

## Preoperative Intensive Pulmonary Rehabilitation: Positive Preliminary Results at CHU-JRA Antananarivo

Raharinantenaina HA<sup>1\*</sup>, Razafimanjato NNM<sup>2</sup>, Raherinandrasana AH<sup>3</sup>, Tiaray H M<sup>3</sup>, Rakotovao HJL<sup>4</sup> and Solofomalala GD<sup>5</sup>

<sup>1</sup>Rehabilitation Service CHU-JRA, Antananarivo, Madagascar

<sup>2</sup>Thoracic surgery service CHU-JRA, Antananarivo, Madagascar

<sup>3</sup>University of Public Health and Care Analakely, Antananarivo, Madagascar

<sup>4</sup>De Pneumology Service CHU-JRB, Antananarivo, Madagascar

<sup>5</sup>General Surgery Service CHU-Anosiala, Antananarivo, Madagascar

\*Corresponding Author: Raharinantenaina HA, Rehabilitation Service CHU-JRA, Antananarivo, Madagascar.

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### Abstract

**Aim and Introduction:** The goal of preoperative pulmonary rehabilitation of thoracic surgery is to optimize patients operability by improving respiratory function. Sometimes this program takes a long time. The objective of our study is to evaluate the effect of intensive preoperative pulmonary rehabilitation in thoracic surgery by monitoring the parameters of lung function and exercise capacity of the patient.

**Method:** This is an analytical study of patients scheduled for thoracic surgery who continued daily ten days rehabilitation sessions at the CHU-JRA Rehabilitation center during the period from 01 September 2019 to 01 July 2020. Patients scheduled for emergency thoracic surgery, lost of sight during rehabilitation and those who did not perform a control EFR are not included in our study.

**Results:** During this period, 21 patients were collected with an average age of 47.7 years and predominantly male. The 33.3% had a history of smoking but were all weaned before starting treatment. After the pulmonary rehabilitation program there was a clear improvement in functional parameters but are not statistically significant: FEV1 (before 1.70 +/- 0.62 after 1.73 +/- 0.68) FVC (2.15 +/- 0.73 vs 2.18 +/- 0.87) PED (4.41 +/- 2.007 vs 4.63 +/- 2.19) and Tiffeneau report (71.72 +/- 8.94 vs 71.48 +/- 9,75). In addition, a considerable improvement in exercise capacity by the six minutes walking test (318.09 +/- 99.37m before and 399.52 +/- 133, 20m) was objectified after completion of intensive rehabilitation.

**Conclusion:** Preoperative intensive pulmonary rehabilitation has a positive effect on the pulmonary function and exercise capacity of patients and this can solve the waiting time for surgery.

**Keywords:** Intensive; Pulmonary Rehabilitation; Preoperative; Thoracic Surgery

### Introduction

Thoracic and cardiac surgery are associated with an increased risk of post-operative complications [1]. Multiple studies have shown that cardio-respiratory preparation appears particularly appropriate in these patients [2] Non-pharmacological interventions such as exercise before and after thoracic surgery is proved to be a successful intervention that makes physical and psychological health better in different cancer states, including lung cancer and chronic obstructive pulmonary disease [3-5]. It has been shown that pulmonary rehabilitation (PR) can improve exercise capacity, quality of life and can reduce major post-operative complications and depression [6,7]. It is a procedure capable of improving post-surgical deterioration of certain physiological values [3]. In the literature, the frequency of rehabilitation was 5 times per week for an average of 2 to 3 weeks before scheduled surgery [8,9]. In our work, intensive pulmonary rehabilitation aims to reduce the duration of pulmonary rehabilitation of patients in order to reduce the waiting time in scheduled surgery while optimizing the patients operability by improving their functions respiratory.

### Aim of the Study

Our aim was to investigate the effect of intensive pulmonary rehabilitation by comparing the parameters of lung function and exercise capacity of the patients.

