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Successful lung volume reduction surgery after coronary artery bypass grafting: a case report

Koroner arter baypas greftleme sonrası başarılı akciğer hacim küçültme ameliyatı: Olgu sunumu

Tuğra Gençpınar, Çağatay Bilen, Ercan Keleş, Kıvanç Metin, Öztekin Oto

Department of Cardiovascular Surgery, Medical Faculty of Dokuz Eylül University, İzmir, Turkey

ABSTRACT

Lung volume reduction surgery is a resection procedure which reduces the amount of lung parenchyma. Its indications include disabling dyspnea associated with hyperinflation, diaphragmatic dysfunction, and heterogeneous disease distribution. Our case was characterized with difficulties in assisted mechanical ventilation after coronary artery bypass grafting due to excessive lung tissue compressing cardiac structures and hemodynamic instability. She was stabilized after lung volume reduction surgery. We present this case due to its rarity and difficulty in decision-making for the procedure.

Keywords: Coronary artery bypass grafting; dyspnea; lung volume reduction.

ÖZ

Akciğer hacim küçültme ameliyatı, akciğer parankim miktarını azaltan bir rezeksiyon işlemidir. Endikasyonları hiperenflasyon, diyafram disfonksiyonu ve heterojen bir hastalık dağılımı ile ilişkili engelleyici dispnedir. Olgumuz koroner arter baypas greftleme sonrası kalp dokularını komprese eden aşırı akciğer dokusuna bağlı oluşan destekli mekanik ventilasyonda güçlük ve hemodinamik instabilite ile karakterize idi. Olgu akciğer hacim küçültme ameliyatı sonrası stabilize edildi. Bu olgu nadir olması ve işleme karar verme güçlüğü nedeniyle sunuldu.

Anahtar sözcükler: Koroner arter baypas greftleme; nefes darlığı; akciğer hacim küçültme.

Delarue and Brangtigan pioneered lung volume reduction surgery (LVRS) in the 1950s.[1,2] This procedure has been recently re-launched by Cooper[3] who have discovered as a new method of treatment of end-stage emphysema. The most common cause of lung emphysema is chronic obstructive pulmonary disease (COPD), which is primarily caused by vapors.[4] In addition, a genetic disposition is important. Mid-term studies have shown that LVRS significantly improves pulmonary function and reduce perioperative morbidity and mortality.[4,5] Actual indications of LVRS are hyperinflation, dyspnea, diaphragmatic dysfunction, and multisystem disorders.[6] Unilateral resection can be planned for the treatment of hemodynamic instability in selected cases.[7] Herein, we report lung volume reduction in a case with hemodynamic instability early after coronary artery bypass graft (CABG) surgery. Our approach resulted in satisfactory surgical outcomes without any harmful complications in such a difficult case.

CASE REPORT

A 61-year-old female suffered from chronic obstructive pulmonary disease for four years and systemic hypertension for 10 years. She was on metoprolol 50 mg/day and inhaled formoterol fumarate 12 µg/day. She had a history of close contact with paints and adhesives and was dyspneic for one month. Coronary artery disease was diagnosed on coronary angiography: right coronary artery (RCA) proximal 90%, RCA posterior descending artery (PDA) branch 90%, left anterior descending artery (LAD) proximal 90%,

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Correspondence: Tuğra Gençpınar, M.D. Dokuz Eylül Üniversitesi Tıp Fakültesi Kalp ve Damar Cerrahisi Anabilim Dalı, 35210 Alsancak, İzmir, Turkey.
Tel: +90 505 - 433 22 89 e-mail: tugra01@yahoo.com

circumflex (Cx) obtuse marginal 1 (OM_1) 70% stenosis. We performed five-vessel on-pump CABG (left internal mammary artery-left anterior descending artery, aorta-right coronary artery, posterior descending artery, aorta-circumflex obtuse marginal 2, aorta-circumflex posterolateral, aorta-left anterior descending artery diagonal 1). Postoperative chest X-ray in the intensive care unit (ICU) demonstrated increased intercostal distances (Figure 1). During the initial period of ICU, she was hemodynamically stable without any inotropic support. Blood gas analysis results were within normal ranges. She was electively extubated in four hours; however, she was re-intubated due to hypotension and increased drainage. At five hours, SaO_2 was 100%, heart rate was 120 bpm, central venous pressure (CVP) was 12 mmHg, and blood pressure was 78/57 mmHg. She had a total drainage of 1600 mL from the chest tubes and five units of packed red blood cells, seven units of fresh frozen plasma, and randomized pooled platelets were transfused. Dobutamine and dopamine infusions by 10 µg/kg/min were initiated to prevent hypotension and gradually increased to 20 µg/kg/min. Intra-aortic balloon pump support was established. Despite all interventions, her hemodynamic status did not improve. She had 300 mL/h drainage of bleeding. She was transferred to the operation room and re-explored for bleeding. There was no surgical source of bleeding visible. Activated clotting time was 276 sec and protamine was replaced.

