Case Report

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Unexpected Finding on Mammography and MRI due to Accumulation of Iron Oxide Particles Used for Sentinel Lymph Node Detection

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ABSTRACT

We present a case with imaging artefacts on mammography and Magnetic Resonance Imaging (MRI) caused by iron oxide particles. After being diagnosed with the medullary cancer of the breast, the female patient had a breast conserving surgery on right breast. Iron oxide particles were used for the detection of the sentinel lymph node during operation. On follow ups, a de novo density on mammography, which was initially thought to be a new tumour, was found. MR images proved that the lesion is an artefact caused by iron oxide accumulation. Our aim in this case study is to underline and discuss the imaging artefacts caused by these particles and raise awareness.

Keywords: Breast, iron oxide, mammography, MRI

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Introduction

A sentinel lymph node biopsy (SLNB) is a procedure during which the sentinel lymph node, which is the main drainage pathway, is identified, excised, and evaluated histopathologically to detect cancer cells. A negative SLNB result suggests that cancer cells have not developed the ability to spread to nearby lymph nodes or other organs. Sentinel lymph node biopsy (SLNB) is a feasible and reliable method for staging the axilla before breast cancer surgery (1-6). The conventional method is with radiotracer ^{99m}tc using blue dye. In the latest years a new method for detecting sentinel node called iron oxide particle technique ("SentiMag® technique"), has been developed as an alternative to the radiotracer. In this new method a liquid which contains iron oxide particles is injected subareolarly. The liquid dissolves in the breast towards the axilla by manual massage. Later, a probe is used to detect iron oxide particles with ferromagnetic effect. Prospective clinical studies like "The Central-European SentiMag study" and meta analyses of earlier studies showed that magnetic SLNB method can be performed easily, safely and is a promising alternative to the radioactive method. (7-10). By time these iron oxide particles disseminate and are cleared through the lymphatics. However, we know that in some cases they might stay in the breast tissue for years and reduce imaging quality and sensitivity by causing artefacts (7, 8). Our aim in this case study is to discuss those imaging artefacts and help radiologists be aware of them.

Case Presentation

We present a 41-year-old female patient who had breast conserving surgery for biopsy proven medullary cancer a year ago. Informed consent was taken from the patient. She had a 7x3 mm sized palpable right breast mass. Although being palpable, it was occult on mammography (Figure 1a). The lesion was detected by sonography. On sonography a hypoechoic lesion with well-defined borders was found and classified as category 3 by Breast Imaging Reporting and Data System (BI-RADS) (Figure 1b). However, the patient insisted on biopsy and histopathological diagnosis revealed the medullary cancer. A breast conserving surgery was performed on right breast. 12 months later the patient was referred to mammography unit for routine follow up. On mammography, a spiculated de novo lesion that was denser than the radiographically dense breast parenchyma was identified on right upper breast (Figure 2a). The lesion was first thought to be compatible with recurrence. A new primary was also considered since the previous lesion was occult on mammography. We could not identify the new lesion on sonography. Magnetic Resonance images were obtained to delineate the whole breast. On MRI, a marked magnetic

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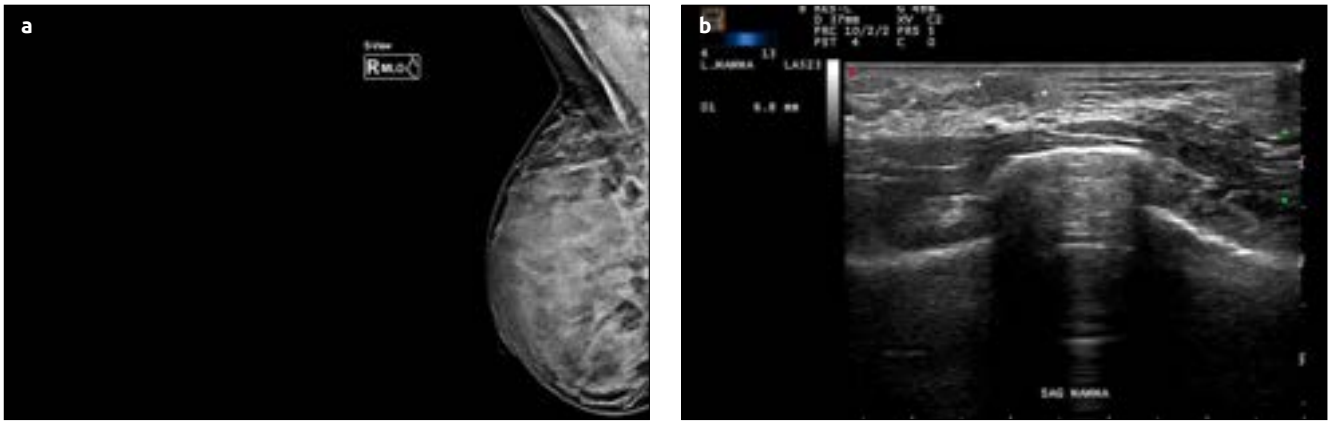

