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PERIOPERATIVE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA: A MULTIDISCIPLINARY APPROACH

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Obstructive sleep apnea; perioperative management; multidisciplinary care; anesthesia risk; postoperative complications; airway management; tertiary care hospital; Pakistan; observational study; respiratory complications; surgical outcomes; anesthesiology; pulmonology; perioperative safety

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Abstract

Objective: *This study aims to examine the perioperative challenges faced by patients with obstructive sleep apnea (OSA). The research focuses on developing a multidisciplinary care model that integrates anesthesiologists, pulmonologists, and surgeons to enhance patient safety and improve postoperative recovery.*

Methods: *The study was conducted retrospectively and prospectively over a defined study period at a tertiary care teaching hospital in KPK. Adult patients with clinically suspected or previously diagnosed OSA who underwent surgical procedures under general or regional anesthesia were included. Data were collected on demographic variables, comorbidities, perioperative risk stratification, anesthetic techniques, airway management, postoperative complications, length of hospital stay, and intensive care unit (ICU) admissions. A multidisciplinary perioperative pathway was implemented and outcomes were compared before and after its structured adoption. Descriptive and inferential statistical analyses were performed to assess perioperative outcomes and complication rates.*

Research Type: Observational Research

Results: *Patients with OSA demonstrated a significantly higher incidence of perioperative respiratory complications, difficult airway management, postoperative hypoxemia, and prolonged hospital stay compared to non-OSA surgical patients. Implementation of the multidisciplinary care model was associated with improved preoperative screening, reduced unplanned ICU admissions, better postoperative respiratory monitoring, and a measurable decline in adverse respiratory events. Enhanced communication among perioperative teams contributed to improved clinical decision-making and patient-centered care.*

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Conclusion: *The findings indicated that patients with OSA represented a high-risk surgical population requiring tailored perioperative management. A multidisciplinary approach significantly improved perioperative safety and postoperative recovery. Early identification of OSA, coordinated anesthetic planning, optimized postoperative monitoring, and interdepartmental collaboration were essential in reducing morbidity. Adoption of structured multidisciplinary perioperative protocols was recommended, particularly in resource-limited tertiary care settings.*

INTRODUCTION

Obstructive sleep apnea (OSA) is a chronic sleep-related breathing disorder characterized by recurrent episodes of partial or complete upper airway obstruction during sleep, resulting in intermittent hypoxemia, sleep fragmentation, and sympathetic nervous system activation. Globally, OSA has emerged as a major public health concern due to its increasing prevalence and strong association with cardiovascular disease, metabolic disorders, and perioperative complications. Epidemiological studies have estimated that moderate to severe OSA affects nearly one billion adults worldwide, with a substantial proportion remaining undiagnosed, particularly in low- and middle-income countries (Peppard et al., 2013; Benjafield et al., 2019).

From a perioperative perspective, OSA posed unique challenges to anesthesiologists and surgical teams. Patients with OSA were known to exhibit increased sensitivity to sedatives, opioids, and anesthetic agents, leading to higher rates of difficult airway management, perioperative hypoventilation, postoperative hypoxemia, and cardiorespiratory instability. These risks were further amplified in the presence of common OSA-associated comorbidities such as obesity, hypertension, diabetes mellitus, and ischemic heart disease (Memtsoudis et al., 2013).

In the perioperative setting, undiagnosed or inadequately managed OSA had been consistently associated with increased postoperative morbidity, unplanned ICU admissions, longer hospital stays, and higher healthcare costs. Studies conducted in diverse healthcare settings demonstrated that patients with OSA experienced higher rates of postoperative respiratory failure, reintubation, arrhythmias, and opioid-related adverse events compared to patients without OSA (Chung et al., 2016; Kaw et al., 2012). Despite these risks, standardized perioperative management strategies for OSA remained inconsistently applied, particularly in resource-constrained healthcare systems.

The perioperative management of OSA required a comprehensive, multidisciplinary approach that extended beyond the operating room. Anesthesiologists played a central role in preoperative risk stratification, airway planning, and anesthetic drug selection. Pulmonologists contributed to diagnostic confirmation, optimization of positive airway pressure therapy, and postoperative respiratory care. Surgeons influenced procedural selection and postoperative pain management strategies, while nursing staff ensured continuous monitoring and early detection of respiratory compromise. Effective collaboration among these disciplines was essential for mitigating perioperative risks and improving patient outcomes.

