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Research letters

Can magnetic-resonance imaging help elucidate natural history of breast cancer multicentricity?

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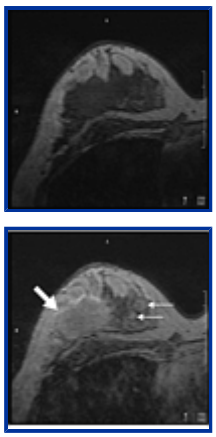
When mastectomy specimens are examined by detailed radiological-histological correlational methods, small additional invasive or in-situ cancer foci are found in over 60% of patients; 80% of these lie remote from the index quadrant.[1] Since 90% of local recurrences occur in the index quadrant, the clinical relevance of small cancer foci has been questioned.[2]

Angiogenesis is a prerequisite for tumour growth beyond 12 mm in diameter and is directly correlated with poor prognosis.[3] It is of interest that while radiography relies on tissue density for detecting cancers, magnetic resonance imaging (MRI) relies on tumour vascularity and vascular permeability,[4] as demonstrated by contrast enhancement. MRI is highly sensitive for breast cancer detection but its specificity is relatively low.[5] We evaluated prospectively whether small enhancing foci, seen separately from the main tumour on contrast-enhanced MRI, were indeed cancer foci and whether MRI could detect all cancer foci identified by radiological-histological correlation.

We studied ten patients and did preoperative contrast-enhanced breast MRI. High resolution transverse T1-weighted 3D FLASH images (TR=18 ms, TE=7 ms, FA=40°, TA=4 m 56 s, FOV=410 mm) before and after an intravenous bolus hand injection of dimeglumine gadopentetate (Magnevist, 0·2 mL/kg) were acquired at 1·0 T (Siemens Magnetom Scanner 42 SP with dedicated breast coil). The 3D volume was 64 mm thick with 32 partitions giving an effective slice thickness of 2 mm and this was sufficient to cover the entire breast in all cases.

After surgical excision (four mastectomies, six wide local excisions), the specimens were fixed and sliced at 5 mm intervals in the same plane as the MRI. Routine histopathological examination was performed by an experienced breast pathologist and the remaining material was radiographed. Two observers identified radiological abnormalities (calcifications, densities, or spiculations) and all lesions that were deemed suspicious by either observer were sampled and examined histologically. MRI images were reviewed independently and findings were compared with histopathology results.



T1-weighted breast MRI before (A) and after (B) contrast

Two separate enhancing foci (small arrows) are visible away from the primary tumour (large arrow) after contrast enhancement.

On MRI, 19 enhancing foci separate from the main tumour were identified in seven out of ten patients (figure). On radiography of specimen slices, 71 suspicious areas were sampled and histological examination revealed 15 areas of in-situ cancer (nine) or invasive cancer (six) in five patients. All five patients with cancer foci were amongst the seven patients who had enhancing foci on MRI. In two of these five patients, the tumour was surrounded by widespread enhancement on MRI and all 11 (four+seven) areas sampled showed cancer foci. In all wide local excision specimens, the enhancing foci on MRI were within 11 mm of the tumour edge and therefore within the resected specimen.

Our data suggest that enhancing foci on MRI represent cancer foci and that MRI detected 14 out of 15 cancer foci (sensitivity 93%). Of course, this is based on the assumption that the radiological-histological correlational method is indeed the gold standard. If that is so, the

specificity of MRI for tumour detection would be 79% (15/19). However, bearing in mind that the spatial resolution of MRI is of the order of 12 mm, it may yet transpire that MRI could have even greater sensitivity and specificity which may become apparent with an even more obsessional sampling of the specimen.

Our findings provide strong circumstantial evidence that small enhancing foci on MRI represent cancer foci and that MRI is highly sensitive for the detection of invasive or in-situ cancer foci. However, small cancer foci may never become clinically apparent in a woman's lifetime,[1,2] and therefore resecting them may not be necessary. We fear that the high sensitivity of MRI for breast cancer detection would result in many women suffering unnecessary mastectomies. Our results suggest that MRI could be used to investigate prospectively the clinical significance of unresected cancer foci in order to convincingly determine their natural history in the context of breast conserving surgery. Such a study would be deemed ethical because breast MRI is still considered experimental for preoperative planning of surgery.

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