Case report

Coronary artery bypass grafting after pneumonectomy

Karim A. Diab, Mohamad F. Khatib, Mounir Obeid, Ghassan W. Jamaleddine*

Department of Internal Medicine, American University of Beirut Medical Center, Beirut, Lebanon

Received 11 September 2000; received in revised form 30 November 2000; accepted 29 December 2000

Abstract

The need to perform coronary artery bypass grafting in patients who have a single lung is not uncommon. To date, the safety of such procedures has not been well documented. In this article, we review the literature using the Medline 1966 to September 2000 database to identify patients with pneumonectomy who underwent coronary artery grafting and we provide a compilation of all reported cases. We also present an additional case in whom the use of nasal bilevel positive airway pressure was beneficial in preventing postoperative pulmonary complications. © 2001 Elsevier Science B.V. All rights reserved.

Keywords: Cardiac surgery; Coronary artery bypass; Pneumonectomy; Mechanical ventilation

1. Introduction

Pneumonectomy is associated with physiologic changes that interfere adversely with pulmonary function. The fact that post-pneumonectomy patients occasionally require major operations, particularly open-heart surgery, raises a question about the risks and safety of such procedures.

The risk of performing coronary artery bypass grafting (CABG) on a patient with a single lung is unclear from the literature. In this report, we reviewed the literature on patients with a single lung who underwent CABG. In addition, we report a case in which CABG was carried out 6 years after the patient had undergone pneumonectomy.

2. Case report

A 64-year-old diabetic man with a history of right pneumonectomy 6 years prior to presentation was admitted with unstable angina. The patient was an ex-smoker with 130 pack-years. An electrocardiogram revealed left anterior hemiblock. An echocardiogram showed hypokinesia of the posterobasal and inferior segments of the left ventricle. Cardiac catheterization revealed severe triple-vessel disease. Arterial blood gases showed normal pH (7.38), mild hypercapnea (PaCO₂ = 46 mmHg) and hypoxemia (PaO₂ = 68 mmHg). Pulmonary function tests revealed severe restrictive disease consistent with a history of pneumonectomy. After several days of vigorous chest physiotherapy and bronchodilation, the patient underwent CABG with the use of the right saphenous vein. He was extubated on the first day post-operation but he developed CO₂ retention (PaCO₂ = 65 mmHg) that necessitated reintubation on the second day. Flow-by was added to the mode of ventilation. The effort required for him to breathe decreased and he was extubated 70 h post-operation. As he redeveloped respiratory failure with an increase in PCO₂, nasal bilevel positive airway pressure (BiPAP; Respironics Inc.; Murrysville, PA) was started at 10/3 cm H₂O. His shortness of breath and hypoventilation improved markedly, and he was gradually weaned off BiPAP over 2 days. The patient was discharged home with no BiPAP.

3. Discussion

Patients with pneumonectomy always present a challenge when they need to undergo thoracic surgery, and in particular CABG. These patients are predisposed perioperatively to a much higher risk of cardiopulmonary complications. Even frequently encountered consequences of surgery such as atelectasis, congestion, and nosocomial infection could lead to lethal outcomes in these patients. No prospective study has been done to evaluate the morbidity and mortality on pneumonectomized patients undergoing CABG.

Using the Medline 1966 to September 2000 database, a review of the literature identified six reported cases of...
patients who underwent CABG after pneumonectomy (Table 1) [1–6]. All reported patients were elderly with a mean age of 65.6 years. In the entire series, the mortality was 14.3% (1/7 patients). The mean time for successful extubation in all cases was 33.8 h post-operation. The mean interval time between performing pneumonectomy and CABG surgery was 21.7 years.

It is worthwhile noting that no death resulted from respiratory failure despite the compromised pulmonary function in these patients. Pulmonary complications occurred in 42.8% of patients, with pneumothorax being the most common (2/7 patients or 28.6%). Re-intubation was needed in two cases. The patient we reported developed CO₂ retention with respiratory failure and was re-intubated on the second postoperative day. He was weaned off successfully to room air after the use of nasal BiPAP.

