DOI: 10.7860/JCDR/2023/60797.17388

Original Article

Physiotherapy Section

Efficacy of Buteyko Breathing Technique on Anxiety, Depression and Self Efficacy in Coronary Artery Bypass Graft Patients: A Randomised Clinical Trial

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ABSTRACT

Introduction: Psychiatric issues, particularly depression and anxiety, have been observed in the proportions of patients undergoing cardiovascular surgery. Such findings provide a window of opportunity for integrating intervention, targeting psychological components into post-Coronary Artery Bypass Graft (CABG) patient management to provide effective care. The Buteyko Breathing Technique (BBT), which is named after its inventor Konstantin Pavlovich Buteyko, is one of the numerous breathing techniques that aims to regulate breathing. By alternating between periods of controlled breathing reduction and breath holding.

Aim: To explore the effect of BBT as a psychological rehabilitation technique on anxiety, depression and self-efficacy in post CABG subjects having anxiety and depression.

Materials and Methods: This randomised clinical trial was performed at Cardiovascular and Thoracic Surgery Unit, Acharya Vinobha Bhave Rural Hospital, Sawangi, Wardha, Maharashtra, India, from June 2021 to May 2022. Total 44 post CABG patients who all screened positive for anxiety and depression by General Anxiety Disorder-7 (GAD-7) questionnaire and Patient Health Questionnaire-9 (PHQ-9) were enrolled. They were randomly assigned using computed generated block randomisation. They were allocated using the Sequentially Numbered Opaque Sealed Envelope (SNOSE) method to group A Conventional group (n=22) and group B Experimental group (n=22). Both groups competed the in-hospital phase 1 cardiac rehabilitation as per American Association of Cardiovascular and Pulmonary Rehab (AACVPR) guidelines, whereas group B received additional BBT for psychosocial rehabilitation for two weeks post surgery. The evaluations were performed using the GAD-7 questionnaire, PHQ-9, General Self-Efficiency Scale (GSS), Breath Holding Test (BHT), and Borg Rate of Perceived Exertion Scale (RPE), at baseline on Post Operative Day (POD)1 and at their last rehabilitation session. Patients in both groups were given self management and education handouts at the time of discharge. Statistical Package for Social Sciences (SPSS) version 27.0 was used for statistical analysis.

Results: The mean age of patients in group A was 59.72±7.84 years and in group B 60.81±7.42 years, respectively. The age, gender, height, weight and Body Mass Index (BMI) of the patients were similar between the groups. On intra group comparison, there was statistically significant difference observed for GAD-7, PHQ-9, GSS, BHT, and RPE in group A and group B following the intervention, but the change was more pronounced in group B. The results for the inter group comparison showed a significant difference in group B on anxiety, depression, self-efficacy, BHT, and RPE as compared to the group A, i.e. group B showed a larger improvement in outcome measure scores than group A.

Conclusion: The present study demonstrated that on intra group weeks of BBT along with phase 1 cardiac rehabilitation in post CABG patients brings favourable changes in levels of anxiety, depression and self-efficacy.

Keywords: Breathing exercise, Cardiac rehabilitation, Cardiac surgery, Psychological consequences

INTRODUCTION

Surprisingly, there is increased number of CABG patients in India with annual count of 1,40,000 CABG procedures [1,2]. The necessity of psychological evaluation in those undergoing surgery has received less attention, may be due to crowded outpatient setting, they are reluctant to engage and not willing to share their private worries [3,4]. After CABG surgery, up to 60% of patients had depression symptoms, with about 23% reporting serious depression, which is frequently related to poor quality of life and venous graft degradation [5]. Moreover, anxiety symptoms were reported in around 40% of patients before heart surgery [6]. As recommended by American Heart Association (AHA), phase one Cardiac Rehabilitation (CR) aims to provide the best physical and psychological well-being post discharge with early independence and productive life [7]. The existing literature that has found CR to be of limited benefit to post CABG patients for their emotional distress and psychological needs, explains why the psychological demands of post CABG patients are not well met by current approaches and indicates that new approaches anchored with psychological rehabilitation would need to be acceptable to post CABG patients [8].

