To Compare the Effects of the Buteyko Breathing Technique with Incentive Spirometry versus Progressive Muscle Relaxation Technique with Incentive Spirometry on Anxiety and Depression in Hospitalized Post-CABG Patients

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ABSTRACT

Background - Coronary artery bypass grafting (CABG) is a common surgical procedure that restores myocardial blood flow by bypassing arterial blockages with grafts. Despite its clinical efficacy, patients often experience postoperative anxiety and depression, which can delay recovery. Exercise-based cardiac rehabilitation, including breathing techniques, has demonstrated significant benefits in managing psychological symptoms among hospitalized post-CABG patients.

Methods - A total of 40 post-CABG patients were randomly assigned to two groups (n=20 each). Group A received Buteyko Breathing Techniques with Incentive Spirometry, while Group B received Progressive Muscle Relaxation with Incentive Spirometry for six days. Pain levels were assessed using the Visual Analogue Scale (VAS), and psychological parameters were evaluated using the Hospital Anxiety and Depression Scale (HADS). Pre- and post-treatment scores were analyzed using paired and independent t-tests.

Results - Group A showed a significant reduction in VAS scores (9.00 ± 0.89 to 1.55 ± 1.02), HADS-Anxiety (15.20 ± 3.23 to 1.75 ± 1.73), and HADS-Depression (15.50 ± 3.47 to 1.95 ± 1.56), with $p < 0.001$ across all variables. While both groups demonstrated improvements, Group A achieved significantly greater reductions across all parameters ($p< 0.001$).

Conclusion - The study concludes that Buteyko Breathing with Incentive Spirometry is more effective than Progressive Muscle Relaxation in reducing pain, anxiety, and depression in hospitalized post-CABG patients. Incorporating targeted breathing interventions may enhance early cardiac rehabilitation outcomes.

Keywords *- Buteyko Breathing Techniques(BBT) , Incentive Spirometry(IS), Progressive Muscle Relaxation(PMR), CABG, HADS, VAS.*

INTRODUCTION

Coronary artery bypass grafting (CABG) is a common surgery used to treat blocked arteries in the heart caused by a build-up of fatty deposits. In this procedure, blood vessels taken from another part of the body are used to create a new path for blood to flow to the heart muscle, helping relieve chest pain (angina) and improve heart function. Although CABG is still widely performed, with nearly 400,000 surgeries each year, its use has declined over time due to

improvements in medications and non-surgical treatments like angioplasty The surgery can be done using a heart lung machine (on-pump) or while the heart is still beating (off-pump).[1]

Preoperative Risk Factors and Pulmonary Complication in CABG

Patients undergoing CABG may present with various preoperative risks, including pulmonary hypertension, cardiogenic shock, stroke, heart failure, chronic obstructive pulmonary disease (COPD), diabetes mellitus, renal dysfunction, prior myocardial infarction, systemic hypertension, and triple-vessel coronary artery disease. These comorbidities can significantly influence surgical outcomes and postoperative recovery.[2] Pulmonary Complication One notable pulmonary complication is phrenic nerve palsy, resulting from intraoperative injury to the phrenic nerve, which innervates the diaphragm the primary muscle of respiration. Dysfunction of the diaphragm due to phrenic nerve palsy impairs respiratory mechanics and can lead to significant postoperative respiratory compromise.[3]

Prevalence and Psychological Impact of Anxiety and Depression in Patients Undergoing Coronary Artery Bypass Graft Surgery

Anxiety is frequently observed in patients undergoing coronary artery bypass graft (CABG) surgery, with approximately 40% reporting symptoms preoperatively and a substantial proportion continuing to experience symptoms postoperatively. Depression is also common following CABG and is known to adversely affect recovery. Up to 60% of patients experience depressive symptoms, and approximately 23% exhibit clinically significant levels.[4] This psychological distress is associated with reduced quality of life, delayed postoperative recovery, and poorer long-term outcomes.[5] Postoperative anxiety may manifest through physical indicators such as tachycardia, rapid respiration, and sleep disturbances, as well as psychological symptoms including agitation, fear, and uneasiness. Contributing factors include surgical stress, postoperative pain related to sternotomy, and the unfamiliar hospital environment. If left unaddressed, anxiety may impair oxygenation, elevate the risk of complications, and hinder participation in rehabilitation programs.[“6,7”]

