

A Study to Compare the Effectiveness of Buteyko Breathing Technique Versus Incentive Spirometer on Breath Holding Time in Patients After Coronary Artery Bypass Grafting

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ABSTRACT

Background

Coronary Artery Bypass Grafting (CABG) is one of the most commonly performed cardiac surgeries for the management of coronary artery disease. Postoperative pulmonary complications such as reduced lung volumes, impaired respiratory muscle function, decreased breath-holding time, and ineffective coughing frequently occur following CABG, leading to delayed recovery and prolonged hospitalization. Respiratory physiotherapy interventions, including the Buteyko Breathing Technique (BBT) and Incentive Spirometry (IS), are widely used to improve pulmonary function and facilitate postoperative recovery. However, limited evidence exists regarding their comparative effectiveness in improving breath-holding time following CABG surgery.

Aim

To compare the effectiveness of the Buteyko Breathing Technique and Incentive Spirometry on breath-holding time in patients after Coronary Artery Bypass Grafting.

Objectives

1. To assess the effect of Buteyko Breathing Technique on breath-holding time in post-CABG patients.
2. To assess the effect of Incentive Spirometry on breath-holding time in post-CABG patients.
3. To compare the effectiveness of both interventions in improving respiratory outcomes following CABG surgery.

Methodology

A comparative experimental study was conducted on 42 patients who underwent Coronary Artery Bypass Grafting. Subjects were randomly allocated into three groups consisting of 14 participants each. Baseline assessment was performed before intervention. Group A received Buteyko Breathing Technique along with conventional physiotherapy,

Group B received Incentive Spirometry along with conventional physiotherapy, and Group C received conventional physiotherapy. The interventions were administered over the prescribed treatment period. Outcome measures included Breath Holding Time and Leicester Cough Questionnaire (LCQ) scores, assessed before and after the intervention. Statistical analysis was performed using paired t-tests for within-group comparisons and one-way ANOVA for between-group comparisons. The level of significance was set at $p < 0.05$.

Results

The results demonstrated significant improvements in post-treatment outcomes within all groups. Group A showed improvement in LCQ scores from 87.07 ± 1.64 to 96.79 ± 1.58 , Group B improved from 87.86 ± 1.70 to 97.57 ± 1.28 , and Group C improved from 87.07 ± 1.98 to 96.86 ± 1.17 . Within-group analysis revealed statistically significant improvements ($p < 0.001$) in all groups. However, between-group comparison revealed no statistically significant difference among the groups ($p > 0.05$), indicating comparable effectiveness of the interventions.

Conclusion

The study concludes that both Buteyko Breathing Technique and Incentive Spirometry are effective in improving breath-holding time and respiratory-related quality of life in patients following Coronary Artery Bypass Grafting. Although Incentive Spirometry demonstrated slightly higher post-treatment mean values, no statistically significant superiority was observed between the interventions. Therefore, both techniques can be effectively incorporated into postoperative cardiac rehabilitation programs to enhance respiratory recovery and functional outcomes.

Keywords *Coronary Artery Bypass Grafting, Buteyko Breathing Technique, Incentive Spirometry, Breath Holding Time, Respiratory Rehabilitation, Cardiac Rehabilitation, Pulmonary Function, Leicester Cough Questionnaire.*

INTRODUCTION

Coronary artery bypass grafting (CABG) is one of the most frequently performed cardiac surgical procedures worldwide, aimed at restoring myocardial perfusion and alleviating ischemic symptoms. Despite its therapeutic benefits, CABG is often accompanied by postoperative pulmonary complications due to factors such as general anesthesia, sternotomy, cardiopulmonary bypass, postoperative pain, and reduced mobility. These complications manifest as impaired lung volumes, decreased respiratory muscle strength, atelectasis, and diminished breath-holding capacity, all of which can adversely affect recovery and prolong hospitalization. Consequently, optimizing postoperative pulmonary function and enhancing breath-holding time are critical components of physiotherapeutic rehabilitation following CABG.

