RESEARCH
O&G Forum 2024; 34 – 3s: 2125-2132

ANESTHETIC MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: STRATEGIES FOR OPTIMIZATION AND RISK REDUCTION

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ABSTRACT

Patients with obstructive sleep apnea syndrome (OSAS) pose unique challenges during anesthesia due to their heightened susceptibility to respiratory complications induced by sedative and anesthetic agents, which can disrupt respiratory control and precipitate upper airway collapse. These challenges are compounded in cases where fixed anatomic obstructions obstruct the upper airway. Herein, we present a case study involving OSAS patients scheduled for general anesthesia for nasal polypectomy and correction of a deviated septum. Preoperative assessment revealed multiple risk factors associated with difficult intubation and ventilation, including nasal obstruction, maxillofacial anomalies (e.g., micrognathia), limited temporomandibular joint mobility, and obesity. An individualized airway management strategy, informed by established protocols, was devised and effectively implemented. This approach included fiberoptic-guided intubation facilitated through a laryngeal mask airway, demonstrating a tailored management plan for OSAS patients with concomitant conditions that compromise upper airway patency.

Keywords: *Obstructive Sleep Apnea Syndrome (OSAS) Anesthesia Management Laryngeal Mask Airway (LMA) Perioperative Care Airway Management*

INTRODUCTION

Obstructive sleep apnea syndrome (OSAS) presents a significant challenge in the perioperative setting, particularly during anesthesia and airway management. This disorder is characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, leading to intermittent hypoxia, hypercapnia, and fragmented sleep patterns. OSAS affects a substantial portion of the population, with estimates varying depending on the studied cohort and diagnostic criteria but often cited to affect around 9-38% of middle-aged adults and older populations.

The pathophysiology of OSAS primarily revolves around the collapse of the pharyngeal airway during sleep, which results from a combination of anatomical factors (e.g., obesity, craniofacial abnormalities) and functional impairments (e.g., reduced muscle tone). During wakefulness, individuals with OSAS may exhibit varying degrees of upper airway patency depending on the presence of compensatory mechanisms such as increased neuromuscular tone. However, the transition to sleep often leads to relaxation of these muscles, exacerbating the tendency for airway collapse.

The clinical implications of untreated or poorly managed OSAS extend beyond disturbed sleep and daytime somnolence. Patients with OSAS are at heightened risk for cardiovascular diseases, metabolic derangements, neurocognitive deficits, and an increased incidence of perioperative complications. Of particular concern in the anesthesia context is the potential for respiratory compromise under the influence of sedative and anesthetic agents. These drugs can further depress respiratory drive and compromise upper airway muscle tone, thereby exacerbating the risk of airway obstruction and respiratory failure.

In the surgical setting, the challenges posed by OSAS are compounded by the necessity of administering anesthesia and maintaining adequate ventilation while ensuring patient safety. The presence of anatomical factors such as enlarged tonsils, adenoids, or soft tissue hypertrophy in the upper airway can contribute to difficulties in both mask ventilation and tracheal intubation.

Additionally, patients with OSAS frequently present with comorbidities such as obesity, hypertension, and cardiovascular disease, which further increase their perioperative risk profile.

Effective management of OSAS in the perioperative period requires a multidisciplinary approach involving anesthesiologists, otolaryngologists, sleep specialists, and other healthcare providers. Preoperative assessment plays a pivotal role in identifying patients at increased risk of perioperative complications. Tools such as the STOP-Bang questionnaire, which evaluates snoring, tiredness, observed apnea, blood pressure, body mass index, age, neck circumference, and gender, are commonly utilized to screen for OSAS and stratify perioperative risk.

Once identified, patients with OSAS benefit from tailored anesthetic techniques aimed at minimizing the risk of airway obstruction and perioperative complications. Strategies include preoperative optimization of comorbidities, careful selection of anesthetic agents with favorable respiratory profiles, and meticulous planning for airway management. Regional anesthesia techniques, when feasible, may offer advantages by avoiding the risks associated with general anesthesia-induced airway compromise.

