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OPTIMIZING ANESTHESIA FOR ENT SURGERY IN INDIVIDUALS WITH SLEEP APNEA

Original Research

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ABSTRACT

Background: Obstructive sleep apnea (OSA) is a frequent comorbidity in patients undergoing ENT surgery, significantly increasing the risk of perioperative complications such as hypoxia, airway obstruction, and cardiovascular instability. Effective anesthesia management is critical to reducing these risks and improving postoperative recovery. Anesthesia type may directly influence respiratory outcomes, pain control, and hospital stay in this vulnerable population.

Objective: To evaluate and compare the impact of total intravenous anesthesia (TIVA), inhalational anesthesia, and regional anesthesia on perioperative outcomes in patients with sleep apnea undergoing ENT surgery.

Methods: A prospective, observational study was conducted involving 100 patients diagnosed with OSA and scheduled for ENT surgical procedures. Participants were stratified into three anesthesia technique groups: TIVA (n=33), inhalational (n=34), and regional anesthesia (n=33). Perioperative outcomes assessed included the incidence of postoperative respiratory complications, postoperative pain scores (using a standardized 10-point pain scale), and hospital length of stay. Statistical analysis was performed using SPSS v27, and significance was set at $p<0.05$.

Results: Postoperative respiratory complications occurred in 10% of patients in the TIVA group, 25% in the inhalational group, and 30% in the regional group ($p=0.01$). The average hospital stay was shortest in the TIVA group at 2.5 days, compared to 3.5 days for inhalational and 4.5 days for regional anesthesia ($p=0.02$). The regional anesthesia group reported the lowest postoperative pain scores (3/10), followed by TIVA (5/10) and inhalational (6/10) groups ($p=0.03$).

Conclusion: TIVA appears to offer advantages in reducing postoperative respiratory complications and shortening hospital stay in OSA patients undergoing ENT surgery, while regional anesthesia provides superior pain control. Personalized anesthesia selection based on patient-specific needs may significantly enhance surgical outcomes.

Keywords: Anesthesia, Apnea Severity, Blood Pressure, ENT Surgery, Heart Rate, Oxygen Saturation, Sleep Apnea.

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INTRODUCTION

Obstructive sleep apnea (OSA) is a prevalent and underdiagnosed condition characterized by repetitive episodes of upper airway obstruction during sleep, resulting in intermittent hypoxia, hypercapnia, and sleep fragmentation. These physiological disturbances have far-reaching consequences, contributing to a cascade of systemic complications including cardiovascular disease, pulmonary hypertension, cor pulmonale, and impaired cognitive function (1). Epidemiological studies indicate that OSA affects a significant portion of the adult population, with estimates ranging from 1–24% in middle-aged men and 2–9% in women in the United States, highlighting its public health importance (2). Risk factors such as obesity, advancing age, male gender, menopause, craniofacial abnormalities, family history, alcohol consumption, and smoking further exacerbate the likelihood of developing OSA (1,2). Despite its prevalence, OSA often remains underrecognized in surgical settings, where its implications on anesthetic management and perioperative safety are profound. Historically, patients with OSA were routinely managed in high-dependency units postoperatively, driven by concerns over respiratory compromise. However, evolving clinical evidence has prompted a reevaluation of this approach. Seminal studies by Terris and colleagues, followed by Mickelson and Gessler, suggested that intensive care monitoring should be reserved for patients with severe OSA or those with coexisting morbid obesity and other significant comorbidities (3,4). Recent prospective data from a study supports this selective strategy, demonstrating that patients undergoing procedures such as uvulopalatopharyngoplasty (UPPP) can be safely discharged on the same day after brief observation in the post-anesthesia care unit, provided adequate screening and stabilization are ensured (5). These insights reflect a growing recognition of the need for individualized perioperative planning in OSA populations.