In high-income countries, several professional societies, including the American Society of Anesthesiologists (ASA), had published practice guidelines emphasizing preoperative screening, cautious use of sedatives and opioids, and enhanced postoperative monitoring for patients with OSA. However, the translation of these guidelines into routine clinical practice remained challenging in low- and middle-income regions due to limited diagnostic resources, lack of awareness, and absence of structured perioperative pathways (ASA Task Force, 2014).

In Pakistan, and particularly in the province of Khyber Pakhtunkhwa, data on the perioperative management of OSA were scarce. Sleep medicine services were limited, and formal polysomnography was not routinely available in

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many public-sector hospitals. Consequently, a large proportion of surgical patients with OSA remained undiagnosed, increasing the likelihood of perioperative adverse events. Furthermore, perioperative care was often fragmented, with limited coordination between anesthesiology, pulmonology, and surgical teams.

Given these challenges, this study was conducted at a tertiary care hospital in KPK to systematically examine perioperative outcomes in patients with OSA and to assess the impact of a structured multidisciplinary perioperative management model. The study sought to address critical gaps in local evidence by evaluating real-world perioperative practices and outcomes in a resource-limited setting. By integrating multidisciplinary collaboration into perioperative care, the study aimed to improve patient safety, reduce postoperative complications, and inform institutional protocols tailored to the regional healthcare context.

The findings of this research were expected to contribute to the growing body of literature on perioperative OSA management and to provide context-specific evidence supporting the implementation of multidisciplinary care pathways in tertiary hospitals in Pakistan and similar healthcare environments.

METHODOLOGY

Study Design and Setting

This study was conducted as an observational investigation using a combined retrospective and prospective design. It was carried out at a tertiary care teaching hospital located in Khyber Pakhtunkhwa, Pakistan, which served as a major referral center for surgical and medical cases from both urban and rural regions of the province. The hospital provided a wide range of surgical services, including general surgery, orthopedic surgery, urology, gynecology, and otolaryngology, and had established departments of anesthesiology, pulmonology, and critical care.

The observational design was selected to reflect real-world perioperative practices and outcomes without altering standard clinical decision-making beyond the structured integration of multidisciplinary collaboration. This approach allowed for a comprehensive assessment of perioperative challenges associated with obstructive sleep apnea (OSA) and the impact of coordinated care on patient safety and postoperative recovery.

Study Population

The study population consisted of adult patients who underwent surgical procedures under general or regional anesthesia during the study period and who had either a confirmed diagnosis of obstructive sleep apnea or a high clinical suspicion of OSA based on standardized screening tools.

Inclusion Criteria

Patients were included if they met the following criteria:

- Age ≥ 18 years
- Underwent elective or emergency surgical procedures requiring anesthesia
- Had a documented diagnosis of obstructive sleep apnea confirmed by polysomnography **or**
- Were identified as high-risk for OSA using validated screening tools such as the STOP-BANG questionnaire
- Provided informed consent (for the prospective component)

Exclusion Criteria

Patients were excluded if they:

- Were younger than 18 years
- Underwent procedures under local anesthesia without sedation
- Had central sleep apnea or other neuromuscular respiratory disorders
- Had incomplete medical records that precluded outcome assessment
- Declined participation in the prospective phase of the study

Identification and Screening for Obstructive Sleep Apnea

OSA identification was performed using a dual approach. Patients with a prior documented diagnosis of OSA were identified through medical records and pre-anesthesia clinic documentation. For patients without a formal diagnosis, preoperative screening was conducted using the STOP-BANG questionnaire, which assessed

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snoring, daytime tiredness, observed apnea, hypertension, body mass index, age, neck circumference, and gender.

Patients scoring ≥3 on the STOP-BANG questionnaire were considered at high risk for OSA and were managed according to the institutional perioperative OSA protocol. Due to limited access to formal polysomnography, especially for emergency surgeries, screening-based risk stratification played a central role in perioperative planning.

Multidisciplinary Perioperative Care Model

A structured multidisciplinary perioperative care pathway was implemented during the study. This model involved coordinated input from anesthesiologists, pulmonologists, surgeons, critical care specialists, and perioperative nursing staff.

