

Is Inspiratory muscle training affect chest expansion in acute cardiac bypass surgery patients with respiratory complications? - A case series study

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Abstract

Objectives: To investigate the influence of inspiratory muscle training in chest expansion of post CABG patients. **Methods:** Five post-operative CABG patients with respiratory complications were taken for this study. Subjects were asked to perform inspiratory exercises for three consecutive days 10 times every 2 hours when a patient awake. To assess impact of this training we examined chest expansion during inspiration and expiration at two levels one at upper chest at 3rd intercostal space and second at lower chest at the xiphoid process with a measuring tape. **Result:** Post test result shown, an increasing trend in chest expansion was observed at both the levels in the third post-operative day. But, it was significantly noticed that the chest expansion at the level of 3rd intercostal space increased greatly to about 0.5cm to 1cm as compared to the level of the xiphoid process. **Conclusion:** This study stated that use of incentive spirometer exercise affects the chest expansion in post- CABG patients were clinically significant. Key words: CABG, inspiratory muscle training, chest expansion, incentive spirometry.

INTRODUCTION

Coronary artery bypass surgery (CABG) (1) Coronary artery disease (CAD) patients are indicated to relieve symptoms and improve quality of life. (2) This is one of the most commonly used treatments, as more than 1 million coronary artery bypass surgery procedures are performed worldwide each year. (3) Arteries from within the chest wall, the arm, or veins of the leg, were collected. (4) These drains are grafted to bypass the blockages in native heart vessels, restoring the adequate blood supply to heart. (5) It may be recommended if patients have disease involving multiple arteries of heart, or involving the left anterior descending artery known as the widow maker artery. (6) Pulmonary complications are highly common in post-CABG patients, which contribute to increased morbidity, mortality, and hospitalization-related expenses. (7) To avoid further postoperative pulmonary complications associated with reduced oxygenation and gas exchange inconsistencies, the detection of the condition and early interventions are

required. (8) Atelectasis and arterial hypoxemia was commonly seen after cardiac surgery. (9) Other common complications include Low Cardiac Output Syndrome (LCOS), arrhythmia, pneumonia, pulmonary effusion. (10, 11) Lung volumes and capacities, forced expiratory volume, functional residual capacity and arterial blood gas tensions are also continuously and persistently reduced. (12) Postoperative treatment involves early mobilization, posture change, respiratory exercises and coughing which is known as forced expiratory techniques (FET). (13)

There were several pulmonary functions, assessing tools such as the Vitals, ABG analysis, chest expansion measurements, lung function tests, 6MWT and Borg's scale, etc. (14) Measurement of chest expansion is used in this research as an outcome measure for postoperative evaluation of the pulmonary function. Measurements of chest expansion provide information about the baseline respiratory condition of the patient, and provide values for comparison to assess the impact of the particular intervention provided to the patient. Professionals such as physiotherapists, use chest expansion measurements to evaluate the effect that restrictive and obstructive pulmonary diseases have on a chest wall range of motion. A simple and inexpensive method for measuring expansion of the chest in the clinical setting is a tape measure that serves as a reliable one. (15)

Incentive spirometry is one of the aids used in the rehabilitation programme post-CABG. (16) It consists of three balls of varying colors and volumes. The red ball has a volume of 600ml/cc, yellow ball has a volume of 900ml/cc and the blue ball has a volume of about 1200ml/cc. The aim of this study is to check effect of incentive spirometry in chest expansion for post CABG patients. This study was carried out in the three post-operative days of CABG. (17)

CASE SERIES

Case 1

A 74 year old male had a chest pain and was under hypertension management for 10 years. On admission he has been experiencing breathless and chest pain while walking. He has been brought to a hospital at Jalandhar where he underwent coronary artery bypass graft. He was a vegan, non-alcoholic and old smoker 25 years before. He has no family history, follows an active lifestyle with proper diet and exercises. On observation patient was having grade 2 dyspnea, which was persistent. There was aching type of chest pain, gradual in nature from 1 month and wheezing was absent. Patients were having stable vitals breathing rate 21 b/m, pulse rate 75 bts/m, BP 120/80, SPO2 95%. The General appearance of the patient was conscious and Ectomorphic. Color of conjunctiva was yellow with presence of nasal flaring and pursed lip breathing, cyanosis was absent. The Patient was using accessory muscles for breathing. Chest movement was normal and symmetrical. Talking about the extremities of patient clubbing of fingers was present, oedema was also present. There was an intravenous line on right forearm and supported by chest binder. On palpation trachea position was normal, there was grade 1

chest wall tenderness. On percussion dullness was seen. On auscultation in breathing sounds wheezing present over expiration phase at upper, middle and lower lobe. S1 and S2 heart sounds were normal.

