adequacy of sampling are superior to other techniques is less certain. Early data on diagnostic yields are encouraging, but multicenter prospective data are not yet available.

MEDICAL IMAGING

Imaging has revolutionized the practice of medicine. Technologies such as x-ray, CT, MRI, and positron emission tomography (PET) can provide noninvasive assessments of alveolar perfusion, the metabolic activity of a lung nodule, the bronchovascular source of hemoptysis, or the earliest disease-related changes in parenchymal structure. Given the breadth of advances in respiratory system imaging and increasingly specialized applications across diseases, the following section is organized by technology. The final part of this section is dedicated to deep learning and the role it is increasingly playing in medical image interpretation.

■ CHEST X-RAY

The field of medical imaging can be traced back to work done by Wilhelm Roentgen in the 1890s. Roentgen noted that after connecting a cathode ray tube to a power supply, material in his lab would fluoresce even if the emission of visible light from the tube was blocked. He quickly deduced the presence of additional invisible “x-rays” and subsequently observed that their passage through solid material was attenuated in proportion to the material’s density. Within weeks of its discovery, x-ray technology was being widely leveraged to guide surgical exploration and the extraction of foreign objects such as shrapnel from the battlefield. Chest x-ray (CXR) has since become the foundation of clinical practice for respiratory medicine and is a widely available technology even in resource-limited settings.

The most commonly used CXR images for respiratory medicine are the posteroanterior (PA) and lateral films in the outpatient setting and anteroposterior (AP) films for those studies obtained at the bedside. These are 2-dimensional representations of 3-dimensional structures and the differing views can be used to examine superimposed structures (for example, a parenchymal opacity in the