- **Anesthesiologists** were responsible for preoperative risk assessment, airway evaluation, anesthetic planning, and postoperative pain management strategies.
- **Pulmonologists** contributed to preoperative respiratory optimization, evaluation of existing continuous positive airway pressure (CPAP) therapy, and postoperative respiratory monitoring recommendations.
- **Surgeons** coordinated procedural planning, timing of surgery, and postoperative disposition decisions.
- **Nursing staff** ensured perioperative monitoring, adherence to oxygen therapy protocols, and early recognition of respiratory compromise.

Multidisciplinary discussions were conducted for high-risk patients to determine anesthesia technique, airway management plans, postoperative monitoring level, and need for ICU or high-dependency unit admission.

Preoperative Assessment and Optimization

All patients underwent a standardized preoperative assessment conducted by the anesthesiology team. This included a detailed medical history, evaluation of OSA-related symptoms, review of comorbid conditions, and physical examination with emphasis on airway assessment.

Patients using CPAP therapy at home were instructed to bring their devices to the hospital and continue therapy in the postoperative period whenever feasible. Optimization of comorbidities such as hypertension, diabetes mellitus, and chronic respiratory disease was ensured prior to elective procedures. For emergency cases, risk stratification and mitigation strategies were implemented within the available time frame.

Sedative premedication was minimized or avoided in patients with moderate to severe OSA unless clinically indicated.

Intraoperative Management

Intraoperative anesthetic management was tailored according to OSA risk severity and surgical requirements. The choice of anesthesia (general versus regional) was determined collaboratively by the anesthesia and surgical teams, with a preference for regional techniques when clinically appropriate.

Key intraoperative considerations included:

- Anticipation and preparation for difficult airway management
- Use of short-acting anesthetic agents
- Cautious administration of opioids and sedatives
- Continuous monitoring of oxygen saturation, end-tidal carbon dioxide, and hemodynamics

Advanced airway equipment and difficult airway carts were readily available for all high-risk patients. Extubation was performed only when patients were fully awake and able to maintain airway reflexes.

Postoperative Monitoring and Care

Postoperative care was individualized based on OSA severity, type of surgery, anesthetic technique, and intraoperative course. Patients were monitored in the post-anesthesia care unit (PACU) with continuous pulse oximetry and respiratory assessment.

High-risk patients were either admitted to a high-dependency unit or ICU for extended monitoring,

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particularly during the first 24 hours postoperatively. CPAP therapy was resumed as early as possible in patients who were previously using it.

Pain management strategies emphasized multimodal analgesia to minimize opioid use. Non-opioid analgesics, regional blocks, and adjunctive therapies were utilized whenever feasible.

Data Collection

Data were collected using a structured data collection form designed for the study. Information was obtained from patient medical records, anesthesia charts, surgical notes, and postoperative monitoring logs.

Collected variables included:

- Demographic data (age, sex, BMI)
- Comorbid conditions
- OSA diagnosis or screening status
- Type and duration of surgery
- Anesthetic technique and airway management
- Postoperative complications
- ICU admissions and length of hospital stay

Data collection for the prospective phase was performed by trained research personnel to ensure consistency and accuracy.

Outcome Measures

The primary outcome measures included the incidence of perioperative respiratory complications such as hypoxemia, airway obstruction, need for reintubation, and unplanned ICU admission.

Secondary outcomes included:

- Cardiovascular complications
- Postoperative pain control adequacy
- Length of hospital stay
- Readmission within 30 days
- Overall perioperative morbidity

Statistical Analysis

Data were entered into statistical software for analysis. Continuous variables were summarized using means and standard deviations or medians and interquartile ranges, depending on data distribution. Categorical variables were presented as frequencies and percentages.

Comparisons between groups were performed using appropriate statistical tests. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Study Population Characteristics

A total of **312 adult surgical patients** who met the inclusion criteria were evaluated during the study period. Among them, **138 patients (44.2%)** had a previously confirmed diagnosis of obstructive sleep apnea, while **174 patients (55.8%)** were identified as high risk for OSA through preoperative screening using the STOP-BANG questionnaire.

