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„Light sedation" strategy vs. deep sedation in mechanically ventilated patients: An analysis of clinical outcomes and safety

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Abstract

Background. Sedation management is a cornerstone of supportive care for critically ill patients receiving mechanical ventilation. While deep sedation was historically the standard, contemporary practices are shifting toward an "eCASH" model (Comfort and patient-centered Care without excessive Sedation and High levels of analgesia).

Aim. The objective of this study was to comprehensively evaluate and compare clinical outcomes between light sedation and deep sedation strategies in mechanically ventilated patients, focusing on mortality rates, duration of mechanical ventilation, length of stay (LOS), and neurological complications.

Material and methods. A detailed analysis was performed based on 40 scientific sources, including randomized controlled trials and meta-analyses. Sedation depth was primarily defined using the Richmond Agitation-Sedation Scale (RASS).

Results. Early deep sedation (within 48 hours) is an independent predictor of increased mortality (Hazard Ratio = 1.661). Light sedation was associated with a reduction in mechanical ventilation duration by an average of 2.1 days and shorter ICU stays by 3 days.

Conclusions. Targeting light sedation should be the default standard of care to improve patient survival and recovery, as deep sedation is a strong predictor of delirium and increased mortality.

Key words: light sedation, deep sedation, mechanical ventilation, intensive care unit, mortality, delirium, Richmond Agitation-Sedation Scale (RASS)

1. Introduction

Sedation and analgesia are essential components of care for millions of critically ill patients requiring mechanical ventilation to ensure safety, comfort, and synchrony with the ventilator [26,30,31]. Historically, the clinical paradigm in the 1980s and 1990s favored deep sedation to minimize oxygen consumption and facilitate adaptation to mechanical support, often leading to prolonged periods of immobility and unconsciousness[21]. However, over the past two decades, there has been a dramatic shift toward a patient-centered approach aiming to keep individuals "calm, conscious, and cooperative" [2,37]. Current international guidelines, such as the PADIS recommendations, now strongly advocate for targeting light sedation (RASS 0 to -2) or even no sedation to facilitate early mobilization and faster weaning from mechanical support [2,13].

Despite these clear recommendations, early deep sedation remains highly prevalent in modern clinical practice, often initiated as early as the emergency department or within the first 48 hours of ICU admission[9,17,38,39]. Growing evidence identifies the depth of sedation during this initial phase as a critical, modifiable determinant of patient outcomes [10,17,21]. Early deep sedation has been established as a potent and independent predictor of increased short- and long-term mortality, prolonged duration of mechanical ventilation, and longer intensive care unit (ICU) stays [3,5,17,30]. Furthermore, deep sedation is a major driver of acute brain dysfunction, correlating with a significantly higher prevalence of delirium and the distortion of physiological sleep architecture [13,17,19].

The management of sedation depth must also consider the severity of the patient's underlying respiratory failure, particularly in high-acuity cases. In patients with severe lung injury (PaO_2/FiO_2 <

100), the preservation of strong spontaneous breathing effort under light sedation may paradoxically exacerbate lung damage through Patient Self-Inflicted Lung Injury (P-SILI) and lead to fewer ventilator-free days. This complex balance between wakefulness and lung protection became especially evident during the COVID-19 pandemic, where early deep sedation was prevalent and independently associated with nearly triple the mortality rate in some cohorts compared to light sedation strategies [9]. This paper provides a comprehensive analysis of the clinical outcomes and safety profiles associated with these competing sedation strategies to clarify the optimal approach for the modern mechanically ventilated patient.

2. Research materials and methods

This paper was developed through a comprehensive analysis of clinical studies and meta-analyses retrieved from PubMed. The search focused on keywords including "light sedation strategy," "deep sedation," "mechanically ventilated patient," and "clinical outcomes." The analysis prioritizes randomized controlled trials (RCTs) and high-quality prospective cohort studies. Key outcome measures evaluated include 28-day and 90-day mortality, ventilator-free days (VFDs), intensive care unit (ICU) length of stay (LOS), and safety metrics such as delirium incidence and adverse events.

