Postoperative Complication With Obstructive Sleep Apnea

Zubair Ahmad Sheikh[1*], Sripathi Sowmya Priya[2]

[1,2] Department of Anesthesia & Operation theatre Technology, Acharya Institute of Allied Health Sciences, Bengaluru

***Corresponding Author:** arunfrancis@gmail.com

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ABSTRACT

Obstructive Sleep Apnea (OSA) is a common disorder defined by recurrent episodes of upper airway obstruction during sleep, resulting in intermittent hypoxia, hypercapnia, and disrupted sleep patterns. Patients with obstructive sleep apnea (OSA) encounter increased risks of postoperative complications in surgical contexts, such as respiratory problems, cardiovascular incidents, and extended recovery durations. The perioperative management of patients with obstructive sleep apnea (OSA) poses distinct challenges for anesthesiologists and surgeons, primarily due to risks of airway obstruction, heightened opioid sensitivity, and associated comorbidities like hypertension and obesity. Postoperative complications are significant, as the sedative effects of anesthesia and analgesics heighten airway collapsibility, thereby increasing the risk of hypoxemia and apneic events. This review examines the range of postoperative complications linked to obstructive sleep apnea, emphasizing respiratory issues, cardiovascular instability, and the likelihood of extended hospitalization. It also delineates contemporary strategies for the perioperative management of patients with obstructive sleep apnea, encompassing preoperative screening, intraoperative monitoring, and postoperative care. The role of continuous positive airway pressure (CPAP) therapy, opioid-sparing analgesic techniques, and the necessity for individualized anesthesia plans to reduce risks is emphasized. Comprehending these management strategies is crucial for enhancing patient outcomes and decreasing the occurrence of postoperative complications in individuals with OSA.

INTRODUCTION

One common sleep problem is obstructive sleep apnea (OSA), which is characterized by repeated bouts of partial or complete blockage of the upper airway while sleeping. This causes oxygen saturation to drop and the sleep to be interrupted. Anatomical problems (such as retrognathia or big tonsils), neuromuscular issues (such as insufficient compensatory responses to increased airway resistance), and decreased muscle tone during rapid eye movement sleep all come together to cause this multifactorial collapse [1,2]. The body goes through a cascade of reactions when these blockages occur repeatedly; they include sympathetic activation and systemic inflammation, which can impact the cardiovascular, metabolic, and pulmonary systems [3].

Estimates put the worldwide prevalence of OSA at 22.6%, making it a serious public health issue [4]. The prevalence of OSA in the surgical group ranges from 7 to 10% to approximately 70% in bariatric surgery candidates [5]. The lack of public awareness and the subtlety of the symptoms cause the majority of obstructive sleep apnea (OSA) patients to go untreated, even though the condition is common and affects an estimated 24% of adult males and 9% of adult women [6,7]. An increased risk of cardiac adverse events, pulmonary difficulties, severe oxygen desaturation, and intensive care unit (ICU) admission are among postoperative consequences that patients with OSA are more likely to have, according to empirical research [8,9]. Postoperative problems might occur in OSA patients, especially in non-cardiac procedures, due to the particular physiological abnormalities that patients experience, such as hypoxemia, heightened sympathetic activity, and altered respiratory mechanics [10]. In addition, this group of patients may be more vulnerable to perioperative hazards due to the combined effects of opioids, surgical stress, and anesthesia [11]. Despite these obstacles, there is often no discernible increase in data regarding postoperative mortality within a 30-day interval. More stringent monitoring of patients after surgery is thought to be the cause of this phenomena. Finding these high-risk patients correctly is, hence, critical for optimum perioperative care [9].

