Lung transplant patients benefit from 64-slice CT

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Lung transplantation is an accepted treatment option for patients with end-stage lung disease. The procedure can increase quality of life and prolong survival. Single-lung transplants are performed more frequently than bilateral procedures, which increases the number of transplant recipients, given the shortage of suitable donors. Complications occur frequently, however, significantly reducing the success of grafts and patients' survival time.

Access to state-of-the-art technology can give radiologists a key role in diagnosing early and delayed complications during post-transplant follow-up. The high temporal and spatial resolution possible with 64-slice CT provides practitioners with optimal information on lung parenchyma. Compared with previous generation CT scanners, these systems have a shorter acquisition time and deliver a lower radiation dose to patients. Three-D reconstruction and/or virtual navigation inside the bronchial tree can be performed easily. The use of intravenous contrast together with 3D reconstruction can provide additional information on pulmonary vessel disease.

CT studies following lung transplantation have been performed with a high-resolution protocol, during inspiration and expiration, using a high radiation dose (140 kV; 240 to 340 mA), and without contrast. The advent of multislice CT systems, in particular 64-slice CT, has improved spatial resolution while lowering acquisition time and radiation dose, thanks to the increased number of detector elements. Acquired data can be reconstructed by changing the slice thickness and/or the kernel filter. Data on vasculature, acquired from contrast-enhanced CT, can be integrated into the complete study.

Multislice CT scans are performed routinely within six months of a lung transplant at our institution and also in the case of suspected complications, using a 64-slice system (LightSpeed VCT, GE Healthcare). Multiplanar reconstruction (MPR), maximum intensity projection (MIP), volume rendering, and virtual bronchoscopy are used to evaluate dehiscence, stenosis, endobronchial stents, distal airway patency, and vascular anatomy. Inspiration and expiration axial MSCT thin-section images are compared to evaluate lung parenchyma and air trapping.

POTENTIAL PROBLEMS

Many different complications can arise following a lung transplant procedure (see table). Infections are the most important cause of post-transplant mortality. Organ recipients are susceptible to infection as a result of long-term immunosuppression, impaired mucociliary clearance, altered phagocytosis of alveolar macrophages, poor lymphatic drainage, blunted coughing due to postoperative pain and lung denervation, and the passive transfer of organisms with the donor lung. Infection is usually diagnosed from bronchoalveolar lavage, serological tests, imaging, and lung biopsy. MSCT-based diagnosis of respiratory infection is not related to etiology and consists of a combination of radiological signs. The most common such findings are areas of consolidation, ground-glass opacification, well-circumscribed nodules, septal thickening, peribronchial thickening, mucoid filling of bronchiolar lumen, air bronchograms, "tree-in-bud" opacities, and pleural effusion (Figure 1). No contrast media is required. We have found lung transplant recipients with existing cystic fibrosis to have a greater risk of lower respiratory tract infection. Bronchiolitis obliterans syndrome is a chronic airway rejection affecting terminal and respiratory bronchioles with inflammatory infiltrate. This leads to fibrosis and luminal obliteration. The patchy distribution of disease means that transbronchial lung biopsy is of limited value in detection (sensitivity: 15% to 20%). The overall prognosis is poor, with a mortality rate of 40% within two years.
after diagnosis. CT plays an important role in the detection of the condition in lung transplant recipients. Thin-section CT images at inspiration and expiration are often used to diagnose obstructive small-airway disease and obtain information on regional obstruction. Expiratory air trapping, which is the paradigm of small-airway disease, is reportedly a strong predictor of airflow obstruction in adults. CT findings of bronchiolitis obliterans syndrome include air trapping on expiratory images, mosaic pattern of lung attenuation, peripheral bronchiectasis, peribroncholar thickening, tree-in-bud opacities, and parenchymal consolidation (Figure 2). Bronchial stenosis, airway complications, stenosis (Figure 3), and dehiscence (Figure 4) have been attributed to ischemia of the donor bronchus and to failure of surgical technique. Bronchial arterial circulation is compromised after lung transplantation. Rearterialization can occur one or two weeks after graft implantation. This will depend on retrograde filling of bronchial vessels from the pulmonary circulation through communication with pulmonary capillaries and other precapillary anastomoses.

Bronchial stenosis can be single or multiple, and it usually occurs in the first months after transplantation. Patients can be treated with conservative therapy or with a combined approach, including laser therapy, balloon dilatation, and/or stent placement. Recurrent stenoses are possible. Three-D volumetric reconstructions may be used to visualize the proximal and distal bronchial tree. Vascular pathology, such as stenosis and embolism, is a less common complication. Contrast-enhanced MSCT and MPR can detect possible anastomotic arterial or venous stenosis (Figure 5) and embolism.

A comparison of inspiration and expiration coronal MSCT MPR images can show reduced movement to the diaphragm caused by phrenic nerve injury (Figure 6). Dysfunction resulting from transection of the phrenic nerve will be permanent. Recovery of function is possible, however, when the root cause of diaphragm paralysis is a stretch injury.

In conclusion, 64-slice MSCT is a valuable tool for the detection of numerous complications that may occur after lung transplant and for generating a differential diagnosis. Virtual bronchoscopy can diagnose anastomotic and nonanastomotic stenosis accurately and evaluate the patency of endobronchial stents and distal airways. Thin-section MSCT with forced inspiration/expiration acquisition is useful for the diagnosis of bronchiolitis obliterans syndrome. The radiological findings of respiratory infections on MSCT are often nonspecific. The modality can, however, identify the best sites for transbronchial biopsy and bronchoalveolar lavage. Two-D and 3D postcontrast reconstructions can delineate pulmonary vascular anatomy and detect stenosis or embolism. Images can be reformatted quickly in different planes to enhance the display of critical areas.

MSCT shows subtle changes in lung transplant patients that may not be apparent on conventional radiographs or respiratory tests. This allows early diagnosis and intervention, and improves the success of the graft and patient outcomes. DR. CARUSO and DR. MIRAGLIA are radiologists at the Istituto Mediterraneo Trapianti e Terapie ad Alta Specializzazione (IsMeTT), University of Pittsburgh Medical Center, in Palermo, Italy. Assisting in the preparation of this manuscript was Prof. Angelo Luca from the IsMeTT.

References

7. O'Donovan PB. Imaging of complications of lung transplantation. Radiographics
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COMPPLICATIONS FOLLOWING LUNG TRANSPLANT

Complications: Patients affected
Respiratory infections: 15 (65%)
Bronchiolitis obliterans syndrome: 7 (30%)
Stenosis of bronchial anastomosis: 7 (30%)
Paralysis of diaphragm: 6 (26%)
Stenosis of vascular anastomosis: 4 (17%)
Dehiscence of bronchial anastomosis: 2 (8%)
Atelectasia: 2 (8%)
Alveolar hemorrhage: 1 (4%)
Thoracic hematoma: 1 (4%)

Disclosures:

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