Case 2

Patient aged 70 years old, male, with complaint of cough, pain radiating from chest to left upper limb with difficulty in breathing. Patient had history of chest pain since 1 year but he didn't prefer to visit doctor. Now again he started feeling shortness of breath and pain in his chest radiating to left arm and visited local hospital, from there he was prescribed for angiography and referred to Tagore Hospital Jalandhar. On 14th march he got to admit in hospital and on 19th march Coronary Artery Bypass Surgery was done for him. The Patient is non-vegetarian, non-alcoholic and follows an active lifestyle with proper diet and exercises. No family history was there.

Since Observes patient has been mesomorphic and had Grade 2 dyspnea that is dyspnea on moderate exertion. The Patient had a dry cough since 2-4 days, there was no sputum production. No nasal flaring observed, cyanosis were absent. Use of accessory muscle was observed and symmetry of chest movement was normal. Chest binder, central IV line, bandage on the left hand, urinary catheter were there. On Palpation chest wall tenderness was present due to the incision, dull percussion notes were there. On Auscultation wheeze was present, respiratory rate was 22rpm, heart rate was 76bpm, blood pressure was 120/80 mmHg, SpO2 was 98%.

Case 3

A 72 year old male patient is a retired worker who underwent CABG. He experienced various episodes of radiating pain in chest to the left upper limb and shortness of breath since the past 3 months. Hence, he visited to the local hospital and the pain subsided with the medications he took. As the severity of the chest pain increased from the past 20 days, he was advised for a proper treatment procedure. So, he was admitted to Tagore hospital on 17/3/18. A Coronary Angiography procedure was carried out and it found that the patient had total occlusion in the left anterior descending artery.

As per the assessment taken on 21/3/18 that is the post-operative day 1, the patient complained of chest pain at the incision site, difficulty in breathing and difficulty in performing Activities of Daily Living. There is no other relevant past history in relation to the condition as described by the attendants. There is no medical history of Diabetes mellitus and Hypertension. Personal history includes the patient is non-vegetarian, non-smoker and non-alcoholic, lifestyle is active. There isn't any known history of Cardiac disease in the family. Subjective evaluation of the five cardinal symptoms manifested Grade 2 Dyspnea and chest pain at the incision site with a severity of 7 on NPRS. Symptoms of cough, sputum production, and wheezing were not present for the patient. As per the observation, patient had a mesomorphic built, was in semi-fowler's position and was conscious. Cyanosis was absent. He used his accessory muscles during breathing. The Shape of the chest was normal. Shallow pattern of breathing was perceived. Palpation indicated normal tracheal position and Grade-1 tenderness at the incision site.

Vitals examined on Post-operative day 1 are as follows-

Heart Rate	64 beats/ min
Respiratory Rate	21 breaths/ min
Blood Pressure	100/70 mm/ Hg
SpO ₂	97%

Heart sounds and lung sounds were detected as normal on auscultation. Investigations advised included CBC, Chest X-ray, ECG. The angiography of heart revealed total occlusion of anterior descending on the left. Based on this, the patient was diagnosed with Coronary artery disease with Angina.

Case 4

A 60 years old male patient was apparently well, but a few hours ago suddenly complains of restlessness, palpitation and chest pain. He reported that the pain was radiating to his left arm and was profusely sweating. He was then immediately taken to a local hospital by the family members where he was given the first aid. Nitroglycerin was administered sublingually and he was revived after a few minutes. He was then referred to the Hospital in Jalandhar for further medical intervention. Patient was admitted to hospital on 10/03/2018.

He has no relevant past history for the same as reported by the attendants. Also, he has no history of systemic disease like diabetes and hypertension. He is alcoholic for 20 years. He takes vegetarian diet strictly. On receiving him for the first time he was conscious (GCS = E₄V₅M₆) and totally orientated. He has a mesomorphic built with the negative signs of clubbing and cyanosis. Palpation technique revealed normal tracheal alignment, warm and a palpable peripheral pulse and grade 2 tenderness around the incision for median sternotomy.

