DOI: 10.7860/JCDR/2024/71161.20153

Research Protocol

Physiotherapy Section

Immediate Effect of Breath Stacking and Buteyko Breathing on Physiological Parameters in post Laparoscopic Cholecystectomy Patients: A Research Protocol of a Randomised Controlled Trial

DEEKSHA MEHTA[1], POOJA MEHRA[2], GEETANJALI KAUL[3], NITESH VERMA[4]

ABSTRACT

Introduction: Laparoscopic cholecystectomy is frequently performed in acute, chronic, symptomatic, and asymptomatic cholelithiasis. It is simple, safer, and requires less recovery time than open cholecystectomy, which is why this procedure is increasingly utilised for various abdominal surgeries. Patients may experience postoperative pulmonary problems during the recovery phase and as per available literature there is a noticeable decline in the vital capacity of the patient. It was observed that Buteyko breathing and breath stacking breathing techniques has a good impact on the physiological parameters and vital capacity of patients with hypertension, asthma, Chronic Obstructive Pulmonary Disease (COPD), and other respiratory conditions.

Need of the study: Buteyko breathing and breath stacking breathing techniques are effective in different conditions like hypertension, asthma, and cardiac surgery. The need of the study is to compare both techniques and find out which one is more effective and implement that with the standard exercises in the patients to help them improve their quality of life, reduce hospital stay, and improve lung capacity.

Aim: To compare the effects of the Breath Stacking Technique (BST) and Buteyko Breathing Technique (BBT) on the physiological parameters of patients undergoing laparoscopic cholecystectomy.

Materials and Methods: This will be a randomised controlled trial in which 140 patients will be included using purposive sampling via block randomisation. The study will be conducted in Surgery Intensive Care Unit (SICU) of Maharishi Markandeshwar Medical College and Hospital, Kumarhatti, Solan, from December 2023 to May 2024. Patients in Group-A will perform the BBT and Group-B will perform the BST. Each cycle of breathing consists of five repetitions with five sets and 30 seconds of rest in between. Outcome measures will be taken at baseline and after intervention on Postoperative Day 1 (POD). The normality of the data will be checked by Kolmogorov-Smirnov test. A paired t-test will be used if the data is normal, and the Wilcoxon Signed Rank test will be used if the data is non-normal. A p-value < 0.05 will be considered significant.

Keywords: Cardio-respiratory parameters, Healthcare, Numerical pain rating scales, Quality of life, Vital capacity

INTRODUCTION

Cholelithiasis is a frequent, chronic hepato-biliary condition that occurs due to the malfunction in the metabolism of bile acids, bilirubin, and cholesterol [1]. The prevalence rate of cholelithiasis is 2-29%, which is more common in women, in India. Nonetheless, 80,000 Americans are admitted to hospitals due to gallstone disease each year, affecting over 20 million people in the country. On the contrary, Black Americans (13.9% of women and 13.9% of men) and Asian populations (5-20%) have shown an intermediary prevalence rate [2].

A more conservative and minimally invasive surgical technique called laparoscopic cholecystectomy is used to remove a damaged gall bladder. Laparoscopic surgeries have been used for stomach, oesophagus, bowel, liver, and kidney resection [3]. These procedures are minimally invasive, require small incisions, and are preferable to exploratory surgery because of less discomfort, lower risk of bleeding, and faster recovery period due to fewer lacerations [4]. A previous study has shown that patients who undergo cholecystectomy are more likely to suffer from respiratory complications and have a 40%-50% reduction in vital capacity compared with their preoperative level [5]. Postoperative pulmonary complications are very common after cholecystectomy. It directly affects the respiratory mechanism and pulmonary function and leads to certain complications such as changes in the respiratory rate, ventilation-perfusion ratio, reduced mobility of the diaphragm, and depressed central nervous system [6,7].

The rehabilitation regime of individuals who undergo laparoscopic cholecystectomy is crucial for which chest physiotherapy and other techniques play an important role [8]. It includes percussion, vibration, postural drainage, autogenic drainage, and different breathing techniques. Arora R et al., conducted a study to identify the effectiveness of the BBT on functional capacity and haemodynamic parameters in primary hypertensive patients. It showed that both Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) as well as Resting Heart Rate (RHR) exhibits a considerable decrease [9]. Another study was conducted among university football players to determine the effects of Buteyko breathing. It showed a considerable improvement in RHR, SBP and DBP, VO_2 max, Control Pause (CP), and other cardiorespiratory parameters [10].

