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ASSESSMENT OF PREOPERATIVE PULMONARY FUNCTION TEST TO REDUCE INTRAOPERATIVE ANAESTHETIC COMPLICATIONS

Original Research

Ajmal Shahbaz[1]*, Zeeshan Ahmad[2], Liaqat Abbas[2], Umar Farooq[2], M Danish[2], Jawaria Barkat[1]

[1]Lecturer, Department of Emerging Allied Health Technology, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan.

[2]Student of BS Anesthesia Technology, Department of Emerging Allied Health Technology, FAHS, Superior University Lahore, Pakistan.

Corresponding Author: Ajmal Shahbaz, Lecturer, Department of Emerging Allied Health Technology, Faculty of Allied Health Sciences, Superior University, Lahore, Pakistan, ajmalshahbaz089@gmail.com

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ABSTRACT

Background: Postoperative pulmonary complications (PPCs) remain a significant contributor to perioperative morbidity and mortality, particularly in patients with pre-existing respiratory conditions. Risk factors such as smoking history, respiratory diagnoses, and limited patient awareness of intraoperative risks further exacerbate surgical outcomes. Accurate identification of high-risk patients and the use of individualized preoperative strategies—including pulmonary function evaluation and patient education—can substantially reduce the incidence of PPCs and improve perioperative safety.

Objective: To identify the relationship between smoking history, type of respiratory condition, diagnostic test selection, and intraoperative pulmonary risk awareness in determining the occurrence of PPCs, and to propose evidence-based strategies for personalized respiratory risk management.

Methods: A cross-sectional study was conducted at Gulab Devi Hospital, Lahore, involving 286 elective surgery patients aged 45–65 years with pre-existing respiratory conditions such as COPD, asthma, obstructive sleep apnea (OSA), and pulmonary hypertension. Data were collected through patient questionnaires and clinical records. Chi-square tests and cross-tabulation analyses were used to assess associations among variables including smoking status, diagnostic testing, risk awareness, and postoperative outcomes.

Results: A statistically significant association ($p = 0.018$) was observed between smoking history and type of respiratory illness: COPD and pulmonary hypertension were more prevalent in former smokers, while asthma was common among current smokers. Pulmonary function tests (PFTs) were the preferred diagnostic modality in 217 out of 286 patients (75.9%), significantly correlated with the type of respiratory condition ($p = 0.000$). Notably, 100% of the 76 patients educated on intraoperative pulmonary risks developed no PPCs, compared to 71.4% complication incidence in uneducated groups ($p = 0.000$).

Conclusion: The study highlights the critical role of smoking history, diagnostic selection, and patient education in predicting and preventing PPCs. Implementation of individualized preoperative protocols incorporating targeted assessments and informed counseling is essential for optimizing surgical outcomes.

Keywords: Asthma, COPD, Patient Education, Perioperative Care, Postoperative Complications, Pulmonary Function Tests, Smoking.

INTRODUCTION

Intraoperative pulmonary complications (IPCs) are a significant cause of perioperative morbidity and mortality, contributing to prolonged hospitalizations, increased intensive care admissions, and escalating healthcare expenditures. Among surgical populations, patients undergoing lung resections are particularly vulnerable, with the extent of surgery directly influencing outcomes—pneumonectomy, for instance, carries a markedly higher 30-day mortality rate compared to lobectomy (1). Despite advances in surgical methods and anesthesia, the risk of postoperative pulmonary complications (PPCs) remains substantial, reinforcing the need for comprehensive preoperative evaluations that can proactively identify high-risk individuals and facilitate tailored clinical strategies. Over the past two decades, the volume of major surgeries has surged, highlighting the growing importance of robust preoperative pulmonary assessments. Standardized practices, such as pulmonary function testing (PFT), have been in use since the 1950s, offering valuable insights into respiratory reserve and functional capacity (2). However, emerging evidence suggests that conventional assessments alone may be insufficient to address the multifactorial nature of PPCs, especially as patient populations become older and present with complex comorbidities. The persistence of pulmonary complications even in optimized surgical settings suggests a need to reevaluate and enhance risk stratification approaches through multidimensional frameworks.

