Automated Whole Breast Ultrasound

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KEYWORDS

• Breast ultrasound screening • Dense breast tissue • Occult breast cancer
• Automated breast ultrasound • Coronal view

KEY POINTS

- Automated breast ultrasound is a developing technology that has recently been approved by the US Food and Drug Administration for use in screening for breast cancer as an adjunct to mammography.
- Given the current national trend toward adopting legislation requiring the reporting of breast density to women having mammography, and the requirement in some of this legislation requiring physicians to provide adjunctive screening such as ultrasound, the need for an efficient, reproducible method to provide such screening is developing.
- Automated breast ultrasound has become a viable option for providing widespread ultrasound screening to fulfill this newly developing demand for adjunctive breast cancer screening.

HISTORY

The use of bilateral whole breast ultrasound for women with dense breast tissue as an adjunct to screening mammography has been a topic of discussion and debate for many years. Several single-institution studies that validated ultrasound's use as an effective screening tool in the subset of women with dense tissue were published in the mid 1990s and early 2000s.[1–4] With these studies as a catalyst, a large multi-institutional trial was published in *The Journal of the American Medical Association* in 2008,[5] confirming the results of the earlier smaller studies. These published studies all showed a 0.3% to 0.5% cancer detection rate. However, in addition to the ability to detect occult breast cancer at an early stage in women with dense breast tissue, these studies shared several issues that have limited ultrasound's widespread implementation as a screening test. The 2 most important of these limitations are the number of false positives generated by ultrasound screening and the difficulty associated with offering and performing the examination because of a lack of adequate personnel, equipment, and time needed to perform and interpret the examination.

Most studies evaluating breast ultrasound for screening that have been published to date were designed using traditional hand-held scanning, with a radiologist having performed the actual scanning.[1,3–5] To date, only 2 studies have been published in which ultrasound scanning was performed by an ultrasound technologist.[2,6] These 2 technologist-performed studies demonstrated equivalent cancer detection results when compared with studies using physician-performed scanning. Despite these results, performance of the examination has remained one of the obstacles for implementing an ultrasound screening program outside of a study protocol. On average, a hand-held bilateral screening ultrasound examination takes 15 minutes to complete,[2]

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though 1 study demonstrated the examination could be completed in 5 minutes.[1] In most patient populations, at least 40% of patients will have dense breast tissue, and therefore would be candidates for screening ultrasound. Radiologists working in medium- to high-volume centers do not have the time necessary to spend scanning the number of patients recommended for the examination. Although training ultrasound technologists to perform the examination is a viable option, most radiologists have been reluctant to introduce this concept into their normal daily practice.

The necessity for radiologists to offer screening breast ultrasound has become more of an issue in recent years. The diligence of advocacy groups has increased public awareness with regard to the concept that dense breast tissue limits mammography's ability to detect breast cancer. The nonprofit organization Are You Dense is the most active of these groups. This organization has been instrumental in helping to pass legislation in several states that requires a patient to be informed of her breast density as part of the mammography report sent to both the physician and the patient. In addition, breast density has been established as an independent risk factor for breast cancer. As the number of states adopting these laws continues to increase, the demand for supplemental ultrasound screening will grow. In addition, attempts are being made to pass a federal law requiring breast density reporting to all patients throughout the United States. If this legislation is passed, widespread offering of supplemental screening ultrasound will become necessary.

A recent technological advance may provide the impetus (or the solution if mandated by law) for the widespread implementation of ultrasound as an adjunct to mammography for breast cancer screening. Automated breast ultrasound (ABUS) is a technology in which ultrasound scanning is performed mechanically, eliminating the effect of operator dependence on image quality and reproducibility.

EQUIPMENT/SYSTEMS

Currently, there are several types of automated breast ultrasound systems available. Thus far, only 1 system has been granted US Food and Drug Administration (FDA) approval specifically for use in breast cancer screening in the United States.

One system uses a standard ultrasound transducer mounted onto an articulating arm (**Fig. 1**). Scanning is then accomplished by mechanically moving the articulating arm over the breast, in a way similar to the way in which hand-held ultrasound is performed. Imaging data are acquired continuously throughout the scanning process, and stored on a computer hard drive for review and interpretation on a workstation by a radiologist at his or her convenience. This technique does not allow for 3-dimensional manipulation or reconstruction of the raw data. The imaging is reviewed in real time, in the same fashion as any standard ultrasound examination would be reviewed, either at the time the examination is performed, or later if the examination were recorded and stored. Several studies have been published in which this type of automated system was utilized, with results similar to those studies using hand-held ultrasound for screening.[7,8]

Another type of automated scanner currently available has been FDA approved for screening and operates in a different fashion from handheld ultrasound. These units acquire raw data via a larger transducer similar in size and shape to a standard mammography compression paddle (**Fig. 2**). The transducer paddle is placed over the breast, with a small amount of compression

Fig. 1. FDA-approved ABUS using an articulating arm for scanning. This system works in conjunction with a standard ultrasound transducer and unit. (*Courtesy of* SonCiné, Reno, NV; with permission.)