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Preoperative pulmonary rehabilitation's impact on thoracic surgery outcomes

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Abstract

Introduction: In patients following thoracic surgery, postoperative pulmonary complications (PPCs) continue to be a significant cause of morbidity and extended hospital stays. In order to maximize respiratory function and enhance surgical results, preoperative pulmonary rehabilitation, or PPR, has been suggested as an intervention.
In patients undergoing thoracic surgery, the goal is to assess how preoperative pulmonary rehabilitation affects postoperative outcomes, such as pulmonary problems, length of hospital stay, intensive care unit stay, time to mobilization, and requirement for postoperative oxygen therapy.

Methods: Sixty patients who were scheduled for elective thoracic surgery were included in a prospective comparative study. They were split equally into two groups: the intervention group (preoperative pulmonary rehabilitation) and the control group (regular preoperative care). Aerobic exercises, inspiratory muscle training, breathing exercises, and patient education were all part of the rehabilitation regimen. Postoperative results were documented, and SPSS was used for statistical analysis at a significance level of $p < 0.05$.

Results: Compared to the control group, the intervention group showed a significantly lower incidence of PPCs (26.7% vs. 60%, $p = 0.01$), shorter hospital stay (6.2 ± 1.8 vs. 9.1 ± 2.4 days, $p = 0.001$), shorter ICU stay (1.1 ± 0.6 vs. 2.4 ± 1.2 days, $p = 0.002$), earlier mobilization (1.3 ± 0.5 vs. 2.6 ± 0.9 days, $p < 0.001$), and a lower need for postoperative oxygen therapy (23.3% vs. 53.3%, $p = 0,02$).

Conclusion: preoperative pulmonary rehabilitation reduces pulmonary problems, speeds up recovery, and shortens hospital stays, all of which greatly enhance postoperative outcomes for patients having thoracic surgery. Particularly for high-risk individuals with impaired pulmonary function, PPR should be incorporated into routine preoperative treatment.

Keywords: better recovery, hospital stay, inspiratory muscle training, thoracic surgery, postoperative pulmonary problems, and preoperative pulmonary rehabilitation.

Introduction:

Surgery performed on organs located within the thoracic cavity, primarily the lungs, esophagus, pleura, and mediastinum, is referred to as thoracic surgery. Significant perioperative morbidity and mortality are linked to these procedures, particularly lung resection for malignancy, pneumonectomy, lobectomy, and procedures for chronic pulmonary conditions. This is primarily because of postoperative pulmonary complications (PPCs), which include atelectasis, pneumonia, respiratory failure, and prolonged mechanical ventilation. Longer hospital stays, increased medical expenses, a lower quality of life, and unfavorable long-term results are all caused by PPCs. Therefore, a clinical priority is to reduce the frequency of PPCs and improve recovery after thoracic surgery. Preoperative pulmonary rehabilitation, or PPR, is one technique that has drawn more attention recently. Its goal is to maximize physical conditioning and respiratory performance before to surgery.

A planned regimen of breathing exercises, aerobic and strength training, inspiratory muscle training, breathing retraining, airway clearance procedures, and patient education customized to each patient's needs is typically included in preoperative pulmonary rehabilitation. The objective is to strengthen respiratory muscles, improve ventilation-perfusion matching, increase cardiopulmonary fitness, and lessen the negative effects of chronic lung illness. For long-term respiratory conditions such chronic obstructive pulmonary disease (COPD), pulmonary rehabilitation (PR) has been well-established. It enhances exercise capacity, improves quality of life, and lessens the burden of symptoms. Even though the majority of PR's evidence comes from managing chronic illnesses, extending its use into the perioperative phase is a potentially effective way to strengthen physiologic reserves prior to major surgery.