Recent studies emphasize the utility of tools like the Canet scoring system, which integrates demographic, clinical, and functional variables to better predict respiratory risks during surgery (3). Additionally, the inclusion of respiratory muscle training, endurance exercises, and individualized pulmonary rehabilitation protocols has demonstrated efficacy in improving lung mechanics and reducing the incidence of complications such as atelectasis, pneumonia, and respiratory failure (4,5). Innovations in bedside diagnostics, including lung ultrasound and electrical impedance tomography, now allow for more precise visualization of pulmonary conditions and enable timely adjustments to perioperative care strategies. Integrating these modalities into standard preoperative workflows enables clinicians to make informed decisions, particularly in cases involving cardiac, thoracic, abdominal, or vascular procedures. Early identification of patients with impaired pulmonary function supports the adoption of lung-protective anesthetic techniques, limits the need for intensive care interventions, and helps decrease overall hospital stay and costs (6,7). In a recent investigation, 230 surgical candidates and uncovered a high prevalence of previously undetected obstructive ventilatory and gas exchange abnormalities, especially among elderly patients and those with poor exercise tolerance—further validating the necessity for thorough respiratory evaluation before surgery (8). Similarly, a study reported a 38% incidence of PPCs in a cohort of 200 patients, with key risk factors including gender, smoking status, and preoperative oxygen saturation and spirometry markers (9).

Despite these insights, there remains a critical gap in the systematic application of personalized preoperative pulmonary evaluation protocols. Many healthcare settings continue to rely on generalized assessment methods, which may not sufficiently account for the individual variability in pulmonary risk profiles. Therefore, there is a pressing need to develop standardized yet patient-specific approaches that integrate predictive scoring systems, functional assessments, and tailored rehabilitation to mitigate the likelihood of PPCs. This study aims to identify the determinants of intraoperative pulmonary complications and establish evidence-based strategies to minimize respiratory risks in surgical patients. By leveraging modern assessment tools and individualized care pathways, the research seeks to improve perioperative outcomes, enhance patient safety, and promote more efficient use of healthcare resources (10).

METHODS

This research employed a prospective cohort study design to evaluate the association between preoperative pulmonary assessments and intraoperative pulmonary complications. The study was conducted over a 3 to 6-month period following the approval of the research synopsis by the institutional review boards of Mayo Hospital, Lahore, and Gulab Devi Hospital, Lahore. Ethical clearance was obtained prior to the commencement of data collection, and informed consent was taken from all participants in accordance with ethical guidelines for human subject research. A total of 286 participants were recruited using Yamane's formula for sample size calculation, expressed as $n = N / (1 + Ne^2)$ (11). A convenient non-probability sampling technique was used, reflecting the practical constraints of clinical settings while ensuring timely and feasible patient recruitment. Eligible participants were adults aged 45 to 65 years who were scheduled for elective general surgeries, orthopedic procedures, or cesarean sections. This specific age range and surgery type selection helped maintain population homogeneity and focused the analysis on surgeries known to carry diverse pulmonary risks. Emergency surgical cases were excluded due to the lack of adequate preoperative pulmonary assessment time. Additionally, patients with incomplete medical records or preexisting organ failure were excluded, as such variables posed potential confounding risks and reduced the generalizability of the findings (12).

The data collection process was structured to ensure both reliability and validity. It combined primary clinical assessments with retrospective analysis of medical records. Independent variables included patient demographics, spirometric findings, arterial blood gas results, and baseline oxygen saturation levels, while dependent variables encompassed intraoperative pulmonary complications such as hypoxia, bronchospasm, and ventilatory disturbances, along with postoperative outcomes including ICU admission, prolonged hospital stay, and the need for mechanical ventilation. All preoperative evaluations were conducted using standardized diagnostic tools, including spirometry for lung function, arterial blood gas (ABG) analysis for evaluating gas exchange, and pulse oximetry for SpO_2 monitoring. Intraoperative data regarding ventilatory parameters and oxygenation levels were obtained directly from anesthesia records. Postoperative outcomes were followed until discharge to assess complication profiles and resource utilization. The rigorous and multifaceted data collection strategy ensured that all relevant clinical parameters were captured to support robust analysis. Statistical analysis was conducted using IBM SPSS Statistics version 27. Descriptive statistics were applied to summarize patient characteristics and outcome frequencies. Inferential tests, including chi-square tests for categorical variables and independent t-tests or ANOVA for continuous data, were used to examine the relationship between pulmonary assessment results and intra/postoperative outcomes. A p-value of <0.05 was considered statistically significant for all analyses (13), establishing the basis for evidence-based conclusions.

