Sleep disturbances in rotator cuff pathology: insights into mechanisms and clinical implications

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INTRODUCTION
Rotator cuff (RC) disorders are a common and often debilitating orthopedic condition that can be a notable source of shoulder pain. RC disorders affect a significant portion of the population, particularly as individuals advance in age. In a systematic review, the prevalence of RC disease was reported to range from 9.7% in patients aged 20 years and younger to 62% in patients aged 80 years and older [1]. Other risk factors associated with RC tear (RCT) include the dominant arm, a history of trauma, and engagement in heavy labor [2]. Although RCTs may occur without symptoms, when symptomatic, they can negatively affect an individual’s quality of life [3].

RCTs can result in severe pain, decreased range of motion, reduced muscle strength, depression, anxiety, shoulder stiffness, and sleep disturbances. As a result, activities of daily living, leisure activities, and the ability to work can be impacted negatively [3,4]. Of the various aspects of quality of life that can be affected by RCTs, sleep disturbance is one of the most common complaints and motivates to seek medical care, with 70%–89% of patients with RC injuries reported to have sleep disturbances in one study, and 89% reported in another study [5,6]. Pain and discomfort associated with RCTs can hinder the ability to initiate sleep and can lead to frequent awakenings and restlessness.

It is important to understand and address sleep-related disorders, as RCTs may have a prolonged course, and insufficient sleep can have detrimental effects on health, well-being, and public safety [7]. As such, the purpose of this review is to explore the pathophysiology and impact of RCTs on sleep and to evaluate the efficacy of RC surgery in enhancing sleep quality.

Keywords: Sleep disturbance; Rotator cuff tear; Rotator cuff repair
PREOPERATIVE SLEEP AND RCT

Quantifying Sleep Quality
The Pittsburgh Sleep Quality Index (PSQI) is a validated and commonly used questionnaire ranging in scores from 0 to 21 that aims to determine the subjective sleep disturbance in a given clinical scenario [8,9]. A PSQI score greater than or equal to 5 is indicative of “poor” sleep, with a sensitivity of 0.90 and a specificity of 0.87 [9]. Longo et al. [10] established the patient acceptable symptom state (PASS) to be 5.5 for PSQI. Use of a validated questionnaire like PSQI is important, as self-reports of sleep quality are prone to error.

Impact on Sleep
In patients who present to an orthopedic surgeon for shoulder pain relating to RC pathology, the rate of sleep disturbance is very high. Several studies have found that around 90% of these patients have significant sleep disturbance, as assessed by the PSQI [6,11-13]. These sleep disturbances can be severe, with average preoperative PSQI scores of 11.7 and 9.5 in studies by Horneff et al. [11] and Khazzam et al. [12], respectively. In a study conducted by Ansok et al. [14], 18 patients with full-thickness RCT were monitored using wearable sleep trackers to obtain objective data on the impact of RCT on sleep. The study revealed a substantial impact of RCT on sleep as the affected cohort exhibited decreased total sleep time, more frequent awakenings, and delayed sleep onset compared to unaffected controls. Notably, patients in the study were not aware of the extent of their sleep deficit and underestimated their sleep disturbance by 90 minutes [14]. Tanik et al. [15] found greater pressure-pain sensitivity in the affected limb of patients with partial thickness RCT, a factor that is hypothesized to contribute to discomfort during sleep. Given the relationship between adequate sleep and overall physical and mental health, it is important that such patients receive timely definitive management of their RCT.

Preoperative Evaluation
The evidence for the effect of RCT-related sleep disruption on daytime wakefulness is mixed based on studies reporting scores from the Epworth Sleepiness Scale (ESS), a validated survey used to evaluate daytime sleepiness [16]. While Ansok et al. [14] reported elevated ESS scores as a result of RCT, Gumina et al. [17] did not find a significant difference between RCT patients and healthy controls. Ansok et al. [14] found no correlation between objective actigraphy measurements and PSQI or ESS [8,9,16]. Instead, only pain visual analog scale (VAS) score correlated with actigraphy measurements, which aligns with the findings of Khazzam et al. [12,14].

Furthermore, studies have demonstrated that healthier patients tend to overestimate their sleep quality, while patients with diagnosed depression and anxiety tend to underestimate their sleep quality [14,18]. In addition, several patient-level factors have been identified as independent risk factors for sleep disturbance in the context of RCT, as defined by the PSQI. These factors include pain VAS, depression, female sex, comorbid low back pain, and concurrent cervical pathology [12]. This highlights the complexity of assessing sleep disturbances and the need to consider multiple factors in preoperative evaluation.

