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围术期患者睡眠障碍及其干预策略研究进展

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摘　要

围术期睡眠障碍是外科患者常见的围术期问题，可发生于术前、术后早期及恢复期，主要表现为入睡困难、睡眠时间缩短、夜间觉醒增多、睡眠片段化和睡眠质量下降等，不仅影响患者主观舒适度和恢复体验，还可能与术后疼痛加重、术后谵妄、康复延迟等不良结局相关。目前，围术期睡眠障碍的干预策略主要包括非药物干预和药物干预。本文拟对围术期患者睡眠障碍的流行病学特征、评估方法、病理生理机制、预后影响及干预策略进行综述，以期为临床围术期睡眠管理提供参考。

关键词

围术期，睡眠障碍，睡眠质量，干预策略

Research Progress on Sleep Disturbances and Intervention Strategies in Perioperative Patients

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Abstract

Perioperative sleep disturbance is a common perioperative problem among surgical patients and may occur before surgery, during the early postoperative period, and throughout recovery. It is mainly characterized by difficulty falling asleep, shortened sleep duration, increased nocturnal awakenings, sleep fragmentation, and reduced sleep quality. These disturbances not only affect patients' subjective comfort and recovery experience but may also be associated with adverse outcomes such as aggravated postoperative pain, postoperative delirium, and delayed rehabilitation. Current intervention strategies for perioperative sleep disturbances mainly include non-pharmacological and pharmacological approaches. This review summarizes the epidemiological characteristics, assessment methods, pathophysiological mechanisms, prognostic implications, and intervention strategies for sleep disturbances in perioperative patients, aiming to provide a reference for clinical perioperative sleep management.

Keywords

Perioperative Period, Sleep Disturbance, Sleep Quality, Intervention Strategy

1. 前言

睡眠是维持机体生理稳态的重要过程，与神经内分泌调节、免疫功能、情绪稳定、疼痛感知和组织修复密切相关。良好的睡眠能帮助机体在应激后快速恢复，而睡眠不足或睡眠结构紊乱则可能削弱患者对手术创伤的耐受能力。围术期患者处于疾病、麻醉、手术创伤和住院环境共同作用的特殊阶段，容易出现不同程度的睡眠障碍[1]。

近年来，随着加速康复外科和围术期医学理念的发展，临床关注点已不再局限于麻醉安全、手术顺利和生命体征稳定，而是更加重视患者从术前准备到术后康复全过程的综合恢复质量[2]。已有研究提示，围术期睡眠质量下降可能与术后疼痛加重、镇痛药物需求增加、焦虑抑郁情绪、术后谵妄、认知功能波动、免疫炎症调节异常及康复延迟等不良结局相关[3]-[5]。特别是老年患者、重大手术患者以及既往存在睡眠障碍的患者，睡眠障碍发生风险更高，对术后恢复的影响也更为突出。

然而，在实际临床工作中，围术期睡眠障碍仍常被低估。睡眠问题表现相对隐匿，易被忽视，且术后睡眠不佳常被简单归因于疼痛和环境不适，缺乏系统、连续的评估[6]。此外，临床上对睡眠质量的监测尚不统一，评估工具、观察时间和干预措施存在较大差异[7]。如何早期识别睡眠障碍高危患者，并采取合理、有效的干预措施，是围术期管理中值得重视的问题。

基于此，本文拟围绕围术期患者睡眠障碍的流行病学特征及评估方法、病理生理机制、对术后预后的负面影响以及相关干预策略进行综述，以期为临床开展围术期睡眠管理、改善患者恢复质量提供参考。

2. 流行病学及评估

围术期睡眠障碍在外科患者中较为常见，可发生于术前、术后早期及出院后恢复阶段。不同研究纳入的患者类型、手术方式、评估工具和观察时间点不同，发生率差异较大[8]-[10]。研究显示，术前睡眠

质量下降并不少见，发生率可达 30%~60%，而术后急性期，尤其是术后前三晚，睡眠质量显著恶化的患者比例可超过 80%。围术期睡眠障碍主要表现为入睡困难、睡眠时间缩短、夜间觉醒增多、睡眠浅、再入睡困难、早醒、白天疲乏及昼夜节律紊乱等[3]。部分患者虽能入睡，但睡眠连续性较差，醒后仍感疲劳，这也是睡眠恢复作用不足的表现。

