### Title

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CASE REPORT

# Diffusion-weighted imaging is helpful in the accurate non-invasive diagnosis of breast abscess: correlation with necrotic breast cancer

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## SUMMARY

Clinical differentiation of atypical breast abscesses from necrotic tumour in premenopausal women is challenging and may delay appropriate therapy. In this case report, we present a 36-year-old woman with signs, symptoms and conventional imaging features of malignancy who underwent breast MRI. On diffusion-weighted imaging (DWI), profoundly low apparent diffusion coefficient values were a distinguishing sign of breast abscess from necrotic breast cancer, and helped manage the patient conservatively. We present a companion case of necrotic breast tumour highlighting significant differences in DWI.

## BACKGROUND

Differentiation of atypical breast abscesses from necrotic tumour at presentation may be problematic by clinical assessment or conventional imaging techniques including mammography, ultrasound or dynamic contrast-enhanced (DCE)-MRI. Diffusion-weighted imaging (DWI) is an MRI technique based on the random, microscopic motion of free water molecules in tissue ('Brownian' motion), and produces contrast related to the structure of tissues at microscopic level.[1] It can be applied within a few minutes, and does not require intravenous contrast. DWI allows estimation of cellularity and tissue structure quantitatively by calculating apparent diffusion coefficient (ADC) values of each pixel, and generating quantitative ADC maps that correlate with tissue cellularity.[1] DWI can be used in the differential diagnosis of the brain masses with fluid components, because cystic brain tumours show, respectively, higher ADC values compared with abscesses.[2 3] But there are few reports about the use of DWI in the differential diagnosis of breast masses versus abscesses, differentiation of which may not be possible by DCE-MRI findings alone. In this report, we are presenting a case of breast abscess that mimicked cystic malignancy clinically, by conventional imaging and DCE-MRI features, to show the critical role of DWI in establishing the correct diagnosis non-invasively. We also provide a representative case of necrotic tumour to allow for comparison.

## CASE PRESENTATION

A 36-year-old woman with a family history of breast cancer in mother and maternal grandmother presented to an outside-facility surgeon with a 'pea-sized' palpable mass in the immediate subareolar region. There was no associated nipple discharge, blood or pain. The patient did not have a history of smoking. The patient underwent immediate palpation-guided core needle biopsy without prebiopsy imaging due to a high level of suspicion, histopathology revealing benign breast tissue. Over a period of 2 weeks, the patient experienced progression of symptoms, with an increase in the mass size, developing yellowish nipple discharge, and presented to our clinic for further evaluation.

On clinical examination, a palpable, painless hard mass of 3–4 cm size was noted in the retroareolar region of right breast, associated with mild erythema and nipple inversion, suspicious for malignancy. No palpable axillary lymphadenopathy was identified. The patient underwent bilateral mammogram, demonstrating a mass lesion measuring 5.4×4.7×4.2 cm in the retroareolar region of the right breast (figure 1A). Left breast was negative (figure 1A). Ultrasound of the right breast revealed a complex mixed cystic and solid mass measuring 3.7 cm (figure 1B). These findings were assumed to represent postbiopsy changes obscuring the primary lesion and a discrete mass correlating with the initial palpable abnormality precipitating outside-facility core biopsy was not noted. Therefore, MRI was recommended to further evaluate the primary mass.

Using a 3-T GE Signa scanner (General Electric, Milwaukee, WI, USA) with the patient positioned prone on a dedicated eight-channel breast array coil, bilateral diagnostic breast MRI was performed using bilateral axial T2-weighted, DWI and 3D fast spoiled gradient echo series before and after the administration of 7 mL of intravenous Gadovist, with delayed sagittal series per our institutional protocol. For each slice, DWIs were acquired prior to the dynamic sequence and quantitative ADC maps were generated. On MRI images, there was a round retroareolar mass with irregular margins measuring 5 cm in the right breast, which demonstrated central high T2 signal (figure 2, top left). On contrast-enhanced series, irregular thick rim enhancement and internal enhancing septa (figure 2, top right) were identified. Time–intensity kinetics was consistent with fast initial upslope with delayed plateau and wash-out enhancement patterns. The thick rim enhancement of the mass extended anteriorly to the nipple, with enhancing

