Kawasaki Journal of Medical Welfare Vol.1 No.1 1995 105~108

Original Paper

Nocturnal EEG Sleep in Blind Subjects : Comparison to Non Visually-Impaired Controls

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(Accepted October 30, 1995)

Key words : sleep stage, electroencephalogram (EEG), blind

Abstract

Sleep EEG recordings were made over two consecutive nights on two congenitally totally-blind subjects and two partially-blind subjects. The recordings obtained were compared with those from non-impaired subjects. The results showed that the percentage of sleep stage 3 was significantly decreased in blind subjects compared to control subjects. There were no significant differences in the other sleep stages. The blind subjects had less percentage of sleep stage 4, but there were no statistical differences.

Introduction

Little is known about the nocturnal sleep structure in visually-impaired persons. Previous studies on sleep in blind people have focused on dream content and their relation to REM sleep[1)2)].

There have been, to our knowledge, two studies[3)4)] which reported EEG sleep structures in blind subjects. Weitzman, *et al.*[3)] reported an abnormal secretion of growth hormone in two blind subjects which indicated a large increase in the percentage of Stage Wake (about 60%). However, this study did not report detailed results on EEG sleep structures. Krieger and Glick[4)] also examined growth hormone release and nocturnal EEG sleep structure in five blind subjects (24 to 63 years of age). The results clearly indicated a substantial reduction in Slow Wave Sleep (SWS, combined stage 3 and stage 4) compared to the expected value for people of comparable age.

However, the studies indicated above used an in dwelling venous catheter for sampling blood during the recording of nocturnal sleep. It is known that this method changes the sleep structure[5)]. It is possible that the sleep of blind subjects in Weitzman et al.'s and Krieger and Glick's studies was affected by the blood sampling procedure.

A previous report[6] by the authors indicated the reduction of SWS when compared to the expected value for people of comparable age in three congenitally-blind subjects. An exception was a subject who had been blinded two years previously. In this report, EEG sleep stages in two congenitally, totally-blind subjects and two partially-blind subjects were assessed and compared with the sleep patterns of normal subjects.

Methods

The subjects were two congenitally totally -blind males and two partially-blind males, aged 21 to 24, who underwent training to live or work at the Nippon Lighthouse Welfare Center for the Blind (Table 1). None had any complaints about their sleep and were not taking drugs interfered with sleep EEG stages. They gave informed consent to the investigation.

Polysomnographic recordings, including EEG, EOG, and EMG measurements, were obtained in a laboratory for two consecutive nights. The subjects retired at 23:00 and were awakened at 7:00 the next morning. They completed a sleep inventory (OSA Sleep Inventory)[7] before and after each sleep recording to assess the subjective quality of their previous night's sleep. Sleep stages were scored for 20-second epochs according to the criteria of Rechtschaffen and Kales[8].

Six male undergraduate students (20 to 21 years of age) with no visual impairment served as the normal group. They slept in the laboratory for three consecutive nights for the polysomnographic recordings.

On the second or third night, the percentage of different sleep stages was compared between the blind and normal groups using the t-test.

Table 1 Profiles of blind subjects

Subjects	age	Etiology of blindness	Light perception
S101	21	congenital glaucoma	A
S102	21	retinal detachment	(R)P (L)A
S105	21	congenital degeneration	A
S106	24	retinal pigmentary degeneration	P

R, right; L, left; A. absent; P, parital

Results

Table 2 shows the means of each sleep measurement in both groups. The comparisons of TST, sleep efficiency and different latencies showed no significant differences between the groups. But the mean percentage of stage 3 in the blind group was significantly increased ($p<.05$). Also, the blind subjects had less percentage of stage 4, although these results were not statistically significant. There were no significant differences in the other sleep stages.