3. Research results

3.1. Mortality and Survival Outcomes

Early depth of sedation is a critical determinant of patient survival, with aggregate data from over 4,500 patients showing a significantly lower hospital mortality rate in those managed with light sedation (9.2%) compared to those receiving deep sedation (27.6%)[17]. Meta-analytic evidence indicates an odds ratio of 0.34 for mortality in favor of light sedation, suggesting a robust survival benefit across various ICU populations. During the first wave of the COVID-19 pandemic, this trend was even more pronounced, with mortality reaching 30.4% in deeply sedated patients versus 11.1% in those receiving light sedation [9]. Furthermore, early deep sedation within the first 48 hours of mechanical ventilation acts as a strong independent predictor of mortality, even after adjusting for baseline illness severity and other clinical confounders [5,9,39].

The impact of initial sedation depth extends well beyond the acute phase of illness, significantly influencing long-term survival trajectories up to two years post-admission. In a large European cohort study, early deep sedation was associated with a nearly two-fold increase in the hazard of death at a two-year follow-up (HR 1.866) [5]. Long-term survival analysis indicates that mortality at two years is as high as 62.0% for patients deeply sedated early in their stay, compared to 39.9% for matched patients managed with lighter sedation targets. Other studies have corroborated these findings, demonstrating that the depth of early sedation is a reliable predictor of survival at 180 days and even up to 60 months, where 60-month survival rates were significantly lower for the deep sedation group (38.1%) compared to those receiving light sedation or daily interruptions (90.5%) [39].

However, the survival benefit of light sedation may be modulated by specific clinical pathologies and the severity of respiratory failure. For instance, a sub-study of the ROSE trial found no significant difference in 90-day mortality between light and deep sedation in a propensity-matched cohort specifically of moderate-to-severe ARDS patients (OR 0.72) [22]. This suggests that in high-acuity cases where strict lung-protective ventilation is paramount, the benefits of lighter sedation might be counterbalanced by the need for synchronization and reduced respiratory drive. Conversely, in specific neurological populations such as postoperative intracerebral hemorrhage patients, a short course of deep sedation was actually associated with lower 3-month mortality and improved quality of life [16]. Therefore, while early light sedation remains the recommended default for improving survival, clinicians must carefully tailor sedation depth targets to the specific clinical requirements of the underlying disease.

3.2. Duration of Mechanical Ventilation and ICU Stay

Light sedation and daily sedation interruption strategies are strongly associated with improved clinical efficiency and shorter recovery periods. A meta-analysis of 4,521 patients demonstrated that early light sedation targets lead to a significant reduction in the duration of mechanical ventilation, with a mean difference of 2,1 fewer days compared to deep sedation groups[17]. Similar trends were observed in pediatric populations, where deeply sedated children required significantly longer ventilatory support (193.38 hours) than those managed with light sedation (123,14 hours)[6]. Furthermore, implementing daily sedative interruptions has been shown to reduce time on the ventilator by approximately 2,5 days and shorten the intensive care unit (ICU) length of stay by 3,5 days [8,20]. Studies consistently indicate that these reductions are often driven by earlier successful extubation and higher rates of passing spontaneous breathing trials (SBT) [21].

However, the impact of sedation depth on clinical stay and ventilation duration is modulated by both diurnal practices and the severity of the underlying lung injury. Evidence suggests that higher doses of opioids and benzodiazepines administered at night are independently associated with SBT failure and delayed extubation, highlighting the need for consistent diurnal sedation management [30]. During the COVID-19 pandemic, deep sedation was linked to significantly fewer ventilator-free and ICU-free days [9]. Conversely, in the specific subset of patients with severe lung injury ($PaO_2/FiO_2 < 100$), early light sedation was associated with a decrease of 10.8 ventilator-free days compared to deep sedation [3]. This counterintuitive finding suggest that in the most severe cases of respiratory failure, the preservation of strong spontaneous breathing effort under light sedation may exacerbate lung injury through mechanisms like overdistension and asynchrony, thereby paradoxically prolonging the need for mechanical support [3].

3.3. Delirium and Acute Brain Dysfunction

Delirium and acute brain dysfunction represent significant clinical challenges in the management of mechanically ventilated patients, with delirium occurring in approximately 70% to 80% of patients with acute respiratory failure [20]. Current evidence demonstrates a strong correlation between the depth of early sedation and the prevalence of these conditions, as deep and prolonged sedation is consistently associated with an increased incidence of delirium [13]. Specifically, clinical data indicates that the prevalence of delirium rises sharply as sedation levels intensify, increasing from 65.4% in the lightest tertile of patients to 89.8% in those receiving the deepest sedation [19]. Furthermore, deep sedation initiated early in the course of treatment, such as in the emergency department, has been identified as a potent predictor for the subsequent development of acute brain dysfunction in the ICU—a composite measure of delirium and coma—with an adjusted odds ratio of 2.15 [10].

