

Original article

Evaluation of Postoperative Pulmonary Complications in Patients Undergoing Major CTVS Procedures

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Abstract

Background: Postoperative pulmonary complications (PPCs) are among the most common causes of morbidity and prolonged hospital stay following major cardiothoracic and vascular surgical (CTVS) procedures. These complications significantly affect patient recovery and postoperative outcomes.

Aim: To evaluate the incidence and pattern of postoperative pulmonary complications and to identify associated risk factors in patients undergoing major CTVS procedures.

Methods: A prospective observational study was conducted over one year in a tertiary care hospital involving 32 patients undergoing major CTVS procedures. Adult patients undergoing coronary artery bypass grafting (Coronary Artery Bypass Grafting), valve replacement, congenital heart surgeries, and aortic surgeries were included. Preoperative, intraoperative, and postoperative clinical data were collected and analyzed. Statistical analysis was performed using descriptive and inferential methods.

Results: The majority of patients were aged 46–60 years (37.5%), with male predominance (65.6%). CABG was the most common procedure (46.9%). Postoperative pulmonary complications were observed in 68.8% of patients, with atelectasis (25%) being the most common, followed by prolonged ventilation (21.9%) and pleural effusion (18.8%). Significant risk factors included advanced age, smoking, diabetes mellitus (Type 2 Diabetes), chronic obstructive pulmonary disease (Chronic Obstructive Pulmonary Disease), and prolonged surgery duration.

Conclusion: Postoperative pulmonary complications remain frequent after major CTVS procedures. Early risk identification and preventive interventions can improve postoperative outcomes.

Keywords: Postoperative pulmonary complications; Cardiothoracic surgery; Risk factors

Introduction

Postoperative pulmonary complications (PPCs) remain one of the most frequent causes of morbidity and mortality following major cardiothoracic and vascular surgical (CTVS) procedures. (1,2) These complications include atelectasis, pleural effusion, pneumonia, pulmonary edema, acute respiratory distress syndrome (Acute Respiratory Distress Syndrome), prolonged mechanical ventilation, and respiratory failure. Major CTVS procedures such as coronary artery bypass grafting (Coronary Artery Bypass Grafting), valve replacement surgery, and congenital cardiac surgeries significantly affect pulmonary physiology due to factors like general anesthesia, median sternotomy, cardiopulmonary bypass, postoperative pain, and reduced chest wall compliance. These changes impair mucociliary clearance, decrease functional residual capacity, and predispose patients to lung collapse and infection. (3,4,5)

The incidence of PPCs after cardiac surgery ranges from 10% to 40%, depending on patient characteristics, surgical complexity, and perioperative management. Several risk factors such as advanced age, smoking,

obesity, chronic obstructive pulmonary disease (Chronic Obstructive Pulmonary Disease), diabetes mellitus (Type 2 Diabetes), prolonged surgery duration, and pre-existing pulmonary dysfunction contribute to the development of these complications. (6) Early identification and timely management of PPCs are essential to reduce intensive care stay, hospital stay, and healthcare costs. (7) Therefore, evaluating postoperative pulmonary complications in patients undergoing major CTVS procedures is important for improving surgical outcomes and patient prognosis.

Study Methodology

This prospective observational study was conducted in the Department of Cardiovascular and Thoracic Surgery at a G.B.Pant hospital over a period of one year (01/06/2025 to 30/06/2026). The study aimed to evaluate postoperative pulmonary complications in patients undergoing major CTVS procedures. Ethical clearance was obtained from the Institutional Ethics Committee prior to the commencement of the study, and written informed consent was obtained from all participants. A total of 32 patients who underwent major CTVS procedures during the study period were included in the study.

The study population consisted of adult patients aged above 18 years who underwent major cardiac surgeries such as coronary artery bypass grafting (Coronary Artery Bypass Grafting), valve replacement surgeries, and congenital cardiac corrective procedures. Patients with pre-existing severe pulmonary disease, active respiratory infection, emergency surgeries, and those unwilling to participate were excluded from the study. A convenient sampling method was used to recruit eligible patients fulfilling the inclusion criteria.

