



A Comprehensive Analysis of Influencing Factors and Clinical Insights into Perioperative Sleep Disorders

Rui Mao¹, Hong Chang^{2*}

¹Department of Anesthesiology, Shangjin Nanfu Hospital, Chengdu, China

²Department of Anesthesiology, West China Hospital, Sichuan University, China

Corresponding Author: **Chang Hong**

Address: Department of Anesthesiology, West China Hospital, Sichuan University, No. 37 Guoxue Lane, Wuhou District, Chengdu, Sichuan Province 610041, China; Tel: +18980606523; Email: zhuerliuliu@126.com

Received date: 17 March 2025; **Accepted date:** 25 March 2026; **Published date:** 01 April 2026

Citation: Mao R, Chang H. A Comprehensive Analysis of Influencing Factors and Clinical Insights into Perioperative Sleep Disorders. *Asp Biomed Clin Case Rep.* 2026 Apr 01;9(1):27-33.

Copyright © 2026 Mao R, Chang H. This is an open-access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium provided the original work is properly cited.

Abstract

Perioperative sleep disorders (PSDs), affecting approximately 60% of surgical patients, are a significant yet often overlooked challenge that hinders recovery and increases the risk of complications. This paper provides a systematic analysis of the complex mechanisms and key risk factors contributing to PSDs from four distinct dimensions. It identifies preoperative vulnerabilities such as baseline insomnia, obstructive sleep apnea (OSA), anxiety, and chronic comorbidities as primary predisposing factors. Furthermore, it examines the direct impacts of intraoperative factors, including the suppression of sleep architecture by anesthetic drugs (propofol, opioids) and the disruption of circadian rhythms caused by surgical timing and trauma. The review also highlights the synergistic exacerbation of sleep disturbances in the postoperative phase due to pain-inflammation cycles, adverse ward environments (noise and light), and medication side effects. Based on these findings, the study concludes that a multidisciplinary strategy combining preoperative screening, optimized anesthetic management, and environmental interventions is essential to mitigate PSDs. By improving perioperative sleep quality, clinicians can significantly enhance patient satisfaction, reduce hospital stays, and promote rapid rehabilitation.

Keywords

Perioperative Period, Sleep Disorders, Risk Factors, Anesthesia, Circadian Rhythm, Postoperative Recovery

Sleep, as one of the most fundamental physiological activities in the human body, plays an irreplaceable role in maintaining normal physiological and psychological states [1]. Postoperative sleep disorders are a common clinical issue, with the incidence of perioperative sleep disorders (PSDs) reaching as high as 60% [2,3]. Early postoperative sleep disturbances are characterized by reduced total sleep duration, decreased or absent rapid eye movement (REM) and

slow-wave sleep, as well as frequent fragmented sleep. Notably, approximately 25% of patients still experience sleep disturbances more than 15 days after surgery [4,5]. Sleep disorders can cause a range of physical and mental reactions, such as fatigue, drowsiness, and distraction, and even negative emotions such as tension, anxiety, depression, and irritability. In addition, perioperative sleep disorders are closely related to adverse events such as

postoperative cardiovascular events, chronic pain, and impaired respiratory function, which in turn affect the quality of patient recovery and length of hospital stay. They are also associated with postoperative metabolic disorders and immune diseases [6].

Therefore, this paper combines the latest research progress at home and abroad in recent years, systematically analyzing the influencing mechanisms and key risk factors of PSDs from four dimensions: preoperative, intraoperative, postoperative, and susceptibility factors in special populations, providing a theoretical basis for formulating targeted prevention and intervention strategies in clinical practice. By improving perioperative sleep quality, reducing the incidence of postoperative complications, promoting rapid patient recovery, and enhancing patient satisfaction and quality of life, perioperative management has significant guiding significance and application value in clinical practice.