Buteyko breathing and stacking breathing are both effective and report no harm, as documented in the literature. However, there is a lack of literature available for comparison of both these techniques in any kind of abdominal surgery. Therefore, this study aimed to determine which breathing technique is more effective in improving physiological parameters in patients undergoing laparoscopic cholecystectomy.

Primary objectives: To identify the effect of Buteyko breathing in improving physiological parameters {Heart Rate (HR), Respiratory Rate (RR), Oxygen Saturation (SpO_2), and Blood Pressure (BP)} of the patients with laparoscopic surgery.

To identify the effect of breath stacking in improving physiological parameters (HR, RR, SpO_2, and BP) of the patients with laparoscopic surgery.

Secondary objectives:

- To determine which technique showed better results on physiological parameters based on age and gender.
- To compare which technique is more effective in improving pain in patients with laparoscopic surgery.

Null Hypothesis (H_0): No significant difference will be found in physiological parameters in patients who performed Buteyko breathing or stacking breathing after laparoscopic cholecystectomy.

Alternate Hypothesis (H_a): Significant differences will be found in physiological parameters in patients performing Buteyko breathing or stacking breathing after laparoscopic cholecystectomy.

REVIEW OF LITERATURE

The effect of upper abdominal surgeries on respiratory mechanics and pulmonary function are well known to cause postoperative pulmonary complications likely, tachypnea, decreased diaphragm mobility, changes in ventilation-perfusion ratio, central nervous system depression, and reduced cough efficacy [7]. Previously, a randomised controlled trial was done in which 34 patients participated and were split into two groups: the breath stacking (BS) group (n=18), who received both BS and standard physiotherapy, and the control group (n=16), which received standard physiotherapy. From the second POD up to hospital discharge, both groups received two exercise sessions per day. The Forced Vital Capacity (FVC) and tidal volume (TV) were the key results. The frequency of gastrointestinal, cardiovascular, and pulmonary side-effects was used to evaluate the safety of BS. The trial discovered that the BST decreased RR and improved SpO_2 in patients with abdominal surgery [11].

A study was conducted among young asthmatic patients to find out the effectiveness of Buteyko breathing on functional and clinical parameters. Over the course of three months, two groups of asthmatic patients (n=30 each) receive either BBT or conventional therapy (UT) with or without BBT, were examined using a randomised, controlled methodology. The study showed improvement in breathing patterns, a reduction in the use of respiratory pharmacotherapy, and a mild increase in the bronchial volume. Self-controlled buteyko breathing was well accepted by the participants and could be used as supporting tool in asthma therapy being worth of wider attention in clinical practice [12].

Another study was done among young adults in which 80 participants who were selected for research were given a detailed explanation of the process and instructed on how to use the BBT. Pre-test evaluation was done at baseline HR, BP, Rate of Perceived Exertion (RPE), and Pulmonary Function Test (PFT). Post-test evaluation of outcome measures was done after 12 minutes of intervention. Study concluded that there was significant decrease in the SBP and increase in HR, RPE and in forced expiratory volume [13].

A study that compares the two methods was conducted on asthmatic individuals. Based on the inclusion criteria, patients (n=60) between the ages of 20 and 40 were enrolled in the study investigation. The Buteyko and stacking breathing techniques were applied to the participants in split groups, following that order. The pre-and post-measures were assessed using peak flow meters and a modified Borg scale, and it was found that Buteyko breathing is more efficient than the breath stacking approach [14]. Multiple studies have shown that the use of BBT helps to decrease HR, SBP and DBP, pulse rate, and SpO_2 [3,15]. On the other hand the use of the BST helps in reduction of respiratory work, improves lung volume, gaseous exchange, lung mechanics, respiratory performance, peripheral oxygenation and also helps to recover pulmonary function [11,16-18].

A randomised control trial was done to find out the effectiveness of incentive spirometer and BBT on CP. Two groups of 40 patients were randomly assigned. BBT was performed by Group-A and incentive spirometer was done by Group-B. Data collection was done in three phases. Phase 1: On the first POD, a stopwatch was used for both techniques to measure baseline data of the control Phase 2: For five consecutive days, individuals were advised to perform BBT and incentive spirometry twice a day for five minutes. Phase 3: On the 5th day, post-treatment measures were evaluated. Results showed that the incentive spirometer (p-value 0.01) was effective as compared to buteyko breathing (p-value 0.18) [19].