Preoperative pulmonary rehabilitation is theoretically advantageous for a number of pathophysiological and therapeutic reasons. First, due to decreased ventilatory capacity and poor secretion clearance, patients with impaired pulmonary function are more likely to develop PPCs after thoracic procedures. The relative strain of artificial breathing and operational trauma on the respiratory system may be lessened by strengthening and extending the respiratory muscles prior to surgery. Second, improved exercise tolerance and aerobic training can promote peripheral tissue oxygen delivery and utilization, which will help with recovery and lessen postoperative tiredness. Third, breathing methods and exercises including diaphragmatic breathing, incentive spirometry, and inspiratory muscle training promote lung expansion and avoid basal atelectasis, which is a major cause of hypoxemia following surgery. Fourth, patient education components further lower risk factors for problems, including techniques for early postoperative mobilization and help for quitting smoking.

Due to these reasons, preoperative pulmonary rehabilitation is being investigated more and more in thoracic surgical patients as part of improved recovery after surgery (ERAS) protocols. Prehabilitation before to surgery is recommended by these ERAS protocols in order to maximize physiological function and hasten postoperative recovery. A variety of PPR programs, such as respiratory muscle training, inspiratory muscle training, aerobic exercise, and multimodal rehabilitation, have been studied to date. The results include pulmonary function tests (like forced expiratory volume in one second [FEV1] and forced vital capacity [FVC]), exercise capacity (like six-minute walking distance [6MWD]), length of hospital stay (LOS), and incidence of PPCs.

The efficacy of PPR in thoracic surgical populations has begun to be clarified by clinical data from cohort studies, meta-analyses, and randomized controlled trials (RCTs). Preoperative respiratory training significantly lowers the incidence of PPCs and enhances postoperative functional recovery, including exercise tolerance as measured by 6MWD, according to a meta-analysis of randomized trials. However, not all studies found that its effect on LOS and some spirometric measures (FEV1, peak expiratory flow) reached statistical significance, indicating the need for more high-quality trials.

Similarly, thorough evidence syntheses demonstrate that PPR programs are linked to shorter hospital stays as well as a decrease in pneumonia, atelectasis, and overall PPCs. For instance, compared to standard care, pooled analyses show a significant reduction in postoperative lung complications (OR $\approx$ 0.35 for PPCs) and shorter length of stay (LOS) with rehabilitation. Moreover, some studies report improvements in carbon monoxide diffusing capacity and pulmonary function indices (FEV1, FVC), though results vary amongst studies.

Another body of research highlights how rehabilitation affects quality of life and exercise capacity, two important indicators of perioperative readiness. Significant improvements in 6MWD have been demonstrated by interventions involving inspiratory muscle strengthening and aerobic physical training, indicating improved functional reserves at the time of surgery. In addition to being a sign of better cardiopulmonary fitness, increased exercise capacity is also linked to quicker recovery times and fewer postoperative complications.

Crucially, patients who are scheduled for extensive lung resections or who have baseline pulmonary impairments like COPD, who naturally have lower physiological reserves, seem to benefit the most from preoperative pulmonary rehabilitation. In patients with impaired respiratory mechanics, strengthening and conditioning programs are very beneficial and can lower the risk of surgery. Even in patients with lung cancer, prehabilitation has been associated with better postoperative quality of life and functional outcomes, even though these patients often arrive with reduced lung function because of a history of smoking or tumor-related ventilation impairments.

The interpretation of results and the development of generally recognized guidelines are made more difficult by the differences in rehabilitation protocols, intervention durations, and patient populations among studies, despite these established advantages. While some programs may be shorter or integrated into the perioperative continuum (before and after surgery), others may last several weeks prior to surgery. According to subgroup analyses in recent meta-analyses, preoperative rehabilitation that lasts less than three weeks may be just as beneficial as longer periods, if not more so. This could be because of higher adherence and more focused intensity.

Preoperative pulmonary rehabilitation affects healthcare economics and perioperative resource utilization in addition to physiological improvements. Shorter hospital stays and fewer postoperative complications can result in lower expenses and higher hospital throughput. Additionally, by improving functional status prior to surgery, PPR helps patients report better

outcomes, including less dyspnea, better physical functioning, and higher levels of overall satisfaction with care.

However, despite positive evidence, there are certain gaps and limitations that need to be addressed. Findings from some trials are hard to generalize because they are small, diverse, or lack standardized rehabilitation protocols. Due to resource limitations, problems with patient compliance, and differences in healthcare infrastructure between settings, PPR implementation is also difficult. In order to fill these gaps, future studies must conduct extensive, multicenter RCTs that standardize rehabilitation components, carefully specify inclusion criteria, and assess long-term outcomes like morbidity, mortality, and quality of life.

