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EFFECTIVENESS OF INCENTIVE SPIROMETRY VERSUS ACAPELLA IN POST CORONARY ARTERY BYPASS GRAFTING PATIENTS

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ABSTRACT

Background: CABG is performed daily on a worldwide basis in patients with coronary artery disease. The initial postoperative phase is the most vulnerable period, but decrease in pulmonary function persists for several months after surgery.Pulmonary rehabilitation programs significantly improve the patient's health by reducing breathlessness, providing ways to control the disease and by improving the patient's ability to carry out daily activities. Better health leads to improvements in lung function and thereby improving quality of life. Objective of this study is to quantify the effects of Acapella and Incentive spirometry on Spo2 (Spo2), Pulse rate and arterial blood pressure for improving pulmonary ventilation in post CABG patients. Methodology: Study design: Pre- test and Post- test study design in nature. Study duration: 5-monthperiod between Jan. 2021 and May 2021. The institutional review board approved the study protocol. Sample method: 50 Eligible patients of elective CABG were selected according to inclusion and exclusion criteria and divided randomly into two groups, as Group A and Group B, consisting of 25 patients each. Group A is treated with ACBT along with Acapella and Group B receive ACBT along with Incentive Spirometry. Conclusion: The result of this study concluded that Acapella and Incentive spirometry both have beneficiary effects on oxygen saturation (Spo2), Pulse rate and arterial blood pressure in post coronary artery bypass grafting but statistically Acapella give more significant improvement than Incentive spirometry.

KEYWORDS: Coronary Artery Bypass Grafting(CABG), Active Cycle Breathing Technique (ACBT), Incentive Spirometry (IS),Coronary Artery Disease (CAD), Saturation of oxygen (Spo2).

INTRODUCTION

Cardiovascular diseases have now become the leading cause of death in India. The global burden of disease estimate of age-standardized CVD death rate of 272 per 100,000 is higher than the global average of 235 deaths per 100,000. Coronary artery disease has reached epidemic proportions in Southeast Asia, particularly India, in recent years[1]. CABG is performed daily worldwide on patients with coronary artery disease. Most heart surgeries are performed for ischemic CAD.

CABG is usually performed through a median sternotomy. The procedure is performed by taking a graft from a vein or internal mammary artery and placing it proximal and distal to the lesion[2]. The first postoperative phase is the most vulnerable phase, but lung function decline continues for several months after surgery [3, 4].

Pulmonary rehabilitation programs significantly improve a patient's health by reducing shortness ofbreath, providing ways to manage the disease, and improving the patient's ability to perform daily activities. Better health improves lung function and therefore quality of life[5].

Chest physical therapy has long been a standard component of postoperative care to prevent or reduce complications such as pulmonary insufficiency, atelectasis, pneumonia, sputum accumulation, and impaired gas exchange[6-7]. Various chest physiotherapy techniques and breathing exercises with or without mechanical devices are routinely recommended to CABG patients to prevent or reduce lung dysfunction. These include early mobilization, positioning, incentive spirometry (IS), expiratory positive airway pressure, deep breathing exercises, respiratory muscles, cough support and active cycle breathing techniques (ACBT) [8].

IS, also called continuous maximal inspiration, is achieved with a device that provides feedback when the patient inhales at a predetermined flow or volume and holds the air for at least 5 seconds[9]. Another breathing exercise is that ACBT is one of the ways to help you get rid of phlegm from your chest. ACBT is a series of breathing exercises that relax and clear mucus from your airways[10].

Another commonly used technique is the Acapella, which is a respiratory therapy device that vibrates to break up mucus and encourage airway secretions. The device can be used in any position relative to the gravity of the breathing patient, including sitting, standing or lying down. Acapella Choice helps open airways in patients with lung disease and excretory problems. The great advantage of this product is that it can be disassembled for cleaning. In addition, this sludge remover has adjustable frequency and current resistance. Treatment times for patients can also be completed in less than half of a normal chest physiotherapy session. When patients use the Acapella device, they do not need to remove the device from their mouth to breathe[11].

This study compares the effectiveness of ACBT with incentive spirometry versus acapella with ACBT in patients undergoing CABG.

METHODOLOGY:

Study design: Pre- test and Post- test study design in nature.
Study setting: Thisstudy was conducted in Holy heart Super Specialty & Trauma Centre, Rohtakfrom Intervention Cardiology Department of hospital.
Study duration: 5-monthperiod between Jan. 2021 and May 2021. The institutional review board approved the study protocol.
Criteria for selection:
Inclusion criteria:

- Patients who were enrolled for elective CABG procedure,
- Age 18-80 years, and
- An ejection fraction above 20%.