In cases necessitating general anesthesia, the choice of airway management technique is critical. Awake fiberoptic intubation and the use of supraglottic airway devices such as laryngeal mask airways (LMAs) have gained prominence in managing patients with difficult airways, including those with OSAS. These techniques allow for a controlled approach to airway management while maintaining spontaneous ventilation and reducing the risk of perioperative complications.

Moreover, advancements in monitoring technology have enhanced perioperative care for patients with OSAS. Continuous monitoring of oxygen saturation, capnography, and respiratory parameters provides real-time feedback on respiratory status, enabling prompt intervention in the event of airway compromise or respiratory depression. Collaboration between anesthesia providers and sleep medicine specialists ensures comprehensive perioperative care plans that address the unique needs of patients with OSAS.

Despite these advancements, challenges remain in optimizing perioperative outcomes for patients with OSAS. Variability in disease severity, anatomical considerations, and the presence of multiple comorbidities necessitate individualized treatment approaches. Ongoing research efforts continue to explore novel strategies for airway management, pharmacological interventions, and perioperative care protocols aimed at reducing the incidence of adverse events and improving patient outcomes.

The management of patients with obstructive sleep apnea syndrome during anesthesia requires a nuanced understanding of the disorder's pathophysiology, perioperative risks, and tailored management strategies. By employing a multidisciplinary approach and leveraging advances in perioperative care, healthcare providers can mitigate risks, optimize outcomes, and enhance the safety of surgical interventions for this vulnerable patient population.

Research Gap

Obstructive sleep apnea syndrome (OSAS) presents a complex challenge in the perioperative period, particularly concerning anesthesia management and airway control. Despite advancements in anesthesia techniques and perioperative care, significant gaps in research persist, particularly in understanding the optimal strategies for mitigating perioperative complications in patients with OSAS.

One notable research gap revolves around the variability in anesthesia practices and their impact on outcomes for OSAS patients. While guidelines exist for managing difficult airways and mitigating perioperative risks, evidence specific to OSAS patients—especially those undergoing elective surgeries like nasal polypectomy and septoplasty—is limited. Current literature predominantly focuses on general recommendations rather than tailored approaches that account for the spectrum of OSAS severity and associated comorbidities.

Moreover, the specific challenges posed by anatomical abnormalities in OSAS patients, such as micrognathia, obesity, and nasal obstruction, necessitate nuanced airway management strategies that are not extensively covered in existing research. Understanding how these factors interact with anesthetic agents and surgical interventions is crucial for developing targeted perioperative protocols that optimize outcomes and minimize complications.

Furthermore, there is a need for prospective studies that assess the long-term effects of different anesthesia techniques on OSAS patients' postoperative recovery, including respiratory function, sleep quality, and cardiovascular outcomes. Such studies could provide valuable insights into refining perioperative care practices and tailoring interventions to enhance patient safety and satisfaction.

In summary, the research gap lies in the paucity of specific, evidence-based guidelines for anesthesia management in OSAS patients undergoing elective surgeries, particularly those involving the upper airway. Addressing this gap requires comprehensive studies that evaluate the efficacy and safety of different anesthesia techniques, consider individual patient characteristics, and explore long-term outcomes beyond immediate perioperative care.

Specific Aims of the Study

The specific aims of this study are designed to address the aforementioned research gap and

enhance understanding of perioperative management strategies for OSAS patients undergoing nasal polypectomy and septoplasty. The study aims to:

1. **Evaluate Preoperative Risk Assessment Tools**: Assess the utility of preoperative screening tools, such as the STOP-Bang questionnaire, in predicting perioperative complications and guiding anesthesia management decisions for OSAS patients.
2. **Compare Anesthesia Techniques**: Compare the efficacy and safety of awake fiberoptic intubation versus laryngeal mask airway (LMA) insertion as primary airway management strategies in OSAS patients undergoing elective nasal surgeries.
3. **Assess Postoperative Outcomes**: Evaluate postoperative outcomes, including respiratory function, incidence of airway complications, and patient-reported outcomes (e.g., quality of recovery, satisfaction) following different anesthesia techniques.
4. **Explore Long-term Effects**: Investigate the long-term effects of anesthesia techniques on OSAS severity, sleep architecture, and cardiovascular health in the postoperative period.

