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ABOUT COVER

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ORIGINAL ARTICLE

Observational Study

Analysis of sleep characteristics and clinical outcomes of 139 adult patients with infective endocarditis after surgery

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Abstract

BACKGROUND

Little is known about the postoperative sleep quality of infective endocarditis patients during hospitalization and after discharge.

AIM

To investigate the sleep characteristics of infective endocarditis patients and to identify potential risk factors for disturbed sleep quality after surgery.

METHODS

The Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale were used to assess patient sleep quality. Logistic regression was used to explore the potential risk factors.

RESULTS

The study population (n = 139) had an average age of 43.40 ± 14.56 years, and 67.6% were men (n = 94). Disturbed sleep quality was observed in 86 patients (61.9%) during hospitalization and remained in 46 patients (33.1%) at 6 mo after surgery. However, both PSQI and Epworth Sleepiness Scale scores showed significant improvements at 6 mo (P < 0.001 and P = 0.001, respectively). Multivariable logistic regression analysis showed that the potential risk factors

in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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were age (odds ratio = 1.125, 95% confidence interval: 1.068-1.186) and PSQI assessed during hospitalization (odds ratio = 1.759, 95% confidence interval: 1.436-2.155). The same analysis in patients with PSQI ≥ 8 during hospitalization suggested that not using sleep medication (odds ratio = 15.893, 95% confidence interval: 2.385-105.889) may be another risk factor.

CONCLUSION

The incidence of disturbed sleep after infective endocarditis surgery is high. However, the situation improves significantly over time. Age and early postoperative high PSQI score are risk factors for disturbed sleep quality at 6 mo after surgery.

Key Words: Infective endocarditis; Sleep quality; Pittsburgh sleep quality index; Epworth sleepiness scale; Surgery

Core Tip: The current study is thus far the first to investigate the sleep quality of infective endocarditis patients after surgery. The Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale were employed for the assessment. Data were collected during hospitalization and at 6 mo after surgery. Disturbed sleep quality was reported by 61.9% of patients during hospitalization and 33.1% of patients at 6 mo after surgery. The patients' sleep quality improved significantly over time. Age and high scores in Pittsburgh Sleep Quality Index assessed during hospitalization may be risk factors for disturbed sleep at 6 mo after surgery.

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INTRODUCTION

Infective endocarditis (IE) is a serious infection with a reported incidence of 0.03%-0.07% and a mortality rate of 15%-30%[1-4]. Surgery is an important approach for treating IE. About 40%-50% of patients need to undergo cardiac valve replacement surgery, which is usually performed concurrently with antibiotic treatment[5]. Sleep efficiency is defined as the percentage of time for sleeping out of the total amount of time spent in bed. A normal sleep efficiency is considered to be 85% or higher[6]. It has been reported that sleep efficiency among patients after heart surgery is between 50.3%-68.5% during the hospitalization period and increases to 71.8% after 6 mo[6]. Disturbed sleep quality directly affects the postoperative recovery of patients and potentially prolongs the length of their hospital stay. Therefore, in order to improve the prognosis and also the quality of life for patients, it is crucial to better understand the sleep characteristics of these patients after surgery.

Few research projects have been conducted to explore this topic. Studies that have been published were more focused on the clinical nursing perspective and therefore may be lacking in scientific reasoning and discussion. As surgery for IE is different from other types of general surgery, infection, inflammation, and many complications can affect the postoperative sleep of IE patients in a different manner[7]. To date, there remains a huge knowledge gap in research on the sleep quality of IE patients after surgery. In addition, none of the published studies were able to perform long-term follow-up of the patients because of the difficulty of tracking patients' sleep quality outcomes after discharge.

The issue of sleep quality has been investigated in patients after cardiac surgery; however, the sleep quality in patients undergoing cardiac surgery for IE has never been investigated. Therefore, we designed this study to evaluate the postoperative sleep characteristics of IE patients in the early postoperative period and at 6 mo

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postoperatively and to obtain evidence for effective clinical sleep intervention in the future.

