

Recovery of Pulmonary Function After Lung Resection as Compared to Release Surgery: A Retrospective Study

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Abstract

Aim: To study the demographic, etiology and clinical characteristics of patients undergoing thoracotomy and to assess the changes in pulmonary functions after surgery. **Materials and Methods:** A retrospective observational study was conducted in 50 patients who had undergone decortications or lung resection surgeries for benign lung diseases over a period of 2 years and 8 months between March 2017 to Nov 2019. Baseline clinical and demographic data were collected. All patients (aged 18 years & above) admitted or referred to CTVS department and who underwent decortications and lung resectional surgery done for benign lung diseases were included in this study. All demographic details, symptoms, associated co morbidities, pre and post operative PFT (FVC and FEV1), and complications after surgery were reviewed. Percentage change in PFT a 3 and 6 months after surgery were assessed. Repeated measure ANOVA were used for statistical analysis. **Results:** In this study 50 thoracotomies were performed. The mean age of patient was 38.6 yrs (range 16-62 yr). There were 35 male & 15 female (M:F =2.3:1). Cough was the most common symptom (60%). Etiology was infectious in 40 cases (80%) and non infectious in 10 (20%). Decortications was done in 25 patients while lung resection surgeries were done in 25 patients. In decortication group, change in FEV1/FVC was not significant. FVC was raised from 53.8 % to 81.6 % (of predicted value) and FEV1 from 60.9 % to 89.5 % (of predicted value) after 6 month. Improvement in these spirometric values after 6 months was quantified statistically significant. In lung resection group, functional loss in FVC and FEV1 after 6 month was about 14.33% and 15.32 % respectively. **Conclusion** After lung resection, FVC & FEV1 decreases significantly from pre operative value after surgery till 3 months after surgery and increases again from 3 to 6 months while after decortication, FVC & FEV1 were significantly raised in comparison to pre-op values after 6 months.

Keywords: Forced expiratory volume, Lung diseases, Pulmonary function test, Thoracotomy, Tuberculous/surgery, Vital capacity.

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Introduction

Pulmonary complications are always associated with thoracotomies leading to increased morbidity in postoperative period and leads to decreased lung capacities afterwards. In contrast to western countries, still in India benign diseases especially infectious diseases are common indications for thoracotomy with decortications, lobectomy, segmentectomy and pneumonectomy either done by open or video assisted.[1,2] In India, majority of the surgeries are for empyema and post- tubercular bronchiectasis [2] Although incidence of empyema is decreasing due to advent of antibiotics, early diagnosis and better treatment facilities .Morbidity and mortality associated with these thoracic surgeries has also reduced in recent years.[3] Decortication for empyema is still a commonly done procedure in India. Apart from decortication, lung resection surgery for bronchiectasis, Aspergilloma, benign lung tumors and resection of mediastinal tumors are routinely done in most of the tertiary care centres.[1]Pulmonary complications are always associated with thoracotomies leading to increased morbidity in postoperative period and leads to decreased lung capacities afterwards. All these limitations are due to restricted chest wall movement, impaired diaphragm movement, and loss of lung parenchyma if associated with lung resection. Although these parameters starts to improve two

weeks after surgery but the deleterious effects do not resolve for nearly 3 months after surgery. It has been reported by many studies that major lung resection permanently reduces the lung capacity depending on the extent of lung resection.

When measured 6 months to 1 year postoperatively, segmental or wedge resections reduce lung function by <10%, lobectomy or bilobectomy results in decreases of 5% to 15%, and pneumonectomy reduces values by 20% to 40% [4-6]. The aim and objectives of this study was to study the demographic, etiology and clinical characteristics of patients undergoing thoracotomy and to assess the changes in pulmonary functions after surgery.

Materials and Methods

This retrospective observational study was conducted in tertiary level hospital for a period of two years and 8 months from March 2017 to Nov 2019. All patients (aged 18 years & above) admitted or referred to CTVS department and who underwent decortication& lung resectional surgery were included in this study. All demographic details, symptoms, associated co-morbidities in form of DM, hypertension and pulmonary tuberculosis, pre operative PFT, diagnosis, type of surgery performed, type of incision given and complications after surgery were collected. All traumatic thoracotomies as well as thoracic surgeries done for diaphragmatic, esophageal & cardiac causes were excluded from the study. Patients who were already operated for similar pathology were also excluded. Details of improvement in symptoms and pulmonary functions (FVC and FEV) 3 and 6 months post operative period were collected.

