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## Active Cycle Breathing Technique on Pulmonary Complications After Coronary Artery Bypass Graft

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### ABSTRACT

The most widely recognized postoperative complexities are watched and overseen after abdominal or cardiothoracic surgery are pulmonary complications and it is continue to contribute to patient morbidity and mortality. Hence, this study was conducted with the aim to determine the effectiveness of active cycle of breathing technique on pulmonary complications after coronary artery bypass surgery. Pre-experimental research design was adopted to conduct the study with 20 samples who met the inclusion criteria. Demographic variables were collected by using structured questionnaire and assessed the physiological parameters such as oxygen saturation, respiratory rate, and heart rate, systolic and diastolic blood pressure. Followed by active cycle of breathing technique was administered to the participants twice a day for 3 days from the first post-operative day onwards. Pre and post assessment was done each day before and after the intervention and post-test value was taken for analysis. Post-operative complications were assessed at the end of 3<sup>rd</sup> day of intervention by using the checklist contains the pulmonary complications due to surgery. Data were analyzed using SPSS statistical package. There was a significant improvement was observed in oxygen saturation, respiratory and heart rate at the level of  $p < 0.05$  and the percentage of complications also very minimal. The findings of the study concluded that active cycle breathing technique is effective in pulmonary function thereby prevent the pulmonary complications after coronary artery bypass graft.



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### INTRODUCTION

Coronary artery bypass grafting (CABG) is a technique of an area of a vein is joined from the aorta to

the coronary artery to bypass the congested part of the coronary artery to alleviate the coronary perfusion to the myocardium of the heart in the event of coronary artery disease such as myocardial infarction. It is as yet the most ordinarily executed cardiac surgery strategy around the world, speaking to yearly volumes of roughly 200,000 segregated cases (Weiss and Elixhauser, 2001) in the US and a normal occurrence pace of 62 for each 100,000 occupants in western European nations (OECD, 2009; Head et al., 2017). The number of bypass procedures is expanding in India and it is around 60,000 coronary bypass procedures are made every year (Kaul and Bhatia, 2010).

The most widely recognized postoperative complexities are watched and overseen after abdominal or cardiothoracic surgery are pulmonary complica-

tions (Brooks-Brunn, 1995). It continues to contribute to patient morbidity and mortality, length of stay, and generally utilization of assets regardless of various advances in preoperative, intraoperative, and postoperative consideration. The most as often as possible discovered hazard factors for pulmonary hazards are propelled age, overabundance weight, history of cigarette smoking, diabetes mellitus, irregular pneumonic capacity, and chronic obstructive pulmonary disease (Gaynes *et al.*, 1991; Garibaldi *et al.*, 1981). The aetiology of pulmonary hazards after cardiac surgery are open heart multifactorial association between anesthesia, (Wind-sor and Hill, 1988; Nogare, 1994; Renault *et al.*, 2008) surgical trauma, cardiopulmonary bypass, cardiac arrest, time of medical procedure, duration of the mechanical ventilation and pain, causing decreased functional residual capacity, increased intrapulmonary shunt and enlargement of alveolar-arterial oxygen (Luchesa *et al.*, 2009; Westerdahl *et al.*, 2005). The most common postoperative respiratory complications are atelectasis and hypoxemia (Guizilini *et al.*, 2005; Feltrim *et al.*, 2007). However, different hazards such as dry or productive cough, dyspnea, bronchospasm, hypercapnia, pleural effusion, pneumonia, pneumothorax, re-intubation and insufficiency ventilation are also observed (Moreno *et al.*, 2011). Also, the duration of hospital stay for this type of interventions usually leads to distress, stress, depression, eagerness, weariness, intensification of pain and uneasiness both in the pre and postoperative period, which can influence oxygen transport preferring the improvement of postoperative complications (Stiller and Munday, 1992).