Preoperative Influencing Factors: The Priming Role of Disease Baseline and Psychological Stress

Baseline Health and Physiological Characteristics:

Basic sleep disorders are the most critical preoperative risk factors. Meta-analyses show that patients with preoperative insomnia, obstructive sleep apnea (OSA), restless legs syndrome, and other sleep-related disorders have a significantly increased incidence of postoperative sleep disorders (PSD). Particularly in OSA patients, abnormal airway structure and sleep apnea episodes can be further exacerbated by surgical stress and anesthetic drugs during the perioperative period, leading to frequent nocturnal hypoxemia and disruption of sleep continuity [7]. A survey of 640 patients undergoing spinal surgery found that the incidence of sleep disorders was 61.4%, and risk factor analysis suggested a close relationship between preoperative sleep disorders and perioperative sleep disorders [8].

In addition, chronic underlying diseases and nutritional status cannot be overlooked. Chronic conditions such as diabetes, hypertension, and cardiovascular diseases indirectly disrupt sleep rhythms by affecting neuroendocrine regulation and

reducing the body's stress tolerance. Additionally, relevant meta-analyses have found that preoperative malnutrition, high preoperative PSQI scores, and anxiety are also significant risk factors for postoperative sleep disorders [6,9,10]. In terms of demographic characteristics, being female, aged >70 years, and having a BMI ≥ 24 kg/m² are clear risk factors. Elderly individuals experience a decline in the function of the suprachiasmatic nucleus and a decrease in lens transparency, leading to weakened circadian rhythm regulation. Patients over the age of 55 have reduced endogenous melatonin production, which may further impair sleep quality in this population [11].

Psychological Stress and Environmental Adaptation:

Preoperative anxiety, fear, and other negative emotions are the primary psychological factors that induce sleep disorders. Sympathetic nervous system excitation leads to increased cortisol levels, which in turn inhibit sleep initiation [12]. A randomized controlled trial by Guangdong Medical University demonstrated that preoperative anxiety, as measured by the Self-Rating Anxiety Scale (SAS), was significantly elevated in patients undergoing laparoscopic myomectomy. The control group exhibited a low Richards–Campbell Sleep Questionnaire (RCSQ) score of 63.9 ± 8.4 on the night before surgery. However, after receiving preoperative education via virtual reality (VR) technology, patients showed significantly reduced anxiety and improved sleep quality, with RCSQ scores rising to 67.4 ± 9.4 ($P=0.045$). This experiment confirmed a causal relationship between preoperative anxiety and sleep disturbances.

In addition to psychological factors, changes in the preoperative hospital environment also play a crucial role. Unfamiliar surroundings, noise, and constant lighting can disrupt a patient's established sleep patterns. Studies have shown that patients hospitalized for more than one week experience a decline in sleep quality [13]. A survey of hospitalized patients identified noise and lighting as primary factors contributing to sleep disturbances. Beyond noise levels, staff activities were also associated with

increased sleep disruption in the hospital environment. Studies indicate that up to 7% of sleep interruptions among inpatients are related to nursing interventions tied to staffing arrangements [14].

Intraoperative Influencing Factors: Direct Effects of Anesthetic Intervention and Surgical Trauma

Anesthesia Methods and Drug Selection:

Different anesthetic drugs and methods have varying effects on sleep. Commonly used anesthetics such as propofol, opioids, and benzodiazepines can directly suppress central sleep pathways, leading to a significant reduction in deep sleep (N3 stage) and rapid eye movement (REM) sleep postoperatively [15]. The route of administration may also influence the effect of anesthesia on PSD. A systematic review observed that patients receiving intravenous propofol anesthesia had better sleep quality compared to those undergoing inhaled anesthesia [16].

In comparison, intraspinal anesthesia or intraoperative combined nerve block has a lesser impact on sleep, as it reduces systemic medication dosage through regional analgesia and mitigates the inhibitory effects on central sleep pathways. Relevant studies indicate that patients receiving intraspinal anesthesia exhibit a lower incidence of postoperative PSD [17].

It is noteworthy that novel anesthetic drugs such as dexmedetomidine possess certain sleep-protective effects. By activating receptors to mimic natural sleep states, they can preserve partial sleep architecture while providing sedation, offering a new intervention approach for perioperative sleep protection [18]. Changes in melatonin secretion are a potential factor in the role of anesthesia in sleep disorders. During surgery, melatonin secretion levels drop sharply and then rebound above average levels. Although increased melatonin levels appear to benefit sleep quality, studies suggest that altered circadian melatonin secretion leads to elevated daytime melatonin levels, increasing daytime sleepiness and, conversely, exacerbating nocturnal sleep-wake disturbances. Evaluations using a rat model revealed that these effects were observed in

trials involving the anesthetics sevoflurane and desflurane [19-21].