Objectives of the Study

This study aims to achieve the following objectives:

1. **To Determine Optimal Preoperative Assessment**: Identify specific preoperative risk factors and their impact on perioperative outcomes in OSAS patients undergoing nasal polypectomy and septoplasty.
2. **To Compare Airway Management Techniques**: Compare the effectiveness and safety of awake fiberoptic intubation and laryngeal mask airway insertion in maintaining perioperative airway patency and minimizing complications in OSAS patients.
3. **To Assess Immediate Postoperative Complications**: Evaluate the incidence of immediate postoperative complications related to airway management and anesthesia techniques in OSAS patients.
4. **To Investigate Long-term Respiratory and Cardiovascular Effects**: Investigate the long-term effects of different anesthesia techniques on OSAS severity, sleep parameters, and cardiovascular outcomes postoperatively.

Scope of the Study

This study focuses on patients diagnosed with obstructive sleep apnea syndrome (OSAS) who are scheduled for elective nasal surgeries, specifically nasal polypectomy and correction of a deviated septum. The scope includes adults of varying ages and both genders, reflecting the diverse demographic affected by OSAS.

The study will be conducted in a perioperative setting, encompassing preoperative evaluation, intraoperative anesthesia management, and postoperative monitoring. Key interventions under investigation include awake fiberoptic intubation and laryngeal mask airway (LMA) insertion as primary airway management techniques.

Outcome measures encompass a range of parameters, including but not limited to perioperative complications (e.g., airway obstruction, desaturation), postoperative respiratory function (e.g., spirometry, arterial blood gas analysis), and long-term outcomes such as changes in OSAS severity, sleep quality, and cardiovascular health.

Hypothesis

Based on the literature and clinical experience, the hypothesis of this study is twofold:

1. **Primary Hypothesis**: Awake fiberoptic intubation will be superior to laryngeal mask airway (LMA) insertion in maintaining perioperative airway patency and minimizing complications in OSAS patients undergoing nasal polypectomy and septoplasty.
2. **Secondary Hypothesis**: OSAS patients managed with awake fiberoptic intubation will exhibit improved postoperative respiratory function, reduced incidence of airway complications, and better long-term outcomes compared to those managed with LMA insertion.

Research Methodology Section

This study investigates the perioperative management of obstructive sleep apnea syndrome (OSAS) in a 53-year-old female patient undergoing nasal polypectomy and septum correction. The patient's clinical presentation, preoperative assessment, anesthesia management, and postoperative outcomes are detailed to elucidate the complexities and challenges encountered in managing OSAS during elective surgery.

Patient Presentation and Preoperative Assessment

The patient presented with a history of excessive daytime sleepiness, habitual snoring, and disturbed sleep characterized by frequent arousals and nasal congestion. Despite being obese (BMI 34.4 kg/m²) and having mild untreated hypertension, her medical history was otherwise unremarkable. Physical examination revealed micrognathia, a reduced incisive gap (20 mm, normal > 35 mm), and a thyromental distance of 51 mm. Nasal polyposis and septal deviation further complicated nasal breathing. Polysomnography confirmed a diagnosis of OSAS, demonstrating significant sleep disruption with

frequent obstructive apneas and severe oxygen desaturation (baseline SpO_2 95% dropping to 68%).

Anesthesia Management

Given the anticipated difficulties with upper airway instrumentation and intubation due to anatomical abnormalities and patient intolerance, a comprehensive anesthesia plan was devised. Premedication included intravenous metoclopramide and ranitidine to mitigate aspiration risk. Anesthesia induction aimed to optimize airway management while ensuring patient safety under general anesthesia.

Initially, attempts at fiberoptic-guided transoral intubation with topical pharyngeal anesthesia and intravenous sedation were unsuccessful due to patient anxiety. Consequently, general anesthesia was induced using propofol and alfentanil. Conventional laryngoscopy proved impractical due to the patient's reduced incisive gap, prompting the use of a laryngeal mask airway (LMA) #4. The LMA facilitated effective ventilation and served as a conduit for subsequent fiberoptic-guided endotracheal tube insertion to secure the airway for surgery.

