

Lung Transplant, Double Valve Repair, and Pulmonary Artery Aneurysm Resection

Hossein Shayan, MD, Basar Sareyyupoglu, MD, Norihisa Shigemura, MD, Jnanesh Thacker, MD, Christian Bermudez, MD, and Yoshiya Toyoda, MD, PhD

Heart, Lung and Esophageal Surgery Institute, Division of Cardiothoracic Surgery, University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania

Up to 66% of giant pulmonary artery aneurysms are associated with severe pulmonary hypertension. For these patients, lung or heart-lung en bloc transplantation is the only definitive therapy available. To date, there have been only two reports of concomitant double lung transplant and resection of a giant pulmonary artery aneurysm. We report a case of combined mitral and pulmonary valve repair, resection of a giant pulmonary artery aneurysm, and double lung transplant in a patient with primary pulmonary hypertension.

(Ann Thorac Surg 2012;93:e3–5)

© 2012 by The Society of Thoracic Surgeons

The true incidence of pulmonary artery (PA) aneurysms in the general population remains unclear. In 1947, Deterling and Claggett [1] reported eight cases of PA aneurysm in a series of more than 100,000 autopsies. In their review of literature, they found only six other cases of PA aneurysms before 1947. Up to 30% of these aneurysms resulted in fatality because of rupture or PA dissection, and the rest mostly presented with right-sided heart failure or pulmonary embolism [2].

A 25-year-old man with a history of pulmonary hypertension and a giant PA aneurysm (Fig 1) was referred to our center after being declined as a candidate for lung transplantation by his regional transplant center. His medical history was significant for diagnosis of primary pulmonary hypertension (PPH) at 9 years of age, bronchial asthma, recurrent pneumonias, and hemoptysis. Despite various medical therapies for PPH, including sildenafil, bosentan, and nifedipine, his cardiopulmonary status continued to decline. At the time of presentation, he was in New York Heart Association functional class III and requiring 7 L of oxygen at rest. Preoperative pulmonary function tests showed a forced expiratory volume in 1 second of 1.26 L (27% of predicted). Right-sided heart catheterization revealed PA pressure of 78/29 mm Hg, right atrial pressure of 14 mm Hg, and a normal cardiac index without evidence of any intracardiac shunt. Preoperative echocardiography demonstrated normal left ventricular function, moderate right ventricular dysfunction, moderate pulmonary valve insufficiency, and moderate mitral valve regurgitation. Computed tomography imaging of the chest showed a 12-cm main PA aneurysm extending into the right and left



Fig 1. Preoperative chest radiograph.

branches and causing extrinsic compressions of the right and left main stem bronchi (Fig 2). Given the severity of his symptoms, the patient was listed for double lung transplantation and reconstruction of the PA with a lung allocation score of 35.4.

Shortly after listing, a 16-year-old donor became available. Because of prolonged cardiac arrest, the donor heart was not procured, allowing for retrieval of the entire pulmonary trunk. Our recipient was taken to the operating room and placed in the supine position. Intraoperative transesophageal echocardiography revealed moderate pulmonary valve insufficiency, severe mitral regurgitation with a central jet, and normal valvular and subvalvular apparatus. We exposed the thoraces through the fourth intercostal space using bilateral anterior thoracotomies and transverse division of the sternum (clamshell). The PA aneurysm was seen extending from the origin of the main PA all the way into both pulmonary hila (Fig 3). Cardiopulmonary bypass was established using bicaval and ascending aortic cannulation. After bilateral pneumonectomies, an aortic cross clamp was applied, and the heart was arrested with cold custodial histidine-tryptophan-ketoglutarate cardioplegia solution. Examination of the mitral valve revealed the presence of normal anterior and posterior leaflets. The chordae tendineae and the subvalvular apparatus appeared unremarkable. The mitral valve annulus was grossly dilated and likely responsible for the regurgitation jet. Mitral valve annuloplasty was performed using a 34-mm Cosgrove-Edwards ring through a left atriotomy incision. After closure of the atriotomy and meticulous de-airing of the left ventricle, the cross clamp was removed and cardiac function resumed. The lung allograft bloc was positioned posterior to the heart, and a tracheal anastomosis was performed using a running 3-0 polypropylene suture. The right and the left pulmonary veins were then anastomosed to the right and left atrial cuffs, respectively, using a running 4-0 polypropylene suture. Finally, our attention turned to the PA aneurysm.