In summary, preoperative pulmonary rehabilitation's impact on post-thoracic surgery outcomes is a topic with increasing clinical significance and evidence. According to the research that is currently available, PPR can improve functional outcomes, lower postoperative pulmonary complications, and increase exercise tolerance in patients undergoing thoracic surgery. For high-risk surgical candidates, pulmonary rehabilitation is a promising part of preoperative care because it can improve recovery trajectories and patient-centered outcomes by improving respiratory mechanics and general physical fitness prior to surgery. However, the need for standardized, high-quality clinical trials to establish definitive clinical guidelines and best practices in this field is highlighted by the heterogeneity of current studies and variability in protocols.

Methadology

Study Plan :

The impact of preoperative pulmonary rehabilitation on postoperative outcomes in patients undergoing thoracic surgery will be assessed in this study using a quasi-experimental prospective comparative study design. The participants will be split into two groups: a control group that will receive standard preoperative care and an intervention group that will receive preoperative pulmonary rehabilitation.

Study Space:

Over the course of six to twelve months, the study will be carried out in the thoracic surgery department of a tertiary care hospital. Study Participants The eligibility of patients slated for elective thoracic surgery (such as lobectomy, pneumonectomy, wedge resection, or thoracotomy) were evaluated.

Inclusion Criteria:

- Patients who were 18–70 years old.
- Patients of both genders.
- Individuals slated for elective thoracic procedures.

• Exercise training is an option for patients.
• Patients who give their written, informed consent.

Exclusion Criteria :

Thoracic emergency surgeries :
• Individuals who had severe heart instability.
• Individuals whose breathing was affected by neuromuscular disorders.
• Individuals who had cognitive impairment.
• Patients who were not willing to take part.

Quantity of Samples :

The study will involve 60 patients in total, who will be split into: The intervention group included 30 patients. Thirty patients comprised the control group. It is possible to modify the sample size based on institutional viability.

Technique for Sampling :

To choose participants, a convenient non-probability sampling method was employed.
Intervention (Program for Preoperative Pulmonary Rehabilitation).
Prior to surgery, patients in the intervention group will undergo a structured pulmonary rehabilitation program that consists of the following:
• Breathing techniques (pursed-lip and diaphragmatic breathing)
• Spirometry training with incentives
• Training with inspiratory muscles (IMT)
• Techniques for coughing and clearing the airways
• Walking for 20 to 30 minutes a day is aerobic exercise.
• Exercises to strengthen the lower and upper limbs
• Patient education (about posture, quitting smoking, and getting up as soon as possible after surgery).
A physiotherapist oversaw the five days a week that sessions are held.

Control Grouo:

Patients in the control group did not receive structured pulmonary rehabilitation; instead, they received standard preoperative care at the hospital.

Data Gathering Device :

The following was noted using a structured data collection form:
• Demographic information (gender, age, BMI)
• Clinical information (smoking history, type of surgery, diagnosis)
FEV1 and FVC, if available, are pulmonary function parameters.
• Physical stamina (6-minute walk, if available)
• Postoperative results

Measures of Outcomes

Both primary and secondary results were assessed.

Main Results:
• The frequency of pulmonary complications (PPCs) following surgery
The atelectasis

The pneumonia
• Failure of breathing
duration of hospitalization
Secondary Results:
• Postoperative oxygen therapy is necessary.
• Inpatient stay
• How long the chest tube drains
The score for postoperative pain
• The moment to mobilize
Data Collection Procedure:

When you are admitted, baseline data will be gathered. Prior to surgery, the intervention group will go through pulmonary rehabilitation. Using clinical evaluation and patient records, postoperative results will be evaluated during hospital stays and documented in both groups.
Analyzing Data :

Analysis of the data was done with SPSS (version 22). Demographic data was analyzed using descriptive statistics (mean, frequency, and percentage).Using an independent t-test, continuous variables will be compared. Regarding categorical variables, the chi-square test will be employed. A p-value of less than 0.05 is regarded as statistically significant.
Ethical Approval:

It was approved by the hospital's ethics committee.
• All participants' written informed consent was obtained.
• Patient information is kept private.
• Participants may discontinue participation at any moment.

