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Analysis of Nighttime Sleep and the Impact of Selected Predictors (Pain and Delirium) on its Quality in Hospitalized Patients Over Sixty Years of Age

Altmış Yaş Üstü Yatan Hastalarda Gece Uykusunun Analizi ve Seçilmiş Prediktörlerin (Ağrı ve Deliryum) Uykunun Kalitesi Üzerindeki Etkisi

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Abstract

Objective: Sleep disturbances, commonly seen in hospitalized patients, are influenced by the presence of disruptive factors. There is a proven relationship between sleep disturbances and delirium, or pain. It may be assumed that the association is bidirectional, has negative impacts, and leads to poor outcomes.

Materials and Methods: A prospective observational study. To analyze sleep quality (assessed subjectively with the Richards-Campbell Sleep Questionnaire (RCSQ), and objectively using actigraphy) in a high-risk population of patients (age over 60 years, a hospital stay longer than 48 hours) and its relationships to selected risk factors-pain [assessed with a visual analog scale (VAS)] and delirium (assessed with the confusion assessment method for the intensive care unit).

Results: Nighttime sleep was disrupted, as seen from some studied parameters, both objective and subjective. It was found that nurses tended to overestimate sleep quality. In delirious patients, significant changes ($p<0.05$) were noted for several autography parameters (total sleep time -0.5707; movement index 0.4155; number of awakenings 0.2868; wake after sleep onset 0.3874) as well as RCSQ items (sleep depth -0.3712; sleep quality -0.2985). In patients with pain (VAS ≥4), certain changes were also found in autography (movement index 0.3226) and RCSQ parameters (sleep depth -0.2908; returning to sleep -0.2856; RCSQ total -0.2746)

Conclusion: The study demonstrated relationships between sleep disturbances and selected factors (pain and delirium) in hospitalized patients. To objectively assess the obtained data, a combination of subjective and objective measures is a prerequisite. However, a more robust multicenter study would be needed to strengthen the evidence base.

Keywords: Sleep disturbances, delirium, pain, elderly patient, autography

Öz

Amaç: Hastanede yatan hastalarda yaygın olarak görülen uyku bozuklukları, yıkıcı faktörlerin varlığından etkilenir. Uyku bozuklukları ile deliryum veya ağrı arasında kanıtlanmış bir ilişki vardır. Bu ilişkinin çift yönlü olduğu, olumsuz etkilerinin olduğu ve kötü sonuçlara yol açtığı varsayılabilir.

Gereç ve Yöntem: Bu çalışma prospektif gözlemsel bir çalışma olarak dizayn edildi. Yüksek riskli bir hasta popülasyonunda (60 yaşın üzerinde, hastanede 48 saatten uzun bir süre kalış) uyku kalitesini değerlendirmek için, sübjektif olarak Richards-Campbell Uyku Ölçeği (RCSQ) ve objektif olarak aktigrafi kullanıldı. Ayrıca bunun seçilen risk faktörleriyle, yani ağrı ve deliryum ile olan ilişkilerini analiz etmek amacıyla sırasıyla görsel analog skala (VAS) ve yoğun bakım ünitesi konfüzyon değerlendirme yöntemi kullanıldı.

Bulgular: Çalışılan bazı parametrelerden görüldüğü gibi, hem nesnel hem de öznel olarak gece uykusu bozuldu. Hemşirelerin uyku kalitesini fazla önemseme eğiliminde oldukları gözlendi. Deliryumlu hastalarda, birkaç aktigrafi parametresinde (toplam uyku süresi -0,5707; hareket indeksi 0,4155; uyanma sayısı 0,2868; uyku başlangıcından sonra uyanma 0,3874) ve ayrıca RCSQ maddelerinde (uyku derinliği -0,3712; uyku kalitesi -0.2985) anlamlı değişiklikler görüldü ($p<0,05$). Ağrısı olan hastalarda (VAS ≥4), aktigrafide (hareket indeksi 0,3226) ve RCSQ parametrelerinde (uyku derinliği -0,2908; uykuya dönüş -0,2856; RCSQ toplam -0,2746) bazı değişiklikler bulundu.

