Original Article

Validation of a novel sleep-quality questionnaire to assess sleep in the coronary care unit: a polysomnography study

Luciana J. Storti [a,*], Denise M. Servantes [a], Melania Borges [a], Lia Bittencourt [b], Fabrizio U. Maroja [a], Dalva Poyares [b], Patrick R. Burke [b], Vinicius B. Santos [a], Rita S.L. Moreira [a], Frederico J.N. Mancuso [a], Angelo A.V. de Paola [a], Sergio Tufik [b], Antonio C.C. Carvalho [a], Fatima D. Cintra [a]

[a] Discipline of Cardiology, Department of Internal Medicine, Federal University of São Paulo/Escola Paulista de Medicina, Sao Paulo, Brazil
[b] Discipline of Sleep Biology and Medicine, Department of Psychobiology, Federal University of São Paulo/Escola Paulista de Medicina, Sao Paulo, Brazil

ARTICLE INFO

ABSTRACT

Introduction: The sleep of patients admitted to coronary care unit (CCU) may be compromised. A feasible and cost-effective tool to evaluate sleep in this scenario could provide important data. The aim of this study was to evaluate sleep with a questionnaire developed specifically for the CCU and to validate it with polysomnography (PSG).
Methods: Ninety-nine patients (68% male; 56 ± 10 years old) with acute coronary syndrome were included. PSG was performed within 36 h of admission. A specific 18-question questionnaire (CCU questionnaire) was developed and applied after the PSG. Cronbach's alpha test was used to validate the questionnaire. The Spearman test was used to analyze the correlation between the PSG variables and the questionnaire, and the Kruskal–Wallis test was used to compare the PSG variables among patients with good, regular, or poor sleep.
Results: The total sleep time was 265 ± 81 min, sleep efficiency $62 \pm 18\%$, REM sleep $10 \pm 7\%$, apnea/hypopnea index 15 ± 23, and the arousal index 24 ± 15. Cronbach's alpha test was 0.69. The CCU questionnaire showed correlation with the sleep efficiency evaluated by PSG (r: 0.52; $p < 0.001$). Sleep quality was divided into three categories according to the CCU questionnaire: patients with good sleep had a sleep efficiency of $72 \pm 9\%$, better than those with a regular or poor sleep ($60 \pm 16\%$ and $53 \pm 20\%$, respectively; $p < 0.01$).
Conclusion: The CCU questionnaire is a feasible and reliable tool to evaluate sleep in the CCU, showing correlation with the PSG sleep efficiency.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

Sleep is important for the maintenance of cardiovascular homeostasis through heart rate and blood pressure modulation [1]. Heart rate and blood pressure control are part of acute coronary syndrome (ACS) treatment [2]. Sleep disturbances, such as deprivation, fragmentation, low efficiency, and sleep apnea, are known to be deleterious to the cardiovascular system [3], and they may cause tachycardia and hypertension [3,4]. Recently, some studies have demonstrated that obstructive sleep apnea increases cardiovascular mortality [5].

The sleep quality of patients admitted to an intensive care unit is typically compromised [6–8], and it may result in peculiar sleep patterns that are influenced by the environment and physical factors, such as equipment sounds, lights, lack of privacy, and anxiety [6–8]. Sleep in the coronary care unit (CCU) has been evaluated with nonstructured questionnaires [9,10] or with questionnaires that did not examine the environment's influence on sleep [11]. A few studies, which included a small number of patients, used polysomnography (PSG) as an objective measurement of sleep parameters in critically ill patients who have not been sedated [12–14].

Although PSG is the gold standard to evaluate the sleep, it is expensive, not widely available [15], and presents difficulties when performed in a critical care unit. A feasible and cost-effective tool to evaluate sleep in this scenario could bring important information for the clinicians. Thus, the aim of this study was to evaluate sleep with a questionnaire specifically developed for the CCU (i.e., the CCU questionnaire) and to correlate it with PSG.

* Corresponding author. Rua Domiciano Leite Ribeiro, 51, Apt 13, Bloco 2, Sao Paulo, SP 04317-000, Brazil. Tel.: +55 11 99686 4570; fax: +55 11 5572 5462.
E-mail address: ljstorti@hotmail.com (L.J. Storti).

2. Methods

2.1. Population

ACS patients admitted to the CCU of a tertiary hospital between March 2012 and October 2012 were studied. ACS was defined as any group of clinical symptoms compatible with acute myocardial ischemia including unstable angina (UA), non-ST segment elevation myocardial infarction, and ST segment elevation myocardial infarction [16]. Acute myocardial infarction was defined as elevated high-sensitivity T-troponin ≥14 mg/dl associated with symptoms of ischemia, ST–T wave changes in electrocardiogram (ECG), development of Q waves in the ECG, or intracoronary thrombus in the angiography [17]. Patients with hemodynamic instability (classified as Killip III and IV), the use of vasoactive drugs, sedation, acute respiratory failure, the use of oxygen, and patients under mechanical ventilation were excluded. It was not allowed to prescribe medicines that could have altered the sleep quality, including antidepressants, anxiolytics, and atypical antipsychotics. All patients gave informed consent, and the study protocol was approved by the ethics committee of the institution.