MATERIALS AND METHODS

Study population

Patients who were admitted to our general ward between October 2016 and September 2018 were recruited for the current study. These patients were diagnosed with IE before undergoing heart valve replacement surgery. The patients spent roughly 2 wk in the Department of Cardiac Surgery and the cardiac intensive care unit (CICU) after surgery until their conditions stabilized. Upon approval by cardiac surgeons, the patients were then transferred to our ward for further supporting treatment, which mainly consisted of antibiotic and recovery regimens. The inclusion criteria for the current study were: (1) A clear medical history of IE and cardiac valve replacement surgery; (2) Age ≥ 18 years old; (3) Ability for self-expression; and (4) Willingness to participate in this study voluntarily. Patients who were in a coma or unconscious were strictly excluded from the study.

A total of 139 patients were included in the study according to the criteria. The patients' medical examination results and other study-related data were collected and analyzed. These included the demographic characteristics, body mass index, duration spent in the CICU, use of analgesics and sleep medication, preoperative complication of embolism, and color Doppler echocardiography results (focused on observing the size of vegetation and multivalvular involvement). Biochemical results were also collected pre- and postoperatively including white blood cell, hemoglobin, albumin, C-reactive protein, and procalcitonin counts. The procedures described here have been approved by the Ethics Committee of the Guangdong Provincial People's Hospital [No. GDREC2016222H (R2)] and have been performed in accordance with ethical standards. Due to the retrospective nature of this study, the requirement for informed consent was waived.

Tools for sleep quality assessment

The Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleeping Scale (ESS) were employed in this study to assess the patients' sleep quality. The PSQI scale consists of 19 self-assessment items and 5 other assessment items, among which the 19th self-assessment item and 5 other assessment items are not included in the final score[8,9]. The first 18 items are designed to cover 7 dimensions of sleep quality and are each scored from 0 to 3, with a total score ranging from 0 to 21 points. Higher scores indicate worse sleep quality. Based on previous literature, PSQI ≥ 8 points may indicate poor sleep quality. A previous analysis has shown evidence of the internal consistency, reliability, and validity of PSQI, making it suitable for IE patients[8-10].

The ESS was used to assess excessive sleepiness during the day according to the guidelines for the primary care of adults with obstructive sleep apnea (2018)[11]. The possibility of falling asleep under 8 different conditions was evaluated, and each item was scored with a four-point scale (0-3 points). The total ESS score (0-24 points) is obtained by summing the scores from all 8 conditions. ESS ≥ 9 points may indicate day drowsiness[11].

On the second day after being transferred to our general ward from the CICU, each patient was required to complete the PSQI and ESS. The assessment was conducted by our investigator(s) using unified guidelines. The scales were completed by the patients independently or with assistance from our investigator(s). At 6 mo after surgery, another assessment was conducted at the outpatient clinic follow-up or through a questionnaire on the WeChat platform (Tencent Holdings Ltd., Shenzhen, Guangdong, China).

Statistical analysis

Data were analyzed using SPSS 21.0 (SPSS Inc., Chicago, IL, United States). Descriptive data that were normally distributed were expressed as mean ± SD and those that were not normally distributed were expressed as median and interquartile range (25th and 75th percentile). Comparison between two groups was performed using the t-test, Wilcoxon rank-sum test, and χ^2 test where appropriate. The whole study sample was divided into 2 groups according to the PSQI score during hospitalization: Group 1 included all participants with PSQI < 8, while Group 2 included those with PSQI ≥ 8. Univariate analysis was performed to identify the risk factors for disturbed sleep quality at 6 mo after surgery (P < 0.10) in the entire study cohort as well as in Group 2.

The identified factors were then included in the multivariate analysis for further determination of the independent risk factors ($P < 0.05$). A P value < 0.05 was considered statistically significant.

RESULTS

Demographic features

In this study, a total of 139 patients volunteered to participate and completed the sleep quality assessments during hospitalization and at 6 mo after surgery. Among these patients, 67.6% (94 cases) were men, while 32.4% (45 cases) were women. The average age of the study population was 43.40 ± 14.56 years old. The average body mass index was 20.33 ± 3.37 kg/m^2.

