

COMPARISON OF POST-OPERATIVE ATELECTASIS IN PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFTING WITH AND WITHOUT PRE-OPERATIVE INCENTIVE SPIROMETRY

Syed Raffay Ali Gilani¹, Ghulam Hussain², Naseem Ahmad³, Mirza Ahmad Raza Baig⁴, Haider Zaman⁵

¹⁻⁵ Department of Cardiac Surgery, Choudhary Pervaiz Elahi Institute of Cardiology, Multan - Pakistan.

Address for correspondence:

Dr. Ghulam Hussain

Department of Cardiac Surgery, Choudhary Pervaiz Elahi Institute of Cardiology, Multan - Pakistan.

E-mail: hussain.surgery@gmail.com

Date Received:
November 20, 2015

Date Revised:
February 25, 2016

Date Accepted:
March 14, 2016

ABSTRACT

Objective: To see the effect of pre-operative incentive spirometry on post-operative atelectasis in patients undergoing Coronary Artery Bypass Grafting.

Methodology: This was a randomized prospective study. The duration of study was 05 months from 01-02-2015 to 31-06-2015. A total number of 170 patients were included in this study. In Group I, there were patients in whom incentive spirometry was done before surgery (Study group). While in Group II patients pre-operative spirometry was not done (Control group). There were 85 patients in each group. Data was analyzed using SPSS Version 19. Chi-square test and independent sample t-test were used for analysis of qualitative and quantitative variable respectively. P-value < 0.05 was taken as a significant difference.

Results: There were 42.4% patients who have positive smoking history in group I as compared to only 24.7% smoker patients in group II (p-value 0.02). Ventilation time was significantly less in group I patients, it was 5.49±2.28 hours versus 6.74±5.46 hours in group II patients (p-value 0.05). Incidence of post-operative atelectasis was 14.10% in group I and 27.10% in group II patients (p-value 0.04). So we found that pre-operative incentive spirometry results in considerable reduction in incidence of post-operative atelectasis and it also can reduce ventilation time as well.

Conclusion: Pre-operative incentive spirometry helps to reduce and prevent post-operative atelectasis in patients undergoing coronary artery bypass grafting.

Key Words: Incentive Spirometry, Coronary artery bypass grafting, Atelectasis

This article may be cited as: Gilani SRA, Hussain G, Ahmad N, Baig MAR, Zaman H. Comparison of post-operative atelectasis in patients undergoing coronary artery bypass grafting with and without pre-operative incentive spirometry. *J Postgrad Med Inst* 2016; 30(2): 169-72.

INTRODUCTION

CABG surgery is associated with a number of pulmonary complications such as atelectasis, pneumonia and pleural effusion¹. Atelectasis is considered to contribute significantly to post-operative complications thus increasing morbidity and mortality of the cardiac surgery patients. The incidence of atelectasis ranges from 40-90 percent^{2,3}. The main risk factors for the development of pulmonary complications are; age more than 70 years, smoking history, COPD, cough, previous reduction in pulmonary function, extracorporeal circulation, utilization of internal mammary artery graft, and post-operative pain⁴⁻⁶. It has been demonstrated that pulmonary function did not recover even eight weeks after the surgery, and remains 25-35% low even after 3 months of surgery⁷⁻⁹. Chest physiotherapy is a routinely used method

for the prevention and treatment of pulmonary complications¹⁰. Ward et al demonstrated that post-operative atelectasis can be reduced by taking a deep breath and holding the breath for 3 seconds and then by taking multiple deep breaths (incentive spirometry)¹¹. Whereas some researchers have concluded that there is no benefit of incentive spirometry in reducing pulmonary complications in patients undergoing CABG surgery¹². So we conducted this study to find out that is pre-operative spirometry beneficial in patients undergoing on pump coronary artery bypass graft surgery in preventing the occurrence of post-operative atelectasis.

METHODOLOGY

This was a randomized prospective study. The study was conducted in Department of cardiac surgery of

Choudhary Pervaiz Elahi Institute of Cardiology Multan, Pakistan. The duration of this study was from 01-02-2015 to 31-06-2015. All patients undergoing on pump coronary artery bypass graft surgery having age more than 40 years were included in the study. While patients undergoing any other surgery along with CABG, having prolonged mechanical ventilation (more than 24 hours) or reintubation, chronic obstructive pulmonary disease (COPD), asthma, restrictive lung disease, having pre-operative major chest infection e.g. pulmonary tuberculosis, chest deformities like pectus carinatum, pectus excavatum, thoracolumbar scoliosis, diaphragmatic hernias diagnosed on history, examination and chest x-rays were excluded from the study.