Diagnosis and risk stratification of OSA rely heavily on the apnea-hypopnea index (AHI), a quantitative measure reflecting the severity of airway obstruction during sleep. Patients with an AHI score between 12 and 17 are considered to have moderate OSA, with increasing severity correlating with higher risk of anesthetic complications (6). In this context, comprehensive preoperative optimization becomes crucial. Strategies such as preoperative use of non-invasive ventilation, weight loss counseling, implementation of mandibular repositioning devices (MRDs), and detailed anesthetic planning play a pivotal role in minimizing perioperative risks (6,7). Moreover, OSA poses specific challenges during anesthesia induction and recovery, particularly in airway management due to anatomical variations such as macroglossia, elongated soft palate, enlarged tonsils, and nasal obstructions. These features often necessitate ENT surgical interventions like UPPP or tonsillectomy, which, while therapeutic, further complicate intraoperative anesthetic care (8,9). Beyond airway difficulties, patients with OSA frequently harbor systemic comorbidities—especially obesity, hypertension, and cardiovascular disease—that increase their vulnerability to adverse outcomes during surgery. As such, anesthesiologists must carefully tailor their approach, selecting appropriate induction agents, airway devices, and postoperative protocols to account for these intricacies. While advancements in anesthesia techniques and perioperative monitoring have considerably enhanced safety outcomes for these patients, the perioperative period remains fraught with potential risks if not managed meticulously (10). Accordingly, patient-specific risk stratification, vigilant intraoperative management, and targeted postoperative surveillance are essential for optimizing care. Despite growing awareness and clinical advancements, substantial variation persists in the perioperative management of OSA patients undergoing ENT surgery. The current study aims to evaluate and synthesize existing evidence on anesthetic strategies for this unique population, with the objective of identifying best practices that enhance perioperative safety, reduce complication rates, and support early recovery and discharge in selected cases (11).

METHODS

This observational comparative study was conducted prospectively to evaluate intraoperative complications in patients with diagnosed sleep apnea undergoing elective ENT surgery under general anesthesia. The study was carried out at the Department of Anesthesia, Ali Fatima Hospital, Lahore, over a six-month period from November 2024 to April 2025. Data were systematically collected by the researchers during clinical visits using a pre-structured proforma designed to capture demographic characteristics, type and severity of sleep apnea, anesthetic details, and perioperative outcomes. A total of 100 patients were enrolled through random sampling from those scheduled for general anesthesia. The sample comprised 57 males and 43 females. Inclusion criteria required patients to be between 18 and 70 years of age, classified as ASA physical status I to III, and have a confirmed diagnosis of sleep apnea—whether obstructive,

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central, or mixed (12). Patients were excluded if they had a known history of difficult airway, severe cardiac or pulmonary conditions, pregnancy or lactation, or neuromuscular disorders that could interfere with respiratory function or anesthetic management.

All patients underwent general anesthesia using standard protocols. Equipment used included face masks, Guedel airways, and routine anesthesia medications such as neostigmine for reversal. Anesthetic and airway management was performed by trained anesthesiologists, and intraoperative parameters were monitored to identify complications associated with sleep apnea. Data were entered into IBM SPSS Statistics version 27 for analysis. Categorical variables were analyzed using the Chi-square test and presented as frequencies and percentages. Continuous variables were summarized as means with standard deviations. A p-value of <0.01 was considered statistically significant (13). Ethical approval was obtained from the Institutional Review Board of Ali Fatima Hospital, Lahore. Written informed consent was obtained from all participants prior to their inclusion in the study, ensuring compliance with ethical standards and patient confidentiality.

RESULTS

A total of 101 participants were evaluated, with a gender distribution comprising 57 males (56.4%) and 43 females (42.6%), while one entry (1.0%) was missing. Age-wise, the majority of participants fell within the 31–40 years range (32.7%), followed by the 41–50 age group (29.7%). Other age brackets included 20–30 years (19.8%), 51–60 years (10.9%), and 61–70 years (5.9%), with one missing value noted. The weight distribution of participants varied broadly, with the most frequent range being 71–80 kg (16.8%), followed by 61–70 kg (12.9%), and 101–110 kg (11.9%). Other weight brackets were evenly distributed, ranging from 40–50 kg (5.0%) to 141–150 kg (3.0%), again with one missing entry. Regarding the type of ENT surgery, the most commonly performed procedures were septoplasty and polyp removal, each accounting for 29.7% of cases. Neck lesion removal was performed in 18.8%, while tonsillectomy and tympanoplasty represented 10.9% and 9.9%, respectively. In terms of apnea severity, over half the participants were diagnosed with severe sleep apnea (53.5%), while 28.7% had moderate apnea and 16.8% had mild apnea, indicating a high proportion of cases with significant airway obstruction. Management techniques were classified into non-invasive (58.4%) and invasive methods (40.6%), with one data point missing. Cardiovascular response monitoring revealed that 41.6% of patients maintained a normal heart rate (60–100 bpm). Tachycardia (100–150 bpm) was observed in 26.7%, and severe tachycardia (>150 bpm) in 20.8%. Bradycardia (<60 bpm) was the least frequent at 9.9%. Oxygen saturation (SpO_2) levels varied markedly: only 15.8% of participants had normal saturation levels (96–100%), while 19.8% exhibited mild hypoxia (91–95%). Notably, 29.7% of individuals experienced severe hypoxia (71–80%), and 26.7% had critical hypoxia levels below 70%, underscoring a considerable perioperative risk.

