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Evaluation and Management of Sleep Disorders in the Hand Surgery Patient.

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Abstract

Despite posing a significant public health threat, sleep disorders remain poorly understood and often mismanaged. Though seemingly unrelated, hand surgeons should be particularly mindful of sleep disorders, as numerous conditions of the upper extremity have known associations with sleep disturbances which can adversely affect patient outcomes, function and satisfaction. In addition, patients with sleep disorders are at significantly higher risk for severe, even life-threatening medical co-morbidities, further supporting the important role of hand surgeons in the recognition and management of sleep disorders that are most common in hand surgery.

Introduction

Sleep disorders are a major public health concern, affecting as many as 70 million adults in the United States alone, while accounting for billions of dollars in financial costs, disability, and even death. [1-5] Sleep disorders are also associated with a myriad of medical conditions including obesity, hypertension, diabetes heart disease, and overall higher mortality risk. [6]

Unfortunately, despite these exorbitant socioeconomic and health costs, sleep disorders are often overlooked or improperly treated. [7,8] In hand surgery, numerous conditions have known associations with sleep disorders, and sleep symptoms can directly affect patient outcomes, function and satisfaction. Thus, these disorders are important for hand surgeons to recognize and manage. The purpose of this review is to provide an overview of sleep disorders that are most common in hand surgery, with focus on the preoperative evaluation, and perioperative management of these disorders.

Sleep Disorders in Hand Surgery

This discussion will focus primarily on two classes of disorders most relevant to hand surgery: (1) d*yssomnias* which are disorders that produce excessive sleepiness or difficulty in initiating or maintaining sleep and (2) sleep disorders associated with other medical disorders. [9] A more inclusive outline of general sleep disorders is presented in Figure 1.

Intrinsic Dyssomnias

Intrinsic dyssomnias either (a) originate or develop within the body, or (b) arise from causes within the body. [9] This group includes psychological or medical disorders that *produce* a primary sleep disorder.

Obstructive Sleep Apnea

Perhaps the most widely recognized intrinsic dyssomnia in surgical patients is obstructive sleep apnea (OSA). Patients with OSA who are to undergo surgery require specialized management, as these patients are at higher risk for adverse events in the intraoperative

and postoperative periods. In the perioperative setting, the primary concern is airway management; due to OSA patients' decreased ability to protect their airway, procedures that would otherwise be performed under sedation may require monitored anesthesia care (MAC) or even general anesthesia for. [10,11] Ideally, open communication between the anesthesiologist and the hand surgeon allows these determinations to be made prior to the day of surgery, so as to minimize delays or complications.

In addition to patients with a known diagnosis of OSA, surgeons are often tasked with caring for patients who lack a formal diagnosis, despite exhibiting clinical risk factors for OSA. [12] Chung et al reported an alarming 66% of patients lacking a preoperative OSA diagnosis with difficult intubations were confirmed to have OSA upon further evaluation. [13] Mutter et al found that those patients with undiagnosed OSA were at significantly higher risk of postoperative cardiac arrest than confirmed OSA patients, and that both groups faired worse than non-OSA patients. [14] These studies together point out the importance for the hand surgeon to recognize and screen for OSA, which can be done utilizing validated OSA screening methods, such as the STOP-Bang questionnaire (Table 1). Surgeons should also have a low threshold for referring patients with positive findings on OSA screening for further evaluation. [13,15] Postoperative management of OSA patients is also critical in avoiding morbidity, and OSA patients should resume continuous- or bilevel positive-airway-pressure (CPAP or BiPAP) treatment as soon as they are able. [15] Postoperative pain control regimens in OSA patients also merit special attention, which will be discussed shortly.

Extrinsic Dyssomnias

Extrinsic dyssomnias are those that originate or develop from causes outside of the body. [9] External factors are necessary to produce these disorders, and their removal is often therapeutic to the sleep disturbance. [9] In hand surgery, these most notably include both drug-induced and drug-dependant sleep disorders.

