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Diffusion-weighted magnetic resonance imaging: the influence of different b-gradient factors on the apparent diffusion coefficient for normal fibroglandular tissue of the breast

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Background: Previous diffusion-weighted imaging (DWI) studies of human breast tissues reported discrepant apparent diffusion coefficients (ADC). The ADC-values generally derived from two sets of images acquired with b-gradient factors varying considerably. The purpose of this study is to evaluate the influence of a range of b-values on the measurement of ADC-values for normal fibroglandular tissue of the breast.

Materials and Methods: Fifteen patients (mean age: 40.6 years) underwent breast MRI using a 1.5 Tesla scanner (Avanto; Siemens) equipped with a dedicated bilateral breast coil. DWI was performed with single shot echo planar imaging with b-values of 50, 200, 500 and 800 s/mm2. The scan parameters were TR/TE 8000/91 ms, band width 1630Hz, FOV 340 mm, slice thickness 4 mm. ADC-maps were reconstructed from b-value pairs of 50–200, 50–500, 50–800s/mm2 and all b-values together. The ADC-values of 25 breasts were determined for regions of interest (ROI) in fibroglandular tissue appearing homogeneous on both ADC map and T2-weighted images. ROI's were first drawn on the ADC map with a b value of 800s/mm2 and subsequently reproduced on the others. Variation in the amount of fibroglandular tissue per breast resulted in varying ROI dimensions (32.4−45.4 mm2). A paired t-test was used for analyzing the statistical significance of differences between the ADC-values in the three b-value pair reconstructions compared to ADC derived from all b values together, serving as gold standard.

Results: The mean ADC-value of normal fibroglandular tissue was 2.13 $\pm$ 0.46$\times 10^{-3}$ mm2/s for b-values 50–200 and 2.19$\pm$ 0.33$\times 10^{-3}$ mm2/s for b-values 50–500. For b-values 50–800 and all b values together the mean ADC-values were almost similar, namely 1.96$\pm$ 0.27$\times 10^{-3}$ mm2/s and 1.97$\pm$ 0.29$\times 10^{-3}$ mm2/s, respectively. The standard deviation decreased for higher b-values. A statistical difference was found for b-value pair 50–200 compared to all b-values together ($p = 0.029$) and for b-value pair 50–500 compared to all b-values together ($p = 0.000$). There was no significant difference between b-value pair 50–800 and all b values together ($p = 0.231$).

Conclusion: In clinical DWI of the breast, using just two scans for time saving, one should be acquired with a b-value of at least 800s/mm2. This will improve the accuracy of the reconstructed ADC-maps and thus reduce ADC-measurement discrepancies as reported in several studies.

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Three dimensional fused image of positron emission tomography and CT with contrast medium is useful for breast conserving surgery

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Background: When breast conserving surgery (BCS) is performed, it is important to accurately assess intraductal spread and axillary node involvement before the surgery. For this purpose, breast MRI and enhanced breast CT have achieved the status of gold standard. On the other hand, there has been no report on the usefulness of positron emission tomography (PET) in this field because the spatial resolution is low. However, a PET image fused in three dimensions with enhanced CT can provide a more accurate assessment compared with enhanced CT alone.

Patients and Methods: From June 2006 to December 2007, 113 patients were recruited in the study. 4.5MBq/Kg of 18F Fluoro-2-deoxy-D-glucose (FDG) was injected. At 120 minutes after FDG injection, imaging data were obtained with a Biograph Sensation 16 (Siemens/CTI) scanner. After routine PET study, a CT study with iodine contrast medium was performed immediately with the patient in the same position. A 3-dimensional image combined with PET and contrast enhanced CT used evaluation of intraductal spreading and axillary assessment. Degree of FDG accumulation and enhanced effect of contrast medium were judged by one radiologist specialized in PET image. On the basis of this diagnosis, we decided to select surgical options, which were BCS with sentinel node biopsy (BpSNB), BCS with axillary dissection (BpAx), mastectomy with SNB (BtSNB), and mastectomy with axillary dissection (BtAx).