RESULTS

The analysis of internal consistency using Cronbach's Alpha demonstrated a high level of reliability for the questionnaire utilized in this study. A total of 14 items yielded a Cronbach's Alpha value of 0.781, indicating good internal consistency among the questionnaire items and supporting its effectiveness in measuring constructs related to preoperative pulmonary assessment outcomes. Descriptive statistics for the demographic profile of the 286 participants showed that the majority belonged to the third age group with a mean score of 3.24 ± 0.615. Gender distribution was skewed towards males, with a mean of 1.16 ± 0.368. The mean value for smoking history was 2.47 ± 0.500, reflecting a central tendency between the second and third categories, while pre-existing respiratory conditions averaged 2.50 with a relatively high variability (± 1.222). The mean value for type of surgery was 1.33 ± 0.472, indicating a predominance of minor surgeries among participants. Regarding preoperative evaluation practices, all participants underwent pulmonary assessment as reflected by a mean of 1.00 ± 0.000, denoting no variation. Tests performed showed a mean of 2.24 ± 0.429, suggesting moderate variability in test types. Specialist consultations had a mean of 1.22 ± 0.413, while the preoperative intervention and risk discussion variables both showed full consistency with means and standard deviations of 1.00 ± 0.000, indicating no variation among responses.

Analysis of clinical variables indicated that respiratory symptoms had a mean score of 1.51 ± 0.709, with most responses between the first and second categories. History of postoperative pulmonary complications had a mean of 1.48 ± 0.500, suggesting that most participants did not experience complications. Awareness of intraoperative pulmonary risks had a mean score of 1.73 ± 0.442, and the clarity of information provided was rated at a mean of 2.09 ± 0.293. A frequency analysis further confirmed that 90.6% of participants rated the clarity of information as "Good," while only 9.4% marked it as "Fair." Chi-square testing was conducted to evaluate the association between smoking history and pre-existing respiratory conditions. The results showed a significant relationship (p = 0.018). Former smokers were more likely to have COPD and pulmonary hypertension, while current smokers exhibited higher rates of asthma. This relationship reinforces the role of smoking history in predicting specific pulmonary disorders that may influence perioperative management.

Another chi-square analysis revealed a statistically significant association (p = 0.000) between the type of pre-existing respiratory condition and the diagnostic test performed. Patients with COPD, asthma, OSA, or pulmonary hypertension underwent pulmonary function testing more frequently than chest X-rays. Notably, asthma patients overwhelmingly received PFTs, suggesting that test selection was condition-dependent and clinically informed. A third chi-square analysis tested the association between patient awareness of intraoperative pulmonary risks and the history of postoperative pulmonary complications. Among the 76 participants who were informed about intraoperative risks, none developed postoperative complications, whereas 150 of the 210 uninformed participants did experience such complications. This result was statistically significant (p = 0.000), suggesting a strong protective effect of preoperative education regarding intraoperative risks.

Table 1: Reliability Statistics for Questionnaire

5.1	
5.1.1	N of Items
	14

Table 2: Descriptive Statistics of Study Variables

Variable	N Valid	N Missing	Mean	Median	Mode	Std. Deviation	Variance
Age Group	286	0	3.24	3.00	3	0.615	0.378
Gender	286	0	1.16	1.00	1	0.368	0.135
Smoking History	286	0	2.47	2.00	2	0.500	0.250
Pre-existing Respiratory Conditions	286	0	2.50	2.00	4	1.222	1.493
Type of Surgery	286	0	1.33	1.00	1	0.472	0.223
Preoperative Pulmonary Evaluation	286	0	1.00	1.00	1	0.000	0.000
Tests Performed	286	0	2.24	2.00	2	0.429	0.184
Specialist Consult	286	0	1.22	1.00	1	0.413	0.170
Preoperative Interventions Recommended	286	0	1.00	1.00	1	0.000	0.000
Healthcare Provider Discussed Risks	286	0	1.00	1.00	1	0.000	0.000
Respiratory Symptoms	286	0	1.51	1.00	1	0.709	0.503
History of Postoperative Pulmonary Complications	286	0	1.48	1.00	1	0.500	0.250
Awareness of Intraoperative Pulmonary Risks	286	0	1.73	2.00	2	0.442	0.196
Clarity of Information Provided	286	0	2.09	2.00	2	0.293	0.086

Table 3: Frequency Analysis for the variable Clarity of Information Provided

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	259	90.6	90.6	90.6
	Fair	27	9.4	9.4	100.0
	Total	286	100.0	100.0	

Table 4: Association Between Smoking History and Pre-existing Respiratory Conditions

Count						
		Pre-existing Respiratory Conditions				Total
		COPD	Asthma	OSA	Pulmonary Hypertension	
Smoking History	Former smoker	49	33	17	53	152
	Current smoker	30	50	9	45	134
Total		79	83	26	98	286

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.073[a]	3	.018
Likelihood Ratio	10.144	3	.017
Linear-by-Linear Association	.038	1	.846
N of Valid Cases	286		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.18.