Opioid-Induced Sleep Disorders

A true understanding of the complex interplay of pain, opioid medication, and sleep disturbance remains elusive. Although evidence shows that pain and sleep exhibit a circular relationship with one another (i.e. pain causes sleep disturbance and sleep disturbance intensifies pain), [16-19] opioids used to concomitantly treat both pain and secondary sleep disorders are not always successful. [20,21]

Opioid receptors in the brain are located in the same nuclei that are active in sleep regulation and abnormal sleep architecture has been reported as a characteristic feature of opioid use, with a reduction of rapid eye movement (REM), slow wave sleep stages, and overall sleep quality. [18,20,22] Opioid use in OSA patients can be particularly troublesome, as opioids not only impair arousal, but can worsen airway obstruction, even in non-OSA patients. [21,23,24] Thus, alternative multimodal pain management approaches are recommended to minimize the need for opioids for OSA patients. These include: regional or local anesthesia when appropriate, continuous peripheral nerve blockade, and non-opioid analgesics such as acetaminophen and NSAIDS. [15,23,25-27] Recent evidence also supports use of low-dose ketamine or adjuvant clonidine injections to potentiate local or regional nerve blocks. [23,28,29] Finally, conservative measures aimed at decreasing postoperative pain and inflammation such as icing, elevation, and compression should be emphasized, especially upon discharge home.

Sedative-Dependent Sleep Disorders

The use of short-acting sedative-hypnotics, particularly non-benzodiazepine sedative hypnotics (NBSH, e.g. zolpidem), for treatment of insomnia has increased markedly in recent decades. [30] Generally intended to treat short-term insomnia, NBSH discontinuation may precipitate rebound insomnia, lasting up to weeks in extreme cases, or after taking a single dose. [31-33] Thus, the dependency potential is relatively high. [34-36] Use of zolpidem as a postoperative sleep aid or pain-adjuvant has recently been described following knee and shoulder surgery with reported success in improving sleep quality and function, while decreasing opioid requirements, pain and fatigue. [37-39] However, none of these studies reported patient outcomes beyond the acute treatment period. [37-39] Its

similar utility in hand surgery has not been reported. Perhaps surprisingly, antihistamines used as sleep aids may warrant similar caution. [41] A recent survey of patients who took the commonly-used sedative H1 antihistamine doxylamine found the majority of patients used the medication daily for at least six months, including 77% who experienced rebound insomnia when attempting to discontinue use. [41] These findings suggest that sedative hypnotics and antihistamines should be used with judiciously in hand surgery patients with sleep disorders.

Sleep Disorders Associated with Mental, Neurologic, or Other Medical Disorders

This second category includes a variety primary medical disorders that *secondarily* involve sleep disturbance or excessive sleepiness as a major clinical feature, [9] including several hand and upper extremity conditions.

Carpal Tunnel Syndrome

Insomnia is a nearly universal finding in patients with carpal tunnel syndrome (CTS), often serving as the primary motivating factor for seeking surgical care. [42-48] Although the mechanism linking these two conditions is unclear, McCabe and colleagues reported that patients with CTS are more likely to prefer sleeping on their side compared to control patients. [42-44] The authors acknowledge, however, that these associative findings do not necessary prove causation. In an effort to further characterize the severity of sleep disturbance in CTS patients, Patel et al prospectively studied patients with CTS and found that 78% of patients met the threshold for poor sleep quality using the Pittsburgh Sleep Quality Index (PSQI), a validated sleep-quality outcome measure. [46,49,50] The authors also noted a positive correlation between CTS-related functional impairment and severity of sleep symptoms. [46] The authors did not study the potential association of preoperative electrodiagnostic findings with sleep symptom severity, nor did they investigate the potential therapeutic effect of median nerve decompression on sleep symptoms. Both of these associations may warrant further study, as the ability to predict relief of sleep symptoms following decompressive surgery would allow clinicians to better tailor management for CTS patients whose primary complaints are sleep-related.

Rheumatoid Arthritis and Other Inflammatory Arthropathies

Sleep disturbances in patients with Rheumatoid Arthritis (RA) are multifactorial, codependent on pain, fatigue, and depression. [51-53] In a prospective analysis of RA patients seen at an outpatient clinic, Løppenthin et al reported that 61% met criteria for poor sleep using the PSQI. [52] Westhovens et al found that RA disease activity showed significantly positive correlation with worsening sleep symptoms, [53] while Fragiadaki et al reported improvement in sleep symptoms in a series of 15 RA patients treated with tocilizumab, [54] together suggesting that primary management of underlying RA activity may serve as an optimal strategy for co-managing sleep symptoms. Recent evidence has also demonstrated a significant association between psoriatic arthritis and sleep disorders, particularly OSA and insomnia. [55-58] Although etanercept was reported to improve insomnia symptoms in patients with psoriatic arthritis, treatment with adalimumab did not show a therapeutic effect on patients' OSA symptoms. [57,58] Patients with both psoriatic arthritis and OSA who are to undergo hand surgery should be managed according to the OSA principles discussed earlier.

