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RECOMMENDATIONS FOR WIDESPREAD APPLICATION OF ULTRASOUND VISUALIZATION TECHNIQUES FOR EXAMINATION OF THE FEMALE BREAST

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Breast cancer is not confined to the breast proper but, over the lifetime of most patients is a systemic pathology.[1,2] As such, it should be identified prior to the formation of an overt mass in the breast. Although previous and more recent studies of the author and associates indicate that ultrasound techniques may be capable of accomplishing this task, successful attainment of such a goal requires sustained basic research, followed by intensive clinical testing of the techniques suggested by this research. However, since the statistical data of many investigators[3,4] indicates that the length of time a patient survives following breast cancer surgery is related to the size of the malignant tumor at the time of surgery and to the occurrence or non-occurrence of metasteses, there is strong justification for clinically applying ultrasound at its present level of development, to determine if this technique can improve on the present poor success in detecting breast cancer. Statistics indicate that, in the United States, at the time of the initial discovery of a malignant breast mass, metastesis has already occurred in over fifty percent of the patients and only 38 percent of those with one to three positive nodes at the time of surgery survive ten years.[2,5]

In comparison to the level of understanding associated with the use of ultrasound for examining regions of the body other than the breast, there apparently is a lack of widespread knowledge in regard

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to the advantages of using this method, to the full extent of its capability, as an adjunct technique for breast examination. As indicated by the work of many investigators, presently available ultrasound methods can provide the physician with information which is significant to successful differential diagnosis of a breast mass.[6] Further, for the patient with a known history of benign breast pathologies ultrasound has the advantage of being a non-injurious modality which can be applied at multiple intervals to insure the continuing benign state of the pathology. Although there are limitations and inadequacies in the ultrasound visualization techniques, as they are currently applied to breast examination, these inadequacies are not innate, but simply the consequence of insufficient research and clinical investigations.

The results obtained in this study demonstrate that useful clinical data on detection of breast pathologies can be obtained while using wide aperture, focused transducers and a modified water bag coupling technique previously described.[7] Malignant tumors and various types of benign breast pathologies were detected and specific tissue structures such as glandular tissue, subcutaneous fat lobules, connective tissue and muscle were clearly identified. The results of the ultrasound scanning were usually in agreement with the data obtained by xeromammography; in some cases, the ultrasound data was more definitive, particularly in cases of multiple cysts and multiple fibroadenomas.

It was also demonstrated that in the case of patients who have symptoms of a possible breast pathology, but the suspected pathology cannot be located either by x-ray methods or manual palpation, ultrasound examination can determine if an overt abnormal mass exists. Unfortunately, the time required to examine this type of patient, using presently available ultrasound instrumentation, is excessive in terms of a clinical environment.

Ultrasound visualization of whole, excised breasts, almost immediately following their surgical removal, was also used as an investigative technique. A significant advantage of this approach is that it allows detailed studies which might not be feasible with a patient. For example, the effectiveness of new designs of individual components of ultrasound instrumentation, such as transducers or electronic units, can be precisely evaluated and compared to previous units, without restrictions on scanning time. One of the excised breasts scanned contained an infiltrating duct cell carcinoma with mixed comedo, medullary and mucinous patterns. Attenuation of the ultrasound in the region of this mixed type tumor was demonstrated. This finding is of interest in regard to the relation between attenuation of ultrasound by certain malignant breast tumors and the histological structure of the tumor.

The modified water bag/wide diameter transducer technique is adequate for ultrasound scans confined to the region of a palpable tumor, but it is not suitable for detailed studies of the tissue structures beneath the nipple, for the purpose of detecting malignancy prior to the overt mass stage. Any pressure on the nipple affects the geometry of structures below it and thus causes artifacts which may lead to errors in interpretation of echo data. If, however, the breasts are freely floating in a water medium, the internal structures assume their natural contour and orientation. Further, if the method of floating the breast can be accomplished with a minimum preparation time and with the patient in a supine position, additional advantages accrue. The crux of this problem is to make a seal around the outside of the breast without irritating or injuring the skin, and to do this quickly and easily. The fact that breasts vary tremendously in size and contour adds to the complexity of the task. An apparently successful technique, which should have application to many different types of medical ultrasound instrumentation, was devised and tested.

Although wide diameter, focused transducers have advantages as acoustic devices, their physical dimensions are a disadvantage from the viewpoint of designing a relatively simple clinical instrument. Results will be shown on the use of small diameter, high frequency focused transducers for examination of the breast.** Included will be preliminary studies on the ductal structures of the breast with such high frequency units.***

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