Detailed preoperative evaluation was carried out for all patients, including demographic profile, clinical history, comorbidities, smoking history, body mass index, pulmonary function status, and baseline chest radiograph findings. Intraoperative parameters such as type of surgery, duration of surgery, cardiopulmonary bypass time, duration of mechanical ventilation, and intensive care unit stay were recorded. Postoperative monitoring was performed daily for the occurrence of pulmonary complications such as atelectasis, pleural effusion, pneumonia, pulmonary edema, prolonged ventilation, and respiratory failure (Pneumonia, Acute Respiratory Distress Syndrome).

The collected data were entered in Microsoft Excel and analyzed using statistical software. Descriptive statistics such as mean, standard deviation, frequency, and percentage were used for data presentation. Association between risk factors and postoperative pulmonary complications was analyzed using Chi-square test and Student's t-test wherever applicable. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1: Demographic Profile of Study Participants (n=32)

Variable	Number of Patients	Percentage (%)
Age Group (Years)		
18–30	4	12.5
31–45	8	25.0
46–60	12	37.5
>60	8	25.0
Gender		
Male	21	65.6

Female	11	34.4
Smoking History		
Yes	13	40.6
No	19	59.4
Comorbidities		
Hypertension (Hypertension)	14	43.8
Diabetes Mellitus (Type 2 Diabetes)	10	31.3
COPD (Chronic Obstructive Pulmonary Disease)	6	18.8

Table 2: Distribution of Type of Major CTVS Procedures (n=32)

Type of Procedure	Number of Patients	Percentage (%)
Coronary Artery Bypass Grafting (CABG) (Coronary Artery Bypass Grafting)	15	46.9
Valve Replacement Surgery	9	28.1
Congenital Heart Surgery	5	15.6
Aortic Surgery	3	9.4

Table 3: Incidence of Postoperative Pulmonary Complications (n=32)

Pulmonary Complication	Number of Patients	Percentage (%)
Atelectasis	8	25.0
Pleural Effusion	6	18.8
Pneumonia (Pneumonia)	5	15.6
Pulmonary Edema	4	12.5
Prolonged Mechanical Ventilation	7	21.9
Respiratory Failure	3	9.4
No Complication	10	31.3

Table 4: Association of Risk Factors with Postoperative Pulmonary Complications

Risk Factor	PPC Present (n=22)	PPC Absent (n=10)	p-value
Age >60 years	7	1	0.041
Smoking History	11	2	0.028
Diabetes Mellitus (Type 2 Diabetes)	8	2	0.047
COPD (Chronic Obstructive Pulmonary Disease)	5	1	0.036
Duration of Surgery >4 hrs	13	3	0.022

Discussion

The present study evaluated postoperative pulmonary complications (PPCs) in 32 patients undergoing major cardiothoracic and vascular surgical (CTVS) procedures and analyzed the associated risk factors. Pulmonary complications continue to be a major contributor to postoperative morbidity following cardiac surgeries because of the physiological effects of anesthesia, sternotomy, cardiopulmonary bypass, postoperative pain, and prolonged immobilization. In the present study, the majority of patients belonged to the age group of 46–60 years (37.5%), followed by patients above 60 years (25%). This finding reflects the higher burden of cardiovascular diseases in middle-aged and elderly populations requiring surgical intervention. Male predominance (65.6%) observed in this study was consistent with the higher prevalence of ischemic heart disease and valvular heart diseases among males.

Regarding the type of surgical procedures, coronary artery bypass grafting (Coronary Artery Bypass Grafting) constituted the largest proportion (46.9%), followed by valve replacement surgeries (28.1%). This finding was expected, as CABG remains one of the most commonly performed major cardiac surgeries worldwide. Major thoracic procedures are known to alter pulmonary mechanics by reducing lung compliance, decreasing functional residual capacity, and impairing diaphragmatic function, thereby predisposing patients to PPCs.(8)

The incidence of postoperative pulmonary complications in the present study was notable, with atelectasis being the most common complication (25%), followed by prolonged mechanical ventilation (21.9%) and pleural effusion (18.8%). Atelectasis remains the most frequent PPC after cardiac surgery due to anesthesia-induced alveolar collapse, shallow breathing secondary to postoperative pain, and impaired secretion clearance. Prolonged mechanical ventilation observed in nearly one-fifth of patients may be attributed to delayed recovery, poor cardiac function, or underlying pulmonary compromise. Pneumonia (Pneumonia) occurred in 15.6% of cases, which is clinically significant because it contributes to prolonged ICU stay and increased mortality. Respiratory failure, though less common (9.4%), represents a severe postoperative event requiring intensive respiratory support.(9,10,11)