Pulmonary complications in patients undergoing CABG can result from diaphragmatic dysfunction secondary to a compromise of blood perfusion to the diaphragm, as well as from alterations in chest wall mechanics due to the surgical incision. Van Belle et al. [7] reported a significant impairment in pulmonary function post-CABG and demonstrated that respiratory muscle weakness contributed to this immediate postoperative restrictive lung function loss.

Pulmonary insufficiency post-CABG can also result from other factors than respiratory muscle disturbances, such as lung edema, which is a potential consequence of cardiopulmonary bypass (CPB). The use of CPB in patients with a single lung may increase the risk of cardiac surgery. Although this has not been used in any of the reported cases, it would be interesting in such patients to assess the benefit of off-pump CABG in reducing postoperative respiratory dysfunction by avoiding CPB. Off-pump CABG has been shown in previous reports to reduce morbidity and hospital stay in high-risk and elderly patients [8].

The use of IMA versus SV grafts is also of concern in patients with a single lung. Despite previous reports of increased pulmonary morbidity in patients who had IMA grafts compared to those who had SV grafts, a recent study [9] indicates that the use of one or two IMA grafts does not increase respiratory dysfunction compared to the use of vein grafts. In the pneumonectomized patients we reviewed, those who underwent IMA grafts (2/7 patients) did not have a higher incidence of respiratory failure compared to those who received SV grafts alone (5/7 patients). However, in patients with pneumonectomy, it is prudent to avoid IMA harvest on the side of the intact lung. We believe that a previous pneumonectomy is not a contraindication to CABG. With optimal preoperative chest physiotherapy and bronchodilation, and adequate postoperative management including the use of noninvasive mechanical ventilation, CABG can be performed in these patients with a single lung with acceptable morbidity and mortality.

<table>
<thead>
<tr>
<th>Author [Ref.]</th>
<th>Age (years)/sex</th>
<th>Side of pneumonectomy</th>
<th>Type of graft operation</th>
<th>Time of post-operation extubation</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berrizbeita et al. [1]</td>
<td>61/M</td>
<td>Right</td>
<td>3 SV grafts</td>
<td>1 day</td>
<td>None; discharged on day 18 post-operation</td>
</tr>
<tr>
<td>Soltanian et al. [2]</td>
<td>70/F</td>
<td>Left</td>
<td>1 SV graft</td>
<td>5 h</td>
<td>None; discharged on day 7 post-operation</td>
</tr>
<tr>
<td>Medalion et al. [3]</td>
<td>70/F</td>
<td>Left</td>
<td>3 SV grafts, 1 left IMA graft</td>
<td>20 h</td>
<td>None; discharged on day 11 post-operation</td>
</tr>
<tr>
<td>Shibata et al. [4]</td>
<td>–</td>
<td>Left</td>
<td>3 SV grafts</td>
<td>–</td>
<td>None; discharged on day 57 post-operation</td>
</tr>
<tr>
<td>Lecharpentier et al. [5]</td>
<td>66/M</td>
<td>Left</td>
<td>SV graft</td>
<td>1 day</td>
<td>Re-intubation for 24 h; pneumothorax; discharged on day 10 post-operation</td>
</tr>
<tr>
<td>Current report</td>
<td>64/M</td>
<td>Right</td>
<td>SV graft</td>
<td>70 h</td>
<td>Re-intubation needed for respiratory failure; discharged on day 12 post-operation</td>
</tr>
<tr>
<td>Demirtas et al. [6]</td>
<td>63/M</td>
<td>Left</td>
<td>1 SV graft, 1 left IMA graft</td>
<td>36 h</td>
<td>Pneumothorax 44 h post-operation; mediastinitis on day 6; septic shock and death on day 12</td>
</tr>
</tbody>
</table>

a SV, saphenous vein; IMA, internal mammary artery.

References