E19. Ultrasound in breast cancer: current status and future trends

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Ultrasound imaging has become widely accepted as a very reliable imaging modality for the examination of the breast, and its use is increasing with our improved knowledge and with the availability of better equipment. Sonography of the breast has been shown to be an important adjunct to mammography in the clinical assessment of both palpable and impalpable breast abnormalities and for guided interventions, i.e. percutaneous biopsies.

The International Breast Ultrasound School (IBUS) was formed in December 1991 by a dedicated international group of breast ultrasound experts to provide high-quality multidisciplinary teaching seminars in breast ultrasound, and to improve the quality of ultrasonic examinations for assessing the breast and its pathology. IBUS has been successful in many countries and has provided almost 50 courses since the first programme was held in Rhodes in 1992. Over the years, courses have been held in Europe, North and South America, Asia and Africa, and more than 6000 clinicians have participated in lectures, demonstration sessions and "hands-on" interactive workshops. IBUS is continuing with its educational commitments, and is planning to conduct four to six seminars each year in different countries. Moreover, IBUS is a non-profit society organisation with considerable experience in education and the knowledge to teach this special subject.

In addition to teaching breast ultrasound, IBUS has published in the *European Journal of Ultrasound* in 1999 a set of guidelines in order to improve the standards of ultrasonic breast examinations [1]. Topics covered in the guidelines include the requirements of the ultrasonic imaging system; the examination technique to ensure high quality images; a description of the features to be found with lesions and the adjacent tissues; the information to be contained in the ultrasonic report; and particulars about interventional procedures. Recommendations for the number of examinations which should be undertaken to achieve accuracy and confidence with the examination technique are also included. The guidelines have been adopted by a number of national breast ultrasound societies, and are included on the IBUS web page located at http://www.ibus.org.

The Special Workshop of IBUS

The educational sessions will start with an overview of breast ultrasound technology and its applications. Conventional ultrasound today with panaromic and real-time compounding is still the common technique in use. However, 3-dimensional (3D) technology, has made progress recently and is recommended by different authors because of its advantages.

Elastography is an interesting extension of ultrasound examination, showing tissue structures of different hardness, but is still under investigation and not in current clinical use.

Compound technology on the basis of different scan angles and frequencies permits better documentation as artefacts and speckles can be eliminated or reduced. The Doppler technique, with and without contrast medium, has enabled advances to be made. It will be used more and more on a routine basis. Advanced dynamic flow using a broad-range Doppler technique allows for better axial resolution, which is important for precise vascular imaging, even of very small vessels with a low flow. Another potential helping vascular recognition is pulse subtraction technology with its low contrast imaging. Blood flow and perfusion of parenchymal tissues are discernible. The method combines harmonic filtering and pulse subtraction technology. Linear, and not non-linear, signals of contrast bubbles are compared with each other and simple harmonic signals only are registered.

Ultrasound and the diagnosis of breast cancer

Classification of lesions

The differentiation between solid and cystic lesions is based on the presence or absence of an internal echostructure. Additionally benign focal alterations show a sharp border and there is an enhancement effect behind the lesion in the depth of breast tissues. Simple, rounded shape and a tissue architecture without any interruption or discontinuity are further indicators of a benign lesion (Table 1).

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Table 1. Benign and malignant breast lesions in the sonogram

	Benign	Malignant
Border	sharp	faint, irregular
Internal echo structure	homogenous	chaotic
Attenuation	no	yes
Enhancement	yes	no or sometimes
Architectural distorsion	no	yes

There are different points of identification for a malignant tumour. Breast carcinomas contain collagen fibres in their centre of degeneration. Due to their high absorption of ultrasound waves there is an attenuation effect behind the lesion in the depth, which is easily discernable, especially in ductal carcinomas. The borders of such tumours are irregular, often showing a certain "halo"-effect, which demonstrates infiltration of normal tissues by the tumour. The internal echo structure appears heterogeneous and a loss of echo information in their centre is typical.

If one performs the dynamic compression test, benign lesions are soft and can be deformed easily, while cancers are hart and less compressible. Another possible differentiation is width/depth coefficient, which is valuable for tumours larger than 1 cm in size in particular. Carcinomas, on average show a ratio of up to 1, while benign fibroadenomas have higher values.

Due to better resolution in the method used today, the ductal systems can also be evaluated by ultrasound. This may be of importance and cases of abnormal secretion and makes it possible to find an intraductal tumour, i.e. mainla papillomas, although on occasion even an invasive cancer can be identified. Another advantage of sonography is the more exact measurement of the tumour size in comparison to mammography. Last, but not least, ultrasound permits precise information on the vascularity of breast tissues.

The vascularity of tissues is important to determine as, to a certain extent, it permits the differentiation of benign and malignant structures. Thus, sonography can provide both anatomical information and a dynamic evaluation recording the spectral Doppler of blood flow velocity with time, direction of flow and capillary perfusion by colour, especially when one uses an adequate ultrasound contrast media. Larger vessels document laminar or turbulent type of flow and permit the assessment and calculation of blood flow volumes. Although the Doppler signal is not really decisive for diagnosis, it can be of help in difficult cases. Chaotic flow is "typical" for carcinomas and was found in 78% of breast tumours [2]. Moreover, a larger number of different vessels is indicative of cancer. The evaluation of pulsed Doppler in very small arteries is still too time-consuming today and therefore not an acceptable technique. New technology (pulse subtraction) might be of use in the future.

Different authors evaluated the potential of ultrasound for examinations of the breast. It has been demonstrated that ultrasound is able to accurately find the breast cancer [3]. 52 from 53 cancers were visible using ultrasound and demonstrated local tissue abnormalities, i.e. architectural distorsion, attenuation or irregular ultrasound absorption.

Fine-needle biopsies resulted in a sensitivity of 92%, a specificity of 83% and an overall accuracy of 88%. No false-positive and only few false-negative malignancies were described.

The addition of magnetic resonance (MR) imaging in mammographically and sonographically equivocal cases of benign or potentially malignant alterations resulted in even better data, with a sensitivity of up to 100% being observed.

Conclusions

Mammography today is still the "gold standard" when searching for breast cancer. However, its sensitivity rate depends on several factors, including the experience of the interpreting radiologist, tumour structure and tumour size. Ultrasound helps to evaluate palpable lumps, and also impalpable mammographical densities. It increases the overall accuracy rates dramatically.

However, in many cases, the definite diagnosis remains uncertain and a cyto- or histological evaluation is required. Using sonographical guidance, it is now possible to perform biopsies under continuous visual control of a suspicious focal lesion with a high degree of accuracy. Therefore, ultrasound has become an essential supplementary method of the accurate examination of the breast.

References

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