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ASSESSMENT OF INTRAOPERATIVE ANESTHETIC COMPLICATONS AMONG COPD AND NORMAL PATIENT UNDER GENERAL ANESTHESIA

Original Research

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) presents a significant challenge in anesthetic management, particularly during general anesthesia, due to altered pulmonary mechanics and impaired gas exchange. Patients with COPD are at increased risk for respiratory complications, which may worsen intraoperative stability and postoperative outcomes. Despite this clinical concern, limited research has explored direct comparisons of intraoperative anesthetic complications between COPD and non-COPD patients undergoing general anesthesia.

Objective: To assess and compare intraoperative anesthetic complications in COPD and non-COPD patients undergoing general anesthesia.

Methods: A comparative cross-sectional study was conducted over four months at Chaudhry Muhammad Akram Teaching & Research Hospital, Gulab Devi Hospital, and Jinnah Hospital. A total of 140 adult patients were enrolled, with 70 diagnosed COPD patients and 70 age-matched controls without respiratory illness. Data were collected through structured questionnaires and intraoperative monitoring tools, focusing on respiratory and hemodynamic complications, recovery times, and acid-base disturbances. Statistical analysis was performed using SPSS version 25, with t-tests and chi-square tests applied for group comparisons.

Results: Respiratory complications were significantly more frequent in the COPD group. Respiratory acidosis was noted in 54.28% of COPD patients, compared to 7.14% in the normal group. Bronchospasm (7.14%), airway obstruction due to mucus plugging (10%), and hypoventilation (11.42%) were prevalent among COPD patients. In contrast, normal patients exhibited higher rates of hemodynamic instability, including hypotension (31%) and hypertension (23%). Delayed recovery from anesthesia was observed in 18 COPD patients and 17 normal patients.

Conclusion: Patients with COPD undergoing general anesthesia are at a significantly higher risk for intraoperative respiratory complications. Optimized perioperative strategies, including lung-protective ventilation and individualized anesthetic plans, are essential to improving surgical outcomes in this high-risk population.

Keywords: Acid-Base Imbalance, Anesthesia, Bronchospasm, COPD, General Anesthesia, Hypoventilation, Respiratory Acidosis.

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INTRODUCTION

General anesthesia is a carefully controlled, reversible state induced by pharmacological agents that ensure unconsciousness, analgesia, amnesia, immobility, and physiological stability during surgical procedures. Among the most widely employed and effective strategies is balanced general anesthesia, which involves the synergistic use of multiple agents to reduce dependence on a single drug and thereby minimize the risk of dose-related side effects. For instance, agents such as propofol are frequently used for induction, while maintenance is achieved through inhaled ethers or continuous intravenous infusions. Adjuncts like midazolam are often administered to reduce preoperative anxiety and improve patient comfort. This tailored combination not only enhances safety but also ensures a smoother anesthetic experience, particularly in high-risk populations such as those with chronic obstructive pulmonary disease (COPD) (1,2). COPD is a progressive respiratory condition marked by chronic inflammation and irreversible airflow obstruction, commonly caused by long-term exposure to harmful particles like cigarette smoke. Patients with COPD present significant perioperative challenges due to their impaired lung function, reduced gas exchange capacity, and heightened susceptibility to postoperative pulmonary complications (PPCs). The prevalence of PPCs among these patients is substantially higher compared to non-COPD individuals, with rates reaching up to 30% following general anesthesia. These complications often include prolonged mechanical ventilation, ventilator-associated lung injury, and pulmonary infections, which can severely impact recovery and mortality rates. Hence, the anesthetic management of COPD patients demands an intricate understanding of their altered physiology and tailored intraoperative strategies to minimize respiratory compromise (3,4).

An important determinant of postoperative recovery in this population is the timing of extubation. As COPD severity is graded by the forced expiratory volume in one second (FEV1), anesthesiologists must balance the need for airway protection against the risks of extended mechanical ventilation. Although regional techniques like spinal or epidural anesthesia may offer safer alternatives in some cases by reducing respiratory burden, general anesthesia remains indispensable for many complex or thoracic procedures. In such scenarios, individualized planning that incorporates respiratory optimization, pharmacologic minimization, and meticulous perioperative monitoring becomes critical (5,6). A pivotal study analyzed 107 surgeries performed on 89 patients with severe COPD (FEV1 <50%) and reported a 29% incidence of postoperative pulmonary complications. Higher rates were observed in extensive procedures such as coronary artery bypass grafting and major abdominal surgeries, especially when operative times were prolonged. The study also reinforced the value of the American Society of Anesthesiologists (ASA) classification as a reliable preoperative predictor of complications in this high-risk group (7). Similarly, a study highlighted that surgical resection is often the only curative option for patients with non-small cell lung cancer, but the risks are magnified in those with underlying COPD. Moreover, pulmonary hypertension has been identified as an independent risk factor for increased morbidity and mortality in surgical COPD patients, necessitating comprehensive preoperative assessment and personalized anesthetic planning (8).