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Consent

Written consent was obtained from the relatives of patients after explaining them the nature and purpose of the study. They were assured that confidentiality would be strictly maintained. The option to withdraw from the study was always open.

Methodology

In this study 50 thoracotomies were performed. Thoracotomies were performed in the left & right side in 20 (40%) & 30 patients (60%) respectively. Posterolateral incision was utilized in 45 patients

(90%). Out of 50 thoracotomies etiology was infectious disease in 40 cases (80%) while in 10 patients had non infectious etiology (Table-1). Encysted pleural collection & collapse was seen in 14 cases (35%), empyema in 11 (27.5%), fibrocavitary changes in 5(12.5%), bronchiectasis in 5 (12.5), ruptured hydatid cyst in 2 (5%) and destroyed lung in 1 case (2.5%). Benign lesion includes hamartoma, lung cyst and bronchial adenomas, papillomas, fibromas etc. (Table-2)

Observation Chart**Table 1:** Indications for thoracotomy

Indications	No.of patients
Benign lesion	10 (20%)
Infectious diseases	40 (80%)

Table 2: Infectious causes of thoracotomy

Infectious lesion	No. of patients (% of patients)
Encysted pleural collection & collapse	14 (35%)
Empyema	11 (27.5%)
Fibrocavitary changes	5(12.5%)
Fungus ball	2(5%)
Bronchiectasis	5(12.5%)
Ruptured hydatid cyst	2(5%)
Destroyed lung	1(2.5%)

Table 3: Procedure done

Lobectomy	12 (24%)
Bilobectomy	3(6%)
Segmentectomy	4(8%)
Wedge resection	4 (8%)
Pneumonectomy	2 (4%)
Decortication	20(40%)
Decortication with thoracoplasty	5(10%)

Table 4: Spirometry variables in patients treated with thoracotomy &decortication

	Expected	Before surgery	After 3 months	After 6 months
FVC (ml)	3.92± 0.75 (100%)	2.11±0.94(53.8%)	2.82± 0.75(71.9%)	3.20±0.90(81.6%)
FEV1 (ml)	3.15± 0.78(100%)	1.92±0.78(60.9%)	2.58±0.62(81.9%)	2.82 ±0.60(89.5%)
FEV1/FVC		90.99±12.26	9.48±8.75	88.12±8.12

Table 5: Spirometry variables in patients treated with lung resection surgery

	Expected	Before surgery	After 3 months	After 6 months	Functional loss at 6 month post operation
FVC (ml)	4.12±0.68(100%)	2.86± 1.65 (69.4 %)	2.10± 1.48(50.9%)	2.45±1.42 (59.46%)	14.33%
FEV1 (ml)	3.48±0.53(100%)	2.48±1.54(71.26%)	1.92±1.20(55.17%)	2.10±1.58(60.34%)	15.32%
FEV1/FVC		85.47± 14.36	84.48±15.68	85.61±16.5	

In decortication group, FVC & FEV1 after 6 months were significantly raised in comparison to pre op values. However, change in FEV1/FVC was not significant. FVC was raised from 53.8 % to 81.6 % (of predicted value) and FEV1 raised from 60.9 % to 89.5 % (of predicted value) after 6 month (Table-4). In lung resection group, spirometry variables (FVC& FEV1) were decreased significantly from pre operative value after surgery till 3 months after surgery and increased again from 3 to 6 months. Difference between pre op - post op (3 month) and pre op - post op (6month) was significant. However, change in FEV1/FVC was not significant. Functional loss in FVC and FEV1 after 6 month was about 14.33% and 15.32 % respectively as compared to the pre-operative values.(Table-5)

