

EDITORIAL

Alterations of circadian rhythms in critically ill patients: can we sleep on it?

Frank A. RASULO *, Elisa SEGHELINI

Department of Medical, Surgical, Radiological Sciences and Public Health, Institute of Anesthesia, Intensive Care and Emergency Medicine, University of Brescia, Brescia, Italy

*Corresponding author: Frank A. Rasulo, Department of Medical, Surgical, Radiological Sciences and Public Health, Institute of Anesthesia, Intensive Care and Emergency Medicine, ASST degli Spedali Civili di Brescia, University of Brescia, Piazzale Spedali Civili 1, 25123 Brescia, Italy. E-mail: frank.rasulo@gmail.com

Alterations in sleep and core body temperature represent an important and underestimated problem, despite it is well known that critically ill patients frequently may have sleep abnormalities during their Intensive Care Unit (ICU) stay. These patients suffer a considerable reduction of the most refreshing sleep stages, including rapid eye movement (REM) and slow wave sleep (SWS), as well as an increase of N1 (the stage which occurs at sleep onset, also representing a transition from wakefulness to sleep) and N2, (light sleep or the moment of falling asleep, characterized by spindles and K complexes on EEG), which are the most superficial sleep stages.¹ In addition, sleep is severely fragmented and disorganized, with a high number of cortical arousals (CA).²⁻⁵ Furthermore, sleep disorders and circadian rhythm alterations have also been associated with many diseases, including cardiometabolic disorders, depression, delirium, cognitive impairment.⁶⁻⁹ Similarly, the circadian rhythm of core body temperature, (CBT) is also known to be altered in critically ill patients, and that the degree of circadian abnormality correlate with severity of illness, as showed by Gazendam *et al.* when describing that the APACHE (Acute Physiology and Chronic Health Evaluation) III Score was found to be significantly predictive of circadian displacement.¹⁰

In their study published in the current issue of *Minerva Anestesiologica*, Boots *et al.*¹¹ collected data pertaining to sleep by polysomnography

(PSG) during the evening hours, and temperature rhythm patterns in 20 critically ill mechanically ventilated patients. Their results show that the quality of sleep was in line with what is reported in literature. In fact, their patients were characterized by a short or abolished REM phase, with 45.0% (IQR: 13.8-77.2) of patients remaining awake for half of the study period, five of whom awake for more than 90% of the time, and an increase of the N2 and N3 (deep sleep, the hardest to interrupt, characterized by a slow-wave activity that exceeds 20% of the time) in a 3 is 0-s epoch. phase duration. Similarly, the 24-hour CBT had a rhythmic pattern in 13 (65%) patients. Yet they found no significant associations between CBT rhythmicity, sleep stages, sleep EEG frequency density, illness severity scores or TISS (therapeutic intervention scoring system) on the day of PSG, and no relationship between time awake and CBT rhythmicity or CBT peak time.

We thank the authors for this contribution; however, a few considerations must be made: first of all, the CBT site is quite relevant, as temperature readings may vary significantly. For example, between bladder and axillary the temperature readings may differ up to -0.33 ± 0.5 °C.¹²

It should be underlined that many patients were sedated: 60% with benzodiazepines during the polysomnography exam and 15% with general anesthetics, which may have altered the quality of sleep itself.

Finally, the relation between CBT and the polysomnographic exam was analyzed only in the evening hours, during which the different distribution of the sleep pattern in the critical patient within the 24-hour period is well known.

However, it is interesting to note how the authors were able to obtain a maximal noise reduction to 32-dB through use of earplugs; therefore, eliminating an important factor influencing the quality of sleep.^{13, 14} The noise level in general the ICU's has continued to increase over time, with average values measured near the patient's bed between 50 dB and 65 dB, and peaks between 70 dB and 85 dB.^{15, 16} This has prompted the World Health Organization to recommend keeping a daily average sound level in the ICU below 30 dB and a maximum level of 40 dB, equivalent to the background noise in an urban setting. Furthermore, a prospective randomized study investigated the use of earplugs and eye masks in 64 critically ill ICU patients and demonstrated a reduction in long awakenings and an increase in N3 duration when they are well tolerated.¹⁷

Although this study by Boots *et al.* represents an eye opener regarding the possible relation between CBT rhythms and ICU sleep, the number of patients was too scarce in order to draw any definite conclusions, and therefore we can neither confirm nor exclude this issue, leaving the task to future larger and statistically stronger studies.