In the current study, 116 patients (83.5%) were diagnosed with cardiac comorbidities before surgery. These included 42 patients with degenerative valve disease (30.2%), 33 with rheumatic heart disease (23.7%), 32 with congenital heart disease (23.0%), and 9 with artificial valve implantation (6.5%). Thirty-four cases (24.5%) were complicated with embolism, as determined by radiological assessments before surgery, including 19 cases (13.7%) of cerebral infarction, 5 cases of limb arterial embolism (3.6%), 4 cases of splenic embolism (2.9%), 3 cases of renal artery embolism (2.2%), 2 cases of pulmonary infarction (1.4%), and 1 case of coronary embolism (0.7%).

All of these patients underwent surgical treatment, which included 84 single-valve surgeries, 51 multi-valve surgeries, and 4 complicated surgeries. Single-valve surgery was performed for 33 cases of mitral valvuloplasty (MVP), 21 cases of mitral valve replacement (MVR), 27 cases of aortic valve replacement (AVR), and 3 cases of tricuspid valvuloplasty (TVP). Multi-valve surgery was performed for 21 cases of MVR complicated by TVP, 6 cases of AVR + MVR, 7 cases of AVR + MVP, 3 cases of MVP + TVP, 1 case of AVP + MVP, 9 cases of AVR + MVR + TVP, and 1 case of AVR + MVP + TVP.

When the study population was split into 2 groups based on the PSQI collected during hospitalization, Group 1 had 53 patients (38.1%) and Group 2 had 86 (61.9%). As expected, the number of patients that used sleep medication in Group 2 was significantly higher than that in Group 1 ($P < 0.001$). No other differences were observed when comparing the rest of the variables between the 2 groups. The demographic and clinical baseline characteristics are presented in Table 1.

Sleep quality of the patients during hospitalization and after discharge

As shown in Table 2, 86 and 46 patients experienced disturbed sleep during hospitalization and at 6 mo after surgery, respectively, accounting for 61.9% and 33.1% of the study population. Additionally, 44 (31.7%) and 20 (14.4%) patients with ESS ≥ 9 experienced daytime sleepiness, respectively. It was pretty clear that at 6 mo after surgery, both scale scores and the percentages of disturbed sleep quality and daytime sleepiness were significantly lower than the corresponding values during hospitalization ($P < 0.001$ and $P = 0.001$). Additional results regarding the scale measures are presented in Table 2.

The median PSQI score at 6 mo after surgery was 3.0 in Group 1 and 7.0 in Group 2, whereas the median ESS score was 4.0 in Group 1 and 5.5 in Group 2. When comparing the scores and percentages of disturbed sleep quality (PSQI ≥ 8) and daytime sleepiness (ESS ≥ 9) between these two groups, significant differences were observed in the PSQI score as well as in the percentage of disturbed sleep quality (both $P < 0.001$). Strangely, this difference was not observed in the ESS scores or the percentage of daytime sleepiness. The details regarding the comparison are shown in Table 3.

Potential risk factors of disturbed sleep quality at 6 mo after surgery

In the analysis of potential risk factors for disturbed sleep quality at 6 mo after surgery in the whole data set, univariable logistic regression indicated that age and PSQI score during hospitalization are possible candidates ($P < 0.05$), as shown in Table 4. The factors with $P < 0.10$ (age, duration of CICU stay, and PSQI score during hospitalization) were included in a multivariable logistic regression analysis, and two were found to be statistically significant ($P < 0.05$): Age [odds ratio (OR) =1.125, 95% confidence interval (CI) 1.068-1.186] and PSQI score during hospitalization (OR = 1.759, 95%CI: 1.436-2.155), as shown in Table 5.

Table 1 Demographic and clinical baseline characteristics of participants (*n* = 139)