On examining him on first post-operative day his vitals were as follows-

Respiratory Rate	16 breaths/ min
Pulse Rate	78 beats /min
Blood Pressure	110/70 mm/Hg
SpO ₂	98%

Examination of respiratory system revealed the following symptoms-

Dyspnea	Absent
Cough	Present
Sputum	Absent
Chest pain	Present (Throbbing pain)
Wheezing	Absent

Auscultatory findings showed normal heart sounds and normal lungs sounds. ECG reports revealed ST segment elevation and chest secretions in the lower lobes on an X-ray film. Based on the findings the patient has myocardial infarction and coronary artery disease.

Case 5

A male patient of 63 year old complains of chest pain and difficulty in breathing. The Patient had an acute exertion of chest pain in January 2018 and the consulting doctor planned for CABG which was performed on 3 march 2018. The Patient has a history of diabetes for the past 10 years and have since which was diagnosed in 2017. The Patient is alcoholic and has no dyspnoea. The patient has productive cough which is mucopurulent. Patient complains of pain on the incision site on the chest. There is no sign of wheezing on observation, it was found that the patient was conscious and of mesomorphic built. The Patient used accessory muscle while breathing. The jugular vein was distended. The patient had normal shaped chest

An observation of the extremities, it was found that there was no sign of clubbing, oedema or cyanosis. On examination of the vitals the results are as follows RR 18 b/m, pulse rate 86 bts/m, BP 144/81 mmHg, Spo2-100. On auscultation of lungs, there was a presence of wheezing. On examination of the heart sounds, S1 sound is high pitched, and S2 is low.

INTERVENTION

Prior to the intervention consent was taken and the patient was explained about the protocol of Incentive spirometry exercise and it's importance. Inspiratory muscle trainer is a device that provides feedback when the patient inhales at a preset flow. It is useful in increasing inspiratory volume and maintains the patency of airways.

To begin with, he was placed in semi recumbent position (45 degrees) for performing spirometer procedure. The CABG under went patient was instructed to hold the spirometer in an upright position in leveled with the mouth, and then place the lips tightly around the mouthpiece. The main aim was to train the inspiratory muscles as it is an active process. After that, slow inhalation to raise the ball. At maximum inhalation, patient was asked to sustain it for 3 seconds, followed by removal of mouth piece. After that the he was asked to exhale slowly though the mouth or with pursed lips. And they were cheered to perform 10 times deep breathing with incentive spirometer on 2 hours in the daytime for 3 days after surgery. (18) Care was taken that this exercise was carried out prior to the meals and the incision was supported using a chest binder. The attendants and the Nursing staff were instructed to follow the protocol in our absence efficiently.

OUTCOME MEASURE

Anthropometric methods involve the external measurement of morphological traits of human beings. It is a noninvasive, measurement technique for determining an individual's specific dimension of the body, such as height, skin-fold thickness, and bodily circumference at the waist, hip, and chest.

To measure the chest expansion patient was in sitting position. An inelastic tape was used for this procedure. Both arms were at the sides with abducted shoulder and semi flexed elbow, extended wrist, abducted thumb with web between thumb and fingers placed on the level of iliac crest. During this procedure the chest binder was taken off. The chest expansion was measured at two levels. First, for the upper thoracic excursion, the tape measure was placed at the level of the 3rd intercostal space at the midclavicular line. Second, for the lower thoracic excursion, the tape measure was placed at the xiphoid process level. (19) The patient was asked to exhale as far as possible followed by inhalation as deep as possible. During maximal expiration and inspiration measurements were taken. Care was taken not to pull the tape too tightly while making the measurements. The chest expansion is taken at the end of forced inspiration minus thoracic circumference at the end of forced expiration.