Additional Management Considerations

Given the potential adverse effects associated with sedatives and opioid pain medication, alternative treatment modalities for concomitant sleep disturbance and acute postoperative pain warrant further discussion. Gamma-aminobutyric acid (GABA) analogues gabapentin and pregabalin may have utility for treating concomitant pain and sleep symptoms, either as primary therapeutic or adjuvant agents. [59,60] Gabapentin has previously been shown as an effective treatment for both pain and sleep disturbance in CTS patients, [61] although this finding has been both supported and refuted in more recent studies. [62,63] Pregabalin shows promise in the concomitant treatment of sleep and pain symptoms, albeit in patients with fibromyalgia, for which it is FDA-approved. [64,65] While neither medication is currently FDA-approved for neuropathic pain associated specifically with conditions of the upper extremity, further investigation to that end could be worthwhile. [59]

Another promising agent for use in hand surgery is exogenous melatonin. Although its sleep-promoting characteristics are widely-reported, melatonin possesses numerous additional benefits which suggest an ideal role as a therapeutic agent in hand surgery. [66] In vitro studies on chondrocytes demonstrate that melatonin is chondrogenic and promotes matrix synthesis, and can also serve as a rescue agent for chondrocytes that are exposed to damaging pro-inflammatory or cytotoxic factors. [67-69] In an animal model of median nerve injury, sleep deprivation made rats more vulnerable to nerve injury-induced neuropathic pain, while melatonin reversed nerve injury-induced hypersensitivity. [70] In the lone clinical study evaluating its efficacy in hand surgery, melatonin was found to improve tourniquet tolerance while decreasing opioid requirement in patients receiving regional anesthesia intravenously. [71] Given this therapeutic potential and limited adverse effect profile, use of melatonin in hand surgery certainly warrants ongoing trial and further investigation.

Current Limitations and Future Directions

Due to the complex interplay of sleep with pain, psychiatric disorders, social factors, and other associated conditions, the evaluation of sleep disorders in the hand surgery patient is rarely straightforward. In a recent study by Peters and colleagues, the authors attempted to determine a relationship between sleep disturbance and upper-extremity disability, and found that psychological factors such as ineffective coping strategies were more likely to predict arm disability than sleep symptoms. [72] The authors discussed the possibility that sleep disturbance was also the product of these psychological factors, suggesting a bidirectional relationship. Their study exemplifies the challenging nature inherent to determining underlying pathology and causal relationships regarding sleep disturbances. This is echoed by Shulman et al, who found that sleep disturbance following distal radius fracture at long-term follow-up was more dependent on mental health than on functional status. [73]

A second limitation of the current evidence regarding sleep disorders in hand surgery is with respect to the heterogeneity of the patient populations studied; a shortcoming fully

acknowledged by Peters and colleagues. [72] In their study fractures, soft-tissue injuries, and degenerative conditions were all treated as equivalent upper extremity disabilities. Furthermore, CTS and cubital tunnel syndrome were lumped together although there is no current literature that describes sleep disorders in patients with cubital tunnel syndrome. Similarly, in their study of melatonin's utility in improving tourniquet tolerance and decreasing opioid requirements, Mowafi and Ismail did not stratify or match patients based on condition or procedure. [71] Future studies using larger, more homogenous patient cohorts, would be critical to fully understanding the relationships between sleep disorders and hand pathologies, and developing precise and effective regimens to treat coexisting sleep and hand disease.

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Figure 1. Flow chart outlining the key types of sleep disorders relative to hand surgery in the context of a broader overview of all sleep disorder categories. The first level represents the three main categories of sleep disorders. Note that boxes in grey are not relevant to this discussion, those in red highlight the key types of sleep disorders known to be related to hand surgery patients, and those in purple represent conditions that are likely to be associated with sleep disorders based on current evidence.