The best mediations, for example, breathing and coughing exercises, early ambulating, and pneumonic clearing methods are frequently used to forestall aspiratory inconveniences after coronary artery bypass graft (CABG) surgery (Mckoy *et al.*, 2012). Amongst active cycle of breathing technique (ACBT) is a functioning breathing procedure might be actualized by the patient to extricate and clear discharges from the lungs (Thomson *et al.*, 1994), improve ventilation in the lungs and to improve the adequacy of a cough (Guy and Thomas, 2018; Sumansheraz and Ahmedsiddiqi, 2015). It can be performed freely by quiet with about applying manual strategy. ACBT is very compelling method to improve oxygen saturation, control respiratory rate, and chest clearance after major surgeries. In 2015 an investigation was led to assess the impacts of ACBTs on chest extension, blood vessel blood gases, oxygen saturation, blood pressure, respiratory rate and other vitals in chronic obstructive

pulmonary disease patients during the first phase of cardiac recovery after CABG medical procedure and presumed that ACBT are a lot of viable than routine physiotherapy convention in patients who have gone under coronary artery bypass grafting (Pryor and Webber, 1994). Considering the potential improvement the investigators are interested in studying the effectiveness of active cycle of breathing technique with the hypothesis of significant reduction in pulmonary complications after the implementation of ACBT among patients who had undergone coronary artery bypass surgery.

## MATERIALS AND METHODS

Pre-experimental study was conducted with twenty samples at cardio thoracic intensive care unit after obtaining an authorized setting permission from the hospital. Convenience sampling technique was adopted to select the samples who met the inclusion criteria. Patients with more than 18 years of both male and female undergone elective coronary artery bypass graft, having hearing, speaking and cognitive ability were included for the study and the exclusion criteria were patient who had the habit of smoking, history of cerebrovascular accident, renal dysfunction, previous open heart of pulmonary surgery, cardiovascular instability or an aneurysm and on the treatment of immunosuppressive treatments during the 30 days prior to surgery. St. Gorge Respiratory Assessment scale was also used to select the participants. This scale score ranging from 0-100 with lowest score indicating low limitations in respiratory function. Participants were explained about the purpose of the study. Informed consent was obtained after assuring the confidence. Demographic variables were collected by using structured questionnaire and assessed the physiological parameters such as oxygen saturation, respiratory rate, heart rate, systolic and diastolic blood pressure. Followed by an active cycle of breathing technique was administered to the participants twice a day for 3 days from the first post-operative day onwards. This technique consists of breathing control, deep breathing exercise and huffing. Participants were instructed to close their eyes and take breathe in and out through the nose / mouth and gradually reduce breathes slower. Deep breathing exercise was continued by the participants for 3-5 times followed by 1-2 medium volume huffing was performed. The total duration for each session was 10-15 minutes. Physiological parameters was assessed each day before and after the intervention and post-test value was taken for analysis. Post-operative complications was assessed at the end of 3<sup>rd</sup> day of intervention by using the check-

list contains the pulmonary complications due to surgery. Confidentiality was maintained throughout the study. Data were analyzed by both descriptive and inferential statistics using SPSS statistical package.

## RESULTS AND DISCUSSION

The present study observed that majority 9 (45%) were in the age group of 31 – 60 years and 14(70%) were and doing heavy work. More than 60% had the habit of smoking. Around 15(75%) had no past history of respiratory asthma and only 5(25%) had the past history of respiratory asthma as depicted in Table 1.

The Table 2 shows that the pretest mean score of oxygen saturation was  $98.65 \pm 1.19$  and post test score mean and standard deviation of Day 1, Day2 and Day 3 was  $99.32 \pm 1.95$ , was  $99.75 \pm 1.25$  and  $99.85 \pm 1.50$  respectively. The calculated repeated measures ANOVA F value of  $F = 15.18$  was found to be statistically significant at the level of  $P < 0.05$  which clearly indicates that there was significant difference in the level of oxygen saturation. Regarding respiratory rate, the pretest mean and SD was  $24.65 \pm 3.92$  and post test score mean and standard deviation was  $23.27 \pm 1.76$ ,  $21.70 \pm 1.68$  and  $20.93 \pm 1.27$  in Day 1, Day2 and Day 3 respectively. The pre-test and post-test score of mean and SD values were calculated by repeated measures of ANOVA and found value of  $F = 5.64$  was revealed to be statistically significant at the level of  $P < 0.001$ . The pre-test mean score of heart rate was  $88.20 \pm 3.92$  and post test mean and standard deviation of Day 1, Day2 and Day 3 was  $90.97 \pm 7.51$ , was  $91.37 \pm 6.90$  and  $91.65 \pm 5.75$  respectively. The calculated repeated measures of ANOVA found the value of  $F = 0.672$  which shows significant difference in the level of heart rate. The systolic and diastolic blood pressure score of pre-test and post-tests mean value were also calculated by repeated measures ANOVA which found to be no significant difference in different level at the level of  $p < 0.05$ .