Symptoms Relief Techniques in Post-CABG Patients: The Buteyko Breathing Technique (BBT) is a type of breathing method developed by Ukrainian Physician Konstantin Buteyko in the 1950s. It is primarily used to treat conditions such as asthma, Chronic obstructive pulmonary disease (COPD), and anxiety by focusing on controlled, shallow Breathing. Aims to improve health by correcting dysfunctional breathing patterns. It emphasizes slow, controlled nasal breathing to reduce hyperventilation and restore a healthy balance between oxygen and carbon dioxide in the body. This technique has shown benefits in improving sleep quality, reducing anxiety and depression, increasing energy and focus, and enhancing overall respiratory efficiency.[8]

Incentive spirometry (IS): Is a simple device-assisted breathing exercise designed to promote lung expansion and prevent postoperative pulmonary complications. By encouraging deep, sustained inhalation, it helps maintain alveolar ventilation, reduces the risk of atelectasis, and lowers the incidence of respiratory infections following surgery. It is commonly used in postsurgical care to support respiratory recovery and improve overall pulmonary function. [“9-10”]

Progressive Muscle Relaxation (PMR): Developed by Dr. Edmund Jacobson in the early 1900s, Progressive Muscle Relaxation (PMR) is a stress-reduction technique involving the systematic tensing and relaxing of specific muscle groups. Regular practice promotes physical and mental relaxation, helping to reduce anxiety, muscle tension, headaches, and sleep disturbances. PMR is widely used to manage stress-related conditions and enhance overall well-being.["11-12"]

NEED OF STUDY : Several studies have been conducted on the effectiveness of the Buteyko Breathing Technique, Incentive Spirometry, and Progressive Muscle Relaxation Technique. However, very few have compared the combination of Buteyko Breathing with Incentive Spirometry to Progressive Muscle Relaxation with Incentive Spirometry in post-CABG patients. As pain, anxiety, and depression are common after cardiac surgery (Sicouri et al., 2020), and recent findings support the benefits of Buteyko Breathing (Mavkar & Shukla, 2024; Jain et al., 2021), this study aims to address the gap by evaluating the effects of these combined approaches on psychological distress and pain.

MATERIAL AND METHODS

Ethics: Ethical clearance was obtained from the ethical committee of Mahatma Gandhi Medical College and Hospital (MGMC&H/IEC/JPR/2023/1815) to conduct the study on Post operative CABG patients. Written informed consent was obtained from all participants prior to their inclusion.

Study Design: A comparative experimental study was conducted to assess the effectiveness of two therapeutic interventions Buteyko Breathing with Incentive Spirometry and Progressive Muscle Relaxation with Incentive Spirometry on postoperative pain, anxiety, and depression in patients undergoing coronary artery bypass graft (CABG) surgery.

Sample Size : A total of 40 subjects (both male and female) participated in the study.

Source of Sampling : Participants were selected from the Cardiothoracic and Vascular Surgery (CTVS) Intensive Care Unit at Mahatma Gandhi Medical College and Hospital (MGMC&H) Jaipur.

Sampling Methods :- A total of 40 post-CABG patients were selected using simple random sampling and were randomly allocated into two equal groups (n = 20 each) using a computer-generated randomization method. Group A received the Buteyko Breathing Technique combined with Incentive Spirometry, while Group B received Progressive Muscle Relaxation along with Incentive Spirometry.

Inclusion criteria : Participants included in the study were individuals aged between 50 and 75 years who had Undergone coronary artery bypass graft (CABG) surgery. Both male and female patients were Considered eligible. Only those who were willing to participate, capable of understanding and Following verbal instructions, and had a left ventricular ejection fraction (LVEF) of 50% or above Were included in the study.

