International Breast Ultrasound School (IBUS) workshop

E9. Breast ultrasound update

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Abstract

The spatial resolution of high frequency breast ultrasound (US) transducers has been optimised using broad bandwidth and high-dynamic range technology. New techniques such as compounding and harmonic imaging promise to further improve contrast by reducing artefacts without sacrificing specificity. The sensitivity of standard breast US for breast cancer ranges from 55% to 95%. Many countries have adopted the American College of Radiology BI-RADS breast ultrasound classification to introduce some consistency to reporting. Ultrasound is now considered routine for the further assessment of mammographic abnormalities, for further evaluation of breast symptoms and is the method of choice for image guided breast biopsy (sensitivity 93% to 98%; specificity 95% to 100 %). US-guided vacuum-assisted biopsy (VAB) is being increasingly used for diagnosis of borderline lesions and for therapeutic excision. Magnetic resonance imaging is the gold standard for assessing the size and extent of established breast cancer and for screening younger women at increased risk, but in daily routine practice mammography and ultrasound remain highly effective diagnostic methods.

International Breast Ultrasound School (IBUS)

The International Breast Ultrasound School (IBUS) was formed in December 1991 by an 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. Since then IBUS has been successful in providing four to six workshops every year worldwide and has also started international one-week courses of a residential teaching programme in conjunction with the University of Ferrara's Institute for Higher Studies and the Munster Reference Centre for Mammography focussing on multimodality imaging and interventional techniques. [1]

Modern equipment and examination

High spatial resolution and contrast resolution are prerequisites for high quality near field imaging of the breast. The spatial resolution of modern breast ultrasound equipment is such that ductal and lobular anatomy can be resolved. Most benign and most malignant changes evolve from and finally enlarge the terminal ductal-lobular unit (TDLU), the functional unit of the breast. Modern linear transducers apply a bandwidth with a maximum frequency of 12 to 16 MHz and a lower end of the bandwidth of 5 to 8 MHz. Centre frequencies between 7 and 13 MHZ, continuous electronic focussing on transmit and receive, short pulse length, and high-dynamic range complete are standard requirements in modern fundamental high frequency systems that ensure optimal image quality of 2D, 3D and 4D ultrasound technologies. Spatial compounding on transmit and/or receive, frequency compounding, tissue harmonic imaging, and processing techniques reduce noise and thus increase the contrast resolution. [2]

Examination technique

The IBUS guidelines for the ultrasonic examination of the breast recommend a systematic, comprehensive and reproductible approach for performance and documentation of the examination. The scanning procedure following the setting of gains, focal zones and field of view should involve a minimum of two scan planes such as overlapping meandric ('lawnmower') (a) sagittal, (b) transversal, (c) radial ductal-oriented, (d) orthogonal antiradial scans. [3]

Role of US in the German Mammography Screening Programme

Several ultrasound studies have shown cancer detection rates of only 0.3% compared to 0.7% for screening mammography, but US screen detected cancers are of similar size and stage as mammographically detected clinically occult cancers. The benefit of ultrasound as

an adjunct to mammography is greatest in women with palpable lesions and those at increased risk, including those with mammographically dense breasts. Women with a high mammographic background density (>75%) have a four- to six-fold increased risk compared to women with a fatty pattern. [4]

In Germany, an organised breast screening programme of screening ultrasound will have been established nationally by the end of 2008. [5] First results from the digital mammography reference centre in Munster show higher cancer detection rates (1.1%) compared to the screen-film centres. [6] The German National Screening Programme uses ultrasound only for the further assessment of mammographic abnormalities and for guiding minimally invasive biopsy.

Adapted ultrasound BI-RADS criteria

The American College of Radiology (ACR) developed a Breast Imaging Reporting and Data System (BI-RADS) lexicon for mammography, ultrasound and MRI and most European ultrasound societies have adopted the original or modified ACR BI-RADS-US for recording breast US findings. However, several studies report substantial interobserver variability. [7] The German Ultrasound Society has published an ACR adapted standardised reporting system. [8] A recent study of 445 solid index masses classified by this system concluded that follow-up of solid, non-palpable masses with benign US features (BI-RADS -US 3, probably benign) is an acceptable alternative to biopsy (negative predictive value of 99.8%). [9]