Exclusion criteria

- Patients with a history of current smoking.
- A history of a cerebrovascular accident.
- Use of immunosuppressive treatments during the 30-day period before surgery.
- The presence of neuromuscular disorders or obstructive pulmonary disease.

PROCEDURE:

50 Eligible patients of elective CABG were selected according to inclusion and exclusion criteria and divided randomly into two groups, as Group A and Group B, consisting of 25 patients each. A brief explanation about the treatment session was given to all the patients and informed consent is obtained. Group A was treated with ACBT along with Acapella and Group B receive ACBT along with IS.

GROUP A (ACBT AND ACAPELLA)

ACBT: Patient is positioned in a relaxed sitting position and asked to do several minutes of relaxed diaphragmatic breathing exercise. Then he is asked to take 3-4 active deep inspiration with passive relaxed exhalation, followed by relaxed diaphragmatic breathing. The patient is asked to feel the secretions entering the larger central airway, and then to do 2-3 huffs at higher volume and then relaxed Breathing control. The cycle is repeated 2-4 times as per patient's tolerance.

ACAPELLA: Subjects were asked to seat in a comfortable position leaning forward with elbows supported on a table and neck slightly extended in order to open up the airway. The acapella was held horizontally and tilted slightly upwards in order to get maximal oscillatory effect and was place in the mouth. Inspiration was done through the nose. A slow breath in, only slightly deeper than normal with a breath hold of 3-5 seconds followed by breath out through the acapella at a slightly faster than normal. After 4-8 of these breaths, a deep breath with a hold at full inspiration was followed by a forced expiration through the acapella. This precipitates expectoration and was followed by a pause for breathing control, and then according to the subject's preference a cough or huff was done.The full effects of the vibrations induced by the acapella may be received by changing the angle of the device. While doing the procedure the patient must keep the cheeks flat and use the abdominal muscles effective exhalation. An acapella session consists of 10 to 15 breaths followed by huffing. To avoid dizziness due to hyper ventilation, a patient should refrain from forced exhalation. It may be necessary topause every 5 to 10 exhalations before resuming the session.

GROUP B (ACBT AND SPIROMETRY)

ACBT: Patient is positioned in a relaxed sitting position and asked to do several minutes of relaxed diaphragmatic breathing exercise. Then he is asked to take 3-4 active deep inspiration with passive relaxed exhalation followed by relaxed diaphragmatic breathing. The patient is asked to feel the secretions entering the larger central airway, and then to do 2-3 huffs at higher volume and then relaxed Breathing control. The cycle is repeated 2-4 times as per patient's tolerance.

Incentive Spirometry: Subject asked to sit upright with theSpirometer held in an upright position, ask the subject to normallyexhale and place his lips tightly around the mouthpiece. To achieve a Slow Sustained Maximal Inspiration, inhale at a sufficient rate to raise only the ball in the first chamber, while the ball in the second chamber remains at rest. For a higher flow rate, inhale at a rate sufficient to raise the first and second balls, while the ball in the third chamber remains at rest. Exhale after performing the exercise, remove the mouthpiece from your lips and exhale normally. Relax following each prolonged deep breath, take a moment to rest, and breathe normally.

Frequency of Treatment:
20 minutes per session, twice a day.
Treatment duration:
4 days.

RESULTS

This study was done on 50 patients of post CABG patients. Efforts were made in this study to compare the effect of Acapella and IS exercises on Spo2, Pulse rate, and arterial blood pressure in post CABG patients.By applying Paired-t test we compared with in group values of (Spo2) for group A. We found significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 93.24 ±.78 SD, 94.84 ±.55 SD, 96.40 ±.50 SD, and 97.96 ±.20 SD respectively.Similarly we compared with in group values of (Spo2) for group B. We found significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 91.60 ±1.08 SD, 92.68 ±1.03 SD, 93.72 ±1.43 SD, and 95.76 ±1.05 SD respectively.