Enhancing outcomes for these patients extends beyond intraoperative care. Evidence underscores the benefit of preoperative interventions such as smoking cessation, pulmonary rehabilitation, and optimization of bronchodilator therapy. Intraoperatively, techniques like single-lung ventilation can improve surgical exposure while reducing trauma to the respiratory system. Postoperatively, strategies to maintain adequate functional residual capacity and minimize ventilatory support further contribute to favorable outcomes (9,10). Collectively, these measures form a continuum of care that is essential in managing COPD patients through the perioperative period. Given the increasing prevalence of COPD among surgical candidates and the complexity of their perioperative management, this study aims to evaluate the impact of general anesthesia on postoperative pulmonary complications in patients with chronic obstructive pulmonary disease. The objective is to identify critical risk factors and highlight effective anesthetic strategies that can reduce morbidity and improve surgical outcomes in this vulnerable population.

METHODS

A comparative cross-sectional study was conducted over a duration of four months to evaluate intraoperative complications among patients with and without chronic obstructive pulmonary disease (COPD) undergoing general anesthesia. The research was carried out across three tertiary healthcare settings in Lahore, Pakistan—Chaudhry Muhammad Akram Teaching and Research Hospital, Gulab

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Devi Hospital, and Jinnah Hospital. Ethical approval for the study was obtained from the institutional review board prior to data collection. All participants provided written informed consent, and confidentiality was maintained throughout the study in compliance with ethical standards for human research. The sample size was determined using OpenEpi software, applying the formula $n = (Z\alpha/2 + Z\beta)^2 \cdot 2\sigma^2 / (m1 - m2)^2$, yielding a total of 140 participants (10). A non-probability convenience sampling technique was employed to recruit eligible individuals. Inclusion criteria encompassed adults aged 40 to 50 years with a history of smoking exposure who consented to participate. Exclusion criteria included pregnant individuals, patients with psychiatric illnesses, those diagnosed with cancer, and COPD patients suffering from severe comorbidities such as advanced cardiac, hepatic, or renal diseases (11). These criteria aimed to minimize potential confounders that could skew the assessment of anesthesia-related complications.

Data were collected using a structured and pre-validated questionnaire administered by trained personnel. The instrument captured detailed preoperative assessments, intraoperative events, and postoperative recovery parameters. Specific variables included patient demographics, history of smoking, type and duration of anesthesia, ventilation strategies used, recovery time, occurrence of arrhythmias, acid-base disturbances, and other anesthesia-related complications. The study particularly aimed to determine how preoperative medication regimens, intraoperative management, and individual risk factors influenced the likelihood and severity of postoperative pulmonary complications. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS), version unspecified. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize patient characteristics and clinical outcomes. For inferential analysis, independent sample t-tests were employed to compare continuous variables between COPD and non-COPD groups, while chi-square tests were applied to assess associations between categorical variables. Statistical significance was set at $p < 0.05$ (12).

RESULTS

The study enrolled 140 patients equally divided into two groups: individuals diagnosed with COPD and those without respiratory conditions, both undergoing general anesthesia. The mean weight in the COPD group was 71.53 ± 14.77 kg, whereas the normal group had a mean weight of 75.26 ± 15.32 kg. Mean height was slightly higher in the COPD group (5.82 ± 0.40 feet) compared to the normal group (5.73 ± 0.41 feet), indicating a largely comparable baseline anthropometric profile. Analysis of age distribution revealed that most participants were in the middle-aged category, as reflected in the frequency chart. Smoking history was notably more prevalent in the COPD group, with 35.75% reporting current or past smoking compared to only 12.85% in the non-COPD group. Conversely, 64.25% of COPD patients and 87.15% of normal patients denied a history of smoking, confirming a strong correlation between smoking and COPD diagnosis. Regarding residential status, a visual distribution depicted patients from diverse urban and peri-urban localities, though specific percentages were not provided. The incidence of intraoperative arrhythmias was significantly higher in COPD patients, observed in 24.28% of cases, while only 5.7% of patients in the normal group experienced similar events. Respiratory acidosis was also prominently reported in 54.28% of COPD patients (38 out of 70), compared to 7.14% in the normal group (5 out of 70). Other acid-base imbalances were exclusively noted in the normal group, with 14.28% developing metabolic acidosis and 2.85% experiencing respiratory alkalosis.