Exclusion Criteria: Patients were excluded from the study if they had a history of neurological disorders, were Hemodynamically unstable, or were unwilling to provide informed consent.

Individuals diagnosed With epilepsy or cancer, those who developed post-operative complications, and patients with a Left ventricular ejection fraction (LVEF) below 50% were also excluded.

Independent Variables : Buteyko Breathing Technique: This technique involves conscious control of breathing to Reduce hyperventilation, encourage shallow and nasal breathing, and improve autonomic Balance. It is known to reduce anxiety, enhance sleep, and improve respiratory efficiency.[13]Progressive Muscle Relaxation (PMR): PMR is a stress-relief technique developed by Edmund Jacobson in 1938. It involves the systematic tensing and relaxing of specific Muscle groups to reduce somatic tension and psychological stress, especially effective in Lowering anxiety.[14] Incentive Spirometry: Incentive spirometry is a pulmonary intervention that promotes deep inspiration. It is used to prevent post-operative pulmonary complications and enhance sputum clearance.[15]

Dependent variables: Anxiety and Depression assessed using the Hospital Anxiety and Depression Scale (HADS), a 14-item self-report questionnaire that measures psychological distress in Medically ill patients. Scoring System: 0–7: Normal, 8–10: Borderline (mild) ,11–21: Abnormal (moderate to severe) .[16] Pain Intensity: Evaluated using the Visual Analogue Scale (VAS), a 10-cm horizontal line That allows patients to rate their perceived pain from 0 (no pain) to 10 (worst imaginable Pain). It is widely used for assessing subjective pain levels.[17]

PROCEDURE: Group A Intervention Procedure A total of 40 participants were enrolled, with 20 assigned to Group A and 20 to Group B. Ethical Approval was secured from the MGUMST Ethics Committee. Eligibility was determined based on Predefined inclusion and exclusion criteria. Informed consent was obtained, and the intervention Protocols were clearly explained to each participant.

Pre-assessment (Post-operative Day 1) : Demographic details and vital signs, including blood pressure, oxygen saturation, heart rate, and Respiratory rate, were documented. Chest expansion was assessed at the lower sternum using a measuring tape. Pain was evaluated using the Visual Analog Scale (VAS), and psychological status Was screened using the Hospital Anxiety and Depression Scale (HADS).

Post-operative Day 2 (POD-2) : Participants were guided through general breathing exercises along with upper limb and lower Limb exercises.

Post-operative Days 3 to 6 (POD-3 to POD-6): Patients in Group A were taught the Buteyko Breathing Technique along with the use of an Incentive spirometer. The intervention consisted of the following steps.

Step 1: Control Pause (CP)- The patient was positioned upright with relaxed shoulders and lower Back. Without altering their natural breathing pattern, the patient was asked to take a gentle breath in (2 seconds) followed by a slow exhalation (3 seconds). **Step 2:** Shallow Breathing- The airflow through the nostrils was monitored using the patient's Finger placed just below the nose to ensure minimal airflow, indicating reduced breathing effort. Step 3: Integrated Practice- Patients practiced reduced breathing for 3 minutes following a Control pause. This cycle was repeated based on tolerance and session goals.[18]Incentive Spirometry Training (Group A)

Participants were taught to perform deep, controlled inhalation using an incentive spirometer. While seated comfortably, they were instructed to inhale slowly through the device to elevate the indicator ball, hold the breath for 1–2 seconds, and then exhale gently. The procedure was repeated based on clinical tolerance and prescribed frequency.[19]

Group B – Procedure :