Epidemiology

Globally, the prevalence of obstructive sleep apnea (OSAS) has been on the rise due to the general population's aging and obesity epidemics. Depending on the criteria used to characterize sleep apnea, the prevalence in the general population might range from 2% to 25%. Sleep apnea, which is defined as an apnea-hypopnea index (AHI) of 5 or more episodes per hour, was found in 9% of women and 24% of men, according to an epidemiological study by Young et al. [12]. Nevertheless, 2% of women and 4% of men were found to have OSAS, which is characterized as an AHI of 5 or more per hour and persistent daytime drowsiness. [12]. The 2005 Sleep in America Poll by the National Sleep Foundation (NSF) indicated that, according to the Berlin Questionnaire, one out of four Americans are at high risk of suffering from sleep apnea [13]. Sleep apnea is more common in postoperative patients and the exact incidence varies with procedure. Over 70% of people who undergo bariatric surgery also suffer from sleep apnea [14,15]. Prior to bariatric surgery, it is recommended that these patients receive a professional sleep examination. A higher prevalence of sleep apnea is also observed in patients who are coming for general surgery. Preoperative use of the Berlin Questionnaire by Chung et al. identified 24% of surgical patients as having a high risk of sleep apnea [16]. After administering the STOP-BANG Questionnaire to our elective surgical patients, we discovered that 41% of them had a high risk of sleep apnea [17]. Before having epilepsy surgery, 39 patients participated in a cross-sectional study that used nocturnal polysomnography (NPSG). A study revealed that sleep apnea was present in one-third of patients having epilepsy surgery [18]. Another study indicated that 64 percent of a small group of individuals having surgery for an intracranial tumor had sleep apnea [19]. Before elective surgery, most of these patients had no idea they have sleep apnea. More than eighty percent of surgical patients with sleep apnea did not know they had the condition before their procedure, according to an observational study by Finkel et al. [20].

Pathophysiology

During the time leading up to surgery, patients are given sedatives, anesthetics, and opioids. Perioperative sleep apnea is worsened by these medications because they raise the risk of pharyngeal collapse, lower the ventilatory response, and hinder the arousal response.

Impact of Sedation, Anesthesia, and Opioids

Individuals diagnosed with sleep apnea experience repeated instances of either partial or total obstruction of the upper airway during sleep. These episodes typically arise when the negative pressure generated by inspiratory muscles surpasses the activity of upper airway dilator muscles, known as critical airway pressure [21]. General anesthetics reduce the activity of upper airway dilator muscles in a dose-dependent manner, leading to increased upper airway collapsibility [21-23]. In a study involving 12 healthy subjects undergoing minor surgery, it was observed that a deeper level of propofol anesthesia correlated with a gradual rise in critical airway pressure and an increase in upper airway collapsibility [23,24]. The observed increase in upper airway collapsibility was attributed to a progressive reduction in genioglossus muscle activity. Upper airway collapsibility can exacerbate sleep apnea and elevate the risk of hypoxemia, cardiac arrhythmias, and complications following surgery.

Anesthetic agents also diminish the arousal response, which serves as a protective defense mechanism against sleep apnea, aiding in the resolution of airway obstruction. Anesthetics, opioids, hypnotics, and benzodiazepines can induce respiratory depression, resulting in a reduction of minute ventilation. Research indicates that halothane diminishes the ventilatory response to hypoxemia and hypercapnia in humans [25,26]. The observed depression is likely a result of halothane's selective impact on the peripheral chemoreflex loop. A subanesthetic dose of isoflurane reduces the hypoxemic ventilatory response through peripheral chemoreceptors [27,28].

Patients undergoing surgical procedures often receive opioids for the management of pain. Opioids impair ventilatory function by influencing both peripheral and central carbon dioxide chemoreflex mechanisms [29,30]. Research indicates that small doses of narcotics delivered epidurally can depress respiratory function, even in healthy adults [31-33]. Opiate-induced ventilatory depression is influenced by both sex and ethnicity [34,35]. Morphine reduces hypoxic and hypercapnic ventilatory responses in women, but not in men. Conversely, it elevates the apneic threshold in men while having no impact on women. The co-administration of opiates and benzodiazepines has been demonstrated to result in increased occurrences of hypoxemia and apnea [36]. This is likely due to a significant reduction in the hypoxic ventilatory response to both opiates and benzodiazepines [37].