Figure 1. a, b. Right MLO Mammography images. No mass is seen (a). A hypoechoic lesion with well-defined borders is seen on sonography compatible with BI-RADS 3 lesion (b)

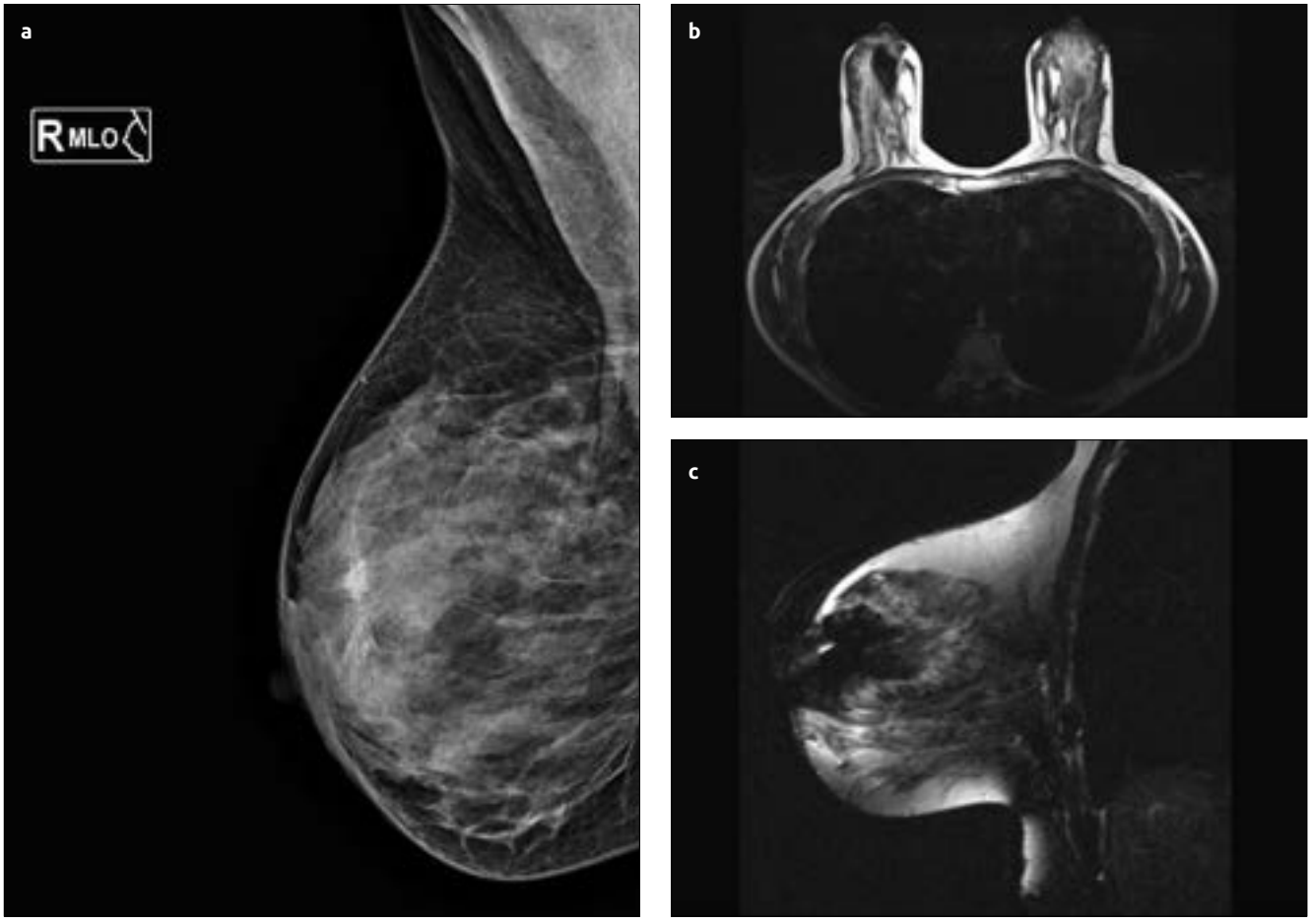

Figure 2. a-c. Postop mammography. Right MLO images. A spiculated density is seen on the right upper breast (a). Postop MRI. Axial and sagittal T2 weighted TSE, non-fat saturated image. A prominent susceptibility artefact is obscuring the right breast (b, c)

susceptibility artefact obscuring the central part of the breast was seen. These areas were attributed to previous iron oxide particles which were injected for SLN detection (Figure 2b, c) (SentiMag® technique).

Discussion and Conclusion

Iron oxide technique is a new, promising safe and effective method used as an alternative to radiotracer method for sentinel lymph node detection (1-6**).** Large metanalyses such as Nordic SentiMag trial and The Central-European SentiMag study have shown their efficacy and safety (7-8). The Central-European SentiMag study found that more pathologically positive SLNs were found with the SentiMag technique compared to the radiotracer method (7). However, the artefact caused by iron oxide particles and its effect on the quality of follow up imaging have not been discussed in these trials. Although a couple of previous studies (11-13) have shown the susceptibility artefacts caused by iron oxide particles on MRI, the appearance of these particles on mammography which is the first line modality used during the follow ups after breast conserving surgery have not been previously discussed. To

our knowledge, this is the first case study to demonstrate the iron oxide particles on mammography. Knowing the appearance of iron deposits on MRI and especially mammography is essential. In our case, the iron deposits were highly dense and denser than the breast parenchyma on mammography but interestingly occult on sonography. The density depends on the amount of particles accumulated; hence it might not be so dramatic in all cases. Iron oxide particles