### Materials and Methods

This was an analytical study of patients programmed for thoracic surgery who underwent rehabilitation sessions in the Functional Rehabilitation Department of the CHU/JRA and who received a respiratory functional exploration (EFR) before and after the ten rehabilitation sessions (10 days) during the period from 01 September 2019 to 01 July 2020. Patients who were operated on in an emergency, lost of sight during the rehabilitation period and those who did not carry out a control EFR are not included in our study. Data recruitment is done after a consultation of patients in the Rehabilitation Service referred by the Thoracic Surgery Service of the CHU- JRA. The student test was used to compare the two averages before and after intensive rehabilitation sessions, the threshold of significance was set at  $p < 0.05$ . During this study period, 21 patients were collected, 2 excluded. All patients consented to the study.

#### Exercise capacity: Six minute walking test

The six -minute walking test was performed in the hallway of our service. Patients were instructed to walk as fast as possible for 6 minutes on foot. Before, during and after the test, oxygen saturation was taken into account.

#### Pulmonary function

All patients received a spirometry lung function test (FEV1, vital capacity, Tiffeneau ratio, peak flow).

#### Intensive pulmonary rehabilitation program

Our intensive rehabilitation program includes respiratory training, chest expansion and controlled breathing training. The intensity has been increased according to dyspnea, shortness of breath and fatigue. The duration of the rehabilitation program is ten days.

### Results

During this study period, 21 patients were collected and met our inclusion criteria. They were aged 19 to 69, with an average age of 47.71 (Table 1).

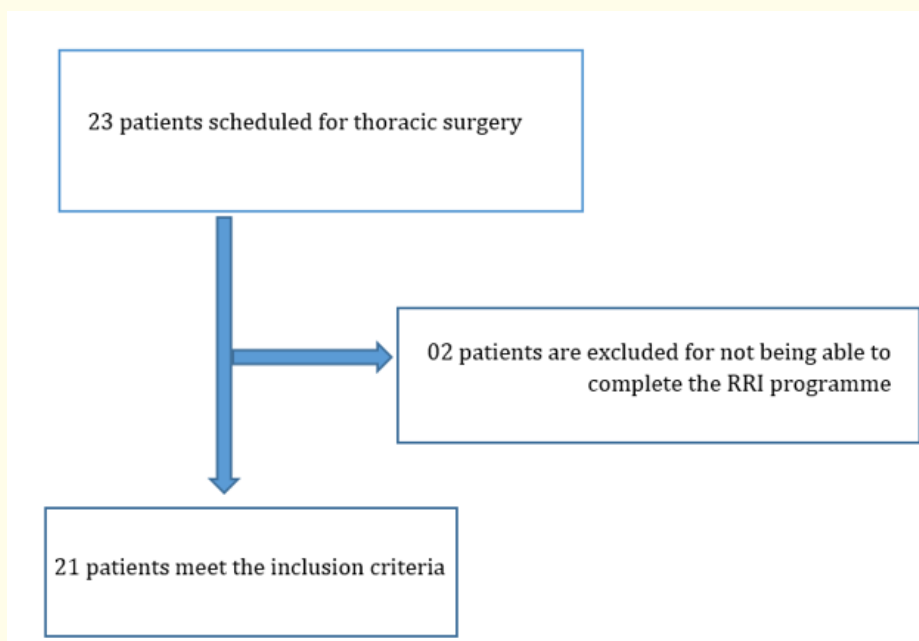


Figure 1: Patients recruitment.