2.2. PSG in the intensive care unit

Patients underwent a full night (ie, 10 p.m. until 6 a.m.) PSG on the first night in the CCU using a 12-channel computerized sleep ambulatory system (Digital Embla System, Embla Systems Inc., CO, USA). The following variables were collected: the electroencephalography (EEG) (C3–A2, C4–A1, and O1–A2 derivations of the 10–20 International System), bilateral electrooculography, submental electromyography, and ECG (D2-modified derivation). Respiration was monitored as follows: the air flow was measured by a nasal air pressure transducer (Pro-Tech Services Inc., Everett, WA, USA) and an oronasal thermal sensor; thoracic and abdominal movements were measured with the aid of uncalibrated inductance plethysmography straps; the arterial oxygen saturation (SaO_2) was measured by pulse oximetry (Ohmeda, Hatfield, Herts, England); snoring was evaluated by a microphone in the neck; and body positions were surveyed with a position sensor.

An experienced researcher blinded to the participants' condition interpreted the PSG of each individual according to the parameters previously established by the American Academy of Sleep Medicine [18].

The following variables were evaluated: total sleep time, percentage of each sleep stage by total sleep time, sleep efficiency, latency to sleep onset, apnea and hypopnea events per hour of sleep (apnea and hypopnea index, AHI), obstructive apnea, central apnea, mixed apnea, respiratory disturbance index (RDI), respiratory effort-related arousal (RERA), arousal index, mean and minimum oxygen saturation, desaturation index during rapid eye movement (REM) and non-REM sleep, percentage of total sleep time with SaO_2 below 90%, respiratory event index, and periodic leg movement index.

2.3. Sleep questionnaire

The CCU questionnaire was designed to evaluate the sleep quality in a coronary care environment, and it included questions that covered important issues that could impact sleep quality according to sleep experts' opinion. First, a pilot study was performed with 30 patients to evaluate 15 questions and to determine which ones were the most relevant to be included in the final questionnaire. The questions included issues raised by sleep medicine experts based on previous studies that demonstrated the factors that more commonly compromise the sleep in the intensive care scenario. Six questions that addressed food, cleanliness, venous access, visiting hours, medical care, and nursing care were excluded from the final

questionnaire after analysis with Cronbach's alpha test. The final questionnaire included nine questions that were applied for nocturnal and daytime sleep; these are shown in Appendix. Bed quality, influence of the time of taking medication, light exposure, equipment and patients' sounds, staff conversations, environment temperature, physical discomfort (i.e., pain, dyspnea, and nausea), and concern about their cardiac disease were included in the final questionnaire. The questionnaire was developed and applied in Portuguese. The questions were read by a single trained nurse and answered by the patient according to a 1–5 points scale using a visual analog scale. The total score was calculated as the sum of the points of each question, varying between 18 (worse score) and 90 points (best score). The population was divided into poor, regular, and good sleepers according to the questionnaire score terciles. Poor sleep was considered to be scores between 18 and 48 points, regular sleep between 49 and 62 points, and good sleep >62 points.

Although the Pittsburgh Sleep-Quality Index (PSQI) [19] is designed to evaluate the sleep at home in the last month, it was also applied in the studied patients because it is the only sleep questionnaire validated to address sleep.

2.4. Statistical analysis

The statistical analysis was performed with the Statistical Package for Social Science (SPSS) 15.0 software (SPSS Inc., Chicago, IL, USA). Continuous data were reported as the mean ± standard deviation (SD), and categorical data were described as a percentage. Cronbach's alpha test was used to evaluate the questionnaire's internal consistency. The Spearman coefficient was used to identify the correlation between the questionnaire's total score and the associated PSG values. The Spearman coefficient was also used to identify the correlation between the PSQI and the PSG values. According to the total score, patients were divided into three groups (ie, poor, regular, and good sleep qualities), as described above, for questionnaire validation. The Kruskal–Wallis test was used to compare the PSG values among these groups. A p-value <0.05 was considered to be significant.

3. Results

One hundred and twenty-eight patients with ACS were eligible, and 29 patients were excluded due to reinfarction ($n = 1$); discomfort with the monitoring ($n = 18$); and PSG technical problems ($n = 10$). Ninety-nine patients were included with a mean age of 56 ± 10 years, and this included 67 (68%) males. All patients were submitted to cardiac catheterization. The baseline clinical characteristics are listed in Table 1.

Sleep characteristics of the study population according to PSG are shown in Table 2. The total sleep time was 265 ± 81 min, the sleep latency was 22.3 ± 31.8 min, the REM sleep latency was

Table 1
Baseline clinical characteristics of patients ($n = 99$).

Age (years)	56.2 ± 9.8
Male (n, %)	67 (67.7%)
BMI (kg/m^2)	26.6 ± 5.0
SBP (mm Hg)	123 ± 19
DBP (mm Hg)	79 ± 12
Hypertension (n, %)	51 (51.5%)
DM (n, %)	17 (17.2%)
Smokers (n, %)	39 (39.4%)
ST elevation ACS (n, %)	82 (82.8%)
Non-ST elevation ACS (n, %)	17 (17.2%)

Values are expressed as the mean ± standard deviation or frequency.
ACS: acute coronary syndrome; BMI: body mass index; DBP: diastolic blood pressure; DM: diabetes mellitus; SBP: systolic blood pressure.