Muscle relaxation was achieved with atracurium to facilitate surgical conditions and minimize patient movement. Postoperatively, vigilant monitoring with ECG, noninvasive blood pressure, pulse oximetry, and capnography ensured immediate detection of any respiratory compromise or airway obstruction. The patient received analgesia with diclofenac and was monitored closely for the first 24 hours postoperatively.

Postoperative Course and Outcome

During the initial recovery phase, the patient experienced episodes of paradoxical thoracoabdominal motion accompanied by snoring, decreased respiratory rate, and oxygen desaturation to 88%. Prompt detection via pulse oximetry alarm led to arousal and resolution of respiratory obstruction without necessitating further intervention. Continuous monitoring over 24 hours revealed stable vital signs, and the patient was discharged on the fifth postoperative day without complications.

Methodological Considerations

This study employed a case report methodology to provide a detailed account of anesthesia management tailored to the unique challenges posed by OSAS in a patient undergoing elective nasal surgery. Case reports serve as valuable sources of clinical insight, offering nuanced observations and lessons for managing similar cases in clinical practice. The utilization of detailed preoperative assessment, meticulous anesthesia planning, and vigilant postoperative monitoring underscores the importance of individualized care in optimizing outcomes for OSAS patients undergoing surgery.

A key strength of this study lies in its comprehensive documentation of the perioperative course, highlighting both successful strategies and challenges encountered in managing OSAS during nasal surgery. The detailed description of anesthesia techniques, intraoperative events, and postoperative monitoring enhances understanding and facilitates knowledge dissemination among healthcare providers.

However, this study is limited by its retrospective nature and the absence of comparative data with alternative anesthesia approaches. Future research could benefit from prospective studies that systematically evaluate different anesthesia strategies, their efficacy, and long-term outcomes in OSAS patients undergoing various surgical procedures.

Results and Analysis

Patient Characteristics and Preoperative Findings

The patient, a 53-year-old female, presented with symptoms consistent with obstructive sleep apnea syndrome (OSAS), including excessive daytime sleepiness, habitual snoring, disturbed sleep with frequent arousals, and nasal congestion. Clinical examination revealed obesity (BMI 34.4 kg/m^2), micrognathia, a markedly reduced incisive gap (20 mm), and nasal polyposis with septal deviation obstructing nasal breathing. Polysomnography confirmed severe OSAS, characterized by significant sleep fragmentation (total sleep time 314 minutes, sleep efficiency 76%), predominantly stage I and II non-REM sleep (97%), minimal stage III and IV non-REM sleep (1%), and REM sleep (2%). The study recorded 92 apneas/hypopneas per hour, with arterial oxygen desaturation down to 68% during episodes.