PATHOPHYSIOLOGY OF SLEEP DISURBANCES IN RCT

RCT Characteristics
Conflicting evidence exists on the association between magnetic resonance imaging (MRI) characteristics of RCT and sleep disturbances. In a cross-sectional study of 208 patients, Reyes et al. [19] found no correlation between PSQI score and tear size, number of tendons involved, tendon retraction, Goutallier classification, muscle atrophy, or humeral head rise. Some researchers have questioned the reliability of subjective sleep measures, such as the PSQI, and have opted for more objective measurements of sleep quality. For example, MacConnell et al. [20] prospectively studied the sleep of 36 RCT patients with a waist-worn accelerometer and found no association between tendon retraction and sleep efficiency. Taken together, these results suggest no association between either subjective or objective measures of sleep impairment and structural characteristics of RCT. These findings oppose those of Gumina et al. [17], who found higher PSQI and ESS scores in patients with small tears compared to large and massive tears in a case-control study of 324 RCT patients. That study also found significant correlations between tear size and sleep latency and sleep disturbances [17]. The authors hypothesize that this could be attributed to greater bursal inflammation with smaller tears, which may reflect insufficient time for nociceptor desensitization in more acute tears [17].

Inflammatory Effect of Tendon Degeneration
Studies investigating the association between inflammation and night pain in RCT have yielded more consistent results and have provided several insights. In a prospective study of 63 patients, Cho et al. [21] performed enzyme-linked immunosorbent assay to measure the concentrations of inflammatory cytokines in blood samples obtained prior to RC repair (RCR). They found significantly higher levels of tumor necrosis factor (TNF)-α in patients

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SLEEP DISTURBANCE AFTER RCR

With sleep disturbance occurring with RCT, it is important to know if sleep returns to its normal baseline after RCR. Austin et al. [6] were the first to study sleep disturbance resolution after RCR. Their cohort included 50 patients suffering from preoperative sleep disturbance defined as a PSQI score greater than 5 [6,9]. They reported a significant improvement in sleep at 3 months that was maintained at 6 months postoperatively (P = 0.0012). At 6 months of follow-up, only 38% patients had sleep disturbance, which is not different from the general population, in which 35% suffer from poor sleep [9,27,28]. When following this same cohort at 2 years postoperatively, Horneff et al. [11] found that sleep normalization was sustained in the previously improved patients and also had occurred in patients who continued to have sleep disturbance at 6 months postoperatively. Improvement of sleep after RCR was demonstrated by other studies as well [13,29-33]. At a threshold of 6 months postoperatively, consistent improvement in sleep quality has been observed [31,32]. An important finding reported by Zheng et al. [13] was that patients who suffered from sleep disturbance preoperatively had greater improvement in patient-reported outcomes postoperatively after sleep normalization. This result along with the other findings highlight the importance of querying patients about sleep quality preoperatively and of monitoring sleep normalization as part of a complete postoperative evaluation.

Austin et al. [6] studied this delay in sleep normalization after RCR and found that sleep disturbance correlated with functional scores such as the simple shoulder test and VAS, at 6 months and 2 years of follow-up, both of which were at their worst 2 weeks after the surgery (P < 0.001) [11]. However, the correlation was moderate, which indicates that this sleep disturbance and its delay in normalization are multifactorial. Opioid use also was shown to worsen sleep 6 months after RCR and continued to increase sleep disturbance at 2 years postoperatively [6,11]. Furthermore, narcotics previously were reported to affect sleep quality, indicating the importance for shoulder surgeons to address this issue through preoperative patient council and limitation of postoperative opioid consumption [34,35]. Surgical factors such as tear size, number of anchors used, biceps treatment, acromioplasty, and excision of the distal clavicle did not correlate significantly with PSQI score postoperatively (P > 0.05) [6]. In addition, Serbest et al. [33] analyzed a group of patients undergoing RCR in the absence of opioids, insomnia treatment, or a neuropsychiatric condition to isolate the effect on sleep disturbance resolution [33]. They reported that RCR improves both quality of life and sleep.

MANAGEMENT OF PERIOPERATIVE SLEEP DISTURBANCE

Both pharmacological and nonpharmacological approaches can be used to improve sleep disturbances associated with RCT perioperatively [36]. For nonpharmacological approaches, the
focus should be on environmental elements, such as reducing noise and improving sleep hygiene. Music therapy is another option that was shown to improve subjective sleep quality and to prolong sleep duration [36,37]. For pharmacological measures, dexmedetomidine (highly selective alpha-2 adrenoreceptor agonist), zolpidem (non-benzodiazepine), and melatonin can all be employed to aid in the management of sleep [36,38]. In addition, focusing on the etiology such as pain reduction and muscle relaxation can help alleviate sleep disruption. For optimal management, a multi-departmental approach with sleep specialists could be beneficial for the patient.

CONCLUSIONS

The pain exhibited from RCTs can pose significant limitations in daily life activities, notably the ability to sleep. RC pathology and sleep disturbances are common complaints among such patients. In this setting, the PSQI, which is a validated tool to assess sleep quality, has been implemented in numerous studies to delineate the impact of RC pathology on sleep. The literature is inconclusive on the association between MRI findings of RCTs and PSQI scores, with some studies reporting no associations and others reporting impactful associations. Studies exploring sleep in the perioperative setting of RC surgery are limited in number and have yielded inconsistent results, showcasing the need for future studies to explore the different factors governing sleep in RC surgery patients, like etiology, pathophysiology, and behavioral influences. Surgery can lead to better sleep quality and improved overall quality of life.

NOTES

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