Figure 1. Preoperative chest X-ray.

Both lungs were emphysematous and extending to the mediastinum. Blood pressure tended to decrease after closing the chest. Therefore, we decided to leave the sternum open. Vital signs were relatively stable after revision surgery: arterial blood pressure 94/58 mmHg, SaO_2 100%, CVP +6 mmHg, heart rate 126/bpm. The settings of the mechanical ventilation were synchronized intermittent mandatory ventilation (SIMV) mode, frequency 15/min, tidal volume 450 mL, and inspiration time/expiration time 1/2. However, her status deteriorated and hypotension which was non-responsive to inotropic support developed. Settings of mechanical ventilation were modified: frequency 30/min, SIMV mode, tidal volume 350 mL, FiO_2 50%, inspiration/expiratory time 1/2. Arterial blood gas analysis results were significantly improved. However, PCO_2 values in blood gas increased.

The possibility of hemodynamic instability was considered after the sternum closure. Therefore, we decided to perform LVRS in addition to chest closure on the third postoperative day. Upper lobe of the left lung moved into the mediastinum and left upper lobe with a part of the left middle lobe was resected with a linear stapler and Seam-guard (Seam-guard, W.L. Gore, Flagstaff, Arizona, USA) device. Postoperative results are shown in Figure 2. Bronchovascular prominence and increased cardiothoracic ratio were detected. Settings of the mechanical ventilation were efficiently changed: SIMV mode with 12/min frequency, tidal volume 650 mL. Dobutamine and dopamine infusions reduced to 2.5 µg/kg/min. Intra-aortic balloon pump was retrieved from 1:1 to 1:3. Antibiotherapy was switched to piperacillin and tazobactam. She was weaned from intra-aortic balloon pump. Normal

Figure 2. Postoperative chest X-ray.

values of arterial blood pressure (120/60 mmHg) and arterial blood gas analyses were performed. She was successfully weaned from the mechanical ventilation on the fourth postoperative day. The patient, then, underwent pulmonary rehabilitation. The rest of the follow-up period was uneventful.

DISCUSSION

Lung volume reduction surgery basically defines an approach which is a progressive loss of lung parenchyma, such as parenchymal resection.[1,2] Lung volume reduction surgery is effective in selected cases for palliation of symptoms. This treatment option can also improve survival and respiratory muscle inefficiency. Unilateral rather than bilateral lesions are predominantly operated on a single-sided resection, which is a less morbid procedure.[6] Posteroanterior radiography, high-resolution chest computed tomography, and ventilation perfusion scintigraphy, and finally intraoperative imaging studies are used to visualize the determination of weakened regions. Currently there is no gold standard method to show where and to what extent it would be for the resection. Mostly preferred surgical technique is the resection of the affected part of the lung with a stapler and edge reinforcement material (pericardium, Seamguard, etc.).[6]

Chronic obstructive pulmonary disease is an important cause of morbidity during cardiac surgery. Lung volume reduction surgery can improve pulmonary function, quality of life of the patients, and may even prolong survival with end-stage emphysema in hemodynamic instability early after CABG. It can be performed successfully in selected patients with disabling dyspnea associated with hyperinflation and diaphragmatic dysfunction during cardiac surgery. After cardiac surgery, satisfactory outcomes may be achieved with a significantly improved lung function. Also, LVRS is more accessible option for advanced emphysema extending to the mediastinum. The goal of LVRS is to reduce respiratory muscle inefficiency and to perform resection LVR of 20% rather than the traditional lobectomy. Small randomized series showed also some yield for the surgical intervention.[6,7] This procedure has been recently suggested by Trotter et al.[8] in 552 randomized patients and the authors demonstrated that the choice of LVRS techniques did not affect the outcomes. Due to an extremely limited respiratory reserve, this is the safest technique which minimizes possible air leaks. In our case, the cause of the hemodynamic instability was hyperinflation of the lungs, preventing the chest closure. Lung tissue was resected in the left upper lobe with the least possible volume. Sternum was closed after resection and hemodynamic stability was maintained. She was extubated safely without any need of inotropic and mechanical circulatory support. This is a rare and somehow marginal indication for lung volume reduction in a case after cardiac surgery and hemodynamic instability without any cardiac origin with improved functional outcomes.

In conclusion, LVRS can be safely done to improve hemodynamic stability and the lung function. Patients can maintain a near-normal life in activities of daily living.

Declaration of conflicting interests

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