Results

Our study comprises of 50 thoracotomies performed in 2 years duration. The mean age of patient was 38.6 yrs (range 16-62 yr). There were 35 male & 15 female (M:F=2.3:1). In our study cough was the most common symptom present in 30 patients (60%), haemoptysis in 20 (40%), difficulty in breathing in 20(40%), anorexia and loss of weight in 15 (30%), fever in 20 (40%),

hemoptysis in 15 (30%), chest pain 15 (30%), recurrent pleural effusion 10(20%). Tubercular etiology was present in 20 pts (40%). 5 patients were diabetic & 5 pt was hypertensive. 30 patients were addicted to smoking. In our study, decortications were done in 25 patients while lung resection surgeries were done in 25 patients. Decortication was done in 20 patients (40%), decortication with thoracoplasty in 5(10%), lobectomy in 12 (24%), segmentectomy and wedge resection in 4 cases each(8%), bilobectomy in 3(6%) and pneumonectomy in 2 (4%).(Table-3) In our study mean ICU stay was 3 days±2 days and hospital stay was 12 days±5.22 days. In our study there were 2 deaths .One died due to post operative bleeding & complication of massive blood transfusion. Other died due to respiratory failure & sepsis. In follow up, after 1 month 4 patients (8%) had fever & their chest X-ray were suggestive of mild pleural effusion. 4 patients (8%) were having persistent chest pain.

Statistical Analysis

Statistical analysis was done with statistical software SPSS version 20. Normally distributed numerical variables were analyzed by student t-test. Mann-Whitney test U test was used for variables which

were not normally distributed. Categorical variables were analyzed by Fisher's exact test. Intra group were compared by using repeated measure ANOVA test. All analysis were two tailed, P value <0.05 was considered as statistically significant

Discussion

In this study 50 thoracotomies were performed in more than 2 years duration. The mean age of patient was 38.6 yrs (range 16-62 yr). There were 35 male & 15 female (M:F=2.3:1). In the study done by Janso Kollanur et al over 70 patients who underwent thoracotomies 52 were males and 18 were females. Male to Female ratio was 3:1.[1] In our study cough was the most common symptom present in 30 patients (60%), haemoptysis in 20 (40%), difficulty in breathing in 20(40%), anorexia and loss of weight in 15 (30%), fever in 20 (40%), hemoptysis in 15 (30%), chest pain 15 (30%), recurrent pleural effusion 10 (10%). Tubercular etiology was present in 20 patients (40%). 5 patients were diabetic and 5 were hypertensive. 30 patients were addicted to smoking. Harmouchi et al in their study of pulmonary lobectomies for benign diseases, 95% of cases were related to hydatidosis, tuberculosis and its complications like bronchiectasis, aspergilloma, and destroyed lobe. Hemoptysis was the most common symptom observed in this study and it was an important indication to perform lobectomy. Bronchorrhea was present in 50 patients (41.6%), dyspnea in 11 patients (9.1%), hydatid membrane rejection in 6 patients (5%), and chest pain in 4 patients (3.3%). The etiologies were predominated by bronchiectasis in 38 patients (31.6%), hydatid cyst of the lung in 31 patients (25.8%), aspergilloma in 29 patients (24.1%), a tuberculosis destroyed lobe in 14 patients (11.6%), emphysema bubble in 3 patients (2.5%), a hydatid cyst of the liver broken in the thorax in 2 patients (1.6%).[7] Similar etiology for benign causes leads to thoracotomy was also observed by Weber et al in their study. A total of 117 lobectomies for benign disease were analyzed in their study. Bronchiectasis was most common indication for surgery followed by chronic infections. Tuberculosis and emphysema were present in 5 cases each. [8] In our study, out of 50 thoracotomies etiology was infectious in 40 cases (80%) while in 10 patients had non infectious etiology. Encysted pleural collection & collapse was seen in 14 cases (35%), empyema in 11 (27.5%), fibrocavitary changes in 5 (12.5%), bronchiectasis in 5 (12.5), ruptured hydatid cyst in 2 (5%) and destroyed lung in 1 case (2.5%). Decortication was done in 20 patients (40%), decortication with thoracoplasty in 5(10%), lobectomy in 12 (24%), segmentectomy and wedge resection in 4 cases each (8%), bilobectomy in 3 (6%) and pneumonectomy in 2 (4%). Gorman et al in their study over one hundred ninety-two patients who underwent decortications reported that the most frequent disease processes resulting in decortication were pneumonia (60%), trauma (13%), malignancy (8%) and procedural complications (5%).[9] Kollanur et al also reported the most common surgical procedure was decortication for empyema performed in 17 cases (24.2%) in their study, followed by lobectomy in 14 cases (20%). Mediastinal mass lesion excision surgeries were done in 13 cases (18.6%). There were 6 (8.5%) pneumonectomies done for post-tubercular destroyed lung.[1] Average post-operative stay in intensive care unit was 2 days. Average post operative hospital stay was 9 days. Immediate post-operative complications occurred in 9 in cases, all were due to pulmonary cause. All these patients had hypoxia. Two patients required mechanical ventilation for 3 days. No post-operative mortality was recorded.[1] In our study mean ICU stay was 3 days±2days and hospital stay was 12 days±5.22 days. There were 2 deaths. One died due to post operative bleeding and other died due to respiratory failure & sepsis. In lung resection group, spirometry variables (FVC & FEV1) decreased significantly from pre op to 3 months after surgery & increased from 3 to 6 months. Difference between pre op - post op (3 month) and pre op - post op (6month) was significant. However, change in FEV1/FVC was not significant. Functional loss in FVC and FEV1 after 6 month was about 14.33% and 15.32 % respectively. Bolliger et al had also

