

Off-Pump Coronary Bypass Grafting in a Post-pneumonectomy Patient: Challenges and Management

Abstract

Pulmonary complications are common in cardiac surgical patients. Limited respiratory reserves along with the pain associated with sternotomy add to the morbidity. Patients undergoing cardiac surgery who have had a pneumonectomy done before can be even more challenging to manage perioperatively due to a single-functioning lung. We present a case of a postpneumonectomy patient who underwent off-pump coronary artery bypass grafting. Perioperative optimization of lung function tests was stressed upon including the chest physiotherapy and early mobilization. Preoperative thoracic epidural catheter was inserted for postoperative pain and other proven benefits of thoracic epidural in coronary artery disease patients. We could conclude from our experience that proper optimization of lung function tests and meticulous pain management along with fast-tracking are keys to the management of such patients.

Keywords: Coronary artery disease, off-pump coronary artery bypass, pneumonectomy, thoracic epidural

Introduction

Pulmonary dysfunction is, perhaps, one of the most common and most challenging Complication after cardiac surgery. It is the leading cause of postoperative morbidity and mortality after cardiac surgery.^[1] Assessment of pulmonary functions is of utmost importance before any cardiac surgery.^[1] Midline sternotomy leads to postoperative deterioration of lung function tests. Pain and prolonged supine position without ambulation are also culprit factors, leading to postoperative pulmonary complications. Patients with single lung pose a serious challenge – mediastinal displacement to the opposite side, changed anatomy of the heart, and limited reserves of the existing lung pose both surgical and anesthetic challenges. We present a case of single-lung patient undergoing off-pump coronary artery bypass grafting (OPCAB).

Case Report

A 66-year-old male patient, who was hypertensive and non-diabetic, presented to the outpatient department with complaints of dyspnea on exertion (New York Heart

Association Grade III) and unstable angina. He had right-side pneumonectomy done 12 years back for small-cell carcinoma. He was chronic alcoholic and had quit smoking 12 years ago. The patient was currently on methylprednisolone. Pulmonary function tests showed moderate obstructive pattern with reversibility (forced vital capacity [FVC] – 1.60%, 45% of predicted and forced expiratory volume 1 (FEV₁) – 1.11%, 39% of predicted, and FEV₁/FVC 0.69). Room air arterial blood gas analysis showed pO₂ of 68 mmHg and a pCO₂ of 43 mmHg. Chest X-ray showed post right-sided pneumonectomy changes [Figure 1]. Computed tomography showed right-sided deviation of the mediastinum with overinflated left lung [Figure 2].

Incentive spirometry was started a week in advance with addition of bronchodilators, and deep breathing exercises were initiated. The patient was put on prophylactic antibiotic cefuroxime, as total leukocyte counts were high. Preoperative workup was done as per the protocols. It was decided to insert a thoracic epidural catheter pre-induction on the day of surgery for postoperative pain control and the proven benefits of thoracic epidural anesthesia on lung functions.

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**Anand Kumar,
Udgeath Dhir¹,
Vishal Jain,
Surendra Yadav¹,
Ankit Purohit**

Departments of Cardiac Anaesthesia and ¹CTVS, Fortis Memorial Research Institute, Gurgaon, Haryana, India

Address for correspondence:

*Dr. Vishal Jain,
Department of Cardiac Anaesthesia, Fortis Memorial Research Institute, Sector-44, Gurgaon - 122 001, Haryana, India.
E-mail: vishal_jain80@yahoo.com*

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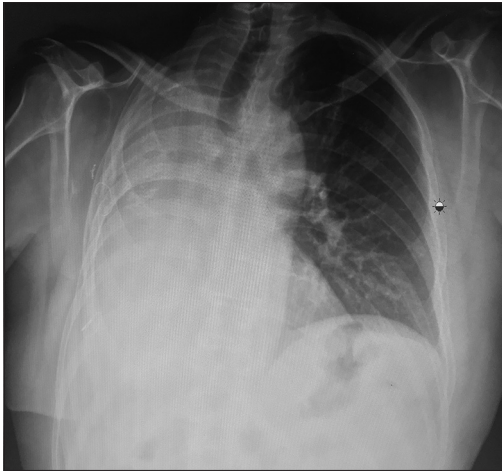


Figure 1: Preoperative chest X-ray

On the day of surgery, after taking an informed consent, a thoracic catheter was inserted in the T1–T2 interspace under all aseptic precautions. The patient was induced with thiopentone, midazolam, fentanyl, and vecuronium. Anesthesia was maintained with sevoflurane and incremental doses of vecuronium and fentanyl. The patient was put on volume control mode with a tidal volume of 450 cc, a respiratory rate of 16/min, and a F_{iO_2} of 0.55. Minimal opioids were used thereafter during the surgery. After a midline sternotomy, an OPCAB was performed, and venous grafts were placed (reversed saphenous vein graft to left anterior descending and ramus intermedius). The patient tolerated the procedure well with normal arterial blood gas values throughout the surgery. The patient was shifted to the Intensive Care Unit (ICU) with minimal inotropes. ICU course was uneventful. The patient was given 0.25% bupivacaine infusion through the thoracic epidural catheter. The patient was extubated 3 h after the surgery. The pain score of the patient on visual analog scale never crossed more than 4. On postoperative day 1, with regular chest physiotherapy, deep breathing exercises, and incentive spirometry, the patient showed good recovery with normal PaO_2 on arterial blood gas analysis. Intermittent biphasic positive airway pressure (BiPAP) was given on postoperative day 1 and 2. Inotropes were tapered by the first postoperative day, and chest tubes and invasive monitoring lines were removed on the second postoperative day. The patient was ambulated on the second day itself. The thoracic epidural catheter was removed on the evening of the second postoperative day. The patient was discharged on 7th post-operative day.