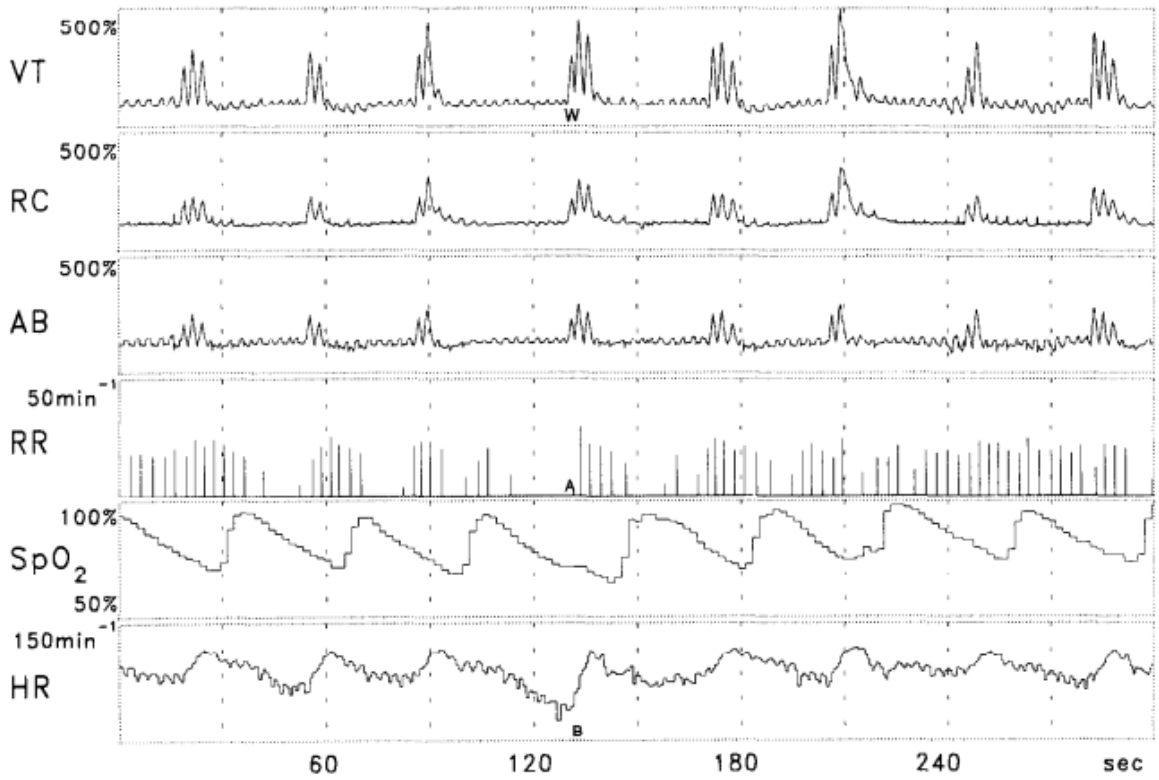

Figure 1 depicts the recording during polysomnography, capturing respiratory signals using ribcage (RC) and abdominal (AB) sensors, alongside heart rate (HR) from ECG and SpO_2.

Anesthesia Management and Intraoperative Course

Preoperative evaluation highlighted the patient's intolerance to upper airway instrumentation, necessitating a decision for general anesthesia over local or topical approaches. Premedication with intravenous metoclopramide and ranitidine aimed to mitigate aspiration risk. Despite initial attempts at fiberoptic-guided transoral intubation with topical pharyngeal anesthesia and sedation (propofol and alfentanil), the patient's extreme anxiety precluded successful intubation, leading to abandonment of this technique. General anesthesia induction with propofol and subsequent placement of a laryngeal mask airway (LMA) #4 facilitated effective ventilation and airway management.

Table 1. Airway Management Strategy

Step	Airway Management	Anesthesia
1	Transoral fiberoptic intubation	Topical, awake
2	Transoral fibcroptic intubation	General
3	Laryngeal mask airway (LMA)	General
4	Fiberoptic guided intubation through the LMA	General anesthesia and relaxation
5	Transtracheal puncture and jet ventilation	General anesthesia and relaxation

Marked anatomical challenges, including the reduced incisive gap and posteriorly displaced tongue base, precluded conventional endotracheal intubation via fiberoptic scope. Therefore, an ETT

was inserted through the LMA under fiberoptic guidance to secure the airway for surgery. Intraoperative monitoring using ECG, noninvasive blood pressure, pulse oximetry, and capnography ensured optimal oxygenation and ventilation throughout the procedure. Muscle relaxation with atracurium facilitated surgical conditions, and meticulous attention to preventing aspiration of blood and secretions was maintained.