MATERIALS AND METHODS

The present study will be a single-blinded, randomised controlled trial in which patient will be blinded to intervention. The total duration of the study will be for 6-months from December 2023 to May 2024. The patients will be recruited from the Surgery Intensive Care Unit (SICU) using purposive sampling. Informed consent will be obtained and duly signed by the patients before recruitment. Study protocol complies with principles outlined in the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) and is approved by the Institutional Ethical Committee with reference number MMMCH/IEC/23/765. The study has been registered in clinicaltrials.gov with registration number CTRI/2024/03/063688. The research will be conducted per the Code of Ethics of the World Medical Association (Declaration of Helsinki) and the National Ethical Guidance for Biomedical Research [20,21]. All procedures will be performed under relevant guidelines, regulations and ethical principles.

The study aims to recruit 140 patients aged between 30 to 60 years.

Inclusion criteria for patient recruitment will be male and female patients with only laparoscopic cholecystectomy on POD-1, Glasgow Coma Scale (GCS) score 13 and above, oriented to time, place and person, non-smoker, patient with normal build as per ASIAN Body Mass Index (BMI) classification [22] and normal body temperature (37°C).

Patients with respiratory distress, acute chest pain, chest deformity, any other illness such as Chronic Obstructive Pulmonary Disease (COPD), asthma, Tuberculosis (TB), pneumonia, pleural effusion, haemodynamically unstable patients, previous abdominal surgery and patients with psychiatric disorders will be excluded from the study.

Sample size calculation: The sample size was calculated using G*power 3.1.9.4 software (Franz Faul, University of Kiel, Kiel, Germany), where the level of significance (α), power of the study ($1-\beta$) and clinically significant difference were 0.05, 0.80 and 0.5 (medium effect size), respectively [23]. The sample size was calculated as 128 patients. After the addition of 10% dropout, the final sample size was n=140, allocated into two groups (70 patients per group) using block randomisation.

Procedure

The study will be explained and if patients are not able to perform exercise, after giving consent (because of any reason), they will be excluded from the study. A curtain will be placed to maintain the privacy of the patient, as well as for intervention. Patient will be asked to lie in a semi-fowler position with minimal clothing for intervention, with head-end elevated to 30°-45° and pillows placed under the knee to keep the diaphragm in a relaxed position. Physiological parameters will be measured on the baseline and after the intervention, such as

RHR and SpO_2 using a pulse oximeter (Model: MCP X1805), resting SBP and DBP by a sphygmomanometer (Model: BPDL 237) and movement of the rib cage will be observed for RR using a mobile phone stopwatch (OPPO f11) for one minute. Pain assessment with the help of NPRS will be measured before and after the intervention.

Group-A: Buteyko Breathing Technique (BBT): The patient will be instructed to take 2-3 normal breaths. Subsequently, they were asked to take a deep inspiration followed by expiration and hold it by plugging the nose using the index finger and thumb until they had an urge to breathe again. This cycle will be repeated five times and five sets will be completed with 30 seconds rest in between [10,12,14]. Total time taken for the intervention will be approximately 15 minutes. Immediately after the intervention, all parameters will be documented. The intervention will be provided for only one day on POD-1.

Group-B: Breath Stacking Technique (BST): The patient will be asked to take 3-4 consecutive breaths one after another, hold them as long as they can, and then slowly exhale through pursed lips. This cycle will be repeated five times and five sets are completed with 30 seconds rest in between [14,24]. The intervention will take approximately 15 minutes. Immediately after the intervention, all parameters will be documented. The intervention will be provided for only one day on POD-1.

Measurement time points: The schedule of enrolment, interventions, and assessments of the study protocol has been illustrated in [Table/Fig-1]. Every assessment listed, will be carried out twice during the measurement period.

Timepoint	t0	t0	t0	t1	t2
Enrolment					
Eligibility screen	X				
Informed consent	X				
(HR, RR, SpO_2, BP)	X				
Allocation		X			
Intervention					
Experimental group-1 (BBT)			←	—	→
Experimental group-2 (BST)			←	—	→
Assessments					
(Pre HR-Post HR)	X		X	X	X
(Pre RR-Post RR)	X		X	X	X
(Pre SpO_2-Post SpO_2)	X		X	X	X
(Pre SBP-Post SBP)	X		X	X	X
(Pre DBP-Post DBP)	X		X	X	X

[Table/Fig-1]: Schedule of enrolment, interventions, and assessments of the study protocol.
BBT: Buteyko breathing technique; BST: Breath stacking technique; HR: Heart rate; RR: Respiratory rate; SpO_2: Peripheral oxygen saturation; BP: Blood pressure; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; t0: Allocation and enrolment; t1: Pre-intervention; t2: Post-intervention

Primary outcome measures: Primary outcome measures will be RR, SBP and DBP, SpO_2, and pulse rate [25-27].