The presence of delirium is a critical determinant of patient prognosis, acting as an independent predictor of both in-hospital mortality and long-term cognitive impairment following discharge[20,39]. Sedation depth further complicates these outcomes by contributing to "rapidly reversible" sedation-related delirium, which, although often transient when sedatives are held, still reflects a period of brain dysfunction that can delay recovery. Meta-analytic findings emphasize that light sedation strategies significantly increase the number of delirium-free and coma-free days during the first 28 days of admission compared to deep sedation[13,17]. Additionally, the choice of pharmacological agents is vital, as benzodiazepines are heavily implicated in transitioning patients to delirious states, whereas using non-benzodiazepine sedatives like dexmedetomidine or propofol may reduce delirium frequency and foster a more awake and interactive patient environment [2,20].

3.4. Sleep Architecture and Autonomic Function

Sleep architecture is profoundly disrupted in mechanically ventilated patients, with deep sedation serving as a primary driver of these alterations. Synthesis of clinical data, particularly in pediatric cohorts, demonstrates that deep sedation is associated with a significantly higher incidence of NREM-1 and REM sleep stage loss compared to light sedation. While sedatives may increase the total sleep duration and the proportion of deep sleep, they severely distort the physiological sleep cycle and reduce overall sleep efficiency [6]. A critical advantage of light sedation strategies is the facilitation of sleep recovery; patients managed with lighter targets exhibit more normalized sleep cycles and better REM sleep restoration within the first 24 hours after weaning from mechanical ventilation. These findings are clinically significant, as disrupted circadian rhythms and the loss of sleep spindles—a key feature for memory integration—have been linked to prolonged ventilation and increased mortality risk [6].

Depth of sedation also exerts a significant influence on autonomic nervous system (ANS) function, which is essential for maintaining physiological stability in the intensive care unit [7]. Clinical evaluations using heart rate variability (HRV) analysis reveal that deep sedation is strongly associated with the depression of parasympathetic nervous activity [7]. Specifically, markers of parasympathetic tone, such as the high-frequency (HF) component, RMSSD, and pNN50, are significantly lower in deeply sedated patients compared to those under light sedation. This reduction in autonomic balance, frequently complicated by the use of benzodiazepines, may lead to hemodynamic instability and an impaired ability to respond to external stressors. Emerging research suggests that personalized HRV-based algorithms can discriminate between light and deep sedation states with an accuracy of approximately 75%, offering a potential objective metric for titrating sedation depth to preserve autonomic health [28].

3.5. Severe Respiratory Failure and P-SILI Risk

The relationship between sedation depth and clinical outcomes is heavily modulated by the severity of the patient's respiratory failure, specifically when the PaO2/FiO2 ratio falls below 100 [3]. While light sedation is the international standard, a retrospective study found that in patients with severe lung injury, it was associated with significantly fewer 28-day ventilator-free days compared to deep sedation (0 days vs. 16 days), representing an adjusted mean reduction of 10.8 days [3]. This phenomenon highlights spontaneous breathing as a "double-edged sword"; although it can improve gas exchange and prevent diaphragm atrophy, the preservation of respiratory drive in high-acuity cases may lead to deleterious effects like overdistension and patient-ventilator asynchrony.

These deleterious effects are encapsulated in the concept of Patient Self-Inflicted Lung Injury (P-SILI), where strenuous spontaneous inspiratory efforts generate large negative swings in intrathoracic pressure and excessive transpulmonary pressure swings [3]. Such physiological stress can cause regional alveolar overstretch, increased pulmonary perfusion, and extravascular leakage, ultimately exacerbating the original lung injury. Therefore, in the early phase of severe ARDS, clinicians must balance the benefits of conscious sedation against the need to control respiratory effort through strategies like neuromuscular blockade or deeper sedation, utilizing bedside tools such as airway occlusion pressure (P0.1) to monitor and mitigate the risk of myotrauma and iatrogenic lung damage [3, 33]

3.6. COVID-19 Specific Outcomes

The management of sedation for mechanically ventilated patients underwent a significant shift during the COVID-19 pandemic, with approximately 72.4% of all patients experiencing early deep sedation within the first 48 hours [9]. Data indicate that patients with COVID-19 were more frequently maintained in deep sedation throughout their first week of care compared to non-COVID cohorts. This practice is strongly associated with adverse survival outcomes; the mortality rate for deeply sedated patients was nearly triple that of the light sedation group (30.4% vs 11.1%) [9]. Even after adjusting for confounders, early deep sedation remained an independent predictor of hospital mortality with an adjusted odds ratio of 3.44 [9]. Furthermore, clinical reports highlight a static approach to sedation in this population, noting that 38.4% of COVID-19 patients remained deeply sedated until their death.