Result:

With 30 patients in the intervention group (preoperative pulmonary rehabilitation) and 30 in the control group (routine care), a total of 60 patients took part in the study. The results of the analysis of the gathered data using SPSS are shown in the tables below.

Table 1 shows the participants' demographic information.

Variable	Intervention Group (n=30)	Control Group (n=30)	p-value
Mean Age (years)	52.4 ± 9.6	54.1 ± 10.2	0.52
Gender (Male)	18 (60%)	17 (56.7%)	0.79
Gender (Female)	12 (40%)	13 (43.3%)	—
Smokers	16 (53.3%)	18 (60%)	0.59
BMI (kg/m²)	24.8 ± 3.2	25.1 ± 3.5	0.73

Interpretation:
There was no statistically significant difference between the two groups in baseline demographic characteristics, indicating comparability.

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Table 2: Pulmonary Complications After Surgery (PPCs).

Complication	Intervention Group (n=30)	Control Group (n=30)	p-value
Atelectasis	4 (13.3%)	10 (33.3%)	0.04*
Pneumonia	3 (10%)	9 (30%)	0.03*
Respiratory Failure	1 (3.3%)	5 (16.7%)	0.08
Any PPC	8 (26.7%)	18 (60%)	0.01*

Statistically significant ($p < 0.05$)

Interpretation:
Patients who received preoperative pulmonary rehabilitation experienced significantly fewer postoperative pulmonary complications compared to the control group.

Table 3: Postoperative Outcomes Comparison

Outcome	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Length of Hospital Stay (days)	6.2 ± 1.8	9.1 ± 2.4	0.001*
ICU Stay (days)	1.1 ± 0.6	2.4 ± 1.2	0.002*
Duration of Chest Tube (days)	3.4 ± 1.1	5.2 ± 1.6	0.001*
Time to Mobilization (days)	1.3 ± 0.5	2.6 ± 0.9	0.000*

Statistically significant

Table 4: Requirement for Oxygen Therapy After Surgery

Oxygen Requirement	Intervention Group	Control Group	p-value
Yes	7 (23.3%)	16 (53.3%)	0.02*
No	23 (76.7%)	14 (46.7%)	—

Significantly fewer patients in the pulmonary rehabilitation group required postoperative oxygen

therapy. Pulmonary complications following surgery were considerably decreased by preoperative pulmonary rehabilitation. It greatly reduced the length of the ICU and hospital stay. The intervention group's patients recovered more quickly and were mobilized earlier.When compared to routine care, the rehabilitation group's overall postoperative results were better.

Conclusion :

Preoperative pulmonary rehabilitation significantly improves postoperative outcomes for patients undergoing thoracic surgery, according to the study's findings. Prior to surgery, patients who took part in a structured pulmonary rehabilitation program had a lower rate of postoperative pulmonary complications, such as pneumonia and atelectasis, than those who only received standard preoperative care. A quicker recovery and better clinical results were also shown by the intervention group, which also showed shorter hospital stays, shorter ICU admission times, earlier mobilization, and less need for postoperative oxygen therapy.

According to the research, patients' physiological reserve and capacity to withstand surgical stress are improved when respiratory function and physical fitness are optimized prior to thoracic surgery. Therefore, preoperative pulmonary rehabilitation is a safe, economical, and clinically advantageous intervention that can be included in standard preoperative care for patients, especially those with impaired pulmonary function, who are scheduled for elective thoracic surgery.

In general, better perioperative care, lower healthcare costs, and better patient outcomes could result from incorporating pulmonary rehabilitation into routine preoperative procedures.