REM Sleep Rebound

Surgical patients exhibit fragmented sleep during the first two postoperative nights, characterized by a notable decrease in REM sleep and slow wave sleep, alongside an increase in stage 2 NREM sleep.40 to 46 Sleep disturbances typically arise as a consequence of surgical stress, pain, and the administration of anesthetic and analgesic medications [38]. Surgical trauma induces elevated cortisol levels, which significantly reduce REM sleep. Surgical trauma induces a significant inflammatory response, characterized by elevated levels of pro-inflammatory markers such as tumor necrosis factor alpha (TNF-α), interleukin 1 (IL-1), and IL-6. Inflammatory markers, particularly IL-1 and TNF-α, have demonstrated a suppressive effect on REM sleep. Studies indicate that REM sleep is typically absent during the first and second postoperative nights. This is typically accompanied by a significant increase in the quantity and density of REM sleep (REM sleep rebound) during recovery nights 3 to 5 [39] Episodes of sleep-disordered breathing and hypoxemia typically exacerbate during REM sleep, attributed to hypotonia and unstable breathing patterns. REM sleep is linked to heightened sympathetic discharge, resulting in tachycardia, hemodynamic instability, and myocardial ischemia.

Most complications following surgery are recognized to occur within the first postoperative week, particularly between days 2 and 5, which align with periods of REM rebound. Hypoxemia episodes following surgery predominantly occur during postoperative nights 2 to 5 [40]. These episodes may elevate the risk of wound infection, cerebral dysfunction, and cardiac arrhythmias.66 An observational study conducted at Mayo Clinic revealed that the incidence of acute myocardial infarction reached its peak on the third day post-surgery. Episodes of delirium, nightmares, and psychomotor dysfunction have been documented to occur during postoperative nights 3 to 5 [41]. Surgical patients exhibit an elevated risk of complications due to several factors, including ASA (American Society of Anesthesiologists) class, age, type of paralytics, current smoking status, low albumin levels, duration of surgery, type of anesthesia, and various comorbidities, particularly chronic obstructive pulmonary disease, coronary artery disease, and renal failure. The likelihood of postoperative complications is influenced by the specific type of surgery performed.

The complication rate is elevated in patients undergoing abdominal surgery and is further increased with aortic aneurysm repair, vascular, thoracic, and neck surgeries [42]. Gupta et al. demonstrated a higher incidence of postoperative complications (39% vs 18%), an elevated rate of transfer to the ICU (24% vs 9%), and an extended length of hospital stay in patients with obstructive sleep apnea compared to control subjects matched for age, sex, and body mass index (BMI). This study indicated that patients with obstructive sleep apnea (OSA) who underwent continuous positive airway pressure (CPAP) therapy before surgery experienced a lower incidence of serious complications and a one-day decrease in hospital stay duration. Liao et al. conducted a case-control study revealing that patients with obstructive sleep apnea (OSA) experienced a higher rate of postoperative complications, with 44% compared to 28% in the control group. Notably, it was observed that patients with obstructive sleep apnea who did not adhere to CPAP therapy exhibited the highest incidence of postoperative complications. Kaw et al. demonstrated that patients with obstructive sleep apnea (OSA) experienced a higher incidence of encephalopathy, postoperative infections such as mediastinitis, and an extended length of stay in the intensive care unit (ICU). Memtsoudis et al. conducted a case-control study revealing that orthopedic and general surgical patients with sleep apnea face an increased risk of perioperative pulmonary complications [43].

Hwang et al. found that the incidence of postoperative complications increased with the frequency of overnight desaturation events observed during home nocturnal oximetry [43]. This study involved 172 patients who underwent home nocturnal oximetry as part of their preoperative evaluation for elective surgery. The oxygen desaturation index (ODI 4%), defined as the number of episodes per hour of oxygen desaturation ≥ 4%, was calculated for each patient based on home nocturnal oximetry data. Patients exhibiting an ODI 4% ≥ 5/h experienced a markedly elevated incidence of postoperative complications compared to those with ODI 4% < 5/h (15.4% versus 2.7%). The incidence of postoperative complications correlated positively with the severity of ODI. Patients with an ODI 4% of 5-15 experienced a 13.8% incidence of complications, whereas those with an ODI 4% greater than 15 had a 17.5% incidence.

A recent cohort study evaluated 471 patients who underwent non-cardiac surgery within three years of polysomnography for postoperative complications and hospital length of stay. Patients with sleep apnea exhibited a higher incidence of postoperative complications and hypoxemia [44]. The STOP-BANG Questionnaire was utilized preoperatively to identify patients at elevated risk for

OSAS.Sixteen Patients identified as high risk for OSAS exhibited a significantly elevated incidence of postoperative pulmonary and cardiac complications compared to those at low risk (19.6% vs 1.3%). Patients identified as high risk for OSAS exhibited a significantly longer hospital length of stay in comparison to those classified as low risk. Gali et al. employed Flemons criteria and the Sleep Apnea Clinical Score (SACS) to assess patients' risk levels for obstructive sleep apnea [45]. Patients exhibiting elevated SACS and PACU events demonstrated an increased incidence of postoperative respiratory complications. Auckley et al. employed the Berlin Questionnaire to identify patients at high risk.One hundred five The study indicated that patients at high risk for sleep apnea experienced a higher rate of postoperative complications (20% compared to 4.5%); nonetheless, this difference lacked statistical significance.

