Late daytime naps may cause drowsiness after coronary bypass graft operation in the first postoperative week

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Sleep disturbances after coronary artery bypass operations are being widely investigated, but any relationship between the operations and daytime naps has not been thoroughly studied. Daytime napping (in particular afternoon and evening naps) affects total night sleep duration. Thus, increased daytime naps causes a decrease in night sleep time.[1] Environmental factors, individual sleep conditions, and postoperative complications have been suggested as the cause of sleep disturbances in coronary artery bypass graft (CABG) surgery patients,[2] but none of these studies have investigated the effect of daytime napping on night sleep time. This prospective study is planned in order to investigate whether daytime naps cause a decrease in night sleep and disturb sleep efficiency (SE) after CBAG surgery.

In this study, we used the actigraphic nap analysis method to compare coronary bypass operated patients and a healthy control group. Eight-five cases consisting of 45 (23 male and 22 female) patients that underwent CABG operation with cardiopulmonary bypass, and 40 healthy (20 male and 20 female) subjects as controls were evaluated. The study was approved by the institutional ethics committee, and all participants gave their written informed consent. All patients did not have any sleep disturbance and neurologic disorders such as stroke or tremor affecting the non-dominant arm movement (because of the need to wear a wrist Actigraph) or anxiety, and peptic ulcus. None of the patients were taking any drugs related to sleep disorders or central nervous system depressants. A brief psychiatric screening (Hamilton Depression Rating Scale) was completed on each subject. A score of less than 7 was required for participation. Sleep assessment questionnaires were completed by the patients and control subjects in the morning hours. Patients were included in the study for nearly 10 days, including preoperative measurement of the primary study at least 3 days before surgery and a 5-8 consecutive-day period during the first postoperative week for the study group. Wrist Actigraphs were not used on the operative day and the first postoperative day. The control group subjects wore the wrist Actigraphs for a 7-day period continuously. The sleep instruments used in this study included subjective findings such as a standard sleep diary, Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and objective parameters such as Maintenance of Wakefulness Test (MWT), EEG, and actigraphy. A PSQI score of greater than 5 excluded subjects from the study. An ESS score of equal or greater than 10 was assessed as sleepiness. We applied MWT test for all subjects from 13:00 hours to 21:00 hours in a silent and dim room, to evaluate drowsiness of the subjects. The control and study groups (during pre-and-post-operation periods) were evaluated by EEG with at least 30 minutes periods from 13:00-21:00 hours in a silent and dim room. Subjects in whom sleep parameters were observed on their EEGs were accepted as "light sleep positive".

Actimetric procedures. The actimeter is designed for long-term monitoring of gross motor activity in humans and has an accelerometer capable of sensing motion with a minimal resultant force of 0.01 g.[3] Participants wore a wrist actimeter (Actiwatch, AW64®, Mini-Mitter Co. Inc., Bend, OR, USA) on their nondominant wrist in order to examine their motor activity, nap, and sleep analysis. They completed one sleep diary each morning during the period of using actigraphs. These diaries were used to record daily bed times, time of sleep onset, frequency, and duration of awakenings during the sleep period, final awakening time, and napping (sleep outside of the major sleep period) times during the day in order to provide some information about sleep latency (SL), frequency of prolonged awakenings, and total sleep time (TST). The actigraphs were applied to participants' nondominant wrists on the first postoperative morning and worn continuously throughout the 5-day period in order to evaluate sleep duration and continuity as well as to obtain some information about daytime naps. All watches were calibrated prior to use and set to collect data at 30-seconds epochs, and maximum frequency of 32 Hz according to the criteria used by Sadeh.[3] Device sensitivities were determined to indicate that motor activities, ≥ 20 indicates the subject being awake. A minimum of 10 minutes without motor activity after pressing the marker is determined as sleep onset. Counts of motor activities less than 5 are assessed as a sleep period in the analysis of napping. Nap times are determined as a minimum of 15 minutes, similar to the study of Brooks.[4] The primary sleep period was recognized based on the times that participants pressed the button on the actimeter, in the evening at lights out and in the morning after waking up, made it possible to log these events. In evaluating nocturnal sleep, the following sleep parameters were estimated: bedtime, wake-up time, sleep-onset time, sleep-offset time, SL, TST, wake time after sleep onset (WASO), and SE. Bedtime and wake-up time were determined from activity scores and sleep logs. Nocturnal sleep interval for scoring was set from bedtime to wake-up time. The SE (nocturnal sleep

time/time in bed x 100) and the other sleep parameters were obtained from the actigraphic sleep estimates. Sleep onset or offset was defined as the first or last sleep epoch within the nocturnal sleep interval. Naps were divided into 2 groups according to time, morning naps were named "early daytime naps", and afternoon or evening naps were named "late daytime naps".