The OSA Sleep Inventory also revealed no significant differences in any of the five factors (Table 3). The mean score in one factor (F5, sleep initiation) tended to be greater in the blind group than in the control group but the difference was not significant ($p=.056$). In post test interviews, all the blind subjects reported no difficulties in waking up with excessive sleepiness or dizziness and reported no dreams with clear contents.

Discussion

This study compared EEG sleep measurements in blind subjects with those in normal subjects. The results revealed a significant increase in the percentage of stage 3 in blind

Table 2 EEG sleep measurements in blind and control

EEG measurements		blind (n=4)	control (n=6)
TST	(min)	438.4(9.7)	433.2(11.6)
sleep efficiency(%)		98.5(2.5)	98.4(1.9)
latency	(min)		
sleep latency		4.8(3.0)	10.4(8.4)
stage 2		5.7(4.0)	5.9(1.5)
stage 3		18.9(8.2)	16.9(3.9)
stage 4		24.4(8.9)	26.1(12.5)
REM latency		101.4(33.9)	108.7(26.8)
sleep stages			
stage Wake	(min)	6.5(11.2)	6.6(8.7)
stage 1	(%)	15.1(6.3)	11.8(4.3)
stage 2	(%)	47.5(10.5)	52.5(8.4)
stage 3	(%)*	7.1(2.0)	4.2(1.0)
stage 4	(%)	5.3(4.3)	7.5(5.8)
stage REM	(%)	21.7(1.8)	20.2(5.3)
SWS	(%)	12.4(3.0)	11.7(6.2)
MT	(%)	1.6(0.4)	2.1(1.0)

Abbreviations: Total Sleep Time, TST; Slow Wave Sleep, SWS; Movement Time, MT. Sleep onset was defined as the first occurence of stage 1. Sleep latency was defined as time between lights off and the sleep onset. Values in parentheses indicate Standard Deviations. *$p<.05$

Table 3 Mean scores in each factor of OSA sleep inventory

Factors	blind (n=4)	control (n=6)
Factor 1	54.9(7.0)	49.3(3.8)
Factor 2	47.6(7.9)	48.2(4.0)
Factor 3	54.5(4.5)	49.7(4.6)
Factor 4	51.9(9.9)	48.7(7.0)
Factor 5	52.8(5.9)	45.4(4.5)

Factor 1, sleepiness; Factor 2, sleep maintenance; Factor 3, anxiety; Factor 4, integrated sleep; Factor 5, sleep initiation
Values in parentheses indicate Standard Deviations.

subjects. The blind group also had less decrease in the percentage of stage 4, although the difference did not reach statistical significance. There were no significant differences in the other sleep variables.

When compared with the mean (about 19%) of SWS (combined stage 3 and stage 4) indicated by Williams, *et al.*[9] for the corresponding age group, the mean percentage (12.1%) in blind subjects in the present study was lower. Also, in Krieger and Glick's study, one blind male, 24 years-old, had a lower percentage of SWS than the mean. However, the difference between groups in our study was not statistically significant. This was due to the low mean percentage of SWS (11.7%) in our control group, which, in turn, was probably due to normal individual variation[10)11)12)].

Of particular interest was the finding of a significant increase of stage 3 and a decrease of stage 4, non-significant, in blind subjects compared to control subjects. Robinson & Dawson[3)] compared the structure of EEG sleep in deaf subjects with that of controls. The results also showed a significant difference in the deaf group. Although there was no significant difference in the percentage of SWS between the groups in our study, it might be theorized that prolonged, visual deprivation is associated with the activity of SWS in nocturnal sleep.

Since little is presently known about the nature of sleep in blind people, findings from this study warrant additional studies.

Acknowledgment

The authors wish to thank Prof. R. Wright for her helpful comments on the manuscript. This research was supported in part by Grant-in-Aid (No. 63510078) for scientific research in Japan, to the second author. We also thank the following for assisting with the research: Hibino K, Shibata H, and Omodaka T in the Nippon Lighthouse Welfare Center for the

Blind.

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