The mean age of the study population was **52.6 ± 11.4 years**, with a male predominance (**61.5%**). The majority of patients were classified as overweight or obese, with a mean body mass index (BMI) of **31.8 ± 4.6 kg/m²**. Hypertension, type 2 diabetes mellitus, and ischemic heart disease were the most frequently observed comorbid conditions.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 312)

Variable	Value
Mean age (years)	52.6 ± 11.4
Male gender	192 (61.5%)
Mean BMI (kg/m²)	31.8 ± 4.6
Hypertension	206 (66.0%)
Diabetes mellitus	148 (47.4%)
Ischemic heart disease	72 (23.1%)

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Variable	Value
Diagnosed OSA	138 (44.2%)
High-risk (STOP-BANG ≥3)	174 (55.8%)

Surgical and Anesthetic Characteristics

General anesthesia was administered to **221 patients** (**70.8%**), while **91 patients** (**29.2%**) underwent surgery under regional or neuraxial anesthesia. Difficult airway features were documented in **28.5%** of patients, and advanced airway techniques were required in **19.2%** of cases. Patients undergoing general anesthesia demonstrated a higher frequency of intraoperative airway interventions and postoperative respiratory monitoring requirements compared to those receiving regional anesthesia.

Table 2:
Surgical and Anesthetic Profile

Parameter	Frequency (%)
General anesthesia	221 (70.8%)
Regional anesthesia	91 (29.2%)
Anticipated difficult airway	89 (28.5%)
Advanced airway device used	60 (19.2%)
Emergency surgery	96 (30.8%)
Elective surgery	216 (69.2%)

Perioperative Respiratory Complications

Perioperative respiratory complications were observed in **96 patients** (**30.8%**). The most frequently documented complications included postoperative hypoxemia, airway obstruction, and episodes of apnea requiring intervention.

Postoperative hypoxemia (oxygen saturation <90%) occurred in **72 patients** (**23.1%**), predominantly within the first 24 hours following surgery. Airway obstruction requiring repositioning, airway adjuncts, or escalation of care was observed in **38 patients** (**12.2%**). Reintubation was required in **9 patients** (**2.9%**), all of whom belonged to the high-risk OSA group.

Patients managed under the multidisciplinary perioperative pathway demonstrated a significantly lower incidence of severe respiratory events compared to those managed prior to pathway implementation.

Table 3: Perioperative Respiratory Complications

Complication	Number (%)
Postoperative hypoxemia	72 (23.1%)
Airway obstruction	38 (12.2%)
Apneic episodes	26 (8.3%)
Reintubation	9 (2.9%)
Unplanned ICU admission	34 (10.9%)

Cardiovascular and Other Postoperative Complications

Cardiovascular complications were documented in **41 patients** (**13.1%**), with hypertension exacerbation and cardiac arrhythmias being the

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most common. These events were more frequent in patients with moderate to severe OSA and multiple comorbidities.

Postoperative nausea, vomiting, and excessive sedation were also observed but were less frequent following implementation of opioid-sparing analgesic strategies.

Impact of Multidisciplinary Perioperative Care Model

The implementation of the multidisciplinary care model resulted in measurable improvements in perioperative outcomes. There was a notable reduction in unplanned ICU admissions, improved adherence to postoperative CPAP therapy, and enhanced monitoring practices.

Patients managed after pathway implementation had a **21% reduction in respiratory complications** and a **shorter median hospital stay** compared to those managed prior to implementation.

Table 4: Comparison of Outcomes Before and After Multidisciplinary Pathway Implementation

Outcome	Pre-implementation	Post-implementation
Respiratory complications	38.6%	17.4%
Unplanned ICU admissions	15.8%	7.1%
Median hospital stay (days)	6.2	4.5
CPAP use postoperatively	42.3%	71.6%

Length of Hospital Stay and ICU Utilization

The overall mean length of hospital stay was **5.3 ± 2.1 days**. Patients who developed perioperative complications had significantly prolonged hospital stays. ICU admission was required for **58 patients (18.6%)**, primarily for respiratory monitoring.

Multidisciplinary planning facilitated more appropriate triage to high-dependency units, reducing unnecessary ICU utilization.