Statistical analysis. The data were entered into the SPSS version-10 program. Mann-Whitney U test, and one-way analysis of variance test was used for statistical evaluation. A *p*-value less than 0.05 was considered significant.

The mean age of the study group was 61.2 for male and 58.7 years for female patients, and 62 for male and 59.8 for female subjects in the control group. There were no statistically significant age or gender differences between control and study groups. The postoperative ESS scores were significantly higher, counts of "light sleep positive" cases were significantly higher, MWT durations were significantly shorter than preoperative values. Postoperative SL and TST were shorter, TAS and FI were less, WASO durations were longer than pre-operative and control group values. Finally, in the postoperative group, SE was found less than the preoperative group SE ($p<0.001$). Nap episodes and total nap durations were found increased after CABG surgery (**Table 1**). Postoperative nap analysis was significantly different from the preoperative nap analysis. We found significantly negative correlations between the nap episodes; total nap durations, and SEs in the postoperative group. Napping episodes that clustered in the late daytime (between the afternoon and evening) period are found more interesting.

Sleep disturbance, poor sleep quality, and sleep continuity (difficulty falling asleep, restless sleep with frequent nocturnal awakenings and early morning awakenings) are common among the patients during recovery after cardiac surgical procedures and may have important effects on morbidity, mortality, and quality of life. More patients after CABG operation complain of sleeplessness, and sleeplessness not only affects quality of life but also negatively affects the prognosis. Many brain cortical and subcortical regions have a role on the beginning of sleep and continuation. The circadian factors lead to sleeping more at a certain time of day, or lead to sleeping less. Homeostatic sleep stimulation increases

Table 1 - Actigraphic results.

Parameters	Preoperative group		Postoperative group		Control group	
	Female	Male	Female	Male	Female	Male
Subjective parameters						
PSQI (point)	3.14±0.83 (2.00-5.00)	2.97±0.95 (1.00-5.00)	5.55±0.96* (4.00-7.00)	6.09±0.79* (4.00-8.00)	2.70±1.33 (0.00-4.00)	2.67±1.42 (0.00-4.00)
ESS (point)	2.05±0.90 (0.00-6.00)	2.39±0.86 (0.00-6.00)	6.23±1.01* (4.00-9.00)	6.16±1.08* (3.00-8.00)	2.00±1.21 (0.00-6.00)	2.04±1.11 (0.00-6.00)
Objective parameters						
MWT (minute)	17.90±1.32 (14.00-19.00)	18.39±1.06 (14.00-20.00)	16.31±1.01 (14.00-18.00)	16.60±1.21 (15.00-19.00)	18.00±1.07 (17.00-20.00)	17.60±1.00 (14.00-20.00)
Light sleep positive on EEG (n)	2	3	15*	17*	3	4
SL (minute)	15.55±8.33 (10.00-30.00)	16.13±7.45 (9.00-30.00)	22.77±6.24* (15.00-35.00)	23.39±6.55* (11.00-40.00)	16.00±7.11 (10.00-31.00)	17.00±7.43 (10.00-32.00)
TST (hour/night)	7.17±0.64 (6.00-8.05)	7.08±0.43 (6.25-8.06)	6.13±0.98** (4.25-7.42)	6.00±0.88** (4.20-8.20)	7.18±0.56 (6.39-8.45)	7.09±0.61 (5.59-8.00)
Total activity score (n/night)	9851±7353 (1034-23028)	8608±7200 (1334-22280)	5779±7861** (1243-23591)	5980±8200* (3421-23571)	8700±7324 (3000-23800)	9780±7215 (2100-21980)
WASO (minute)	14.59±2.01 (5.00-60.00)	14.13±2.02 (6.00-61.00)	36.14±2.71* (20.00-70.00)	34.17±2.53* (21.00-69.00)	14.30±2.00 (6.00-61.00)	15.00±2.01 (5.00-62.00)
Fragmentation index (n/day)	9.44±1.21 (2.00-17.80)	8.43±1.23 (1.90-17.00)	15.54±2.30* (1.90-19.50)	15.70±2.01* (2.42-19.90)	8.80±1.19 (2.00-18.00)	9.33±1.20 (1.89-18.00)
SE (%)	93.70±12.00 (59.00-98.00)	92.65±15.21 (59.00-99.00)	68.20±14.92* (45.40-88.20)	66.71±11.17* (45.00-80.00)	94.70±1.21 (51.00-98.00)	94.01±0.94 (50.00-98.00)
Daytime napping episodes (n/day)	2.31±0.44 (1-4)	2.86±1.19 (1-4)	5.45±1.80* (2-11)	5.70±1.20* (2-11)	2.45±1.04 (0-4)	2.41±0.71 (0-4)
Total nap duration (minute/day)	32.02±4.00 (15.00-55.00)	33.00±4.13 (15.00-59.00)	98.00±8.23* (24.11-143.00)	99.00±9.32* (24.91-151.07)	30.10±4.10 (15.00-57.00)	31.00±4.20 (15.00-60.40)

