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Original Article

Clinical Outcomes of Pulmonary Resections for Benign Lung Diseases in Adults

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ABSTRACT

Benign lung diseases (BLD) are a spectrum of diseases that require medical and surgical attention. Surgical treatment in majority cases provides curative treatment in majority of the cases. **Objective:** To assess the clinical outcome in patients who undergo pulmonary resection for various indications in BLD. **Methods:** A prospective study was conducted in The Department of Thoracic surgery at Jinnah Postgraduate Medical Center, Karachi from June 2021 to June 2022. All symptomatic patients above the age of 12 years with radiological evidence of resectable lung disease with good cardiopulmonary reserve were included. **Results:** Eighty-four patients were included; sixty-six (78.6%) were males. Most common indication for resection was bronchiectasis (n=32; 38.1%) and aspergilloma (n=22; 26.2%). Majority of the patients presented with productive cough (44; 52.3%), chest pain (41; 48.8%) and hemoptysis (28;33%). Eighteen (81.8%) out of 22 patients of aspergilloma were complex in nature. Lobectomy (67; 78.8%) was most commonly performed followed by wedge resection (10; 11.7%). Forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) both were significantly improved after lung resection (p<0.001). The most common complications were post resection fluid (n=12; 14.2%), residual pleural space (n=10;11.9%). Three patients (3.6%) died; two (2.38%) due to respiratory failure and one (1.2%) after myocardial infraction. **Conclusions:** Despite limitations, lobectomy and lesser pulmonary resections are safe procedures when patients are carefully selected and prepared. Management in a dedicated Thoracic Surgical unit is essential to keep the complication rate under control and patients should be assessed for symptomatic (spirometric) and radiological improvement on follow up visits to document ongoing clinical improvement for an improved quality of life.

INTRODUCTION

The rationale for lung surgery in benign lung disease (BLD) is to resect permanently damaged lung, as it is not beneficially participating in gaseous exchange and may be the source of lingering infection, hemoptysis, antibiotic resistance, dyspnea and poor quality of life [1]. Major lung resections are among the procedures with a considerable morbidity and mortality (2-12%) despite improvement in surgical methods and intensive care [2]. Pulmonary resection (PR) has undergone a number of significant evolutionary modifications to improve outcome as a result of advancement in surgical techniques [3]. Both benign and malignant lung pathologies are common reasons for lobectomy [4]. The predominant rationale for lobectomy among BLD is persistent lung infection (bronchiectasis, drug-resistant tuberculosis, aspergilloma lung, large pulmonary hydatid cyst), whereas other conditions include emphysema, pulmonary sequestration and arteriovenous malformations [5]. Patients with BLD may require anatomical to nonantomical lung resections under specific circumstances [6]. The most common resection performed is lobectomy followed by segmentectomy and pneumonectomy in cases of aspergilloma lung, pulmonary tuberculosis (TB) sequel, bronchiectasis, hydatid cyst and giant bulla [6,7]. Additionally, uncommon causes are taken into account, such as severe pulmonary trauma, bronchopleural fistula (BPF), emphysema coupled with severe hyperinflation, and uncommon congenital abnormalities like pulmonary sequestrations [8]. Pneumonectomy for destroyed lung due to complicated tuberculosis is still a challenge for thoracic surgeons in many areas of the world [9]. Pulmonary complications are mainly responsible for morbidity of patients undergoing

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major PR [10]. The rationale of this study was to identify various benign etiologies presenting with clinical symptoms that require surgical intervention. The aim was to assess both clinical and spirometric outcomes of pulmonary resection in BLD and to add to the scarcity of local literature in this aspect..