Pre-assessment (Post operative day 1) Demographic details and vital signs, including blood pressure, oxygen saturation, heart rate, and Respiratory rate, were documented. Chest expansion was assessed at the lower sternum using a Measuring tape. Pain was evaluated using the Visual Analog Scale (VAS), and psychological status Was screened using the Hospital Anxiety and Depression Scale (HADS). **On postoperative day 2 (POD-2) :** Participants were guided through general breathing exercises along with upper and lower limb Exercises. Postoperative day 3 to 6 (**POD -3 to POD -6) :**Patients in Group B were taught the Progressive muscle relaxation techniques along with the use Of an incentive spirometer. The intervention consisted of the following steps Group B participants received Progressive Muscle Relaxation (PMR) training based on Jacobson's Technique. Sessions were conducted in a quiet environment with patients in a seated or semi Reclined position. The intervention involved sequential contraction and relaxation of major muscle Groups, including the hands, arms, face, shoulders, chest, abdomen, thighs, and lower legs. Each muscle group was contracted for 7–10 seconds and then relaxed for 15–20 seconds. Clear Verbal cues guided the patients through the sequence, promoting awareness of tension and Relaxation. Sessions lasted approximately 15–20 minutes .[20]**Incentive Spirometry Training (Group B) :** Participants were taught to perform deep, controlled inhalation using an incentive spirometer. While seated comfortably, they were instructed to inhale slowly through the device to elevate the Indicator ball, hold the breath for 1–2 seconds, and then exhale gently. The procedure was repeated Based on clinical tolerance and prescribed frequency.[21]

RESULT

Statistical analysis was performed using SPSS Statistics Version 26.0. Paired t-tests were used for intragroup comparisons (Day 1 vs Day 6), and independent t-tests were used for intergroup comparisons on Day 6. The level of significance was set at $p < 0.05$.

Demographic Profile of Participants

A total of 40 participants were included in the study and were randomly allocated into two equal groups: Group A and Group B (20 participants each).

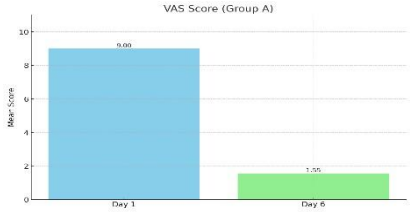
Gender Distribution: Each group consisted of 12 males and 8 females, indicating equal gender distribution across both groups.

Age Distribution: In Group A, 10 participants were aged 50–60 years and 10 were aged 61–70 years. In Group B, 11 participants were aged 50–60 years and 9 were aged 61–70 years.

Table 1. Paired t-test for VAS Score on Day 1 and Day 6 (Group A – Buteyko Breathing + Incentive Spirometry)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	9.00 ± 0.89 → 1.55 ± 1.02	21.19	<0.001	Significant

There was a significant reduction in pain (VAS score) in Group A after 6 days of intervention.

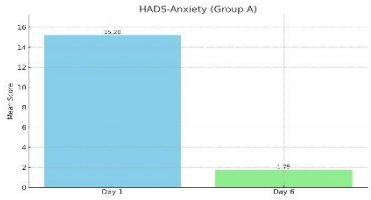


Graph 1. VAS Score (Group A) – Significant reduction from Day 1 to Day 6.

Table 2. Paired t-test for HADS-Anxiety Score on Day 1 and Day 6 (Group A)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	15.20 ± 3.23 → 1.75 ± 1.73	15.27	<0.001	Significant

A significant reduction in anxiety levels was observed in Group A following the intervention.

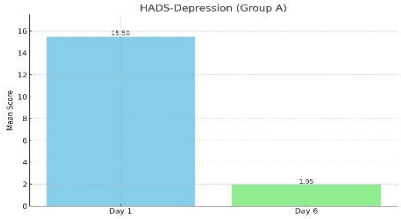


Graph 2. HADS-Anxiety (Group A) – Marked improvement in anxiety.

Table 3. Paired t-test for HADS-Depression Score on Day 1 and Day 6 (Group A)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	15.50 ± 3.47 → 1.95 ± 1.56	13.26	<0.001	Significant

Depression levels were significantly reduced in Group A after 6 days.

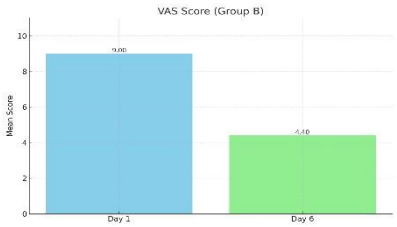


Graph 3. HADS-Depression (Group A) – Significant decrease in depression scores

Table 4. Paired t-test for VAS Score on Day 1 and Day 6 (Group B – Progressive Muscle Relaxation + Incentive Spirometry)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	9.00 ± 0.89 → 4.40 ± 1.28	11.90	<0.001	Significant

Group B also demonstrated a significant reduction in pain scores.



