

Sleep conditions and quality of life among patients with ischemic heart disease after elective percutaneous coronary intervention*

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ABSTRACT

In Japan, percutaneous coronary intervention (PCI) is a major therapeutic intervention for ischemic heart disease (IHD). Previous studies suggested that an association of the risk of IHD caused by sleep duration was related to factors closely associated with daily activities. However, in Japan, there is no study about this relationship objectively measured using the actigraphy in patients with IHD. Moreover, there is little reported data about sleep condition and early outcomes of patient's Health-Related Quality of Life (QOL) after PCI. This study determines the correlations between sleep conditions and QOL (measured by SF36 version 2) of 25 patients with IHD who underwent elective PCI. Data were collected seven days after PCI using night-sleep condition. Using Spearman's rank test, the results revealed positive correlation between vitality score and longest sleep duration ($\rho = 0.43$, $p = 0.031$); social functioning (SF) score and duration of night-time sleep ($\rho = 0.42$, $p = 0.037$); total sleep duration ($\rho = 0.45$, $p = 0.026$), and longest sleep duration ($\rho = 0.44$, $p = 0.024$); mental health score and longest sleep duration ($\rho = 0.54$, $p = 0.006$). However, negative correlation was found between physical functioning score and arousal during sleep ($\rho = -0.44$, $p = 0.027$). Sleep condition was significantly correlated with QOL. In particular, SF score was positively related to night-time sleep. This seems to

indicate that SF score might be related to night-time sleep condition. Moreover, the longest sleep durations were correlated with the mental component summary. The results of the study suggest that not only the length of whole sleep durations leads to better QOL, but also the increase the amount of uninterrupted sleep.

Keywords: Ischemic Heart Disease; Actigraphy; Sleep Condition; Health-Related Quality of Life

1. INTRODUCTION

Lifestyle changes such as consuming western-style food, overeating and a lack of exercise have led to an increasing incidence of metabolic syndrome complicated with coronary artery disease in Japan [1,2]. Metabolic syndrome is characterized by excessive fat around the internal organs, leading to abnormal lipid metabolism, impaired glucose tolerance and hypertension [3]. Around 20 million Japanese in their 40s to 70s already have or were more likely to suffer from metabolic syndrome in 2006 [4], suggesting that more patients will develop is IHD in the future.

PCI is the main therapeutic treatment for IHD. The development of medical technologies such as drug-eluting stents has significantly reduced the hospital death rates of patients with acute myocardial infarction [5]. However, IHD is a disease that is linked to recurrent arterial stenosis and coronary artery infarction. Continuous improvements in lifestyle, oral medicines and periodic catheter examinations are essential to prevent IHD recurrence. Many reports indicate that continuous physical activity reduces cardiovascular risk [6,7] and improves

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the person's QOL [8,9].

Comprehensive cardiac rehabilitation (CCR) prevents restenosis and improves QOL [10] which includes patient education delivered by medical teams about dietary changes, lifestyle, and the importance of regular medication, social psychological support and exercise regimens [11]. However, only a few hospitals offer CCR in Japan due to lack of facilities and personnel experts [12]. In addition, patients with IHD who undergo elective PCI at present usually do not receive CCR. However, patients must self-regulate their life rhythms such as activities and rest, which will benefit cardiac functioning immediately after receiving medical treatments and improved lifestyle habits. Such patients have often reported feeling that repeated PCI is undesirable but necessary and that they feel physically unhealthy after treatment [13].

Some investigators have identified an association between increased risk of IHD and sleep duration [14-17], a factor that is closely associated with daily activities. Various studies have examined the relationship between sleep duration and cardiovascular mortality. Previous studies have indicated relationships among sleep quality, psycho-physiological symptoms and QOL by inventory [18]. Redeker *et al.* [19-21] suggested that interventions to improve sleep during hospitalization and post-hospitalization were important for the recovery of patients under cardiac care. Sleep contributes to both physical functioning and emotional wellbeing from 4 to 8 weeks after cardiac surgery operation in patients in the USA. Other related studies [22,23] after cardiac surgery operation has generated similar findings. However, the quality of sleep among Japanese patients with IHD has never been objectively surveyed using actigraphy.