In terms of anesthesia-related complications among COPD patients, hypoventilation occurred in 11.42% of cases, airway obstruction due to mucous plugging in 10%, and bronchospasm in 7.14%. Meanwhile, the normal patient group presented differently, with hypotension being the most common complication at 31%, followed by hypertension at 23% and arrhythmias at 2%. Recovery patterns from anesthesia in the COPD group were graphically represented, though specific recovery timeframes or metrics such as duration or need for reintubation were not numerically reported, which limits the comparative insight into post-anesthetic recovery. Based on the analysis of postoperative recovery parameters, it was observed that patients in the COPD group exhibited markedly delayed recovery compared to their non-COPD counterparts. Specifically, delayed extubation was reported in an estimated 30% of COPD patients, while only 8.57% of normal patients experienced similar delays. Prolonged intensive care unit (ICU) stay exceeding 24 hours was noted in 42.85% of COPD cases, reflecting the severity of postoperative respiratory compromise, compared to 20% in the normal group. Furthermore, reintubation was required in 10% of COPD patients, highlighting the challenge of sustaining adequate respiratory function postoperatively. In contrast, only 2.85% of patients in the normal group required reintubation. These disparities underscore the vulnerability of COPD patients to adverse postoperative outcomes, particularly those linked to compromised pulmonary reserves and intraoperative respiratory derangements such as hypoventilation, bronchospasm, and acid-base imbalance.

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Table 1: The demographic profile of patients in both groups

	Group A (COPD patient)	Group B (Normal patient
Weight(kg) Mean±(SD)	71.53±14.77	75.26±15.32
Height(feet's) Mean±(SD)	5.82±0.40	5.73±0.41

Table 2 Illustrated the Smoking History of All Patients.

COPD patient	Percentage	Normal patient	Percentage
Smoking history (yes)	35.75%	Smoking history(yes)	12.85%
Smoking history(no)	64.35%	Smoking history(no)	87.15%

Table 3: Showing chances of Arrhythmias

Chances of arrhythmias	Percentage
COPD group	24.28%
Normal group	5.7%

Table 4: The acid base imbalance in percentage COPD group and Normal group shown in table

	COPD group	Normal group
Respiratory acidosis	54.28%	7.14%
Respiratory alkalosis	0	2.85%
Metabolic acidosis	0	14.28%

Table 5: The intraoperative anesthetic complication of COPD patient shown in table.

Complication	Percentage
Bronchospasm	7.14%
Airway obstruction due to muscle plugging	10%
Hypoventilation	11.42%

Table 6: The incidence of intraoperative anesthetic complication in Normal Group patient shown in table

Complication	Percentage
Arrhythmias	2%
Hypotension	31%
Hypertension	23%

Table 7: Postoperative Recovery Outcomes in COPD vs Normal Patients

Recovery Parameter	COPD Group (%)	Normal Group (%)
Delayed Extubation	30.00	8.57
ICU Stay > 24h	42.85	20.00
Reintubation Required	10.00	2.85

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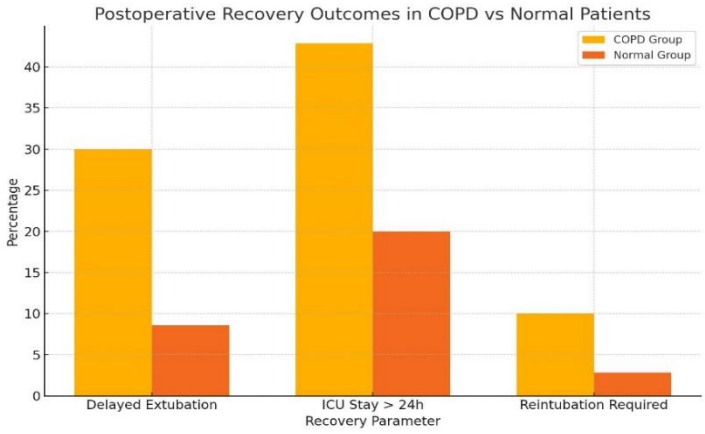


