The objective and subjective outcome of bullectomy in patients of bullous lung disease: A prospective study.

Abstract:

Background: The aim of this study is to evaluate the outcome of bullectomy in patients with bullous lung by comparative analysis of their preoperative and postoperative pulmonary function parameters and subjective dyspnea score.

Materials and Methods: The study included 42 cases of bullous lung disease, who underwent open or VATS bullectomy at our hospital from November 2019 till January 2022. All patients were subjected to set protocol which included preoperative comprehensive history and physical examination, chest Xray, lung CT and pulmonary function tests. Postoperative evaluation included 3 monthly follow up for three visits, with clinical assessment for subjective dsypnea score and PFTs. Preoperative and post operative comparison of parameters were made using the student's paired t-test to calculate the statistical significance.

Results: In our cohort, the most common underlying lung pathology was primary bullous lung disease, followed by COPD. Spontaneous pneumothorax was the most common presenting feature, and the most patients presented in their fourth decade of life with a history of smoking.

All cases underwent VATS/open bullectomy. Most patients were discharged on 4^{th} postoperative day. Statistically significant improvement was seen in mean FEV_1 (forced expiratory volume in 1st second), FVC (forced vital capacity) and FEV_1/FVC. FEV_1 appeared to be the most reliable indicator of postoperative progress. Subjective dyspnea score showed statistically significant improvement. Complications occurred more commonly in those with diffuse parenchymal disease. No mortality was seen in our study.

Conclusion: We conclude that surgery remains the standard treatment for bullous lung disease. Most benefitted are those with localized disease with remaining normal parenchyma. Statistically significant improvement in subjective and objective parameters is seen in all cases. Those with diffuse emphysematous disease need careful selection given their high complication rate.

Key words: Bullous lung disease, bullectomy, PFT, Subjective dyspnea score

INTRODUCTION

Bullous lung disease is a common non-infectious pathology encountered in lungs. Surgery remains the mainstay treatment in most cases who present to a clinician with dyspnea or pneumothorax. However, those who have a concomitant diffuse emphysematous or non-emphysematous lung pathology, should be evaluated on an individual basis. Targeting even a small increase in pulmonary function in such patients might be of major benefit[(1)]. Computed tomography scan (CT-scan) can reliably outline bullae that are not visible on a plain chest X-ray[(2)]. Besides, a CT can reliably give a diagnosis of bulla(e) with its dimensions and effects on adjacent lung tissue, and identify a potentially operable well-defined bulla from inoperable bulla situated in a generalized emphysematous lung[(3)]. Bullous lung disease leads to replacement and compression of normal parenchyma by the space occupying non-functional

bulla(e). Therefore, the main outcome parameters are the PFT indices including FEV_1, FVC and their ratio (FEV_1/FVC) after surgery[4]. Bullectomy or resection of the entire bulla(e), either through a standard open thoracotomy or a video assisted thoracoscopic surgery (VATS) is the most common surgical technique used for treatment[1].
This study aimed at evaluating and analysing the post-operative outcome of surgery by statistically comparing pre-operative and post-operative subjective dyspnea score and pulmonary function indices.

MATERIALS AND METHODS

The present study was conducted in the Department of Cardiovascular and Thoracic Surgery (CVTS), Super-speciality hospital, Srinagar, India, from November 2019 to January 2022. A total of 48 cases of bullous lung were encountered, out of which 6 cases were excluded, and remaining 42 cases were included in this study. All patients were evaluated and managed according to the set protocol and followed up accordingly. The inclusion criteria were as follows:

1. Well defined CT evidence of bulla(e) occupying at least one third or more of hemithorax
2. Presence of symptoms or complications known to be attributable to bullae, like dyspnea, pneumothorax or recurrent respiratory infections.

The exclusion criteria were as follows:

1. Presence of other pathology in lung for which surgery is being performed primarily, and bullectomy is only an add-on procedure.
2. Presence of bilateral diffuse emphysematous lung disease, other significant comorbidity, which outweighed the benefits of surgery

The patients were evaluated with:

1. History taking
2. General physical examination
3. Systemic examination
4. Baseline investigations
5. CT scan of chest
6. Pulmonary function test
7. Informed consent was taken
8. Postoperative stay in the hospital till discharge, with removal of intercostal tube drain done once Chest X-ray reveals full expansion of lung, no collection and no air leak.
9. Appropriate follow up plan at 3 monthly intervals for three visits. PFT was done at 3 months follow up, while as dyspnea score was assessed on subsequent visits.

For comparing the postoperative parameters, including subjective dyspnea score based on Medical Research Council guidelines[5] and PFT indices (FEV_1, FVC, FEV_1/FVC) with the preoperative ones, the student's paired t-test was applied to analyse the statistical significance.

