Bilateral lung transplantation and pulmonary artery reconstruction in a patient with chronic obstructive pulmonary disease and a giant pulmonary artery aneurysm

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Aneurysms of the pulmonary artery are a rare entity. In a review in 1947, Deterling and Clagett documented only 8 cases in more than 100,000 autopsies. Similarly, there were only 6 cases of pulmonary artery aneurysms in 4000 patients documented from 1785 to 1946.¹ These aneurysms are most commonly found with congenital heart anomalies, but acquired aneurysms may be associated with atherosclerosis, cystic medial necrosis, trauma, infections such as syphilis and endocarditis, or inflammatory processes such as giant cell arteritis. Although many patients with pulmonary artery aneurysms demonstrate pulmonary hypertension, this has not been proven to be a causative factor. In fact, most patients with pulmonary hypertension never have aneurysms. Symptoms are usually vague and may represent manifestations of the primary disease process or may be related to local compression. The disease process leads to rupture and death in approximately 30% of patients, with other deaths resulting from right-sided heart failure or pulmonary embolus.²

Clinical Summary

A 64-year-old man with a history of chronic obstructive pulmonary disease and pulmonary hypertension with giant pulmonary artery aneurysms came to our lung transplant center for evaluation. The pulmonary history was significant for tuberculosis treated at 8 months of age and an open lung biopsy performed in 1965 that showed pulmonary fibrosis.

Preoperative pulmonary function tests revealed a forced expiratory volume in 1 second of 0.650 L (20% of predicted) and a diffusing capacity of lung for carbon monoxide of 28.9 (23% of predicted). Lung volumes were consistent with emphysema with a total lung capacity of 139% of predicted and a residual volume of 338% of predicted. Arterial blood gas analysis demonstrated a PaO_2 of 53 mm Hg and a Paco_2 of 46 mm Hg on 21% inspired oxygen. The chest radiograph revealed enlarged bilateral pulmonary hila (Figure 1), and a computed tomographic (CT) scan of the

chest performed in August 2000 showed a 6.2-cm main pulmonary artery with eccentric thrombus extending to the aneurysmal right and left pulmonary arteries (Figure 2). The lung parenchyma showed evidence of emphysema but no evidence of pulmonary fibrosis. Pretransplant cardiac blood pool imaging revealed decreased right and left ventricular ejection fractions at 29% and 39%, respectively. Cardiac catheterization showed pulmonary hypertension with a pulmonary artery pressure of 58/26 mm Hg, a cardiac index of 2.9 L/min, and no evidence of an intracardiac shunt.

The patient was deemed a suitable candidate and was placed on the waiting list for a bilateral lung transplant. When donor lungs became available, he underwent a bilateral lung transplantation with reconstruction of the recipient pulmonary artery using donor aorta. The donor was an otherwise healthy 40-year-old patient who had died in a motor vehicle crash. However, the heart was not harvested because of poor left ventricular function. We were, therefore, able to harvest the entire thoracic aorta along with the lungs. The entire donor thoracic aorta was received with the specimen and was dissected from the lungs and placed in cold heparinized saline solution. The donor lungs were separated while the donor aorta was prepared.

The patient was placed in the supine position, and the right and left sides of the chest were exposed through the fourth intercostal space using bilateral anterior thoracotomies and transverse division of the sternum. The lungs were then mobilized, and the aneurysm was seen extending from the origin of the main pulmonary artery into both pulmonary hila. The pericardium was opened, and the patient was placed on cardiopulmonary bypass with bicaval and ascending aortic cannulation. After this, both lungs were excised. When the pulmonary arteries were opened, a large amount of fibrinous clot was seen.

The left lung was implanted first. The bronchial anastomosis was performed first, by our previously described technique.³ The pericardium was then opened circumferentially around the pulmonary vein stumps, and the pulmonary vein anastomosis was performed using an everting, running 4-0 polypropylene suture. The lung was then inflated, the atrial clamp was removed, and the atrium was de-aired. Retrograde flow through the donor left pulmonary artery was controlled with a bulldog clamp. After this, the sequence was repeated on the right side with the right donor lung.

The recipient main pulmonary artery was then opened, and the neck of the aneurysm was isolated just distal to the pulmonic valve (Figure 3). The proximal donor ascending aorta was then anastomosed to the pulmonary outflow tract, with a running 4-0 polypropylene suture, with the donor descending aorta oriented toward the right side of the patient's chest. The intercostal arteries and bronchial arteries on the donor aorta were ligated. A common orifice

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Figure 1. Preoperative chest radiograph.

Figure 2. Preoperative chest CT scan.

was then made by connecting the orifices of the donor innominate and left carotid arteries, and the orifice of the donor left subclavian artery was sealed with a vascular stapler. After this, the pulmonary artery of the left donor lung was anastomosed to this common orifice with a running 5-0 polypropylene suture. The descending donor aorta was then placed within the aneurysm lumen, posterior

Figure 3. Completed bronchial and pulmonary vein anastomoses.

Figure 4. Completed right and left pulmonary artery to aortic homograft anastomoses.

to the recipient aorta and vena cava. The donor right pulmonary artery and descending aorta were trimmed to an appropriate length, and an end-to-end anastomosis was created with a running 5-0 polypropylene suture (Figure 4). The lungs were reinflated and perfused, and the patient was weaned from cardiopulmonary by-

Figure 5. Postoperative chest radiograph.

pass. Chest drains were then placed, the chest was closed, and the bronchial anastomoses were inspected with a bronchoscope. The patient was then transferred to the intensive care unit.

The pathology report on the recipient's lungs revealed patchy, nonspecific interstitial fibrosis, hypertensive vascular changes, and marked pulmonary artery dilatation with atherosclerosis and organizing thrombus. The patient did well and was extubated on postoperative day 2. A postoperative chest radiograph showed normal pulmonary hila (Figure 5), and a contrast chest CT scan obtained on postoperative day 13 revealed patent bilateral patent pulmonary arteries without evidence of stenosis (Figure 6). The patient was discharged on postoperative day 12. His course has been significant for mild acute (IA) rejection and recurrent fevers that resolved with the drainage of a right hemothorax.

Discussion

Treatment of pulmonary artery aneurysms has been recommended and includes angioplasty and plication, prosthetic graft reconstruction, autologous tissue reconstruction, and homograft reconstruction.⁴⁻⁶ These techniques are only suitable for patients who have adequate lung function. Patients with pulmonary artery aneurysms and end-stage lung disease, as in our patient, require repair of the aneurysm and transplantation of the diseased lungs. Lung transplantation for this disease has been reported for a patient with a giant pulmonary artery aneurysm and pulmonary hypertension. In this case, the donor pulmonary arteries were anastomosed directly to the recipient's main pulmonary artery.⁷ This was not an option in our patient, because the aneurysm extended to the proximal main pulmonary artery that, in turn, required resection. The donor

Figure 6. Postoperative chest CT 3-dimensional reconstruction.

pulmonary arteries lacked adequate length to reach to the recipient's main pulmonary artery orifice. Combined heart-lung transplantation was considered in our patient, and although this was technically feasible, we believed that it was impractical because of the lack of available heart-lung donors and the absence of a specific indication for replacing the recipient's normal heart. In addition, because the donor heart was not being harvested for transplant, the entire donor thoracic aorta was available as a conduit. We were thus able to avoid the use of any prosthetic graft material. The donor aorta conduit provided a good technical and functional result in our patient and should be considered as an option for patients with pulmonary artery aneurysms who require lung transplantation.

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