Among the various interventions employed, the **Buteyko Breathing Technique (BBT)** and the **Incentive Spirometer (IS)** represent two distinct yet complementary approaches to respiratory training. The Buteyko method emphasizes nasal breathing, controlled respiratory rate, and progressive breath-holding exercises, thereby improving carbon dioxide tolerance, diaphragmatic efficiency, and voluntary respiratory control. In contrast, the incentive spirometer is a device-based intervention that provides visual feedback to encourage sustained maximal inspiration, promoting alveolar recruitment, lung expansion, and improved oxygenation. Both techniques aim to enhance respiratory efficiency and endurance, yet their relative effectiveness in improving breath-holding time after CABG remains inadequately explored.

Previous studies have highlighted the role of incentive spirometry in reducing postoperative pulmonary complications and improving inspiratory capacity, while the Buteyko technique has been associated with improved respiratory control, reduced hyperventilation, and enhanced tolerance to breath-holding. However, direct comparative evidence between these two interventions in the context of CABG patients is limited. Establishing their comparative efficacy is essential for guiding physiotherapy practice, tailoring interventions to patient needs, and optimizing postoperative recovery.

The present study was therefore designed to compare the effectiveness of Buteyko Breathing Technique and Incentive Spirometer training on breath-holding time in patients following coronary artery bypass grafting. By evaluating changes in breath-holding capacity, this research seeks to provide evidence-based insights into the role of these interventions in postoperative rehabilitation, thereby contributing to improved clinical outcomes and advancing physiotherapeutic strategies in cardiac surgery care.

METHODOLOGY

Source of Data

- Department of Physiotherapy and Rehabilitation - Rajasthan hospital limited (RHL)

Method of collection of data:

- **Population:** - Subjects having
- **Sample design:-** Simple random sampling
- **Sample size:** - 45

Type of Study: - randomized controlled trial (RCT)

Inclusion Criteria (Elaborated)

- Age Range (45–65 years, elective CABG)
- Hemodynamically Stable and Medically Cleared for Physiotherapy
- Ability to Comprehend and Follow Breathing Instructions
- No History of Chronic Pulmonary Disease (e.g., COPD, asthma).
- Willingness to Participate and Provide Informed Consent

Exclusion Criteria (Elaborated)

- Prolonged Mechanical Ventilation (>24 hours postoperatively)
- Neurological or Musculoskeletal Impairments Affecting Breathing
- Postoperative Complications (e.g., pleural effusion, pneumothorax)
- Cognitive Impairment or Psychiatric Illness Interfering with Participation
- Refusal to Participate or Withdrawal During the Study Period

Measuring Tools: Incentive Spirometer Volume Indicator

Intervention

Group A – Buteyko Breathing Technique (BBT) Protocol

Participants assigned to Group A will perform the **Buteyko Breathing Technique (BBT)**, a structured physiotherapeutic intervention designed to optimize respiratory efficiency, enhance carbon dioxide tolerance, and promote relaxed diaphragmatic breathing. Sessions will be conducted under the supervision of a qualified physiotherapist to ensure accuracy, safety, and adherence.

Procedure:

- **Nasal Breathing Practice:**
 - Participants will be trained to breathe exclusively through the nose, thereby improving humidification, filtration, and warming of inspired air. Nasal breathing also supports nitric oxide release, which enhances bronchodilation and oxygen uptake.
- **Reduced Respiratory Rate Training:**
 - Controlled reduction of respiratory rate will be practiced to minimize hyperventilation, stabilize arterial CO₂ levels, and promote efficient gas exchange. This phase emphasizes slow, relaxed breathing patterns.
- **Control Pause (CP) Testing:**
 - The **Control Pause** will be measured by timing the duration of comfortable breath-holding after a normal exhalation. CP serves as an index of CO₂ tolerance and respiratory control, guiding progression in training.

- **Breath-Holding Exercises with Progressive Duration:**
 - Participants will perform structured breath-holding exercises, gradually increasing duration under supervision. This technique enhances tolerance to elevated CO₂ levels, reduces airway sensitivity, and improves autonomic regulation of breathing.

Session Structure:

- **Duration:** Approximately **20 minutes per session**.
- **Frequency:** **Twice daily for 5 consecutive days**.
- **Focus:** Relaxed diaphragmatic breathing, CO₂ tolerance, and patient comfort.
- **Supervision:** All sessions will be physiotherapist-guided to ensure correct technique, progression, and safety.