Based on the devoted work of Russian scientist Konstantin Buteyko which states that proper breathing volume is essential for optimal health [9]. The trajectory may be elucidated that breathing techniques are profoundly intermingled to decrease the psychological response [10]. One such key techniques proven to aid in the management of stress and anxiety disorders is BBT [11]. Therefore, reversing homeostatic alterations with BBT might improve the whole body changes that occur in anxiety and depression in post CABG patients [12].

It is a well-known fact that people who practice BBT have more ability to hold their breath comfortably, a measure known as the Control Pause (CP) [13]. A longer CP is linked to fewer symptoms, according to Buteyko practitioners [13]. For asthmatics and cardiac patients, the CP is inversely proportional to disease severity. A CP result that lasts fewer than 20 seconds implies a depleted cardiac or pulmonary reserve [14].

One of the approaches used to promote healthy behaviour and quality of life in CAD patients is the self-efficacy in CR program [15]. Low self-efficacy is associated with poor health and depression in patients with significant risk of rehospitalisation [16]. These findings suggest that targeting self-efficacy provides a potential solution for accessing cardiac function post CABG [17].

The utilisation of the BBT is based on a study that suggests breathing retraining has a positive effect on anxiety. Also, anxiety and depression often co-occur, which was used relatively in this study. Therefore, the aim of the present study was to evaluate the effect of BBT on existing phase 1 CR in post CABG patients. The primary outcome measures were GAD-7, PHQ-9 and GSS. The secondary outcome measures were BHT and Borg RPE scale.

MATERIALS AND METHODS

This randomised clinical trial was performed at Cardiovascular and Thoracic Surgery (CVTS) Unit, Acharya Vinobha Bhave Rural Hospital (AVBRH), Sawangi, Wardha, Maharashtra, India, from June 2021 to May 2022. Approved from the Committee for Institutional Ethics of Datta Meghe Institute of Medical Sciences (DMIMS, DU), Wardha, with trial registration done at Clinical Trial Registration of India CTRI/2021/05/033632.

Sample size calculation: The number of subjects were calculated using Software G. Power 3.1.9.4 with 44 subjects (22 each in both conventional and experimental group) including a 12% drop out were shown to be necessary based on the effect size of 0.93, an alpha level of 0.05 and power (1-β) of 0.91 [18]. Four participants were recruited additionally to maintain the sample size to overcome the incidence of dropout or problems with data collection.

Inclusion criteria: Total 44 post CABG patients of ages between 40-75 years with BMI <30 Kg/m^2, who screened positive for anxiety by GAD-7 score >8 and depression by PHQ-9 questionnaire score >10 were included in the study [19,20].

Exclusion criteria: The CABG patients having any preoperative haemodynamic complications e.g. recent myocardial infarction (last two week), lung congestion, etc., postoperative mechanical ventilation for more than 24 hours, history of heart failure and ejection fraction less than 20% and chronic smoker were excluded.

Patients were explained the purpose, methodology and possible risks of the study as per Declaration of Helsinki, 1964 after obtaining signed informed consent [21]. Randomisation was done using computer generated random number table and allocation using SNOSE method to an experimental or conventional group. It was done by primary researcher not involved in data collection, who was a postgraduate resident in physiotherapy under the supervision of a professor from the Department of Cardiovascular and Respiratory Physiotherapy. Outcome measures were assessed on postoperative day one and at the time of their last rehabilitation session after two weeks by a postgraduate resident in physiotherapy of the same experience, who was aware of the study and blinded about the intervention.