Beyond mortality, depth of sedation in COVID-19 patients profoundly impacted clinical efficiency and resource utilization. Patients in the deep sedation group experienced significantly fewer ventilator-free, ICU-free, and hospital-free days compared to those managed with lighter targets. These patients also received significantly higher cumulative doses of fentanyl, propofol, midazolam, and ketamine, and required neuromuscular blocking agents much more frequently than non-COVID patients (41.4% vs. 2.1%) [9]. Maintaining light sedation was particularly challenging in this cohort, as COVID-19-associated ARDS served as an independent risk factor for excessive respiratory drive and failure to transition to assisted breathing. Specifically, COVID-19 patients were nearly seven times more likely to require a transition back to deep sedation or controlled ventilation within 48 hours of an initial attempt at spontaneous breathing.

4. Discussion

The shift from historical deep sedation practices toward targeting a "calm, conscious, and cooperative" state is supported by robust clinical evidence demonstrating superior outcomes for the majority of mechanically ventilated patients. Synthesis of current data indicates that early light sedation (RASS 0 to -2) or daily sedation interruptions significantly reduce hospital mortality (9.2% vs. 27.6% in large cohorts) and are associated with improved long-term survival up to two years post-admission [5,17]. Beyond survival, light sedation targets facilitate earlier liberation from mechanical ventilation and shorter ICU stays, primarily by reducing the incidence of delirium and preserving more physiological sleep architecture [6,17,19]. Current international guidelines, such as the PADIS recommendations, consequently advocate for the judicious use of non-benzodiazepine sedatives like propofol or dexmedetomidine to achieve these lighter targets while minimizing iatrogenic harm [2, 13].

Despite these clear benefits, light sedation is not a "one size fits all" strategy and poses significant challenges in high-acuity cases. In patients with severe lung injury ($PaO_2/FiO_2 < 100$), the preservation of strong spontaneous breathing under light sedation can be a "double-edged sword", leading to Patient Self-Inflicted Lung Injury (P-SILI) through excessive transpulmonary pressure swings and overdistension [3]. Retrospective analysis has shown that in this specific sub-population, light sedation may actually result in significantly fewer ventilator-free days compared to deep sedation/muscle paralysis, necessitating a more controlled approach in the early phase of severe ARDS [3]. Furthermore, maintaining wakefulness in intubated patients increases nursing workload and the risk of unplanned extubations and patient-ventilator asynchronies, such as reverse-triggered breaths, which are more frequent under light sedation [8,23,38]

The COVID-19 pandemic served as a critical stress test for these paradigms, revealing a widespread return to early deep sedation (prevalent in over 70% of patients), which was independently associated with a nearly triple-fold increase in mortality [9]. This highlights that even in a global crisis, adhering to proven sedation protocols remains vital for patient survival. Moving forward, the integration of advanced bedside monitoring—such as airway occlusion pressure (P0.1) to assess respiratory drive and EEG-based tools or heart rate variability (HRV) algorithms—may provide the objective data needed to accurately titrate sedation depth [3,13,26,28]. Ultimately, while light sedation should remain the default clinical target for most ICU patients, clinicians must remain flexible and tailor sedation depth to the severity of respiratory failure to balance patient comfort with the necessity of lung protection [3,40]

5. Conclusions

The evidence synthesized in this analysis confirms that early light sedation (RASS 0 to -2) should be the default clinical target for the majority of mechanically ventilated patients to improve both survival and clinical efficiency [17]. Aggregate meta-analytic data demonstrate that light sedation strategies significantly reduce hospital mortality compared to deep sedation (9.2% vs. 27.6%) and act as a modifiable determinant of long-term recovery [5,13,17]. By facilitating earlier successful extubation and higher rates of passing spontaneous breathing trials, light sedation effectively shortens the duration of mechanical ventilation and ICU length of stay, thereby minimizing the iatrogenic risks associated with prolonged immobility and unconsciousness [2,6,8,15,26].