准确评估是进行有效干预的前提。围术期睡眠评估主要包括主观评估和客观监测[11]。主观量表操作简便、成本低，是目前临床和研究中最常用的方法。匹兹堡睡眠质量指数(Pittsburgh Sleep Quality Index, PSQI)应用较广，主要评价过去 1 个月的睡眠质量，适合用于术前基础睡眠状况筛查，但对术后短期睡眠变化不够敏感[12]。阿森斯失眠量表(Athens Insomnia Scale, AIS)侧重评估入睡困难、夜间觉醒、早醒及日间功能受损等失眠症状，可用于围术期失眠症状筛查[13]。理查兹–坎贝尔睡眠量表(Richards-Campbell Sleep Questionnaire, RCSQ)主要评价前一晚睡眠深度、入睡难度、觉醒次数、再入睡情况和整体睡眠质量，更适合术后早期的连续观察[14]。此外，视觉模拟评分法或数字评分法可快速评估患者前一夜睡眠质量，但评价维度较单一，主观性较强。

多导睡眠监测(polysomnography, PSG)是评价睡眠结构的金标准，可记录脑电、眼电、肌电、呼吸、血氧饱和度等指标，准确分析睡眠分期、睡眠效率、觉醒次数及睡眠相关呼吸事件[15]。但 PSG 设备复杂、费用较高，并可能影响术后患者舒适度和活动，难以作为常规围术期监测手段。腕式活动记录仪可通过肢体活动推测睡眠–觉醒状态，具有无创、便携和可连续监测等优点，适合观察围术期睡眠节律变化，但难以准确识别睡眠分期和微觉醒，在术后卧床或活动受限患者中准确性可能下降[16]。近年来，可穿戴设备和床旁睡眠监测系统逐渐应用于围术期睡眠研究，但其准确性和临床适用性仍需进一步验证[17]。

总之，围术期睡眠评估应兼顾简便性和准确性，并涵盖术前基线、术后急性期及亚急性期。术前基线评估有助于识别睡眠障碍高危人群，术后连续监测可反映睡眠障碍的动态变化，为个体化干预提供依据。由于主观与客观评估结果可能存在差异，临床实践中可根据患者特点和评估目的，合理联合主观量表与客观监测手段，以获得更全面的睡眠信息。

3. 核心病理生理轴及预后影响

围术期睡眠障碍并非由单一因素引起，而是手术创伤、神经内分泌应激、炎症反应、疼痛刺激、麻醉及镇痛药物、心理因素和昼夜节律紊乱等多种机制共同作用的结果[18]。这些因素相互影响，导致患者在围术期处于持续的高应激和高觉醒状态，从而破坏正常睡眠结构和睡眠–觉醒节律。

3.1. 炎症–免疫轴

手术创伤和炎症反应是围术期睡眠障碍的重要基础。手术操作可造成不同程度的组织损伤，激活机体免疫炎症反应，促使 IL-1β、TNF-α 和 IL-6 等炎症因子释放[19]。适度炎症反应有助于组织修复，但过度或持续的炎症激活可影响中枢神经系统功能，干扰睡眠–觉醒调控[20]。炎症因子还可通过血脑屏障、迷走神经通路或神经免疫调节机制作用于下丘脑、脑干等睡眠调节区域，导致睡眠片段化、觉醒次数增加和睡眠质量下降[21]。一般而言，手术创伤越大、炎症反应越明显，对术后睡眠结构的影响也越大。

睡眠障碍也可能进一步影响免疫稳态和组织修复。慢波睡眠与免疫稳态和组织修复密切相关，而睡眠剥夺可抑制自然杀伤细胞活性，削弱细胞免疫反应，并可能增加术后感染易感性[22] [23]。围术期患者本身已处于创伤应激和炎症激活状态，若合并明显睡眠障碍，可能进一步增强促炎反应，影响免疫细胞功能，使机体修复能力下降。