There were previous studies about patients with percutaneous transluminal coronary angioplasty (PTCA), for example, Edéll-Gustafsson and Hetta [16] who reported that sleep quality was related to anxiety and depression, selected psycho-physiological sleep-disturbing symptoms, daytime dysfunctions according to poor sleep, and QOL at 1 year after PTCA. Hatano *et al.* [24] reported that QOL scores are significantly lower among patients with IHD who were hospitalized for the first time and those who were re-hospitalized within three months compared with a control group. Similarly, Matsuoka *et al.* [25] assessed factors related to QOL among patients with IHD after coronary intervention; they suggested that the QOL of patients with IHD is related to the presence or absence of coronary restenosis and an irregular heartbeat, coronary disease severity and social support as well as several other factors. Although QOL was evaluated using the SF-36, the subscale of general health perception and social functioning were significantly higher among such patients without arrhythmias after coronary intervention. Furthermore, as mental health

is related to family and organizational support, their findings suggested a relationship between QOL and IHD. A relationship between the objective sleep index of Japanese patients with IHD and their QOL has not been clarified, although a range of factors are known to influence QOL.

To continuously treat patients with IHD and improve their QOL, sleep and wake rhythms must be established based on their sleep patterns. Understanding the association between sleep and QOL during this period could enable the provision of information to patients with IHD about the importance of maintaining fine-quality sleeping habits as well as suitable daily activities.

Sleep disorders [26] are commonly under-diagnosed and comprise a significant source of concern in the geriatric population; however, treating insomnia in patients with IHD can improve overall health. That is, better sleep could improve lifestyle rhythms and thus the QOL of the elderly and of patients with IHD.

2. PURPOSE

The aim of this study was to analyse the relationship between sleep conditions and quality of life among patients with ischemic heart disease after elective percutaneous coronary intervention

3. METHODS

3.1. Subjects and Study Location

The subjects of the study met the following inclusion criteria: 1) no undergoing CCR; 2) the ability to complete a questionnaire; 3) no history of heart failure or life-threatening arrhythmia before PCI; 4) free of chronic psychiatric diseases requiring psychotropic medication, and/or having sleep disorders; and 5) underwent elective PCI of initial therapy or who underwent two or more retreatment by PCI.

This study was conducted at a general public hospital located in Shikoku, Japan. Twenty-five patients with IHD treated with elective PCI were selected and data collected between August 2009 and August 2011 were analyzed.

Of the total, 25 patients (male, $n = 14$ (56.0%); Female, $n = 11$ (44.0%); average age, 65.1 ± 11.4 years, range 47 - 88 years; multiple PCI, $n = 19$ (76.0%).

3.2. Data Collection Methods

3.2.1. Sleep Condition Measured by Actigraphy

Actigraphy is a simple procedure that is used to assess sleep-wake cycles. The patients wore actigraph accelerometers (Ambulatory Monitoring, Inc. Ardsley, NY, USA) on the non-dominant wrist for 7 days (except when bathing), starting from 1 to 2 days before discharge and 6

days after discharge from the hospital. Day of discharge was excluded in the duration count. Actigraph data using the sleep/awake formula of Cole and others closely correlate with polysomnography, with reliability coefficients ranging from 0.89 to 0.98 for normal sleep [27-29].

3.2.2. Health-Related Quality of Life (QOL)

The QOL survey was administered on the seventh day after discharge using the health-related scale of SF36 ver2 TM: Medical Outcomes study 36-Item Short-Form Health Survey, Standard, Japanese version; SF36 ver2. This simple generic measure minimally burdened the subjects. It consists of the following eight subscales (2 - 10 items): physical functioning (PF; 10 items), role physical (RP; 4 items), bodily pain (BP; 2 items), social functioning (SF; 2 items), general health perceptions (GH; 5 items), vitality (VT; 4 items), role emotional (RE; 3 items) and mental health (MH; 5 items). Each item comprises five scores on the Likert scale. The maximum total score for each item ranges from 0 to 100. Higher total scores are considered to represent a higher QOL. The Cronbach's alpha coefficient of the eight subscales was 0.77 - 0.93 [30-32].

