Original Article

Post-Operative Complications of Pneumonectomy and It's Management

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ABSTRACT

Objective: To evaluate post-operative complications of pneumonectomy and their management.
Study Design: Prospective study
Place and Duration of Study: This study was conducted at the thoracic surgery Lady Reading Hospital, Peshawar from January 2023 to December 2023.
Methods: Overall, 150 patients were included in this study. The study examined various factors including age, sex, preoperative conditions, pulmonary function, gas exchange tests, indications for operation, preoperative clinical stage, neoadjuvant treatment, type of analgesia, morbidity.
Results: Minor complications were observed in 83.3% patients. The most common minor complication in the patients was atrial dysrhythmia, noted in 53.6% patients. Major complications were observed in 56.7% patients. The most common major complication was pneumonia and noted in 51.8% patients. BMI was the effect modifier for the major complications, ($p<0.050$).
Conclusion: Pneumonectomy poses higher risks compared to other lung surgeries. Sleeve resections should be considered first. A multidisciplinary team must assess the necessity of pneumonectomy and be vigilant for potential complications. Preoperative evaluation and postoperative monitoring are important for early complication detection and treatment.

Key Words: Pneumonectomy, Post-operative complications, Management, Pneumonia, COPD

Citation of article: Imran M, Ali N, Ehsan Z, Jamil ur Rehman, Hameed J, Ashraf MS. Post-Operative Complications of Pneumonectomy and It's Management. Med Forum 2024;35(3):23-26.doi:10.60110/ medforum.350305.

INTRODUCTION

Pneumonectomy, a surgical procedure involving the removal of an entire lung, carries risks of various complications including respiratory issues like pneumonia and atelectasis, cardiovascular problems such as arrhythmias or pulmonary embolism, potential infections in surgical wounds[1], bleeding complications, post-operative pain[2], and nutritional challenges due to difficulty in eating or swallowing[3]. On April 5, 1933, Evarts Graham achieved the first successful pneumonectomy, targeting T2 N1 squamous cell carcinomas; however, despite advancements in surgical methods and perioperative care, pneumonectomy continues to entail higher mortality and morbidity rates compared to lesser resections[4,5].

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Received: January, 2024
Accepted: February, 2024
Printed: March, 2024

The management of post-operative complications following pneumonectomy typically involves a multidisciplinary approach, where the surgical team, intensivists[6], respiratory therapists, and other specialists collaborate to address specific issues[7,8]. This may include prescribing antibiotics to prevent or treat infections, employing respiratory therapy techniques such as chest physiotherapy and incentive spirometry to promote lung expansion and prevent complications like atelectasis, managing pain through analgesic medications or regional anesthesia techniques, administering intravenous fluids and electrolyte management to maintain hydration and prevent pulmonary edema[9], closely monitoring vital signs and oxygen saturation for early detection and management of complications, and implementing rehabilitation interventions such as physical and respiratory therapy to aid in regaining strength, mobility, and respiratory function post-surgery[10].
The findings of this study can guide the surgeons in implementing preventive measures to reduce the risk of complications associated with pneumonectomy. Strategies such as pre-operative optimization of pulmonary function and perioperative physiotherapy may help mitigate postoperative complications.

METHODS

Study was conducted at department of thoracic surgery Lady Reading Hospital, Peshawar from January 2023 to

December 2023. Study was started after ethical approval from hospital ethical board and written informed consent was taken from patients. In this study, patients diagnosed with small cell lung cancer or low-grade malignant histological types such as carcinoid tumor, mucoepidermoid carcinoma, or unclassified carcinoma were excluded from the analysis. The study examined various factors including age, sex, preoperative conditions, pulmonary function, gas exchange tests, indications for operation, preoperative clinical stage, neoadjuvant treatment, type of analgesia, morbidity, and operative mortality.

The preoperative respiratory function was meticulously evaluated using blood gas analysis, spirometry, and a lung perfusion scan, alongside the assessment of predicted postoperative forced expiratory volume in 1 second (ppoFEV). Patients with risk factors for coronary artery disease (CAD) underwent further assessment via echocardiography, myocardium scintigraphy, or coronary angiogram. Additionally, the American Society of Anesthesiology (ASA) score was utilized for risk classification. Clinical and pathological staging adhered to the TNM criteria of the international system for staging lung cancer. Standard pneumonectomy, defined as the intrapericardial or extrapericardial removal of the entire lung while performing radical dissection of the mediastinal lymph nodes without resecting the mediastinal chest wall or diaphragmatic structures, was the surgical approach employed.