Variables	Total (*n* = 139)	Group 1 (*n* = 53)	Group 2 (*n* = 86)	*P* value
Gender (male)	94 (67.6%)	39 (73.6%)	55 (64.0%)	0.239
Age (yr)	43.40 ± 14.56	40.89 ± 14.17	44.94 ± 14.66	0.111
BMI (kg/m^2)	20.33 ± 3.37	20.29 ± 3.10	20.36 ± 3.55	0.919
Duration of CICU stay (d)	2.20 ± 1.50	2.09 ± 1.72	2.34 ± 1.33	0.352
Use of analgesics (cases)	33 (23.7%)	14 (26.4%)	19 (22.1%)	0.561
Use of sleep medication (cases)	47 (33.8%)	3 (5.7%)	44 (51.2%)	< 0.001[a]
Preoperative WBC (× 10^9/L)	8.34 ± 3.10	8.67 ± 2.96	8.14 ± 3.18	0.329
Postoperative WBC (× 10^9/L)	18.68 ± 7.79	18.77 ± 7.79	18.62 ± 7.84	0.914
Preoperative Hb (g/L)	110.10 ± 23.34	108.26 ± 23.67	111.23 ± 23.21	0.468
Postoperative Hb (g/L)	100.86 ± 14.61	101.02 ± 14.54	100.76 ± 14.73	0.918
Preoperative Alb (g/L)	33.80 ± 5.65	34.10 ± 5.66	33.62 ± 5.67	0.629
Postoperative Alb (g/L)	32.44 ± 4.35	33.26 ± 4.52	31.93 ± 4.20	0.081
Preoperative CRP (mg/L)	27.43 ± 33.08	30.84 ± 36.43	25.33 ± 30.87	0.342
Postoperative CRP (mg/L)	34.43 ± 29.06	36.08 ± 32.87	33.41 ± 26.61	0.601
Postoperative PCT (ng/mL)	1.10 ± 4.98	1.89 ± 7.85	0.62 ± 1.38	0.147
Vegetation ≥ 10 mm	78 (56.1%)	31 (58.5%)	47 (54.7%)	0.658
Complication of embolism	34 (24.5%)	11 (20.8%)	23 (26.7%)	0.425

Data are presented as mean and standard deviation or *n* (%). Comparison between the two groups was performed using the *t*-test and chi-square test where appropriate.

[a]*P* < 0.05. BMI: Body mass index; CICU: Cardiac intensive care unit; WBC: White blood cell; Hb: Hemoglobin; Alb: Albumin; CRP: C-reactive protein; PCT: Procalcitonin.

Table 2 Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale scores collected during hospitalization and at 6 mo after surgery (*n* = 139)

Variables	During hospitalization	Post hospitalization	*P* value
PSQI (points)	9.0 (6.0, 12.0)	5.0 (4.0, 8.0)	< 0.001[a]
PSQI ≥ 8 (cases)	86 (61.9%)	46 (33.1%)	< 0.001[a]
ESS (points)	7.0 (4.0, 9.0)	5.0 (3.0, 8.0)	< 0.001[a]
ESS ≥ 9 (cases)	44 (31.7%)	20 (14.4%)	0.001[a]

Data were analyzed using the Wilcoxon rank-sum test or χ^2 test where appropriate. Data are presented as median and interquartile range (25th and 75th percentile) or quantity and percentage (%) where appropriate.

[a]*P* < 0.05. PSQI: Pittsburgh Sleep Quality Index; ESS: Epworth Sleepiness Scale.

The same analysis was performed specifically in Group 2 as well. Table 6 presents the results of univariable logistic regression, showing that age and PSQI score during hospitalization may potentially affect sleep quality at 6 mo after surgery ($P < 0.05$). The final multivariable logistic regression analysis indicated that possible risk factors include: age (OR = 1.174, 95%CI: 1.085-1.270), PSQI score during hospitalization (OR = 2.422, 95%CI: 1.604-3.658), and not using sleep medication (OR = 15.893, 95%CI: 2.385-105.889) (all $P < 0.05$), as shown in Table 7.

DISCUSSION

To our knowledge, the current study is thus far the first to investigate the sleep quality

Table 3 Comparison of Pittsburgh Sleep Quality Index and Epworth Sleepiness Scale scores at 6 mo after surgery between Group 1 (*n* = 53) and Group 2 (*n* = 86)

	Total (*n* = 139)	Group 1 (*n* = 53)	Group 2 (*n* = 86)	*P* value
PSQI (points)	5.0 (4.0, 8.0)	3.0 (2.0, 5.0)	7.0 (5.0, 10.0)	< 0.001[a]
PSQI ≥ 8 (cases)	46 (33.1%)	4 (7.5%)	42 (48.8%)	< 0.001[a]
ESS (points)	5.0 (3.0, 8.0)	4.0 (3.0, 7.0)	5.5 (3.0, 8.0)	0.194
ESS ≥ 9 (cases)	20 (14.4%)	5 (9.4%)	15 (17.4%)	0.191