The Table 3 findings revealed that the active cycle breathing technique on physiological parameters in the study group was found effective in improving the oxygen saturation and heart rate. The respiratory rate shows highly significant improvement than the oxygen saturation and heart rate at the level of  $p < 0.001$ . However there was no significant improvement was found in systolic and diastolic blood pressure at the level of  $p < 0.05$ .

Table 4 depicts that only person (10%) had developed the pulmonary complications of pleural effusion and pneumothorax followed by Coronary

artery bypass surgery. None of them had any others complications such as pneumonia, prolonged mechanical ventilation, atelectasis, pulmonary edema, respiratory failure and acute respiratory distress syndrome.

Coronary artery bypass surgery procedure potentially causes the increased incidence of postoperative pulmonary complications. Changes in the pulmonary function following open heart surgery have been well reported by researchers and contribute considerably to post-cardiac morbidity and mortality. There are routine physiotherapy techniques which help to improve the pulmonary function from immediate post-operative period onwards. Amongst Active cycle breathing technique in as excellent breathing exercise because of a significant piece of the clearance mechanism of either an episode or a cough which diminishes the atelectatic area and increase ventilation (Frownfelter and Dean, 2012; Derakhtanjani *et al.*, 2019). Hence the current was conducted to determine the effectiveness of active cycle breathing technique on pulmonary complications and found that there is an improvement in physiological parameters which in turn reduces the postoperative pulmonary complication. The respiratory rate shows highly significant improvement than the oxygen saturation and heart rate. These findings of research supported by Ahmad *et al* who found that ACBT and routine physiotherapy had related outcome on arterial oxygenation, heart rate, and pain discernment following CABG procedure and furthermore it is seen that on the subsequent day there was rise up of the respiratory rate to an unusual span (Savci *et al.*, 2006). However in current study the pain level was not measured and respiratory rate was also stable with ACBT. Further, Savci *et al* who demonstrated adequacy of incentive spirometer and active cycle of breathing techniques following CABG and watched the improved blood vessel oxygenation from the initial day of post-operatively and following a 5<sup>th</sup> day of the treatment, utilitarian limit was very much protected with the utilization of ACBT (Monisha and Muthukumar, 2018). These findings confirmed the result of other study by Monisha *et al.*, 2018 who also found that ACBT improves utilitarian limit from the 6th to ninth day post-operatively and useful limit was very much protected with the utilization of ACBT after a 5-day treatment (Lamuvél *et al.*, 2016). In another study by Maria *et al* who reasoned that ACBT improves the lung function in abdominal surgeries however there is increasingly critical improvement in pneumonic capacity when ACBT is given along with transcutaneous electrical nerve stimulation (Wange *et al.*, 2016).

**Table 1: Frequency and percentage distribution of demographic variables of among the patients undergone CABG**

S.NO	Demographic Variables	Study Group	
		Frequency	Percentage
1.	Age in years		
	a. 18- 30	3	15
	b. 31- 60	9	45
	c. Above 61	8	40
2.	Gender of the Child		
	a. Male	14	70
	b. Female	6	30
3.	Type of Work		
	a. Mild	4	20
	b. Moderate	6	30
	c. Heavy	10	50
4.	History of Smoking		
	a. Yes	12	60
	b. No	8	40
5.	Past History of respiratory Asthma		
	a. Yes	5	25
	b. No	15	75

**Table 2: Comparison of post-test level of Arterial Blood Gases and Vital Signs among patients undergone CABG within the group**