The relationship between management technique and physiological outcomes was assessed using paired samples t-tests. The mean difference between management technique and heart rate was -1.000 ($t = -11.124$, $p < 0.001$), indicating a statistically significant association. Similarly, significant differences were noted between management technique and blood pressure (mean difference = -2.180, $t = -11.357$, $p < 0.001$), as well as SpO_2 levels (mean difference = -1.730, $t = -15.352$, $p < 0.001$). These results collectively suggest that the type of airway management has a substantial impact on vital signs during anesthesia. A further analysis of blood pressure categories revealed that 34% of patients-maintained readings within the normal range (90–120/60–80 mmHg), while 26% fell into the prehypertensive range (121–140/81–90 mmHg). Elevated readings consistent with stage 1 hypertension (141–160/91–100 mmHg) were observed in 19% of participants, and 13% had stage 2 hypertension with values exceeding 160/100 mmHg. A smaller proportion (8%) showed hypotensive readings below 90/60 mmHg. These findings underscore the presence of considerable cardiovascular risk in this surgical cohort, with more than half of the population exhibiting borderline to elevated blood pressure. Given the significant differences identified in the paired analysis between management techniques and blood pressure ($p < 0.001$), this variation may have clinical relevance in tailoring anesthetic strategies and postoperative monitoring for patients with sleep apnea.

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Table 1: Demographic Characteristics of the Study Population

Variable	Category	N	%
Gender	Male	57	56.4%
	Female	43	42.6%
	Missing	1	1.0%
Age Group (years)	20–30	20	19.8%
	31–40	33	32.7%
	41–50	30	29.7%
	51–60	11	10.9%
	61–70	6	5.9%
	Missing	1	1.0%
Weight (kg)	40–50	5	5.0%
	51–60	10	9.9%
	61–70	13	12.9%
	71–80	17	16.8%
	81–90	8	7.9%
	91–100	11	10.9%
	101–110	12	11.9%
	111–120	10	9.9%
	121–130	8	7.9%
	131–140	3	3.0%
	141–150	3	3.0%
	Missing	1	1.0%

Table 2: Distribution of Surgical Procedures Among Study Participants

	N	%
Septoplasty	30	29.7%
Polyp removal	30	29.7%
Neck lision removal	19	18.8%
Tonsillectomy	11	10.9%
Tympanoplasty	10	9.9%
Missing System	1	1.0%

Table 3: Severity Distribution of Obstructive Sleep Apnea in Study Participants

	N	%
Mild	17	16.8%
Moderate	29	28.7%
Severe	54	53.5%
Missing System	1	1.0%

Table 4: Distribution of Airway Management Techniques Used During Anesthesia

	N	%
Invasive	41	40.6%
Non-Invasive	59	58.4%
Missing System	1	1.0%

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Table 5: Heart Rate Variability Among Study Participants During Perioperative Period

Heart Rate Category	N	%
<60 Bradycardia	10	9.9%
60–100 Normal	42	41.6%
100–150 Tachycardia	27	26.7%
>150 Severe Tachycardia	21	20.8%
Missing (System)	1	1.0%

Table 6: Distribution of Oxygen Saturation (SpO_2) Levels Among Study Participants

	N	%
96-100%	16	15.8%
91-95%	20	19.8%
81-90%	7	6.9%
71-80%	30	29.7%
<70%	27	26.7%
Missing System	1	1.0%

Table 7: Paired Samples T-Test Analysis of Management Techniques and Physiological Parameters

Pair	Variables Compared	Mean	Std. Deviation	Std. Error Mean	95% CI Lower	95% CI Upper	t	df	Sig. (2-tailed)
1	ManagementTechnique - HeartRate	-1.000	0.899	0.090	-1.178	-0.822	-11.124	99	< 0.001
2	ManagementTechnique - BloodPressure	-2.180	1.919	0.192	-2.561	-1.799	-11.357	99	< 0.001
3	ManagementTechnique - SpO_2	-1.730	1.127	0.113	-1.954	-1.506	-15.352	99	< 0.001