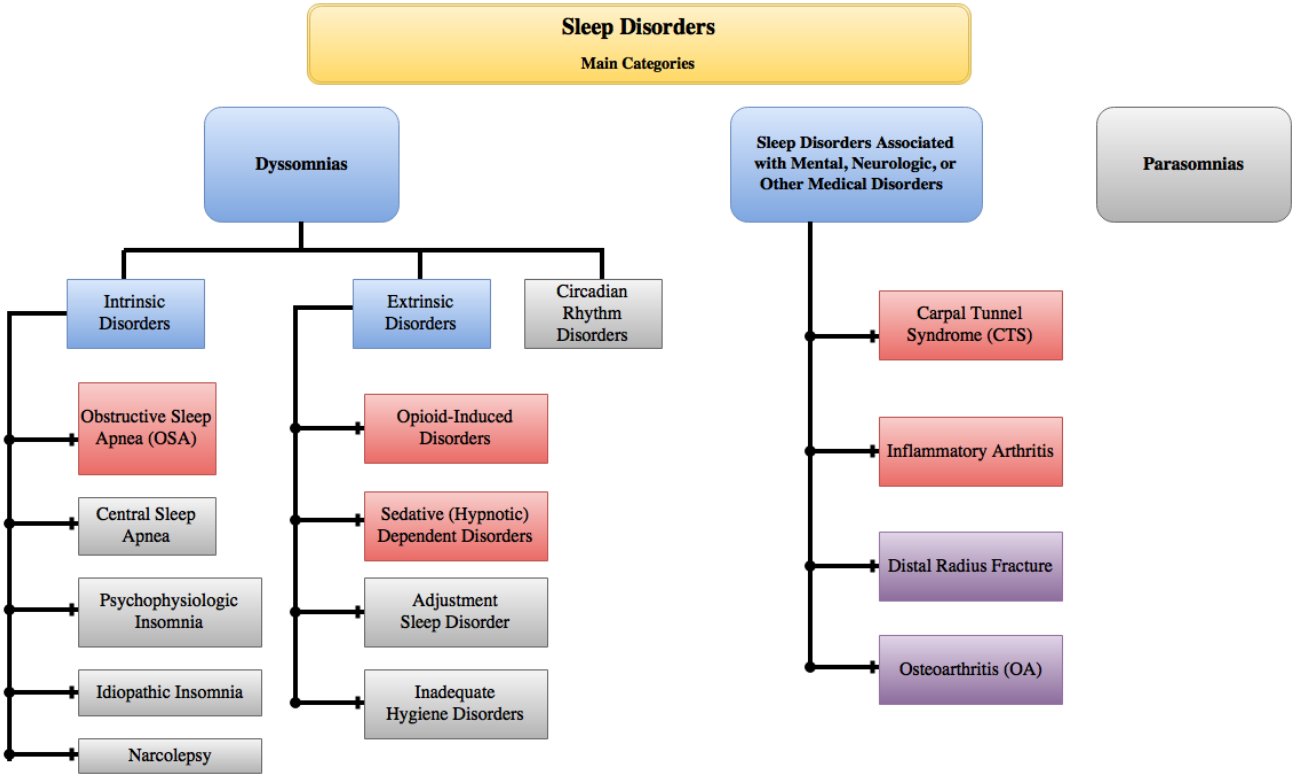

Table 1. STOP-BANG Questionnaire to assess for risk of Obstructive Sleep Apnea (OSA). The first section (STOP) consists of four history or symptom-related questions for the patient to answer, while the second section (BANG) consists of four items that may be objectively measured by the clinician. Answers of "Yes" to any question or measure results in a point, while "No" does not result in a point. Patients with total scores of 0-2, 3-4 and 5-8 points are considered low, intermediate, and high risk of having OSA, respectively.

Question or Variable	YES	NO
STOP		
Do you **SNORE** loudly (louder than talking or loud enough to be heard through closed doors)?	1	0
Do you often feel **TIRED**, fatigued, or sleepy during daytime?	1	0
Has anyone **OBSERVED** you stop breathing during your sleep?	1	0
Do you have or are you being treated for high blood **PRESSURE**?	1	0
BANG		
BMI more than 35kg/m2?	1	0
AGE over 50 years old?	1	0
NECK circumference > 16 inches (40cm)?	1	0
GENDER: Male?	1	0