Discussion

Post-pneumectomy patients pose special challenge in cardiac surgery. The rarity of cardiac surgeries reported in post-pneumectomy status can be assessed from the fact that only 30 such cases have been reported so far.^[3-14] Of these, 24 cases were coronary artery bypass grafting (CABG)

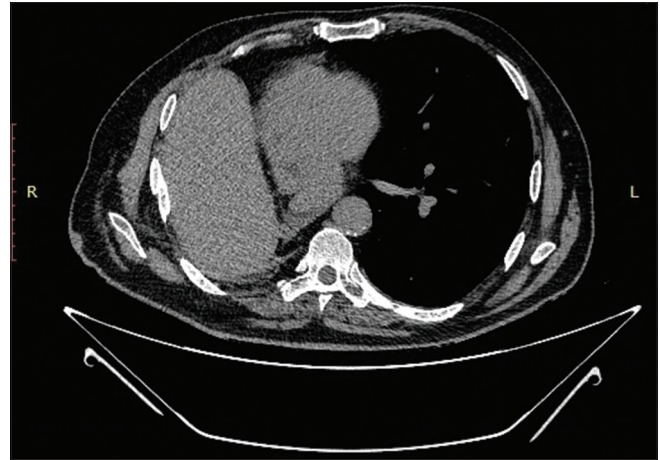


Figure 2: Preoperative chest computed tomography

and rest were mitral valve replacements/repair and tricuspid repair. Only six cases were done off-pump. A mortality of 16% has been reported. Initial reports have mentioned complications such as re-intubation in three cases with one requiring extracorporeal membrane oxygenation.^[9] Hence, it turns out to be a challenging aspect considering the complications reported in the previously reported cases. In patients with right pneumectomy, the heart gets dextropositioned and arch aligns in the frontal plane. Pneumectomy causes hyperinflation of the contralateral lung, shifting of mediastinum, an elevated diaphragm, and adhesions in thoracic cavity. Left pneumectomy pushes heart to left, even though aortic arch alignment does not get distorted much, but the left side of heart turns toward spine, making it difficult to approach lateral wall.^[2] Therefore, grafting turns out to be a challenging task. Left internal mammary artery remains difficult to graft due to length and once grafted over inflated lung may cause kinking of the graft. Kinking of left internal mammary artery caused acute left ventricular function in one of the patients requiring cardiac massage.^[3,11]

Difficulty in establishing cardiopulmonary bypass has been reported in almost all the previous patients with right pneumectomy undergoing on-pump CABG. It may be partly due to a difficult cannulation of a fixed inferior vena cava which forms an acute angle with the right atrium. In addition, venting through pulmonary veins may not be possible.

It is a well-known fact that cardiac surgery affects pulmonary function in multiple manners.^[1] Decrease in FVC, FEV_1 may persist for more than 3 months after the surgery. Prolonged supine position leads to basal atelectasis. The patients, who have had a pneumectomy done before, tolerate the changes in pulmonary functions with even more difficulty as the respiratory reserves usually decrease to half because of a single functioning lung. The patient was told to start incentive spirometry a week before surgery and nebulization with bronchodilators was started. We planned

to insert a thoracic epidural catheter before induction and early extubation and mobilization was planned. Post-pneumectomy state displaces the mediastinum; hence, to avoid any procedure-related complications, central line insertion was done using ultrasound guidance. Meticulous closure ensured minimal drains. Aggressive postoperative chest physiotherapy, incentive spirometry, nebulization, nasotracheal suctioning, and intermittent BiPAP support combined with early ambulation helped in optimal recovery of the patient.

Benefits of thoracic epidural require special mention.^[15,16] Epidural analgesia provides superior analgesia than opioids in the post-operative period and may improve patient outcomes in terms of lung function tests.^[16] Maximum inspiratory lung volumes were 30% more in patients receiving epidural analgesia, thereby reducing the incidences of atelectasis and pulmonary infections. Fast-tracking can be achieved more effectively as the postoperative pain is less. Lower respiratory tract infection rates have shown to be reduced by up to 50%.^[15,16] To conclude, we can say that proper surgical planning, perioperative optimization of pulmonary function tests, and a planned anesthesia (thoracic epidural) along with fast-tracking facilitate better postoperative outcomes in post-pneumectomy patients undergoing coronary artery bypass grafting.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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