Results: 78 of 113 (69.0%) patients were performed BCS on the basis of fused 3D image diagnosis. Only 6 of 78 (7.7%) patients were evident cancer in surgical margin. However, no local recurrence was observed. And there were no significant difference of standardized uptake value (SUV) between patients with positive surgical margin and negative. Sensitivity, specificity and accuracy of axillary node assessment were 46.8% (15/32), 93.7% (75/80) and 79.6% (90/113), respectively. Average SUV of each surgical options were as follows; BtAx 6.80, BpAx 6.68, BtSNB 6.02, BpSNB 4.49 ($p = 0.0065$).

Conclusion: This novel three dimensional fused image of PET and CT with contrast medium was useful for selection of BCS indication. However, because of low tracer uptake of micrometastasis, axillary node assessment was difficult and further instrumental improvement would be needed.

At the conference, we will present some example images which were useful for selection of BCS.

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Outcomes of stereotactic breast core biopsy (SBCB) of BIRADS category 4 microcalcifications

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Background: To evaluate the pathological findings and subsequent surgical management of patients who underwent SBCB of BIRADS category 4 microcalcifications.

Materials and Methods: Patients diagnosed with BIRADS category 4 microcalcifications on screening mammogram were included for analysis in this retrospective review. A 14-gauge device was used to perform SBCB under local anaesthesia utilising an upright stereotactic mammographic localization system. All cases were performed on an ambulatory basis. Routine specimen radiography was done to document the presence of calcium in the cores obtained. Histopathological analysis was reviewed by the same team of pathologists. Assessment for concordance is achieved by reviewing imaging findings alongside the pathology report during a weekly scheduled meeting. Concordant malignant cases are referred to a surgeon for definitive treatment. Discordant cases and high-risk pathology findings (atypical ductal hyperplasia, lobular neoplasia, papillary lesions and columnar cell lesions) are referred to a surgeon for open excision biopsy. Concordant benign cases are placed on a follow-up imaging protocol.

Results: A total of 170 SBCB were performed in 149 consecutive patients over a period of 26 months. The median age of patients was 51 (range 34−75 years old). The median number of cores obtained was 6 (range 2−41). The incidence of high-risk pathology findings, DCIS and invasive cancer was 11.8%, 12.9% and 3.5% respectively. The rate of non-compliance with recommended excision was 22%. The overall discordant rate was 6.5%. The overall false negative rate for malignancy was 15.4%. There were no false positives. 47.6% of DCIS diagnosed on SBCB was found to reveal invasive cancer on subsequent surgery. These findings are found to be independent of the side of biopsy, the quadrant of breast biopsied, number of cores obtained or the radiologist performing the procedure.

Conclusions: The launch of screening mammography in Singapore has resulted in an increase in the incidence of non-palpable breast cancers. Stereotactic large core needle biopsy has been proven to be a reliable alternative to open surgical biopsy; with advantages of minimal scarring, minimal distortion on subsequent mammograms, lower overall costs and faster patient recovery. However, the false negative rate in our study is significantly higher than reported rates of 2−6.7%. This may be contributed by a high percentage of unknown final histology (22%) due to non-compliance with recommended surgery; as well as technical difficulties of difficult visualization of dense Asian breasts (65%) on localization. Vacuum-assisted biopsies with more representative sampling may be able to overcome the high false negative rate as well as the high percentage of underestimation of DCIS.

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Contralateral breast screening using mammography – is it worthwhile in developing countries?

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Background: As per standard guidelines, contralateral mammography is advised in the west for detecting 1.8% incidence of synchronous breast cancers. In view of low breast cancer incidence in India and more than 85% population being below age 50 years, wherein the diagnostic sensitivity of mammography is low, there is no evidence to support these recommendations. A retrospective analysis was therefore carried out to