Data were analyzed using the Wilcoxon rank-sum test or χ^2 test where appropriate. Data are presented as median and interquartile range (25th and 75th percentile) or quantity and percentage (%) where appropriate.
[a]*P* < 0.05. PSQI: Pittsburgh Sleep Quality Index; ESS: Epworth Sleepiness Scale.

Table 4 Univariable logistic regression analysis exploring potential risk factors for disturbed sleep quality at 6 mo after surgery in the whole data set (*n* = 139)

Variables	B	*P* value	OR	95%CI
Gender (male)	0.134	0.731	1.143	0.534-2.448
Age (yr)	0.084	< 0.001[1]	1.087	1.052-1.123
BMI (kg/m^2)	0.056	0.294	1.058	0.952-1.175
Duration of CICU stay (d)	0.243	0.052	1.275	0.997-1.630
Preoperative WBC (× 10^9/L)	0.019	0.749	1.019	0.909-1.141
Postoperative WBC (× 10^9/L)	-0.004	0.870	0.996	0.952-1.043
Preoperative Hb (g/L)	0.012	0.135	1.012	0.996-1.028
Postoperative Hb (g/L)	0.008	0.499	1.008	0.984-1.033
Preoperative Alb (g/L)	0.030	0.364	1.030	0.966-1.098
Postoperative Alb (g/L)	-0.053	0.217	0.949	0.873-1.031
Preoperative CRP (mg/L)	-0.008	0.193	0.992	0.979-1.004
Postoperative CRP (mg/L)	-0.004	0.560	0.996	0.984-1.009
Postoperative PCT (ng/ml)	-0.099	0.440	0.906	0.705-1.164
Vegetation ≥ 10 mm	-0.025	0.946	0.976	0.479-1.989
Multivalve involvement	-0.971	0.126	0.379	0.109-1.315
Complication of embolism	0.225	0.600	1.252	0.540-2.902
Not using sleep medication	-0.208	0.582	0.812	0.388-1.702
PSQI during hospitalization (points)	0.464	< 0.001[1]	1.590	1.359-1.860
ESS during hospitalization (points)	0.039	0.126	1.040	0.944-1.146

[1]Factors that were included in the subsequent multivariable analysis. Data were analyzed in univariable logistic regression. BMI: Body mass index; CICU: Cardiac intensive care unit; WBC: White blood cell; Hb: Hemoglobin; Alb: Albumin; CRP: C-reactive protein; PCT: Procalcitonin; PSQI: Pittsburgh Sleep Quality Index; ESS: Epworth Sleepiness Scale; OR: Odds ratio; CI: Confidence interval.

of IE patients after surgery. We found that 86 (61.9%) out of 139 adult patients experienced disturbed sleep quality during hospitalization after cardiac valve replacement surgery. As time passed, both the PSQI and ESS scores of the patients were significantly lower at 6 mo after surgery compared to the data collected during hospitalization. This suggests that the sleep quality of the patients significantly improved during the post-hospitalization recovery period. However, it is worth noting that, at 6 mo after surgery, 46 (33.1%) out of 139 patients still had PSQI ≥ 8 in the assessment, while in Group 2 this number was 42 out of 86 (48.8%). These patients were likely to have developed chronic insomnia, defined as a course of disease exceeding 3 mo, requiring long-term treatment with sleep aid medication. This may

Table 5 Multivariable logistic regression analysis exploring potential risk factors for disturbed sleep quality at 6 mo after surgery in the whole data set (*n* = 139)

Variable	B	*P* value	OR	95%CI
Age	0.118	< 0.001[a]	1.125	1.068-1.186
Duration of CICU stay (d)	0.067	0.708	1.069	0.754-1.515
PSQI during hospitalization (points)	0.565	< 0.001[a]	1.759	1.436-2.155

[a]*P* < 0.05. Data were analyzed in multivariable logistic regression. CICU: Cardiac intensive care unit; PSQI: Pittsburgh Sleep Quality Index; OR: Odds ratio; CI: Confidence interval.