Sonuç: Çalışma, hastanede yatan hastalarda uyku bozuklukları ile seçilmiş faktörler (ağrı ve deliryum) arasındaki ilişkileri göstermiştir. Elde edilen verileri objektif olarak değerlendirmek için, sübjektif ve objektif ölçümlerin kombinasyonu bir ön koşuldur. Bununla birlikte, kanıt tabanını güçlendirmek için daha sağlam, çok merkezli bir çalışmaya ihtiyaç duyulacaktır.

Anahtar Kelimeler: Uyku bozuklukları, deliryum, ağrı, yaşlı hasta, aktigrafi

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Introduction

Sleep quality and disturbances have been increasingly assessed and monitored in hospitalized patients, particularly those receiving intensive care. The incidence of insomnia is estimated between 36% and 57 % (1), with disturbances commonly persisting for as long as 12 months from discharge (2). Sleep disturbances are associated with a higher risk for developing delirium (3) and hypertension (4), poor blood glucose control in diabetics (5), reduced physical performance (6) and increased pain perception (7). Studies using objective methods to assess sleep have confirmed that sleep architecture is disrupted in hospitalized patients. Even though the total amount of sleep over 24 hours may be normal, daytime sleep accounts for as much as 50% (8). Moreover, this phenomenon is intensified during a hospital stay, with sleep architecture being restored long after discharge (9).

There have been increasing studies not only assessing sleep and its quality but also focusing on factors influencing inpatients' sleep (10-12). The risk factors have traditionally been classified as non-environmental and environmental and. The former include the patient's underlying disease and physical condition, pain or discomfort, psychosocial factors (stress, anxiety) and medication. The latter are noise, light and nursing interventions. As the environmental factors may be controlled, the quality of sleep (and, in fact, the outcome of the entire hospital stay) may be improved (13). Upon identification of negative factors, measures were proposed that may improve sleep and its quality (14,15). At the same time, better sleep quality may reduce the incidence of delirium (16), which itself is a factor impacting on the hospital stay. The association between sleep disturbances and delirium has been reported in several studies, suggesting their neurocognitive similarity (attention disorders, impaired memory and cognition) (17,18). Recent studies (19) have documented a higher risk of delirium in elderly patients with sleep disturbances, irrespective of their dementia status. A promising technique able to detect, objectively assess and quantify both sleep disturbances and delirium based on changes in patients' motor activity seems to be actigraphy. A review (20) has shown that actigraphy may be used to detect sleep disturbances, potentially distinguish delirious from non-delirious patients and, thus, identify at-risk patients.

There is a well-proven, bidirectional association between sleep disturbances and pain (21,22). Poor sleep quality increases nociception and reduces the effectiveness of analgesics, thus increasing their consumption (23). As it is difficult to differentiate these two conditions (and to confirm the superiority of one over the other), a comprehensive, holistic approach appears to be most useful, with the sleep-pain-delirium interactions being considered as multimorbidity. This has a negative impact on the well-being, quality of life and clinical outcome of patients, especially elderly ones (24).

Materials and Methods

Design and Patients

A prospective observational study was carried out on 34 patients receiving follow-up care in a general ward between March and June 2021 (Figure 1).

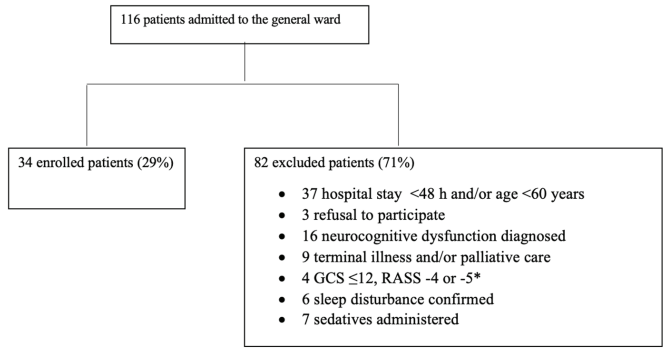

Figure 1. Flowchart of patients in the study
*GCS: Glasgow Coma Scale, RASS: Richmond Agitation-Sedation Scale

Inclusion criteria: Age over 60 years; a hospital stay longer than 48 hours.