Two studies have been conducted on patients undergoing ambulatory surgery to evaluate the impact of obstructive sleep apnea. The studies indicated that the presence of OSA did not elevate the rate of unplanned hospital admissions among patients who underwent outpatient surgical procedures. Stierer et al. employed a prediction model within a cohort of the ambulatory surgical population to evaluate the likelihood of sleep apnea. Patients with a propensity of ≥ 70% for obstructive sleep apnea (OSA) exhibited a higher incidence of difficult intubation, elevated oxygen requirements, and intraoperative tachycardia [46].

Methods for Identifying Patients with Sleep Apnea

Nocturnal polysomnography (NPSG) is regarded as the definitive method for diagnosing obstructive sleep apnea in patients. In the perioperative setting, implementation is challenging due to various factors, including the extension of the surgical process and the increase in overall costs. In numerous hospital environments, it may not be easily accessible. Alternative methods for identifying patients at risk for obstructive sleep apnea include questionnaires, nocturnal pulse oximetry, and home sleep testing.

Questionnaires

Numerous questionnaires exist to identify surgical patients at high risk for obstructive sleep apnea. Three questionnaires have been validated within the surgical population: the Berlin Questionnaire, ASA checklist, and STOP-BANG questionnaire. The Berlin questionnaire is the most prevalent tool for identifying patients at elevated risk for obstructive sleep apnea (OSA). The instrument comprises 11 questions categorized into three symptom groups and has been validated for use in primary care patients.109 The sensitivity is 86%, and the positive predictive value is 89% for identifying patients with a respiratory disturbance index (RDI) greater than 5 per hour in the primary care clinic. Chung et al. recently validated the Berlin questionnaire within a surgical population, reporting a sensitivity range of 74.3% to 79.5% and a negative predictive value between 76% and 89.3% for identifying patients with moderate-to-severe obstructive sleep apnea (OSA).One hundred ten This questionnaire features a complex scoring system and requires considerable time to complete [47]. The checklist developed by the American Society of Anesthesiologists (ASA) is considered useful and has been recommended by the ASA Task Force for identifying patients with obstructive sleep apnea (OSA). The collection comprises 12 items for adults and 14 items for children. The ASA checklist demonstrates a sensitivity ranging from 78.6% to 87.2% and a negative predictive value between 72.7% and 90.9% for identifying surgical patients with moderate to severe OSA.

The STOP-BANG (Snoring, Tiredness during daytime, observed apnea, high blood pressure, Body mass index, Age, Neck circumference, Gender) questionnaire has recently been validated as a screening tool for obstructive sleep apnea syndrome (OSAS) in the preoperative context [48]. The questionnaire is concise, self-administered, and user-friendly, comprising 8 yes/no questions. Patients are classified as high risk for OSAS if they respond affirmatively to three or more items. The STOP-BANG questionnaire demonstrated sensitivities of 83.6%, 92.9%, and 100% for apnea-hypopnea index (AHI) cutoff values of > 5, > 15, and > 30, respectively. The associated negative predictive values (NPV) were 60.8%, 90.2%, and 100%. This questionnaire exhibits a moderate to high sensitivity, specificity, and negative predictive value for identifying patients with moderate (AHI > 15) to severe (AHI > 30) sleep apnea within the surgical population. Consequently, when a patient is classified as low risk for obstructive sleep apnea (OSA) using the STOP-BANG scoring model, healthcare providers can reasonably exclude the likelihood of moderate-to-severe sleep apnea. Abrishami et al. performed a systematic review to identify and assess various screening questionnaires for sleep apnea.114 The Berlin and STOP-BANG questionnaires demonstrated high sensitivities and specificities in predicting moderate to severe sleep apnea. They determined that the STOP and STOP-BANG questionnaires exhibited the highest methodological validity and are user-friendly.