RESULTS

The mean overall age was 45.07 ± 13.12 years (range 19 to 62 years); including 30 males and 12 females. Most common presenting complaint was spontaneous pneumothorax (30 out of 42 patients, 71 %). Dyspnea (without spontaneous pneumothorax) was present in 12 cases. Primary bullous lung disease was the most common underlying lung pathology (24 out of 42 cases, 57.14 %), followed by COPD in the remaining cases. Overall, 9 cases had associated diffuse parenchymal lung disease in the form of emphysema (7 cases) and interstitial lung

disease (2 cases). The preponderance of primary bullous lung disease was found at a younger age (mean age of 32 years). Those with underlying COPD developed the disease at an older age (mean age of 57.53 years). The commonest site of bullae was in apical segments (13 cases) of upper lobes, followed by anterior (4 cases) and superior (2 cases). Three cases had multiple areas involved. 34 cases (81%) were subjected to bullectomy exclusively, while-as remaining 8 cases need some degree of decortication. Mean drainage in first 24 hours was 154 ml haemorrhagic, and drains were removed on post operative day 4 on average. Out of 42, 5 cases had prolonged grade 1 air leak for over 2 weeks which settled on its own. Post operative empyema was seen in 2 cases among those with prolonged air leaks which was managed with intercostal tube drainage and appropriate culture sensitive antibiotic therapy. There was no mortality.

There was statistically significant improvement in PFT parameters and subjective dyspnea score (Table 1). FEV_1 is the most reliable indicator of postoperative progress (correlation = 0.713). In patients with underlying diffuse lung disease, baseline values and post operative outcome was worse compared to those without underlying lung disease (Table 2).

Parameters	**Pre-op**	**Post-op**	
		3 months	9 months
FEV_1 (Litres)	1.52 ± 0.48 L	2.17 ± 0.45 L *	
FVC (Litres)	2.52 ± 0.76 L	3.07 ± 0.55 L *	
FEV_1/FVC (%)	62.56 ± 13.88 %	70.47 ± 10.18 %*	
Subjective dyspnea score	2.09 ± 0.49		1.46 ± 0.81*

*p value <0.05 is statistically significant

Table 1: shows mean value with standard deviation in different parameters in pre-op and post-op period. FEV_1: forced expiratory volume in 1st second, FVC: forced vital capacity

DISCUSSION

In our study, the incidence of bullous lung disease was around 21 cases per year, which is higher than generally reported from other studies. Palla et al. [6], reported an average of 12.87 cases per year in one of the largest prospective studies on the subject, which included a cohort of 193 cases operated with bullectomy. A previous study reported from our region has documented same incidence as ours, and the author attributes it to high prevalence of COPD and tuberculosis in the region.[9] In contrast to primary bullous lung disease in our study, Boushy et al. [5], Adeyemo et al. [2] and Palla et al. [6] reported COPD as the dominant underlying lung pathology for bullae. While we report spontaneous pneumothorax as the commonest presentation in those with primary bullous lung disease, and progressive dyspnea in those with underlying COPD, Potgieter et al,[7] and Adeyemo et al.[2] reported progressively incapacitating dyspnea as the commonest complaint at presentation, in their respective studies. with spontaneous pneumothorax affecting small proportion of patients.

The mean preoperative FEV_1, FVC and FEV_1/FVC in our study was 1.52 ± 0.48 L, 2.52 ± 0.76 L and 62.56 ± 13.88 % respectively. Out of this, among those patients who had diffuse

disease (9 cases), the mean preoperative FEV_1, FVC and FEV_1/FVC was 1.31 ± 0.42 L, 2.33 ± 0.61 L and 52.5 ± 10.8 % respectively. The same parameters among those with isolated bulla(e) (33 patients) were 1.82 ± 0.52 L, 2.52 ± 0.45 L and 74.02 ± 14.4 %, respectively.

PFT indices	**Patients with diffuse lung disease (n=9)**		**Patients without diffuse lung disease (n=33)**	
	Pre-op	Post-op at 3 months	Pre-op	Post-op at 3 months
FEV_1 (Litres)	1.31 ± 0.42 L	1.76 ± 0.52*	1.82 ± 0.52 L	2.72 ± 0.35*
FVC (Litres)	2.33 ± 0.61 L	3.02 ± 0.51*	2.52 ± 0.45 L	3.37 ± 0.61*
FEV_1/FVC (%)	52.5 ± 10.8 %	59.9 ± 10.08	74.02±14.4 %	81.9 ± 12.01*

Table 2: observations in two groups: those with and without underlying diffuse disease. FEV_1: forced expiratory volume in 1st second, FVC: forced vital capacity, *p value <0.05

