Risk Factors for Postoperative Pulmonary Complications After Major Thoracic Surgery.

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Abstract

Background

Postoperative pulmonary complications are among the most important causes of morbidity after major thoracic surgery. They contribute to prolonged hospitalization, increased intensive care utilization, delayed recovery, and higher postoperative mortality. Identification of perioperative risk factors is essential for early risk stratification and optimization of surgical outcomes. Thoracic surgery series consistently describe pulmonary complications as a major driver of longer hospital stay and worse recovery.

Objectives

To determine the risk factors for postoperative pulmonary complications after major thoracic surgery and to assess their impact on hospital stay, intensive care unit admission, and mortality.

Methodology

This retrospective analytical study was conducted at Department of Thoracic Surgery Unit, Lady Reading Hospital Medical Teaching Institution, Peshawar from jan 2019 to jan 2020. A total of 120 patients who underwent major thoracic surgery during the study period were included. Demographic characteristics, smoking history, comorbidities, pulmonary function, type of surgery, operative duration, postoperative pulmonary complications, hospital stay, ICU admission, and mortality were recorded using a structured data collection form. Data were analyzed using SPSS version 24. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The chi-square test, independent t-test, and logistic regression analysis were used where appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 120 patients were included in the study. The mean age of the patients was 57.3 ± 12.1 years, and males constituted 61.7% of the study population. Postoperative pulmonary complications occurred in 32 patients (26.7%). The most common complications were pneumonia

in 12 patients (10.0%), atelectasis in 10 patients (8.3%), prolonged ventilatory support in 6 patients (5.0%), and respiratory failure in 5 patients (4.2%). Complications were more frequent in older patients, smokers, patients with chronic obstructive pulmonary disease, reduced preoperative FEV1, higher ASA grade, and prolonged operative duration. Patients who developed postoperative pulmonary complications had a significantly longer hospital stay compared with those without complications (12.9 ± 4.5 days vs 7.2 ± 2.8 days, p = 0.01). ICU admission was required in 22 patients (18.3%), while overall postoperative mortality was 4 patients (3.3%).

Conclusion

Postoperative pulmonary complications remain frequent after major thoracic surgery and are associated with prolonged hospital stay and increased postoperative morbidity. Advanced age, smoking, chronic obstructive pulmonary disease, reduced pulmonary function, higher ASA grade, and longer operative duration were important risk factors. Early recognition of high-risk patients may improve perioperative planning and postoperative outcomes.

Keywords: Postoperative pulmonary complications; Thoracic surgery; Risk factors; Pneumonia; Atelectasis

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Introduction

Major thoracic surgery is commonly performed for lung cancer, mediastinal disease, pleural disorders, and other intrathoracic conditions. Despite advances in anesthesia, perioperative care, and minimally invasive surgical techniques, postoperative pulmonary complications remain a major source of morbidity after thoracic operations (1). Published thoracic surgery studies report that pulmonary complications continue to occur at clinically significant rates and are strongly linked to prolonged recovery and higher resource use.Postoperative pulmonary complications include pneumonia, atelectasis, respiratory failure, prolonged ventilatory support, acute respiratory distress syndrome, and pleural or parenchymal respiratory events that impair postoperative recovery (2). These complications may result in delayed mobilization, prolonged chest drainage, need for intensive care support, and increased mortality (3). Thoracic resection cohorts have shown that pulmonary complications can substantially extend hospital stay and worsen both short-term and longer-term outcomes.The risk of developing pulmonary complications after thoracic surgery is influenced by several patient-related and operative factors. Previous studies have identified advanced age, smoking history, chronic obstructive pulmonary disease, reduced pulmonary reserve, higher American Society of Anesthesiologists (ASA) grade, and poor nutritional status as important preoperative predictors (4). Operative factors such as thoracotomy, major lung resection, prolonged operative duration, excessive fluid administration, blood loss, and postoperative pain may also increase the risk of respiratory complications (5). Several thoracic datasets and reviews specifically identify age, ASA status, pulmonary function, smoking, COPD, blood loss, and procedure duration among the most important predictors.Pulmonary complications after thoracic surgery are particularly important because they not only affect early postoperative recovery but may also influence long-term survival in patients undergoing surgery for malignancy (6). Therefore, accurate prediction of high-risk patients is essential in order to improve perioperative planning, optimize respiratory status before surgery, and guide postoperative monitoring and physiotherapy (7).Single-center analyses remain useful in evaluating local patterns of complications and