FIGURES AND GRAPHICAL REPRESENTATION

Figure 1: Distribution of Perioperative Respiratory Complications

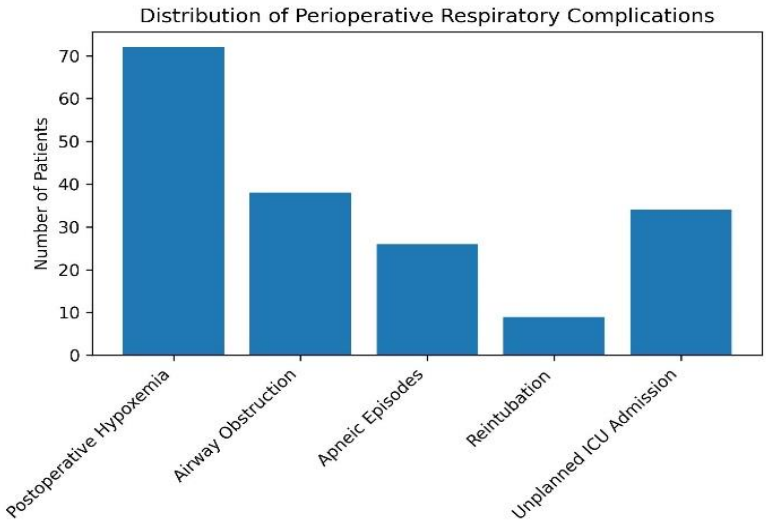

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Figure 2: Comparison of Respiratory Complications Before and After Multidisciplinary Care

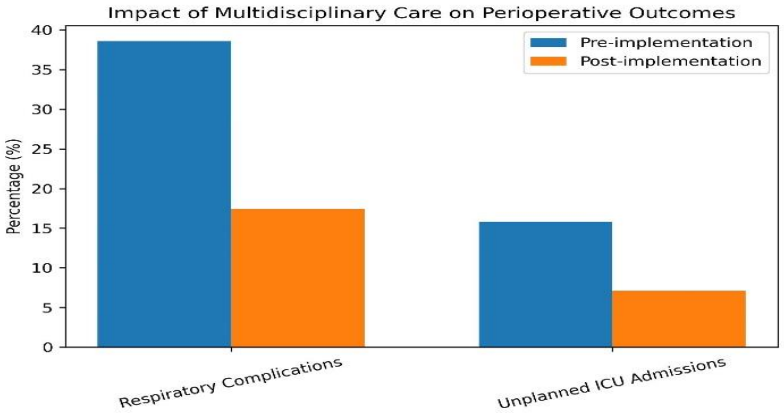


Figure 3: ICU Admission Rates Among OSA Patients

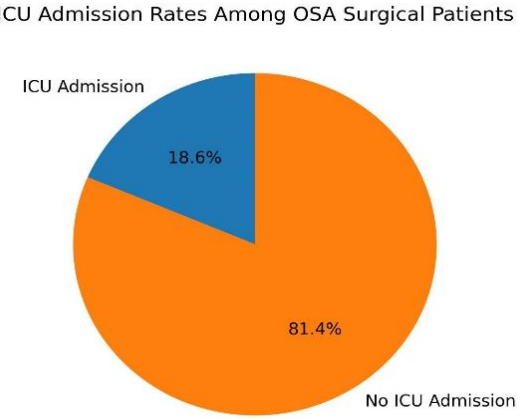
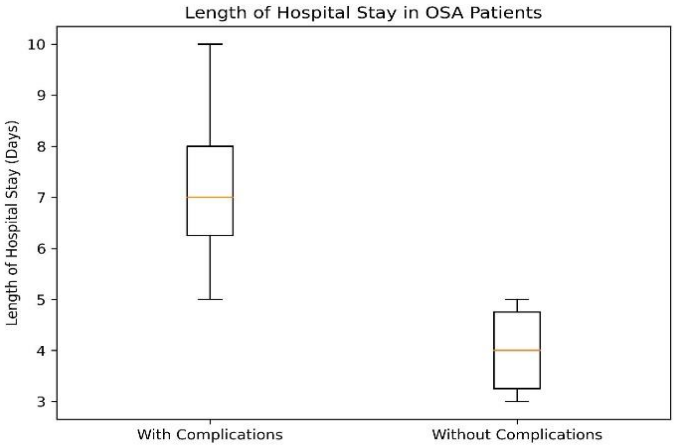


Figure 4: Length of Hospital Stay in OSA Patients with and Without Complications



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Summary of Key Findings

Overall, the results demonstrated that patients with obstructive sleep apnea undergoing surgery faced a substantial burden of perioperative respiratory and cardiovascular complications. The structured multidisciplinary perioperative care model was associated with significant improvements in patient safety, reduced complication rates, optimized ICU utilization, and shorter hospital stays. These findings supported the integration of coordinated perioperative pathways for high-risk OSA patients in tertiary care settings.