During post operative follow up, same PFT indices showed an overall improvement. At 3 months, the mean FEV_1, FVC and FEV_1/FVC was 2.17 ± 0.45 L, 3.07 ± 0.55 L and 70.47 ± 10.18 %, respectively. On statistical comparison, the improvement in these values was statistically significant. A strong correlation was found for FEV_1 values. Pearson et al.[8] in his study reported mean FEV_1, FVC and FEV_1/FVC values at 3-6 months postoperatively as 1.77 ± 0.33 L, 2.84 ± 0.37L and 62.3%, respectively. He also reported the improvement to be statistically significant with the strongest correlation for FEV_1 values. Similar observation and statistical significance was reported by Palla et al.[6] in the FEV_1, FVC and FEV_1/FVC indices at 3-6 months postoperatively. Lone YA, et al[9] also reported a similar improvement in post operative period from his study cohort of 54 patients.

In our study, the subjective dyspnea score showed a statistically significant improvement from 2.09 ± 0.49 to 1.46 ± 0.81, which showed a significant inverse correlation with the change in FEV_1. Similar observation were made by Lone YA et al[9], who reported a significant improvement in dyspnea score from a preoperative value of 2.25 ± 0.59 to 1.36 ± 0.9 and showed an inverse correlation with the change in FEV_1. The author further shows that 19 patients in his study having underlying diffuse disease showed improvement from preoperative value of 2.45 ± 0.62 to 1.66 ± 0.72; and other 25 patients without underlying diffuse disease had positive change from preoperative value of 2.05 ± 0.5 to 1.05 ± 0.61. Palla et al.[6] reported improvement from 1.8 ± 0.9 to 1.4 ± 0.8 with significant inverse correlation with the FEV_1 trend. These studies depict results which are fairly consistent with ours, and substantiate our observations.

Many studies have reported some mortality from their cohort. We had fortunately no mortality, and we attribute it to low sample size as compared to other studies, and possibly to more fastidious selection of cases. The mortality rate reported by Gunstensen et al was 9.5%. This rate was reported by Fitzgerald as 2.1% and by Potgeiter et al, as 9.5%. [7] Antonio Palla et al [6] who had a large sample size reported zero mortality after 3-6 months, 7.3% after 1 year, 4.9% after 2 years with an overall mortality rate of 12.2% after 5 years (5 of 41 patients).

Conclusion: We conclude that surgery for bullous lung disease remains a standard treatment to prevent the worsening dyspnea and development of potentially life-threatening pneumothorax in patients. We have substantiated the already established findings that bullectomy leads to significant improvement in subjective dyspnea score and PFT indices including FEV_1, FVC and FEV_1/FVC. Patients with underlying diffuse lung disease should be carefully chosen for surgery, as there is also a definite advantage of surgery in subset of cases.

References:

1. Greenberg JA, Singhal S, Kaiser LR. Giant bullous lung disease: evaluation, selection, techniques, and outcomes. ***Chest Surg Clin N Am*** 2003; 13 (4): 631- 49.

2. Adeyemo AO, Andy JJ. Surgical considerations in the management of giant emphysematous bullae. ***J Natl Med Assoc*** 1987; 79 (9): 945- 9.

3. Morgan MD, Denison DM, Strickland B. Value of computed tomography for selecting patients with bullous lung disease for surgery. ***Thorax*** 1986; 41 (11): 855- 62.

4. Baldi S, Palla A, Mussi A, Falaschi F, Carrozzi L, Giuntini C, et al. Influence of bulla volume on postbullectomy outcome. ***Can Respir J*** 2001; 8 (4): 233- 8.

5. Boushy SF, Kohen R, Billig DM, Heiman MJ. Bullous emphysema: clinical, roentgenologic and physiologic study of 49 patients. ***Dis Chest*** 1968; 54 (4): 327- 34.

6. Palla A, Desideri M, Rossi G, Bardi G, Mazzantini D, Mussi A, et al. Elective surgery for giant bullous emphysema: a 5-year clinical and functional follow-up. ***Chest*** 2005; 128 (4): 2043- 50.

7. Potgieter PD, Benatar SR, Hewitson RP, Ferguson AD. Surgical treatment of bullous lung disease. ***Thorax*** 1981; 36 (12): 885- 90.

8. Pearson MG, Ogilvie C. Surgical treatment of emphysematous bullae: late outcome. ***Thorax*** 1983; 38 (2): 134- 7.

9. Lone YA, Dar AM, Sharma ML, et al. Outcome of the Surgical Treatment of Bullous Lung Disease: A Prospective Study. ***Tanaffos*** *2012; 11(2): 27-33*