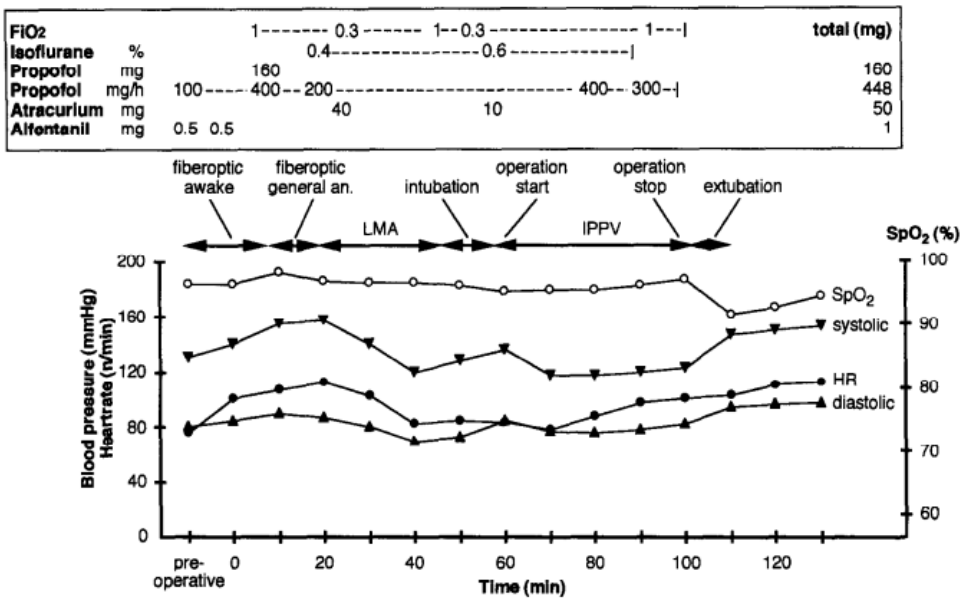

Figure 2. The anesthesia protocol illustrates timing of anesthetic medication, interventions, and course of oxygen saturation, and cardiovascular parameters.

Postoperative Monitoring and Outcome

Following surgery, postoperative monitoring continued with ECG, pulse oximetry, and blood pressure checks, supplemented by frequent visual inspections. The patient received analgesia with diclofenac to manage postoperative pain, with a deliberate avoidance of opioids to minimize respiratory depression. Within the initial three hours postoperatively, the patient exhibited episodes of paradoxical thoracoabdominal motion, loud snoring, decreased respiratory rate, and oxygen desaturation to 88%. Prompt detection by the pulse oximeter alarm at 89% saturation triggered arousal, leading to spontaneous resolution of respiratory obstruction and subsequent improvement in oxygen saturation without requiring intervention.

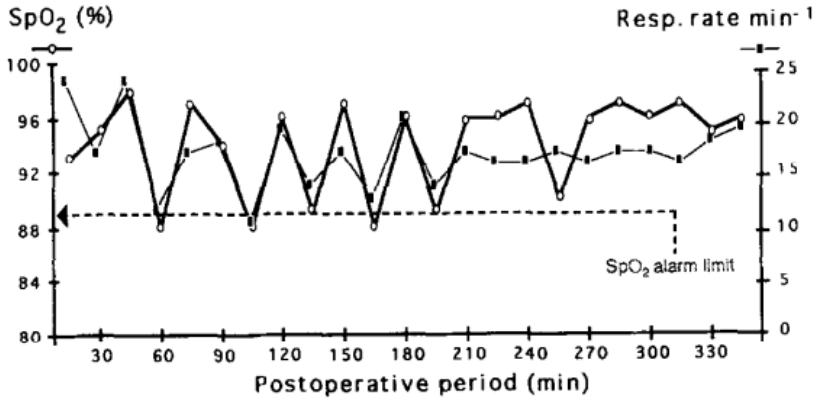

Figure 3. Postoperative monitoring revealed decreases in SpO_2 and in respiratory rate during the early postoperative period. The audible low SpO_2 alarm set at 89% established a closed feedback control on respiration and prevented persistent hypoxia.

Continuous pulse oximetry monitoring over 24 hours postoperatively confirmed stable respiratory function, supporting the decision for uneventful discharge on the fifth day after surgery.

Interpretation

The case underscores several critical aspects of managing OSAS patients undergoing elective nasal surgery under anesthesia. Firstly, the patient's anatomical abnormalities, including micrognathia and nasal obstruction, posed significant challenges to airway management. The initial failure of fiberoptic-guided intubation highlights the importance of individualized anesthesia planning and the need for alternative airway management strategies.

