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Foot-Bathing Therapy Improved Sleeplessness in a Mechanically Ventilated Patient: A Case Report

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It is well known that sedation during mechanical ventilation should not be performed beyond the level necessary while being monitoring sedation status. However, some patients only complain of insomnia, even though the patient's degree of sedation has been assessed to be adequate. A woman aged 50 years with a history of systemic lupus erythematosus was transferred into our ICU with a diagnosis of respiratory infection. In 10 days treatment with antibacterial drug and mechanical ventilation improved her respiratory condition well enough to prepare for weaning from mechanical ventilation support. Her sedation was well managed such that a Richmond Agitation-Sedation Scale (RASS) score of -2 to -4 was achieved during treatment. In the process of ventilator weaning involved reducing her sedation gradually, targeting a RASS score of 0 to -1 , she then began to complain of severe sleep disturbance. Neither ramelteon nor mianserin administration could improve her insomnia. Multidisciplinary discussion decided a trial of foot-bathing therapy for her sleep disorder. After starting warm footbath care during a daytime, her insomnia improved dramatically in a short time without additional medication or increasing the drug dosage. As the result, her extubation succeeded smoothly without delay.

Key Words: sleep disorders in intensive care unit (ICU), mechanical ventilation, foot-bathing therapy

Background

Sleep disturbance in the intensive care unit (ICU) can be induced generally by physical, psychological, and/or environmental factors. It is well known that it may cause the delirium and unexpected complications. Therefore, treating the patient's insomnia is a very important part of intensive care. However, in patients with mechanical

ventilatory support, optimally treating insomnia is often difficult. Additional administration of a sleep-inducing drug or increasing the dose of continuous intravenous sedatives have been the routine mode of treatment. However, the effects on hemodynamics or the prolongation of drug effects to the next day could be the risks involved in delaying weaning from ventilation support.

Foot-bathing therapy has been reported to effectively

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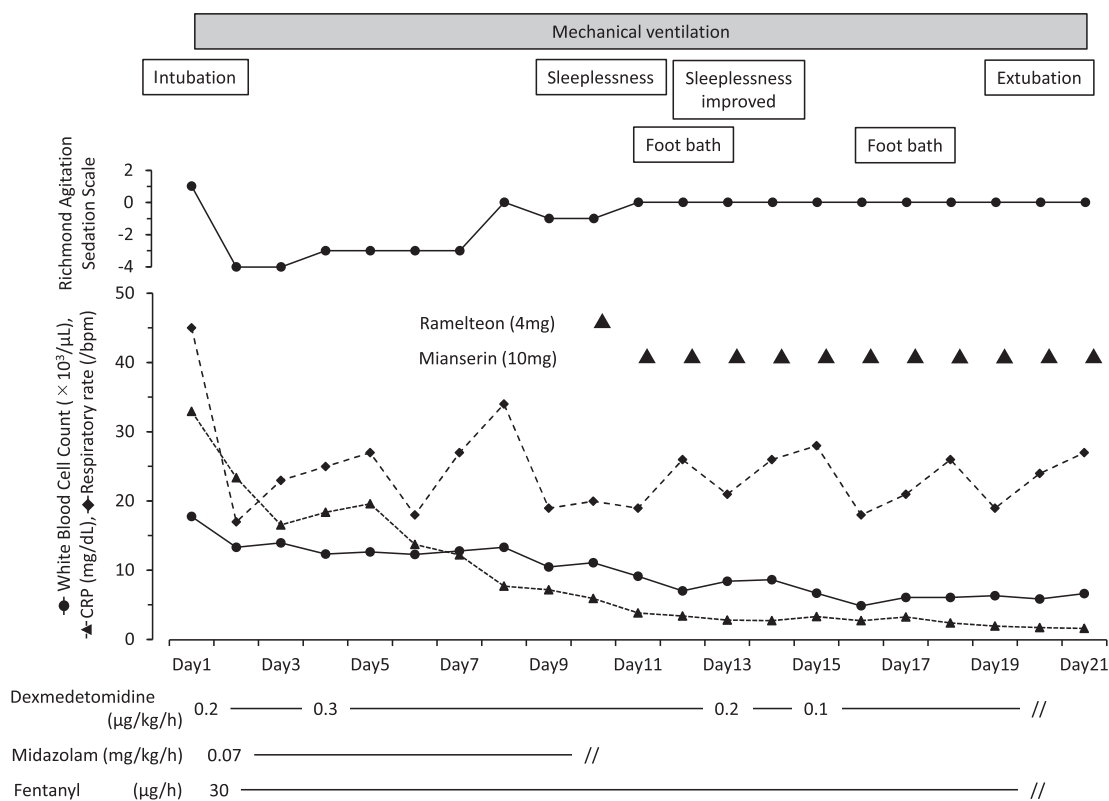