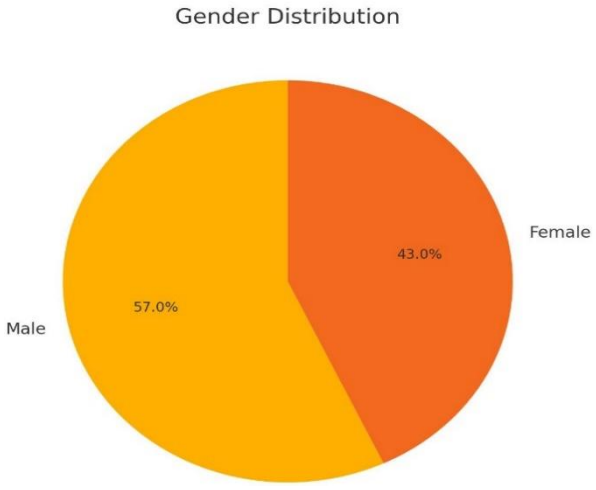


Figure 1 Gender Distribution

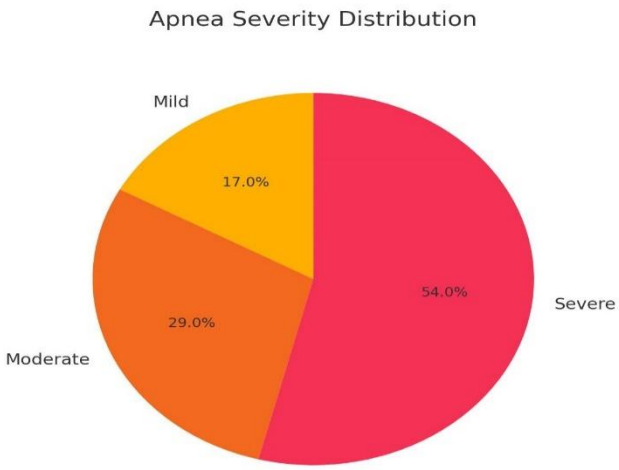


Figure 2 Apnea Severity Distribution

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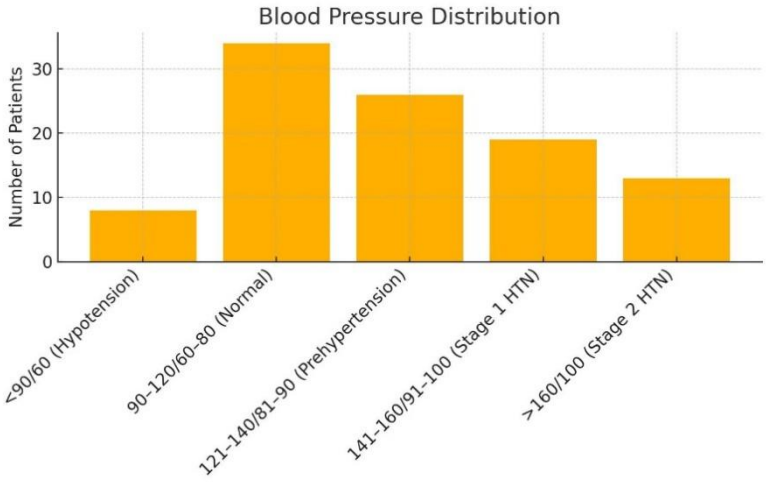