noticed the similar results. In their study, these variables decreased significantly from preoperative to post operative 3 months and increased again significantly from 3rd to 6th month after surgery. However functional loss in lobectomy group was ±10% (FVC-7% & FEV1-9%). In pneumonectomy group PFT loss was ±30% (FVC-36% & FEV1 -34%).[10] In the study done by Elias Amorim et al on patients with pulmonary tuberculosis who underwent lobectomy and they also observed the improvement in respiratory functions determined by spirometry at the 1st postoperative month due to absence of pain and better compliance and there was progressive improvement of the parameters at the 6th postoperative month and continued at 12 months after surgery (FVC about 15 % and of FEV1 of about 11%). They also observed that there was no significant recovery in spirometric parameters (FEV1, FVC and PEF) after 12 months if they did not reached the mean preoperative values.[11] After lung lobectomy, the values of vital capacity, percentage of predicted vital capacity, forced expiratory volume in 1 second, percentage of predicted forced expiratory volume in 1 second, residual volume/total lung capacity, and maximal voluntary ventilation deteriorated significantly. Six months after lung volume reduction surgery, however, vital capacity, percentage vital capacity showed no significant change, and forced expiratory volume in 1 second, percentage of forced expiratory volume in 1 second, diffusing capacity for carbon monoxide and maximal voluntary ventilation showed marked improvement.[12] Thoracotomy alone produces a reduction in forced expiratory volume in one second (FEV1) while wedge resection produces a non-significant reduction in total lung capacity (TLC). Lobectomy reduces forced vital capacity (FVC), TLC, and carbon monoxide transfer factor but exercise capacity was unchanged.[13] In decortication group, FVC & FEV1 after 6 months were significantly raised in comparison to pre operative values. However, change in FEV1/FVC was not significant. Improvement in FVC was from 53.8 % to 81.6 % (of predicted value) and in FEV1 raised from 60.9 % to 89.5 % (of predicted value) after 6 month. Gorman et al in their study over one hundred ninety-two patients who underwent decortications reported that the most frequent disease processes resulting in decortication were pneumonia (60%), trauma (13%), malignancy (8%) and procedural complications (5%).[13] Thoracotomy with decortication is a useful method of treatment of the fibrinopurulent phase of empyema, which solved the problem and also significantly improved lung function, especially at the follow-up after 6 months. [14] Decortication in chronic pleural empyema significantly enhanced spirometric parameters (FEV1, VC/FVC) in all analysed studies. Considerable differences were observed regarding the mean follow-up time (early postoperative to several months after surgery). Surgical decortication in chronic pleural empyema improves lung function and increases perfusion. Besides a significant enhancement of spirometric parameters, re-expansion of the diseased lung leads to equalization of thoracic asymmetry and may even prevent loss of volume in the affected lung.[15]

Conclusion

After lung resection, FVC & FEV1 decreases significantly from pre operative value after surgery till 3 months after surgery and increases again from 3 to 6 months while after decortication, FVC & FEV1 were significantly raised in comparison to pre-op values after 6 months.

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