Surgical Type and Degree of Trauma:

Observations indicate that the timing and type of surgery also play a role in the occurrence of PSD. Studies have shown that compared to patients undergoing surgery in the morning, those operated on in the afternoon (14:00–18:00) exhibit elevated cortisol levels and decreased melatonin levels on the first postoperative night, resulting in an incidence of sleep disturbances nearly twice as high in the afternoon group as in the morning group [22,23]. However, the duration of surgery does not appear to have an impact on postoperative sleep disturbances [22].

The severity of surgical trauma directly determines the intensity of perioperative stress responses, thereby affecting sleep quality. Major surgeries exert a greater inhibitory effect on slow-wave sleep and rapid eye movement sleep compared to minor surgeries. Minimally invasive procedures, such as laparoscopy, cause relatively less disruption to sleep due to their smaller trauma and faster recovery, with postoperative sleep quality returning to normal within less than a week. In contrast, recovery of sleep quality after major abdominal surgeries may take over four weeks [24,25].

In addition, sleep and impaired cognitive function are also associated with cytokines (IL-1, IL-6) released during postoperative inflammatory stress responses [26].

Postoperative Influencing Factors: Synergistic Exacerbation of Multidimensional Stress

Pain and Inflammatory Response:

Pain and sleep interact with each other. Pain stimulates the ascending arousal system, disrupts sleep continuity, and makes it difficult to fall asleep or causes frequent nighttime awakenings, thereby reducing sleep quality. Conversely, sleep deprivation can intensify pain perception [6,27]. Higher pain levels are associated with reduced REM sleep and slow-wave sleep and may persist for months after surgery [28]. Studies show that patients with

postoperative Visual Analogue Scale (VAS) scores >4 experience a significant decline in sleep quality.

Pain and inflammatory factors form a vicious cycle: pain stimulation promotes the release of pro-inflammatory factors such as TNF- α and IL-1 β , which further enhance pain sensitivity while directly interfering with the hypothalamic sleep-regulating center, leading to sleep fragmentation. Research cited by Guangming Online confirms that sleep deprivation can trigger a “systemic inflammatory storm,” increasing the production of prostaglandin D2 in the brain and subsequently inducing a cytokine storm in the periphery, exacerbating neuroinflammation and cognitive impairment. In turn, the inflammatory response further suppresses sleep, perpetuating the cycle. Additionally, postoperative physiological discomforts such as nausea, vomiting, bloating, frequent urination, and restricted positioning can disrupt sleep continuity by persistently stimulating the senses [29,30].

Environmental and Nursing Factors:

The postoperative ward environment is a significant external factor contributing to sleep fragmentation. Noise from monitor alarms, staff movement, and equipment operation, along with continuous lighting in the ward, can markedly suppress melatonin secretion and disrupt circadian rhythms. ICU patients, due to frequent medical interventions such as turning every 2 hours, blood draws, and suctioning, experience particularly severe sleep fragmentation, with a prevalence of PSD as high as 60%–76%, significantly higher than that of general ward patients.

The scheduling of nighttime care procedures, such as irregularly timed medication administration and monitoring, can directly interrupt deep sleep, leading to disrupted sleep architecture. Even when postoperative pain is controlled, environmental disturbances can persistently degrade sleep quality [24,31].

Medication and Complication Effects:

The impact of postoperative drug side effects on sleep cannot be overlooked. While opioid analgesics can alleviate pain, they may induce sleep-related adverse

reactions such as sleep apnea, nightmares, and daytime drowsiness. Hormones, certain antibiotics, and asthma medications, among others, may directly cause insomnia. Studies indicate that sleep fragmentation can lead to changes in gut acetate-producing microbiota and hypothalamic acetate accumulation, thereby triggering glucose metabolism imbalance and cognitive impairment. The interference of postoperative drugs on gut microbiota may further exacerbate this pathological process.