Shows Spo2 level for group A

Group A	N	Mean	Standard Deviation	t-value	p-value
SPo2 Day 1	25	93.24	.78	ref	
Day 2	25	94.84	.55	16.000	.0001**
Day 3	25	96.40	.50	19.750	.0001**
Day 4	25	97.96	.20	29.812	.0001**

Shows Spo2 level for group B

Group B	N	Mean	Standard Deviation	t-value	p-value
SPo2 Day 1	25	91.60	1.08	ref	
Day 2	25	92.68	1.03	3.907	.001**
Day 3	25	93.72	1.43	4.937	.0001**
Day 4	25	95.76	1.05	11.585	.0001**

When we compared with in group values of Pulse rate for group A. We found significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 93.20 ±2.24 SD, 90.00 ±5.25 SD, 88.92 ±3.59 SD, and 82.76 ±2.40 SD respectively.Similarly we compared with in group values of Pulse rate for group B. We found significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 92.80 ±2.12 SD, 89.00 ±2.78 SD, 88.28 ±3.32 SD, and 82.72 ±2.98 SD respectively.

Group-A

Shows Pulse rate level for group A

Pulse Day 1	25	93.20	2.24	ref	
Day 2	25	90.00	5.25	3.070	.005**
Day 3	25	88.92	3.59	5.907	.0001**
Day 4	25	82.76	2.40	18.075	.0001**

Group-B

Shows Pulse rate level for group B

Pulse Day 1	25	92.80	2.12	ref	
Day 2	25	89.00	2.78	8.041	.0001**
Day 3	25	88.28	3.32	6.735	.0001**
Day 4	25	82.72	2.98	13.721	.0001**

When we compared with in group values of Systolic Blood pressure for group A. We found significant difference between Day 1, Day 3, and Day 4 values with a mean of 102.00 ±4.73SD, 115.04 ±5.66 SD, and 117.44 ±3.14 SD respectively but non-significant difference on Day 2 with a mean of 106.72 ±8.79 SD.

Similarly we compared with in group values of Systolic Blood pressure for group B. We found significant difference between Day 1, Day 3, Day 4 values with a mean of 102.52 ±6.64 SD, 113.36 ±6.08 SD, and 118.88 ±9.58 SD respectively but non-significant difference on Day 2 with a mean of 110.72 ±17.68 SD.

Group-A

Shows Systolic blood pressure level for group A.

SBP Day 1	25	102.00	4.73	ref	
Day 2	25	106.72	8.79	2.913	.008**
Day 3	25	115.04	5.66	10.136	.0001**
Day 4	25	117.44	3.14	17.048	.0001**

Group-B

Shows Systolic blood pressure level for group B.

SBP Day 1	25	102.52	6.64	ref	
Day 2	25	110.72	17.68	2.473	.021*
Day 3	25	113.36	6.08	5.236	.0001**
Day 4	25	118.88	9.58	7.271	.0001**

When we compared with in group values of diastolic Blood pressure for group A. We found significant difference between Day 1, Day 2, Day 3, and Day 4 values with a mean of 67.76 ±6.91 SD, 72.24 ±5.01 SD, 76.32 ±4.31 SD, and 79.20 ±3.21 SD respectively.

When we compared with in group values of diastolic Blood pressure for group B. We found significant difference between Day 1, Day 2, Day 3, and Day 4 values with a mean of 69.16 ±6.10 SD, 74.56 ±4.06 SD, 76.88 ±3.83 SD, and 79.60 ±3.70 SD respectively.

So the above findings shows that exercises with Acapella and IS both have significant improvement inSpo2, Pulse rate and diastolic blood pressure but non- significant improvement on Systolic blood pressure level on Day 2.

Group-A

Shows diastolic blood pressure level for group A

DBP Day 1	25	67.76	6.91	ref	
Day 2	25	72.24	5.01	4.017	.001**
Day 3	25	76.32	4.31	5.548	.0001**
Day 4	25	79.20	3.21	8.022	.0001**