A total number of 170 patients were included in this study. We divided the patients into two groups. There were 85 patients in each group. In Group I patients; incentive spirometry was done before surgery (study group). While in Group II patients; pre-operative spirometry was not done before surgery (control group). In the post-operative period incentive spirometry was done in patients of both groups. Draw randomization technique was used to assign individuals to study or control group. We made folded papers containing name of treatment and placed them in a jar. The patients were requested to pick up one folded paper from jar. The patients were divided into study or control group depending upon the folded paper chosen by them. All patients were followed to observe preoperative incentive spirometry and postoperative recovery to see atelectasis.

The patients were asked to exercise spirometry one week before surgery. Patients were asked to hold the spirometer in the upright position, place their lips tightly across the spirometer mouthpiece, and then they were asked to slowly inhaled air into the lungs to raise the ball to the target position. After that the mouth piece was removed and patients were asked to hold their breath for at least 5 seconds followed by normal expiration. Incentive spirometry was done 3 times for a period of 10 minutes every day before surgery. The following criteria was used to rule out atelectasis; patient having difficulty in breathing, chest pain and cough. It was confirmed on X-ray chest and sometimes on chest CT scan report.

Data was analyzed using SPSS Version 19. Chi-square test and independent sample t-test were used for analysis of qualitative and quantitative variable respectively. P-value < 0.05 was taken as a significant difference.

RESULTS

There were 42.4% patients who had positive smoking history in group I as compared to only 24.7% smoker patients in group II (p-value 0.02). Bypass time and aortic cross clamp time were also same between the two

groups. Ventilation time was significantly less in group I, it was 5.49 ± 2.28 hours in group I and 6.74 ± 5.46 hours in group II (p-value 0.05). We found a significant difference in post-operative atelectasis in patients of group I and II (Table 1). Incidence of post-operative atelectasis was 14.10% in group I and 27.10% in group II and the p-value was significant (p-value 0.04).

DISCUSSION

The word atelectasis is a Greek word which denotes incomplete expansion. It was originally used to describe non-expansion of lungs observed in still born babies¹³. Now it is more specifically defined as an airless state of the lung parenchyma resulting from the airways obstruction of the lung¹⁴. In 1910, for the first time, Pasteur observed the occurrence of atelectasis following surgery¹⁵. The greater numbers of operations are being performed today which has resulted in greater awareness of atelectasis. Although simply recognizable and preventable, atelectasis is often ignored resulting in serious pulmonary morbidity and even surgical mortality.

The purpose of pre-op and post-op respiratory therapy is to prevent the occurrence of atelectasis and reverse it and to improve airway clearance¹⁶. The risk of atelectasis and severity of its complications can be reduced or minimized by using therapeutic techniques that increase lung volumes. Since its introduction, incentive spirometry is an important part of respiratory physiotherapy peri-operatively to prevent and to treat pulmonary complications¹⁷. Incentive spirometry is done by asking the patients to take slow, deep and long breaths; this maneuver helps to decrease pleural pressure, increase lung expansion, increase in inspiratory volumes, improvement in inspiratory muscles performance and hence better gas exchange^{18,19}.

Coronary artery bypass grafting results in significant improvements in quality of life of the patients but the benefits are less marked in elderly, obese patients and in female gender²⁰. Patients in whom respiratory therapy protocol is followed present a better quality of life as compared to patients without chest physiotherapy^{21,22}.

There was no significant difference between the age, gender and the diabetic history of patients between group I and group II. In this study, we found a significant reduction in the incidence of post-operative atelectasis in patients who underwent incentive spirometry protocol before surgery. There were higher numbers of smoker patients in incentive spirometry group but the incidence of atelectasis remained low in Group I. We also found a significant reduction in ventilator support time in this subgroup of patients. So pre-operative spirometry helps to reduce and prevent atelectasis in patients undergoing CABG.

Table 1: Comparison of per-operative characteristics between the group I and group II

Name of variable	Group I (with incentive spirometry)	Group II (without incentive spirometry)	P-value
Age (years)	51.30±5.70	50.45±6.02	0.35
Male gender (%)	56 (65.9)	57 (67.1)	0.87
Smoking history (%)	36 (42.4)	21 (24.7)	0.02
Diabetes (%)	24 (28.2)	25 (29.4)	0.86
Bypass time (hours)	107.43±26.85	106.77±34.54	0.89
X-clamp time* (hours)	61.27±17.91	60.94±17.92	0.90
Ventilation time (hours)	5.49±2.28	6.74±5.46	0.05
Post-op atelectasis (%)	12 (14.10)	23 (27.10)	0.04

*X-clamp= Cross Clamp

CONCLUSION

Pre-operative incentive spirometry helps to reduce and prevent post-operative atelectasis in patients undergoing coronary artery bypass grafting.