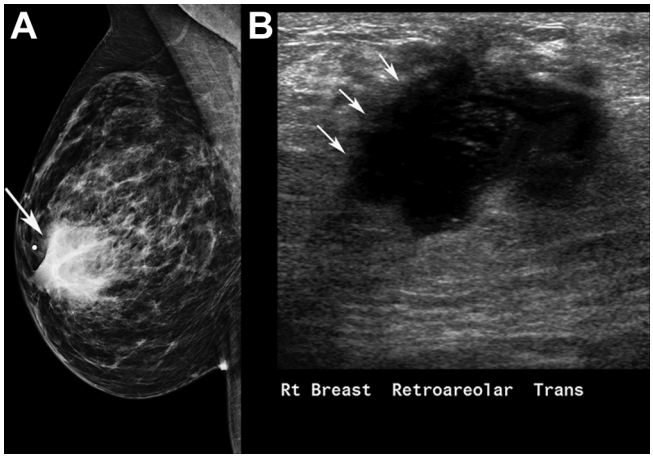


**Figure 1** (A) Digital mediolateraloblique mammographyview of the right breast. The breast is heterogeneously dense. A focal asymmetry (arrow) is seen in the retroareolar region of the right breast. (B) Ultrasound image of the right breast. There is an indistinctly marginated hypoechoic mass in the retroareolar right breast.

nipple retraction. There was marked diffusion restriction within the central mass, with a decreased ADC value of $0.45\times10^{-3}$ $mm^2/s$ (figure 2, bottom left and bottom right). Associated skin thickening, trabecular thickening and prepectoral oedema were present. There were asymmetrically enlarged right axillary lymph nodes, which maintained a normal fatty hilum, and normal cortical contour.

## DIFFERENTIAL DIAGNOSIS

Breast abscess, cystic primary malignancy.

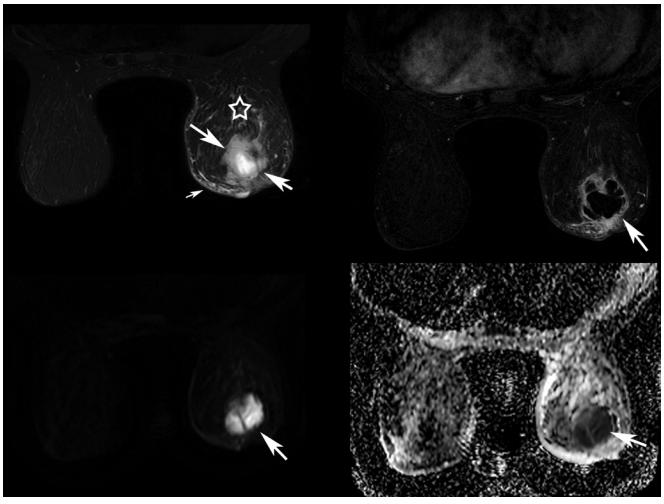

**Figure 2** MR images of bilateral breasts. In the right breast, there is a large retroareolar mass with central high T2 signal (top left, thin long arrow), which demonstrates internal enhancing septa and irregular thick rim enhancement, extending anteriorly to the nipple, with enhancing nipple retraction (top right, arrow). Associated skin thickening of the breast (top left , thin short arrow), trabecular thickening (top left , star) and prepectoral oedema are present. On diffusion-weighted imaging, there is marked diffusion restriction within the central fluid filled cavity with high diffusion-weighted imaging signals (bottom left, arrow) and low apparent diffusion coefficient (ADC) value (bottom right, arrow; ADC=0.45 $mm^2/s$).

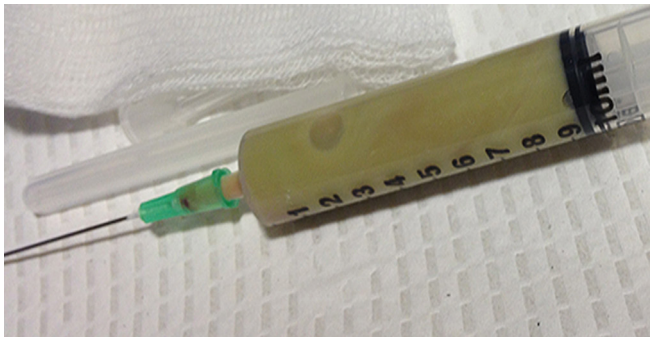

**Figure 3** Syringe following aspiration. The fluid aspirated from the abscess was greenish yellow and opaque.

## OUTCOME AND FOLLOW-UP

Based on DWI findings, a diagnosis of abscess was made. An MRI-directed ultrasound with ultrasound-guided needle aspiration was performed. 30 $cm^3$ of purulent fluid was aspirated, and near complete resolution of the mass was observed. Cultures were positive for *Peptostreptococcus* and beta-lactamase-negative *Bacteroides* (figure 3). The patient was initially treated with cephalexin 750 mg two times a day for 2 weeks. The mass recurred a few weeks later. The antimicrobial treatment was switched to amoxicillin/clavulanate (Augmentin, two times a day), 1000 mg for 10 days. Subsequently, cephalexin was combined with Augmentin for another 2 weeks. The patient experienced increasing nipple discharge and fistula formation to the skin, with partial resolution of her symptoms despite antibiotic treatment. Six weeks after initiation of antibiotics, she underwent surgical incision and drainage in an outside facility with resection of a tissue sample from the abscess cavity. Final histopathology showed neutrophils and secretory material with surrounding fibrosis and exuberant inflammation consistent with abscess formation, and no evidence of malignancy. Postoperatively, the patient reported cessation of nipple discharge to her primary provider; however, she was lost to further follow-up in our institution.