Group-B

Shows diastolic blood pressure level for group B

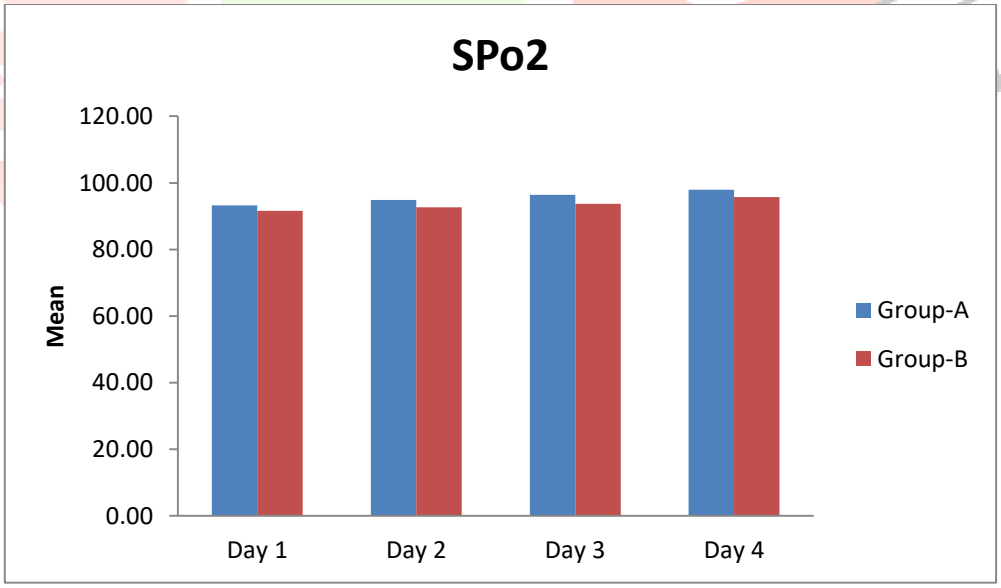
DBP Day 1	25	69.16	6.10	ref	
Day 2	25	74.56	4.06	3.330	.003**
Day 3	25	76.88	3.83	4.900	.0001**
Day 4	25	79.60	3.70	6.607	.0001**

Shows the Spo2 level between group A and B

Group		N	Mean	Std. Deviation	t-value	p-value
SPo2 Day 1	Group-A	25	93.24	0.78	6.158	.0001**
	Group-B	25	91.60	1.08		
Day 2	Group-A	25	94.84	0.55	9.238	.0001**
	Group-B	25	92.68	1.03		
Day 3	Group-A	25	96.40	0.50	8.849	.0001**
	Group-B	25	93.72	1.43		
Day 4	Group-A	25	97.96	0.20	10.272	.0001**
	Group-B	25	95.76	1.05		

Both the groups were showing significant difference where we compare with in group values of Day1,Day 2, Day 3, Day 4 for Spo2, Pulse rate, Diastolic blood pressure except Systolic blood pressure on Day 2 than we found between group difference for that we used Unpaired T-test.

The result of unpaired t-test shows that there was significant difference between Day1, Day 2, Day 3, and Day 4 values of group-A and group-B for Spo2 with a mean of 93.24 ±.78 SD and91.60 ±1.08 SD, 94.84 ±.55 SD and 92.68 ±1.03 SD, 96.40 ±.50 SD and93.72 ±1.43 SD, 97.96 ±.20 SD and 95.76 ±1.05 SD respectively.

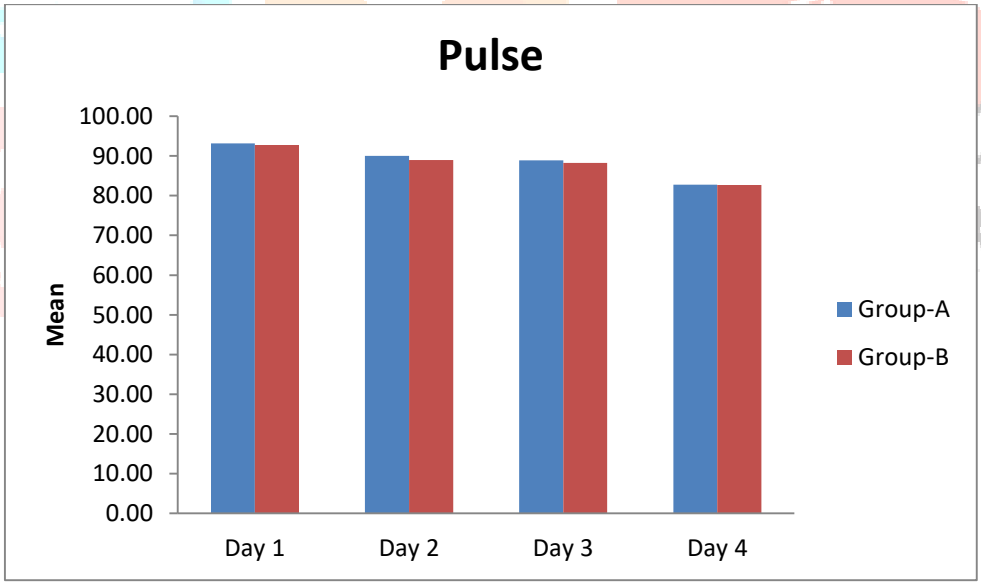


Shows significant difference of Spo2 level between group A and B.