Secondary outcome measures: Secondary outcome measure The secondary outcome will be Numerical Pain Rating Scale (NPRS) for assessment of pain [28].

STATISTICAL ANALYSIS

The statistical analysis of data will be performed by using a Statistical Package for Social Science (SPSS) version 20.00 (SPSS version 20.0 Inc., Chicago, IL) software. The normality of the data will be checked by Kolmogorov-Smirnov test. A paired t-test will be used if the data is normal otherwise Wilcoxon Signed Rank test will be used and a p-value <0.05 will be considered significant.

Harm and safety of data: Previous studies showed that both these breathing techniques are safe and no harmful/adverse effect is observed. If any adverse effect is observed during study, interim analysis will be done by the researcher. Patient demographic details, their allocation, and the result of intervention will be maintained by the primary investigator and kept confidential.

REFERENCES

[1] Gill GS, Gupta K. Pre- and Post-operative comparative analysis of serum lipid profile in patients with cholelithiasis. Int J Appl Basic Med Res. 2017;7(3):186-88.
[2] Bansal A, Akhtar MA, Bansal A. A clinical study: Prevalence and management of cholelithiasis. Int Surg J. 2014;1(3):134-39.
[3] Cetin R. Laparoscopic surgery types of laparoscopic and treatment. J Uni Sur. 2022;10(7):01-03.
[4] Reeve JC, Boden I. The physiotherapy management of patients undergoing abdominal surgery. New Zeal J Physiother. 2016;44(1):33-49.
[5] Dureuil B, Cantineau JP, Desmonts JM. Effects of upper or lower abdominal surgery on diaphragmatic function. Br J Anaesth. 1987;59(10):1230-35.
[6] Ayoub J, Cohendy R, Prioux J, Ahmaidi S, Bourgeois JM, Dauzat M, et al. Diaphragm movement before and after cholecystectomy: A sonographic study. Anesth Analg. 2001;92(3):755-61.
[7] Grams ST, Ono LM, Noronha MA, Schivinski CIS, Paulin E. Breathing exercises in upper abdominal surgery: A systematic review and meta-analysis. Rev Bras Fisioter. 2012;16(5):345-53.
[8] Zahari Z, Subramanian SS. The effect of chest physiotherapy during immediate postoperative period among patients underwent abdominal surgery. Indian J Public Heal Res Dev. 2020;11(05):803-08.
[9] Arora R, Dhokpatil S, Verma C, Rajadhyaksha G. Effect of Buteyko Breathing Technique on haemodynamic parameters and functional capacity in subjects with primary hypertension. Indian J Physiother Occup Ther- An Int J. 2022;16(3):73-80.
[10] Chaudhary S, Khanna S, Maurya UK, Shenoy S. Effects of Buteyko Breathing Technique on Physiological and psychological parameters among University Football Players. Eur J Mol Clin Med. 2021;08(02):1790-800.
[11] Fernandes DDL, Righi NC, Neto LJR, Bellé JM, Pippi CM, Ribas CZDM, et al. Effects of the breath stacking technique after upper abdominal surgery: A randomized clinical trial. J Bras Pneumol. 2022;48(1):e20210280.
[12] Vagedes K, Kuderer S, Ehmann R, Kohl M, Wildhaber J, Jörres RA. Effect of Buteyko breathing technique on clinical and functional parameters in adult patients with asthma: A randomized, controlled study. Eur J Med Res. 2024;29(1):42. Available from: https://doi.org/10.1186/s40001-023-01634-1.
[13] Rai RH, Hembrom RK, Sharma P, Kataria J. A study on immediate effect of Buteyko Breathing technique on cardio-respiratory parameters in young adults. Int J Health Sci Res. 2018;8(7):166-69.
[14] David JJ, Patil HR. Immediate effect of Buteyko Breathing Technique versus stacked breathing technique in asthma patients. Indian J Heal Sci Res. 2022;12(6):158-67.
[15] Sathe SS, Rajandekar T, Hadake S, Shegaonkar V. Immediate effect of buteyko breathing in hypertensive patients: An experimental prospective study. Indian J Forensic Med Toxicol. 2020;14(4):7136-41.
[16] Vaz SFA, Matos TFV, Mendes MER, Preto LSR, Fernandes HJ, Novo AFMP. Effectiveness of the breath-stacking technique in the respiratory function of women undergoing bariatric surgery. Rev Enferm Ref. 2019;2019(23):49-58.
[17] Pellegrino GM, Corbo M, Di Marco F, Pompilio P, Dellacà R, Banfi P, et al. Effects of air stacking on dyspnea and lung function in neuromuscular diseases. Arch Phys Med Rehabil. 2021;102(8):1562-67.
[18] Porto EF, Tavolaro KC, Kumpel C, Oliveira FA, Sousa JF, De Carvalho GV, et al. Comparative analysis between the alveolar recruitment maneuver and breath stacking technique in patients with acute lung injury. Rev Bras Ter Intensiva. 2014;26(2):163-68.
[19] Afshan N, Ahmad S, Shahid S, Fatima A. Effect of buteyko breathing technique and incentive spirometer on breath control pause in post cardiac surgery patients. Rawal Med J. 2020;45(4):970-73.
[20] World Medical Association. World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. JAMA. 2013 Nov 27;310(20):2191-4. Doi: 10.1001/jama.2013.281053. PMID: 24141714.
[21] Mathur R, Thakur K, Hazam RK. Highlights of Indian Council of Medical Research National Ethical Guidelines for Biomedical and Health Research Involving Human Participants. Indian J Pharmacol. 2019;51(3):214-21. Doi: 10.4103/0253-7613.262456.
[22] WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;363(9403):157-63.
[23] Portney LG, Watkins MP. Descriptive Statistics. In: Foundations of Clinical Research: Applications to Practice, 3e. New York, NY: McGraw-Hill Education; 2017. p. 390-91.
[24] Dorça A, Alcântara LA, Diniz DS, Sarmet M, Menezes Mateus SR, Franco Oliveira LV, et al. Comparison between breath stacking technique associated with expiratory muscle training and breath stacking technique in amyotrophic lateral sclerosis patients: Protocol for randomized single blind trial. Contemp Clin Trials Commun. 2020;19:100647. Doi: 10.1016/j.conctc.2020.100647.
[25] Latten GHP, Spek M, Muris JWM, Cals JWL, Stassen PM. Accuracy and interobserver-agreement of respiratory rate measurements by healthcare professionals, and its effect on the outcomes of clinical prediction/diagnostic rules. PLoS One. 2019;14(10):e0223155.
[26] Ogedegbe G, Pickering T. Principles and techniques of blood pressure measurement. Cardiol Clin. 2010;28(4):571-86.