Nocturnal Pulse Oximetry

Nocturnal pulse oximetry has been utilized for the screening of obstructive sleep apnea (OSA). Malbois et al. conducted a comparison of nocturnal oximetry sensitivity against ambulatory monitoring to identify patients with sleep apnea before bariatric surgery. The study indicated that nocturnal oximetry, utilizing a 3% desaturation index as a screening method for obstructive sleep apnea (OSA), is effective in excluding significant OSA (AHI > 10) and identifying patients with severe OSA. This cost-effective and readily accessible method may expedite the preoperative evaluation of these patients [49].

Home Sleep Testing

Ambulatory monitoring represents an additional method applicable to patients at elevated risk for sleep apnea. This approach is advised solely for patients exhibiting a high pre-test probability of sleep apnea and is contraindicated for those with concurrent cardiopulmonary complications [50]. It possesses limitations regarding patient usability. One study demonstrated that ambulatory monitoring effectively confirmed the diagnosis of obstructive sleep apnea (OSA) in 82% of adult surgical patients identified as high risk before surgery at a large academic medical center. Evaluating this diagnostic modality for OSAS in a specific surgical patient population would be beneficial.

Postoperative Management

Risk of Postoperative Complications

Obstructive Sleep Apnea (OSA) is associated with an increased risk of multiple postoperative complications. This encompasses cardiac and pulmonary complications, increased demands on hospital resources, and potentially, mortality [51]. The literature indicates that undiagnosed and untreated obstructive sleep apnea (OSA) presents a greater risk of postoperative cardiovascular complications than treated OSA or the absence of OSA, underscoring the importance of preoperative identification and management of OSA in patients [52]. The relationship between obstructive sleep apnea (OSA) and the incidence of significant postoperative cardiovascular or cerebrovascular events continues to be a contentious issue. A recent study of the national inpatient sample revealed a markedly increased risk of major postoperative cardiovascular and cerebrovascular events in patients with OSA across all surgical categories [53]. Recent meta-analysis findings indicate that obstructive sleep apnea (OSA) is associated with an increased risk of postoperative cardiopulmonary complications, postoperative delirium, bleeding, ICU admission, and prolonged hospital stays [54].

Postoperative care for patients with obstructive sleep apnea necessitates careful consideration of pulmonary complications. The pathophysiology of obstructive sleep apnea (OSA), marked by recurrent hypoxic events and airway instability, significantly contributes to various respiratory complications. The complication incidence rate among patients with OSA was reported at 48.9%, in contrast to 31.4% in patients without OSA. Respiratory complications constitute 40.4% of all complications, compared to 23.2% in the control group [55]. A comprehensive meta-analysis and trial sequential analysis indicated that patients with OSA are nearly twice as likely to encounter postoperative respiratory complications [56].

A significant study of 337,333 non-cardiac orthopaedic surgery cases found a strong association between a diagnosis of OSA and extended hospital length of stay, as well as the requirement for specialized postoperative care. Obstructive sleep apnea (OSA) independently elevates the risk of severe pulmonary complications, including pulmonary embolism, acute respiratory distress syndrome, respiratory failure, and the need for ventilatory support [57]. Other studies have similarly shown a correlation between OSA and an increased incidence of oxygen desaturation, pneumonia, and respiratory failure, even after controlling for age and preexisting pulmonary conditions [58]. Despite elevated risks, OSA patients reportedly demonstrate comparable reintubation rates to controls, suggesting the effectiveness of targeted supportive therapies [55,59]. Furthermore, there was no significant difference in unplanned ICU admissions or hospital readmissions, suggesting that targeted perioperative interventions can effectively mitigate these risks [56].

Preoperative and postoperative screenings can effectively identify these patients, thereby optimizing their postoperative management. Research indicates that patients with positive preoperative screening for obstructive sleep apnea (OSA) exhibit a markedly higher probability of experiencing an oxygen desaturation index (ODI) exceeding 10 events per hour within the first 24 hours postoperatively. Patients exhibiting recurrent events in the Post-Anesthesia Care Unit (PACU) demonstrated an increased likelihood of experiencing an Oxygen Desaturation Index (ODI) greater than 10 events per hour after the initial 24 hours, irrespective of screening outcomes. These findings highlight the necessity of thorough postoperative monitoring for patients with obstructive sleep apnea (OSA).