Table 1. The following diagnostic criteria were included in the adapted US-BI-RADS system in addition to ACR by the DEGUM (German Ultrasound Society) expert group in cooperation with the Austrian and Swiss ultrasound societies

Quantity of vascularity	increased, moderately increased, not increased, number of vessels
Vessel pattern	radial, tangential, irregular
Compressibility	good, low, not compressible, not accessible
Mobility	good, low, not mobile, not accessible
3-D criteria	compression sign, retraction sign
Lymph nodes	axillary, infraclavicular, supraclavicular, neck, parasternal
LN-classification	normal, suspicious, size
Ducts	normal, dilated, smooth, irregular, interruption, inner structure cystic/solid, diameter

3- D, three dimensional; LN, lymph node.

New developments of interventional techniques

Guidelines recommend obtaining a definitive, non-operative diagnosis of all potential breast abnormalities in a timely and cost-effective way. [10] Fine needle aspiration can lead to an accurate diagnosis in lymph nodes, cysts and typical fibroadenomas. [11] US guided fine needle aspiration of axillary lymph nodes shows a high specificity (89–100%) and varying grades of sensitivity, ranging from 54% in T1 tumours to 100% for T4 tumours. [12] When the FNA finding is positive, sentinel lymph node biopsy can be omitted and primary axillary lymph node dissection performed.

US-guided core needle biopsy (USCNB) has developed as the minimal invasive biopsy method of choice for all breast lesions using 14-gauge needles (sensitivity 93% to 98%; specificity ranges from 95% to 100%). US-guided vacuum-assisted biopsy is increasingly being used for diagnosis of borderline lesions and for excision of biopsy proven benign lesions such as fibroadenomas and some papillary lesions and radial scars. [10,13] The diagnostic accuracy of US guided VAB is close to 100%.

Staging the axilla and breast including intraoperative staging

Mammography tends to overestimate the tumour size [14] and magnetic resonance imaging (MRI) of the breast is the most sensitive technique in the pre-operative assessment of multifocal and multicentric cancer. [15–17]

Assessment of the axilla using ultrasound can identify abnormal lymph nodes that can then undergo ultrasound guided biopsy. Diagnosis of axillary node spread of malignancy using this method avoids the need for a sentinel node procedure and the patient can proceed to full axillary lymph node dissection as part of the primary surgical procedure. The role of the modern breast surgeon includes increasingly the application of intraoperative sonography. The breast surgeon should be able to compare and integrate preoperative findings with intraoperative insights in order to restage the lesions, restage the axilla, guide biopsy, inject radio-labelled tracer, localise intraoperatively non-palpable lesions, guide surgery according to anatomy, and assess specimen margins *in vivo* using the US transducer in direct contact with the specimen. [18,19]

New insights in multimodality imaging in DCIS

Eighty percent of DCIS present as microcalcifications mammographically, 10% show the feature of a spiculated lesion, 8% present as a focal mass and 2% show intraductal changes at galactography. Microcalcifications with associated mass are found in 10% of mammographically visible DCIS lesions. [20] Mammographic and histological extension of DCIS corresponds highly in high grade DCIS and less in intermediate and low grade DCIS. [21] The detection rate of DCIS by screening US is low but targeted US of suspected DCIS frequently shows

an abnormality.[22] However, MRI has now been shown to have very high sensitivity for DCIS although is less reliable for assessing extent.[23,24]. The role of MRI in the staging of DCIS focuses on the demonstration or exclusion of additional invasive carcinoma and to suggest the possible extent of non-calcified DCIS in the presence of malignant microcalcifications.[24,25]

MRI of the breast

Current ACR Guidelines define the indications for breast MRI.[26] The National Institute for Health and Excellence in the UK and the American Cancer Society strongly recommend screening MRI for screening women at high genetic risk.[27–30] Screening breast MRI is not recommended in general. Four clinical scenarios are candidates for use of MRI in problem solving: differentiating collapsed or complicated cysts from solid tumours, assessment of focal or global mammographic asymmetries, mammographic abnormality seen in only one view and multiple round smooth masses that are equivocal at mammography and US.[25]

Preoperative MRI provides a change in therapeutic decision in 15%–27% but can lead to over treatment due to false positive findings. Further long time studies are needed to answer the question whether improved preoperative staging could be translated in better local control and potentially improved overall survival of breast cancer patients or not.[25]

Conflict of interest statement

None declared.

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