Additionally, postoperative complications are significant contributing factors. Hypoxemia, infections, cardiac dysfunction, postoperative delirium, and other complications indirectly cause sleep disorders by affecting respiratory function and increasing physiological stress. Conversely, sleep disorders can weaken immunity and elevate the risk of complications, creating a vicious cycle [6,32-34].

Conclusion

This study comprehensively and systematically analyzes the influencing factors of perioperative sleep disorders, revealing that perioperative sleep disorders are a complex issue caused by the combined effects of multiple factors. These influencing factors do not exist in isolation but are interconnected and synergistic, significantly increasing the risk of sleep disorder occurrence and exacerbation. Therefore, in clinical practice, it is essential to consider multiple factors for clinical intervention, paying comprehensive attention to patients' psychological, physiological, and environmental conditions during the perioperative period. Targeted measures should be implemented, such as psychological counseling, optimizing ward environments, rationally selecting anesthesia methods and medications, and strengthening pain management, to improve patients' perioperative sleep quality and promote postoperative recovery.

Future Directions

Future research can be conducted in the following directions. First, further explore the mechanisms of influencing factors by employing advanced technological methods such as gene sequencing and proteomics to reveal the intrinsic mechanisms through which psychological, physiological, and environmental

factors affect sleep at the molecular level, thereby providing a more solid theoretical foundation for clinical interventions. Second, develop more effective interventions by leveraging a thorough understanding of influencing factors and their mechanisms to create personalized intervention plans that combine pharmacological, psychological, and physical therapies to enhance intervention efficacy. Third, strengthen multidisciplinary collaboration by integrating resources and knowledge from fields such as anesthesiology, psychology, nursing, and neuroscience to collectively address the challenge of perioperative sleep disorders and deliver higher-quality medical care to patients.

Conflict of Interest

The authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

References

- [1] Li Y, Zhao L, Yang C, Yu Z, Song J, Zhou Q, Zhang X, Gao J, Wang Q, Wang H. Development and Validation of a Clinical Prediction Model for Sleep Disorders in the ICU: A Retrospective Cohort Study. *Front Neurosci.* 2021 Apr 16;15:644845. [PMID: 33935633]
- [2] Tsukinaga A, Mihara T, Takeshima T, Tomita M, Goto T, Yamanaka T. Effect of melatonin and melatonin agonists on postoperative sleep quality in adult patients: a protocol for systematic review and meta-analysis with trial sequential analysis. *BMJ Open.* 2021 Sep 6;11(9):e047858. [PMID: 34489275]
- [3] Seid Tegegne S, Fenta Alemnew E. Postoperative poor sleep quality and its associated factors among adult patients: A multicenter cross-sectional study. *Ann Med Surg (Lond).* 2022 Jan 31;74:103273. [PMID: 35145662]
- [4] Rosenberg-Adamsen S, Kehlet H, Dodds C, Rosenberg J. Postoperative sleep disturbances: mechanisms and clinical implications. *Br J Anaesth.* 1996 Apr;76(4):552-59. [PMID: 8652329]
- [5] Su X, Meng ZT, Wu XH, Cui F, Li HL, Wang DX, Zhu X, Zhu SN, Maze M, Ma D. Dexmedetomidine for prevention of delirium in elderly patients after non-cardiac surgery: a randomised, double-blind, placebo-controlled trial. *Lancet.* 2016 Oct 15;388(10054):1893-