此外，睡眠障碍还会影响机体合成代谢激素的正常分泌。生长激素分泌高峰主要发生于慢波睡眠期，而睡眠剥夺或睡眠片段化可干扰这一过程，影响蛋白合成、组织修复和伤口愈合[24]。有研究指出，OSA

相关症状是乳腺癌患者术后发生伤口并发症的独立危险因素，提示睡眠相关问题可能与术后修复不良存在一定关联[25]。

3.2. 神经内分泌–昼夜节律轴

神经内分泌应激反应也是重要机制之一。手术创伤作为一种强烈的应激源，可迅速激活下丘脑–垂体–肾上腺(Hypothalamic-Pituitary-Adrenal, HPA)轴和交感神经系统，使皮质醇、儿茶酚胺等应激激素水平升高[26]。正常情况下，皮质醇和褪黑素分泌具有相对稳定的昼夜节律，而围术期应激可打破这一平衡[27]。皮质醇水平升高和交感神经兴奋会使患者处于持续警觉状态，表现为入睡困难、睡眠浅和夜间觉醒增多；同时，神经内分泌波动还可能抑制松果体褪黑素分泌，进一步扰乱睡眠–觉醒周期[27] [28]。值得注意的是，HPA 轴持续激活与炎症反应之间存在相互促进关系，二者共同参与术后睡眠结构改变[29]。

这种持续的高觉醒状态不仅影响夜间睡眠，也可能增加心血管相关风险。睡眠不足会增强交感神经活动，导致心率增快、血压波动和应激激素水平升高。持续的高觉醒状态可能增加已存在心血管疾病或接受重大手术患者的心肌耗氧量，加重围术期循环负担[30] [31]。

昼夜节律紊乱还可能进一步影响患者白天的恢复状态。夜间睡眠不足常导致日间疲乏、注意力下降和主动活动减少，患者早期下床、呼吸训练和康复锻炼的依从性降低。睡眠紊乱还可加重围术期应激反应，扰乱自主神经平衡，不利于腹部手术后胃肠蠕动及胃肠功能恢复[32]。

3.3. 疼痛–感觉敏化轴

疼痛与睡眠障碍存在明显的双向作用。术后切口疼痛、引流管或尿管刺激、咳嗽牵拉痛和体位受限均可直接导致患者夜间觉醒和再入睡困难，尤其是在胸科、腹部和骨科大手术后更为明显[5]。另外，睡眠不足又会降低疼痛阈值，增强痛觉敏感性，使患者对同等强度刺激产生更强疼痛体验，形成“疼痛–睡眠障碍–疼痛加重”的恶性循环[33] [34]。

这一过程在术后早期尤为明显。部分患者白天疼痛尚可耐受，但夜间因镇痛药效减弱、体位固定或环境安静后注意力集中于疼痛而反复觉醒。睡眠质量下降后，患者次日更容易出现疲乏、烦躁和活动意愿下降，进一步影响咳嗽排痰、翻身、下床活动和康复训练。对于胸科、腹部和骨科大手术患者，睡眠障碍造成的活动减少可能间接增加肺部并发症、胃肠功能恢复延迟和静脉血栓风险[35]。

3.4. 麻醉镇痛药物–睡眠结构轴

麻醉药物和镇痛药物对睡眠结构的影响同样不容忽视。全身麻醉虽然可产生意识消失和无反应状态，但其脑电模式与自然睡眠并不相同[36]。研究发现，接受全身麻醉的患者术后快速眼动睡眠明显减少，并在随后出现反弹现象，而接受区域麻醉且避免使用阿片类药物的患者睡眠结构紊乱相对较轻[37]。阿片类药物有助于减轻疼痛对睡眠的干扰，但可能抑制快速眼动睡眠和慢波睡眠[38]。苯二氮䓬类药物也在一定程度改变睡眠结构，增加老年患者谵妄和认知功能的风险[39]。因此，围术期药物对睡眠具有双重作用，合理使用有助于缓解疼痛和焦虑，不恰当使用则可能加重睡眠障碍。

睡眠结构改变还可能进一步影响脑功能恢复。正常睡眠，尤其是慢波睡眠，对维持神经递质平衡、促进突触修复及清除脑内代谢产物具有重要作用[40]。围术期睡眠片段化、慢波睡眠减少和昼夜节律紊乱，可加重神经炎症反应，影响血脑屏障功能，并进一步干扰神经突触可塑性，从而增加术后神经认知功能异常的风险[41]。