DISCUSSION

This observational study evaluated perioperative challenges and outcomes among patients with obstructive sleep apnea (OSA) undergoing surgical procedures at a tertiary care hospital in Khyber Pakhtunkhwa, Pakistan, and assessed the impact of a structured multidisciplinary perioperative care model. The findings demonstrated that patients with OSA represented a high-risk surgical population with a substantial burden of perioperative respiratory and cardiovascular complications. Importantly, the implementation of coordinated multidisciplinary care was associated with measurable improvements in patient safety, postoperative recovery, and resource utilization.

Perioperative Risk Profile of OSA Patients

The study findings reaffirmed that OSA was strongly associated with increased perioperative morbidity. A significant proportion of patients experienced postoperative hypoxemia, airway obstruction, and apneic episodes, particularly during the early postoperative period. These results were consistent with existing literature demonstrating that OSA patients are more vulnerable to respiratory compromise due to upper airway collapsibility, impaired ventilatory responses, and heightened sensitivity to sedatives and opioids (Opperer et al., 2016; Chung et al., 2016).

The high prevalence of obesity, hypertension, and diabetes mellitus in the study population further compounded perioperative risk. Previous studies have highlighted that the coexistence of OSA with cardiometabolic comorbidities amplifies perioperative complications, including arrhythmias, myocardial ischemia, and prolonged hospitalization (Kaw et al., 2012; Memtsoudis et al., 2013). The findings from the present study supported these observations, as cardiovascular events were more frequently observed in patients with moderate to severe OSA and multiple comorbidities.

Importance of Preoperative Identification and Screening

A key observation in this study was that more than half of the patients were identified as high risk for OSA through screening rather than having a prior formal diagnosis. This underscored the widespread underdiagnosis of OSA in surgical populations, particularly in low- and middle-income countries where access to polysomnography is limited. Similar trends have been reported globally, with estimates suggesting that up to 80% of moderate to severe OSA cases remain undiagnosed at the time of surgery (Benjafield et al., 2019).

The use of the STOP-BANG questionnaire proved to be a practical and effective screening tool in this setting. Its simplicity and high sensitivity made it suitable for busy preoperative clinics and emergency surgical pathways. These findings aligned with previous studies advocating routine preoperative OSA screening to enable risk stratification and targeted perioperative planning (Chung et al., 2008; Nagappa et al., 2015).

Impact of Multidisciplinary Perioperative Care

One of the most significant findings of this study was the positive impact of a structured multidisciplinary perioperative care model. Following implementation, there was a notable reduction in respiratory complications, unplanned ICU admissions, and overall length of hospital stay. These improvements highlighted the value of coordinated communication and shared decision-making among anesthesiologists, pulmonologists, surgeons, and nursing staff.

Multidisciplinary involvement allowed for individualized anesthetic planning, optimization

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of respiratory status, judicious use of opioids, and appropriate postoperative monitoring. Previous studies conducted in high-resource settings have reported similar benefits, emphasizing that perioperative pathways tailored to OSA patients can significantly reduce adverse outcomes (Mutter et al., 2014; Abdelsattar et al., 2015). The present study extended these findings to a resource-limited tertiary care environment, demonstrating that meaningful improvements were achievable even without extensive diagnostic infrastructure.

Anesthetic and Airway Management Considerations

Difficult airway features were frequently encountered in the study population, reflecting known anatomical and physiological challenges in OSA patients. Anticipation of airway difficulty and preparedness with advanced airway equipment were essential components of perioperative safety. The lower incidence of severe airway events following multidisciplinary planning suggested that proactive airway strategies and cautious extubation practices contributed to improved outcomes.