Table 5: Association Between Pre-existing Respiratory Conditions and Type of Diagnostic Test Performed

Count				
		Tests Performed		Total
		PFT	Chest X-ray	
Pre-existing Respiratory Conditions	COPD	54	25	79
	Asthma	77	6	83
	OSA	20	6	26
	Pulmonary Hypertension	66	32	98
Total		217	69	286

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	19.294[a]	3	.000
Likelihood Ratio	22.443	3	.000
Linear-by-Linear Association	1.411	1	.235
N of Valid Cases	286		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.27.			

Table 6: Association Between Awareness of Intraoperative Pulmonary Risks and History of Postoperative Pulmonary Complications

Count				
		History of Postoperative Pulmonary Complications		Total
		Yes	No	
Awareness of Intraoperative Pulmonary Risks	Yes	0	76	76
	No	150	60	210
Total		150	136	286

Chi-Square Tests					
	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	114.160[a]	1	.000		
Continuity Correction	111.314	1	.000		
Likelihood Ratio	144.521	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	113.761	1	.000		
N of Valid Cases	286				
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 36.14.					
b. Computed only for a 2x2 table					

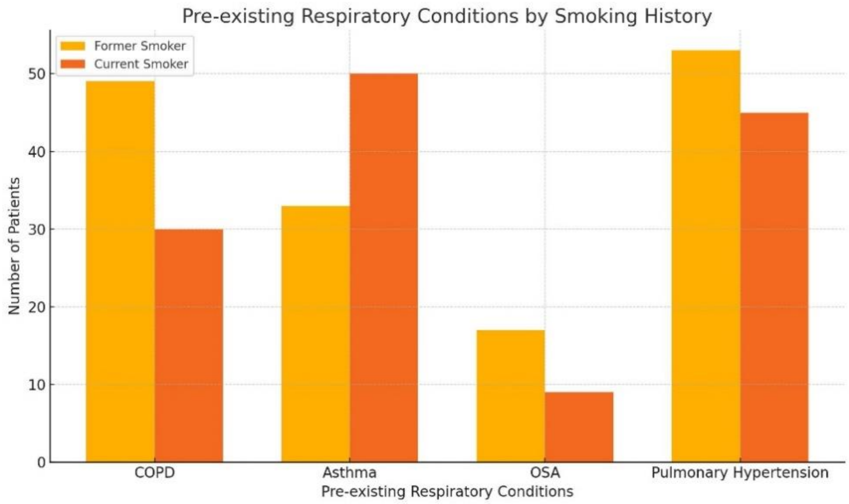

Figure 1 Pre-existing Respiratory Conditions by Smoking History

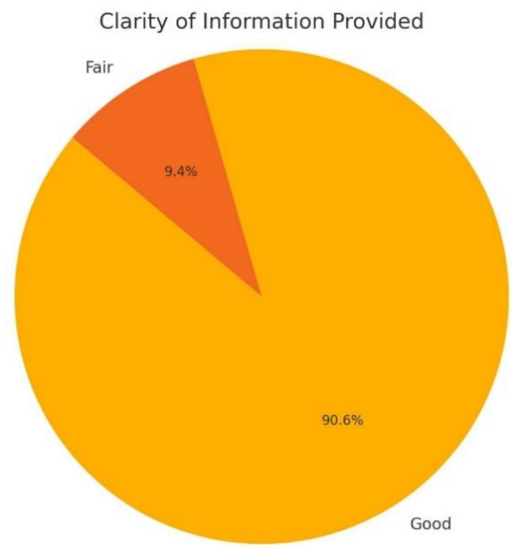

Figure 2 Clarity of Information Provided

DISCUSSION

The present study highlights significant associations between patients' smoking history, pre-existing respiratory conditions, diagnostic test selection, and awareness of intraoperative pulmonary risks in relation to the occurrence of postoperative pulmonary complications (PPCs). These findings align with previous research on perioperative respiratory risk and contribute novel insights into how individualized assessments and educational strategies can mitigate surgical morbidity. The identification of smoking status as a determinant for specific respiratory pathologies reinforces existing evidence, particularly regarding the higher prevalence of COPD and pulmonary hypertension among former smokers and asthma among current smokers. These associations are clinically relevant, as they allow for the stratification of patients based on pulmonary vulnerability and the development of tailored perioperative management plans (14-16). The consistent preference for pulmonary function tests (PFTs) among patients with obstructive lung disorders confirms the critical role of diagnostic accuracy in surgical preparation. This diagnostic preference underscores the necessity of incorporating spirometry and diffusion capacity testing into routine evaluations for patients with known or suspected pulmonary pathology (17,18). Evidence from prior studies supports the use of lung function testing in unmasking undiagnosed conditions, which, if left untreated, can significantly worsen surgical outcomes. The results of this study further validate the integration of personalized diagnostic strategies into clinical pathways, improving both predictive accuracy and therapeutic planning (19,20).

