

Effect of CABG on Respiratory Muscle Strength and PEFR Values: A Pilot Study

Dr. Hridaya Joshi (PG)¹, Dr. Abhijit Diwate (PhD.)², Dr. Arijit Das (MPT)³

¹Department of Physiotherapy in Cardiovascular and Respiratory Sciences, DVVPF's College of Physiotherapy, Ahmednagar
E- mail: [hridayajoshi\[at\]gmail.com](mailto:hridayajoshi[at]gmail.com)

Professor and HOD, Department of Physiotherapy in Cardiovascular and Respiratory Sciences, DVVPF's College of Physiotherapy, Ahmednagar
E- mail: [abhijitdiwate\[at\]gmail.com](mailto:abhijitdiwate[at]gmail.com)

³Associate Professor, Department of Physiotherapy in Cardiovascular and Respiratory Sciences, DVVPF's College of Physiotherapy, Ahmednagar
E- mail: [arijitdasphysio\[at\]gmail.com](mailto:arijitdasphysio[at]gmail.com)

Abstract: Coronary artery bypass grafting remains the foremost choice of surgery in patients with coronary artery diseases despite several other advanced surgical procedures. After surgery, there are several complications, such as pain, reduced cough reflex and reduction in QOL. **Aim:** The study aims to record some more post - operative complications such as changes in functional capacity, respiratory muscle strength and compromised endurance. **Settings and Design:** It is a pilot observational study. The study is undertaken in the Cardiac care unit in a tertiary care teaching hospital. **Methods and Material:** Individuals between age group 45 - 65 were included in the study without any surgical complication and presence of any comorbidities. An analysis was conducted on 9 patients who underwent CABG. **Statistical analysis:** Results are analysed using Instastats Graph pad version 3. **Results:** The mean of preop - MIP values is 74.33 and the post MIP value is 67.45 showing 9.25% reduction. The mean value of preop - MEP is 77, and the post - op MEP mean value is 71.55, showing 8.5% reduction. Similarly, 12.13% reduction seen in PEFR value post - operatively. **Conclusion:** There is a significant reduction in MIP, MEP and PEFR values in CABG patients.

Keywords: CABG, respiratory muscle strength, PEFR

1. Introduction

Cardiovascular diseases are expanding rapidly worldwide for several years, and according to the World Health Organization, 17.5 million people die every year from cardiovascular diseases. [1]

Heart surgeries can lead to postoperative pulmonary complications in these non - communicable diseases, significantly impacting morbidity and postoperative mortality and hospital spending. [2] It is not uncommon to observe the mechanical changes in the lung, restrictive breathing pattern and shallow breathing. Atelectasis is also seen alone with reduced lung capacity and muscle strength. [3]

Thus, this study aims to assess strength MIP (maximum inspiratory pressure) and MEP (maximum expiratory pressure) and PEFR (peak expiratory flow rate) in patients undergoing open thoracic surgery.

2. Literature Survey

As there are studies that have already proven that there is some major effect on respiratory strength in patients undergoing open thoracic and general abdominal surgeries however, there are no specific studies showing effect of CABG and as respiratory muscle training in cardiac rehabilitation has been a huge part in recent years it become important to assess both the respiratory muscle individually.

3. Methodology

This is an observational study approved by the Government Registered Institutional Ethical Committee. Study is conducted at a Cardiac Care Unit in Tertiary Care Medical College Hospital. The study procedure was explained to all the participants and an informed consent was obtained from them. All the patients were recruited from the cardiac ward who were admitted and planned for CABG. The eligibility criteria included patients undergoing CABG, aged between 45 - 65 years with stable hemodynamic, uncomplicated surgery and willingness to participate. Similarly, patients diagnosed with any respiratory conditions with unstable vitals and requiring additional pharmacological support after surgery with special continuous monitoring were excluded from the study. [4]

A total of 9 patients were recruited in the study and were assessed for MIP, MEP and PEFR pre - operatively and post - operatively.

Peak Expiratory Flow Rate: PEFR, expressed in litres/Min, is an effort dependent parameter which depends on airway resistance and forced expiratory pressure generated by respiratory muscles. It is been used to monitor the state of initial expiratory flow rate when lungs are 75% full with FVC and has been measured according to the standard guidelines of ATS. Device called Peak Expiratory Flow Meter shown in fig.1 is used in this study. [5]

Inspiratory and Expiratory Pressure Measuring Gauge: Widely used to measure the pulmonary Inspiratory and

Expiratory Pressures which indirectly reflect the respiratory muscle strength during a maximum voluntary inspiratory and expiratory effort. MIP/MEP is measured in cmH₂O and standard guidelines by ATS have been followed for the measurement procedure. [6] The pressure measuring gauge (Mfg. by ABP) as shown in Fig.2 is used in this study.