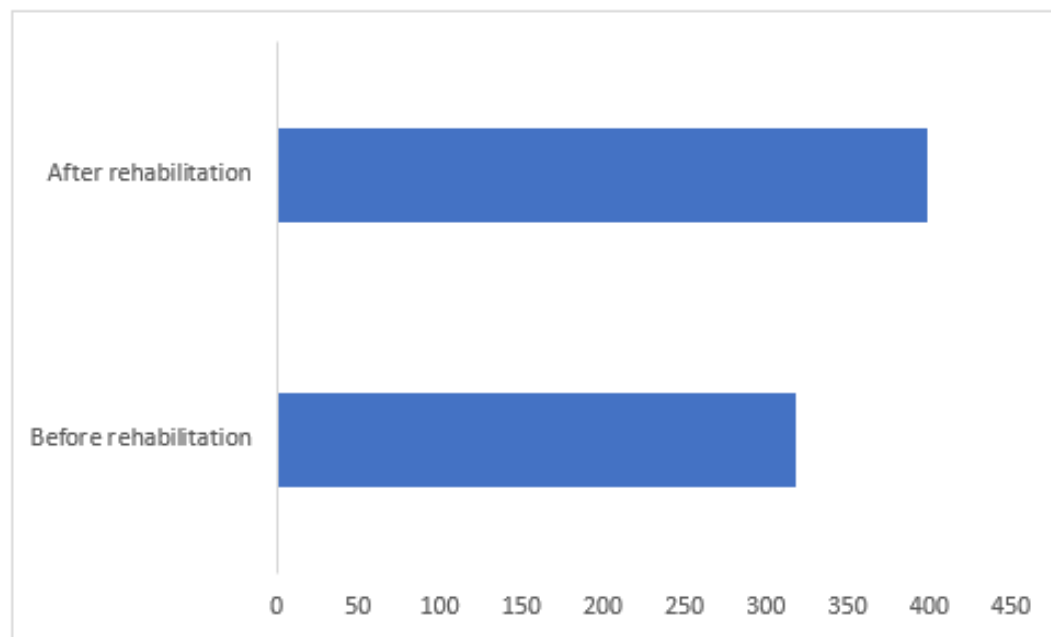
The 33.33% had a history of smoking but were all weaned before the start of rehabilitation (Table 1).

Characteristics	Number (n)	Percentage (%)
Gender male : female	12 :9	57,14 : 42,86
Antecedent		
Pulmonary tuberculosis	6	28,57
Arterial hypertension	5	23,81
Asthma	3	14,29
COPD	1	4,76
Diabetes	1	4,76
Smoking	7	33,33
Smoking cessation	7	100

**Table 1:** Summary of our patients’ medical history.

Clinically significant improvement was detected in respiratory rate, oxygen saturation, 6 minute walking test (Table 2).

Functional parameters FEV1, CVF, DEP, Tiffeneau report improved but had no significant difference (Table 2).



**Figure 2:** Improvement of maximal exercise capacity measured by 6minutes walking test before and after pulmonary rehabilitation.

Parameters	Before pulmonary rehabilitation	After pulmonary rehabilitation	P value
Respiratory frequency (Cycle / minutes)	16,33 +/- 3,16	15,61 +/- 2,49	0,03
Oxygen saturation	97,47 +/- 1,20	97,71 +/- 1,23	0,02
6MWD	318,09 +/- 99,37	399,52 +/- 133,20	0,00001
FEV	1,70 +/- 0,62	1,73 +/- 0,68	0,50
FVC	2,15 +/- 0,73	2,18 +/- 0,87	0,62
PEF	4,41 +/- 2,007	4,63 +/- 2,19	0,15
Tiffeneau report	71,72 +/- 8,94	71,48 +/- 9,75	0,57

**Table 2:** Change in clinical and spirometric parameters before and after RRI.

6MWD: 6 Minutes Walking Distance; FEV: Maximum Expiratory Volume; FVC: Functional Vital Capacity; PEF: Peak Expiratory Flow.

## Discussion

We conducted clinical research to determine the effect of intensive respiratory rehabilitation by assessing the patient's pulmonary functional capacity and exercise capacity.

### Pulmonary function

In our study, we found a clear clinical improvement in lung function parameters (FEV, FVC, PEF, Tiffeneau Report) but none of these were statistically significant in this work (Table 2). Many studies have shown the effectiveness of preoperative pulmonary rehabilitation. According to Vagvolgyi A., *et al.* [4], the effectiveness of our rehabilitation program has been supported by improving lung mechanics and strengthening respiratory and peripheral muscles. The latter effect was highlighted by Spruit M., *et al.* in 2013. This difference between our result and the literature was explained by the small sample size in our study.

