the pulmonary parenchyma and cannot be used if there is any aerated lung between the US probe and the abnormality of interest.

Endobronchial US, in which the US probe is passed through a bronchoscope, is a valuable adjunct to bronchoscopy, allowing identification and localization of pathology adjacent to airway walls or within the mediastinum.

NUCLEAR MEDICINE TECHNIQUES

Nuclear imaging depends on the selective uptake of various compounds by organs of the body. In thoracic imaging, these compounds are concentrated by one of three mechanisms: blood pool or compartmentalization (e.g., within the heart), physiologic incorporation (e.g., bone or thyroid) and capillary blockage (e.g., lung scan). Radioactive isotopes can be administered by either the IV or inhaled routes or both. When injected intravenously, albumin macroaggregates labeled with technetium-99m (^{99m}Tc) become lodged in pulmonary capillaries; the distribution of the trapped radioisotope follows the distribution of blood flow. When inhaled, radiolabeled xenon gas can be used to demonstrate the distribution of ventilation. Using these techniques, ventilation-perfusion lung scanning was a commonly used technique for the evaluation of pulmonary embolism. Pulmonary thromboembolism produces one or more regions of ventilation-perfusion mismatch (i.e., regions in which there is a defect in perfusion that follows the distribution of a vessel and that is not accompanied by a corresponding defect in ventilation [Chap. 300]). However, with advances in computed tomography (CT) scanning, scintigraphic imaging has been largely replaced by CT angiography in patients with suspected pulmonary embolism.

Another common use of ventilation-perfusion scans is in patients with impaired lung function, who are being considered for lung resection. Many patients with bronchogenic carcinoma have coexisting chronic obstructive pulmonary disease (COPD), and the question arises as to whether or not a patient can tolerate lung resection. The distribution of the isotope(s) can be used to assess the regional distribution of blood flow and ventilation, allowing the physician to estimate the level of postoperative lung function.

COMPUTED TOMOGRAPHY

CT offers several advantages over routine chest radiography (Figs. 307-1*A*, *B* and 307-2*A*, *B*; see also Figs. 315-3, 315-4, and 322-4). First, the use of cross-sectional images allows distinction between densities that would be superimposed on plain radiographs. Second, CT is far better than routine radiographic studies at characterizing tissue density and providing accurate size assessment of lesions.

CT is particularly valuable in assessing hilar and mediastinal disease (often poorly characterized by plain radiography), in identifying and characterizing disease adjacent to the chest wall or spine (including pleural disease), and in identifying areas of fat density or calcification in pulmonary nodules (Fig. 307-2). Its utility in the assessment of mediastinal disease has made CT an important tool in the staging of lung cancer (Chap. 107). With the additional use of contrast material, CT also makes it possible to distinguish vascular from nonvascular structures, which is particularly important in distinguishing lymph nodes and masses from vascular structures primarily in the mediastinum, and vascular disorders such as pulmonary embolism.

In high-resolution CT (HRCT), the thickness of individual cross-sectional images is ~1–2 mm, rather than the usual 7–10 mm in conventional CT. The visible detail on HRCT scans allows better recognition of subtle parenchymal and airway disease, thickened interlobular septa, ground-glass opacification, small nodules, and the abnormally thickened or dilated airways seen in bronchiectasis. Using HRCT, characteristic patterns are recognized for many interstitial lung diseases such as lymphangitic carcinoma, idiopathic pulmonary fibrosis, sarcoidosis, and eosinophilic granuloma. However, there is debate about the settings in which the presence of a characteristic pattern on HRCT eliminates the need for obtaining lung tissue to make a diagnosis.

Helical CT and Multidetector CT Helical scanning is currently the standard method for thoracic CT. Helical CT technology results in faster scans with improved contrast enhancement and thinner collimation. Images are obtained during a single breath-holding maneuver that allows less motion artifact and collection of continuous data over a larger volume of lung than is possible with conventional CT. Data from the imaging procedure can be reconstructed in coronal or sagittal planes (Fig. 307-3*A*), as well as the traditional cross-sectional (axial) view.

Further refinements in detector technology have allowed production of scanners with additional detectors along the scanning axis (z-axis). These *multidetector CT* (MDCT) scanners can obtain multiple slices in a single rotation that are thinner and can be acquired in a shorter period of time. This results in enhanced resolution and

A

B

FIGURE 307-1 Chest x-ray (*A*) and computed tomography (CT) scan (*B*) from a patient with emphysema. The extent and distribution of emphysema are not well appreciated on plain film but clearly evident on the CT scan obtained.