When we compared in between group values of Pulse rate for group A and group B. We found non-significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 93.20 ±2.24 SD and92.80 ±2.12 SD, 90.00 ±5.25 SD and 89.00 ±2.78 SD and 88.92 ±3.59 SD,88.28 ±3.32 SD, 82.76 ±2.40 SD and 82.72 ±2.98 SD respectively.

Shows the Pulse rate level between group A and B.

Group		N	Mean	Std. Deviation	t-value	p-value
Pulse Day 1	Group-A	25	93.20	2.24	.649	.520
	Group-B	25	92.80	2.12		
Day 2	Group-A	25	90.00	5.25	.841	.404
	Group-B	25	89.00	2.78		
Day 3	Group-A	25	88.92	3.59	.654	.516
	Group-B	25	88.28	3.32		
Day 4	Group-A	25	82.76	2.40	.052	.959
	Group-B	25	82.72	2.98		

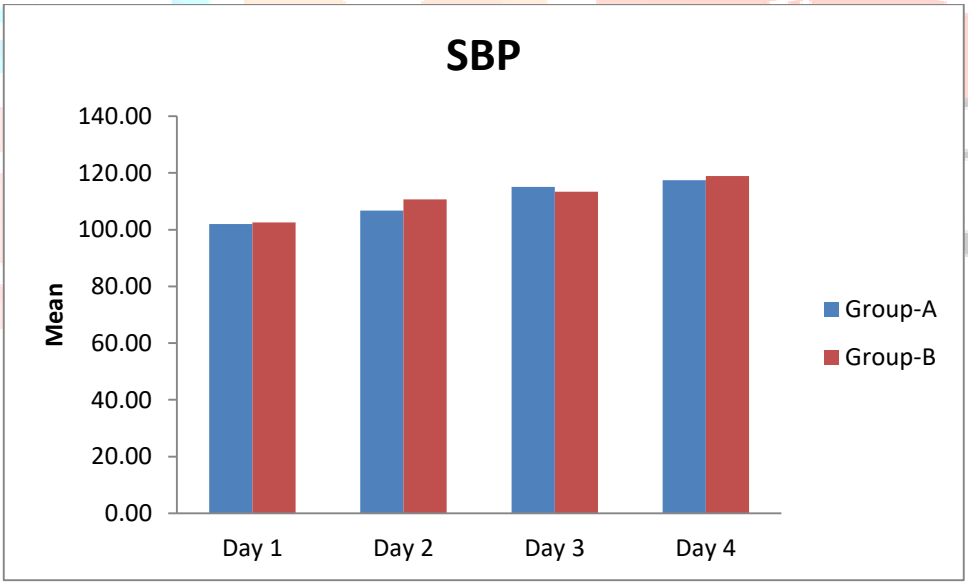


Shows non-significant difference of Pulse rate level between group A and B.

When we compared in between group values of Systolic blood pressure for group A and group B. We found non- significant difference between Day 1, Day 2, Day 3, Day 4 values with a mean of 102.00 ±4.73 SD and102.52 ±6.64 SD, 106.72 ±8.79 SD and 110.72 ±17.68 SD and 115.04 ±5.66 SD,113.36 ±6.08 SD, 117.44 ±3.14 SD and 118.88 ±9.58 SD respectively.

Shows the Systolic blood pressure level between group A and B

Group		N	Mean	Std. Deviation	t-value	p-value
SBP Day 1	Group-A	25	102.00	4.73	.319	.751
	Group-B	25	102.52	6.64		
Day 2	Group-A	25	106.72	8.79	1.013	.316
	Group-B	25	110.72	17.68		
Day 3	Group-A	25	115.04	5.66	1.012	.317
	Group-B	25	113.36	6.08		
Day 4	Group-A	25	117.44	3.14	.715	.478
	Group-B	25	118.88	9.58		



Shows non-significant difference of Systolic blood pressure level between group A and B.