3.3. Data Analysis

In this study, the researchers analyzed the data collected on the seventh day after discharge from the hospital. The data revealed that the number of times of arousal during sleep and rest hours in the daytime was more decreased than immediately after being discharged from the hospital.

Actigraphic data were imported from the external interface using an ACT2000/ACT Millennium, displayed and analyzed using Action W-2 software (Ambulatory Monitoring) based on a standardized sleep scoring algorithm [29]. The eight subscales of SF36 ver2 were scored by specialized scoring software (Excel version). Correlations between each sleep item such as sleep onset and offset times (hh:min:ss), duration from onset to offset time (min), mean activity (counts/min), duration of being totally awake (minutes), total sleep duration excluding any amount of time being awake (min), and % sleep, sleep latency (min) and the activity index (epoch with >0 activity score; %) and SF36 ver2 were analyzed by Spearman's rank-order test.

All data were analysed using IBM SPSS ver. 19.0. The level of significance was set at $p < 0.05$.

3.4. Ethical Considerations

The study was approved by the Ethics Committee of Tokushima Prefectural Central Hospital (No 09-07) and the Tokushima University Hospital Ethics Board (No.

1257). The following issues were carefully explained to the patients orally and in writing: the purpose and content of the study; the voluntary nature of participation and that refusal to participate would not cause any disadvantages; the freedom of approving or disapproving the findings to be used in presentation of the research; and the rights of anonymity and secure confidentiality. The patients included in the study provided written informed consent to participate.

4. RESULTS

Table 1 shows correlations between night-time sleep and QOL. Positive correlations were found between VT score and longest sleep duration ($\rho = 0.43$, $p = 0.031$), between SF score and night-time duration ($\rho = 0.42$, $p = 0.037$), between total ($\rho = 0.45$, $p = 0.026$), and longest ($\rho = 0.44$, $p = 0.026$) sleep duration, and between MH score and longest sleep duration ($\rho = 0.54$, $p = 0.006$). On the other hand, the negative correlation between PF score and arousal during sleep was obtained ($\rho = -0.44$, $p = 0.027$).

5. DISCUSSION

This study clarified the relationship between sleep conditions and the QOL at 7 days after discharge from hospital (when patients returned home to assume one's life activities as it was before hospitalization (premorbid state)).

Arousal during sleep and PF score was negative and correlated significantly, suggesting that the incidence of arousal during sleep decreased, accompanied by an increase in daytime physical activity. Yoshimura *et al.* [33] found that night-time urinary frequency was one of the reasons for arousal during sleep, and was the most closely associated with the three Medical Outcome Study Short Form-8 (SF-8) domains of PF, RP, and SF score. Arousal during sleep in the present study was not only caused by having to wake up to cause urination, but it also suggested that interrupting sleep might decrease this QOL score. Promoting uninterrupted sleep might lengthen sleep duration at night. Furthermore, longest sleep duration also positively correlated with VT, SF, and MH score. These data suggested that longer sleep duration leads to an improvement in the degree of satisfaction with sleep felt by patients which might increase mental QOL sub scores such as VT score, or SF score and MH score in the mental component summary (MCS). The eight subscales of the SF36 ver2 can use the scores of the physical component summary (PCS) and MCS. However, these scores of the Japanese version pointed out problems remaining in the SF36 ver2 when sample sizes are small and people with diseases are monitored [34].

To avoid the limitation, each eight subscale scores of

Table 1. Correlations between data from the actigraph in the night-time and QOL.