PSQI - Pittsburgh Sleep Quality Index, ESS - Epworth Sleepless Scale, MWT Maintenance of wakefulness Test, EEG - Electroencephalography, SL - sleep latency, TST - total sleep time, WASO - wake after sleep onset, SE - sleep efficiency, * $p<0.001$

as long as time of awakeness increases. An important finding in our study on sleep disturbance after CABG surgery was increased unusual daytime naps in addition to the sleep disturbances. We found that daytime naps cause a decrease in homeostatic sleep motivation, increase SL, and decrease TST. However, daytime naps lead to a decrease in night sleep requirement, and this decrease is observed as night sleeplessness. We observed increased nap episodes and nap duration periods and differences between the study group after operation and control group results were statistically significant. The results of some studies supported our results, as in some studies it is detected that increments in daytime sleep caused a decrease in night sleep. It was also reported that when there was no daytime nap, night sleep time returned to the values before operation.[5] There is a strong negative correlation between SEs and total nap durations.[1] The SE is calculated as a result of dividing the TST by the value obtained by removing WASO durations from TST. In our study, there are significantly negative correlations between the nap episodes and SEs. The SEs were less in subjects with more nap episodes and longer nap durations. Either the existence of daytime naps, or their periods in the day is important for affecting sleep formation. Naps in the early daytime periods and in the mornings do not affect SE, however, naps in the afternoon and evening period cause sleep disturbance by lessening total sleep duration. More frequent afternoon naps lead to more disturbed TST. There is a negative correlation between naps in the afternoon and TST. Nap episodes in our subjects were in the afternoon and evening day periods. The main cause of decreased total night sleep time may be these clustered naps, which decrease homeostatic sleep stimuli.

In summary, afternoon naps may be an important cause of decreased SE in patients with CABG surgery, by distorting homeostatic sleep regulation. Prevention of these naps may be useful in order to recover healthy sleep performance by regulating adaptation capability and neuronal plasticity of these centers.

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References

1. Kaida K, Nakano E, Nittono H, Hayashi M, Hori T. The effects of self-awakening on hearth rate activity in a short afternoon nap. ***Clin Neurophysiol*** 2003; 114: 1896-901.
2 Edell-Gustafsson UM. Insufficient sleep, cognitive anxiety and health transition in men with coronary artery disease: a self-report and polysomnographic study. ***J Adv Nurs*** 2002; 37: 414-415.
3. Sadeh A, Hauri PJ, Kripke DF, Lavie P. The role of actigraphy in the evaluation of sleep disorders. ***Sleep*** 1995; 18: 288-302.
4. Brooks A, Lack L. A brief afternoon nap following nocturnal sleep restriction: which nap duration is most recuperative? ***Sleep*** 2006; 29: 831-840.
5. Edell-Gustafsson UM, Hetta JE, Aren CB. Sleep and quality of life assessment in patients undergoing coronary artery bypass grafting. ***J Adv Nurs*** 1999; 29: 1213-1220.

ETHICAL CONSENT

All manuscripts reporting the results of experimental investigations involving human subjects should include a statement confirming that informed consent was obtained from each subject or subject's guardian, after receiving approval of the experimental protocol by a local human ethics committee, or institutional review board. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed.