Original Report

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MR Imaging of Breast Paraffinomas

OBJECTIVE. Our objective is to present the MR appearance of breast paraffinoma, a late complication of breast augmentation by liquid paraffin wax, and to correlate this appearance with the histopathologic findings that were available for three of the 11 breasts we studied.

CONCLUSION. Breast paraffinomas have a characteristic MR appearance that correlates well with histopathologic findings. With MR imaging, we were able to visualize the location and extent of the paraffinoma, best seen on the fat-suppression sequence, and to evaluate the surrounding fibroglandular breast tissue.

Paraffinomas develop as a late complication of breast augmentation by direct injection of liquid paraffin wax or beeswax into the breast. Although no longer practiced today, patients now present after having undergone the augmentation procedure decades previously.

Patients usually present with hard, lumpy breasts, which may mimic advanced breast cancer [1]. The appearances on mammography and sonography have been described [2]. Neither one of these methods can be used to evaluate the normal fibroglandular breast tissue that is obscured by paraffinomas [2]. To our knowledge, the MR appearance of breast paraffinomas has not been reported. We describe the MR appearance of paraffinomas in 11 breasts (seven women) and correlate the appearance with the findings of gross pathology and histology.

Materials and Methods

Seven women who had histories of paraffin oil injection for breast augmentation more than 20 years previously underwent MR imaging using a Signa 1.5-T clinical whole-body imager with version 5.6 software (General Electric Medical Systems, Milwaukee, WI) to exclude breast malignancy. MR imaging was performed on a total of 11 breasts in seven patients. In three patients, MR imaging of only the side of interest was performed.

First, sagittal T1-weighted spin-echo images (TR/TE, 500/8; matrix, 256 × 192) with two excitations were acquired for all 11 breasts. Sagittal fat-suppressed T2-weighted fast spin-echo images (4540/105; echo train length, 12; matrix, 256 × 160) were then acquired for nine breasts, and sagittal T2-weighted conventional spin-echo images (2000/90; matrix, 256 × 160) were acquired for two breasts. A dynamic two-dimensional fast spoiled gradient-recalled echo pulse sequence (10/2; flip angle, 60°; matrix, 256 × 128) was obtained simultaneously with a bolus injection of 0.15 mmol of gadopentetate dimeglumine (Magnevist; Berlex Laboratories, Wayne, NJ) for all breasts. Finally, contrast-enhanced sagittal T1-weighted spin-echo images (680/8; matrix, 256 × 160) were acquired with fat suppression for all breasts. The common imaging parameters used in all pulse sequences were a field of view of 20 × 20 cm, a slice thickness of 5 mm, an interslice gap of 1 mm, and a receiver bandwidth of ±15.6 kHz.

Patients ranged in age from 47 to 70 years old (mean, 55 years 7 months). Five patients presented with painless breast lumps, one patient presented with mastalgia and tender lumps, and one patient presented with tender lumps and skin ulceration. In addition, one patient had a history of incomplete excision of bilateral paraffinomas approximately 1 year after injection, with subsequent insertion of saline breast prostheses. All patients underwent mammography and sonography, which showed findings typical of paraffinoma (Fig. 1). Palpation-guided fine-needle aspiration of the lumps was performed for four breasts. Two had a single lump, one had two lumps, and one had three lumps. Two breasts underwent bilateral subcutaneous mastectomy, and one breast with an ulcer underwent incisional biopsy. Histopathologic findings were not available for the other breasts. We also performed qualitative

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in vitro analysis of liquid paraffin (presumed identical to the substance injected) by comparing a sample of the paraffin with samples of water and lipid in the MR scanner. For this analysis, we obtained spin-echo T1-weighted (500/9), fast spin-echo T2-weighted (2500/99; echo train length, 16), and spin-echo T2-weighted (2500/99; echo train length, 16) sequences with fat suppression.

Results

We found the typical MR appearance for all 11 breast paraffinomas. This appearance comprised two presumed components, which we named the main component and the round component. Both components and the normal fibroglandular tissue of the breast were well visualized.

The main component was plaquelike and had an irregular outline that gave it an infiltrative appearance. The round component was nodular and varied in size (from 2 mm to 2 cm) and number (from five to 30).

On T1-weighted sequences, fibroglandular tissue was of intermediate signal intensity and fat was of high signal intensity. The main component and round component were of intermediate signal intensity, being isointense to fibroglandular tissue (Fig. 2A).

On T2-weighted sequences, fibroglandular tissue was mainly of high signal intensity. The main component and round component were of low signal intensity, being hypointense to fat. A hyperintense signal was noted around the rim of the round component, compatible with magnetic susceptibility artifact (Fig. 2B).

On contrast-enhanced T1-weighted fat-suppressed sequences, we saw mild to moderate enhancement of fibroglandular tissue and minimal homogeneous enhancement of the main component. The round component was markedly hypointense to fibroglandular tissue, to the main component, and even to fat (Fig. 2C). Because of the marked hypointensity of the round component on the fat-suppressed sequence, this sequence was the most sensitive for detection of this component. The round component did not enhance with contrast administration.

In nine breasts, the main component was located deep in relation to the fibroglandular tissue. In addition, the main component extended to the fibroglandular tissue in four of nine breasts, to the subcutaneous fat in three of nine breasts, and to the pectoral muscles in two of nine breasts. In the remaining two breasts, the main component was located within the fibroglandular tissue and extended to the subcutaneous fat.

The round component was located primarily within the main component in all breasts, with additional round components in the pectoral muscles in eight of 11 breasts, in the subcutaneous fat in seven of 11 breasts, and in the fibroglandular tissue in four of 11 breasts. One breast had a superficial skin ulcer that was due to an underlying paraffinoma (Fig. 3). In one breast, a 1-cm area of early, rapid, focal intense enhancement was noted on the dynamic contrast-enhanced scans. Subsequent subcutaneous mastectomy and histologic examination revealed fibroadenomatoid hyperplasia with no evidence of malignancy. No enhancement suggestive of carcinoma was detected on the dynamic contrast-enhanced scans of the other breasts.

In the two breasts that underwent mastectomy and the one that underwent incisional biopsy, gross pathology showed a plaquelike, firm piece of grayish-white fibrous tissue with irregular margins. No clear line of demarcation between normal and abnormal tissue was present. The cut surface showed multiple nodules, some whitish and some containing vesicles of translucent greasy material, compatible with liquid paraffin (Fig. 1C). We hypothesize that the main component seen on MR imaging corresponds to the plaquelike fibrous tissue seen on gross pathology, whereas the round component corresponds to the paraffin-containing nodules.

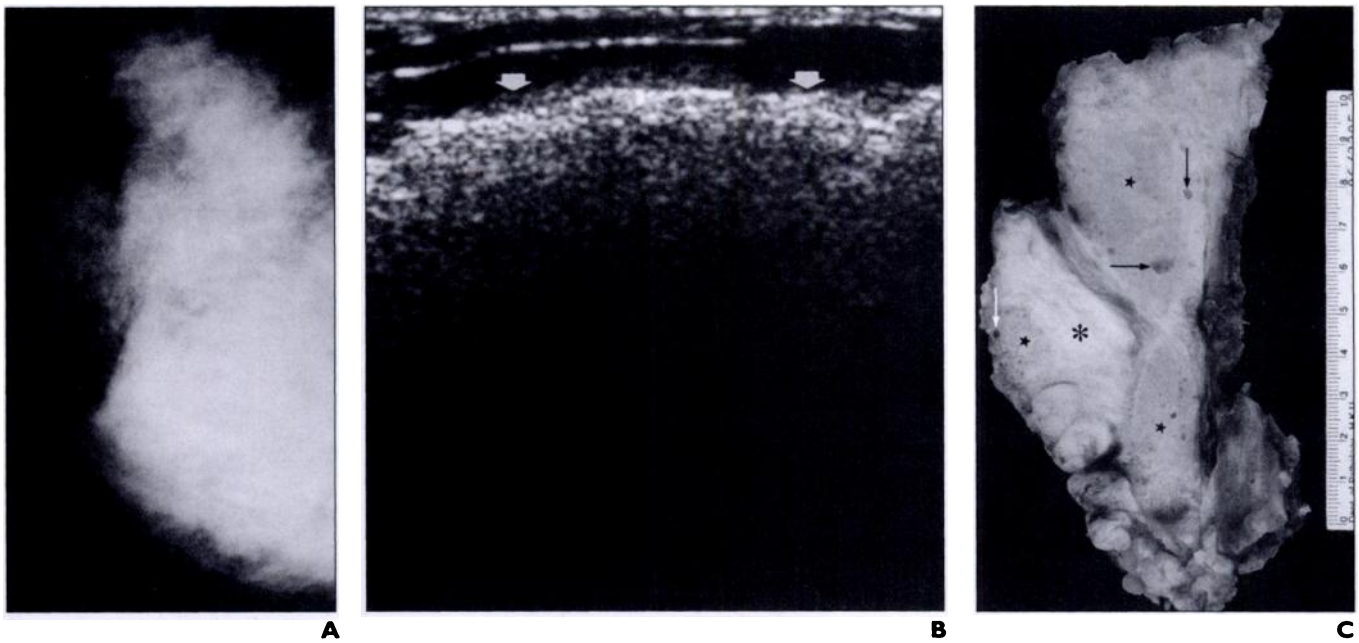

Fig. 1.—46-year-old woman with history of liquid paraffin breast augmentation who presented with bilateral breast lumps. Patient later underwent bilateral subcutaneous mastectomy, which confirmed bilateral paraffinomas.
A, Right mediolateral oblique mammogram shows streaky, dense opacities diffusely involving breast. Normal breast architecture is obscured.
B, Sonogram of right upper outer quadrant shows band of hyperechogenicity (*arrows*) with marked distal acoustic shadowing. Underlying normal breast tissue is not seen.
C, Gross specimen of paraffinoma shows normal fibroglandular breast tissue (*asterisk*) with plaquelike fibrous component (*stars*), both superficial and deep in relation to normal fibroglandular tissue, and multiple vesicular spaces (*arrows*) of various sizes.

American Journal of Roentgenology 1999.173:929-932.