METHODS

A prospective interventional study was conducted in the Department of Thoracic surgery at Jinnah Postgraduate Medical Center, Karachi from June 2021 to June 2022. A non-probability consecutive sampling technique was employed to recruit the participants in the study. All symptomatic patients above the age of 12 years with radiological evidence of resectable BLD with good cardiopulmonary reserve, exercise tolerance, and spirometric values were included in the study. Patients younger than 12 years of age with a low pulmonary reserve, forced expiratory volume in one second (FEV1) of < 0.8L; and forced vital capacity (FVC) of < 1.2L, with a recent (less than 3 weeks) positive AFB smear, or those diagnosed with pulmonary hypertension with pulmonary artery (PA) pressures >32mmHg were excluded from the study. All patients were prepared in terms of adequate cardiopulmonary reserve, infection control, tuberculosis status, coagulopathies, and antifungal therapy. For all patients, preoperative measures were taken including full bronchodilation, tapering of steroids, incentive spirometry, ongoing infection control, pulmonary toilet, adequate nutrition to improve exercise tolerance and reduce the likelihood of post-operative complication. Patients were followed up weekly for the first two weeks then at the 1st, 3rd, 6th and 12th month. On each follow-up visit patients were assessed for improvement in symptom and radiology. Spirometry was done prior to procedure and at six month following surgery where applicable. All data documented on a predefined pro forma were analyzed using SPSS for Windows version 22.0 (IBM SPSS, Chicago, IL, USA). All continuous variables were presented as mean and standard deviation including mean age, FEV1 values, etc. All categorical values including indications for surgery, type of lung resection and any complications were presented as frequency and proportions.

RESULTS

A total of 84 patients with BLD underwent 85 lung resections. One patient underwent completion lobectomy for right lower lobe bronchiectasis. There were 66 (78.6%) males and 18 (21.4%) females. Most common age group was 31-40 years (24; 28.5%), followed by 21-30 years (21; 25%), 41-50 years (19; 22.6%), 12-20 years (11; 13.1%), and 51-60 years (9; 10.7%). Majority of the patients presented with productive cough (n=44; 52.3%) and chest pain (n=41; 48.8%). Twenty-eight (33.3%) patients presented with hemoptysis. Out of these, 16 (57.1%) had aspergilloma while 12 (42.8%) had bronchiectasis caused by treated mycobacterium tuberculosis, pneumonia and foreign body inhalation. Three patients with idiopathic pulmonary fibrosis presented with shortness of breath only, figure 1.

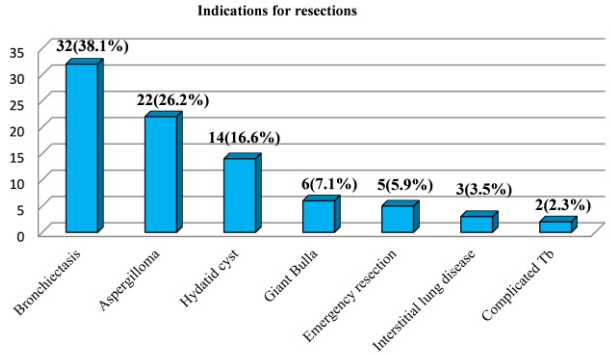

Figure 1: Indication for resections (n=84)

The most common indication for PR was bronchiectasis in 32 (38.1%) patients followed by aspergilloma in 22 (26.2%) as illustrated in Figure 1.

Three-fourths (16; 72.7%) of the aspergilloma cases had right upper lobe (RUL) involvement. In bronchiectasis patients, the left lower lobe (LLL) was the most commonly involved lobe as seen in 16 (50%) cases. Lobectomy (n=67/85; 78.8%) was the most common resection performed followed by wedge resection (n=10/85; 11.7%) and segmentectomy (n=06/85; 7.06%). Pneumonectomy (2/85; 2.3%) was the least common procedure performed. Clinical characteristics along with lung involvement are presented in table 1. In patients undergoing pulmonary resection mean of pre-operative forced expiratory volume in FEV1 was 1.58±0.38 L and pre-operative FVC was 3.00±0.18 L. Statistically significant improvement was seen in both post-operative FEV1 (2.04 ±0.30L; p 0.001) and post-operative FVC (3.52±0.21; p< 0.001), Table 1.