Furthermore, targeting lighter levels of arousal is essential for preserving the neuro-psychological health and physiological integrity of critically ill patients. Deep sedation is identified as a primary driver of acute brain dysfunction, correlating with a significantly higher prevalence of delirium and the severe distortion of sleep architecture, including the loss of critical REM and NREM-1 stages [2,6,13,39]. The implementation of nurse-driven protocols and the prioritized use of non-benzodiazepine sedatives, such as propofol or dexmedetomidine, provides a safe framework for achieving these targets without increasing the risk of autonomic instability or sedation-related adverse events [2,15,26].

Despite these clear benefits, clinical management must remain nuanced and tailored to the severity of the patient's respiratory failure [20]. In the specific high-acuity sub-population with severe lung injury ($PaO_2/FiO_2 < 100$), light sedation can be a "double-edged sword" where excessive spontaneous breathing effort may exacerbate lung damage through Patient Self-Inflicted Lung Injury (P-SILI) [3,33,41]. In such cases, a more controlled approach, potentially involving short-term deep sedation or neuromuscular blockade, may be necessary to ensure lung protection. Ultimately, the modern ICU approach must balance the benefits of conscious, cooperative patients with the physiological requirements of lung-protective ventilation to optimize long-term clinical outcomes [4,13,33,37]

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Author Contributions

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During the preparation of this work, the authors used Grammarly for the purpose of improving language and readability. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the substantive content of the publication

References

1. Boncyk C, Nahrwold DA, Hughes CG. Targeting light versus deep sedation for patients receiving mechanical ventilation. J Emerg Crit Care Med. 2018 Oct;2:79. https://doi.org/10.21037/jeccm.2018.10.03
2. Pearson SD, Patel BK. Evolving targets for sedation during mechanical ventilation. Curr Opin Crit Care. 2020 Feb;26(1):47-52. https://doi.org/10.1097/MCC.0000000000000687
3. Hatozaki C, Sakuramoto H, Ouchi A, Shimojo N, Inoue Y. Early Light Sedation Increased the Duration of Mechanical Ventilation in Patients With Severe Lung Injury. SAGE Open Nurs. 2023 Oct 17;9:23779608231206761. https://doi.org/10.1177/23779608231206761
4. Dzierba AL, Khalil AM, Derry KL, Madahar P, Beitler JR. Discordance Between Respiratory Drive and Sedation Depth in Critically Ill Patients Receiving Mechanical Ventilation. Crit Care Med. 2021 Dec 1;49(12):2090-2101. https://doi.org/10.1097/CCM.0000000000005113
5. Balzer F, WeiÃŸ B, Kumpf O, Treskatsch S, Spies C, Wernecke KD, Krannich A, Kastrup M. Early deep sedation is associated with decreased in-hospital and two-year follow-up survival. Crit Care. 2015 Apr 28;19(1):197. https://doi.org/10.1186/s13054-015-0929-2

6. Zhao X, Yan J, Wu B, Zheng D, Fang X, Xu W. Sleep cycle in children with severe acute bronchopneumonia during mechanical ventilation at different depths of sedation. BMC Pediatr. 2022 Oct 12;22(1):589. https://doi.org/10.1186/s12887-022-03658-8

7. Unoki T, Grap MJ, Sessler CN, Best AM, Wetzel P, Hamilton A, Mellott KG, Munro CL. Autonomic nervous system function and depth of sedation in adults receiving mechanical ventilation. Am J Crit Care. 2009 Jan;18(1):42-50; quiz 51. https://doi.org/10.4037/ajcc2009509

8. Yilmaz C, Kelebek Girgin N, Ozdemir N, Kutlay O. The effect of nursing-implemented sedation on the duration of mechanical ventilation in the ICU. Ulus Travma Acil Cerrahi Derg. 2010 Nov;16(6):521-6. https://pubmed.ncbi.nlm.nih.gov/21153945/

9. Stephens RJ, Evans EM, Pajor MJ, Pappal RD, Egan HM, Wei M, Hayes H, Morris JA, Becker N, Roberts BW, Kollef MH, Mohr NM, Fuller BM. A dual-center cohort study on the association between early deep sedation and clinical outcomes in mechanically ventilated patients during the COVID-19 pandemic: The COVID-SED study. Crit Care. 2022 Jun 15;26(1):179. https://doi.org/10.1186/s13054-022-04042-9

10. Fuller BM, Roberts BW, Mohr NM, Pappal RD, Stephens RJ, Yan Y, Carpenter C, Kollef MH, Avidan MS. A study protocol for a multicentre, prospective, before-and-after trial evaluating the feasibility of implementing targeted SEDation after initiation of mechanical ventilation in the emergency department (The ED-SED Pilot Trial). BMJ Open. 2020 Dec 16;10(12):e041987. https://doi.org/10.1136/bmjopen-2020-041987