[27] Hassan AT, Ahmed SM, AbdelHaffeez AS, Mohamed SAA. Accuracy and precision of pulse oximeter at different sensor locations in patients with heart failure. Multidiscip Respir Med. 2021;16(1):742. Doi: 10.4081/mrm.2021.742.

[28] Cheatham SW, Stull KR, Kolber MJ. Roller massage: Is the numeric pain rating scale a reliable measurement and can it direct individuals with no experience to a specific roller density? J Can Chiropr Assoc. 2018;62(3):161-69.

PARTICULARS OF CONTRIBUTORS:
1. BPT Student, Department of Physiotherapy, Maharishi Markandeshwar Medical College and Hospital, Solan, Himachal Pradesh, India.
2. Assistant Professor, Department of Physiotherapy, Maharishi Markandeshwar Medical College and Hospital, Solan, Himachal Pradesh, India.
3. Assistant Professor, Department of Physiotherapy, Maharishi Markandeshwar Medical College and Hospital, Solan, Himachal Pradesh, India.
4. Assistant Professor, Department of Physiotherapy, Maharishi Markandeshwar Medical College and Hospital, Solan, Himachal Pradesh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Pooja Mehra,
Assistant Professor, Department of Physiotherapy, Maharishi Markandeshwar Medical College and Hospital, Solan-173229, Himachal Pradesh, India.
E-mail: mehra.drpooja@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 10, 2024
- Manual Googling: Apr 27, 2024
- iThenticate Software: Apr 03, 2024 (6%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

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. Yes

Date of Submission: **Apr 08, 2024**
Date of Peer Review: **Apr 29, 2024**
Date of Acceptance: **Aug 05, 2024**
Date of Publishing: **Oct 01, 2024**