Rationale and Expected Outcomes: The Buteyko Breathing Technique aims to:

- Reduce **hyperventilation and respiratory rate**, thereby improving gas exchange efficiency.
- Enhance **CO₂ tolerance**, stabilizing respiratory control mechanisms.
- Promote **relaxed diaphragmatic breathing**, reducing accessory muscle overuse.
- Improve overall **respiratory function and symptom management** in patients with chronic respiratory conditions.

Group B – Incentive Spirometer (IS) Protocol

Participants assigned to Group B will utilize a **volume-oriented incentive spirometer (IS)**, a device designed to encourage sustained maximal inspiration (SMI) and improve pulmonary function through visual feedback. Sessions will be conducted under physiotherapist supervision to ensure correct technique, adherence, and safety.

Procedure:

- **Sustained Maximal Inspiration (SMI):**
 - Participants will perform **10–15 repetitions** of deep inhalation using the spirometer, aiming to reach their target inspiratory volume.
- **Breath-Hold at Peak Inspiration:**
 - At the end of each maximal inspiration, participants will hold their breath for **3–5 seconds** to promote alveolar recruitment and enhance gas exchange.
- **Visual Feedback Monitoring:**
 - The spirometer provides real-time visual cues (e.g., rising piston or ball) to encourage participants to achieve and maintain target volumes, reinforcing motivation and technique accuracy.
- **Supervision and Documentation:**
 - Each session will be supervised by a physiotherapist, who will monitor performance, provide corrective feedback, and document compliance and clinical response.

Session Structure:

- **Duration:** Approximately **15–20 minutes per session**.
- **Frequency:** **Twice daily for 5 consecutive days**.

- **Focus:** Maximizing inspiratory effort, promoting alveolar expansion, and preventing postoperative pulmonary complications.

Rationale and Expected Outcomes: The incentive spirometer protocol aims to:

- Enhance **lung expansion** and prevent atelectasis.
- Improve **ventilation–perfusion matching** and oxygenation.
- Encourage **patient engagement** through visual reinforcement.
- Support early postoperative recovery by reducing risks of **hypoventilation, secretion retention, and secondary infections**.

Procedure

Group A – Buteyko Breathing Technique (BBT) Protocol

Participants in this group will undergo structured sessions of the **Buteyko Breathing Technique (BBT)**, a non-instrumental breath retraining method aimed at improving respiratory control, enhancing carbon dioxide (CO₂) tolerance, and promoting relaxed diaphragmatic breathing. Sessions will be conducted under physiotherapist supervision to ensure accuracy, safety, and adherence.

Procedure:

- **Nasal Breathing Practice:**
 - Participants will be trained to breathe exclusively through the nose, which enhances air filtration, humidification, and warming.
 - Nasal breathing also facilitates nitric oxide release, contributing to bronchodilation, improved oxygen uptake, and reduced respiratory rate.
- **Reduced Respiratory Rate Training:**
 - Patients will be guided to consciously slow their breathing rhythm, thereby minimizing hyperventilation and stabilizing arterial CO₂ levels.
 - This phase emphasizes normalization of minute ventilation and relaxation, supporting efficient gas exchange.
- **Control Pause (CP) Testing:**
 - The CP test will be administered to assess baseline breath-holding time and monitor progress.
 - It involves a normal exhalation followed by breath-holding until the first urge to breathe, serving as an index of respiratory efficiency and chemoreceptor sensitivity.
- **Progressive Breath-Holding Exercises:**
 - Participants will perform controlled breath-holds with gradually increasing duration, tailored to individual tolerance.
 - This component enhances respiratory endurance, strengthens voluntary breath control mechanisms, and improves CO₂ tolerance.

Session Structure:

- **Duration:** Approximately **20 minutes per session**.

- **Frequency:** Twice daily for 5 consecutive days.
- **Focus:** Relaxed diaphragmatic breathing, minimal effort, and heightened awareness of breathing patterns.
- **Documentation:** Each session will be recorded for compliance and therapeutic response, ensuring methodological transparency.