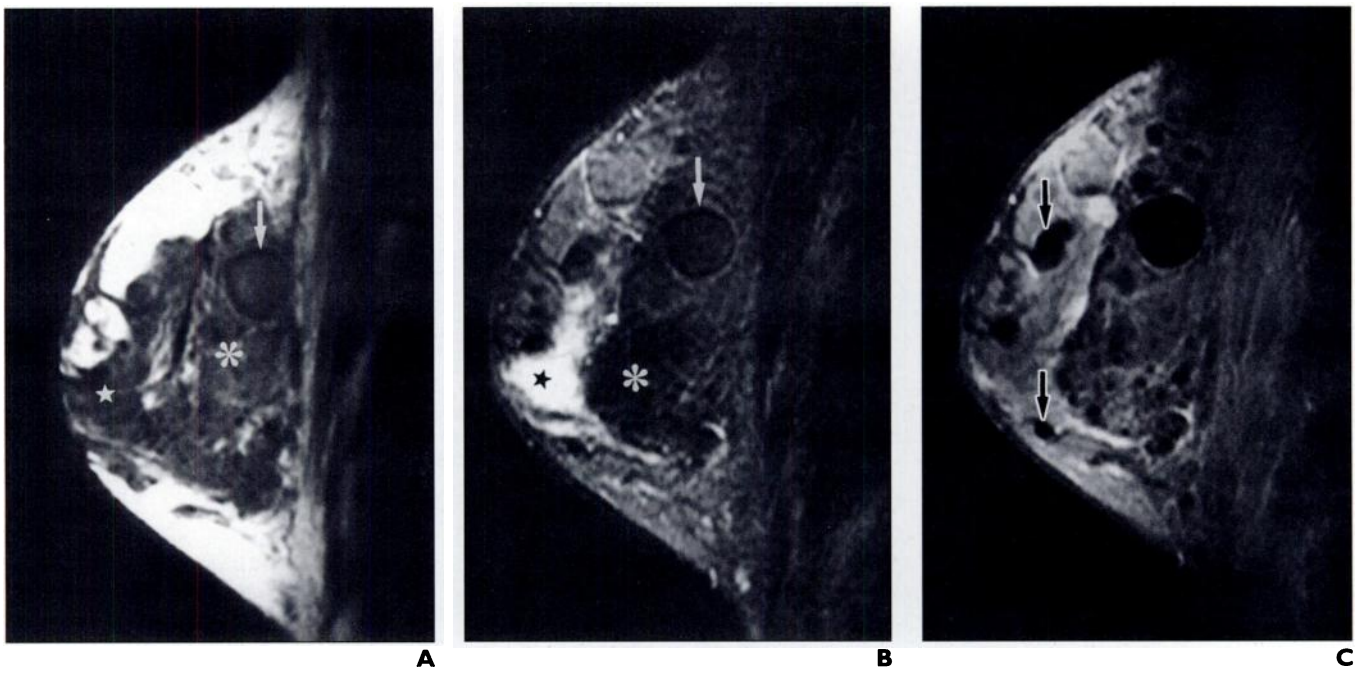

Fig. 2.—50-year-old woman with history of paraffin oil breast augmentation more than 20 years previously in whom bilateral firm breast lumps were found during routine gynecologic examination. Initial clinical diagnosis was bilateral fibroadenomas. Fine-needle aspiration yielded viscous clear fluid consistent with liquid paraffin.
A, Unenhanced sagittal T1-weighted spin-echo MR image. Main component (*asterisk*) is plaquelike and infiltrative, isointense to fibroglandular tissue (*star*), and situated deep in relation to fibroglandular tissue. Round component (*arrow*) is isointense or slightly hypointense to main component.
B, Unenhanced sagittal T2-weighted fast spin-echo MR image with fat suppression. Both main component (*asterisk*) and round component (*arrow*) are slightly hypointense to fat. Rim magnetic susceptibility artifact is noted around round component. On basis of this patient's mammographic findings, which showed multiple ring calcifications, we hypothesized that rim magnetic susceptibility artifact was most likely due to calcification. Fibroglandular tissue (*star*) is hyperintense.
C, Enhanced sagittal T1-weighted MR image with fat suppression. Marked signal suppression is seen in round component (hypointense to fat), which is mostly within main component and is also within subcutaneous fat (*arrows*).