Exclusion criteria: A Glasgow Coma Scale score of 12 or less; terminal illness and/or palliative care; previous or current treatment for sleep disturbances; neurocognitive dysfunction (dementia); sedative administration over the last 24 hours; refusing consent to participate.

Actigraphy

The activity monitor (wGT3X-BT, ActiGraph, USA) was placed on the non-dominant wrist. The epoch length was set at 60 seconds. The obtained data were processed using software (ActiLife 6.13.3, ActiGraph) and a specific algorithm (Cole-Kripke). The continuous measurements lasted for 72 hours (monday through thursday). Nighttime sleep analysis was carried out between 9 PM and 5 AM. The actigraphy parameters are shown in Table 1.

Diagnostic Tools

Delirium was assessed with a validated and standardized Czech version of the Confusion Assessment Method for the Intensive Care (CAM-ICU). The assessment involves several steps. First, the depth of consciousness (sedation) is assessed with the Richmond Agitation-Sedation Scale (RASS); in patients with RASS scores of -4 or less, delirium cannot be assessed and the test must be repeated later. In the next step, four main features of delirium are assessed: acute change or fluctuating course of mental status (feature 1), inattention (feature 2), altered level of consciousness (feature 3) and disorganized thinking (feature 4). Delirium is deemed positive when feature 1 and feature 2 and either feature 3 or 4 are present; otherwise, the patient is CAM-ICU negative. RASS scores ranging from 0 to -3 are associated with hypoactive delirium. A RASS score of +1 to +4 suggests hyperactive delirium. Mixed delirium is when the patient fluctuates between the two forms. The Czech version of the original CAM-ICU used upon approval from the authors from Brno, Czech Republic (25).

Sleep quality was assessed using the Richards-Campbell Sleep Questionnaire (RCSQ) containing five items: sleep depth, sleep latency, awakenings, returning to sleep and sleep quality. Noise, an optional item, is evaluated separately. Each item is scored by using a 0-100 visual analog scale (VAS). The total score is

Table 1. Definitions of actigraphy parameters	
Actigraphy parameter	**Definition**
Time in bed (TIB) (min)	The time between the start and the end of the recording
Total sleep time (TST) (min)	The total number of minutes scored as "asleep"
Sleep efficiency (SE) (%)	Number of sleep minutes divided by the total number of minutes the subject was in bed multiplied by 100
Wake after sleep onset (WASO) (min)	The total number of minutes the subject was awake after sleep onset occurred
Number of awakenings (-)	Number of awakenings per night
Average awakening length (min)	The average length, in minutes, of all awakening episodes
Sleep fragmentation index (SFI) (-)	Expressed as a percentage and calculated as the sum of the proportion of all epochs from sleep onset to sleep offset that were mobile*
*Actigraph software used; calculated per night time (9 PM to 5 AM)	

calculated as the mean of all items, with 0 and 100 representing the worst and best sleep, respectively. The subjective assessment may be supplemented with the Sleep Efficiency Index (SEI) using the following formula: SEI = 46.88 + (0.39 × total RCSQ score), with an SEI higher than 85% indicating good sleep quality. The questionnaire was translated and validated by Locihová et. (26) after obtaining consent from the author (27). For pain assessment, the VAS is most frequently used in common clinical practice. To subjectively assess their pain intensity, the patient makes a mark on a 10 cm line, ranging from "no pain" (0) to "the worst possible" pain (10). In the present study, a VAS score of 4 or more was considered significant.

Measurements and Data Collection

After assessing the eligibility and obtaining consent, the actigraph was put on the non-dominant wrist by a trained nurse to be worn for 72 hours (monday morning to thursday morning). Over that time, delirium and pain were assessed by a nurse every 12 hours. The quality of sleep during the previous night was assessed by a nurse every morning.

Ethical Aspects

The study complied with the Declaration of Helsinki and was approved by the Vzděl.vac. a výzkumný institut AGEL Ethics Committee (reference no: INT 2019003, date: 28.08.2019). Patients who volunteered to participate were guaranteed anonymity. Consent to use the Czech version of the CAM-ICU and to translate the RCSQ was obtained from the authors.

