Journal of Cardiovascular Disease Research

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 01, 2020

Efficiency of Bed Cycling Ergometer in Enhancing Lung Function in Patients Suffering Abdominal Surgery

Dr. Krishna Murari[1], Dr. Sandip Kumar[2]

[1]Associate Professor, Department of General Surgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India

[2]Associate Professor, Department of General Surgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India

Corresponding Author

Dr. Krishna Murari; Associate Professor, Department of General Surgery, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, India

ABSTRACT

Background: Postoperative pulmonary complications (PPCs) are a significant concern for patients undergoing abdominal surgery, often leading to increased morbidity, prolonged hospital stays, and higher healthcare costs. Conventional preventive methods such as respiratory physiotherapy and early mobilization can be difficult for patients with limited mobility or postoperative pain. Recent innovations have introduced the use of a bed cycling ergometer as a potential intervention to enhance pulmonary function.

Objective: This study aims to evaluate the effectiveness of bed cycling ergometer sessions in improving lung function parameters, such as forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and peak expiratory flow rate (PEFR), in patients recovering from abdominal surgery.

Methods: A randomized controlled trial was conducted at Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand with 60 patients undergoing elective abdominal surgery for a period of one year from April 2019 to March 2020. Participants were divided into two groups: the intervention group, which received standard postoperative care plus bed cycling ergometer sessions, and the control group, which received standard postoperative care only. Primary outcomes were measured using a portable spirometer on the first and seventh postoperative days, while secondary outcomes included length of hospital stay and patient compliance.

Results: Significant improvements were observed in the intervention group compared to the control group in lung function parameters on the seventh postoperative day. FVC, FEV1, and PEFR were notably higher in the intervention group. The length of hospital stay was reduced, and patient compliance and satisfaction were high in the intervention group.

Conclusion: Bed cycling ergometer sessions are an effective intervention to enhance pulmonary function in patients undergoing abdominal surgery, potentially reducing the risk of PPCs and promoting faster recovery. These findings support the integration of innovative rehabilitation techniques into postoperative care for patients with mobility constraints.

Keywords: Postoperative pulmonary complications, bed cycling ergometer, abdominal surgery

INTRODUCTION;

Postoperative pulmonary complications are a significant concern in patients undergoing abdominal surgery, contributing to increased morbidity, prolonged hospital stays, and elevated healthcare costs [1]. These complications are primarily due to factors such as pain, anesthesia, and reduced mobility, which collectively impair lung function and hinder effective breathing [2, 3].

Traditional methods to prevent these complications include respiratory physiotherapy and early mobilization, which aim to enhance lung expansion and clear secretions [4]. However, these approaches can be challenging for patients with limited mobility or those experiencing significant postoperative pain [5]. Recent innovations have introduced the use of a bed cycling ergometer as a potential intervention to improve pulmonary function in such patients. This device allows patients to engage in low-intensity exercise while in bed, promoting circulation and respiratory muscle activity without the need for standing or walking [6].

The primary aim of this study is to evaluate the effectiveness of bed cycling ergometer sessions in enhancing lung function parameters, such as forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and peak expiratory flow rate (PEFR), in patients recovering from abdominal surgery. We hypothesize that incorporating bed cycling into postoperative care will significantly improve these pulmonary outcomes compared to standard care alone. Additionally, we will assess secondary outcomes such as the length of hospital stay and patient compliance.

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 01, 2020

This study will contribute to the growing body of evidence supporting innovative rehabilitation techniques for postoperative care and potentially provide a practical solution for enhancing recovery in patients with mobility constraints [7].

MATERIALS AND METHODS;

Study Design

This study was conducted as a randomized controlled trial at Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand, including 60 patients who underwent abdominal surgery. The study was approved by the hospital's ethics committee, and all participants provided written informed consent. Study was conducted for a period of one year from April 2019 to March 2020

Participants

Inclusion criteria:

- Adults aged 18-65 years
- Underwent elective abdominal surgery
- Able to provide informed consent

Exclusion criteria:

- Pre-existing pulmonary diseases
- Hemodynamic instability
- Postoperative complications contraindicating exercise

Intervention

Participants were randomly assigned to two groups:

- Intervention Group (n=30): Received standard postoperative care plus bed cycling ergometer sessions.
- Control Group (n=30): Received standard postoperative care only.

The intervention group participated in bed cycling sessions twice daily, starting from the first postoperative day until discharge. Each session lasted 15 minutes, and cycling resistance was adjusted according to patient tolerance.

Outcome Measures

Primary outcome measures included:

- Forced Vital Capacity (FVC)
- Forced Expiratory Volume in the first second (FEV1)
- Peak Expiratory Flow Rate (PEFR)

These were measured using a portable spirometer on the first and seventh postoperative days.

Secondary outcomes included:

- Length of hospital stay
- Patient compliance and satisfaction (measured by a Likert scale)

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation and analyzed using the t-test. Categorical variables were analyzed using the chi-square test. A p-value of <0.05 was considered statistically significant.

RESULTS AND OBSERVATIONS;

Patient Characteristics

All 60 patients completed the study. Baseline characteristics were similar between the intervention and control groups (Table 1).

Table 1: Baseline Characteristics of Patients

Characteristic	Intervention Group (n=30)	Control Group (n=30)	p-value
Age (years)	48.5 ± 10.2	47.8 ± 11.0	0.72
Gender (M/F)	18/12	17/13	0.79
BMI (kg/m²)	26.4 ± 3.5	25.9 ± 3.7	0.58

Lung Function Outcomes

There was a statistically significant improvement in lung function parameters in the intervention group compared to the control group on the seventh postoperative day (Table 2).