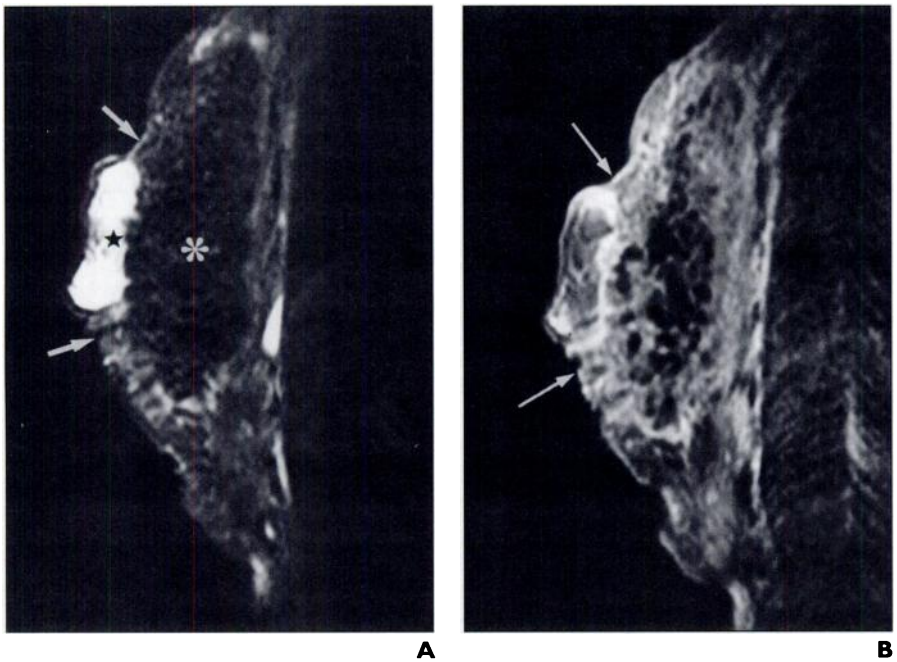

Fig. 3.—66-year-old woman with history of paraffin injection more than 30 years previously who presented with progressive erythema over both breasts of 8 years' duration and painful right breast ulcer of 3 days' duration. Incisional biopsy confirmed paraffinoma.
A, Unenhanced sagittal T2-weighted fast spin-echo MR image with fat suppression shows two superficial skin ulcers (*arrows*), with paraffinoma main component (*asterisk*) situated just beneath ulcers. Round component is predominantly within main component. Note inhomogeneous fat suppression (*star*) of subcutaneous fat.
B, Enhanced sagittal T1-weighted spin-echo MR image with fat suppression at same level as **A** shows marked hypointensity of nodular round component within main component. Arrows point to two superficial skin ulcers.

Microscopy showed dense fibrosis from hyalinization and vesicular spaces surrounded by a foreign-body giant cell reaction and scattered areas of chronic inflammation. The features were consistent with those of paraffinoma. No malignant lesion was present.

Palpation-guided fine-needle aspiration cytology of the lumps in two breasts yielded material of low cellularity and several pieces of fibrofatty tissue. No malignant cells were obtained.

In two breasts with multiple lumps, viscous, clear liquid was aspirated through a palpation-guided fine needle. The smears showed scanty granular material. Overall, the aspirated material was compatible with paraffin injection.

Qualitative in vitro analysis of liquid paraffin samples revealed the following: a high signal intensity on T1-weighted spin-echo sequences (as high as that of lipid) (Fig. 4A), a low signal intensity on T2-weighted fast spin-echo sequences (less signal than that of lipid) (Fig. 4B), and significant signal suppression on fat-suppression sequences (Fig. 4C).

Discussion

Historically, paraffin oil injection has been used to augment body contours in various sites including the breasts, penis, and face [3]. This method of breast augmentation, used in

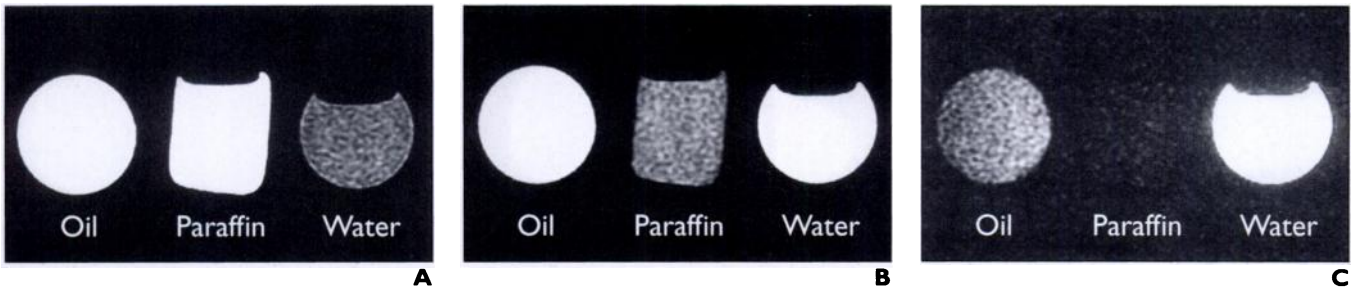

Fig. 4.—Qualitative in vitro comparison of liquid paraffin phantom with lipid and water phantoms.
A, T1-weighted spin-echo MR sequence. Liquid paraffin is high in signal intensity, being as bright as lipid and brighter than water.
B, T2-weighted fast spin-echo MR sequence. Liquid paraffin is low in signal intensity compared with both lipid and water.
C, T2-weighted fast spin-echo fat-suppressed MR sequence. Marked signal suppression is noted in liquid paraffin; degree of signal suppression is more than that in lipid.