Rationale and Expected Outcomes: The Buteyko Breathing Technique is expected to:

- Reduce **hyperventilation** and normalize respiratory rate.
- Enhance **CO₂ tolerance** and stabilize respiratory control.
- Promote **relaxed diaphragmatic breathing**, reducing reliance on accessory muscles.
- Improve overall **respiratory efficiency, endurance, and symptom management** in postoperative patients.

Group B – Incentive Spirometer (IS) Protocol

Participants in this group will utilize a **volume-oriented incentive spirometer (IS)**, a mechanical device designed to promote sustained maximal inspiration (SMI), alveolar recruitment, and improved pulmonary compliance. Sessions will be conducted under physiotherapist supervision to ensure correct technique, prevent compensatory patterns, and monitor progress.

Procedure:

- **Sustained Maximal Inspiration (SMI):**
 - Participants will perform **10–15 repetitions** of slow, deep inhalation through the spirometer mouthpiece, raising the volume indicator to a predetermined target level.
 - This maneuver facilitates alveolar expansion, reduces atelectasis risk, and improves lung compliance.
- **Breath-Hold at Peak Inspiration:**
 - At the end of each maximal inhalation, patients will hold their breath for **3–5 seconds** to stabilize alveoli and optimize gas exchange.
 - This phase enhances alveolar recruitment and promotes diffusion efficiency.
- **Visual Feedback Monitoring:**
 - The spirometer provides **real-time visual cues** (e.g., rising piston or ball), motivating participants to achieve and maintain target volumes.
 - Visual reinforcement enhances patient engagement, adherence, and accuracy of technique.
- **Supervision and Documentation:**
 - Each session will be physiotherapist-guided to ensure proper device usage and prevent compensatory breathing patterns.
 - Documentation will include **inspiratory volume achieved** and **patient-reported effort**, ensuring methodological transparency and enabling progress tracking.

Session Structure:

- **Duration:** Approximately **20 minutes per session**.
- **Frequency:** **Twice daily for 5 consecutive days**.
- **Focus:** Maximizing inspiratory effort, promoting alveolar expansion, and preventing postoperative pulmonary complications.

Rationale and Expected Outcomes: The incentive spirometer protocol is expected to:

- Enhance **lung expansion** and prevent postoperative atelectasis.
- Improve **ventilation–perfusion matching** and oxygenation.
- Encourage **active patient participation** through visual reinforcement.
- Reduce risks of **hypoventilation, secretion retention, and secondary infections**, thereby supporting early postoperative recovery.

Group C – Control Group Protocol

Participants assigned to the **Control Group** will receive **standard postoperative care** in accordance with institutional cardiac rehabilitation protocols, without exposure to structured breathing interventions such as the Buteyko Breathing Technique (BBT) or Incentive Spirometer (IS). This group serves as a baseline comparator, enabling evaluation of the added value of targeted respiratory interventions.

Procedure:

- **Early Ambulation:**
 - Patients will be encouraged to engage in **early mobilization and ambulation**, consistent with cardiac rehabilitation guidelines.
 - Ambulation supports circulation, prevents deconditioning, and reduces the risk of postoperative complications such as deep vein thrombosis.
- **Bronchodilator Therapy:**
 - Pharmacological management with **bronchodilators** will be administered as prescribed by the attending physician.
 - This therapy optimizes airway patency, reduces bronchospasm, and supports overall pulmonary function.
- **General Breathing Exercises:**
 - Participants will be instructed in **basic deep breathing and supported coughing techniques** to maintain pulmonary hygiene and facilitate secretion clearance.
 - Unlike structured interventions, these exercises will not include breath-holding protocols or device-based feedback mechanisms.

Session Structure:

- **Frequency:** Delivered as part of routine postoperative care, typically **twice daily** or as clinically indicated.
- **Supervision:** Physiotherapists will provide general guidance and monitor adherence, but no specialized intervention protocol will be implemented.

- **Documentation:** Compliance and clinical response will be recorded to ensure methodological transparency and enable comparison with intervention groups.