Test	Pre Test		Post Test 1 Day 1		Post Test 2 Day 2		Post Test 2 Day 3		Repeated Measures NOVA
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	
O2saturation	98.65	1.19	99.32	1.95	99.75	1.25	99.85	1.50	F = 15.18 P=0.05, S*
Respiratory Rate	24.65	3.92	23.27	1.76	21.70	1.68	20.93	1.27	F = 5.64 P=0.019, S***
Heart Rate	88.20	9.25	90.97	7.51	91.37	6.90	91.65	5.75	F = 0.672 P=0.587, S*
Systolic BP	113.10	10.55	121.06	9.75	125.67	15.16	126.53	13.42	F = 1.710 P=0.232, N.S
Diastolic BP	68.57	6.49	70.20	9.44	72.10	5.13	72.10	6.31	F = 0.822 P=0.464, N.S

\*\*\*p&lt;0.001,\*p&lt;0.05, S – Significant, N.S – Not Significant

**Table 3: Effectiveness of ACBT on physiological parameters among patients undergone CABG within the group**

Variables	Test	Mean	S.D	Paired 't' Value
Oxygen Saturation	Pre-test	98.65	1.19	t = 13.000
	Post-Test	99.85	1.50	p = 0.05 S*
Respiratory Rate	Pre-test	24.65	3.92	t = 16.389
	Post-Test	20.93	1.27	p = 0.0001 S***
Heart Rate	Pre-test	88.20	9.25	t = 16.426
	Post-Test	91.65	5.75	p = 0.031 S*
Systolic BP	Pre-test	113.10	10.55	t = 0.142
	Post-Test	126.53	13.42	P = 0.353
Diastolic BP	Pre-test	68.57	6.49	t = 1.419
	Post-Test	72.10	6.31	P = 0.167 N.S

\*p<0.05\*\*\*p<0.001,S – Significant NS – Not Significant

**Table 4: Percentage Distribution of Pulmonary Complications among patients undergone CABG**

S.No	Pulmonary Complication	Frequency	Percentage
1	Pleural Effusion	1	10%
2	Pneumonia	-	-
3	Pneumothorax	1	5%
4	Prolonged Mechanical Ventilation	-	-
5	Atelectasis	-	-
6	Pulmonary Edema	-	-
7	Respiratory Failure	-	-
8	Acute Respiratory Distress Syndrome	-	-

Similarly Wang et al who found that active cycle of breathing techniques is better technique compared to incentive spirometry in post abdominal surgery patients (Syropoulos *et al.*, 2016). In contrast with previous studies Syropoulos et al reported that ACBT was related with critical increments in the SPO2 from the third postoperative day, yet was no greater at forestalling aspiratory intricacies than the typical postoperative physiotherapy routine (Çirak, 2015). There are limited studies which supported the present study findings. These study findings are contrast with the study finding by Çirak et al who shown that physiotherapy may help patients in high-hazard bunch for quicker recuperation after CABG and is progressively basic in high-chance patients to get comparable outcomes as in low-risk group (Grammatopoulou *et al.*, 2010). Many studies which proven that ACBT helps to reduce the

pain perception and this finding seems to confirm the findings of a study by Grammatopoulou et al who revealed that ACBT appeared to reduce pain in patients with rib fractures. Though there is great strengths of improvement in oxygen saturation, respiratory rate, heart rate and decrease in the occurrence of pulmonary complications after CABG without any adverse effects. However this study has limited to assess the pain, pulmonary function test such as forced vital capacity, forced expiratory volume, arterial blood gas analysis. Hence this study is recommended to conduct the study adopting true experimental design to analyze these parameters with large number of sample. Similarly comparative study also may be done to compare the ACBT other complementary breathing exercise as well compare the effectiveness between cardiothoracic and thoraco-abdominal surgery.

## CONCLUSIONS

This study finding concluded that ACBT is effective in preventing pulmonary complications and can be administered routinely after CABG as all the physiological parameters within the clinical range during the intervention phase. ACBT is also a safe method as it is done under the direct supervision of investigators.

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## Conflict of Interest

The authors declare that they have no conflict of interest.

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