The clinical and surgical variables associated with complications include patients aged over 70 years, those with a body mass index (BMI) exceeding 30, smokers, individuals with chronic obstructive pulmonary disease (COPD), those classified under higher ASA classes, individuals with coronary artery disease (CAD), patients with advanced carcinological staging (IIIA, IIIB), those who underwent neoadjuvant therapy, the side of the operation, the chosen technique for bronchial stump closure, and the utilization of epidural analgesia.

SPSS version 27 was applied and p value 0.05 was considered as significant after test of significance.

RESULTS

Overall, 150 patients were included in this study with mean age 58.46±5.59 years. Majority of the patients 94 (62.7%) were less than 60 years of age. There were 103 (68.7%) males and 47 (31.3%) females. The average BMI of the patients was 26.68±2.86 kg/m^2. There were 37 (24.7%)patients' current smokers. COPD was noted in 31 (20.7%) patients. Most of the patients i.e. 78 (52.0%) had ASA II. There were 44 (29.3%) patients had II carcinological stage. Neoadjuvant therapy was given to 14 (9.3%) patients. Right and left pneumonectomy was noted as 100 (66.7%) and 50 (33.3%), respectively. Bronchial stump coverage was observed in 42 (28.0%) patients. Further, Epidural analgesia was given to 69 (46.0%) patients. (Table. 1).

Minor complications were observed in 125 (83.3%) patients. The most common minor complication in the patients was atrial dysrhythmia, noted in 68 (53.6%) patients. Major complications were observed in 85 (56.7%) patients. The most common major complication was pneumonia and noted in 44 (51.8%) patients. (Table. 2). BMI was the effect modifier for the major complications, ($p<0.050$). (Table. 3).

Table No. 1: Demographic and baseline characteristics of the study patients

Variable	Presence
Age (years)	58.46±5.59
<60	94 (62.7)
≥60	56 (37.3)
Sex	
Male	103 (68.7)
Female	47 (31.3)
BMI (kg/m^2)	26.68±2.86
<25	45 (30.0)
≥25	105 (70.0)
Smoking status	37 (24.7)
COPD	31 (20.7)
ASA	
I	35 (23.3)
II	78 (52.0)
III	37 (24.7)
CAD	28 (18.7)
Carcinological staging	
I	50 (33.3)
II	44 (29.3)
IIIA	31 (20.7)
IIIB	25 (16.7)
Neoadjuvant therapy	14 (9.3)
Pneumonectomy	
Right	100 (66.7)
Left	50 (33.3)
Bronchial stump coverage	42 (28.0)
Epidural analgesia	69 (46.0)
N (%), Mean±S.D	

Table No. 2: Minor and major complications in thewhole study patients

Variable	Presence
Minor complication	125 (83.3)
Atrial dysrhythmia	68 (53.6)
Bronchoscopy for secretions	34 (27.2)
Vocal cord paralysis	24 (19.2)
Major complications	85 (56.7)
Reintubation	6 (7.1)
Reoperation for bleeding	7 (8.2)
Bronchopleural fistula	12 (14.1)
Empyema	3 (3.5)
Pneumonia	44 (51.8)
Pulmonary oedema /ARDS	5 (5.9)

Pulmonary emboli	5 (5.9)
Myocardial infarction	3 (3.5)
N (%)	

Table No. 3: Association of major complication with demographic and baseline variables of the patients