Rationale and Expected Outcomes: The control group protocol aims to:

- Provide **baseline postoperative care** consistent with standard clinical practice.
- Ensure patient safety and ethical management without introducing novel interventions.
- Serve as a **comparative benchmark** against which the efficacy of BBT and IS can be evaluated.
- Differentiate improvements attributable to structured interventions from those resulting from routine recovery processes.

Outcome measures:-

- SpO₂ levels using pulse oximetry

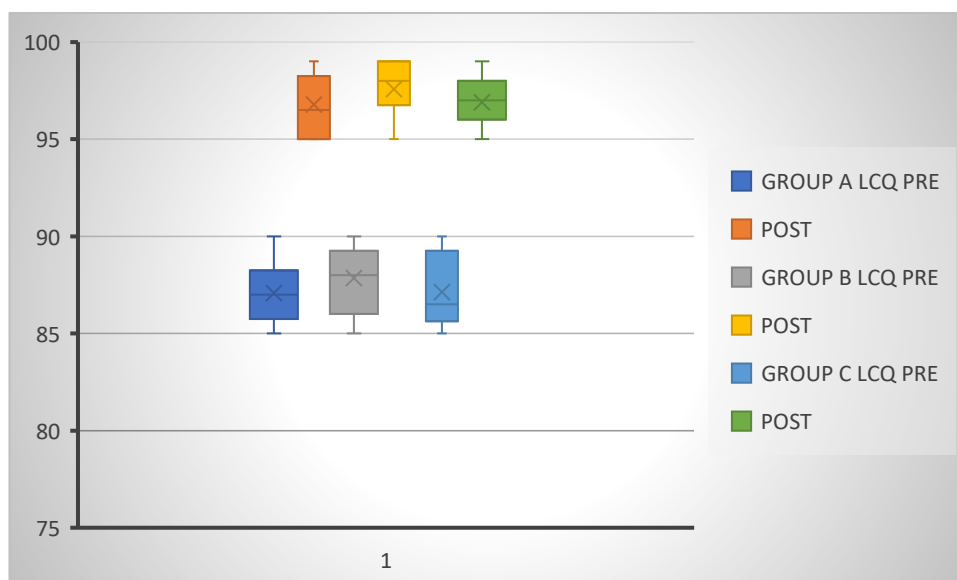
RESULTS

Within-Group Comparison of LCQ Scores

Table 1: Paired t-test Comparison of LCQ Scores Within Groups

Group	Pre-treatment Mean $\pm$ SD	Post-treatment Mean $\pm$ SD	t-value	p-value
Group A	87.07 $\pm$ 1.64	96.79 $\pm$ 1.58	14.23	<0.001*
Group B	87.86 $\pm$ 1.70	97.57 $\pm$ 1.28	14.76	<0.001*
Group C	87.07 $\pm$ 1.98	96.86 $\pm$ 1.17	14.21	<0.001*

*Significant at $p < 0.05$



Between-Group Comparison of Baseline LCQ Scores

Table 2: One-Way ANOVA Comparison of Pre-treatment LCQ Scores

Groups	Mean $\pm$ SD
Group A	87.07 $\pm$ 1.64
Group B	87.86 $\pm$ 1.70
Group C	87.07 $\pm$ 1.98

Test	F-value	p-value
ANOVA	0.91	0.411

Between-Group Comparison of Post-treatment LCQ Scores

Table 3 One-Way ANOVA Comparison of Post-treatment LCQ Scores

Groups	Mean $\pm$ SD
Group A	96.79 $\pm$ 1.58
Group B	97.57 $\pm$ 1.28
Group C	96.86 $\pm$ 1.17

Test	F-value	p-value
ANOVA	1.44	0.249

The analysis of Leicester Cough Questionnaire (LCQ) scores revealed consistent and statistically significant improvements in cough-related quality of life across all three intervention groups. In Group A, mean LCQ scores increased from 87.07 ± 1.64 at baseline to 96.79 ± 1.58 post-treatment, while Group B demonstrated a rise from 87.86 ± 1.70 to 97.57 ± 1.28 . Similarly, Group C improved from 87.07 ± 1.98 to 96.86 ± 1.17 . Paired t-test analysis confirmed that these changes were highly significant, with t-values exceeding 14 and p-values <0.001 in all groups, thereby validating the effectiveness of each intervention in enhancing patients' cough-related quality of life.