	Bronchiectasis	Hydatid cyst	Giant Bulla	Aspergilloma	ILD*	ER*	CTB*
Symptoms							
Productive cough (44)	33(75%)	5(11.3%)	-	6(13.6%)	-	-	-
Chest pain (41)	10(24.3%)	14(34.1%)	5(12.1%)	12(29.2%)	-	-	-
Shortness of breath (34)	9(26.4%)	7(20.5%)	5(14.7%)	8(23.52%)	3(8.8%)	-	2 (5.88%)
Hemoptysis (28)	12(42.8%)	-		16(57.1%)			
Symptoms							
LLL**	16(50%)	4(28.5%)	-	-	-	-	-
RLL**	12(38.7%)	8(57.1%)	-	-	-	1(20%)	-
RUL**	-	-	4(66.6%)	17(77.27%)	-	3(60%)	-
LUL**	-	1(7.15%)	2(33.3%)	4(18.18%)	-	1(20%)	-
RML**	4(12.9%)	1(7.14%)	-	1(4.55%)	-	-	-
Right lung							2(100%

* ILD= Interstitial lung disease, ER= Emergency resection, CTB= Complicated tuberculosis, **LLL= Left lower lobe, RLL= Right lower lobe, RUL=Right upper lobe, LUL=Left upper lobe, RML=Right middle lobe

Table 1: Distribution of clinical characteristics with respect to the indications for pulmonary resection and lobe involvement

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Figure 2 represents Spiro metric values of patient with trend lines showing persistent improvement in both FEV1 and FVC values at 6 months.

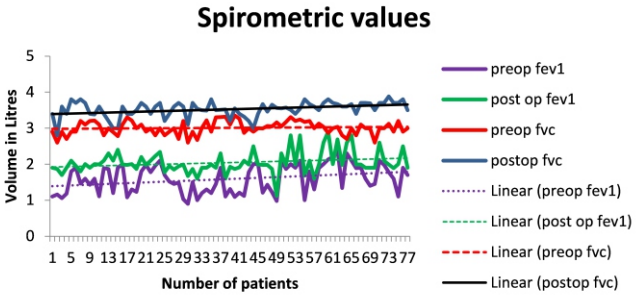

Figure 2: Pre-operative and post-operative spirometric volumes in patients

A total of 78 (92.86%) patients visited the center for a follow-up within one year of surgery. Six (7.14%) patients were lost to follow up. The most common early complications were post resection fluid collection (n=12;14.2%), post resection residual pleural space (n=10;11.9%), and prolonged air leak (PAL) (n=8;9.5%). In these patients, chest physiotherapy and incentive spirometry were performed. In addition, ultrasound guided aspiration and chest tube placement with negative suction techniques were used to remove the post resection fluid (PRF) which was successful in all cases. Figure 3 represents complications encountered in patients undergoing resections. Overall, three patients (3.6%) died. One patient with traumatic thoracotomy who underwent a lobectomy for shattered lobe and severe hemorrhage had an acute myocardial infarction within 24 hours post-surgery. The other two patients who died had type II respiratory failure following lung resection (Interstitial Lung disease, Complex Aspergilloma Lung).