术后谵妄是围术期睡眠障碍相关研究中较受关注的结局之一。睡眠不足可使患者出现注意力下降、定向力减退、昼夜颠倒和意识波动，这与术后谵妄的临床特征存在一定交叉[42]。老年患者的睡眠结构比

较脆弱，认知储备下降，对手术创伤、麻醉药物、炎症反应和住院环境变化十分敏感，术后睡眠持续不佳更容易诱发或加重认知功能波动[43]。已有研究报道，脑膜淋巴系统功能下降与术后认知评分及记忆领域下降存在相关性，睡眠相关的脑内代谢废物清除障碍可能参与围术期神经认知障碍的发生[44]。

3.5. 环境心理–高觉醒轴

医院环境和心理因素也是围术期睡眠障碍的重要影响因素。ICU 或病房内的监护仪报警、人员交谈、夜间照明、频繁生命体征测量、给药和护理操作，均可打断夜间睡眠，造成睡眠片段化和深睡眠减少[45]。普通住院患者虽受干扰程度相对较轻，但也可能出现昼夜节律失同步。

同时，患者术前常因担心手术风险、麻醉安全和疾病预后而焦虑，术后又可能因疼痛、活动受限和恢复不确定性处于持续心理应激状态。焦虑、抑郁和恐惧可提高中枢觉醒水平，并通过激活 HPA 轴和交感神经系统加重神经内分泌紊乱，使患者难以获得连续而有效的睡眠[46]。因此，环境干扰和心理应激并非单纯的外部因素，而是可与疼痛、神经内分泌应激和昼夜节律紊乱相互叠加，进一步加重围术期睡眠障碍。

总体来看，围术期睡眠障碍是多因素、多通路共同作用的结果。手术创伤和炎症反应构成其生物学基础，神经内分泌应激提高中枢觉醒水平，疼痛和药物因素直接影响睡眠连续性，医院环境和心理应激进一步破坏昼夜节律及睡眠质量。睡眠障碍不仅是术后短暂不适或舒适性问题，而是可能增加术后谵妄和认知功能异常风险、加重疼痛敏化、影响免疫炎症调节、延缓组织修复，并降低患者参与康复主动性的重要因素。

4. 围术期睡眠障碍的多模式干预策略

围术期睡眠障碍的发生涉及手术创伤、疼痛、心理应激、麻醉药物、医院环境及昼夜节律紊乱等多种因素，单一干预措施往往难以取得稳定效果。围术期睡眠障碍管理逐渐转向多模式、分阶段、个体化干预，主要包括非药物干预和药物干预。

4.1. 非药物干预

非药物干预是围术期睡眠管理的基础，具有安全性较高、操作相对简单、可重复实施、便于与围术期护理和加速康复外科路径结合等优点[47]。

环境优化是首要且易于实施的措施。降低夜间噪音和光线、集中护理操作、提供耳塞眼罩等，可减少外界干扰，有助于维持夜间睡眠连续性。在术后外科 ICU 患者中，耳塞和眼罩可改善频繁接受监测患者的睡眠质量[48] [49]。但 Leong 等研究并未观察到耳塞和眼罩对术后睡眠的改善作用[50]。

除减少夜间干扰外，维持正常昼夜节律也是睡眠管理的重要内容。光照是调节人体昼夜节律的重要外部线索，适当的白天光照暴露和夜间低光环境有助于维持睡眠–觉醒节律[51]。Pamuk 在 ICU 患者中发现，根据人体生物节律设置的循环光照系统可增加患者深睡眠、浅睡眠和总睡眠时间[51]。Chambe 和 Zhang 等的荟萃分析亦提示，光照疗法在改善睡眠方面具有一定潜力[52] [53]。不过，目前光照疗法在围术期患者中的直接证据仍相对有限，最佳光照强度、干预时间和临床意义仍需进一步研究。