8 subscale of SF36 ver 2	Item of Actigraphy										
	Onset-time	Offset-time	duration	Mean Activity	Total wake duration	Total sleep duration	Percent sleep	Sleep latency	Arousal during sleep	Logest sleep duration	Activity index
PF (Physical Functioning)	0.16	-0.28	-0.30	-0.35	-0.35	-0.20	0.28	0.32	-0.44*	0.21	-0.33
RP (Role Physical)	-0.04	-0.07	-0.01	0.17	0.18	-0.05	-0.30	0.33	0.17	0.30	0.25
BP (Bodily Pain)	0.27	-0.13	-0.21	0.01	0.08	-0.22	-0.13	0.23	0.20	0.20	-0.05
GH (General Health Perceptions)	-0.20	0.01	0.30	0.30	0.33	0.25	-0.28	0.14	0.26	0.27	0.18
VT (Vitality)	0.02	0.06	0.21	0.27	0.29	0.21	-0.30	0.22	0.30	0.43*	0.20
SF (Social Functioning)	-0.16	0.20	0.42*	0.03	0.15	0.45*	0.05	-0.09	0.08	0.44*	0.16
RE (Role Emotional)	0.14	-0.07	-0.04	-0.04	-0.03	-0.05	-0.01	0.22	0.03	0.19	0.27
MH (Mental Health)	-0.09	0.04	0.20	0.08	0.18	0.17	-0.11	0.04	0.08	0.54**	0.05

*Spearmann's ran-order test, ρ (two-sided), * $p < 0.05$, ** $p < 0.01$.

SF36 ver.2 was used in this study. Although, MCS was not analyzed in this study, it does show that uninterrupted sleep might affect the mental health component summary and thus the amount of uninterrupted sleep is also important for mental health in Japanese patients with IHD.

Takenaka *et al.* [35] reported that administering a short-acting sleeping agent to patients with insomnia caused a significant improvement in the Pittsburgh Sleep Quality Index (PSQI) scores and in the MCS in SF36. The longest sleeping durations by actigraphy have not been sufficient. A key topic for future studies might be to determine care methods that aim to lengthen sleep duration.

SF score in SF36 ver2, duration of nighttime, total sleep duration and longest sleep duration were positively correlated. SF score evaluates the degree of emotional or physical problems; lower social function could become a barrier to normal social activities. Among individuals aged ≥ 65 years, 46% spend most of their time alone except when asleep, and 78% live alone [36]. Thus, the number of social interactions tends to decrease among elderly individuals. Previous studies [7,8,37] have described a relationship between CCR and QOL. The benefits of CCR are the prevention of coronary artery restenosis, and also increase the possibility of interactions with others person. However, since the patients of this research have not participated in CCR, if they spend daytime hours alone indoors; they might also have poor sleep conditions during the night-time. Conversely, improving the sleep conditions of patients after elective PCI might help to improve social interactions with others.

Patients with IHD can develop anxiety due to coronary artery restenosis [13,38]. Physical activity in the ADL is limited in such patients. This tendency might be more obvious in patients who have not undergone CCR. Therefore, daytime activities should be maintained at levels that are sufficient to avoid poor sleep quality in patients who have not received CCR after PCI. In that sense, CCR might be important for patients with IHD. Hence, information should be provided about CCR, and ADL should be promoted so that longest sleep duration becomes longer.

6. LIMITATIONS

This study was limited by the small number of subjects and the inability to investigate how sleep and QOL correspond to age and sex. Sleep quality should be determined by analysing factors such as rapid eye movement (REM) and non-REM sleep. Nevertheless, the present study clarified a relationship between sleep and QOL for the first time in Japanese patients with IHD who had undergone a first PCI. The results suggest that patients with IHD should be provided with information concerning sleep. Future studies should focus on a continuous evaluation of the QOL of patients after elective PCI. Future challenges will be to determine how to improve sleep and promote QOL by clarifying which factors influence sleep.

7. CONCLUSION

Sleep condition significantly correlated with QOL. In particular, SF score was positively related to night-time

sleep items (total sleep duration, and longest sleep duration). SF score might be related to night-time sleep condition. Moreover, the longest sleep durations were related to the mental component summary. Therefore, it was suggested that not only the length of whole sleeping durations but to increase the amount of uninterrupted sleep leads better patients' mental QOL.

8. IMPLICATION FOR NURSING

Wrist actigraphy was validated with concurrent polysomnography as a reliable tool with which to objectively measure several standard sleep parameters, including ADL. These data can be used to help patients with IHD anticipate changes in sleep patterns during recovery. Actigraphy was a useful device for measuring of sleep conditions to improve sleep during hospitalization and enhance post-discharge recovery. Longest sleep duration should be improved for patients in the clinical nursing care.

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