Variable	Major complication		p-value
	Yes 85 (56.7%)	No 65 (43.3%)	
Age (years)			
<60	51 (60.0)	43 (66.2)	0.440
≥60	34 (40.0)	22 (33.8)	
Sex			
Male	60 (70.6)	43 (66.2)	0.562
Female	25 (29.4)	22 (33.8)	
BMI			
<25 kg/m^2	31 (36.5)	14 (21.5)	0.038
≥25 kg/m^2	54 (63.5)	51 (78.5)	
Smoking status			
Yes	24 (28.2)	13 (20.0)	0.246
No	61 (71.8)	52 (80.0)	
COPD			
Yes	18 (21.2)	13 (20.0)	0.860
No	67 (78.8)	52 (80.0)	
ASA			
I	23 (27.1)	12 (18.5)	0.427
II	41 (48.2)	37 (56.9)	
III	21 (24.7)	16 (24.6)	
CAD			
Yes	19 (22.4)	9 (13.8)	0.185
No	66 (77.6)	56 (86.2)	
Carcinological staging			
I	30 (35.3)	20 (30.8)	0.719
II	24 (28.2)	20 (30.8)	
IIIA	19 (22.4)	12 (18.5)	
IIIB	12 (14.)	13 (20.0)	
Neoadjuvant therapy			
Yes	8 (9.4)	6 (9.2)	0.970
No	77 (90.6)	59 (90.8)	
Pneumonectomy			
Right	53 (62.4)	47 (72.3)	0.200
Left	32 (37.6)	18 (27.7)	
Bronchial stump coverage			
Yes	25 (29.4)	17 (26.2)	0.660
No	60 (70.6)	48 (73.8)	
Epidural analgesia			
Yes	37 (43.5)	32 (49.2)	0.488
No	48 (56.5)	33 (508)	

DISCUSSION

In this study average BMI of the patients was 26.68±2.86 kg/m^2. There were 24.7% patients' current smokers. COPD was noted in 20.7% patients. Most of the patients i.e. 52.0% had ASA II. There were 29.3% patients had II carcinological stage. In previous studies conducted by Alloubiet al[11] and Algar et al[12], it was reported that underlying pulmonary disease, particularly COPD, has been advocated as a major risk factor for postoperative complications.

Previous study conducted by Bernard et al[14] reported rate of respiratory insufficiency ranging from 3.3% to 21.8%, with post-pneumonia rates falling between 3.3% and 17.4%. Chest physiotherapy is strongly advocated to mitigate atelectasis and prevent secondary infections. Given the grave risk of pneumonia post-pneumonectomy, meticulous preoperative assessment, emphasis on preserving functional residual volume through pre- and postoperative physiotherapy, effective pain management, and prompt mobilization are imperative for improved patient outcomes.

In this study coronary artery disease was found in 18.7% of patients and its part of major complication in 22.4% of patients and emphysema in 3.5% of patients. Weinmann et al[14] reported that myocardial ischemia or infarction was directly attributed to operative death in two patients with pre-existing coronary artery disease (CAD). We advocate for the implementation of a stringent selective screening process to identify patients necessitating heightened preoperative care, including myocardial revascularization if feasible, prior to surgery.Empyema was observed in 2.4% of our patients, while the occurrence rate ranged from 2% to 16% according to existing literature[15].

Vocal cord paralysis and arrhythmias were found 19.2% and 53% in this study. In a study Alloubi et al[12] recurrent laryngeal nerve damage is the second most common complication after pneumonectomy. Treatment involves assessing the extent and permanence of the injury. Fiberoptic study helps in precise evaluation of laryngeal function. Prevention, through techniques like the "no-touch" approach and avoiding excessive coagulation during surgery, is emphasized.In previous study conducted by Vaporciyan et al[16] reported arrhythmia is the most common complication after thoracic surgery, especially following pneumonectomy. Its incidence ranges from 11 to 47%, with supraventricular arrhythmias, such as atrial fibrillation, being most common. These arrhythmias typically occur within the first 72 hours post-surgery.

In this study pulmonary edema and pulmonary emboli was observed in 5.9% of patients. Işik et al[17] found higher risk of pulmonary artery thrombus with transfixation ligature than continuous suture closure due to intimal damage. Prevention outweighs treatment in all diseases. Nagahiroet al[18] strongly advocate intermittent pneumatic compression. Anticoagulant therapy raises concern of increased bleeding and epidural hematoma risk.

CONCLUSION

Pneumonectomy poses higher risks compared to other lung surgeries. Sleeve resections should be considered first. A multidisciplinary team must assess the necessity of pneumonectomy and be vigilant for potential complications. Preoperative evaluation and postoperative monitoring are important for early complication detection and treatment.

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Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: No.202/LRH/MTI dated 21.11.2022

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