Statistical Analysis

Differences between night 1 and night 3 were evaluated using Wilcoxon's robust paired test. Correlations between pairs of variables were tested using robust Kendall's τ correlations (28). Changes between night 1, night 2 and night 3 were evaluated using a repeated measures ANOVA model consisting of the factors night and subject. For the parametric methods, the original data were transformed using power transformations to attain symmetry of the data distribution and constant variance (homoscedasticity) in the data and residuals. The homogeneity and symmetry in transformed data was checked as described elsewhere (29).

The NCSS 12 statistical software from Number Cruncher Statistical Systems (Kaysville, Utah, USA), Statgraphics Centurion 18 from Statgraphics Technologies, Inc. (The Plains, Maryland, USA) and SIMCA from Umetrics (Umeå, Sweden) were used for calculations.

Results

The sample comprised 17 males (50%) and 17 females; there were 14 smokers (41%). Twenty-nine patients (85%) were acutely admitted and six (17%) underwent surgery. Four patients (11%) were transferred from the ICU; four patients (11%) died. The most frequent reasons for hospital admission were diseases of the respiratory system (ICD-10 J00-J99; e.g. respiratory failure, respiratory infections, chronic obstructive pulmonary disease) in 11 patients (32%), diseases of the circulatory system (ICD-10 I00-I99; e.g. heart failure, ischemic heart diseases) in 7 patients (20%) and various injuries in 5 patients (14%). Delirium (CAM-ICU positivity) was found in 13 patients (38%) and significant pain (VAS ≥4) in 16 patients (47%). The participants' mean age was 70.6 years [standard deviation (SD) 17.6] and mean Body Mass Index was 29.0 (SD 18.2). The mean length of hospital stay was 18.0 days (SD 13.5); see Table 2.

The total nighttime sleep duration was reduced to approximately 400 minutes (6.6 hours); the approximate number of nocturnal awakenings lasting about 5 minutes was 12.

Objective analysis of nighttime sleep (9 PM to 5 AM) monitored for 72 hours showed significant changes ($p<0.05$) between night 1 and night 3 (N1-3) in the following parameters: (i) wake after sleep onset (WASO) N1 a median of 54.8 (quartiles, 49.1, 60.9); N2 65.2 (59.2, 71.7); N3: 64.2 (58.1, 70.7); night: $F=2.6$, $p=0.08$ $\eta p2=0.0796$; (ii) Movement Index (MI) N1 19.6 (18.2, 21.2); N2 22.1 (20.5, 23.7); N3 23.6 (21.9, 25.4); night: $F=4.6$, $p=0.014$, $\eta p2=0.128$; (iii) total sleep time (TST) N1 403 (395, 410); N2 392 (385, 399); N3 392 (384, 398); night: $F=2.3$, $p=0.092$, $\eta p2=0.0669$. The other parameters [sleep efficiency, number of awakenings, average awakening length, Fragmentation Index (FI), sleep FI] showed no significant changes ($p>0.05$); see Table 3.

Assessments with the RCSQ showed statistically significant nighttime sleep quality changes ($p<0.05$) between the nights (N1-3) in the following parameters: (i) sleep latency N1 67.3 (65.1, 69.6); N2 70.2 (68.8, 75.2); N3 72.3 (70, 74.5); night: $F=5$, $p=0.033$, $\eta p2=0.148$ and (ii) sleep quality N1 61.2

(57.7, 64.7); N2 65.3 (58.2, 69.4); N3 72.3 (68.8, 75.7); night: F=10.7, p=0.003, ηp2=0.263. The parameters RCSQ total N1 66.6 (63.6,69.5); N2 69.4 (62.8, 76.2); N3 71.5 (68.5, 74.4); night: F=2.8, p=0.102, ηp2=0.084 and SEI N1 73.7 (72.6, 74.8); N2 74.2 (71.6, 77.9); N3 75.4 (74.3, 76.4); night: F=2.4, p=0.135, ηp2=0.0706 were on the border of statistical significance. The remaining parameters (sleep depth, returning to sleep, awakenings and noise) showed no significant changes; see Table 4.

