COMBINED USE OF MAMMOGRAPHY AND ULTRASOUND VISUALIZATION USING A LABORATORY-MODIFIED COMMERCIAL BREAST SCANNER TO IMPROVE DIFFERENTIAL DIAGNOSIS*

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Introduction

A clinical breast cancer detection program is underway with emphasis on the use of mammography and ultrasound visualization as complementary methods. In that regard, x-ray images and acoustic images of the breast are compared on all breast patients examined to determine (1) whether ultrasound imaging improved the differential diagnosis of lesions observed in film mammograms, and (2) whether information shown in film mammograms was significant to the interpretation of acoustic images.

Instrumentation and Procedure

The basic ultrasound unit applied in this program is a commercial instrument, specifically designed for breast examination with the patient in a supine position. This instrument is a linear scan, 1-mode visualization system which includes automatic transverse, longitudinal, or oblique scanning at 5 mm intervals, time gain compensation, water bag coupling, a 5 MHz, 1 cm diameter focused transducer, and, in addition to standard recording of images such as Polaroid, automatic recording of images on 35 mm film from a CRI display. As designed, the linear travel of the transducer covers a tissue viewing distance of 12 cm, and nine such sweeps are automatically taken with a 5 mm distance spacing between each interval. The time required to complete this nine-scan series is 30 seconds. After use on a number of patients in its original form, the automatic motion system was modified to provide a choice of 1 mm or 5 mm spacing intervals. The motion system can be stopped at any of the nine intervals scan series for the purpose of examining a region of interest in 1 mm steps. In order to carry out a detailed study of the characteristics of ovarian masses, a 0-60 dB rotary type attenuator with 1 dB step intervals was incorporated into the basic unit. Additionally, a scan converter, large television image display, and a system for recording the echograms on 8x10 x-ray film was added to the system. Provision was also made for insertion of transducers of other designs than that provided with the basic unit.

Discussion and Results

In a significant number of patients, masses that were indeterminate in appearance on mammograms, even after thorough examination with magnification techniques, proved to be cystic, as clearly shown by ultrasound visualization. With the use of the modified scanner, it was possible to visualize the walls of the cysts at intervals as small as 1 mm. This is particularly valuable in the case of small cysts. It was found that many more cystic lesions can be appreciated with acoustic imaging than with radiographic imaging on patients with fibrocystic disease. It is concluded, therefore, that ultrasound imaging should be the initial examination performed, particularly in the case of the young patient with symptoms of fibrocystic disease of the breast.

The non-classical acoustic image pattern recognition signs used by many investigators for differentiating between the most common type of malignant breast mass (serous carcinoma) and that of a benign mass (i.e., primarily acoustic shadowing and jagged wall structure, in the case of a malignancy and smooth wall contours with internal echoes in the case of a benign solid tumor), were found to be the general case, but exceptions were found, particularly in regard to attenuating characteristics of benign tumors. These image patterns should be used with an awareness that non-malignant tissues within the breast can also cause acoustic shadowing, particularly at frequencies of 5 MHz. Work is in progress on studying the characteristics of solid tumors using transducers of different frequencies, scanning at close (1 mm) intervals, and attempting to quantitate attenuation values.

Conclusion

The opportunity to compare x-ray breast images and acoustic breast images, with both images recorded on x-ray film, is a significant one. With the exception of cysts, it was found that this combined approach is more effective in differential diagnosis of palpable breast masses than either technique used exclusively. In view of present limitations of both x-ray and acoustic imaging, particularly in regard to absolute differentiation of solid masses less than 0.5 cm in diameter, it is recommended that patients with a palpable mass or having other signs of a possible malignancy be examined by both techniques. An exception to this recommendation is the case of a patient with a clearly defined cyst, as imaged with the ultrasound visualization system. The mammogram examination (particularly in the case of a young subject) may be omitted in such cases.

*References to the significant work of many authors cannot be included here because of lack of space.

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