CASE REPORT

A 74-year-old male patient was referred to this hospital with unstable angina and shortness of breath. Medical history included a history of a left pneumonectomy because of bronchial carcinoma 15 years previously. His temperature, heart rate, and blood pressure were all within normal limits. No respiratory sounds could be heard in the left hemithorax, and right breath sounds were normal. Chest x-ray examination showed deviation of the mediastinal structures to the left and hyperinflation of the right lung (Fig 1). His echocardiographic evaluation revealed an ejection fraction of 45% with hypokinesia of the anterolateral and anterior segments. A computed tomography chest scan was undertaken to evaluate for recurrent or metastatic disease. He was free of recurrence, and subsequent cardiac catheterization revealed 70% stenosis of the left main coronary artery, 80% stenosis of the proximal left anterior descending artery, 90% stenosis of the circumflex artery, and 70% stenosis of the right coronary artery.

Lung function tests revealed a combined obstructive and restrictive pattern consistent with a history of pneumonectomy. The forced expiratory volume in 1 second and forced expiratory volume in 1 second/forced vital capacity were 1.35 L (45% of the predicted) and 0.65 (60% of the predicted), respectively. Preoperative arterial blood gases on room air showed a pH of 7.42, PaO₂ of 64 mmHg (arterial oxygen saturation, 91%), and a PaCO₂ of 45 mmHg. Preoperative pulmonary rehabilitation was scheduled for 5 days with steroids, bronchodilators, and chest physiotherapy, and it was decided to delay the surgical intervention to the end of this time. Oral albuterol (4 mg), 3 times daily, was started along with a vigorous chest exercise program, and for the last 2 days, 10 mg of oral prednisone was added to the regimen. The patient also received 1 g of intravenous methylprednisolone 6 hours before the operation and 125 mg at the end of CPB.

The patient was taken to the operating room and premedicated with intramuscular midazolam (5 mg). A radial artery catheter was inserted for pressure monitoring and blood sampling. A pulmonary artery catheter was inserted via the left internal jugular vein (pneumonectomy side). Anesthesia induction was performed with midazolam (0.1 mg/kg), fentanyl (20 µg/kg), and pancuronium bromide (0.1 mg/kg). Maintenance of anesthesia was achieved with a 50/50 oxygen/air mixture, isoflurane 0.1% to 1.0% (Fabius GS; Drager, WI), as well as from alterations in chest wall mechanics because of the surgical incision. Activated leukocytes and their products incite an inflammatory response in the pulmonary vasculature, and the alveolar-capillary barrier becomes more permeable than normal. Macromolecules may enter the pulmonary interstitium and promote development of pulmonary edema.1,2 Although most patients undergoing coronary artery bypass graft (CABG) surgery can tolerate this pulmonary impairment, patients with borderline pulmonary reserve are at increased risk of postoperative pulmonary dysfunction and require special management during the operative period.3 Therefore, the authors report a patient in whom CABG surgery was performed 15 years after he had undergone a left pneumonectomy.

DISCUSSION

Cardiac surgery is usually associated with a decrease in forced vital capacity,2 and respiratory dysfunction presents a significant challenge, especially in elderly patients with borderline pulmonary capacity. CABG patients with a history of a previous pneumonectomy are at increased risk for postoperative respiratory complications and require special perioperative care.

Although respiratory muscle weakness, infections, and atelectasis are all contributing factors to postoperative respiratory failure, pulmonary function after cardiac surgery depends mainly on the patient’s preoperative respiratory reserves.6 It has been reported that preoperative administration of corticoste-
Corticosteroids, by reducing proinflammatory cytokine release and increasing blood interleukin-10 levels, may provide a better degree of lung and myocardial protection in patients undergoing CABG with extracorporeal circulation. Therefore, the reduction of the inflammatory response by corticosteroids may increase the success of the surgical procedure, especially in the treatment of high-risk patients.

The avoidance of fluid overload during CPB is an important adjunct, and fluid balance should be closely monitored in these patients to prevent interstitial fluid accumulation from interfering with the alveolar-arterial oxygen gradient. Dissection, preparation of the internal mammary artery (IMA) graft, and topical cold administration may lead to phrenic nerve injury in up to 30% of patients undergoing CABG. The use of topical hypothermia of the heart should be avoided in these patients to reduce the possibility of diaphragmatic paralysis as a result of cold injury to the phrenic nerve. Good postoperative pain relief is essential to allow patients to maximize their respiratory effort in the early postoperative period.