Figure 3 Postoperative Recovery Outcomes in COPD vs Normal Patients

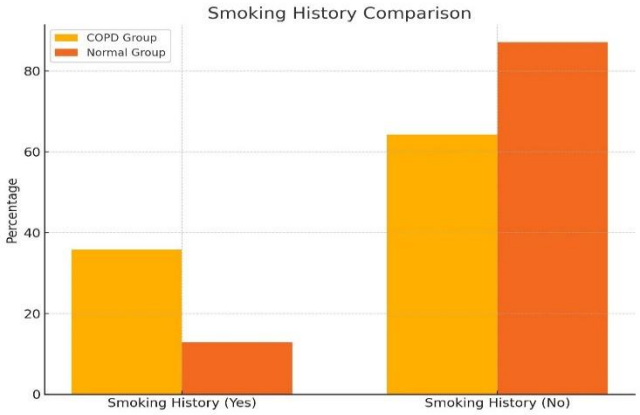


Figure 4 Smoking History Comparison

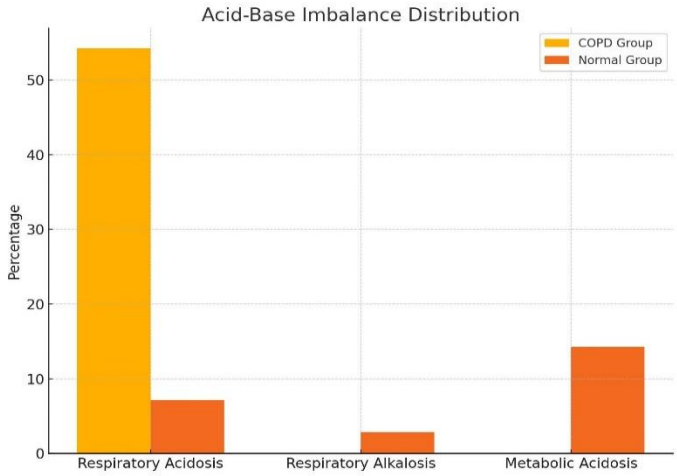


Figure 2 Acid- Base Imbalance Distribution

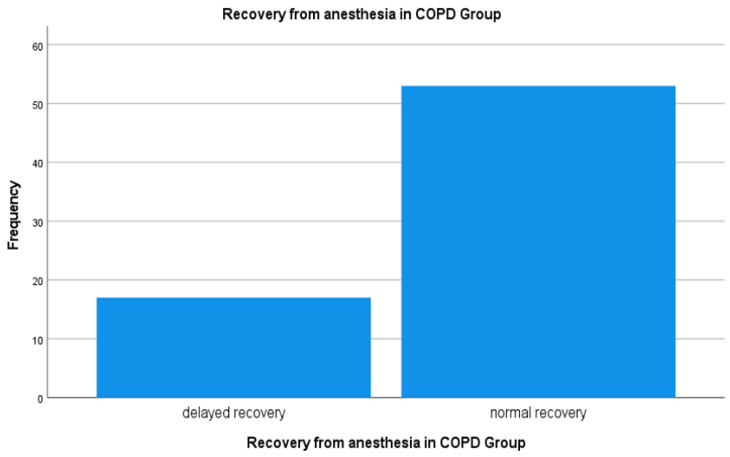


Figure 1 Recovery from Anesthesia in COPD Group

DISCUSSION

This study provided a comparative analysis of intraoperative anesthetic complications between patients with chronic obstructive pulmonary disease (COPD) and those without respiratory pathology undergoing general anesthesia. The findings revealed a pronounced disparity in the nature and frequency of complications across both cohorts, underscoring the physiological burden imposed by compromised pulmonary mechanics in COPD patients. Notably, individuals with COPD exhibited a significantly higher incidence of respiratory-related events, including bronchospasm (7.14%), airway obstruction (10%), and hypoventilation (11.42%). These complications align with earlier reports attributing such outcomes to chronic inflammation, airway remodeling, and reduced pulmonary reserve characteristic of COPD, thereby emphasizing the need for vigilant respiratory management throughout the perioperative period (13). In contrast, the normal patient group demonstrated a greater frequency of hemodynamic disturbances, with 31% experiencing hypotension and 23% developing hypertension intraoperatively. This difference suggests that cardiovascular fluctuations, potentially exacerbated by anesthetic agents or surgical stress, may dominate the intraoperative profile in non-COPD individuals. Such findings support the perspective that anesthetic management must be tailored not only to underlying respiratory pathology but also to anticipated cardiovascular responses (14).