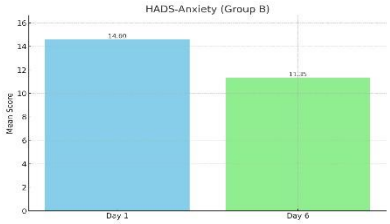
Graph 4. **VAS Score (Group B)** – Moderate reduction in pain.

VAS Score (Group B) – Moderate reduction in pain.

Table 5. Paired t-test for HADS-Anxiety Score on Day 1 and Day 6 (Group B)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	14.60 ± 3.89 → 11.35 ± 2.51	4.18	<0.001	Significant

Anxiety scores improved in Group B, although less significantly than Group A.

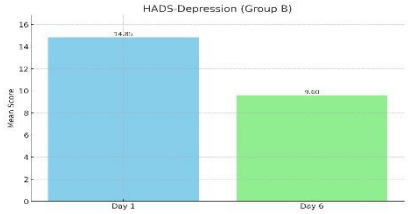


Graph 5. HADS-Anxiety (Group B) – Small improvement in anxiety

Table 6. Paired t-test for HADS-Depression Score on Day 1 and Day 6 (Group B)

Time Point	Mean ± SD	t-value	p-value	Significance
Day 1 → Day 6	14.85 ± 4.04 → 9.60 ± 2.76	5.57	<0.001	Significant

A statistically significant improvement in depression was noted in Group B.

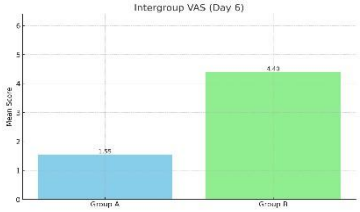


Graph 6. HADS-Depression (Group B) – Moderate decrease in depression levels.

Table 7. Independent t-test Comparison for VAS Score on Day 6 (Group A vs Group B)

Group A	Group B	t-value	p-value
1.55 ± 1.02	4.40 ± 1.28	7.58	<0.001

A significant difference in VAS scores was observed between the two groups, with Group A showing superior outcomes.

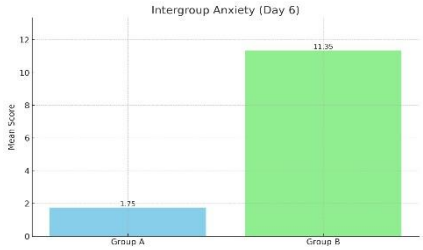


Graph 7. Intergroup Comparison (VAS) – Group A had lower pain than Group B on Day 6.

Table 8. Independent t-test Comparison for HADS-Anxiety on Day 6 (Group A vs Group B)

Group A	Group B	t-value	p-value
1.75 ± 1.73	11.35 ± 2.51	13.71	<0.001

Group A had significantly lower anxiety scores compared to Group B at Day 6.

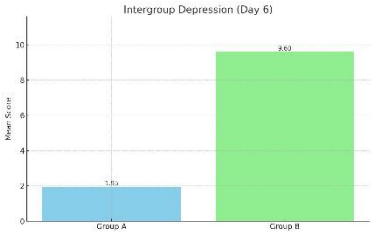


Graph 8. Intergroup Comparison (Anxiety) – Group A showed much lower anxiety.

Table 9. Independent t-test Comparison for HADS-Depression on Day 6 (Group A vs Group B)

Group A	Group B	t-value	p-value
1.95 ± 1.56	9.60 ± 2.76	10.50	<0.001

Depression scores were significantly lower in Group A, indicating better recovery.



Graph 9. Intergroup Comparison (Depression) – Group A had better outcomes in depression reduction.