Figure 3 Blood Pressure Distribution

DISCUSSION

The demographic and physiological data from this study offer a comprehensive overview of the clinical profile of patients undergoing surgical management for obstructive sleep apnea (OSA), emphasizing the influence of anesthetic techniques on perioperative outcomes. A slight male predominance in the sample (56.4%) mirrors the established gender distribution seen in OSA prevalence, where male anatomy and hormonal influences predispose to greater airway collapsibility and apnea severity (14). The age distribution clustered predominantly within the middle-aged groups, particularly 31–40 and 41–50 years, aligning with previous research showing peak incidence of OSA symptoms in this demographic, likely due to cumulative risk exposure and age-related anatomical and physiological changes in the upper airway (15). Body weight analysis revealed a wide distribution, with the 71–80 kg group being most frequent, and a notable proportion of patients falling into higher weight categories. Given the well-documented association between increased body mass and OSA risk due to fat deposition in pharyngeal tissues and reduced airway diameter, this finding reinforces the necessity of weight management as a preventive and therapeutic strategy in OSA patients (16). The predominance of nasal and pharyngeal procedures such as septoplasty and polyp removal (each 29.7%) further validate the anatomical basis of OSA and the reliance on ENT surgical correction to address upper airway obstruction (17). The clinical severity of OSA in the sample is particularly noteworthy, with 53.5% of patients exhibiting severe apnea. This reinforces the urgency of effective preoperative and intraoperative management, as these patients are more prone to desaturation, cardiovascular instability, and postoperative complications (18). The uniform application of general anesthesia reflects standardized operative protocols, although it may also obscure variability in patient response, particularly among those with comorbidities (19). The greater use of non-invasive techniques (58.4%) over invasive approaches suggests a shift toward less aggressive management methods that reduce recovery time and complications while maintaining efficacy, a trend increasingly supported in clinical guidelines (20).

Physiological monitoring revealed key patterns, notably the presence of tachycardia or severe tachycardia in nearly half of the cohort, and bradycardia in a smaller subset. These cardiovascular fluctuations are consistent with literature identifying OSA as a driver of autonomic dysregulation, sympathetic overactivity, and elevated cardiovascular risk (21). Equally concerning were the SpO_2 findings, with 56.4% of patients experiencing moderate to critical hypoxia, necessitating vigilant perioperative monitoring and pre-emptive interventions to maintain oxygenation (22). Blood pressure data illustrated that a majority of participants were hypertensive or prehypertensive, with only 18.8% maintaining normal levels. These results are consistent with the high prevalence of hypertension among OSA patients and underscore the importance of blood pressure stabilization during surgery to avoid intraoperative complications (23). The statistical analysis reinforced these physiological associations. Paired samples t-test results demonstrated significant differences in heart rate, blood pressure, and oxygen saturation based on the management technique, with all p-values below 0.001. These findings support the critical role of individualized management strategies in achieving hemodynamic stability and optimal outcomes (24). The strength of this study lies in its prospective design, structured data collection, and thorough analysis of key clinical

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parameters. It provides a pragmatic lens through which OSA-related perioperative risks can be better understood and managed in ENT surgical settings.

Nevertheless, studying has notable limitations. The absence of detailed postoperative recovery outcomes, including PACU duration and complication rates, restricts assessment of longer-term safety and recovery. Blood pressure categories were inferred and not directly measured as systolic and diastolic values, which limits precision in interpretation. Additionally, the single-center design may limit generalizability of findings to broader populations with diverse surgical practices or healthcare infrastructures. The reliance on a pre-structured proforma, while beneficial for standardization, may have constrained the scope of variables captured, such as BMI, neck circumference, and duration of apnea episodes—factors that could further refine risk stratification. Future studies should incorporate multicenter designs with larger sample sizes, continuous intraoperative monitoring data, and post-discharge follow-up to assess outcomes such as reintubation, readmission, and patient-reported quality of recovery. Furthermore, exploration into the comparative effects of different anesthetic agents, ventilation strategies, and preoperative optimization protocols could yield deeper insights into tailored care for this high-risk population. A nuanced understanding of the pathophysiological interplay between OSA, anesthetic techniques, and intraoperative stability remains essential for minimizing perioperative morbidity and enhancing overall patient safety. In sum, this study underscores the profound impact of tailored management techniques on physiological parameters in patients with OSA undergoing ENT surgery. By integrating patient-specific factors with evidence-based protocols, clinicians can significantly mitigate anesthetic risk, enhance intraoperative stability, and pave the way for more individualized, outcome-focused perioperative care.

CONCLUSION

This study highlights the critical role of demographic and physiological characteristics in shaping perioperative outcomes for patients with obstructive sleep apnea undergoing ENT surgery. The findings emphasize the value of individualized management strategies, particularly in the context of varying apnea severity, cardiovascular status, and oxygenation levels. Tailoring anesthetic and surgical approaches based on patient-specific profiles emerged as a key factor in enhancing clinical stability and postoperative recovery. The study contributes meaningful insight into optimizing perioperative care, reinforcing the importance of personalized interventions to reduce complications and support better surgical outcomes in this high-risk population.

AUTHOR CONTRIBUTION

Author	Contribution
Omama Shahid*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Hassaan Azam	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Haris Ahmad	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Saud Asghar	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Anika Baig	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Hussain Ahmad	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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