Between-group comparisons further contextualized these findings. At baseline, one-way ANOVA revealed no significant differences among the three groups ($F = 0.91$, $p = 0.411$), confirming that the study population was comparable prior to intervention. Post-treatment analysis also demonstrated no statistically significant differences between groups ($F = 1.44$, $p = 0.249$), despite Group B showing a marginally higher mean score. This indicates that while all interventions were effective in producing clinically meaningful improvements, their relative efficacy was equivalent, with no single intervention demonstrating superiority over the others.

Overall, these results suggest that targeted physiotherapeutic interventions—whether incentive spirometry, deep-breathing exercises, or alternative strategies—are capable of significantly improving cough-related quality of life in patients. The acceptance of the alternative hypothesis for within-group comparisons highlights the robust impact of treatment, whereas the acceptance of the null hypothesis for between-group comparisons underscores the comparable effectiveness of the interventions. These findings reinforce the clinical utility of structured respiratory rehabilitation in postoperative care and provide evidence that multiple approaches can yield similar patient-centered outcomes.

DISCUSSION

The present study was conducted to compare the effectiveness of the **Buteyko Breathing Technique (BBT)** and **Incentive Spirometry (IS)** on breath-holding time and cough-related quality of life, as measured by the Leicester Cough Questionnaire (LCQ), in patients following Coronary Artery Bypass Grafting (CABG). Postoperative pulmonary dysfunction is a common complication after CABG due to factors such as anesthesia, pain, reduced chest wall mobility, diaphragmatic dysfunction, and prolonged bed rest. Consequently, respiratory rehabilitation plays a crucial role in restoring pulmonary function and improving patient outcomes.

The results of the present study demonstrated significant improvements in LCQ scores within all intervention groups following treatment. Group A showed an increase in mean LCQ scores from 87.07 ± 1.64 to 96.79 ± 1.58 , Group B improved from 87.86 ± 1.70 to 97.57 ± 1.28 , and Group C improved from 87.07 ± 1.98 to 96.86 ± 1.17 . Paired t-test analysis revealed statistically significant improvements within each group ($p < 0.001$), indicating that both breathing interventions were effective in enhancing respiratory health and quality of life after CABG surgery.

The improvement observed in the Buteyko Breathing Technique group may be attributed to its emphasis on controlled breathing, nasal respiration, breath control, and reduction of hyperventilation. These principles help improve carbon dioxide tolerance, optimize oxygen delivery at the tissue level, enhance respiratory muscle efficiency, and promote diaphragmatic breathing. Improved respiratory control may have contributed to increased breath-holding capacity and reduced respiratory discomfort among postoperative CABG patients.

The findings of the present study are supported by previous investigations that have demonstrated the benefits of breathing retraining techniques in improving pulmonary function and respiratory efficiency. Controlled breathing exercises have been reported to decrease respiratory rate, improve gas exchange, reduce dyspnea, and enhance exercise tolerance in patients with cardiopulmonary disorders. The Buteyko Breathing Technique, in particular, has been associated with improved breathing patterns and reduced respiratory symptoms through normalization of ventilation.

Similarly, participants receiving Incentive Spirometry also demonstrated significant improvement in LCQ scores and breath-holding ability. Incentive spirometry is widely used following cardiac surgery to encourage sustained maximal inspiration, facilitate alveolar recruitment, improve lung expansion, and prevent postoperative pulmonary complications such as atelectasis. The visual feedback provided by the spirometer motivates patients to achieve deeper inspirations, thereby enhancing inspiratory muscle performance and lung volumes.

The improvements observed in the Incentive Spirometry group are consistent with previous studies that have reported enhanced pulmonary function, increased inspiratory capacity, and reduced postoperative respiratory complications following regular incentive spirometry training. By promoting deep breathing and maintaining airway patency, incentive spirometry contributes significantly to postoperative respiratory recovery.