11. Hohmann F, Wedekind L, Grundeis F, Dickel S, Frank J, Golinski M, Griesel M, Grimm C, Herchenhahn C, Kramer A, Metzendorf MI, Moerer O, Olbrich N, Thieme V, Vieler A, Fichtner F, Burns J, Laudi S. Early spontaneous breathing for acute respiratory distress syndrome in individuals with COVID-19. Cochrane Database Syst Rev. 2022 Jun 29;6(6):CD015077. https://doi.org/10.1002/14651858.cd015077

12. Mittal S, Mohan A, Madan K, Hadda V. Light sedation or no-sedation in ICU:patient experience matters. Monaldi Arch Chest Dis. 2020 Jul 29;90(3). https://doi.org/10.4081/monaldi.2020.1401

13. Gitti N, Renzi S, Marchesi M, Bertoni M, Lobo FA, Rasulo FA, Goffi A, Pozzi M, Piva S. Seeking the Light in Intensive Care Unit Sedation: The Optimal Sedation Strategy for Critically Ill Patients. Front Med (Lausanne). 2022 Jun 24;9:901343. https://doi.org/10.3389/fmed.2022.901343

14. Nassar AP Jr, Zampieri FG, Salluh JI, Bozza FA, Machado FR, Guimaraes HP, Damiani LP, Cavalcanti AB. Organizational factors associated with target sedation on the first 48h of mechanical ventilation: an analysis of checklist- ICU database. Crit Care. 2019 Jan 29;23(1):34. https://doi.org/10.1186/s13054-019-2323-y

15. Jin HS, Yum MS, Kim SL, Shin HY, Lee EH, Ha EJ, Hong SJ, Park SJ. The efficacy of the COMFORT scale in assessing optimal sedation in critically ill children requiring mechanical ventilation. J Korean Med Sci. 2007 Aug;22(4):693-7. https://doi.org/10.3346/jkms.2007.22.4.693

16. Hou D, Liu B, Zhang J, Wang Q, Zheng W. Evaluation of the Efficacy and Safety of Short-Course Deep Sedation Therapy for the Treatment of Intracerebral Hemorrhage After Surgery: A Non-Randomized Control Study. Med Sci Monit. 2016 Jul 28;22:2670-8. https://doi.org/10.12659/msm.899787

17. Stephens RJ, Dettmer MR, Roberts BW, Ablordeppey E, Fowler SA, Kollef MH, Fuller BM. Practice Patterns and Outcomes Associated With Early Sedation Depth in Mechanically Ventilated Patients: A Systematic Review and Meta-Analysis. Crit Care Med. 2018 Mar;46(3):471-479. https://doi.org/10.1097/ccm.0000000000002885

18. Detriche O, Berre J, Massaut J, Vincent JL. The Brussels sedation scale: use of a simple clinical sedation scale can avoid excessive sedation in patients undergoing mechanical ventilation in the intensive care unit. Br J Anaesth. 1999 Nov;83(5):698-701. https://doi.org/10.1093/bja/83.5.698

19. Hwang JM, Choi SJ. Early Sedation Depth and Clinical Outcomes in Mechanically Ventilated Patients in a Hospital: Retrospective Cohort Study. Asian Nurs Res (Korean Soc Nurs Sci). 2023 Feb;17(1):15-22. https://doi.org/10.1016/j.anr.2022.12.002

20. Shah FA, Girard TD, Yende S. Limiting sedation for patients with acute respiratory distress syndrome - time to wake up. Curr Opin Crit Care. 2017 Feb;23(1):45-51. https://doi.org/10.1097/mcc.0000000000000382

21. Hyun DG, Ahn JH, Gil HY, Nam CM, Yun C, Lee JM, Kim JH, Lee DH, Kim KH, Kim DJ, Lee SM, Ryu HG, Hong SK, Kim JB, Choi EY, Baek J, Kim J, Kim EJ, Park TY, Kim JH, Park S, Park CM, Jung WJ, Choi NJ, Jang HJ, Lee SH, Lee YS, Suh GY, Choi WS, Lee KS, Kim HW, Min YG, Lee SJ, Lim CM. The Profile of Early Sedation Depth and Clinical Outcomes of Mechanically Ventilated Patients in Korea. J Korean Med Sci. 2023 May 15;38(19):e141. https://doi.org/10.3346/jkms.2023.38.e141

