

Additive Effect Of Respiratory Muscle Training In Phase I Cardiac Rehabilitation In Median Sternotomy Patients - A Hypothesis

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Abstract:

Background: Cardiac rehabilitation is the process of restoring psychological, physical and social functions in people with the manifestations of coronary artery disease. Cardiac rehabilitation programs usually provide education and counseling services to help patients increase their physical fitness, reduce cardiac symptoms, improve health and reduce the risk of future cardiac problems, including myocardial ischemias & infarctions. Ventilatory performance depends not only on the mechanical properties of the lungs and chest wall, but also on the strength of the respiratory muscles. The inspiratory muscles are mainly involved in repetitive contractions at low intensity; training strategies emphasise on enhancing inspiratory muscle endurance. 3 types of training i.e. inspiratory resistive training, threshold loading and normocapnic hyperpnoea are currently practiced.

Hypothesis: Inspiratory Muscle Training (IMT) given with a inspiratory threshold trainer, along with conventional phase 1 cardiac rehabilitation program may offer higher benefits to the patients with median sternotomy. The aim of our study is to find the effect of respiratory muscle (RM) training in phase I cardiac rehabilitation in post median sternotomy patients.

Clinical Importance: RM tackled early post injuries in the form of planned surgical procedures also, will help in decreasing the incidences of RM fatigue & therefore pulmonary dysfunction.

Future Research: RM training post other general surgical procedures involving the thorax, abdomen can be studied so as to decrease the affection on the pulmonary system commonly seen.

Keywords: Median sternotomy, respiratory muscle training, phase 1 cardiac rehabilitation.

THESIS SUMMARY

Introduction

Cardiac rehabilitation is the process of restoring psychological, physical and social functions in people with the manifestations of coronary artery disease. It is a professionally supervised program to help people recover from myocardial infarctions (conservatively &/or surgically managed), either by angioplasty or cardiac bypass surgeries. Cardiac rehabilitation programs usually provide education and counseling services to help patients increase their physical fitness, reduce cardiac symptoms, improve health and reduce the risk of future cardiac problems, including myocardial ischemia's& infarctions [1].

Median sternotomy is a type of surgical procedure in which a vertical incision is made along the sternum from the jugular or suprasternal

notch to the lower end of the xiphisternum. The sternum is divided and retracted to expose the thymus superiorly and the pericardium inferiorly. The thymus and pleurae are separated from the pericardium, the pericardium is then opened. This procedure provides easy and complete access to the heart and lungs and is mainly used for cardiovascular and pulmonary surgeries like coronary artery bypass grafting (CABG), valve replacement surgeries and pneumonectomy, etc. The main advantage of median sternotomy is the ease with which it exposes the thoracic cavity, its outstanding exposure for all anterior mediastinal lesions, least damage to the muscles and fascia over the thorax and hence faster healing post operatively [2].

Ventilatory performance depends not only on the mechanical

properties of the lungs and chest wall, but also on the strength of the respiratory muscles. Maximal inspiratory pressure (PI max) is determined by having the patient inhale maximally after having exhaled completely to the residual volume (RV). The value recorded is the lowest pressure attained and held for at least 1 second [3].

The inspiratory muscles are mainly involved in repetitive contractions with low intensity, training strategies emphasise enhancing inspiratory muscle endurance. 3 types of training i.e. inspiratory resistive training, threshold loading and normocapnic hyperpnoea are currently practiced. The threshold loading device has an advantage of being independent of inspiratory flow rate but requires a build-up of negative pressure before flow is initiated [4].

Maria R, Asdis K and et al concluded that the breathing pattern before sternotomy is predominantly abdominal but moves to a thoracic or upper thoracic pattern postoperatively and is associated with reduced pulmonary function. Therapeutic interventions should be aimed at correcting the less efficient upper thoracic breathing pattern [5].

The need for this study, therefore, is to know the effect of respiratory muscle training in phase I of cardiac rehabilitation in post median sternotomy patients as the incidence of atelectasis and pleural effusion, which may be caused mainly by reduced ability to expectorate sputum and insufficient diaphragmatic breathing, is very high in the postoperative period. Also inspiratory muscle weakness remains a common finding.

Hypothesis

Inspiratory muscle training (IMT) improves inspiratory muscle strength and endurance, functional exercise capacity, dyspnea and quality of life. Inspiratory muscle endurance training was shown to be less effective than respiratory muscle strength training. In patients with inspiratory muscle weakness, the addition of IMT to general exercise training program improved PI max and tended to improve exercise performance.

Therefore, we hypothesize that IMT given with a threshold trainer, along with conventional phase I cardiac rehabilitation program [6] may offer higher benefits to the patients with median sternotomy. The aim of our study is to find the effect of respiratory muscle training in phase I cardiac rehabilitation in post median sternotomy patients.

A Prospective Randomized Control Trial will be performed post ethical approval from the parent institution and cardiac centers in the city of Pune (Maharashtra). The inclusion criteria being patients of age group 40-70 years (both males and females) with median sternotomy incision for coronary artery bypass grafting (CABG), any valve replacement surgeries, septal defect closures etc. Patients having post-operative complications like lung collapse, pleural effusion, pulmonary embolism, prolonged intubation period, lengthened ICU stay, etc. will be excluded from the study. Also patients with pulmonary hypertension, any underlying lung pathology like COPD, higher function affection, un co-operative patients or those unable to obey commands will be excluded from the study.