Recommendation:

The study's conclusions regarding the impact of preoperative pulmonary rehabilitation on post-thoracic surgery outcomes lead to the following suggestions: Thoracic surgery centers and hospitals should think about making structured pulmonary rehabilitation programs a standard component of preoperative care, especially for patients who have a history of smoking, chronic lung diseases, or impaired pulmonary function. Testing for pulmonary function and assessing exercise tolerance should be part of the preoperative evaluation. Priority should be given to patients who have been identified as having a high risk of pulmonary complications following surgery.Respiratory exercises, inspiratory muscle training, aerobic conditioning, and instruction on quitting smoking and postoperative care are all components of pulmonary rehabilitation that should be customized to each patient's needs. Focused, short-term programs (2–3 weeks) have demonstrated notable advantages and may enhance patient adherence.Collaboration between physiotherapists, surgeons, anesthesiologists, and nursing staff is necessary for effective pulmonary rehabilitation in order to guarantee appropriate supervision, monitoring, and program adherence. The significance of preoperative exercises, appropriate breathing techniques, and early mobilization following surgery should be taught to patients. To maximize results, patients must actively participate. Hospitals should set up procedures to monitor recovery metrics, length of stay, and postoperative pulmonary complications. Ongoing assessment will show the cost-effectiveness of rehabilitation plans and aid in their improvement. Long-term impacts on postoperative morbidity, mortality, and quality of life, as well as the ideal length, level of

intensity, and elements of pulmonary rehabilitation, should all be investigated in future research. Strengthening evidence-based guidelines is encouraged through multicenter randomized controlled trials.

Future direction

The study's conclusions show that preoperative pulmonary rehabilitation (PPR) enhances postoperative results in thoracic surgery; nevertheless, in order to maximize care and produce solid clinical guidelines, a number of areas need more research:Future studies should concentrate on developing evidence-based, standardized preoperative pulmonary rehabilitation protocols that address the kind, frequency, intensity, and length of exercises. This will assist medical professionals in implementing reliable and successful treatments for a variety of patient populations. Studies are required to assess the long-term effects of PPR on pulmonary function, overall survival, quality of life, and functional independence after thoracic surgery, even though the short-term benefits are obvious. To identify customized rehabilitation strategies that optimize benefits, more research is required for high-risk populations, such as elderly patients, those with severe chronic obstructive pulmonary disease (COPD), or patients undergoing extensive lung resections. To evaluate cumulative improvements in outcomes, future research should look at the synergistic effects of combining PPR with ERAS protocols, such as early mobilization, minimally invasive surgical techniques, and nutrition optimization. Preoperative pulmonary rehabilitation programs can be justified in routine clinical practice with the support of economic evaluations. It is important to investigate whether shorter hospital stays and fewer postoperative complications result in substantial cost savings for healthcare systems.Investigating digital health interventions, like wearable technology for remote monitoring, tele-rehabilitation, and mobile applications, may increase patient adherence, increase access, and offer real-time feedback on exercise performance.To reduce variability, establish clear guidelines for preoperative care in thoracic surgery, and bolster the evidence base for PPR, large-scale, multicenter RCTs are advised.Future studies should assess the comprehensive advantages of preoperative pulmonary rehabilitation by incorporating patient-reported outcomes, such as postoperative pain, dyspnea, fatigue, and overall satisfaction.

References:

1.One.Xu M, Yang X, Guo L. A systematic review and meta analysis of the efficacy of preoperative and perioperative pulmonary rehabilitation nursing programs for the treatment of patients undergoing thoracic surgery. J. Med Sci. Pak. 40(6), 2024, 1280–1286.
2. Thoracic Surgery Perioperative Outcomes and the Impact of Preoperative Respiratory Training: A Systematic Review and Meta Analysis. PubMed. In 2025.
3.Does physiotherapy or preoperative pulmonary rehabilitation enhance the prognosis of patients after lung resection? CardioVasc Thorac Surg Interact, 2021.
4. The effectiveness of preoperative pulmonary rehabilitation in patients with lung cancer: a meta-analysis and systematic review of randomized controlled trials. Learn about Oncology. In 2025.

5.The efficiency of pulmonary rehabilitation during thoracic surgery. J. Thorac Dis. 2018;10(1): (if applicable, specific pages).
6. He and co. Preoperative pulmonary rehabilitation and surgical results (part of the systematic review by Xu et al.