The successful use of a laryngeal mask airway (LMA) in this case exemplifies its utility in securing the airway and facilitating ventilation when conventional methods are impractical. The decision to insert an endotracheal tube through the LMA under fiberoptic guidance ensured optimal positioning and minimized the risk of perioperative complications associated with suboptimal airway control.

Moreover, the patient's postoperative course, characterized by transient episodes of respiratory compromise and oxygen desaturation, underscores the importance of vigilant monitoring in OSAS patients. The prompt response to pulse oximetry alarms and spontaneous resolution of respiratory events without intervention highlight the effectiveness of continuous monitoring in preventing adverse outcomes.

This case report provides valuable insights into the perioperative management of OSAS patients undergoing elective nasal surgery. By delineating the challenges encountered and strategies employed, it emphasizes the importance of tailored anesthesia planning, meticulous intraoperative monitoring, and proactive management of respiratory events in optimizing outcomes for these high-risk patients.

Conclusion

This case study illuminates the intricate challenges and successful strategies in managing obstructive sleep apnea syndrome (OSAS) during elective nasal surgery under anesthesia. The patient's presentation with severe OSAS, compounded by anatomical anomalies such as micrognathia and nasal obstruction, necessitated careful preoperative evaluation and individualized anesthesia planning. Despite initial difficulties with fiberoptic-guided intubation, the adoption of a laryngeal mask airway (LMA) facilitated effective airway management, ensuring patient safety and surgical success.

The perioperative course highlighted the critical role of continuous monitoring and prompt intervention in managing transient respiratory complications postoperatively. The findings underscore the importance of tailored anesthesia techniques and vigilant postoperative care in optimizing outcomes for OSAS patients undergoing surgery. This case reinforces the need for further research and refinement of perioperative protocols to enhance the safety and efficacy of anesthesia management in this complex patient population.

Limitations of the Study

Several limitations merit consideration in interpreting the findings of this case report. Firstly, as a single-case study, the generalizability of findings to broader patient populations may be limited. Each OSAS patient presents a unique set of anatomical and physiological challenges, and individual responses to anesthesia and surgical interventions can vary widely. Therefore, caution is warranted in extrapolating specific management strategies without corroborating evidence from larger cohort studies or randomized controlled trials.

Additionally, the retrospective nature of the study limits the ability to establish causality between anesthesia techniques and patient outcomes. Prospective studies with standardized protocols and comparative analyses of different anesthesia modalities are needed to validate the efficacy and safety of specific interventions in OSAS patients undergoing nasal surgeries.

Implications of the Study

This case study has several implications for clinical practice and healthcare delivery. It underscores the importance of comprehensive preoperative assessment, including detailed evaluation of airway anatomy and function, in OSAS patients scheduled for surgery. Healthcare providers should prioritize individualized anesthesia planning and consider alternative airway management techniques, such as LMAs, in patients with challenging upper airway anatomy.

Furthermore, the study highlights the pivotal role of continuous monitoring and early detection of respiratory events in optimizing perioperative outcomes. Vigilant postoperative care and proactive management of complications, including respiratory distress and desaturation episodes, are essential to mitigating risks and ensuring patient safety in this vulnerable population.

Future Recommendations

To advance knowledge and clinical care for OSAS patients undergoing surgery, several avenues for future research are recommended. Firstly, prospective studies with larger sample sizes are needed to systematically evaluate the efficacy and comparative effectiveness of different anesthesia strategies, including awake fiberoptic intubation versus LMA insertion, in diverse OSAS populations.

Additionally, longitudinal studies assessing long-term outcomes, such as postoperative respiratory function, sleep quality, and cardiovascular health, would provide valuable insights into the lasting

impact of anesthesia techniques on OSAS severity and patient well-being. These studies could inform evidence-based guidelines for perioperative management and contribute to improved clinical outcomes and patient satisfaction.

Furthermore, collaborative efforts between anesthesia specialists, sleep medicine experts, and surgical teams are crucial for developing multidisciplinary protocols tailored to the unique needs of OSAS patients. Integration of technological advances, such as enhanced monitoring systems and simulation-based training for healthcare providers, could further enhance safety and efficacy in anesthesia management for this challenging patient population.

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