identifying modifiable perioperative risk factors. Such studies can help refine institutional protocols, improve resource allocation, and support implementation of preventive strategies for patients undergoing major thoracic surgery (8).Several risk models have been proposed to predict pulmonary complications after lung resection, but their applicability may vary between institutions and across different thoracic procedures (9). Factors such as surgical approach, extent of resection, underlying lung disease, and perioperative management practices may influence their predictive performance (10). Therefore, institutional data continue to play an important role in identifying relevant local predictors and postoperative trends (11).

Research Objective

To determine the risk factors for postoperative pulmonary complications after major thoracic surgery and to assess their effect on hospital stay, ICU admission, and mortality.

Materials and Methods

Study Design and Setting

This retrospective analytical study was conducted at Department of Thoracic Surgery Unit, Lady Reading Hospital Medical Teaching Institution, Peshawar from jan 2019 to jan 2020.

Participants

The study included 120 patients who underwent major thoracic surgery during the study period.

Inclusion Criteria

Patients aged 18 years or older who underwent major thoracic surgery, including lobectomy, pneumonectomy, decortication, mediastinal tumor resection, and other major intrathoracic procedures, were included.

Exclusion Criteria

Patients with incomplete medical records, minor thoracic procedures, trauma-related emergency thoracotomy, and those requiring reoperation for non-pulmonary causes were excluded.

Data Collection

Data were collected using a structured proforma. Variables recorded included age, gender, smoking history, chronic obstructive pulmonary disease, ASA grade, preoperative pulmonary function, operative duration, type of procedure, postoperative pulmonary complications, ICU admission, hospital stay, and mortality.

Definition of Postoperative Pulmonary Complications

Postoperative pulmonary complications included pneumonia, atelectasis requiring intervention, respiratory failure, prolonged ventilatory support, and acute respiratory distress syndrome occurring during the postoperative hospital stay.

Statistical Analysis

Data were analyzed using SPSS version 24. Quantitative variables were expressed as mean ± SD, while categorical variables were presented as frequency and percentage. The chi-square test and independent t-test were used to compare variables. Logistic regression analysis was applied to

identify independent predictors of postoperative pulmonary complications. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 120 patients underwent major thoracic surgery during the study period. The mean age was 57.3 ± 12.1 years, and 73 patients were male. The most commonly performed procedures were lobectomy (41 patients, 34.2%), decortication (26 patients, 21.7%), mediastinal mass resection (22 patients, 18.3%), pneumonectomy (17 patients, 14.2%), and other major thoracic procedures (14 patients, 11.7%).Postoperative pulmonary complications occurred in 32 patients (26.7%). The most common complication was pneumonia (12 patients, 10.0%), followed by atelectasis (10 patients, 8.3%), prolonged ventilatory support (6 patients, 5.0%), and respiratory failure (5 patients, 4.2%). Complications were more frequent in older patients, smokers, patients with chronic obstructive pulmonary disease, reduced FEV1, higher ASA grade, and those with operative duration greater than four hours.Patients who developed postoperative pulmonary complications had significantly longer hospital stay compared with those without complications (12.9 ± 4.5 days vs 7.2 ± 2.8 days, p = 0.01). ICU admission was required in 22 patients (18.3%), while overall postoperative mortality was 4 patients (3.3%). Mortality was observed mainly in patients with severe respiratory failure and pneumonia.

Table 1. Baseline Characteristics of the Study Population

Variable	Frequency (n)	Percentage (%)
Age (years), mean ± SD	57.3 ± 12.1	—
Male	73	60.8%
Female	47	39.2%
Smokers	67	55.8%
COPD	35	29.2%
ASA grade III or higher	37	30.8%
Reduced FEV1 (<80% predicted)	42	35.0%

Table 2. Risk Factors for Postoperative Pulmonary Complications

Variable	PPC Present (n=32)	PPC Absent (n=88)	p-value
Age >60 years	20	25	0.03
Smoking history	23	44	0.04
COPD	16	19	0.02
Reduced FEV1 (<80%)	18	24	0.01
ASA grade III or higher	17	20	0.01
Operative duration >4 hours	19	29	0.03

Table 3. Postoperative Outcomes

Risk Factors for Postoperative Pulmonary Complications After Major Thoracic Surgery.