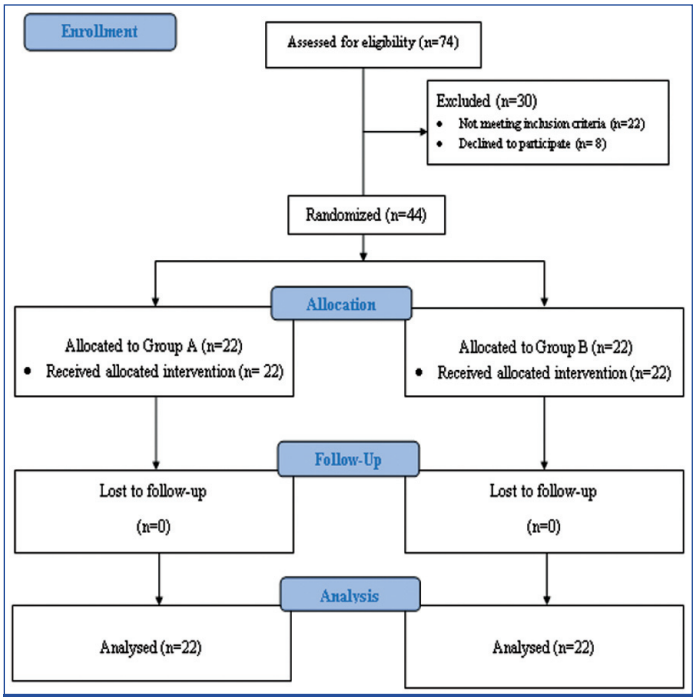
Study Procedure

A total of 44 patients in both groups underwent postoperative assessment on POD 1 and BHT and were asked to complete the Borg RPE scale, GAD-7 questionnaire, PHQ-9 and GSS as truthfully as they can, emphasising that there is no right or wrong response only the response they believe most accurately describes themselves.

Each patient completed two weeks of rehabilitation after enrolment in the study with no dropouts. The evaluations were performed at baseline on POD 1 and at their last rehabilitation session after two weeks. During discharge patients were given self-management and education hand-outs, which included relaxation techniques to decrease dyspnoea, tobacco cessation, nutritional recommendations, prevention of triggers and awareness about the rehabilitation program's benefits.

Group A: Conventional group: Once the patients were weaned off the mechanical ventilator and were haemodynamically stable, two weeks of the phase I CR program twice daily with each session of 25-40 minutes were provided in accordance with the AACVPR guidelines [7].

Group B: Experimental group: The experimental group received 20 minutes of BBT twice daily for two weeks along with phase 1 CR [Table/Fig-1].



[Table/Fig-1]: CONSORT study procedure flowchart.

Step 1: The "control pause": Patients were instructed to gently inhale for two seconds, exhale for three seconds and then pinch their noses with their fingers to hold the breath. The therapist next counts how many seconds the patient can hold their breath calmly before feeling the need to breathe in again. Then instructed to open the nose and take a breath in.

Step 2: Shallow breathing: Patients were asked to place their index finger below the nostrils in the horizontal position to monitor the amount of air flowing in and out during each breath. Then, they were asked to breathe in a flicker of air with enough to fill the nostrils. Followed by, breathing out gently onto their finger. They were asked to concentrate on calming their breath by pretending their finger was a feather that should not move while breathing out. This reduces the amount of warm air they feel on their finger. Once the amount of warm air reduces patient will begin to need air.

Step 3: Repeat steps 1 and 2 three to four times [9].

STATISTICAL ANALYSIS

Statistical analysis was done by using descriptive and inferential statistics using student's paired and unpaired t-tests and the software used in the analysis was SPSS 27.0 version and Graph Pad Prism 7.0 version and $p<0.05$ is considered a level of significance. The Chi-square test of independence was done to assess the association between the number of individuals utilised in the study and their age, gender, height, weight and BMI.

RESULTS

All 44 patients enrolled in the study completed two weeks of rehabilitation. The participant's baseline characteristics are presented in [Table/Fig-2]. There were no significant differences between the experimental and the control group for demographic and clinical variables at baseline.