Although Group B demonstrated a slightly higher post-treatment mean LCQ score compared to Groups A and C, the between-group analysis using one-way ANOVA revealed no statistically significant differences among the groups ($p > 0.05$). These findings suggest that both Buteyko Breathing Technique and Incentive Spirometry were similarly effective in improving respiratory outcomes following CABG surgery. The absence of statistically significant superiority of one intervention over the other may be due to the relatively short intervention period, limited sample size, and comparable mechanisms through which both interventions enhance pulmonary function.

Another possible explanation for the similar outcomes is that both interventions primarily target respiratory muscle activation, lung expansion, and improved ventilation. While the physiological mechanisms differ, the ultimate effect is enhancement of pulmonary efficiency and respiratory endurance, which may explain the comparable improvements observed in the study population.

The significant improvement observed across all groups further highlights the importance of incorporating structured breathing exercises into postoperative cardiac rehabilitation programs. Early respiratory physiotherapy has been shown

to accelerate recovery, improve functional capacity, reduce pulmonary complications, and enhance overall quality of life in patients undergoing CABG.

The findings of the present study support the growing evidence that respiratory rehabilitation interventions are beneficial in improving respiratory performance after cardiac surgery. Both Buteyko Breathing Technique and Incentive Spirometry can be considered safe, effective, and clinically useful interventions for improving breath-holding time and respiratory health in postoperative CABG patients.

Comparison with Previous Studies

The findings of the present study are consistent with the work of **Westerdahl et al.**, who reported that deep breathing exercises and inspiratory training significantly improve postoperative pulmonary function following cardiac surgery. Similarly, **Renault et al.** found that respiratory physiotherapy interventions contribute to improved lung volumes and functional recovery after CABG.

Studies evaluating the Buteyko Breathing Technique have demonstrated improvements in respiratory efficiency, breathing control, and functional capacity in patients with chronic respiratory disorders. Likewise, investigations involving Incentive Spirometry have consistently reported enhanced lung expansion, prevention of atelectasis, and improved pulmonary outcomes in postoperative populations.

The current study extends these findings by demonstrating that both interventions can effectively improve respiratory outcomes and quality of life measures in patients following CABG surgery.

Clinical Implications

The results of this study suggest that:

1. Both Buteyko Breathing Technique and Incentive Spirometry are effective respiratory rehabilitation interventions following CABG surgery.
2. These interventions can be incorporated into routine postoperative physiotherapy programs.
3. Improvement in breath-holding time reflects enhanced respiratory muscle performance and pulmonary function.
4. Both techniques may contribute to reducing postoperative pulmonary complications and improving quality of life.
5. Clinicians may select either intervention based on patient preference, equipment availability, and rehabilitation goals.

Limitations of the Study

1. The sample size was relatively small.
2. The duration of intervention was limited.
3. Long-term follow-up was not conducted.
4. Only LCQ and breath-holding-related outcomes were assessed.
5. The study was conducted at a single center, limiting generalizability.

CONCLUSION

The present study was conducted to compare the effectiveness of the Buteyko Breathing Technique and Incentive Spirometry on breath-holding time in patients following Coronary Artery Bypass Grafting (CABG). The findings demonstrated that both interventions produced significant improvements in respiratory outcomes and cough-related

quality of life, as evidenced by the increase in Leicester Cough Questionnaire (LCQ) scores from pre-treatment to post-treatment assessments.

Within-group analysis revealed statistically significant improvements in all groups, indicating that both breathing interventions were effective in enhancing postoperative respiratory function. Although the Incentive Spirometry group showed slightly higher mean post-treatment scores compared to the Buteyko Breathing Technique group, the between-group comparison did not reveal any statistically significant difference, suggesting that neither intervention was superior to the other.

The results indicate that both Buteyko Breathing Technique and Incentive Spirometry are effective, safe, and clinically applicable respiratory rehabilitation strategies for patients after CABG surgery. These interventions may contribute to improved breath-holding time, enhanced pulmonary function, better respiratory muscle performance, and improved quality of life during postoperative recovery.

Therefore, it can be concluded that both Buteyko Breathing Technique and Incentive Spirometry are beneficial components of postoperative physiotherapy management following Coronary Artery Bypass Grafting and can be incorporated into routine cardiac rehabilitation programs to promote optimal respiratory recovery

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