A particularly impactful finding was the absence of postoperative pulmonary complications among patients who were made aware of their intraoperative pulmonary risks. This statistically significant observation reflects the preventative value of preoperative education and reinforces the importance of patient engagement in surgical care (21). Such findings emphasize the protective role of informed consent discussions that include potential pulmonary risks and tailored risk communication. When paired with personalized anesthetic techniques, this educational element contributes to a reduction in PPCs and promotes a culture of shared decision-making. The study findings also affirm the effectiveness of structured preoperative interventions, including educational modules and targeted diagnostics, in reducing respiratory complications postoperatively. Evidence-based protocols that address smoking history, SpO_2 levels, and lung capacity parameters can significantly enhance perioperative safety (22,23). The implementation of systematic care pathways that integrate these components could reduce ICU admissions, hospital length of stay, and healthcare costs. By identifying and managing pulmonary risk factors preoperatively, clinicians can shift from reactive to preventive care strategies.

A strength of this study lies in its prospective design and the use of validated tools to assess both clinical and perceptual variables. The reliability of the instrument, as reflected in the Cronbach's Alpha value, enhances the credibility of the findings. Furthermore, the large

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and demographically diverse sample size provides a robust dataset for analysis and allows for generalizability within similar clinical contexts. The incorporation of chi-square analyses to test associations between categorical variables adds methodological strength and supports data-driven conclusions. However, the study is not without limitations. The use of a non-probability sampling method introduces the possibility of selection bias, which may affect the external validity of the findings. Moreover, the absence of multivariable regression analysis prevents the control of potential confounding factors such as age, comorbidities, or type of surgery. While statistically significant associations were identified, causality cannot be confirmed due to the observational nature of the study. Future research should incorporate logistic regression models or propensity score matching to isolate independent predictors of PPCs more accurately.

Another limitation is the lack of longitudinal follow-up beyond hospital discharge, which restricts insights into longer-term respiratory outcomes. Including postoperative follow-up at intervals such as 30 or 90 days would provide a more comprehensive understanding of the sustained impact of preoperative pulmonary interventions. Additionally, while the study addressed educational awareness, it did not quantify the content, timing, or delivery method of the information provided, which could influence the effectiveness of preoperative counseling. Future research should standardize and evaluate the educational components to determine optimal practices. This study contributes important evidence to the ongoing discussion on perioperative respiratory management. It supports the call for patient-specific pulmonary risk assessment models that integrate diagnostic, clinical, and behavioral dimensions. The findings advocate for clinical protocols that combine spirometry, targeted preoperative education, and individualized anesthetic strategies. These insights not only strengthen the foundation for best practices in perioperative care but also suggest policy-level implications where institutional guidelines can be updated to incorporate structured pulmonary evaluations for high-risk populations. As the surgical landscape evolves, integrating multidisciplinary approaches that address modifiable risk factors such as smoking and patient knowledge may yield sustainable improvements in surgical outcomes and resource optimization.

CONCLUSION

This study concludes that smoking history, pre-existing respiratory conditions, diagnostic test selection, and awareness of intraoperative pulmonary risks are interlinked factors that significantly influence the development of postoperative pulmonary complications. The findings emphasize the importance of incorporating individualized preoperative strategies into routine surgical care, including targeted pulmonary diagnostics, structured risk education, and smoking-related risk profiling. Educating patients about their pulmonary vulnerabilities before surgery emerged as a key preventive approach, reinforcing the value of patient-centered communication in reducing complications. By identifying these critical risk elements, the research provides actionable insights that support more informed clinical decision-making and promote safer perioperative outcomes through evidence-based care pathways.

AUTHOR CONTRIBUTION

Author	Contribution
Ajmal Shahbaz*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Zeeshan Ahmad	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
Liaqat Abbas	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Umar Farooq	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
M Danish	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Jawaria Barkat	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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