Respiratory Medicine 114 (2016) 97–102

Contents lists available at ScienceDirect

Respiratory Medicine

journal homepage: www.elsevier.com/locate/rmed

Assessment of sleep quality post-hospital discharge in survivors of critical illness

Kevin J. Solverson [a, c], Paul A. Easton [b, c], Christopher J. Doig [a, d, *]

[a] Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada
[b] Division of Respiratory and Sleep Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada
[c] Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada
[d] Department of Community Health Sciences, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada

ARTICLE INFO

Article history:
Received 17 December 2015
Received in revised form
3 March 2016
Accepted 15 March 2016
Available online 21 March 2016

Keywords:
Actigraphy
Sleep
Critical care
Intensive care units
Adult/therapy
Quality of life

ABSTRACT

Background: Sleep quality is impaired during critical illness and may remain abnormal after discharge from hospital. Sleep dysfunction in patients after critical illness may impair recovery and health related quality of life. The purpose of this study was to use objective and subjective measures to evaluate sleep quality in critical illness survivors 3 months after hospital discharge.

Methods: This was a prospective cohort study of 55 patients admitted to a multidisciplinary intensive care unit (ICU) between April 1st, 2009 and March 31, 2010. Patients enrolled were over 17 years of age and stayed a minimum of 4 days in the ICU. Patients were assessed in an outpatient clinic 3-months after hospital discharge. Sleep quality was measured using multi-night sleep actigraphy and the Pittsburgh Sleep Quality Index (PSQI).

Results: A total of 62% of patients had poor sleep quality measured with the PSQI. The average (SD) sleep time, sleep efficiency and number of sleep disruptions per night was 6.15 h (3.4), 78% (18), and 11 disruptions (5) respectively. The APACHE II score was correlated with total sleep time ($\beta = -12.6$, $P = 0.019$) and sleep efficiency ($\beta = -1.18$, $P = 0.042$). The PSQI score was associated with anxiety ($\beta = 4.00$, $p = 0.001$), reduced mobility ($\beta = 3.39$, $p = 0.002$) and EuroQol-5D visual analogue scale score ($\beta = -0.85$, $p = 0.003$) and low Physical Composite Scores ($\beta = -0.13$, $p = 0.004$) and Mental Composite Scores ($\beta = -0.15$, $p = 0.002$) of the Short-Form 36 survey.

Conclusions: Reduced sleep quality following critical illness is common and associated with reduced health related quality of life. Critical illness severity is a predictor of reduced sleep duration and sleep disruption 3 months after hospital discharge. This cohort study highlights the important role sleep may contribute to the long-term recovery from critical illness.

1. Introduction

Recently there has been increased attention to examine out of hospital outcomes in critical illness survivors. Critical illness can have a lasting burden on health related quality of life (HRQL) including reduced physical functioning, increased mental illness and trouble returning to work [1,2]. Sleep has an essential role in the recovery from acute illness and has been associated with long-term HRQL [3,4]. Despite the significant health burden poor sleep quality may have on critical illness survivors it has received limited study. Additionally, the study of sleep in the critical illness survivors is important as it may identify potential risk factors during critical illness that can be modified in order to improve long-term sleep and HRQL.

There is evidence that patients' sleep in the intensive care unit (ICU) during critical illness is severely disrupted. Studies have used polysomnography (PSG) and found that critically ill patients have significantly decreased total sleep time, decreased rapid eye movement sleep, more arousals, and increased fragmentation [5–21]. Subjective assessments have also shown patients' report poor sleep quality during their ICU stay [22–26]. The etiology of poor sleep quality in ICU is thought to be multifactorial and associated with severity of illness, increased noise, nursing

* Corresponding author. Department of Critical Care Medicine, Cumming School of Medicine, University of Calgary, 3134 Hospital Drive NW, Calgary, AB, T2N 5A1, Canada.
E-mail address: cdoig@ucalgary.ca (C.J. Doig).

http://dx.doi.org/10.1016/j.rmed.2016.03.009
0954-6111/

interventions, pain, ambient light and sedation [7,12,23,25–34].

A small number of studies have used questionnaires to show survivors of critical illness may be at increased risk of chronic sleep disorders [35–39], but the questionnaires have been variably chosen, and inconsistently validated. With these concerns noted, up to 50% of patients have reported poor sleep quality from 6 to 12 months post ICU discharge [37–39]. Sleep quality has been associated with reduced HRQL and concurrent disease [38]. Prior studies have not shown a relationship between ICU factors such as length of stay, severity of illness or duration of mechanical ventilation and out of hospital sleep quality [38,39].

Only one study to date used objective measures (PSG) to assess sleep quality in 7 patients after critical illness, all which were found to have sleep abnormalities [36]. It is important to include objective measures of sleep quality to further inform patient's subjective reporting [40]. PSG is the gold standard for the measurement of objective sleep, however its application is limited because it is resource intensive [16]. Actigraphy is a device that measures motion and has been used in the sleep literature as a surrogate to PSG for over 20 years [41–43]. The device allows for the patient to sleep at home, have multiple nights of sleep assessed and uses minimal resources. Several studies exist showing a correlation between PSG and actigraphy for the measurement of sleep time and efficiency in the outpatient population with a sensitivity and specificity of approximately 90% and 70% respectively [42,44,45]. Previous studies have used actigraphy to measure sleep during critical illness [6,16], however it has not been studied in critical illness survivors.