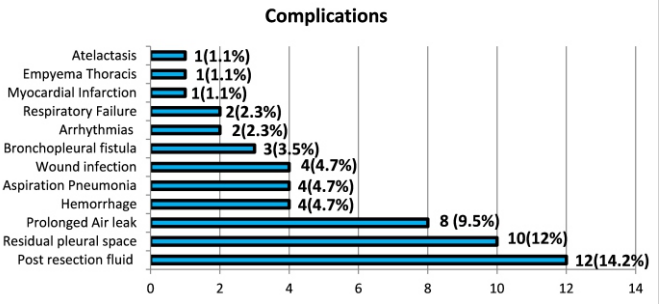

Figure 3: Frequency of complications following resections

DISCUSSION

Surgical resection is sometimes the only realistic chance of achieving lasting cure for many BLD including bronchiectasis, aspergilloma lung, large hydatid cyst, giant bullae, complicated TB and emphysema lung [5, 6, 7, 11, 12]. Acquired bronchiectasis is commonly caused by recurrent bacterial, viral and tuberculosis infection, other rare causes include secondary obstruction by tumor or foreign body [1, 11, 13]. In our study most of bronchiectasis was caused by recurrent tuberculosis, pneumonia and foreign body. Majority of the studies report LLL as the most common lobe with bronchiectic changes with frequency ranging from 35 % to 53% [1,6,11,12,13]. This is comparable with our study, in which most common lobe involved was LLL (16; 50%).Thirty-two (38.1%) patients with bronchiectasis underwent lobectomy with favorable outcome. We found that non anatomical resections are less effective in bronchiectasis as one patient underwent completion lobectomy after having a segmentectomy of LLL. In bronchiectasis patient's postoperative complications is seen in 10% to 14 % which include wound infection, pneumonia, prolong air leak (PAL), empyema and BPF [11,13,14]. This is in accordance with our study, where most common complications were residual pleural space (RPS) in 6 (18.18%) followed by PRF collection in 4 (12.12%) and PAL in 3 (3.57%) and BPF in 1 (1.19%). Many complications were prevented by use of double lumen endotracheal tube and avoidance of spillage in thoracic cavity. In our study we found complex aspergilloma lung involving upper lobe in 18 (81.8%) cases. This group of patient had significantly higher complications observed due to dense, extensive adhesions and pleural fibrosis. The mortality with complex aspergilloma was 4.5% (one death). One male patient with history of smoking, chronic obstructive pulmonary disease(COPD) and diabetes died secondary to type two respiratory failure within 48 hours of left upper lobectomy for complex aspergilloma lung. In a study by Setianingrum et al., it was found that 25 (41%) patients with aspergilloma lung relapsed within 26 months of wedge resection and segmentectomy [15]. Alemu et al, operated 72 patients and reported a mortality of 4.2% secondary to respiratory failure, intraoperative massive bleeding and sepsis. Postoperative non-fatal complications occurred in 29 patients (29.1%). Most common complications included as PAL, empyema, BPF and others [16]. Our study endorses a similar mortality rate (4.5%). In this study, 14 (16.6%) patients with complicated hydatid cyst with more than half of lobe underwent anatomic lung resection: lobectomy in 12 (85.7%) and segmentectomy in 2 (14.2%). In a study by Dogru MV et al., authors discovered that younger patients were diagnosed with giant pulmonary hydatid cysts due to more stretchable lung tissue which frequently involved right lower lobe in 50.5% of the patients. In his study 34 out of 283 patients underwent lobectomy. Similarly, postoperative complications were seen in 29 (10.2%) patients. PAL was observed in 12 (4.2%) patients as the most common complication which is higher than encountered in our study (n=2; 2.3%) [17]. In this study, five patients (5.9%) underwent emergency thoracotomy with anatomical lung