Figure 1 Clinical course in the ICU. The solid line of circle means white blood cell count, the dashed line of triangle means CRP and the broken line of rhombus means respiratory rate. From day 1 to day 21, she received mechanical ventilation support and from day 1 to day 10 she was sedated with dexmedetomidine, midazolam and fentanyl. After discontinued midazolam administered, she complained sleeplessness and ramelteon nor mianserin could improve her sleeplessness. After foot bath her sleeplessness was dramatically improved and successfully extubated.

enhance the quality of sleep by decreasing the core body temperature through peripheral vasodilation without relying on medications.¹

Here we present a mechanically ventilated patient in whom a foot-bathing therapy facilitated a drastic improvement in sleep quality.

Case Presentation

A woman aged 50 years with a history of systemic lupus erythematosus, hypertension, diabetes and lipidosis visited the emergency department with a complaint of dysarthria. In the emergency department, her Glasgow Coma Scale was 12/15 (motor 5, eyes 4, verbal 3), heart rate was 124 beats per minute (bpm), blood pressure was 122/76 mmHg, oxygen saturation was 87% in room air, and body temperature was 37.3°C. Even though oxygen therapy (10 L/minute by face mask) improved her oxygen saturation to 98%, her respiratory rate was remained

at rate of 45 breaths/minute. Initial arterial blood gas analysis while receiving 10 L/minute oxygen administered by a face mask showed pH of 7.44, PaCO₂ of 15.0 mmHg, PaO₂ of 79.3 mmHg, HCO₃⁻ of 10.0 mmol/L, and standard base excess of -11.9 mmol/L. A chest radiograph showed infiltration shadows in the upper right lung field. Chest computed tomography (CT) images also showed infiltration shadows in right upper lobe.

She was transferred into the ICU with a diagnosis of respiratory infection.

Immediate after entering the ICU, her trachea was intubated and respiratory support with a mechanical ventilator was started under sedation with dexmedetomidine, midazolam and fentanyl (**Figure 1**). The target sedation level was set at a Richmond Agitation-Sedation Scale (RASS) score of -2 to -4 to control the tachypnea.

Ten days treatment with antibacterial drug and mechanical ventilation helped improve her respiratory condition gradually and allowed planning for weaning from



Figure 2 Sample of foot-bathing therapy in a mechanically ventilated patient.

mechanical ventilation. For the purpose, the target sedation level was changed lighter into a RASS score of 0 to -1. Sedation management was also performed without any problems during these 10 days. In the process of weaning, continuous administration of midazolam (0.07 mg/kg/h) was terminated first, without changing the doses of dexmedetomidine and fentanyl. Consequently, the patient began to strongly complain of sleep disturbance. At first, 4 mg of ramelteon administration was tried, but it did not improve her insomnia. On the next day, 10 mg of mianserin administration was attempted, which also, however, did not improve her insomnia. On the third day, following a multidisciplinary discussion, we decided to offer foot-bathing therapy to manage her sleep disorder.

Our foot-bathing therapy protocol was as follows: first, the high-performance ICU bed was transformed to the sitting position paying attention the patient and the connection with the ventilator. Then immersed the patient's both foot in a water bath (the temperature of the water 40-42°C) and the duration of bathing was planned in 10 minutes (**Figure 2**).