## DISCUSSION

For typical breast abscess, ultrasound is the first-line investigation and mammography is recommended to exclude the presence of calcifications heralding malignancy.[4 5] However, some breast abscesses without clinically evident mastitis may be difficult to differentiate from necrotic breast cancers.[3] In this young patient, the clinical presentation of a hard palpable mass without fever or pain favoured malignancy, especially high-grade invasive breast cancer.[6] The findings on mammography and ultrasound were assumed to represent postbiopsy changes with concern that the initially targeted palpable abnormality for needle biopsy was obscured and incompletely evaluated. Therefore, MRI was performed for further evaluation. The DWI obtained during routine MRI was useful to distinguish abscess from malignancy.

The role of DWI in differentiating malignant from benign breast lesions has been well reported,[7–9] with the mean ADC value of malignant lesions being significantly lower than that of benign lesions. DWI has also been shown to be useful in differentiating the causes of rim-enhancing brain lesions.[10] Abscesses show diffusion restriction of the central necrotic component due to purulent material in the cavity, while neoplastic lesions with central cystic changes do not show central diffusion restriction, possibly related to the less viscous and cellular materials in the cavity. This difference was also found in breast rim-enhancing

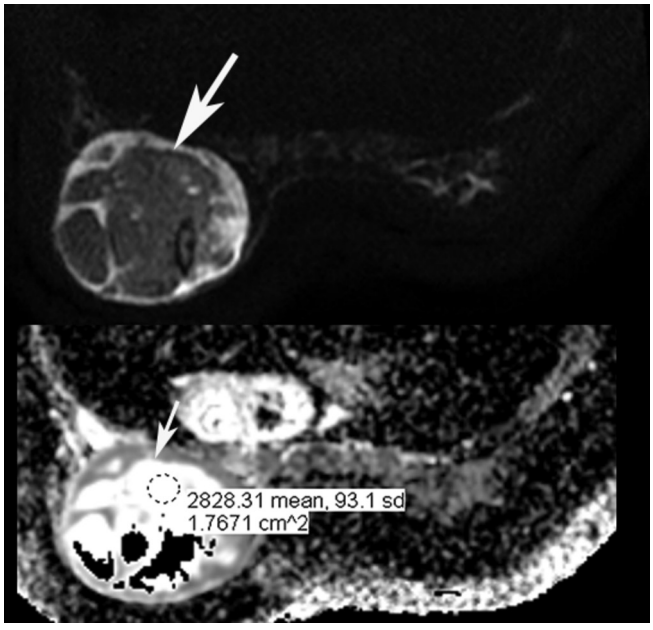


**Figure 4** Diffusion-weighted (DW) imaging and apparent diffusion coefficient (ADC) map of a 21-year-old woman recently diagnosed sarcomatoid carcinoma. A central hypointensity on DWI (top, arrow) and relatively high ADC value (bottom, arrow; ADC=2.84 $mm^2/s$) are present.
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## Learning points

- Some breast abscess may lack the signs and symptoms of infection and mimic necrotic cancer.
- Profoundly low apparent diffusion coefficient (ADC) values in diffusion-weighted imaging-restricting lesions are a distinguishing sign of breast abscess from necrotic breast cancer.
- Profoundly low ADC values may help suggest the correct diagnosis in patients presenting with a palpable breast mass who lack the signs and symptoms of infection.

lesions. Wang *et al*[11] reported that on DWI breast abscesses showed a central hyperintensity and a lower ADC value ($1.05\pm0.44$ $mm^2/s$) of the central part in contrast to breast tumours ($1.94\pm0.51$ $mm^2/s$) with central cystic changes, using b values of 0, 600 and 800 $s/mm^2$. The mean ADC value obtained from the tumour was similarly low ($0.45\times10^{-3}$ $mm^2/s$), which helped differentiate the growing mass from necrotic tumour non-invasively (figure 4).

Most common aetiological organism of mastitis is *Staphylococcus* and *Streptococcus* species.[12] *Peptostreptococcus* and *Bacteroides* are both parts of body flora in many organs, which can also infect breast after trauma, insect bite or in the personal history of diabetes. Our patient has only undergone a biopsy and denied any other problems. It is possible that breach of skin due to her initial palpation-guided biopsy might have predisposed to *Peptostreptococcus* or *Bacteroides* infection, with the resultant atypical clinical presentation.

**Contributors** All authors listed participated in the planning, conduct, reporting, conception and design, acquisition of images and manuscript drafting/editing. CW: conception, design and manuscript draft. ME and WY: imaging and manuscript editing. BED: conduct, reporting, conception and design, acquisition of images and manuscript drafting/editing.

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