Pulse oximetry is the primary method for monitoring respiratory function after surgery. End-tidal carbon dioxide monitoring has shown the ability to identify adverse respiratory events significantly earlier than the onset of oxygen desaturation, even in patients receiving supplemental oxygen [60]. Capnography, due to its improved sensitivity and specificity, could serve as a crucial tool for enhancing postoperative safety by providing early warning signs for identifying patients at higher risk of respiratory complications beyond the PACU setting. A systematic review and meta-analysis indicated that continuous pulse oximetry following surgery enhanced the likelihood of detecting desaturation by a factor of 15, while continuous capnography improved the odds of identifying postoperative respiratory depression by a factor of 6 [61]. Impedance-based non-invasive respiratory volume monitoring represents an innovative technology; however, its utility and practicality require further investigation [62].

The current literature inadequately defines the optimal timing for transitioning OSA patients to unsupervised settings, despite the critical need for vigilant postoperative respiratory and sedation monitoring. This issue is particularly urgent given the growing body of literature identifying preventable monitoring deficiencies as the main cause of adverse outcomes in OSA patients [63,64]. The allocation of resources for postoperative surveillance of the expanding OSA cohort is a significant concern for global healthcare systems.

Supplemental Oxygen

Postoperative adjuvant oxygen administration in patients with obstructive sleep apnea (OSA) has shown improved oxygenation and a decrease in the apnea-hypopnea index (AHI) without extending the duration of apnea-hypopnea episodes [65]. According to the guidelines established by the American Society of Anesthesiologists (ASA), it is essential to provide continuous supplemental oxygen (O_2) to patients with obstructive sleep apnea (OSA) during the post-anesthesia recovery period until they can maintain their baseline SpO_2 levels in ambient air [66]. A specific group of OSA patients may demonstrate carbon dioxide retention, which is linked to the significant role of hypoxemia in triggering respiratory arousals [65]. Supplemental O_2 can eliminate hypoxemia, potentially resulting in prolonged apnea duration, which may lead to hypoventilation and hypercarbia, ultimately decreasing respiratory arousal. This strategy seeks to reduce hypoventilation, prolonged apneic episodes, and atelectasis, which may not be detected by pulse oximetry during O_2 therapy, particularly when additional monitoring methods, such as respiratory rate assessment or capnography, are lacking [66,67]. A recent systematic review and meta-analysis indicates that O2 therapy effectively reduces the apnea-hypopnea index in patients with obstructive sleep apnea (OSA) and enhances SpO_2 levels. CPAP demonstrates greater efficacy in decreasing the apnea–hypopnea index compared to oxygen therapy; however, both O_2 therapy and CPAP exhibit comparable effectiveness in enhancing SpO_2 levels and reducing CT90. High flow nasal oxygen therapy effectively reduces the Apnea-Hypopnea Index (AHI) [67].

Positive Airway Pressure

Positive Airway Pressure (PAP) therapy serves as a pneumatic stabilizer, aimed at preventing airway collapse during sleep. Sustained PAP therapy can improve the quality of life in patients with OSA by enhancing ventilation, alertness, and cognitive function. Adherence to PAP is frequently suboptimal due to perceived discomfort, resulting in uncertainties about its perioperative application. The optimal duration for preoperative PAP therapy and the ideal initiation time for PAP therapy are currently undetermined. It has been reported that fewer than 20% of patients receive PAP therapy during the perioperative phase [68].

Currently, there is insufficient robust evidence regarding the perioperative effectiveness of PAP therapy, primarily due to the challenges associated with randomizing this widely accepted treatment. A recent systematic review and meta-analysis [29] has yielded significant insights. In patients with obstructive sleep apnea undergoing non-cardiac surgery, positive airway pressure therapy was linked to a notable 28% reduction in the risk of postoperative respiratory complications and a 56% decrease in the rate of unplanned intensive care unit admissions.