Summary of Results : Both groups showed statistically significant improvements in pain, anxiety, and depression post treatment. Group A (Buteyko Breathing + Incentive Spirometry) consistently showed greater improvements than Group B (Progressive Muscle Relaxation + Incentive Spirometry). Intergroup comparisons on Day 6 revealed statistically significant differences favouring Group A for all parameters ($p < 0.001$).

DISCUSSION

This study aimed to evaluate the efficacy of Buteyko Breathing Techniques combined with Incentive Spirometry versus Progressive Muscle Relaxation Techniques with Incentive Spirometry on psychological and physical recovery among post-CABG patients. The findings revealed significantly greater improvements in anxiety, depression, and pain scores in the Buteyko group (Group A) compared to the Progressive Muscle Relaxation group (Group B). The integration of Buteyko breathing with incentive spirometry appears to offer multiple physiological advantages that facilitate enhanced postoperative recovery. These practices enhance respiratory function by strengthening respiratory muscles, improving breathing efficiency, and reducing dyspnea. Buteyko breathing, in particular, stimulates the parasympathetic nervous system, promoting relaxation, reducing heart rate, and mitigating postoperative stress and cardiovascular strain. Incentive spirometry aids in expanding lung capacity, improving chest wall mobility, and reducing pain and stiffness commonly seen after

CABG surgery. By enhancing oxygenation, optimizing carbon dioxide levels, and improving pulmonary compliance, these techniques contribute to faster recovery, a lower risk of intubation, and improved cardiopulmonary function ultimately enhancing the quality of life in post-CABG patients. Comparison with Existing Literature The present findings are consistent with prior studies demonstrating the value of breathing and relaxation interventions in improving psychological outcomes among post-cardiac surgery patients. For instance, Jain et al. (2021) assessed the efficacy of Buteyko breathing on anxiety, depression, and self-efficacy among CABG patients. Their results highlighted the importance of psychological rehabilitation in promoting recovery and reducing healthcare costs.[22] Our study reinforces these findings, with Group A showing statistically significant reductions in anxiety (mean difference = 13.45, $p < 0.001$) and depression (mean difference = 13.55, $p < 0.001$) by Day 6. Similarly, Dehdari et al. (2009) examined the effects of Progressive Muscle Relaxation (PMR) on quality of life in anxious post-CABG patients. Their study concluded that PMR improves psychological health.[23] Although Group B in our study showed significant improvements in anxiety and depression, the magnitude of change was notably smaller. Specifically, anxiety scores in Group B decreased from 14.6 to 11.35 ($p < 0.001$), which, while statistically significant, was less substantial than the reductions observed in the Buteyko group. Sicouri et al. (2020) explored the trajectory of pain, anxiety, and depression following minimally invasive aortic surgery.[24] Their study found progressive improvements in VAS and HADS scores over one to three months. Despite the shorter time frame in our study (six days), Group A demonstrated rapid improvements in pain, with VAS scores dropping from 9.00 to 1.55 ($p < 0.001$), compared to Group B's reduction from 9.00 to 4.40 ($p < 0.001$), emphasizing the accelerated benefit of Buteyko breathing when initiated early in the recovery phase. Clinical Implications: The findings suggest that the combination of Buteyko breathing and incentive spirometry is more effective than progressive muscle relaxation in reducing pain, anxiety, and depression following coronary artery bypass graft (CABG) surgery. This integrated approach may be incorporated into early postoperative rehabilitation protocols to enhance recovery, improve patient comfort, and support psychological well-being in clinical settings. However, limitations of the study include a short follow-up period (six days), a small sample size, and potential variation in patient compliance. Future research should involve larger, multicenter trials with extended follow-up durations and include objective physiological parameters such as pulmonary function to strengthen validity and enhance generalizability.

CONCLUSION

This study demonstrated that Buteyko Breathing Techniques combined with Incentive Spirometry resulted in significantly greater reductions in pain, anxiety, and depression among post-CABG patients compared to Progressive Muscle Relaxation. These improvements were rapid and clinically meaningful, indicating enhanced psychological recovery and respiratory function. Incorporating Buteyko breathing into routine post-CABG rehabilitation may optimize recovery outcomes, reduce complications, and improve patient quality of life.

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