音乐疗法、芳香疗法和放松训练等心理行为干预也逐渐被用于围术期睡眠管理[54] [55]。研究表明，音乐疗法可显著降低心脏瓣膜置换术后患者的疼痛和焦虑评分，并延长睡眠时间[56]。Kim 等进一步发现，患者导向的互动音乐干预可改善术后老年 ICU 患者短期主观睡眠质量[57]。然而，Jiang 等研究显示，个体化音乐干预虽可改善术后血压、焦虑、恶心呕吐和总体满意度，但对睡眠质量未见显著改善，这可能与干预时机、音乐类型、持续时间、患者偏好及围术期应激程度有关[58]。

此外，认知行为疗法也是围术期睡眠障碍非药物干预的重要方向。针对失眠的认知行为疗法(cognitive behavioral therapy for insomnia, CBT-I)通常包括刺激控制、睡眠限制、放松训练、认知重构和睡眠卫生教育等内容，可通过纠正不良睡眠信念、降低入睡前焦虑和条件性觉醒水平来改善睡眠[59]。Wang 等随机对照研究显示，围术期认知行为干预可降低老年手术患者焦虑和术后疼痛水平，并改善睡眠质量[60]。Yang 等也报道了计算机辅助认知行为疗法对外科患者手术相关心理生理反应和围术期结局的积极作用[61]。近年来，数字化 CBT-I 进一步拓展了应用场景[62]。总体而言，CBT-I 在围术期睡眠管理中具有一定前景，但相关研究仍有限，干预方案和结局指标尚不统一，最佳实施时机和临床获益仍需更多随机对照研究验证。

4.2. 药物干预

当非药物干预效果不佳时，药物干预可作为补充或替代方案。由于围术期患者常合并麻醉药物残留、镇痛药物使用、循环波动和呼吸功能变化，药物治疗不仅要关注睡眠质量改善，还应重视睡眠结构和用药安全性。

右美托咪定作为一种高选择性 $\alpha 2$ 肾上腺素能受体激动剂，可通过抑制蓝斑核去甲肾上腺素释放，产生类似非快速眼动睡眠的镇静状态，同时具有一定镇痛辅助和抗交感作用[63]。Mei 等在老年胸腔镜肺手术患者中发现，术中输注右美托咪定可改善术后睡眠质量[64]。Liu 等采用多导睡眠监测客观评价术后睡眠结构，结果显示右美托咪定可提高睡眠效率、降低觉醒指数、减少 N1 期睡眠并增加 N2 期睡眠[65]。不过，系统综述和 Meta 分析指出，右美托咪定的疗效可能受给药剂量、给药时机、麻醉方式、手术类型和评价工具等影响[66]。同时，右美托咪定可引起心动过缓和低血压，高龄、低血容量、心功能不全或传导功能异常患者应谨慎使用。

褪黑素及褪黑素受体激动剂理论上可以通过调节昼夜节律发挥作用，但围术期研究结果尚存在争议。Tsukinaga 等发现，成人手术患者补充褪黑素并未较安慰剂显著改善术后主观睡眠质量[67]；而 Perez 等研究显示，褪黑素可改善关节镜肩袖修补患者术后早期 PSQI 评分，并减少后期麻醉性镇痛药物使用[68]。雷美替胺是选择性褪黑素 MT1/MT2 受体激动剂，可作用于视交叉上核参与睡眠-觉醒节律调节，具有成瘾性和呼吸抑制风险较低的特点[69]。不过，目前围术期以睡眠质量为主要结局的研究仍较少，现有证据更多来自住院患者或谵妄预防研究，且睡眠相关结局并不一致[70]。在围术期睡眠管理中，褪黑素及雷美替胺虽有潜在应用价值，但其最佳适用人群、给药时机及真实获益仍需进一步研究。

镇静催眠药物及部分具有镇静作用的精神类药物在围术期应用需谨慎。苯二氮䓬类药物虽可缩短入睡时间，但可能增加老年患者谵妄、认知功能异常、跌倒和呼吸抑制风险，不宜常规用于老年及谵妄高危患者[71]。非苯二氮䓬类药物，如唑吡坦、右佐匹克隆等，虽可短期改善入睡困难或睡眠维持障碍，但可能增加日间嗜睡、头晕、异常行为及呼吸抑制的风险[71]。曲唑酮、米氮平及小剂量喹硫平等药物可用于合并焦虑、抑郁或顽固性失眠的患者，但围术期证据有限，且存在体位性低血压、QT 间期延长、抗胆碱样反应和跌倒等风险，因此不宜作为普通围术期失眠患者的一线治疗[72]。