Careful examination of the pulmonary valve revealed dilatation of the annulus in the presence of normal leaflets. As a result, we performed a commissuroplasty using pledgeted 2-0 Ti-Cron suture at all three commis-

Accepted for publication July 21, 2011.

Address correspondence to Dr. Toyoda, UPMC-Presbyterian University Hospital, 200 Lothrop St, Ste C900, Pittsburgh, PA 15213; e-mail: toyoday@upmc.edu.

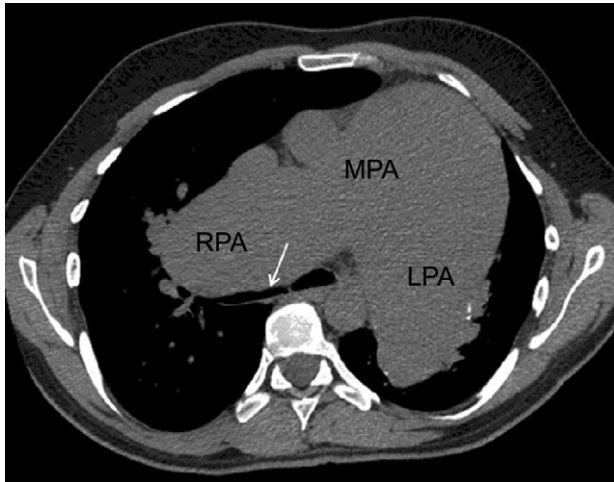


Fig 2. Preoperative chest computed tomography image. The arrow depicts extrinsic compression of the right main stem bronchus. (LPA = left pulmonary artery; MPA = main pulmonary artery; RPA = right pulmonary artery.)

tures. Using a 5-0 polypropylene suture, the main donor PA (measuring 3.3 cm) was then anastomosed to recipient proximal main PA, at the level of the sinotubular junction. At this level, the recipient main PA was 4.5 cm in diameter. The lungs were then reinflated and perfused, and the patient was weaned from cardiopulmonary bypass without difficulty. Total cardiopulmonary bypass time was 297 minutes, and the aortic cross clamp time was 40 minutes. The total allograft ischemic time was 365 minutes. The pathologic examination of the recipient's lungs revealed pulmonary vasculopathy with medial and intimal thickening of pulmonary arteries and atheromatous changes with calcifications in the main pulmonary trunk. The pulmonary artery grossly and histologically showed findings in keeping with chronic pulmonary hypertension. Verhoeff-Van Gieson staining

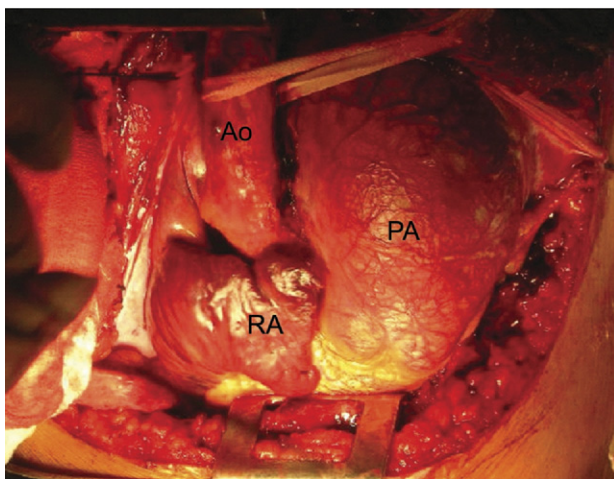


Fig 3. Operative view. (Ao = aorta; PA = pulmonary artery; RA = right atrium.)

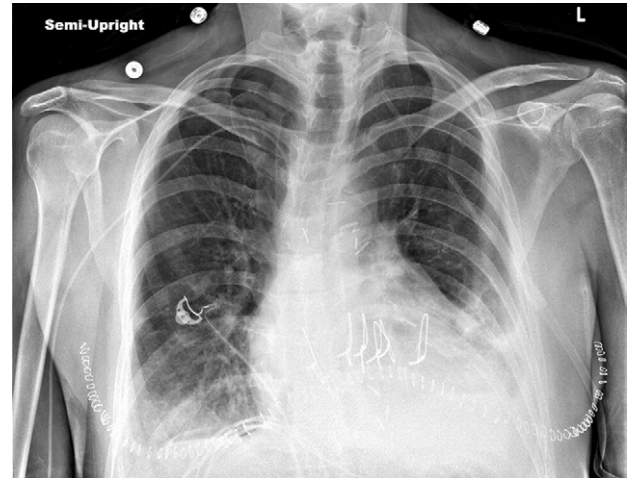


Fig 4. Postoperative chest radiograph.

for elastic fibers of the recipient PA did not reveal any evidence of vasculitis.

