.00 ±11.00	8.73 ±11.81	19.05 ±12.38	15.18 ±12.20	19.63 ±12.24	19.73 ±13.46	18.82 ±14.85	16.10 ±12.27
OSA	10.63 ±8.85	9.89 ±10.21	16.84 ±9.92	20.00 ±10.52	21.16 ±11.34	19.58 ±12.08	20.53 ±12.34	18.95 ±10.59
P-value	.042*	.192	.220	.187	.010*	.049*	.000*	.023*

Data expressed as the mean of the individual scores.

* ; $p < 0.05$(P-value by Kruskal Wallis Test)

Among the divided SDB groups, the snoring group had the most significant differences in the number of the measured spots, but there was no difference among the snoring, mixed, and OSA groups ($p>0.05$) (Table 4).

Table 4. Comparison of P-values between control and each group of Sleep Disordered Breathing

	P-value							
	LA	RA	LM	RM	LP	RP	LS	RS
Control vs snoring	.049*	.050	.169	.026*	.006*	.018*	.000*	.006*
Control vs mixed	.008*	.231	.079	.692	.019*	.043*	.008*	.172
Control vs OSA	.347	.126	.181	.375	.024*	.153	.001*	.021*

* ; $p < 0.05$(P-value by Mann-whitney U test)

Ⅳ. Discussion

Sleep disordered breathing(SDB) is a common sleep disorder that describes various distinct or occasionally overlapping syndromes related to respiratory dysfunction during sleep, from primary snoring to obstructive sleep apnea (OSA).[9] Especially OSA is a common, chronic disorder that is characterized by sleep fragmentation due to apnea, hypopnea, and repeated arousals resulting from partial or complete closure of the upper airway, and it occurs in patients of all ages.[10] Anatomic factors such as a narrow upper airway may predispose a patient to SDB,[11] although having a narrow airway does not guarantee that a subject will have this condition. It is possible that the narrowed anatomical size and the blunted neuromuscular responses of upper airways are both required for the development of SDB.[12] Many studies investigated the relationship between a peripheral neuropathy of the upper airway and SDB. The mechanoreceptors that respond to changes in airway pressure, airflow, and temperature , especially

those involved with afferent sensory receptors, could indirectly play a role in maintaining upper airway patency.[10] Gustatory function is mediated by special sensory receptor neurons. These sensory receptors are innervated by the chorda tympani and greater superficial petrosal nerves from geniculate ganglia in the anterior oral cavity, by the glossopharyngeal nerves from petrosal ganglia in the posterior oral cavity, and by the superior laryngeal nerves from nodose ganglia in the epiglottis.[13] Although there are different nerve innervations between afferent sensory receptors and special sensory taste receptors, the long-standing mechanical vibrations could cause neurogenic lesions in upper airway tissues,[2] so it could be applied to taste buds where taste receptors are located. Therefore we hypothesized that gustatory dysfunction could be predisposed to SDB. To the best of our knowledge, gustatory function in SDB patients has not been evaluated yet.

We evaluate gustatory function using electrogustometry(EGM). Chemosensory-based gustatory testing (the 3-drop method, impregnated taste strips, spatial taste test) is useful in the research setting for testing taste, but it is time-consuming and complicated.[7] In contrast, EGM is a quick, repeatable, and quantifiable method of assessing taste dysfunction.[14] Its reliability and validity have been evaluated in previous clinical studies.[15,16] The results of this study showed that SDB patients had statistically significant higher EGM scores than the control group in all area except for right middle(RM) (Table 2.). In previous studies, evaluating gustatory function, the difference between groups was assessed using independent t tests.[7] Although independent t tests are often used to determine the differences between groups, we analyzed the data with the Mann-Whitney U test and Kruskal-Wallis test, characterized as non-parametric statistics. These tests were used because the distribution of the obtained data did not meet normal distribution conditions, and the data were considered as orderly variables. We also evaluated the difference between groups using the independent t tests, and the results were the same.

In the comparison between the control groups and divided SDB groups using the Kruskal Wallis Test, there was a statistically significant difference in the five tested sites (LA, RP, LP, RS, LS) (Table. 3), and there was a statistical significance in the comparison between the control group and divided SDB groups, respectively($p < 0.05$). Notably, among the three SDB groups, the

snoring group had the most significant differences in the number of the measured spots (Table 4). These results suggest that sustained mechanical vibration could be associated with neurologic alteration in gustatory function, although there was no difference among the snoring, mixed, and OSA groups ($p > 0.05$). Generally, OSA seems to be progressive over time, and many patients reported years of snoring before witnessing apneas and symptoms.[2,17] So we hypothesized that the electrical taste thresholds might increase over the stages of SDB, from primary snoring to OSA. However, the results did not match our expectations, possibly due to the manner in which the SDB patients were divided. Although the results might be clinically significant, further studies are indicated to evaluate the progression of SDB quantitatively.

This study has several limitations. First, we did not use a questionnaire to assess subjective symptoms of tastes. It should be needed to correlate the subjective symptoms and objective signs. A validated questionnaire or chemosensory-based gustatory testing should be combined with EGM in future studies. Second, we divided into patient group, according to the PSG results, but the results of Apnea-Hypopnea Index (AHI) and Snoring Index were not considered quantitatively in this study. In the future, analyses correlating the progression of SDB and gustatory function will be needed to further evaluate the results of this study.

V. Conclusion

1. The patients with SDB had higher EGM scores than the control group at all spots tested, except for the right midlateral of the tongue, and there was a statistical significance in the comparison between the control group and the divided SDB groups, respectively.
2. Among the divided SDB groups, the snoring group had the most significant differences in the number of the measured spots, but there was no difference among the snoring, mixed, and OSA groups.

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