Concomitant Single Vessel Coronary Revascularization and Single Lung Transplant in an Elderly Patient with End-Stage Idiopathic Pulmonary Fibrosis and Reduced Ejection Fraction

Wendy K. Bernstein* and Bianca M. Conti

1Department of Anesthesiology, Director of Cardiothoracic Anesthesia Fellowship Program, University of Maryland School of Medicine, Maryland, USA
2Division of Trauma Anesthesiology, R Adams Cowley Shock Trauma Center, University of Maryland School of Medicine, Maryland, USA

Abstract

Coronary artery disease is not uncommon in lung transplant recipients. Traditionally, the presence of coronary artery disease would exclude a patient from having a lung transplant due to the adverse effect of coronary artery disease on survival after lung transplantation. There have been several reports of patients who have undergone simultaneous single lung transplant and a single vessel off-pump coronary artery bypass graft suggesting that the presence of clinically significant coronary artery disease need not be an absolute contraindication to lung transplantation in selected patients. However, all have been performed in patients with good cardiac function. We report on a 64 year old man with coronary artery disease and reduced ejection fraction who underwent a successful concomitant surgery of unilateral lung transplant and single vessel off-pump coronary revascularization.

Keywords: Coronary Revascularization; Lung Transplant; Pulmonary Fibrosis

Introduction

Significant coronary artery disease (CAD) is a common finding in older patients presenting for lung transplant [1,2]. Traditionally, the presence of CAD would exclude a patient from having a lung transplant due to the adverse effect of coronary stenosis on survival after lung transplantation [3]. The International Lung Transplant Registry reports a 5% mortality in lung transplant recipients due to CAD [4].

Most transplant centers limit lung transplants to patients who have advanced irreversible lung disease, but do not have other significant comorbidities that may complicate or decrease survival after transplantation. With the scarcity of lung donors and the desire for the best available outcome, CAD is considered a prohibitive surgical risk [2,5].

Cigarette smoking and obesity, are common to both end stage lung disease and cardiac disease resulting in an increased incidence of CAD in potential lung recipients [6]. The strong association between smoking and cardiovascular disease as well as smoking and lung cancer results in a high risk of perioperative cardiac complications including myocardial ischemia, infarction and even death.

There has been limited data regarding the perioperative treatment for CAD in potential lung transplant recipients. There have been a few cases of lung transplantation following coronary artery bypass grafting (CABG) and CABG after lung transplantation [1,6-8]. These cases have occurred despite several months or even several years of delay between the staged procedures. There have been only a few or isolated reports of cases done simultaneously in highly selected patients both with the assistance of cardiopulmonary bypass and without bypass. Revascularization techniques can be achieved using hybrid techniques which are considered to be a viable alternative to conventional coronary artery bypass surgery [9]. What makes this case unique is that this patient had a reduced ejection fraction and previous case studies were performed in patients with better left and right ventricular function.

We believe that the combined procedure of coronary revascularization and lung transplantation is technically feasible, and carries an acceptable morbidity and mortality risk in this specific patient population. We report on a 64 year old man with coronary artery disease and reduced ejection fraction who underwent a concomitant surgery of unilateral lung transplant and single vessel off-pump CABG.

Case Report

A 64 year old man with a past medical history of idiopathic pulmonary fibrosis (IPF) was referred to University of Maryland Medical Center Transplant Program. The patient reported that he was experiencing a progressive increase in dyspnea with a marked deterioration within the past two weeks.

Chest computed tomography (CT) with contrast showed persistent widespread reticular opacities consistent with severe underlying pulmonary fibrosis (Figure 1). Pulmonary function tests were performed and results are seen in Table 1. The cardiac...
catheterization revealed significant coronary artery disease including a mid left main 50% lesion, ostial left anterior descending artery (LAD) 80% lesion, mid LAD 60-70% lesion, ostial first obtuse marginal artery (OM1) 50% lesion, right posterior descending artery (PDA) ostial lesion at 80%, with evidence of mild pulmonary hypertension (35/15 mmHg) and reduced ejection fraction. The patient had a past medical history of smoking, hypertension, gastroesophageal reflux, and obstructive sleep apnea for which he was unable to tolerate continuous positive airway pressure (CPAP).

It was thought that the patient would benefit from lung transplantation with simultaneous grafting of a single coronary artery. The surgeon planned to have complete revascularization using percutaneous coronary intervention at a later date. General anesthesia was induced and single lung isolation was achieved with a 39 French double-lumen endotracheal tube. Adequate arterial and venous access was established with a radial arterial line, peripheral venous catheter, and 9 Fr cordis with a Swan Ganz catheter. Starting pulmonary arterial pressures were higher than expected (58/23 mmHg) and the cardiac index was 2.5 L/minute/meter. The lowest oxygen saturation noted was 93%. Intraoperative transesophageal echocardiography (TEE) showed estimated ejection fraction 40%, dilated right ventricle with depressed systolic function and trace mitral regurgitation.

Coronary revascularization was performed prior to lung transplantation. A left thoracotomy incision in the sixth intercostal space was made with anterior extension to accommodate the dissection of the left internal mammary artery (LIMA). The LIMA was dissected from the origin to the distal region of bifurcation to maximize the length using a Bionet Ratchet retractor. The coronary bypass was performed first with the in situ LIMA to the LAD off CPB using a Nuvo Octopus tissue stabilizer. Ten thousand units of heparin were given without reversal since a lower dose of heparin was used during the operation as compared to on pump cases [10]. No intracoronary shunts were used and the patient tolerated the procedure well without arrhythmia or hemodynamic instability. Post TEE showed improved left ventricular function without need for inotropic support.