22. Palakshappa JA, Russell GB, Gibbs KW, Kloefkorn C, Hayden D, Moss M, Hough CL, Files DC; NHLBI PETAL Network. Association of early sedation level with patient outcomes in moderate-to-severe acute respiratory distress syndrome: Propensity-score matched analysis. J Crit Care. 2022 Oct;71:154118. https://doi.org/10.1016/j.jcrc.2022.154118

23. Longhini F, Simonte R, Vaschetto R, Navalesi P, Cammarota G. Reverse Triggered Breath during Pressure Support Ventilation and Neurally Adjusted Ventilatory Assist at Increasing Propofol Infusion. J Clin Med. 2023 Jul 24;12(14):4857. https://doi.org/10.3390/jcm12144857

24. Ma P, Wang T, Gong Y, Liu J, Shi W, Zeng L. Factors Associated With Deep Sedation Practice in Mechanically Ventilated Patients: A Post hoc Analysis of a Cross-Sectional Survey Combined With a Questionnaire for Physicians on Sedation Practices. Front Med (Lausanne). 2022 Jun 9;9:839637. https://doi.org/10.3389/fmed.2022.839637

25. Ferrero F, Lupo E, Caldara L. Analgesia sedazione e blocco neuro muscolare in terapia intensiva pediatrica. Procedure attuali e recenti sviluppi [Analgesia, sedation and neuromuscular block in pediatric intensive care units: present procedures and recent progress]. Minerva Anestesiol. 2004 May;70(5):373-8. Italian. https://pubmed.ncbi.nlm.nih.gov/15181418/

26. Kaila M, Everingham K, Lapinlampi P, Peltola P, Särkelä MO, Uutela K, Walsh TS. A randomized controlled proof-of-concept trial of early sedation management using Responsiveness Index monitoring in mechanically ventilated critically ill patients. Crit Care. 2015 Sep 11;19(1):333. https://doi.org/10.1186/s13054-015-1043-1

27. Tarazan N, Alshehri M, Sharif S, Al Duhailib Z, MÃ¸ller MH, Belley-Cote E, Alshahrani M, Centofanti J, McIntyre L, Baw B, Meade M, Alhazzani W; GUIDE Group. Neuromuscular blocking agents in acute respiratory distress syndrome: updated systematic review and meta-analysis of randomized trials. Intensive Care Med Exp. 2020 Oct 23;8(1):61. https://doi.org/10.1186/s40635-020-00348-6

28. Nagaraj SB, Biswal S, Boyle EJ, Zhou DW, McClain LM, Bajwa EK, Quraishi SA, Akeju O, Barbieri R, Purdon PL, Westover MB. Patient-Specific Classification of ICU Sedation Levels From Heart Rate Variability. Crit Care Med. 2017 Jul;45(7):e683-e690. https://doi.org/10.1097/ccm.0000000000002364

29. Georgopoulos D, Kondili E, Alexopoulou C, Younes M. Effects of Sedatives on Sleep Architecture Measured With Odds Ratio Product in Critically Ill Patients. Crit Care Explor. 2021 Aug 10;3(8):e0503. https://doi.org/10.1097/cce.0000000000000503

30. Mehta S, Meade M, Burry L, Mallick R, Katsios C, Fergusson D, Dodek P, Burns K, Herridge M, Devlin JW, Tanios M, Fowler R, Jacka M, Skrobik Y, Olafson K, Cook D; SLEAP Investigators and the Canadian Critical Care Trials Group. Variation in diurnal sedation in mechanically ventilated patients who are managed with a sedation protocol alone or a sedation protocol and daily interruption. Crit Care. 2016 Aug 1;20(1):233. https://doi.org/10.1186/s13054-016-1405-3

31. Liu S, Su L, Liu X, Zhang X, Chen Z, Liu C, Hong N, Li Y, Long Y. Recognizing blood pressure patterns in sedated critically ill patients on mechanical ventilation by spectral clustering. Ann Transl Med. 2021 Sep;9(18):1404. https://doi.org/10.21037/atm-21-2806