Relationships with risk factors (delirium, pain) were assessed with the Kendall test and their power was expressed as Kendall's τ (using 95% confidence interval), with higher values indicating stronger relationships and positive or negative values indicating direct or indirect causality, respectively. For delirium, the selected sleep parameters were as follows: TST -0.5707, MI +0.4155, WASO +0.3874, sleep depth (RCSQ) -0.3712, sleep quality (RCSQ) -0.2985 and number of awakenings +0.2868; see Table 5. Similarly, the relationships between sleep parameters and pain (VAS ≥4) were assessed and the results were as follows (in ascending order): MI +0.3226; sleep depth -0.2908, returning to sleep -0.2856 and RCSQ total -0.2746; see Table 6.

Table 2. Summary table for dichotomous variables (n=34)

Variable	n (%)	Median (quartiles)	Mean (SD)
Male sex	17 (50%)	-	-
Smoker	14 (41%)	-	-
Acute admission	29 (85%)	-	-
Surgery	6 (17%)	-	-
Previous ICU stay	4 (11%)	-	-
Death in hospital	4 (11%)	-	-
ICD-10 I00-I99	7 (20%)	-	-
ICD-10 J00-J99	11 (32%)	-	-
ICD-10 S00-S99	5 (14%)	-	-
CAM-ICU+	13 (38%)	-	-
VAS ≥4	16 (47%)	-	-
Age (years)	-	72.5 (61.5, 81.3)	70.6 (17.6)
Weight (kg)	-	73.5 (67.3, 80.0)	76.7 (19.9)
Height (cm)	-	170 (165, 175)	170 (29.8)
BMI (kg/m^2)	-	28 (12.0, 36.8)	29.0 (18.2)
Patient/room	-	2 (2, 2)	1.910 (0.628)
Alcohol	-	1 (0, 1)	0.824 (0.753)
Hospital days	-	21 (9, 36)	18.0 (13.5)

SD: Standard deviation, CAM-ICU: Confusion Assessment Method for the Intensive Care, BMI: Body Mass Index, VAS: Visual analog scale

Discussion

The study results confirm disturbed sleep quality in hospitalized patients, as reported by other authors (30,31). Despite literature data (32,33) and our initial assumptions, there was no improvement in objective parameters over monitored nights and some of them even deteriorated. This may be explained by numerous factors that were not considered in the study (e.g. severity or worsening of the patient's condition, other patients sharing the same room with the patient, undiagnosed preexisting sleep disorder). Even though sleep assessment by nurses is considered effective, easy to perform and inexpensive, it is limited by observer bias. When sleep quality was subjectively assessed by nurses in the present study, almost all parameters

Table 3. Changes in objective (actigraphy) parameters during 3 nights (n=34)

	Night		
Variable	**N1 median (quartiles)**	**N2 median (quartiles)**	**N3 median (quartiles)**
SE	83.9 (82.4, 85.3)	82.0 (80.5, 83.4)	81.9 (80.4, 83.4)
	Night: F=1.7, p=0.186, ηp2=0.0512		
TST	403 (395, 410)	392 (385, 399)	392 (384, 398)
	Night: F=2.3, p=0.092, ηp2=0.0669		
WASO	54.8 (49.1, 60.9)	65.2 (59.2, 71.7)	64.2 (58.1, 70.7)
	Night: F=2.6, p=0.08, ηp2=0.0796		
Number of awakenings	11.7 (10.6, 12.8)	12.5 (11.5, 13.6)	12 (11, 13)
	Night: F=0.5, p=0.642, ηp2=0.014		
Average awakening length	5.16 (4.66, 5.69)	5.75 (5.23, 6.31)	5.83 (5.30, 6.40)
	Night: F=1.4, p=0.244, ηp2=0.0425		
MI	19.6 (18.2, 21.2)	22.1 (20.5, 23.7)	23.6 (21.9, 25.4)
	Night: F=4.6, p=0.014, ηp2=0.128		
FI	10.60 (7.82, 13.80)	13.5 (10.3, 17.0)	11.1 (8.27, 14.4)
	Night: F=0.7, p=0.508, ηp2=0.0203		
SFI	32.7 (28.9, 36.8)	38.3 (34.2, 42.8)	36.7 (32.7, 41.1)
	Night: F=1.5, p=0.235, ηp2=0.0436		