RESULT

This case series includes the study of five post CABG patients for the three post-operative days in the CV- ICU using Incentive spirometry as the intervention and Chest expansion measurements as the outcome measure. The age criteria was above the 60 years of age. The results for the chest expansion improvement on day 3 after surgery are as follows:

CASE 1

Levels	Phases	Day 1(before incentive spirometry)	Day 3(after incentive spirometry)
At the 3 rd intercostal space	Inspiration	86 cm	99.5 cm
	Expiration	82 cm	93.5 cm
At the xiphoid process	Inspiration	78 cm	82 cm
	Expiration	75 cm	77.5 cm

CASE 2

Levels	Phases	Day 1(before incentive spirometry)	Day 3(after incentive spirometry)
At the 3 rd intercostal space	Inspiration	92.5cm	101.5 cm
	Expiration	89 cm	96.5 cm
At the xiphoid process	Inspiration	87 cm	89 cm
	Expiration	84 cm	85 cm

CASE 3

Levels	Phases	Day 1(before incentive spirometry)	Day 3(after incentive spirometry)
At the 3 rd intercostal space	Inspiration	99 cm	102 cm
	Expiration	96 cm	97 cm
At the xiphoid process	Inspiration	93 cm	95 cm
	Expiration	91 cm	92 cm

CASE 4

Levels	Phases	Day 1(before incentive spirometry)	Day 3(after incentive spirometry)
At the 3 rd intercostal space	Inspiration	100cm	103cm
	Expiration	96cm	97 cm
At the xiphoid process	Inspiration	95 cm	97cm
	Expiration	94 cm	95 cm

CASE 5

Levels	Phases	Day 1(before incentive spirometry)	Day 3(after incentive spirometry)
At the 3 rd intercostal space	Inspiration	108.5 cm	112 cm
	Expiration	105 cm	107 cm
At the xiphoid process	Inspiration	96cm	98 cm
	Expiration	94cm	95 cm

DISCUSSION

The study was to determine the influence of incentive spirometry on chest expansion in post CABG patients. To conduct the study five patients who underwent Coronary artery Bypass Grafting were taken. They had no previous history of cardiac surgeries. Consent was taken from the patients prior to initiation of the treatment. Firstly, the chest expansion were measured at 3rd intercostal space and xiphoid level. Then the patient was given 10 repetitions of inspiratory incentive spirometry for three consecutive post-operative days. This was repeated every 2 hourly during the daytime. Nursing and attendants were explained about the dosage to be followed. On the 3rd post- operative day chest expansion measurements again to record the change.

In Case 1, the chest expansion at the level of 3rd intercostal space was found to be 4 cms during first day after surgery and 6cms on third post-operative day which shows a improvement of 2 cm. The chest expansion at the level of xiphoid was found to be 3 cm on the first post-operative day and 4.5 cms on the 3rd post-operative day which shows an improvement of 1.5 cm.

In Case 2, the chest expansion at the level of 3rd intercostal space was found to be 3.5 cms during first day after surgery and 5cms on third post-operative day which shows an improvement of 1.5 cms. The chest expansion at the level of xiphoid was found to be 3 cm on the first post-operative day and 4 cm on the 3rd post-operative day which shows an improvement of 1 cm.

In Case 3, the chest expansion at the level of 3rd intercostal space was found to be 3 cms during first day after surgery and 5cm s on third post-operative day which shows an improvement of 2cms. The

chest expansion at the level of xiphoid was found to be 2 cm on the first post-operative day and 3 cms on the 3rd post-operative day which shows an improvement of 1 cm.

In Case 4, the chest expansion at the level of 3rd intercostal space was found to be 4 cms during first day after surgery and 6cms on third post-operative day which shows a improvement of 2 cms. The chest expansion at the level of xiphoid was found to be 1 cm on the first post-operative day and 2 cms on the 3rd post-operative day which shows an improvement of 1 cm.

In Case 5, the chest expansion at the level of 3rd intercostal space was found to be 3.5 cms on the first day after surgery and 5cms on third post-operative day which shows a improvement of 1.5 cm. The chest expansion at the level of xiphoid was found to be 2 cm on the first post-operative day and 3 cm on the 3rd post-operative day which shows an improvement of 1 cm.

Thus, an increasing trend in chest expansion was observed at both the levels in the third day after surgery. But, it was significantly noticed that the chest expansion at the level of 3rd intercostal space improved greatly to about 0.5cm to 1cm as compared to the level of the xiphoid process.

CONCLUSION

This study said the use of incentive spirometry exercise in post-CABG patients caused significant improvement in chest expansion.

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