Single lung ventilation was maintained throughout the rest of the case without complication. The clamping of the left lung was well tolerated. No intravenous or inhaled medications were needed to control pulmonary hemodynamics during lung transplantation. The total graft ischemic time was four hours and three minutes.

At the conclusion of the procedure, the double lumen endotracheal tube was replaced with a single lumen endotracheal tube via direct laryngoscopy. The patient was extubated on postoperative day one. Chest CT post transplantation showed improved lung field with the transplanted left lung and persistent pulmonary fibrosis in the right lung field (Figure 2). His postoperative course was complicated by pulmonary deterioration on post operative day 4 requiring emergent intubation and mediastinal reexploration, as well as pneumonia which was successfully treated with antibiotics. On postoperative day 18, the patient was transferred to a rehabilitation facility.

**Discussion**

Transplantation of a lung, either unilateral or bilateral, is a last resort treatment for irreversible lung disease. Common indications for lung transplantation include chronic obstructive pulmonary disease (COPD), cystic fibrosis, IPF and pulmonary hypertension. Single lung transplantation is considered by many to be the best option for treating patients with idiopathic pulmonary fibrosis [11]. Death occurs in most IPF patients within 3-6 years from onset of symptoms [12]. The survival rate for patients with end-stage IPF that have undergone lung transplantation is approximately 68% at 1 year and 60% at 2 years [13].

We describe the dilemma of managing patients with surgically correctable coronary artery disease who also have end stage pulmonary disease and would benefit from lung transplantation. Several options are available and include either foregoing transplantation, performing CABG surgery before actively listing the patient for transplantation, performing CABG surgery after completion of lung transplantation or performing coronary revascularization simultaneously with lung transplantation. The choice of treatment will depend on the extent and severity of disease, as well as the comorbidities of the patient. In performing coronary revascularization prior to listing the patient for transplantation, one has determined that the patient is at higher risk from cardiac sequelae than morbidity due to pulmonary causes. In addition, one has determined that it may take considerable time to locate a suitable donor organ. Then if the surgery is performed after the lung transplantation, one puts the patient at undue risk of cardiac complications despite a potentially successful lung operation.

Simultaneous procedures can place the patient at increased risk secondary to increased technical needs, a more prolonged operative procedure which exposes the patient to longer anesthetic times, and possible increased infection risks. Furthermore, patients that required use of bypass pumps have had a higher incidence of mediastinal reexploration for bleeding [1]. Prolonged postoperative recovery and increased mortality should be expected when the FEV1 is less than 1.5 L [14,15]. Increased risk for bleeding and coagulopathies exist secondary to heparinization and CPB. In addition, median sternotomy combined with LIMA dissection can also be associated with short-term pulmonary dysfunction and possible hypoxia [16].

The extent of revascularization must also be considered. In this patient, several stenotic lesions were described on the coronary
artery catheterization, however only the LAD was revascularized. While this may seem suboptimal, it was the decision of the cardiac surgeon to minimize operating time, decrease heparin use and prevent the need for cardiopulmonary bypass by only performing the LIMA to LAD graft. The LIMA is considered the "gold standard" for surgical revascularization since significant coronary flow can be obtained by this arterial conduit, and the LIMA bypass is associated with a greater event-free probability than either PTCA or medical treatment [17,18]. If symptoms persist, percutaneous coronary intervention could be used at a later date to further increase coronary flow. Hybrid coronary revascularization, left mammary artery to left anterior descending artery combined with non-left anterior descending artery percutaneous coronary intervention stenting, is considered a viable alternative to conventional coronary artery bypass graft surgery or to multivessel percutaneous coronary intervention to perform a functionally complete revascularization [9].

By using a left thoracotomy incision, the surgeon was also limited in his exposure and could probably only obtain revascularization of the LAD. However, the patient would have only one incision and that would accelerate his recovery time. It was felt that with the poor quality of the target vessels, there would be the most benefit by completing this anastomosis alone, leaving the other stenotic vessels and relying on the multiple collaterals that had developed.

The long term outcome in terms of patency of grafts must also be considered. Perioperative steroids and cyclosporine contribute to hyperlipidemia and accelerated atherosclerotic disease after organ transplantation. Hyperlipidemias have been identified as risk factors for ischemic heart disease through accelerated atherosclerosis [19]. Cyclosporine is the most widely used immunosuppressive agent and is associated with improvements in graft viability, but carries the risk of altering serum lipids and raising serum cholesterol levels, but has not been shown to demonstrate a measurable changes in left ventricular function [20,21]. In addition, cyclosporine is associated with hypertension, which is a known risk factor for CAD.

Lung transplantations performed for IPF has worse outcomes than those performed for other indications. There is recent literature that questions the choice of single versus double lung transplantation for IPF [21]. Recent reports have suggested a better outcome, and longer survival with bilateral lung transplantation for pulmonary fibrosis [22]. In this patient, the decision was made to perform a single lung transplant.

Despite the smooth intraoperative course, several postoperative complications did occur in this patient. The hemorrhoxia may have been related to the heparin dose. The postoperative pneumonia may have been related to the need for re-exploration. The short duration of follow up, combined with the complicated postoperative course makes it difficult to support the use of scarce organs, however, there was no other suitable candidate for this lung due to the advanced age of the donor.

In an era where donor organs are scarce, older patients with more advanced coronary artery disease may not be considered suitable candidates for lung transplantation. The potential adverse impact of coronary artery disease on survival after lung transplantation has excluded these patients from consideration for transplantation. Nevertheless, unilateral lung transplantation can be performed safely and effectively in patients that may otherwise have been rejected because of a high risk of cardiac related morbidity and mortality.

References