4.3. 综合管理路径

疼痛控制和麻醉管理优化也是改善围术期睡眠的重要组成部分。多模式镇痛可联合区域神经阻滞、椎管内镇痛、局部浸润镇痛、非甾体抗炎药、对乙酰氨基酚及低剂量阿片类药物等，在保证镇痛效果的同时减少阿片类药物用量，从而降低恶心呕吐、呼吸抑制和睡眠结构改变等不良影响[73]。麻醉管理方面，应合理选择麻醉药物和麻醉深度，避免低氧、长时间低血压、过度镇静及药物残留对睡眠恢复的不利影响[73]。针刺、耳穴压豆、穴位按摩、中药足浴等辅助干预也可能改善术后主观睡眠质量，减轻焦虑和疼

痛感受，但仍需更多高质量研究验证[74]。

另有研究基于最佳疗愈环境模式构建多模式睡眠管理路径，通过标准化睡眠评估、环境降噪、光线控制、医护行为调整及患者教育等综合措施，降低了围术期情境性失眠发生率，并提高了患者对住院环境管理的满意度[75]。

综上，围术期睡眠障碍的管理应以综合评估为基础，优先采用环境优化、节律维护、疼痛控制和心理行为干预等低风险措施，必要时再辅以个体化药物治疗。未来仍需更多高质量随机对照研究明确不同干预措施的最佳适用人群、实施时机，并推动形成更规范、可操作的围术期睡眠管理路径。

5. 小结与展望

围术期睡眠障碍是外科患者常见但容易被低估的问题，其发生与手术创伤、炎症反应、神经内分泌应激、疼痛、麻醉及镇痛药物、住院环境和心理状态等因素密切相关。持续睡眠不佳不仅影响患者住院期间的舒适度，还可能加重术后疼痛，增加谵妄和认知功能异常风险，影响免疫修复、胃肠功能恢复和早期康复活动。因此，围术期睡眠管理应贯穿术前评估、术中麻醉优化和术后康复全过程，并与疼痛控制、心理支持、环境优化和加速康复策略相结合。

目前，围术期睡眠障碍的研究和管理仍面临一些问题。首先，评估方法尚不统一。现有研究多采用主观量表，不同研究在评估工具、观察时间和睡眠障碍定义方面差异较大。PSG 虽为评价睡眠结构的金标准，但临床应用受限。未来应建立适用于围术期快速筛查和连续观察的标准化评估体系，并探索褪黑素节律、皮质醇变化、炎症因子、心率变异性及可穿戴设备数据等客观指标或生物标志物。

其次，干预策略的证据仍不充分。环境优化、光照疗法、音乐疗法、CBT-I、右美托咪定、褪黑素及褪黑素受体激动剂等均有一定潜力，但不同研究的人群、手术类型、干预时机和结局指标差异较大。未来应针对老年患者、胸腹部大手术患者、骨科患者、ICU 患者及既往睡眠障碍患者等特定人群，开展不同干预措施之间的头对头比较研究，明确更适合不同患者的精准睡眠干预方案。

此外，睡眠障碍与术后不良结局之间的因果关系仍需进一步明确。虽然已有研究提示睡眠障碍与疼痛加重、谵妄、认知功能异常、免疫功能下降和康复延迟有关，但仍以相关性分析为主，尚不能完全说明睡眠障碍是独立危险因素，还是手术创伤、疼痛和应激反应共同作用下的表现。未来可结合客观睡眠监测、炎症免疫指标、神经内分泌指标和术后结局进行连续观察，以进一步明确其作用路径。

总体来看，围术期睡眠障碍研究需要从单纯描述睡眠质量变化，逐渐转向标准化评估、机制探索和针对性干预。随着可穿戴监测技术和围术期综合管理理念的发展，睡眠管理有望更早地融入术前评估、术后护理和康复随访中，从而为改善患者围术期恢复质量提供更多依据。

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