the West in the early 1900s and up to the 1970s in the Far East, is no longer practiced today because of its disastrous effects. Its complications include the formation of paraffinomas, inflammatory reactions, tissue necrosis, and drainage sinus tracts. More serious complications include pulmonary and cerebral embolism [4]. The injection of paraffin oil causes a foreign body granulomatous reaction and fibrosis, with the end result of hard masses in the breasts. Paraffinomas can be extensive, making complete surgical resection difficult [1]. Extension along fascial planes into the chest wall and supraclavicular soft tissue and dissemination through the lymphatic system into the axilla and anterior mediastinum have been reported [5].

On mammography, paraffinomas appear as dense, streaky opacities causing bizarre architectural distortion and, often, amorphous ring calcifications [2]. Paraffinomas often involve the whole breast diffusely, obscuring the underlying normal fibroglandular breast tissue. Some opacities may have spiculated borders and may be difficult to differentiate from breast cancer. On sonography, marked acoustic shadowing associated with dense fibrosis and oil granulomas is noted [2]. Although useful for the diagnosis of paraffinomas, neither mammography nor sonography can be used to evaluate the surrounding breast tissue that is obscured by the paraffinoma.

Our histopathologic correlation is limited because few patients undergo surgery. The proposed explanation for the different components of paraffinoma observed on MR imaging is based on the available histopathologic correlation for three breasts in our series and also on the histopathologic descriptions of previously reported paraffinoma specimens.

Previous histopathology reports describe a plaquelike fibrous component and multiple paraffin-containing cystic spaces similar to our histopathologic findings [1, 6]. In addition, multiple foci of dystrophic calcification in the interstitial space and cystic spaces have been reported [1]. On the basis of this report and the multiple ring calcifications often seen on mammography, we hypothesize that the magnetic susceptibility artifact around the rim of the round component is likely to be due to calcification within the paraffin-containing cystic spaces. Calcification distorts the magnetic field locally, causing MR signals to be misregistered and compressed at the rim.

The signal intensity of the main component, in keeping with the signal intensity of fibrous tissue, is low to intermediate on both T1-weighted and T2-weighted MR imaging sequences.

The signal intensity of the paraffin-containing round component is characteristic: It is low on both T1-weighted and T2-weighted sequences and is markedly suppressed on fat-suppression sequences (even hypointense to subcutaneous fat). The fat-saturation sequence was optimal for detection of this component.

We found the signal of paraffinomas to be different from the signal of in vitro liquid paraffin on T1-weighted sequences; that is, paraffinomas were gray but in vitro liquid paraffin was bright. We propose the following explanation for this discordance. Liquid paraffin, a long period after being injected into the breast, converts into a semisolid state. Because protons in a semisolid state are relatively restricted, they generate little MR signal, and semisolid paraffin is therefore hypointense on T1-weighted images. This reasoning also explains why, on T2-weighted images, the signal intensity of paraffinomas is lower than the signal intensity of in vitro liquid paraffin.

With MR imaging, we were able to evaluate normal fibroglandular breast tissue clearly, without obscuration by paraffinomas. We hypothesize that MR imaging would be the best imaging technique for the detection of breast carcinoma in patients with paraffinomas. In addition, the whole extent of the paraffinoma can be delineated with MR imaging, especially with the advantage of multiplanar imaging. Because the treatment for paraffinoma is surgical, MR imaging is useful for preoperative evaluation to aid complete excision and to prevent the development of "recurrent" masses in cases of incomplete excision [1].

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