902. [PMID: 27542303]
- [6] Butris N, Tang E, Pivetta B, He D, Saripella A, Yan E, Englesakis M, Boulos MI, Nagappa M, Chung F. The prevalence and risk factors of sleep disturbances in surgical patients: A systematic review and meta-analysis. *Sleep Med Rev.* 2023 Jun;69:101786. [PMID: 37121133]
- [7] Hillman DR. Postoperative sleep disturbances: understanding and emerging therapies. *Advances in Anesthesia.* 2017 Jan 1;35(1):1-24.
- [8] Du J, Zhang H, Ding Z, Wu X, Chen H, Ma W, Qiu C, Zhu S, Kang X. Development and validation of a nomogram for postoperative sleep disturbance in adults: a prospective survey of 640 patients undergoing spinal surgery. *BMC Anesthesiol.* 2023 May 4;23(1):154. [PMID: 37142982]
- [9] Seibert PS, Valerio J, DeHaas C. The concomitant relationship shared by sleep disturbances and type 2 diabetes: developing telemedicine as a viable treatment option. *J Diabetes Sci Technol.* 2013 Nov 1;7(6):1607-15. [PMID: 24351187]
- [10] Psycho-Cardiology Group of Chinese General Practitioner Society of Chinese Medical Doctor Association; Consensus Group of Chinese Experts on the Diagnosis and Treatment of Cardiovascular Diseases Combined with Insomnia. [A consensus statement on the diagnosis and treatment of cardiovascular diseases combined with insomnia from Chinese experts]. *Zhonghua Nei Ke Za Zhi.* 2017 Apr 1;56(4):310-15. Chinese. [PMID: 28355730].
- [11] Ancoli-Israel S, Ayalon L. Diagnosis and treatment of sleep disorders in older adults. *Am J Geriatr Psychiatry.* 2006 Feb;14(2):95-103. [PMID: 16473973]
- [12] Van Reeth O, Weibel L, Spiegel K, Leproult R, Dugovic C, Maccari S. Physiology of sleep (review)-interactions between stress and sleep: from basic research to clinical situations. *Sleep medicine reviews.* 2000 Apr 1;4(2):201-19.
- [13] Bozdemir H, Şimşek Yaban Z, Usta E. Sleep assessment in patients after surgery: a systematic review. *Biological Rhythm Research.* 2024 Aug 2;55(7-8):408-25.
- [14] Roostaei G, Khoshnam Rad N, Rahimi B, Asgari A, Mosalanejad S, Kazemizadeh H, Edalatfard M, Abtahi H. Optimizing Sleep Disorder Management in Hospitalized Patients: Practical Approach for Healthcare