The most frequent postoperative complication in patients undergoing cardiac surgery after pneumonectomy is a pneumothorax. The placement of the pulmonary artery catheter via the pneumonectomy side and performing the sternotomy with an oscillating redo saw after the lungs were deflated may have helped to prevent this serious complication. Maintaining peak inspiratory pressure and tidal volume at low levels, with an increase in the frequency of respiration, provided sufficient gas exchange and reduced the likelihood of barotrauma. In this particular case, tidal volume was kept at 6 mL/kg and the frequency at 14 to 16 per minute, and the patient was weaned from mechanical ventilation at the sixth postoperative hour.

Some other authors have reported successful off- and on-pump CABG operations in patients with a previous pneumonectomy (Table 1). After pneumonectomy, there is a marked mediastinal shift toward the pneumonectomy space. Although the avoidance of CPB is helpful in the prevention of fluid overload, the authors did not use an off-pump technique because it was believed that the heart could not tolerate the needed dislocation because of the presence of significant coronary lesions and marked deviation of the heart to the left. The use of the IMA as a conduit for CABG in patients after a pneumonectomy is also a subject of considerable debate. In this patient, the IMA was harvested on the side of the pneumonectomy. The prerequisite for using an IMA in these patients is sufficient length for an in situ IMA to reach the desired anastomotic site on the coronary territory. Because the mediastinal structures were shifted to the left in this patient, the length of the LIMA was not a major concern. However, patients with a previous right pneumonectomy present important surgical challenges and deserve a word of caution. In this particular group of patients with a shift of the mediastinum to the right, the length of the LIMA and its position across the hyperinflated left lung are important limitations for its use. Therefore, in these

![Preoperative chest radiograph showing mediastinal displacement to the left and hyperinflation of the right lung.](image)

Table 1. The Cases Reported in the Literature

<table>
<thead>
<tr>
<th>Reference/Author</th>
<th>Age/Gender</th>
<th>Site</th>
<th>Grafts Used</th>
<th>Extubation Time</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berrizbeita10</td>
<td>61 y/male</td>
<td>Right</td>
<td>3 SV</td>
<td>1 day</td>
<td>None. Discharge on day 18</td>
</tr>
<tr>
<td>Soltanian11</td>
<td>70 y/female</td>
<td>Left</td>
<td>1 SV → left thoracotomy, off-pump hybrid intervention</td>
<td>5 hours</td>
<td>None. Discharge on day 7</td>
</tr>
<tr>
<td>Medalion12</td>
<td>70 y/female</td>
<td>Left</td>
<td>3 SV + left IMA</td>
<td>20 hours</td>
<td>None. Discharge on day 11</td>
</tr>
<tr>
<td>Shibata13</td>
<td>70 y/male</td>
<td>Left</td>
<td>Left IMA + 1 SV (off-pump)</td>
<td>1 hour</td>
<td>Discharge on day 57</td>
</tr>
<tr>
<td>Kumar8</td>
<td>58 y/male</td>
<td>Right</td>
<td>3 SV</td>
<td>6 hour</td>
<td>None. Discharge on day 7</td>
</tr>
<tr>
<td>Gölbasi14</td>
<td>63 y/male</td>
<td>Right</td>
<td>1 SV + left IMA</td>
<td>36 hours</td>
<td>Pneumothorax at 44 hours, mediastinitis at day 6, shock and death at day 12</td>
</tr>
<tr>
<td>Diab9</td>
<td>64 y/male</td>
<td>Left</td>
<td>1 SV</td>
<td>70 hours</td>
<td>Re-intubation due to hypoxemia. Discharge on day 10</td>
</tr>
</tbody>
</table>

Abbreviations: SV, saphenous vein; IMA, internal mammary artery; Px, pneumothorax.
patients, the right IMA should be harvested, and if additional length is required for the revascularization of the left coronary territory, a skeletonized technique or a free graft that allows additional length should be considered to prevent serious postoperative complications that may be associated with the use of the left IMA.

In conclusion, a previous pneumonectomy is not a contraindication for CABG, which can be accomplished successfully with appropriate preoperative preparation and close postoperative monitoring. The management of patients who are dependent on a single lung should be comprehensive and requires close vigilance by anesthesiologists and cardiothoracic surgeons. A good preoperative respiratory rehabilitation program, shorter CPB time, and shorter duration of mechanical ventilation are the most important means to prevent respiratory complications. With attention to the specific features of the preoperative, intraoperative, and postoperative management, cardiac surgical procedures can be performed on patients after pneumonectomy with acceptable operative mortality and morbidity.

REFERENCES