Baseline characteristics	Group A	Group B	p-value
Age (years)	59.72±7.84	60.81±7.42	0.63
Age range	46-71 years	48-72 years	
Gender			
Male	13 (59.01%)	12 (54.56%)	0.54
Female	09 (40.99%)	10 (45.45%)	
BMI (Kg/m^2)	26.93±1.91	25.51±2.12	0.24

[Table/Fig-2]: Distribution of patients according to baseline characteristics.

The [Table/Fig-3] shows the statistical evidence of all the outcome measures. Post rehabilitation the results observed for GAD-7 (25.62, p=0.0001), PHQ-9 (11.79, p=0.0001), GSS (23, p=0.0001), BHT (23.55, p=0.0001) and RPE (18.99, p=0.0001) in group A and group B for GAD-7 (27.37, p=0.0001), PHQ-9 (32.34,p=0.0001), GSS (26.94, p=0.0001), BHT (22.70, p=0.0001, and RPE (25.11, p=0.0001) following the intervention. This shows mean difference was more pronounced in the group B compared with the group A.

Outcome measure	Group A			Group B			Comparison of mean difference between group		
	Pretreatment	Post-treatment	T value, p-value	Pretreatment	Post-treatment	T value, p-value	Group A	Group B	T value, p-value
GAD-7	17.27±1.90	9.13±1.75	25.62, p=0.0001	17.36±1.78	4.13±1.64	27.37, p=0.0001	8.13±1.48	13.22±2.26	8.80, 0.0001
PHQ-9	20.59±2.61	11.22±2.87	11.79, p=0.0001	23.45±2.55	8±2.11	32.34, p=0.0001	9.36±3.72	15.45±2.24	6.57, 0.0001
GSS	12.81±1.76	28±2.42	23, p=0.0001	12.36±1.73	35.18±3.50	26.94, p=0.0001	15.18±3.09	22.81±3.97	7.11, 0.0001
BHT	16.45±2.44	35.36±3.72	23.55, p=0.0001	20.09±5.70	54.18±10.50	22.70, p=0.0001	18.90±3.76	34.09±7.04	8.91, 0.0001
Modified borg scale	17.18±1.50	9.09±2.09	18.99, p=0.0001	17.45±1.62	8±1.82	25.11, p=0.0001	8.09±1.99	9.45±1.76	2.39, 0.021

[Table/Fig-3]: Outcome measures pre and post rehabilitation.

The results for the inter-group comparison showed a significant difference in group B on anxiety (8.80, p<0.0001), depression (6.57, p<0.0001), self-efficacy (7.11, p<0.0001), BHT (8.91, p<0.0001), and RPE (2.39, <0.021) as compared to the group A, i.e. group B showed a larger improvement in outcome measure scores than group A.

DISCUSSION

The present study findings suggests that BBT as an effective treatment adjunct in improving anxiety, depression and self-efficacy in post CABG patients. While there are many instruments available to measure depression and anxiety, PHQ-9, as recommended extensively by AHA for screening and diagnosing depression and the GAD-7 questionnaire for anxiety respectively in CAD patients were used in the study [22,23].

In line with this study, a growing number of empirical literature reported that emotional enhancement and reducing anxiety and depression, practicing breathing exercise is the most cost-effective non pharmacological management [24,25]. The BBT exercises are unique in minimising stress response by training muscles, reflexes, and mind, which suppress sympathetic nervous system activity [9]. Similarly, Brown RP et al., studied links between respiration and emotions and their effect on autonomic nervous system which suggested practicing breathing could be used as a complementary intervention for anxiety disorder [10]. Ma X et al., 2017 reported that diaphragmatic breathing influences physical and mental health [26].

Heuristically, it is widely accepted that low self-efficacy interferes with one's perception of their ability to manage fear or circumstances that cause worry are linked to anxiety and depression and self-efficacy is related to psychological well-being in heart patients [27]. The GSS has become one of the most widely used instruments for assessing self-efficacy in CR [28]. Postrehabilitation the findings in the present study show significant improvement in the experimental group as compared to the conventional group in GSS levels (22.81±3.97 vs 15.18±3.09). Similarly, Millen JA and Bray SR, 2009 reported that the self-efficacy of the intervention group who are adherent to CR, compared with the control group, was significantly higher after one month post surgery [29].