Postoperative application of positive airway pressure (PAP) in cardiac and thoracoabdominal surgeries is linked to a reduction in hypoxemia and a decrease in pulmonary complications, such as reintubation [69,70]. Preliminary evidence indicates that the use of PAP in patients with OSA may reduce the incidence of major postoperative cardiovascular events, such as cardiac arrest and cardiogenic shock [71]. In a study involving OSA patients randomized to auto-titrated PAP preoperatively and for three days postoperatively, a significant reduction in the AHI and enhancement in oxygen saturation were observed [72]. One study indicated that preoperative CPAP use did not have a significant impact on the total postoperative or respiratory complications. Other studies similarly indicate no significant reduction in postoperative complications [73]. In contrast, the meta-analysis by Berezin et al. demonstrates that patients with obstructive sleep apnea (OSA) undergoing cardiac surgery experienced a 37% reduction in postoperative cardiac complications and a 41% decrease in the incidence of atrial fibrillation due to PAP therapy [29].

The ASA and SASM support the preoperative use of PAP due to its potential benefits and lack of expected harm, particularly in severe cases of OSA [66]. The ASA recommends the use of PAP or oral devices for patients who have previously undergone these treatments during surgery. Patients undergoing PAP therapy must maintain its use both prior to and following surgery throughout their hospitalization. For individuals who have not received prior treatment, the initiation of PAP should be considered in cases of severe OSA or when postoperative desaturation episodes are observed [66]. Adaptive servo-ventilation, a type of bilevel Positive Airway Pressure therapy, is increasingly employed to address sleep-related breathing disorders, especially central sleep apnea. It may be applied in postoperative patients with obstructive sleep apnea who exhibit significant uncontrolled hypoventilation.

Mortality and Critical Events

The recent OSA Death and Near Miss Registry indicates that patients with obstructive sleep apnea are especially susceptible to critical postoperative events, primarily occurring within the first 24 hours. Death and brain damage occurred more frequently in situations characterized by unwitnessed events, insufficient supplemental oxygen, inadequate respiratory monitoring, and the concurrent use of opioids and sedative agents. PAP therapy, supplemental oxygen, and central respiratory monitoring, although advantageous, did not completely mitigate the risk of catastrophic outcomes [75]. Case studies and malpractice reports often detail critical incidents or unexpected fatalities in hospitalized patients with obstructive sleep apnea, occurring despite appropriate narcotic dosing and initial alertness. Patients often present as awake and stable initially, yet they may deteriorate or succumb after transitioning to sleep [75]. This has prompted examination of possible preventive strategies, concentrating on OSA subgroups that display occult arousal failure, which is marked by a delayed reaction to apneas and consequent severe desaturation during sleep [74]. This issue is notably difficult to identify preoperatively, as affected patients exhibit no symptoms while awake, obscuring their risk within the surgical population. Hypnotics and narcotics increase this risk by prolonging arousal delay.

The pathophysiology of arousal failure in obstructive sleep apnea (OSA), particularly in severe or obese instances, is believed to involve a reduced response to arterial hypoxemia over time [73]. Conventional screening methods currently lack effectiveness in identifying arousal failure perioperatively, despite the potential indicators of obesity and disease severity reflecting a patient's vulnerability.

Challenges and Future Research

Population-based studies indicate that the application of targeted interventions for obstructive sleep apnea, including regional anesthesia, supplemental oxygen, positive airway pressure therapy, and pulse oximetry monitoring, is consistently underutilized. Reports from the majority of anesthesiologists in North America indicate a lack of specific departmental protocols. The variability in monitoring practices is linked to insufficient evidence regarding the efficacy of these measures and the difficulties arising from the increasing prevalence of OSA, which complicate the implementation of expensive monitoring methods [75]. Alarm fatigue, along with the discomfort resulting from frequent false alarms, exacerbates these challenges [74].

The absence of comprehensive monitoring has been associated with significant adverse outcomes in patients with obstructive sleep apnea. The increasing demand for improved patient safety protocols in the OSA patient demographic necessitates the creation of more sophisticated screening and monitoring algorithms. These should accurately identify specific OSA phenotypes that are at high risk for cardiorespiratory complications necessitating intensive observation [74]. From both healthcare and economic perspectives, it is more beneficial to prevent complications than to address them after they arise. However, the existing OSA screening methods exhibit elevated false-positive rates and inadequate specificity, resulting in a misallocation of resources [75]. Identifying reliable risk indicators beyond the AHI, such as SpO_2, CO_2 levels, pulse oximetry, and cardiac biomarkers, is essential for enhancing patient safety in OSA [76]. Exploring innovative methodologies is

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