Simple random sampling will be done of 80 patients dividing them

into two groups.

GROUP A: 40 patients. They will receive conventional phase I cardiac rehabilitation program.

GROUP B: 40 patients. They will receive conventional phase I cardiac rehabilitation program + inspiratory muscle training with threshold inspiratory muscle trainer [7].

Before starting the treatment, an informed written consent will be taken from the patients, and then demographic data (name, age, gender, height, weight, occupation) will be recorded. Patients will be then assessed for maximal inspiratory pressure (MIP) on post-op day 2 (POD 2) i.e. before treatment and POD 8 i.e. after the treatment.

Both the groups will receive conventional phase I cardiac rehabilitation. The intervention group will in addition get inspiratory muscle training with a threshold inspiratory muscle trainer.

The protocol for conventional phase I cardiac rehabilitation program and inspiratory muscle training is as follows:

CONVENTIONAL PHASE I CARDIAC REHABILITATION PROGRAM: [6]

Level 1 (1 - 1.5 METS) - Evaluation and patient education, Arms supported for meals & ADLs (Activities of Daily Living) and bed exercises and dangle with feet supported.

Level 2 (1.5 - 2 METS) - Sitting 15-20 min, 2-4 times/day, leg exercises, reclining in upright chair and limited ADLs.

Level 3 (2 - 2.5 METS) - Room or hall ambulation upto 5 min as tolerated 3-4 times/day, standing leg exercises optional and independent or assisted ambulation in room or hall as advised by Physiotherapist (PT).

Level 4 (2.5 - 3 METS) - Hall ambulation upto 5-7 min as tolerated 3-4 times/day, standing trunk exercises optional and independent or assisted ambulation in hall as advised by PT.

Level 5 (3 - 4 METS) - Hall ambulation 8-10 min as tolerated, arm exercises optional, independent hall ambulation as advised by Physiotherapist.

Level 6 (4 - 5 METS) - Progressive hall ambulation as advised by Physiotherapist. Full flight of stairs (or as required at home) up and down one step at a time

ADDITIONAL INSPIRATORY MUSCLE TRAINING (FOR GROUP B):

Mode - Threshold-type inspiratory training.

Frequency - 2 training sessions per day (3 sets of 10 breaths with 1-2 min rest between the sets).

Intensity - At 50% of achieved PI max training will be given.

Duration - 15 - 20 mins, twice daily.

Thus the above outcome measures will be assessed using SPSS software. Unpaired t-test will be used for analyzing inter group assessment of maximal inspiratory pressure and paired t-test will be used for intra group comparison of maximal inspiratory pressure.

Discussion

Shenkman Z, Shir Y et al [8] did a study on effects of cardiac surgery on early and late pulmonary functions by evaluating 50 patients undergoing cardiac surgery (coronary artery bypass grafting [CABG,74%], valve replacement or valvuloplasty [20%] and combined procedures [6%]). Anginal and cardiac failure symptoms severity, and smoking history, was evaluated preoperatively. PETS (Positron Emission Tomography) were studied and compared pre, 3 weeks and 3.5 months postoperatively. Pre and postoperative PFTs were inversely related to severity of preoperative symptoms. Forced vital capacity (FVC) dropped from 98% of predicted preoperatively, to 63% and 75% 3 weeks and 3.5 months postoperatively respectively. The study concluded that pulmonary functions deteriorate significantly for at least 3.5 months after cardiac surgery. Preoperative cardiac ischemic and failure symptoms are inversely related to perioperative PETS. Some studies have shown that inspiratory muscle training with threshold trainer with a specific inspiratory load, have shown a significant increase in inspiratory muscle strength [9]. Leith and Bradely in 1976 first demonstrated that like skeletal muscles, respiratory muscles of normal individuals could be trained to improve their strength &/or endurance [10].

Stamatis A, Jean-Paul S in a multicenter study demonstrated that IMT combined with aerobic training provides beneficial effects in functional and serum biomarkers in patients with moderate chronic heart failure (CHF). These findings suggest for application of IMT in cardiac rehabilitation programs [11]. Jakhotiya K, Jain N et al concluded that specific inspiratory muscle training of 6 days per week for 4 weeks shows significant improvement in aerobic capacity of healthy individuals [12]. Also the fact that threshold loading devices enhance velocity of inspiratory muscle shortening could provide additional benefit because this shortens inspiratory time and increases time for exhalation and relaxation. Increased relaxation time may prevent the development of muscle fatigue in patients who are at risk [4].

Dixit A and Prakash S did a study on mechanically ventilated patients in ICU and concluded that threshold inspiratory muscle training (TIMT) along with conventional physiotherapy produces more significant changes in MIP and weaning period of patients receiving mechanical ventilation as compared to conventional physiotherapy alone [13].

Conclusion

Thus we hope to improve the inspiratory muscle strength in patients with median sternotomy by adding IMT (inspiratory muscle training)

to the conventional Phase I cardiac rehabilitation program, even in a small time span of Phase I rehabilitation which is crucial for the prognosis of the patient.

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