The mean of preop and postop MIP values was 74.33 and 67.45 respectively, with a difference of 6.89 cmH₂O. Whereas the mean of preop and postop MEP values was 77 and 71.55 respectively, where the difference is 5.65 cmH₂O.

4. Results

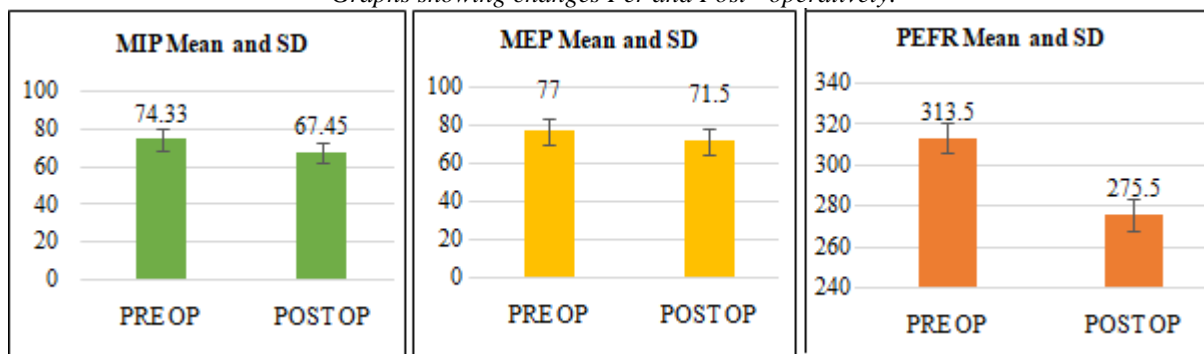
The data was analysed by using Instastats Graph Pad version 3. Paired t - test is used to compare the mean of pre - op and post - op values of a group.

Table 1: Baseline characteristics of demographic data of 9 patients

Demographic data	Mean
Age (in Years)	66.8±4.67
Height (in cms)	158.11±10.43
Weight (in Kgs)	61.45±7.49

Table 2: Pre - op and Post - op Mean values with S. D and mean difference and P - value for all three outcomes. Interpretation: A reduction seen in values of MIP, MEP and PEFR are noted post - operatively.

Graphs showing changes Per and Post - operatively:



5. Discussion

The study focuses on respiratory muscle strength and peak expiratory flow rate values in patient’s undergone thoracic surgery. In this study, respiratory muscles strength and PEFR values were recorded before the surgery and immediately after surgery on postoperative day 1. The parameters used to measure muscle strength and peak expiratory flow rate values were MIP, MEP measuring device and PEFR measuring device, respectively.

This study has shown a reduction in MIP, MEP and PEFR after the surgery. The reduction in inspiratory muscle strength was noted to be 9.25% whereas, an 8.5% reduction in MEP and 12.13% in PEFR value. This reduction in muscle strength is multifactorial. CPB time, use of anaesthesia, post - operative pain, fear, presence of risk factors, use of intercostal chest drains etc.

This decrease in respiratory muscle strength may be due to incisional pain in the sternum, which may hamper the performance of the patients. Another reason may be thoracic wall distortion because of median sternotomy, which reduces the patient’s ability to take deep breaths and reduced thoracic wall compliance. [7] Thus, changes in respiratory pattern, disorientation in thoracic wall configuration and reduction in thoracic wall compliance might be the mechanism behind reduced lung capacity and respiratory strength in patients who underwent CABG. A study done by Sema Savci et al. shows similar results reporting about 27% of reduction in inspiratory muscle strength and about 20% reduction in lung function. [8]

Following the thoracic surgery, patients experience a restrictive pattern due to impaired respiratory pump muscles. In such condition, the patient breaths at low lung volumes and FRC diminishes. With this diminished FRC below lung volume where the small airway closes, the ventilation/perfusion mismatch develops due to the overall reduction in ventilation to a particular area of the lung. [9]

Anaesthetics, opioid, sedatives are respiratory depressants and they reduce the upper airway dilator and respiratory muscle motor drive. Therapeutic respiratory arousal has various mechanisms. One is it minimises the chemo - responsiveness to hypoxia and hypercarbia, and the other is by suppressing the reflexive responsiveness to upper airway pressure and depressing wakefulness. This is also because of impairment to neural input to the upper airway and respiratory muscle pump (Phrenic nerve). [10]

Systemic inflammation causes an imbalance between energy supplies and oxygen consumption which puts the patient into a catabolic state resulting in increased metabolic demand and increasing respiratory drive and pump work.¹

6. Conclusion

Significant reduction in respiratory muscle strength and pulmonary flow rates following the Coronary Artery Bypass Grafting.

7. Future Scope

The treatment for the strengthening of both inspiratory and expiratory muscle group can be given individually and

assessed if 1 week protocol in Phase 1 cardiac rehabilitation is effective or not in patients undergone CABG.

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