SE: Sleep efficiency, TST: Total sleep time, WASO: Wake after sleep onset, MI: Movement Index, FI: Fragmentation Index, SFI: Sleep fragmentation index

Table 4. Changes in subjective (RCSQ) parameters during 3 nights (n=34)			
	Night		
Variable	N1 median (quartiles)	N2 median (quartiles)	N3 median (quartiles)
Sleep depth	69.4 (65.9, 72.9)	68.2 (60.5, 73.4)	67.1 (63.5, 70.6)
	Night: F=0.4, p=0.512, ηp2=0.0132		
Sleep latency	67.3 (65.1, 69.6)	70.2 (68.8, 75.2)	72.3 (70.0, 74.5)
	Night: F=5, p=0.033, ηp2=0.148		
Returning to sleep	70.8 (66.4, 75.0)	75.2 (69.2, 81.7)	71.4 (67.1, 75.6)
	Night: F=0, p=0.883, ηp2=0.000669		
Awakenings	69.6 (65.2, 73.9)	70.1 (66.9, 72.8)	70.6 (66.2, 74.9)
	Night: F=0.1, p=0.819, ηp2=0.00162		
Sleep quality	61.2 (57.7, 64.7)	65.3 (58.2, 69.4)	72.3 (68.8, 75.7)
	Night: F=10.7, p=0.003, ηp2=0.263		
RCSQ total	66.6 (63.6, 69.5)	69.4 (62.8, 76.2)	71.5 (68.5, 74.4)
	Night: F=2.8, p=0.102, ηp2=0.084		
SEI	73.7 (72.6, 74.8)	74.2 (71.6, 77.9)	75.4 (74.3, 76.4)
	Night: F=2.4, p=0.135, ηp2=0.0706		
Noise	82.3 (79.5, 85.0)	81.1 (76.9, 82.3)	80.1 (77.2, 82.9)
	Night: F=0.6, p=0.441, ηp2=0.0181		
RCSQ: Richards-Campbell Sleep Questionnaire, SEI: Sleep Efficiency Index			

Table 5. Significant relationships between delirium (CAM-ICU+) and sleep variables (n=13)		
Variable	Kendall's τ	p-value
TST (OBJ)	-0.5707	0.0008
Sleep depth (SUBJ)	-0.3712	0.0305
MI (OBJ)	0.4155	0.0154
Number of awakenings (OBJ)	0.2868	0.0464
WASO (OBJ)	0.3874	0.0086
Sleep quality (SUBJ)	-0.2985	0.0456
TST: Total sleep time, WASO: Wake after sleep onset, MI: Movement Index, CAM-ICU: Confusion Assessment Method for the Intensive Care		

Table 6. Significant relationships between pain (VAS ≥4) and sleep variables (n=16)		
Variable	Kendall's τ	p-value
Returning to sleep (SUBJ)	-0.2856	0.0483
RCSQ total (SUBJ)	-0.2746	0.0495
MI (OBJ)	0.3226	0.021
Sleep depth (SUBJ)	-0.2908	0.0439
RCSQ: Richards-Campbell Sleep Questionnaire, MI: Movement Index, VAS: Visual analog scale		

(except for sleep depth and noise) were shown to improve. The study results suggest that nurses tend to overestimate sleep quality and, at the same time, are unable to correctly recognize the extent of sleep disturbances that patients may experience. Our findings are therefore consistent with those from earlier studies. Kamdar et al. (34) stated that patient-nurse interrater reliability on the RSCQ was "slight to moderate" and that nurses tended to overestimate sleep quality perceived by patients. Locihová et al. (35) found a very low level of agreement between subjective sleep quality assessment (RCSQ) and objective actigraphy measurements. Based on their study analyzing sleep in 62 older adults, Yeh et al. (36) concluded that sleep is difficult to assess using a single parameter, underscoring the need for a multidimensional approach with both self-reported (questionnaire) and objective methods.

Actigraphy has been increasingly used to assess sleep in hospitalized patients (37), with validation studies reporting a sensitivity of approximately 90% and specificity of approximately 80% as compared with polysomnography (38,39). On the other hand, the above studies claim that one weakness of the method is analysis of the obtained data. Selecting the appropriate algorithm may be crucial for specificity of the measurements.