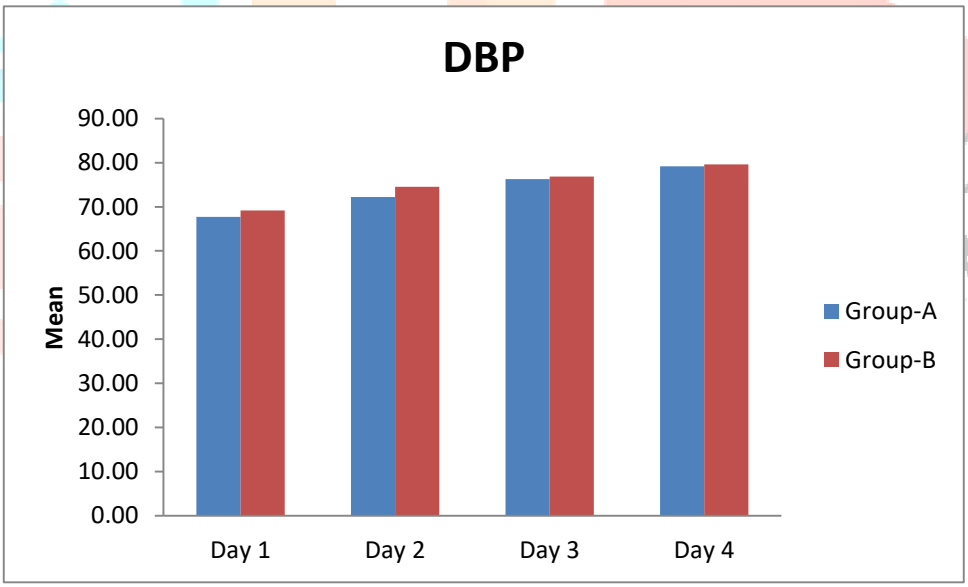
When we compared in between group values of diastolic Blood pressure for group A and group B. We found non-significant difference between Day 1, Day 2, Day 3, and Day 4 values with a mean of 67.76 ±6.91 SD and 69.16 ±6.10 SD, 72.24 ±5.01 SD and 74.56 ±4.06 SD, 76.32 ±4.31 SD and 76.88 ±3.83 SD, 79.20 ±3.21 SD and 79.60 ±3.70 SD respectively.

So the above findings shows that the patient treated with Acapella had more significant improvement than IS on Spo2 but non- significant improvement on Pulse rate and arterial blood pressure because these are the hemodynamic variable.

This indicates that the post CABG patients treated with Acapella had better improvement on Spo2 than Incentive Spirometry.

Shows the Diastolic blood pressure level between group A and B.

Group		N	Mean	Std. Deviation	t-value	p-value
DBP Day 1	Group-A	25	67.76	6.91	.759	.451
	Group-B	25	69.16	6.10		
Day 2	Group-A	25	72.24	5.01	1.798	.078
	Group-B	25	74.56	4.06		
Day 3	Group-A	25	76.32	4.31	.486	.629
	Group-B	25	76.88	3.83		
Day 4	Group-A	25	79.20	3.21	.408	.685
	Group-B	25	79.60	3.70		



Shows non-significant difference of Diastolic blood pressure level between group A and B.

DISCUSSION

This study examines the effectiveness of incentive spirometry in combination with ACBT compared toacapellaand active breathing techniques in CABG patients.

When compared the results with in group A and B respectively for saturation of oxygen (spo2), Pulse rate and arterial blood pressure it shows that the patient treated with incentive spirometry along with active cycle of breathing technique and those treated with Acapella with active cycle of breathing technique had significant improvement in saturation of oxygen (Spo2), Pulse rate and diastolic blood pressure but non-significant improvement on Systolic blood pressure level on Day 2. But on comparison between both groups

for saturation of oxygen (spo2), Pulse rate and arterial blood pressure there was a better improvement on saturation of oxygen in patient treated with Acapella than Incentive Spirometry.

Acapella had a more favorable effect than IS because it combines the resistance properties of a positive expiratory pressure device with vibration, which reduces mucus stickiness and reduces airway compressibility. A previous study by Acapella showed improved sputum clearance, respiratory mechanics and SpO2in mechanically ventilated patients[12].

Therefore, we can say that Acapella is more effective than incentive spirometry in improving spo2, heart rate and arterial blood pressure in CABG patients.

CONCLUSION

The result of this study concluded that Acapella and IS both have beneficiary effects on Spo2, Pulse rate and arterial blood pressure in post CABG but statistically Acapella give more significant improvement than IS.

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