Because the donor lungs were slightly larger than the recipient's chest cavity, the thoracotomy incisions were initially left open. The patient returned to the operating room on postoperative day 4 for chest closure. His postoperative course was complicated by tracheostomy for prolonged intubation and prolonged intensive care unit stay (17 days). He was discharged home on postoperative day 36 in stable condition. After 3 months of follow-up, the patient continues to do well and his chest radiograph appears normal (Fig 4).

Comment

Surgical repair of pulmonary artery aneurysms by means of angioplasty, plication, or reconstruction of the main pulmonary artery with autologous or prosthetic tissue has been reported in the literature in the absence of pulmonary hypertension [3-5]. Up to 66% of giant PA aneurysms are associated with severe pulmonary hypertension [6]. For these patients, lung or heart-lung en bloc transplantation is the only definitive therapy available. To date, there have been only two reports of concomitant double lung transplantation and resection of a giant PA aneurysm [7, 8]. In both cases, the recipients were initially considered for en bloc heart-lung transplantation because of technical difficulties in handling an aneurysmal proximal main PA. Because of the lack of suitable heart-lung donors, the surgeons in both cases proceeded with isolated double lung transplantation instead. In our case, given the normal left ventricular function, we elected to list our recipient only for lung transplantation. Compared with the two previous case reports, we believe that our en bloc double lung approach is technically easier and is superior for reconstructing the entire PA. In the two previous case reports, the authors proceeded with sequential bronchial anastomosis and sequential arterial anastomosis. We elected to perform a tracheal

anastomosis instead of bibronchial anastomosis to avoid sewing to a chronically compressed and likely abnormal recipient bronchus. In addition, by performing a single tracheal and a single pulmonary trunk anastomosis, we believe that we reduced the complexity and the total ischemic time of the operation.

This case presented multiple technical challenges, including arresting the heart for mitral valve annuloplasty, anastomosing a normal-sized donor pulmonary trunk to a dilated but not aneurysmal recipient PA, and downsizing the pulmonary valve annulus by means of commissuroplasty. Precise time management and extensive communication between the implanting and procurement teams allowed for completion of mitral annuloplasty and recipient bilateral pneumonectomy shortly before the arrival of the donor lungs. As a result, despite the complexity of the operation and 120 minutes of donor-lung transit time, the total allograft ischemic time was only 6 hours. Therefore, we are able to report a successful case of combined mitral and pulmonary valve repair, resection of a giant pulmonary artery aneurysm, and double lung transplantation in a patient with PPH.

References

1. Deterling RA Jr, Clagett OT. Aneurysm of the pulmonary artery: review of the literature and report of a case. *Am Heart J* 1947;34:471-99.
2. Butto F, Lucas RV, Edwards JE. Pulmonary arterial aneurysm. *Chest* 1987;91:237-41.
3. Kenji K, Kiyofumi M, Kanshi K, Tomio A. Graft replacement for huge aneurysm of the main pulmonary artery. *Ann Thorac Surg* 2000;70:1714-6.
4. Kiron KS, Adnan CM. Idiopathic main pulmonary artery aneurysm. *Ann Thorac Surg* 2001;71:1688-90.
5. Matthias R, Reuthebuch OT, Wolf-Peter K, Erwin PB. Repair of an aneurysm of the pulmonary trunk in a 65-year-old patient. *Ann Thorac Surg* 1999;67:244-6.
6. Boyd LJ, McGravack TH. Aneurysm of the pulmonary artery: a review of the literature and report of two new cases. *Am Heart J* 1939;8:562-78.
7. Wekerle T, Klepetko W, Shahrokh T, Birsan T. Lung transplantation for primary pulmonary hypertension and giant pulmonary artery aneurysm. *Ann Thorac Surg* 1998; 65:825-7.
8. Force SD, Lau CL, Moazami N, Trulock EP, Patterson GA. Bilateral lung transplantation and pulmonary artery reconstruction in a patient with chronic obstructive pulmonary disease and a giant pulmonary artery aneurysm. *J Thorac Cardiovasc Surg* 2003;126:864-6.