The preference for regional anesthesia when clinically feasible also appeared to reduce respiratory complications, consistent with prior evidence suggesting that regional techniques may mitigate opioid exposure and postoperative respiratory depression in OSA patients (Memtsoudis et al., 2018). The study supported the adoption of opioid-sparing, multimodal analgesic strategies as a key element of perioperative management.

Postoperative Monitoring and ICU Utilization

Postoperative respiratory complications predominantly occurred within the first 24 hours, emphasizing the critical importance of vigilant postoperative monitoring. Continuous pulse oximetry, early resumption of CPAP therapy, and appropriate triage to high-dependency units were central to preventing escalation of respiratory failure.

Notably, while ICU admission rates were relatively high, the multidisciplinary pathway facilitated more appropriate ICU utilization by identifying patients who truly required intensive monitoring. This resulted in a reduction in unplanned ICU admissions and more efficient use of critical care resources. These findings were consistent with reports indicating that structured perioperative pathways can optimize ICU utilization without compromising patient safety (Seet & Chung, 2010).

Relevance to the Local Healthcare Context

The study had particular relevance to the healthcare context of Khyber Pakhtunkhwa and similar regions. Limited access to sleep medicine services, high surgical volumes, and resource constraints posed unique challenges to perioperative care. The successful implementation of a multidisciplinary model demonstrated that system-level improvements did not necessarily require advanced technology but rather depended on structured communication, standardized protocols, and staff education.

This approach may serve as a practical framework for other tertiary care hospitals in Pakistan and comparable low- and middle-income settings. By prioritizing screening, risk stratification, and collaborative care, institutions can significantly reduce perioperative morbidity in high-risk populations such as OSA patients.

Strengths and Limitations

The strengths of this study included its real-world observational design, inclusion of both diagnosed and high-risk OSA patients, and evaluation of a pragmatic multidisciplinary intervention. However, several limitations should be acknowledged. The absence of routine polysomnography limited precise classification of OSA severity in all patients. Additionally, the single-center design may limit generalizability. Despite these limitations, the findings provided valuable insight into perioperative OSA management in a resource-limited setting.

Clinical Implications

The study findings reinforced the need for routine preoperative screening for OSA, particularly in surgical populations with high prevalence of obesity and cardiometabolic disease. They also

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supported the integration of multidisciplinary perioperative pathways as a cost-effective strategy to enhance patient safety. Adoption of such models may contribute to reduced postoperative complications, improved patient satisfaction, and more efficient healthcare delivery.

CONCLUSION

This observational study highlighted the substantial perioperative risks faced by patients with obstructive sleep apnea undergoing surgical procedures at a tertiary care hospital in Khyber Pakhtunkhwa, Pakistan. The findings demonstrated that OSA was associated with a higher incidence of perioperative respiratory and cardiovascular complications, increased need for postoperative monitoring, and prolonged hospital stay. These challenges were particularly pronounced in patients with undiagnosed or inadequately managed OSA and those with multiple comorbid conditions.

The implementation of a structured multidisciplinary perioperative care model played a pivotal role in improving patient outcomes. Coordinated involvement of anesthesiologists, pulmonologists, surgeons, and nursing staff facilitated early identification of high-risk patients, optimized anesthetic and airway management strategies, and ensured vigilant postoperative monitoring. This collaborative approach resulted in a meaningful reduction in respiratory complications, fewer unplanned ICU admissions, and more efficient utilization of healthcare resources.

The study underscored the importance of routine preoperative screening for OSA, especially in resource-limited settings where access to definitive diagnostic tools remains constrained. Practical screening instruments and standardized perioperative pathways proved to be effective alternatives for risk stratification and clinical decision-making. Moreover, the emphasis on opioid-sparing analgesia, early resumption of positive airway pressure therapy, and appropriate postoperative triage contributed significantly to enhanced patient safety.

In conclusion, patients with obstructive sleep apnea constituted a vulnerable surgical population that benefited substantially from a multidisciplinary perioperative management strategy. The findings supported the integration of structured, team-based care pathways into routine surgical practice to mitigate perioperative risks and improve postoperative recovery. Adoption of such models across tertiary care hospitals may lead to sustained improvements in surgical outcomes and set a foundation for safer perioperative care for patients with OSA, particularly in low- and middle-income healthcare systems.

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