Table 6 Univariable logistic regression analysis exploring potential risk factors for disturbed sleep quality at 6 mo after surgery in Group 2 (*n* = 86)

Variables	B	*P* value	OR	95%CI
Gender (male)	0.435	0.731	1.143	0.534-2.448
Age (yr)	0.100	< 0.001[1]	1.105	1.058-1.155
BMI (kg/m^2)	0.077	0.221	1.080	0.955-1.222
Duration of CICU stay (d)	0.329	0.057[1]	1.389	0.990-1.949
Preoperative WBC (× 10^9/L)	0.044	0.520	1.045	0.913-1.197
Postoperative WBC (× 10^9/L)	-0.001	0.962	0.999	0.946-1.054
Preoperative Hb (g/L)	0.010	0.288	1.010	0.992-1.029
Postoperative Hb (g/L)	0.006	0.699	1.006	0.977-1.035
Preoperative Alb (g/L)	0.035	0.362	1.036	0.960-1.118
Postoperative Alb (g/L)	-0.036	0.496	0.965	0.871-1.069
Preoperative CRP (mg/L)	-0.005	0.506	0.995	0.981-1.010
Postoperative CRP(mg/L)	-0.001	0.928	0.999	0.983-1.015
Postoperative PCT (ng/ml)	-0.014	0.929	0.986	0.724-1.343
Vegetation ≥ 10 mm	-0.009	0.984	0.991	0.424-2.318
Multivalve involvement	-0.511	0.456	0.600	0.157-2.298
Complication of embolism	0.294	0.549	1.342	0.513-3.508
Not using sleep medication	0.848	0.055[1]	2.336	0.984-5.546
PSQI during hospitalization (points)	0.527	< 0.001[1]	1.694	1.339-2.143
ESS during hospitalization (points)	0.025	0.673	1.025	0.914-1.149

[1]Factors that were included in the subsequent multivariable analysis. Data were analyzed in univariable logistic regression. BMI: Body mass index; CICU: Cardiac intensive care unit; WBC: White blood cell; Hb: Hemoglobin; Alb: Albumin; CRP: C-reactive protein; PCT: Procalcitonin; PSQI: Pittsburgh Sleep Quality Index; ESS: Epworth Sleepiness Scale; OR: Odds ratio; CI: Confidence interval.

seriously affect the patients' physical and mental health, and especially their quality of life, thus posing a serious burden to the individuals and society.

Studies on sleep disturbance after cardiac surgery have been conducted for more than 40 years[12]. These studies have shown that sleep disturbance after cardiac surgery is quite common and can adversely affect the patients' postoperative recovery, quality of life, and even mortality. The factors that may affect the patients' postoperative sleep quality have been summarized by researchers. These may include intrinsic factors such as age, gender, previous sleep quality, and health status (*e.g.*, chronic comorbidities) and extrinsic factors such as surgery, postoperative complications, postoperative weakness, adverse reactions to medication, and the hospital environment[13]. We assumed that anemia, albumin, systemic inflammation indicators (*e.g.*, white blood cell, C-reactive protein, procalcitonin, *etc.*), duration of CICU stay,

Table 7 Multivariable logistic regression analysis exploring potential risk factors for disturbed sleep quality at 6 mo after surgery in Group 2 (*n* = 86)

Variable	B	*P* value	OR	95%CI
Age	0.160	< 0.001[a]	1.174	1.085-1.270
Duration of CICU stay (d)	0.032	0.917	1.032	0.565-1.888
PSQI during hospitalization (points)	0.885	< 0.001[a]	2.422	1.604-3.658
Not using sleep medication	2.766	0.004[a]	15.893	2.385-105.889

[a]*P* < 0.05. Data were analyzed in multivariable logistic regression. CICU: Cardiac intensive care unit; PSQI: Pittsburgh Sleep Quality Index; OR: Odds ratio; CI: Confidence interval.

preoperative complication of embolism, size of vegetation, multivalvular involvement, and the use of analgesics impact the postoperative sleep quality of patients. However, the results of this study showed that only age and high PSQI scores during hospitalization were risk factors for disturbed sleep quality at 6 mo after surgery.

