Pulmonary artery twisting during lung transplantation

Andrew Lichliter, MD, Joseph Oros, MD, and Louba Laurie, MD

Department of Radiology, Baylor University Medical Center at Dallas, Dallas, Texas

ABSTRACT

To the radiologist, complications of lung transplant are believed to occur along a time continuum, which is key given the nonspecific clinical and imaging findings. Pulmonary artery twisting in the immediate and early postoperative period is a known complication of transplantation, but receives relatively little attention. Early recognition is paramount due to the high morbidity and mortality of such a complication. This case highlights some imaging manifestations of the pulmonary artery.

KEYWORDS Imaging; lung transplantation; pulmonary artery twisting

Classically, complications of lung transplantation occur along a time continuum. The time is key in the differential diagnosis, as complications have overlapping clinical and imaging features. A general differential for complications in the immediate postoperative period (<24 hours) includes reperfusion injury, pulmonary edema, hyperacute rejection, primary graft dysfunction, donor-recipient mismatch, and lobar torsion.^{1–3} Vascular anastomotic complications (stenosis) are complications of the intermediate period (>1 week to <2 months), with pulmonary artery (PA) emboli presenting from the first week to 2 to 4 months.^{1–3} Early identification of PA twisting is critical due to its significant morbidity and mortality. The greatest risk of PA infarct occurs in the immediate postoperative period, as there is no alternate pathway for bronchial circulation.⁴ PA twisting is considered secondary to excessive length of the donor or recipient PAs or hilar misalignment.^{4,5}

CASE REPORT

A 64-year-old male former smoker with advanced chronic obstructive pulmonary disease presented for bilateral lung transplant. Prior imaging revealed advanced centrilobular emphysema with bullous disease and a dilated main PA. The PA pressure was 35/16 mm Hg. Supplementary oxygen was required at rest.

Bilateral lung transplant was performed on cardiopulmonary bypass, with the left lung first. After the hilar structures were dissected, bronchial anastomosis was performed, followed by PA anastomosis. The PA anastomoses were executed in end-to-end fashion with a continuous suture technique. The lungs were reperfused after deairing maneuvers. Bronchoscopy revealed intact bronchial anastomoses. Upon completion of

the surgery, the patient was transferred to the intensive care unit on mechanical ventilator support.

An anteroposterior chest radiograph was acquired when the patient arrived in the intensive care unit (*Figure 1*). The support apparatus was appropriately positioned. Asymmetric lucency was identified throughout the right lung. The nonspecific findings could be due to edema or hemorrhage in the left lung, a right anterior pneumothorax or left layering pleural effusion in a supine patient, or right-sided oligemia, such as a Westermark sign. An indwelling Swan-Ganz catheter revealed a PA pressure of 54/24 mm Hg. Arterial blood gas demonstrated respiratory acidosis with a pH of 7.25. Inhaled nitric oxide was added to the treatment regimen with a goal of keeping systolic PA pressure <40 mm Hg and oxygen saturation >92% on the ventilator. Over the next 14 hours, the systolic PA pressure was weaned to 33 mm Hg, but this required increasing requirements of nitric oxide, up to 27 ppm. Although hemodynamically stable, the patient remained acidotic in this period, with arterial blood gas pH ranging from 7.25 to 7.36 despite multiple ventilator changes. Quantitative perfusion scintigraphy performed 16 hours posttransplant revealed little to no visualization of and only 6% of total perfusion to the right lung (*Figure 2*), suggestive of a PA complication. For confirmation and treatment planning, a computed tomography (CT) angiogram with PA embolism protocol was performed. This demonstrated twisting of the right main PA (*Figures 3 and 4*), and the patient was immediately taken to the operating room.

During reexploration, the right main PA was twisted. The donor PA was divided and untwisted, and then the anastomosis was revised with the patient on cardiopulmonary bypass. Immediately after revision, arterial blood gas revealed resolution of

Corresponding author: Andrew Lichliter, MD, Department of Radiology, Baylor University Medical Center at Dallas, 3500 Gaston Avenue, Dallas, TX 75246 (e-mail: Andrew.Lichliter@BSWHealth.org)

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Figure 1. Initial postoperative chest radiograph. The support apparatus is appropriately positioned. Note the asymmetric lucency over the right hemithorax versus increased density over the left hemithorax.

respiratory acidosis with a pH of 7.45. Repeat quantitative perfusion scintigraphy revealed visualization of the right lung and normalizing lung perfusion, 40% to the right and 60% to the left. The patient was successfully extubated 20 hours postresection and ultimately discharged home 17 days after the initial operation.

DISCUSSION

Intraoperative transesophageal echocardiography and assessment of PA pressure gradients increase the likelihood of identifying complications before leaving the operating room, but do not eliminate them. Transesophageal echocardiography is operator dependent and does not visualize the left main PA anastomosis well. The clinician must have a low threshold for advanced imaging in the posttransplant patient with hemodynamic instability, poor gas exchange, or persistent hypoxia, especially if accompanied by PA hypertension.

Chest radiography is helpful in identifying multiple immediate complications, but often lacks the specificity needed to

Figure 2. Initial lung perfusion scintigraphy. Only very faint radiotracer distribution to the right lung (left of image) is present, essentially resulting in nonvisualization compared to the normal-appearing left lung (right of image).

Figure 3. CT angiogram. Axial slice revealing only thread-like opacification of the right pulmonary artery (arrow), with increased vessel caliber proximal and distal.

guide intervention. Catheter-directed PA angiography is the gold standard in diagnosing vascular complications, but is now reserved for cases in which catheter-based intervention may be required. Ventilation and/or perfusion scintigraphy can be used for initial screening of primary graft dysfunction and is often used routinely in the posttransplant period at our institution, but has multiple drawbacks. Quantitative perfusion scintigraphy can suggest PA twisting, stenosis, or thrombosis with asymmetric perfusion, but is nondiagnostic. This is especially true in the setting of symmetric or near-symmetric ventilation. CT angiography with postprocessing techniques such as

Figure 4. Three-dimensional volume-rendered anterior projection CT angiogram image. Note the severe stenosis of the right pulmonary artery with a twisted appearance (arrow).

multiplanar reformats, volume rendering, and maximum intensity projections better define the extent and degree of stenosis.

Patient demographics that should also raise suspicion for PA twisting are female gender and the presence of fibrotic lung disease. Women typically have smaller thoracic cavities and vascular structures than men.^{4,5} PA twisting during lung transplantation is not a common complication, with an incidence <2%. As the volume of lung transplants continues to increase, this is a complication that will be diagnosed with increasing frequency.

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