The goal of our study was to assess the sleep quality of critical illness survivors 3 months after hospital discharge using both actigraphy and subjective questionnaire measures. Additionally we sought to determine if patients sleep quality after critical illness was associated with HRQL, anxiety, depression or risk factors associated with their ICU stay.

2. Methods

2.1. Design

This was a prospective longitudinal cohort study of patients who were admitted to the ICU at the Foothills Medical Center (FMC) between April 1, 2009 and March 31, 2010. At the time of study enrolment, the FMC contained a 25-bed mixed medical-surgical tertiary referral ICU, which also served as the Level 1 trauma center for southern Alberta [46].

Patients assessed in the ICU follow-up clinic were adult patients ($\geq$18 years), with a minimum 4-day length of ICU stay. Patients were excluded if they had traumatic brain injuries, pre-existing neurocognitive disorders, acute strokes or lived outside of the immediate municipality of Calgary. Patients in the ICU were screened for eligibility during the initial 48 h of their ICU admission, and approached for follow-up once they had stayed in ICU for a minimum of 4 days. Due to limited capacity in the ICU follow-up clinic, patients were enrolled consecutively until clinic capacity was met at which point screening would be temporally suspended. Patients enrolled in the ICU were assessed at 3 months after hospital discharge. 61 patients met inclusion criteria, 2 patients declined follow-up and 1 patient was lost to follow-up. Attendance at the clinic was presented as a natural continuation of care following hospitalization, which individuals had the option to refuse. We sought permission from these patients to include their clinic data in our study. This study was approved by the University of Calgary Human Research Ethics Board (ID# E-22574) and written informed consent was obtained from all patients.

2.2. Instruments/questionnaires

To assess the quality of sleep in patients after hospital discharge, by means of questionnaire, the Pittsburgh Sleep Quality Index (PSQI) [47] and Epworth Sleepiness Scale (ESS) [48] were used. A score greater than 4 on the PSQI denotes 'poor' sleep quality and a score greater than 9 on the ESS screens patient for having significant daytime sleepiness. The PSQI has been shown to be reliable, valid and widely used [49].

Questionnaires to assess HRQL included, the EuroQol-5D (EQ-5D) and Short-Form 36 (SF-36) physical and mental composite score (PCS, MCS). The SF-36 scores were standardized with Canadian national norms [50]. The Hospital Anxiety and Depression Scale (HADS) was used for the assessment of depression and anxiety. HADS scores greater than 7 on either the anxiety or depression subscale correlate with probable anxiety or depression [51].

During the clinic all of the questionnaires were administered. The actigraph device was given to patients to be used at home and worn continuously for three nights. Patients were instructed to trigger the event marker when they were going to sleep and when they awoke in the morning. The patient's data while in bed was analyzed and activity during the day was not included. For each sleep variable collected, an average over the 3 nights was calculated. There was limited availability of the actigraph device and not all patients seen in the clinic could be tested. Patients who did receive the device were selected at random (without knowledge of their clinical history or sleep characteristics) prior to their arrival at the clinic. Previously validated algorithms, provided by Ambulatory Monitoring Inc, New York, USA, were used to analyze sleep and wake cycles [45].

2.3. Statistical analysis

All clinic data were entered into a study specific database. These data were merged with clinical and outcome data from an ICU specific longitudinal database, (the details of the database described elsewhere) [52]. All data analysis was performed using Stata 11.0 (Stata Corp, College Station, TX). Descriptive statistics were used to report sleep quality measured with the PSQI and ESS questionnaires and the actigraph sleep data. Univariate linear regression was used to assess the relationship between the PSQI total and component scores with the corresponding variables of actigraph sleep data. A linear regression model assessed if domains of the EQ-5D, SF-36 and HADS were associated with either the PSQI or actigraph total sleep time. Multivariate regression analysis was performed using the same outcome variables with the addition of the following covariates: age, the presence of any or individual preexisting comorbidities (cancer, asthma/chronic obstructive pulmonary disease, cardiovascular disease, obesity, and diabetes) and anxiety/depression (defined by the HADS questionnaire). A linear regression model assessed if ICU variables including, ICU length of stay (LOS), hospital LOS, severity of illness as measured by the mean Acute Physiology and Chronic Health Evaluation (APACHE) II score or duration of ventilation influenced sleep parameters measured by actigraphy.

3. Results

A total of 56 patients met the inclusion criteria during the study period (Table 1). All patients underwent questionnaire testing. 11 of the 56 patients were selected for actigraph analysis. Those randomized to receive the actigraph device were more likely to be male (57%) and were slightly younger (median age 54 years). The average time to follow-up was 82 days post hospital discharge for those tested with actigraphy and 77 days for those not tested. The