The present study showed that both investigated predictors (i.e. delirium and pain) had an impact on sleep quality. Even though the relationships may be assumed, literature data are not so conclusive regarding delirium. While Jaiswal et al. (17) confirmed the relationship between delirium and sleep disturbances, others (40) failed to show it using a different assessment technique (polysomnography) in a different population (mechanically ventilated ICU patients). In a Chinese study (41), delirious patients had less rapid eye movement (REM) sleep, lower melatonin levels and higher cortisol levels than controls, suggesting impaired circadian rhythm. The so-called PADIS guidelines on sleep in ICU patients recommend the use of a multi-component sleep-promoting protocol which, when implemented, results in improved sleep quality and thus a reduced incidence of delirium (42). A potentially interesting outcome of the present study is a confirmed relationship

between the actigraphy parameter MI and the presence of delirium. This may confirm an earlier hypothesis (20) suggesting differences in motor activity patterns between delirious and non-delirious patients. As actigraphy is able to identify these patterns, it may aid in revealing delirium. However, a more robust high-quality study is needed to definitely confirm the hypothesis.

The present study also found associations between pain and several subjective sleep parameters (returning to sleep, RCSQ total, sleep depth) and one objective parameter (MI). The relationship between sleep quality and pain has been repeatedly and sufficiently confirmed in the literature (23,43). Yet many questions remain concerning the causality as well as mechanisms that may explain it. A review by Moldofsky (7) showed that the risk for the association of insomnia or unrefreshing sleep and pain increases with severity of pain. The relationship between pain intensity and disturbed sleep is expected to increase with age, with the elderly being particularly affected. Experimental animal studies have suggested that REM sleep deprivation increases pain perception. leading to hyperalgesia. According to other authors, this may be explained by sleep deprivation preventing the action of endogenous and exogenous opioids (44). A questionnaire study (166 patients, 28 hospitalists, 37 nurses) on a range of disruptions to sleep in hospital patients identified pain as the most disruptive factor, followed by vitals and tests. The results only highlight the importance of good pain management, not just in relation to sleep (45). The significance of sleep quality in hospitalized patients and the need for interventions to improve it have been documented by numerous authors (14,15,42), raising an awareness of this aspect of nursing care.

Recommendations for Practice

There is a likely relationship between sleep disturbances and the selected predictors (pain, delirium), with the causation being bidirectional.

The presence and extent of the association is difficult to quantify and assess objectively, mainly due to the variable accuracy of assessment methods.

Sleep quality improvements (sleep-promoting interventions) appear to be potentially very important and beneficial.

Study Limitations

The main limitation is the design (single-center study, small number of participants). Sleep quality assessment and objective measures of sleep are limited by accuracy of the assessment method used. This limitation is also essential when the associations are confirmed and quantified. Valid and comprehensive assessment of the impact that selected predictors have on nighttime sleep quality will require a high-quality multi-center randomized study.

Conclusion

The study has revealed a relationship between sleep disturbances and the selected predictors (pain and delirium). The association is difficult to clearly confirm in clinical practice due to a range of limitations, the most important cause of which is the sleep quality assessment method. The most suitable appears to be a combination of objective (actigraphy) and subjective (questionnaire) assessments. In hospitalized patients, sleep is disrupted due to a variety of reasons. Sleep quality and its improvement receive increasing attention in nursing. Mounting evidence suggests that non-pharmacological interventions should be the first choice to promote sleep in hospital patients.

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Ethics

Ethics Committee Approval: Ethics approval of the study was taken from Vzdělávací a výzkumný institut AGEL Ethics Committee (reference no: INT 2019003, date: 28.08.2019).

Informed Consent: Consent to use the Czech version of the CAM-ICU and to translate the RCSQ was obtained from the authors.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Concept: H.L., R.Z., Design: H.L., R.Z., Data Collection or Processing: H.L., B.B., R.Z., J.H., Analysis or Interpretation: H.L., P.Š., B.B., J.H., Literature Search: H.L., K.A., P.Š., Writing: H.L., K.A.

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