Risk factor analysis revealed significant associations between postoperative pulmonary complications and advanced age, smoking, diabetes mellitus (Type 2 Diabetes), chronic obstructive pulmonary disease (Chronic Obstructive Pulmonary Disease), and prolonged duration of surgery. Elderly patients are particularly vulnerable because of reduced pulmonary reserve, impaired immunity, and multiple comorbidities. Smoking history showed a strong association with PPCs due to chronic airway inflammation, impaired mucociliary clearance, and increased secretions. Diabetes predisposes patients to infections and delayed healing, increasing pulmonary morbidity. Similarly, pre-existing COPD significantly compromises baseline lung function, making postoperative recovery more difficult. Longer operative duration further increases the inflammatory response, fluid shifts, and exposure to mechanical ventilation, thereby enhancing pulmonary risk. (12)

Overall, the findings of this study highlight the high burden of pulmonary complications after major CTVS procedures and emphasize the importance of preoperative risk stratification, smoking cessation counseling, pulmonary optimization, early mobilization, respiratory physiotherapy, and vigilant postoperative monitoring. Early identification of high-risk patients and implementation of preventive strategies can significantly improve postoperative outcomes, reduce ICU stay, and enhance overall recovery.

Conclusion:

Postoperative pulmonary complications remain frequent after major CTVS procedures. Early risk identification and preventive interventions can improve postoperative outcomes.

References -

1. Mali S, Haghanejad H. Pulmonary complications following cardiac surgery. *Cardiothoracic Surgery. Arch Med Sci Atheroscler Dis.* 2019;4:e280-e285.
2. Fischer MO, Courteille B, Guinot PG, Dupont H, Gerard JL, Hanouz JL. Postoperative pulmonary complications after cardiac surgery. *J Cardiothorac Vasc Anesth.* 2022;36(5):1329-1340.
3. Tanner TG, Namasivayam M, Tomic V, Playford EG. Pulmonary complications of cardiac surgery. *Semin Cardiothorac Vasc Anesth.* 2020;24(4):315-333.
4. Rong LQ, Di Franco A, Gaudino M. Acute respiratory distress syndrome after cardiac surgery. *J Thorac Dis.* 2016;8(10):E1177-E1186.
5. Apostolakis E, Filos KS, Koletsis E, Dougenis D. Lung dysfunction following cardiopulmonary bypass. *J Card Surg.* 2010;25(1):47-55.
6. Jensen L, Yang L, Risk M. Risk factors for postoperative pulmonary complications in coronary artery bypass graft surgery patients. *Eur J Cardiovasc Nurs.* 2007;6(3):241-246.
7. Odor PM, Bampoe S, Gilhooly D, Creagh-Brown B, Moonesinghe SR. Perioperative interventions for prevention of postoperative pulmonary complications: systematic review and meta-analysis. *BMJ. BMJ.* 2020;368:m540.
8. Dhillon G, Buddhavarapu VS, Grewal H, Munjal R, Verma RK, Surani S, et al. Evidence-based practice interventions for reducing postoperative pulmonary complications: a narrative review. *Open Respir Med J.* 2023;17:18743064271499.
9. Souza AV, Carvalho RC, Dias DC, Santana DGT, Mascarenhas HC, Cordeiro ALL, et al. Clinical and functional outcomes associated with pulmonary complications after coronary artery bypass grafting. *J Cardiothorac Surg.* 2024;19(1):92.
10. Wang D, Zhou X, Liu X, Zhang H. Pneumonia after cardiovascular surgery: incidence, risk factors and interventions. *Front Cardiovasc Med.* 2022;9:911878.
11. Setlers K, Kalnins I, Petersons A. Identifying early risk factors for postoperative pulmonary complications in cardiac surgery patients. *Medicina (Kaunas).* 2024;60(9):1398.
12. Perelló-Díez M, Paz-Lourido B. Prevention of postoperative pulmonary complications through preoperative physiotherapy interventions in patients undergoing coronary artery bypass graft: literature review. *J Phys Ther Sci.* 2018;30(8):1034-1038.