References

1. Moser D, Anderer P, Gruber G, Parapatics S, Loretz E, Boeck M, *et al.* Sleep classification according to AASM and Rechtschaffen & Kales: effects on sleep scoring parameters. *Sleep* 2009;32:139–49.
2. Knauert MP, Haspel JA, Pisani MA. Sleep Loss and Cir-

cadian Rhythm Disruption in the Intensive Care Unit. *Clin Chest Med* 2015;36:419–29.

3. Pulak LM, Jensen L. Sleep in the Intensive Care Unit: A Review. *J Intensive Care Med* 2016;31:14–23.

4. Elliott R, McKinley S, Cistulli P, Fien M. Characterisation of sleep in intensive care using 24-hour polysomnography: an observational study. *Crit Care* 2013;17:R46.

5. Elliott R, McKinley S, Cistulli P. The quality and duration of sleep in the intensive care setting: an integrative review. *Int J Nurs Stud* 2011;48:384–400.

6. Grandner MA, Sands-Lincoln MR, Pak VM, Garland SN. Sleep duration, cardiovascular disease, and proinflammatory biomarkers. *Nat Sci Sleep* 2013;5:93–107.

7. Li L, Wu C, Gan Y, Qu X, Lu Z. Insomnia and the risk of depression: a meta-analysis of prospective cohort studies. *BMC Psychiatry* 2016;16:375.

8. Weinhouse GL, Schwab RJ, Watson PL, Patil N, Vaccaro B, Pandharipande P, *et al.* Bench-to-bedside review: delirium in ICU patients - importance of sleep deprivation. *Crit Care* 2009;13:234.

9. Maas MB, Lizza BD, Kim M, Abbott SM, Gendy M, Reid KJ, *et al.* Stress-Induced Behavioral Quiescence and Abnormal Rest-Activity Rhythms During Critical Illness. *Crit Care Med* 2020;48:862–71.

10. Gazendam JA, Van Dongen HP, Grant DA, Freedman NS, Zwaveling JH, Schwab RJ. Altered circadian rhythmicity in patients in the ICU. *Chest* 2013;144:483–9.

11. Boots RJ, Mead G, Garner N, Rawashdeh O, Bellapart J, Townsend S, *et al.* Temperature rhythms and ICU sleep: the TRIS study. *Minerva Anestesiologia* 2021;87:794–802.

12. Nonose Y, Sato Y, Kabayama H, Arisawa A, Onodera M, Imanaka H, *et al.* Accuracy of recorded body temperature of critically ill patients related to measurement site: a prospective observational study. *Anaesth Intensive Care* 2012;40:820–4.

13. Freedman NS, Gazendam J, Levan L, Pack AI, Schwab RJ. Abnormal sleep/wake cycles and the effect of environmental noise on sleep disruption in the intensive care unit. *Am J Respir Crit Care Med* 2001;163:451–7.

14. Boyko Y, Jennum P, Nikolic M, Holst R, Oerding H, Toft P. Sleep in intensive care unit: the role of environment. *J Crit Care* 2017;37:99–105.

15. van de Pol I, van Iterson M, Maaskant J. Effect of nocturnal sound reduction on the incidence of delirium in intensive care unit patients: an interrupted time series analysis. *Intensive Crit Care Nurs* 2017;41:18–25.

16. Johansson L, Bergbom I, Lindahl B. Meanings of being critically ill in a sound-intensive ICU patient room - a phenomenological hermeneutical study. *Open Nurs J* 2012;6:108–16.

17. Demoule A, Carreira S, Lavault S, Pallanca O, Morawiec E, Mayaux J, *et al.* Impact of earplugs and eye mask on sleep in critically ill patients: a prospective randomized study. *Crit Care* 2017;21:284.

Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions.—Frank Rasulo and Elisa Seghelini have given substantial contributions to manuscript writing and revision. All authors read and approved the final version of the manuscript.

Comment on: Boots RJ, Mead G, Garner N, Rawashdeh O, Bellapart J, Townsend S, *et al.* Temperature rhythms and ICU sleep: the tris study. *Minerva Anestesiologia* 2021;87:794–802. DOI: 10.23736/S0375-9393.21.15232-0.

History.—Article first published online: June 16, 2021. - Manuscript accepted: May 25, 2021. - Manuscript revised: May 24, 2021. - Manuscript received: April 8, 2021.

(Cite this article as: Rasulo FA, Seghelini E. Alterations of circadian rhythms in critically ill patients: can we sleep on it? *Minerva Anestesiologia* 2021;87:750-1. DOI: 10.23736/S0375-9393.21.15777-3)