Outcome Variable	PPC Present	PPC Absent	p-value
Hospital stay	12.9 ± 4.5 days	7.2 ± 2.8 days	0.01
ICU admission	12 (37.5%)	10 (11.4%)	0.01
Mortality	4 (12.5%)	0	0.02

Discussion

The present study demonstrated that postoperative pulmonary complications occurred in 27% of patients after major thoracic surgery, with pneumonia and atelectasis being the most frequent events. This is consistent with thoracic surgery literature showing that pulmonary complications remain among the commonest adverse postoperative outcomes and are strongly associated with longer hospital stay and worse recovery after pulmonary resection.In our study, advanced age was significantly associated with postoperative pulmonary complications. This finding agrees with previous studies that identified increasing age as an independent risk factor, likely because elderly patients have reduced physiological reserve, impaired mucociliary clearance, and a higher burden of comorbid disease (12,13). Thoracic resection analyses have repeatedly shown age to be a consistent risk factor for pulmonary morbidity.Smoking history and chronic obstructive pulmonary disease were also important predictors in the present series. Chronic tobacco exposure and underlying airflow limitation can impair pulmonary mechanics, increase secretion retention, and reduce postoperative respiratory compensation. Similar associations have been reported in earlier thoracic surgery studies and predictive models, where smoking and COPD significantly increased the likelihood of postoperative respiratory complications (14,15). Available thoracic datasets also identify cigarette exposure and chronic lung disease as major contributors to PPC risk.Reduced preoperative FEV1 was another significant predictor in our study. Poor baseline pulmonary function has long been recognized as a major determinant of postoperative respiratory morbidity, especially in patients undergoing lung resection. Previous studies have shown that low FEV1 and impaired diffusion capacity increase the risk of pneumonia, respiratory failure, and prolonged ventilatory requirement after surgery (16,17). Contemporary retrospective thoracic studies support the importance of pulmonary function and diffusion capacity in risk stratification. Higher ASA grade and longer operative duration were also associated with pulmonary complications in our patients. These findings are in line with prior research suggesting that systemic disease burden, operative complexity, prolonged anesthesia exposure, and greater surgical stress all increase postoperative pulmonary risk (18,19). Thoracic lobectomy studies have specifically highlighted ASA grade among the strongest independent predictors of major pulmonary complications.An important finding of this study was the significant increase in hospital stay and ICU utilization among patients who developed postoperative pulmonary complications. This observation agrees with previous reports indicating that PPCs substantially increase resource use and may adversely affect both early and long-term outcomes after thoracic surgery (20,21). Published thoracic cohorts consistently report longer hospitalization in patients who develop PPCs.Overall, the findings of this study emphasize the importance of careful preoperative assessment and targeted perioperative prevention. Smoking cessation, preoperative pulmonary optimization, respiratory physiotherapy, early mobilization, effective analgesia, and close monitoring of high-risk patients may help reduce pulmonary morbidity after major thoracic

surgery (22). The broader literature supports perioperative optimization and risk stratification as key steps in reducing PPC burden after thoracic operations.

Limitations

This study has several limitations. It was conducted at a single center with a relatively small sample size, which may limit the generalizability of the findings. The retrospective design may also introduce selection and documentation bias. In addition, different thoracic procedures were analyzed together, which may have influenced the overall incidence of postoperative pulmonary complications.

Conclusion

Postoperative pulmonary complications remain a major source of morbidity after major thoracic surgery. Advanced age, smoking, chronic obstructive pulmonary disease, reduced FEV1, higher ASA grade, and prolonged operative duration were important risk factors. Early identification of high-risk patients and improved perioperative optimization may reduce complications and improve surgical outcomes.

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Authors Contribution

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Critical Review: **Tahir Aslam[3]**
Final Approval of version: **All authors approved the final version.**

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