- Providers. *Brain Behav.* 2025 Feb;15(2):e70282. Erratum in: *Brain Behav.* 2025 Jul;15(7):e70678. [PMID: 39924675]
- [15] Patel S, Ownby R. Interactions Between Anesthesia and Sleep: Optimizing Perioperative Care to Improve Sleep Quality and Surgical Recovery Outcomes. *Cureus.* 2025 Feb 4;17(2):e78505. [PMID: 39906641]
- [16] Tsang J, Kang J, Butris N, Yan E, Shahrokhi T, Ariaratnam J, Saripella A, Englesakis M, Wang DX, He D, Chung F. Effects of pharmacological therapy on sleep quality in a postoperative setting: A systematic review of randomized controlled trials. *J Anaesthesiol Clin Pharmacol.* 2025 Jan-Mar;41(1):36-47. [PMID: 40026729]
- [17] Kjølhede P, Langström P, Nilsson P, Wodlin NB, Nilsson L. The impact of quality of sleep on recovery from fast-track abdominal hysterectomy. *J Clin Sleep Med.* 2012 Aug 15;8(4):395-402. [PMID: 22893770]
- [18] Liu H, Wei H, Qian S, Liu J, Xu W, Luo X, Fang J, Liu Q, Cai F. Effects of dexmedetomidine on postoperative sleep quality: a systematic review and meta-analysis of randomized controlled trials. *BMC Anesthesiol.* 2023 Mar 21;23(1):88. Erratum in: *BMC Anesthesiol.* 2023 Apr 3;23(1):111. [PMID: 36944937]
- [19] Hou H, Wu S, Qiu Y, Song F, Deng L. The effects of morning/afternoon surgeries on the early postoperative sleep quality of patients undergoing general anesthesia. *BMC Anesthesiol.* 2022 Sep 10;22(1):286. [PMID: 36088298].
- [20] Cronin AJ, Keifer JC, Davies MF, King TS, Bixler EO. Melatonin secretion after surgery. *Lancet.* 2000 Oct 7;356(9237):1244-45. [PMID: 11072950]
- [21] Ocmen E, Erdost HA, Duru LS, Akan P, Cimrin D, Gokmen AN. Effect of day/night administration of three different inhalational anesthetics on melatonin levels in rats. *Kaohsiung J Med Sci.* 2016 Jun;32(6):302-305. [PMID: 27377842]
- [22] Tran D, Tang C, Tabatabai S, Pleasants D, Choukalas C, Min J, Do Q, Sands L, Lee K, Leung JM. The Impact of Surgery duration and Surgery End Time on Postoperative Sleep in Older Adults. *J Sleep Disord Manag.* 2021;7(2):034. [PMID: 34604869]
- [23] Potts AL, Cheeseman JF, Warman GR. Circadian rhythms and their development in children: implications for pharmacokinetics and pharmacodynamics in anesthesia. *Paediatr Anaesth.* 2011 Mar;21(3):238-46. [PMID: 20561229]
- [24] Rampes S, Ma K, Divecha YA, Alam A, Ma D. Postoperative sleep disorders and their potential impacts on surgical outcomes. *J Biomed Res.* 2019 Aug 29;34(4):271-80. [PMID: 32519977]
- [25] Gögenur I, Middleton B, Kristiansen VB, Skene DJ, Rosenberg J. Disturbances in melatonin and core body temperature circadian rhythms after minimal invasive surgery. *Acta Anaesthesiol Scand.* 2007 Sep;51(8):1099-106. [PMID: 17697306]
- [26] Hu XM, Wei WT, Huang DY, Lin CD, Lu F, Li XM, Liao HS, Yu ZH, Weng XP, Wang SB, Hou CL, Jia FJ. The Assessment of Sleep Quality in Patients Following Valve Repair and Valve Replacement for Infective Endocarditis: A Retrospective Study at a Single Center. *Med Sci Monit.* 2021 Aug 26;27:e930596. [PMID: 34433799]
- [27] Rabbitts JA, Zhou C, Narayanan A, Palermo TM. Longitudinal and Temporal Associations Between Daily Pain and Sleep Patterns After Major Pediatric Surgery. *J Pain.* 2017 Jun;18(6):656-63. [PMID: 28131699]
- [28] Haack M, Simpson N, Sethna N, Kaur S, Mullington J. Sleep deficiency and chronic pain: potential underlying mechanisms and clinical implications. *Neuropsychopharmacology.* 2020 Jan;45(1):205-16. [PMID: 31207606]
- [29] Jin D, Nie W, Ren L, Shen L. Research progress on the influence of perioperative sleep quality on postoperative pain. *Med J Peking Union Med Coll Hosp.* 2024;15(4):897-903.
- [30] Ma HX, Yuan CH. Effects of propofol and etomidate on postoperative sleep quality and inflammatory response in patients undergoing gynecological laparoscopic surgery. *J Nantong Univ (Med Sci).* 2025;45(4):343-47.
- [31] Chang VA, Owens RL, LaBuzetta JN. Impact of Sleep Deprivation in the Neurological Intensive Care Unit: A Narrative Review. *Neurocrit Care.* 2020 Apr;32(2):596-608. [PMID: 31410770]
- [32] Mubashir T, Nagappa M, Esfahanian N, Botros J, Arif AA, Suen C, Wong J, Ryan CM, Chung F. Prevalence of sleep-disordered breathing in opioid users with chronic pain: a systematic review and meta-analysis. *J Clin Sleep Med.* 2020 Jun 15;16(6):961-69. [PMID: 32519977]

32105208]

[33] He Q, Ji L, Wang Y, Zhang Y, Wang H, Wang J, Zhu Q, Xie M, Ou W, Liu J, Tang K, Lu K, Liu Q, Zhou J, Zhao R, Cai X, Li N, Cao Y, Li T. Acetate enables metabolic fitness and cognitive performance during sleep disruption. *Cell Metab.* 2024 Sep 3;36(9):1998-2014.e15. [PMID: 39163862]

[34] Van Gastel A. Drug-Induced Insomnia and Excessive Sleepiness. *Sleep Med Clin.* 2018 Jun;13(2):147-59. [PMID: 29759266]