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 01, 2020

Table 2: Lung Function Outcomes

Outcome Measure	Intervention Group (n=30)	Control Group (n=30)	p-value
FVC (L)	2.8 ± 0.5	2.4 ± 0.4	<0.01
FEV1 (L)	2.3 ± 0.4	1.9 ± 0.3	<0.01
PEFR (L/min)	380 ± 40	340 ± 35	<0.01

Secondary Outcomes

- Length of hospital stay was reduced in the intervention group (5.2 ± 1.1 days) compared to the control group (6.1 ± 1.3 days), $p < 0.05$.
- Patient compliance was high in the intervention group, with a mean satisfaction score of 4.5 on a 5-point Likert scale.

DISCUSSION

The findings of this study demonstrate the effectiveness of bed cycling ergometer sessions in enhancing lung function among patients recovering from abdominal surgery. The significant improvements observed in lung function parameters, such as forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and peak expiratory flow rate (PEFR), highlight the potential of this intervention to reduce postoperative pulmonary complications (PPCs) and promote faster recovery.

Pulmonary Function Improvement

The significant increase in FVC, FEV1, and PEFR in the intervention group compared to the control group aligns with previous research that emphasizes the importance of early mobilization and respiratory muscle activity in improving postoperative pulmonary outcomes [1]. The ability of bed cycling ergometers to facilitate low-intensity exercise while patients remain in bed offers a practical solution for individuals with limited mobility or those experiencing significant postoperative pain [6].

Previous studies have indicated the efficacy of various respiratory interventions, such as inspiratory muscle training and incentive spirometry, in preventing PPCs [2, 3]. However, these methods often require patient cooperation and active participation, which can be challenging immediately after surgery. The bed cycling ergometer provides an alternative by engaging patients in passive exercise, thus reducing the effort required from them while still promoting respiratory function.

Reduction in Hospital Stay

A noteworthy secondary outcome of this study was the reduction in the length of hospital stays among patients in the intervention group. The observed decrease in hospital stay duration is consistent with previous findings, suggesting that improving lung function and reducing PPCs can expedite recovery and discharge [1, 5]. This reduction not only benefits the patients by minimizing their risk of hospital-acquired infections but also decreases healthcare costs and resource utilization.

Patient Compliance and Satisfaction

High patient compliance and satisfaction scores in the intervention group further support the feasibility of integrating bed cycling ergometers into standard postoperative care. The use of a bed cycling ergometer was well-received, with patients reporting positive experiences and a sense of active participation in their recovery process. The high compliance rates may be attributed to the non-invasive nature of the intervention and its ability to be tailored to individual patient tolerances.

Limitations and Future Research

Despite the promising results, this study has limitations that warrant consideration. The sample size was relatively small, and the study was conducted at a single center, which may limit the generalizability of the findings. Future studies with larger, more diverse populations across multiple centers are necessary to validate these results. Additionally, long-term follow-up studies are needed to assess the sustained benefits of bed cycling ergometer use beyond the immediate postoperative period.

Further research could also explore the optimal duration and intensity of bed cycling sessions and investigate the potential benefits of combining this intervention with other respiratory therapies. Additionally, studies examining the impact of bed cycling on specific patient populations, such as those with pre-existing pulmonary conditions, could provide valuable insights into tailoring postoperative care.

CONCLUSION

In conclusion, bed cycling ergometer sessions are an effective and innovative intervention for improving pulmonary function in patients recovering from abdominal surgery. This study adds to the growing body of evidence supporting novel

ISSN: 0975-3583, 0976-2833 VOL11, ISSUE 01, 2020

rehabilitation techniques and highlights the potential for bed cycling to become a standard component of postoperative care, particularly for patients with mobility constraints.

REFERENCES;

1. Lawrence, V. A., Cornell, J. E., & Smetana, G. W. (2006). Strategies to reduce postoperative pulmonary complications after noncardiothoracic surgery: systematic review for the American College of Physicians. *Annals of Internal Medicine*, 144(8), 596-608
2. Møller, A. M., Pedersen, T., & Villebro, N. (2003). Effect of preoperative smoking intervention on postoperative complications: a randomized clinical trial. *The Lancet*, 359(9301), 114-117.
3. Agostini, P., & Singh, S. (2009). Incentive spirometry following thoracic surgery: what should we be doing? *Physiotherapy*, 95(2), 76-82.
4. Denehy, L., & Berney, S. (2001). The use of positive pressure devices by physiotherapists. *European Respiratory Journal*, 18(1), 206-207.
5. Hulzebos, E. H., Helders, P. J., Favie, N. J., De Bie, R. A., Brutel de la Riviere, A., & van Meeteren, N. L. (2006). Preoperative intensive inspiratory muscle training to prevent postoperative pulmonary complications in high-risk patients undergoing CABG surgery: a randomized clinical trial. *JAMA*, 296(15), 1851-1857.
6. Boden, I., & El-Ansary, D. (2017). Physiotherapy in the prevention and management of postoperative pulmonary complications: a systematic review. *Physical Therapy Reviews*, 22(1-2), 22-34.
7. Mackay, M. R., & Ellis, E. (2002). Respiratory muscle training as a preoperative rehabilitation intervention for lung resection surgery: a systematic review. *Clinical Rehabilitation*, 16(8), 860-866.
8. Craciun, M., & McGuigan, M. (2014). The effectiveness of inspiratory muscle training on respiratory function in individuals with abdominal surgery. *Journal of Physiotherapy*, 60(1), 39-45.
9. Westerdahl, E., & Moller, M. (2010). Inspiratory muscle training in patients undergoing cardiac surgery: a randomized trial. *Chest*, 137(4), 793-801.