cause significant magnetic susceptibility as they are paramagnetic. On MRI, susceptibility artefact is seen as loss of signal which is called as "signal void" and they cause spatial distortion. The area effected by artefact is usually much larger than the size of the object causing the artefact so even a tiny amount of ferromagnetic material occult on x-ray or sonography can lower image quality on MRI. In the case study by Karakatsanis et al. (13), a patient with a history of iron oxide injection was discussed. In their case, unlike ours, no artefact was seen on the follow up mammogram. However, susceptibility artefacts were observed on the follow up MRI. On post contrast MR images, a new tumour was seen adjacent to artefacts. In our case the artefact on MRI was so evident in all sequences that it was impossible to detect a new lesion. Besides artefacts, staining the skin on the injected area (14) which is usually temporary is another limitation of these particles. Interestingly no staining was observed in our case.

We believe lowering the doses of these particles might be a solution for these undesirable side effects. An ongoing trial (Senti-Dose, https://doi.org/10.1186/ISRCTN11156955) is currently investigating the effect of lower doses.

In conclusion, the artefacts caused by iron deposits might be a problem in the long run. Reducing the amount of the injected material or changing the technique of massage for dissolving the particles might be a solution. As radiologists, we have to be alert for these kind of side artefacts. When we deal with a new density on follow ups of breast cancer on mammography, we have to question the method used for SLNB to avoid unnecessary biopsies and more importantly, to reduce the patient's anxiety. Knowing the patient's history and the method used for SLN detection guide us to consider this differential diagnosis.

Informed Consent: Written informed consent was obtained from patient who participated in this study.

Peer-review: Externally peer-reviewed.

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