32. Walsh TS, Kydonaki K, Antonelli J, Stephen J, Lee RJ, Everingham K, Hanley J, Phillips EC, Uutela K, Peltola P, Cole S, Quasim T, Ruddy J, McDougall M, Davidson A, Rutherford J, Richards J, Weir CJ; Development and Evaluation of Strategies to Improve Sedation Practice in Intensive Care (DESIST) study investigators. Staff education, regular sedation and analgesia quality feedback, and a sedation monitoring technology for improving sedation and analgesia quality for critically ill, mechanically ventilated patients: a cluster randomised trial. Lancet Respir Med. 2016 Oct;4(10):807-817. https://doi.org/10.1016/s2213-2600(16)30178-3

33. Balzani E, Murgolo F, Pozzi M, Di Mussi R, Bartolomeo N, Simonetti U, Brazzi L, Spadaro S, Bellani G, Grasso S, Fanelli V. Respiratory Drive, Effort, and Lung-Distending Pressure during Transitioning from Controlled to Spontaneous Assisted Ventilation in Patients with ARDS: A Multicenter Prospective Cohort Study. J Clin Med. 2024 Sep 3;13(17):5227. https://doi.org/10.3390/jcm13175227

34. Saylan S, Akdogan A, Kader S, Tugcugil E, Besir A, Kola M, Aslan Y. Sedoanalgesia modality during laser photocoagulation for retinopathy of prematurity: Intraoperative complications and early postoperative follow-up. Ulus Travma Acil Cerrahi Derg. 2020 Sep;26(5):754-759. English https://doi.org/10.14744/tjtes.2020.62378

35. Fuller BM, Roberts BW, Mohr NM, Knight WA 4th, Adeoye O, Pappal RD, Marshall S, Alunday R, Dettmer M, Goyal M, Gibson C, Levine BJ, Gardner-Gray JM, Mosier J, Dargin J, Mackay F, Johnson NJ, Lokhandwala S, Hough CL, Tonna JE, Tsolinas R, Lin F, Qasim ZA, Harvey CE, Bassin B, Stephens RJ, Yan Y, Carpenter CR, Kollef MH, Avidan MS. The ED-SED Study: A Multicenter, Prospective Cohort Study of Practice Patterns and Clinical Outcomes Associated With Emergency Department SEDation for Mechanically Ventilated Patients. Crit Care Med. 2019 Nov;47(11):1539-1548. https://doi.org/10.1097/ccm.0000000000003928

36. Xing XZ, Gao Y, Wang HJ, Qu SN, Huang CL, Zhang H, Wang H, Xiao QL, Sun KL. Effect of sedation on short-term and long-term outcomes of critically ill patients with acute respiratory insufficiency. World J Emerg Med. 2015;6(2):147-52. https://doi.org/10.5847/wjem.j.1920-8642.2015.02.011

37. Mistraletti G, Umbrello M, Salini S, Cadringher P, Formenti P, Chiumello D, Villa C, Russo R, Francesconi S, Valdambrini F, Bellani G, Palo A, Riccardi F, Ferretti E, Festa M, Gado AM, Taverna M, Pinna C, Barbiero A, Ferrari PA, Iapichino G; SedaEN investigators. Enteral versus intravenous approach for the sedation of critically ill patients: a randomized and controlled trial. Crit Care. 2019 Jan 7;23(1):3. https://doi.org/10.1186/s13054-018-2280-x

38. Tsuyada H, Inoue S, Tsujimoto T, Ogawa T, Inada M, Kawaguchi M. Impact of nursing experience on cancellation of light sedation for mechanically ventilated patients in a setting of 1 : 2 nurse-patient ratio. Anaesthesiol Intensive Ther. 2019;51(3):210-217. https://doi.org/10.5114/ait.2019.87359

39. Lee CM, Mehta S. Early sedation use in critically ill mechanically ventilated patients: when less is really more. Crit Care. 2014 Nov 10;18(6):600. https://doi.org/10.1186/s13054-014-0600-3

40. Louzon PR, Andrews JL, Torres X, Pyles EC, Ali MH, Du Y, Devlin JW. Characterisation of ICU sleep by a commercially available activity tracker andits agreement with patient-perceived sleep quality. BMJ Open Respir Res. 2020 Apr;7(1):e000572. doi: 10.1136/bmjresp-2020-000572. Erratum in: BMJ Open Respir Res. 2020 Jun;7(1):e000572corr1. https://doi.org/10.1136/bmjresp-2020-000572

41. Uemura K, Inoue S, Kawaguchi M. Successful application of early tracheostomy in an intubated patient who suffered from irritative stimuli by an oral tracheal tube. Saudi J Anaesth. 2021 Jan-Mar;15(1):50-52. https://doi.org/10.4103/sja.sja_790_20