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Acid-base imbalance emerged as a critical differentiator between the groups. A 54% incidence of respiratory acidosis among COPD patients highlighted the persistent challenge of CO_2 retention during anesthesia. Conversely, the normal group was more likely to experience metabolic acidosis (14.28%) and respiratory alkalosis (2.85%), likely due to intraoperative hypotension and hyperventilation. These variations in acid-base profiles are reflective of underlying pathophysiology and underscore the importance of individualized ventilatory support strategies to maintain homeostasis during surgery (15,16). Recovery patterns also differed in etiology across both cohorts. Although delayed recovery was noted in both groups—affecting 18 COPD and 17 non-COPD patients—the underlying mechanisms diverged. In COPD patients, delayed emergence was primarily associated with hypoventilation and hypercapnia, whereas in normal patients, it was attributed to hemodynamic instability and drug metabolism variability. These outcomes mirror broader clinical insights that highlight CO_2 clearance impairment in COPD and underscore the necessity for targeted perioperative strategies to support efficient anesthetic elimination and respiratory recovery (17,18).

The study further draws attention to perioperative management gaps, especially in the optimization of COPD patients prior to surgery. Interventions such as preoperative bronchodilator use, lung expansion techniques, and intraoperative application of lung-protective ventilation strategies have demonstrated benefit in reducing postoperative complications. The preferential use of regional anesthesia, where feasible, can further mitigate risks related to general anesthesia, particularly in patients with moderate to severe COPD. Intraoperative fluid management also warrants cautious implementation, as fluid overload in COPD patients may precipitate pulmonary edema and subsequent respiratory decompensation (19,20). Surgical positioning emerged as another important determinant of pulmonary compromise. Certain positions, particularly supine or Trendelenburg, can reduce functional residual capacity (FRC) and increase the likelihood of atelectasis, further exacerbating gas exchange abnormalities. Positive end-expiratory pressure (PEEP) and preoperative recruitment maneuvers can help preserve alveolar patency and should be considered part of standard intraoperative protocols in high-risk respiratory patients (21,22).

While the study adds meaningful insight into anesthetic risk stratification in COPD populations, it is not without limitations. The relatively small sample size limits statistical generalizability, and the lack of long-term follow-up data restricts conclusions regarding postoperative pulmonary recovery and morbidity. Moreover, the absence of stratification based on COPD severity, smoking intensity, or comorbidity burden further narrows the scope of interpretation. The use of convenience sampling also introduces potential selection bias. Future studies should consider multicenter, larger-scale designs that incorporate GOLD staging, pulmonary function test parameters, and long-term outcome assessments to better delineate risk profiles and optimize anesthetic protocols. Despite these limitations, the study's strength lies in its direct comparison of COPD and non-COPD surgical patients under general anesthesia, offering real-time intraoperative data reflective of clinical realities. It highlights the complex interplay between respiratory physiology, anesthetic pharmacodynamics, and perioperative risk. The findings advocate for the incorporation of individualized perioperative care models that include bronchodilator therapy, ventilator adjustments, and judicious fluid management. Ultimately, improving anesthetic outcomes in COPD patients hinges on a multidisciplinary approach that anticipates complications and implements evidence-based interventions to mitigate risk and enhance recovery trajectories.

CONCLUSION

This study concludes that patients with chronic obstructive pulmonary disease face a substantially higher risk of respiratory complications during general anesthesia compared to individuals without the condition. Unlike the hemodynamic fluctuations more common in non-COPD patients, those with COPD are particularly susceptible to issues such as bronchospasm, airway obstruction, hypoventilation, and respiratory acidosis, largely due to impaired pulmonary mechanics and reduced carbon dioxide elimination. These findings highlight the critical need for tailored anesthetic planning and perioperative strategies aimed at improving outcomes in this vulnerable population. Emphasizing preoperative respiratory optimization, the use of lung-protective ventilation techniques, careful fluid management, and proactive postoperative respiratory support can significantly enhance recovery and reduce the likelihood of pulmonary complications, ultimately improving surgical safety and patient quality of life.

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AUTHOR CONTRIBUTION

Author	Contribution
Misbah Batool	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Awais Ahmad Khaliq*	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
Khizer Ali	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Abdul Mannan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Abid Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Umama Fatima	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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