Dual Energy Chest Radiography

Visual detection of pulmonary abnormalities on screen-film radiographs is notoriously unreliable. Digital radiography can improve diagnostic accuracy due to its greater latitude, improved local contrast and more consistent image quality compared to screen-film systems. In addition to facilitating detection by traditional visual inspection of the image, digital imaging enables advanced techniques such as dual energy subtraction and temporal subtraction, which can improve diagnostic accuracy further, especially for subtle lesions such as early lung cancer.

Dual energy subtraction radiography exploits the energy dependence of x-ray attenuation by different tissues. By subtracting the ribs and other bones from the image and displaying them separately, energy subtraction (ES) radiography can improve diagnostic accuracy. Two fundamentally different methods have been used. One involves the use of sequential x-ray exposures in rapid succession, at different kVp settings. This approach has the advantage of more optimal separation of high and low energy components. However, the inevitable time delay between the first and second exposure can introduce misregistration artifacts in clinical practice. The second approach involves the use of a single exposure, which is recorded by two receptors separated by a filter.

In the case of a CR ES chest unit, a single exposure is made, using standard technique. Instead of a single storage phosphor plate, two plates are used, with a copper filter sandwiched between them. In all, three PA images are produced: the standard image, the soft tissue image, and the bone image. Recently, a new energy subtraction chest unit has been developed that uses a CsI/Amorphous silicon flat panel detector. This unit employs two exposures at different energy levels, with a 200msec interval. Although some motion artifacts are present around vascular structures, pixel shifting and noise reduction software effectively minimizes them.

Temporal Subtraction Chest Radiography

Digital radiography allows various types of image enhancement to be performed, but techniques that improve the visibility of abnormal findings also tend to emphasize certain features of normal anatomy. In the case of patients who have had a previous chest radiograph, an opportunity exists to enhance selectively areas of interval change, including regions with new or altered pathology, by using the previous radiographs as a subtraction mask. The temporal subtraction technique involves automated two-dimensional warping and registration of a previous with a current chest radiograph in order to produce a “difference image” in which unchanged areas appear as uniform grey while new opacities appear as isolated dark foci that stand out from the uniform background. One of the unique advantages of temporal subtraction is that it can highlight areas of subtle change that may not appear obviously abnormal when viewed in isolation. Its ability to improve detection of a broad range of abnormalities, including nodules, infiltrative opacities, and even local pulmonary perfusion deficit alterations, are important advantages.