REFERENCES

- Ferreira GM, Haeffner MP, Barreto SS, Dall'Ago P. Incentive spirometry with expiratory positive airway pressure brings benefits after myocardial revascularization. *Arquivos brasileiros de cardiologia* 2010; 94:246-51.
- Pinilla JC, Oleniuk FH, Tan L, Rebeyka I, Tanna N, Wilkinson A, et al. Use of a nasal continuous positive airway pressure mask in the treatment of postoperative atelectasis in aortic coronary bypass surgery. *Critical care medicine* 1990; 18:836-40.
- Oikkonen M, Karjalainen K, Kahara V, Kuosa R, Schavikin L. Comparison of incentive spirometry and intermittent positive pressure breathing after coronary artery bypass graft. *Chest J* 1991; 99:60-5.
- Ferguson MK. Preoperative assessment of pulmonary risk. *Chest J* 1999; 115:585-63S.
- Groeneveld AB, Verheij J, van den Berg FG, Wisselink W, Rauwerda JA. Increased pulmonary capillary permeability and extravascular lung water after major vascular surgery: effect on radiography and ventilatory variables. *Europ J Anaesth* 2006; 23:36-41.
- Daganou M, Dimopoulou I, Michalopoulos N, Papadopoulos K, Karakatsani A, Geroulanos S, et al. Respiratory complications after coronary artery bypass surgery with unilateral or bilateral internal mammary artery grafting. *Chest J* 1998; 113:1285-9.
- Shenkman Z, Shir Y, Weiss YG, Bleiberg B, Gross D. The effects of cardiac surgery on early and late pulmonary functions. *Acta anaesthesiol Scand* 1997; 41:1193-9.
- Wynne R, Botti M. Postoperative pulmonary dysfunction in adults after cardiac surgery with cardiopulmonary bypass: clinical significance and implications for practice. *Am J Crit Care* 2004; 13:384-93.
- Johnson D, Hurst T, Thomson D, Mycyk T, Burbridge B, To T, et al. Respiratory function after cardiac surgery. *J Cardiothorac Vasc Anesth* 1996; 10:571-7.
- Thoren L. Post-operative pulmonary complications: observations on their prevention by means of physiotherapy. *Acta Chir Scand* 1954; 107:193.
- Ward RJ, Danziger F, Bonica JJ, Allen GD, Bowes J. An evaluation of postoperative respiratory maneuvers. *Surg Gynecol Obstet* 1966; 123:51-4.
- Freitas ER, Soares BG, Cardoso JR, Atallah ÁN. Incentive spirometry for preventing pulmonary complications after coronary artery bypass graft. *Cochrane Database Syst Rev* 2012:9.
- Brattstrom S. Postoperative pulmonary ventilation with reference to postoperative pulmonary complications; a clinicoexperimental investigation by chest-roentgenograms and pulmonary nitrogen elimination measurements performed in connection with high laparotomies under inhalation anesthesia. *Acta Chir Scand Suppl* 1953;195:1-82.
- Dayman HG, Manning LE. Pulmonary atelectasis: physical factors. *Ann Int Med* 1957; 47:460-92.
- Pasteur W. Active lobar collapse of the lung after abdominal operations: A contribution to the study of post-operative lung complications. *Lancet* 1910; 176:1080-3.
- Agostini P, Singh S. Incentive spirometry following thoracic surgery: what should we be doing? *Physiotherapy* 2009; 95:76-82.
- Restrepo RD, Wettstein R, Wittnebel L, Tracy M. Incentive spirometry: 2011. *Resp Care* 2011; 56:1600-4.

18. Renault JA, Costa-Val R, Rossetti MB. Respiratory physiotherapy in the pulmonary dysfunction after cardiac surgery. *Rev Bras Cir Cardiovasc* 2008; 23:562-9.
19. Westwood K, Griffin M, Roberts K, Williams M, Yoong K, Digger T. Incentive spirometry decreases respiratory complications following major abdominal surgery. *Surgeon* 2007; 5:339-42.
20. Parikh CR, Coca SG, Smith GL, Vaccarino V, Krumholz HM. Impact of chronic kidney disease on health-related quality-of-life improvement after coronary artery bypass surgery. *Arch Int Med* 2006; 166:2014-9.
21. Herridge MS, Cheung AM, Tansey CM, Matte-Martyn A, Diaz-Granados N, Al-Saidi F, et al. One-year outcomes in survivors of the acute respiratory distress syndrome. *N Engl J Med* 2003; 348:683-93.
22. Spiraki C, Kaitelidou D, Papakonstantinou V, Prezerakos P, Maniadakis N. Health-related quality of life measurement in patients admitted with coronary heart disease and heart failure to a cardiology department of a secondary urban hospital in Greece. *Hellenic J Cardiol* 2008; 49:241-7.

CONTRIBUTORS

SRAG conceived the idea, planned the study, and drafted the manuscript. GH, NA, MARB helped acquisition of data and did statistical analysis. HZ drafted and critically revised the manuscript. All authors contributed significantly to the submitted manuscript