In fact, pulmonary rehabilitation has had a positive effect on the patient's lung operability criteria with a significant improvement in lung function (lung re-expansion evidenced, thoracic kinetics, exercise capacity, a crude estimator of post-operative morbidity and costs (decrease the length of hospital stay) and finally enhance quality of life using controlled breathing techniques, chest wall mobilization and specific training modalities.

### Exercise capacity

Our study showed a significant improvement in exercise capacity assessed by the 6-minute walking test (Table 2 and figure 2) similar to the literature [11-13]. A phenomenon that is explained by the fact that exercise increases muscle strength and consequently decreases the feeling of fatigue.

### Rehabilitation sessions frequency

In our study, our patients benefited from daily rehabilitation sessions for ten consecutive days.

Benzo R., *et al.* [8] in 2011 reported in their randomized study on short-term preoperative respiratory rehabilitation before lung cancer resection the effectiveness of short-term rehabilitation. Three studies highlighted improved post-operative outcomes with short interventions: with short interventions: the study by Hulzebos., *et al.* [14] two weeks of rehabilitation was mentioned before surgery, a

study by Lai Y, *et al.* [15] two weeks of pre-operative respiratory rehabilitation reduced the length of stay in hospital and another study reported that one day of pre-operative physiotherapy significantly reduced post-operative atelectasis [16,17].

However, Laurent H., *et al.* [18] showed that after three weeks of respiratory preparation, improved fitness and decreased complications were well demonstrated after an exercise program.

To our knowledge, no study similar to ours measures the positive outcome of intensive rehabilitation through the parameters of an EFR exam. In our opinion the studies analysing the post-operative parameters have confusion bias given the patients operated in thoracic surgery similar to our study with 4.76% comorbidity as we observed in our results (Table 1).

In addition, Benzo., *et al.* [7] found that a four-week exercise program was not feasible because patients and surgeons did not want to delay lung cancer surgery and therefore changed to a more intense one-week program.

Improving preoperative fitness in this specific population should limit the loss of postoperative pulmonary function and exercise capacity the real challenge of all staff caring for these patients.

The beneficial effect of a short pre-operative rehabilitation program on the length of stay after the lung cancer resection of COPD patients remains to be demonstrated by the recent Cochrane review.

### Conclusion

The time of preoperative pulmonary rehabilitation is crucial but it must be adapted to the patient and his disease process. Intensive rehabilitation has a positive effect on the exercise capacity of patients and this can solve the waiting time for surgery. This short and intensive procedure is necessary to achieve the balance between the surgical risk, the rapid evolution of certain pathologies and the benefits. It is suggested that clinicians limit the waiting time for surgery by a short duration of preoperative respiratory rehabilitation. While the focus is on reducing preoperative risk, post-operative rehabilitation must remain a priority to help patients recover over the long term.

### Conflict of Interest

None.

### Contributions from the Authors

Study design: Raharinantenaina HA, Razafimanjato NNM.

Methods: Raharinantenaina HA, Razafimanjato NNM, Raheinandrasana AH.

Calculation/computation: Raheinandrasana AH.

Formal analysis: Raheinandrasana AH.

Investigation: Raharinantenaina HA, Razafimanjato NNM.

Investigation: Data and evidence collection: Raharinantenaina HA, Razafimanjato NNM.

Ressources: Raharinantenaina HA, Razafimanjato NNM, Tiaray HM.

Data retention: Raharinantenaina HA.

Initial Draft Writing: Raharinantenaina HA, Razafimanjato NNM.

Writing/preparation of manuscript: Raharinantenaina HA, Razafimanjato NNM, Tiaray HM.

Supervision: Rakotovaio JL, Solofomalala GD.

Project administration: Rakotovaio JL, Solofomalala GD.

### Acquisition of Financial Support

None.

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