The current results reflected that improvement in BHT in group B was superior to group A (34.09±7.04 sec vs 18.90±3.76 sec). Buteyko practitioners consistently report that 30 seconds is a normative value for BHT and longer BHT is associated with decreased symptoms [9,12]. This could be explained as a biochemical and biomechanical mechanism by Courtney R and Cohen M, 2008 who reported that Buteyko practitioners' insistence on nasal breathing as a biochemical mechanism, is likely to influence Nitrous Oxide (NO) levels [30]. Paranasal sinus being the largest producer of NO [31], the combination of long breath holds and reduced volume breathing given by the Buteyko, influence NO and its functions including bronchodilation, vasodilatation, tissue permeability, oxygen transport, mood, and learning [32]. Along with this, activating abdominal muscle tone alongside relaxation of all the other muscles of breathing, mainly the shoulders and chest, facilitates low volume breathing as taught in BBT to improve the biomechanics of breathing [33].

Broadly, study data support previous researchers who have reported a positive effect of BBT on anxiety and depression in different populations. In the study done on university footballers by Chaudhary DS et al., (2021) a decrease in anxiety was observed by 12.4% and an increase in control pause by 134.2% in group A when compared to group B who undergone only usual training [11]. Naik P et al., (2019) reported positive effects of BBT on depression in the geriatric population suggesting that this specific method should be further explored as a rehabilitation method [34].

The output of this research was essential because, first it addressed a major issue in the field of health psychology, for which health professionals are still seeking ways to enhance outcome it in chronic patients. Secondly, rather than being a trivial addition to CR, an intervention as a skill that patients can learn and use to "exercise the mind," would have "face validity". The study's findings lend credence to the notion that the post CABG inpatient period offers a crucial time and opportunity for preventive psychological intervention and that psychological elements at this time can be crucial to the recovery process. It indicates factors that can make psychological assistance more agreeable to worried CABG patients.

Limitation(s)

In this present study, there was no preoperative screening and management has been provided due to COVID-19 protocol, testing and isolation before the surgery. Secondly, there was no follow-up taken as the majority of the patients were from outside, so the post discharge intervention was aided through discharge training and a home exercise program booklet which may not have matched up with the direct professional intervention. The anxiety and depression were screened using clinical assessment tools (GAD-7 and PHQ-9 questionnaire) rather than diagnosing depression through clinical interviews. The study was confined to two weeks and follow-up was difficult due to which it cannot be ascertained whether the gains may be generalised to when the patient returns to fully functional and working life. To ascertain the treatment's long-term effects, a large scale study comprising preoperative screening, management,

and follow-up can be done in the future. More studies are required to determine effect of BBT on CABG patients during the II and III phases of CR and its effect on other heart surgeries.

CONCLUSION(S)

The present study demonstrated that two weeks of BBT along with phase 1 CR in post CABG patients had favourable changes in their levels of anxiety, depression and self-efficacy, it provides substantial evidence for the management of post CABG patients from a psychological perspective. Therefore, as observed in this study Buteyko breathing technique along with the phase 1 CR program may be recommended as a part of early Postoperative management in patients following CABG surgery. Integrating early prevention for psychological repercussions in the post revascularisation intervention strategy can help to reduce chances of prolong recovery, rehospitalisation, rapid return to work cost-effectively and further alleviates symptoms. This will create a window of opportunity for early screening and therapy for psychological repercussions in CR, allowing for holistic and effective management of post CABG patients.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Oct 20, 2022
- Manual Googling: Nov 15, 2022
- iThenticate Software: Nov 23, 2022 (9%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Oct 18, 2022**
Date of Peer Review: **Nov 18, 2022**
Date of Acceptance: **Nov 24, 2022**
Date of Publishing: **Jan 01, 2023**