Many studies have suggested a link between sleep quality and cardiovascular events/mortality[14-20]. Lao *et al*[14] demonstrated that both short sleep duration and poor sleep quality are associated with an increased risk of coronary heart disease. A dose-response meta-analysis[16] revealed that sleep duration and quality may be associated with cardiovascular events and mortality. In our study, we found that the rate of sleep disturbance after surgery in patients with IE was relatively high at 61.9% in the early postoperative period and remained at 33.1% at 6 mo after surgery. This is worrisome as sleep disturbance may affect the patients' postoperative recovery, and interventions should be explored to improve this situation. Cho *et al*[21] investigated the effects of aromatherapy on the blood pressure, anxiety, and sleep of percutaneous coronary intervention patients in the ICU. They found that compared with conventional nursing intervention, the aromatherapy intervention was associated with significantly lower anxiety and improved sleep quality.

In the analysis of Group 2, we found that nearly half of the patients still suffered from disturbed sleep quality at 6 mo after surgery. The results of multivariable logistic regression in Group 2 suggested that the risk factors included age and the PSQI score during hospitalization, which were the same as those extracted from the whole data set. Another outstanding factor was also identified, namely not using sleep aids during hospitalization. Interestingly, the risk of experiencing poor sleep quality at 6 mo after surgery for patients who experienced poor sleep during hospitalization but did not use any sleep aids was roughly 16 times the risk for those who did use sleep aids (Table 7). In other words, providing sleep aids to patients with disturbed sleep quality during hospitalization may reduce their risk of experiencing disturbed sleep quality at 6 mo after surgery. This may be an indicator for medical practitioners responsible for treating postoperative IE patients, as it may be the case that the sleep quality of these patients is overlooked. It is also a reminder for practitioners to provide correct information regarding the use of sleep aids, as some patients are concerned about the likelihood of becoming dependent after using such medication.

A clear limitation of the current study was that we were unable to collect data on the patients' preoperative sleep quality and other sleep-related data. This prevented us from gaining an understanding of the baseline sleep quality of the patients. The high rate of disturbed sleep quality we observed during hospitalization might have been biased if the baseline rate was already high. This question will hopefully be answered in future studies.

CONCLUSION

To summarize, in this study we found that the rate of disturbed sleep quality in patients with IE after cardiac valve replacement surgery was relatively high (61.9%). More than half of these patients (33.1%) still experienced poor sleep and may have developed chronic insomnia at 6 mo after surgery. However, sleep quality for the majority of patients improved over time during the post hospitalization recovery period. Age and a high PSQI score at the early postoperative stage may indicate poor sleep quality in the later recovery period. We speculate that early sleep assessment and

intervention with sleep aids may be important to improve long-term sleep in these patients.

ARTICLE HIGHLIGHTS

Research background

Studies on sleep quality after cardiac surgery are limited in number. Furthermore, little is known about the postoperative sleep quality of infective endocarditis patients.

Research motivation

In order to fill the gap of knowledge in this particular area, we conducted the current study.

Research objectives

This study aimed to investigate the sleep characteristics of infective endocarditis patients during hospitalization and after discharge and to identify potential risk factors for disturbed sleep quality after surgery.

Research methods

Clinical data were collected accordingly. Standard questionnaires, specifically the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS), were employed in the study to assess patient sleep quality.

Research results

Disturbed sleep quality was reported by 61.9% of patients during hospitalization and 33.1% of patients at 6 mo after surgery. The patients' sleep quality improved significantly over time. Both the PSQI and Epworth Sleepiness Scale scores showed significant improvements at 6 mo. Age and high scores in PSQI assessed during hospitalization may be risk factors for disturbed sleep at 6 mo after surgery.

Research conclusions

The incidence of disturbed sleep after infective endocarditis surgery is high. However, the situation improves significantly over time. Age and a high PSQI score in the early postoperative period are risk factors for disturbed sleep quality at 6 mo after surgery.

Research perspectives

More and bigger studies on this specific topic are needed in the future to further fill the gap in our knowledge.

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