Before the start of foot-bathing therapy, heart rate was 109 bpm, blood pressure was 112/79 mmHg, oxygen saturation was 99%, respiratory rate was at rate of 29 breaths/minute, body temperature was 36.4°C, and her mental state was calm. Because her posture change was performed slowly while carefully checking the respiratory and circulation status, her vital signs during posture

change and foot-bathing therapy did not change much.

After starting foot-bathing therapy, her insomnia improved immediately from the night of the therapy day, and also dexmedetomidine could be reduced (from 0.3 to 0.1 µg/kg/h) without complaint about nighttime insomnia. The foot-bathing therapy was done twice in four days. Subsequently, her extubation was performed without any delay or adverse events.

Consent

The patient gave written informed consent for publication of this case report and all accompanying images.

Discussion

Patients on artificial respiration in the ICU are deeply sedated (RASS score of -2 to -4) when their respiratory conditions are severely damaged. With the improvement of the patient's respiratory condition, the level of sedation may be decreased (the target RASS score of 0 to -1). However, patients sometimes complain of sleeplessness when the sedation is reduced. Sleep disturbances in the ICU are still poorly understood; however, they could worsen comorbidities or be the result of some underlying disease.² Furthermore, many cases of hypoactive or mixed delirium in the ICU could be related to the sedative effects of anxiolytic and analgesic drugs that ICU caregivers administer.³ Thus, it is emphasized that the strategies to use the effective lowest dose of sedative drug may help in avoiding delirium.³

Hypnotic agents like benzodiazepines can increase total sleep time, but they also alter the physiological progression of the sleep phases, and decrease the time spent in the most restorative phases, when compared to the phases normally,⁴ Hence, it is important that non-pharmacological intervention be considered in the management of sleep disturbance in the ICU.

There were several studies about non-pharmacological intervention to sleep disruption.⁵⁻⁷ Foot-bathing therapy has also been reported to effectively enhance the quality of sleep. However, no non-pharmacological interventions used for treatment of sleep disruption in ICU, including foot-bathing therapy. Warming of the skin is associated with a typical activation of sleep in the midbrain reticular formation, hypothalamus, and cerebral cortex in animals.⁸

The decreasing part of the circadian rhythm in core temperature has been demonstrated to be mainly determined by heat loss from the skin of the extremities, which is associated with strongly increased skin temperature.⁸ Selective vasodilation of distal skin regions (and hence heat loss) promotes the rapid onset of sleep.⁹ However, the sensitivity of sleep propensity to foot warming changes with age, and is attenuated in age-related insomnia.¹⁰ Foot-bathing therapy has also been reported to improve sleep by reducing sleep-onset latency, thereby increasing non-rapid eye movement (NREM) sleep and reducing rapid eye movement (REM) sleep.¹¹

Kim et al. reported that daily 30 minutes foot-bathing therapy sessions with water at 40°C given at one and a half hours before bedtime were effective in improving the sleep quality in older adults.¹² In this case, just one daytime foot-bathing therapy helped to improve her sleeplessness. It is thought that the resultant sleep occurred due to relaxation brought about by foot-bathing therapy. Preparing and implementing the foot-bathing therapy is quite laborious, but easy to administer and cost-effective, involving minimal risk. During the foot-bathing therapy is required light assistance to hold the posture of the sitting position, in this case did not require assistance only observation. Foot-bathing therapy is a physical therapy that can be performed relatively easily without any contraindications such as surgical wounds on the feet. We believe that it has a potential to be the first-step treatment for sleep disturbance in the ICU.

Conclusion

We here report the improvement of sleep disturbance by foot-bathing therapy during artificial ventilation. The non-pharmacological approach to sleep disturbance is resulted in no complication of psychological problem.

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Authors' contributions are as follows: NS drafted the

manuscript. NS, YS, JI, MN and TN treated the patient and YS, JI, MN, MIId, YS, KO, DK, MIw and TN helped to draft the manuscript and revise it critically. All authors read and approved the final manuscript.

Conflicts of Interest: The authors declare that they have no competing interests.

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