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resection for massive hemothorax following blunt and penetrating injuries. Three (60%) patients underwent wedge resection for partially shattered left upper lobe due to gunshot injury. Other two (40%) patients underwent lobectomy due to severe hemorrhage in deep lobar injuries. In study conducted in Italy, wedge resections were performed in 54 % patients and lobectomy in 38% with mortality of 27% [18]. We saw mortality in one (1/5; 20%) patient. In the present study, the most frequent complication was PRF collection in 12 (14.2%) patients which was managed with ultrasound guided aspiration and chest tube drainage with negative suctioning. Next commonest complication was RPS in 10 (11.9%) patients. The RPS can be observed in 10% of the patients after lobectomy or higher resection and an uncomplicated course following if residual cavity does not get infected and/or a fistulous communication with pleura does not develop [19]. In our study the RPS resolved at 6 months with incentive spirometry, bronchodilation and chest physiotherapy. PAL is a common complication after anatomic lung resection with an incidence of 10%. Patients may require prolonged chest tube drainage, blood pleurodesis or revision of stump [17, 20]. In our study PAL was managed with bronchodilation, low pressure negative suction and Heimlich valve® once discharged home. Wound infection required culture based antibiotics and daily dressing. BPF is a terrible complication with mortality of 11% to 18% usually observed after pneumonectomy and lobectomy. This complication should be identified and addressed earlier to prevent morbidity and mortality [20]. In our study BPF was seen in 3 (3.5%) patients and managed with antibiotics, tube drainage and postoperative residual space control. Guz et al., studied the spirometry values which were obtained preoperatively and postoperatively in patients undergoing pulmonary resection; It was found that patients who underwent lobectomy or segmentectomy had significantly higher forced expiratory volume in 1 second (FEV1) than patients who underwent wedge resection (P<0.01). The studies further revealed that pulmonary function loss was significantly lower after lobectomy than after segmentectomy as per all spirometry indices (P<0.001) [21]. These findings are in line with our study where it was found that the spirometry values were significantly greater postoperatively at 6 month follow-up. The mean spirometric values preoperatively were FEV1 1.58 ± 0.38 L and FVC 3.00 ± 0.18 L. After variable pulmonary resections, the mean spirometry was FEV1 2.04 ± 0.30 L and FVC 3.52 ± 0.21 L at 6 months with p-value of <0.001, respectively. Therefore, average spirometric values significantly improved statistically. In contrast, a study by Taylor et al. revealed no correlation between postoperative complications and FEV1 or diffusion capacity for carbon monoxide (DLCO)< 50% thus concluding that care must be exercised when using pulmonary index score assessing the patient discourse postoperatively [22]. However, Zhang et al. revealed both postoperative FEV1 and DLCO% were found to predict complications in multivariate analysis stratified by disease severity [23]. Ferguson et al, reported similar findings and suggested postoperative lung function assessment as a good tool for predicting survival [24]. Yun et al. evaluated approximately hundred patients who had BLD and opted for lung surgery. It was found that one-quarter of the patients suffered from postoperative complications including prolonged air leak in fourteen cases. The study further revealed an in-hospital mortality rate of 3.2% [12]. This is in accordance with our study where the overall mortality rate was 3.6%.One patient, a smoker, on long term oral steroid use for Interstitial Lung disease (ILD) died while on ventilator support for type II respiratory failure following wedge biopsy. Another patient underwent an emergency right upper lobectomy for shattered lobe, massive hemothorax secondary to trauma and died secondary to significant blood loss that led to acute myocardial infarction. In a study from Peshawar, it was found that the mortality rate for patients who underwent pneumonectomy was 1.63% and morbidity rate was 5.41%. The most common postoperative complications were BPF, empyema, and wound infection [25]. Our patients showed a definitive improvement both clinically, radiologically and through their post-operative spirometric values statistically. They were able to exert without dyspnea and were able to contribute to their family's well-being becoming economically useful members of the society without becoming a burden. This immensely helped their social and psychological outlook and improved their quality of life in the long run. The current study had some limitations. Firstly, as the sample size is small, the findings of the present study should not be projected to a larger targeted population base. Secondly, the long-term patient outcome (> 1year) could not be assessed as it was not the target of our present study. Therefore, it is recommended that a larger, multicenter study should be undertaken to evaluate the role of pulmonary resection in BLD and its outcome in a more comprehensive manner in terms of longer follow up.

CONCLUSIONS

It is evident that lung resection offers improvement in pulmonary function post-resection when patients are chosen cautiously. Despite limitations, lobectomy and lesser pulmonary resections are safe procedures. Use of antibiotic therapy, improved infection control, strict follow-up, early referral of a patient with resectable BLD to tertiary care hospital may aid in improving the patient

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outcomes in terms of improved quality of life.

Conflicts of Interest

The authors declare no conflict of interest.

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