Benign breast lesions mimicking carcinoma at mammography
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ABSTRACT
Many benign breast lesions pose diagnostic challenges. These lesions include abscess, haematoma, radial scar, post surgical scar, diabetic mastopathy, focal fibrosis, sclerosing adenosis, granular cell tumour, extra-abdominal desmoid tumour, medial insertion of pectoralis muscle and sternalis muscle, and axillary lymphadenopathy (due to HIV infection, collagen vascular lesions, tuberculous and bacterial lymphadenitis). Radiologists should be familiar with the characteristic imaging features of these benign lesions, and should include these benign lesions in the differential diagnosis whenever malignant-appearing findings are encountered. Correlation of the patient’s clinical features with the mammographical findings and the additional use of ultrasonography (US), fine-needle aspiration biopsy (FNAB) or core biopsy are helpful in establishing the final diagnosis and obviating unnecessary surgical intervention. In some of these lesions, surgery may be avoided while in others, the appropriate surgical procedure may be planned. Knowledge of these lesions can help radiologists narrow the differential diagnosis and decide whether or not to do a biopsy for a certain condition.

RADIAL SCAR
Radial scar (RS) is a benign lesion that is often mistaken for carcinoma because of its spiculated appearance. Tabar and Dean listed the mammographical characteristics that may help to differentiate RS from carcinoma, which include: varying appearances in different projection, no discrete central mass, long thin radiating spicules against a background of a radiolucent centre that creates a ‘black star appearance’, and absence of a palpable mass or skin changes. Associated microcalcifications have been reported. RS is typically planar in configuration, therefore, it may have varying appearances on the orthogonal view (Fig. 1a). On US, RS is seen as an irregular hypoechoic mass (Fig. 1b). Nevertheless, imaging is unreliable in differentiating RS from carcinoma, since carcinoma may mimic the typical RS. Conversely, RS may have both a dense centre and associated microcalcifications, similar to carcinoma. Contrast-enhanced magnetic resonance mammography

INTRODUCTION
Most of the lesions that occur within the breast are benign. Many of these have typical appearance on mammography and rarely require further evaluation. However, some of these benign lesions cannot be differentiated from carcinoma and need further evaluation or biopsy to arrive at the diagnosis. These benign lesions include:

- Fat necrosis
- Surgical scar
- Abscess
- Extra-abdominal desmoid tumour
- Granular cell tumour
- Haematoma
- Medial insertion of pectoralis muscle and sternalis muscle
- Axillary nodal hyperplasia and lymphadenitis

Radiologists should be familiar with the characteristic imaging of these benign lesions and should include these benign lesions in the differential diagnosis whenever malignant-appearing findings are encountered. Correlation of the patient’s clinical features with the mammographical findings and the additional use of ultrasonography (US), fine-needle aspiration biopsy (FNAB) or core biopsy are helpful in establishing the final diagnosis and obviating unnecessary surgical intervention. In some of these lesions, surgery may be avoided while in others, the appropriate surgical procedure may be planned. Knowledge of these lesions can help radiologists narrow the differential diagnosis and decide whether or not to do a biopsy for a certain condition.
examination, RS has a central fibroelastic core and radiation of distorted ducts and lobules, which are composed of benign proliferation such as sclerosing adenosis, atypical ductal hyperplasia, cyst formation and papillomatosis.

To permit the precise pathological diagnosis of RS, excisional biopsy of the entire lesion is preferable to FNAB or core needle biopsy because of its pathological heterogeneity.

(CE-MRM) has been reported to be superior to mammography in differentiating RS from carcinoma. Breast carcinomas are usually enhancing, but RS is non-enhancing, at CE-MRM. However, some carcinoma foci existing within RS may not enhance. Therefore, surgical biopsy is recommended in all mammographically-visible spiculated lesions that do not develop after surgical biopsy. At pathological examination, RS has a central fibroelastic core and radiation of distorted ducts and lobules, which are composed of benign proliferation such as sclerosing adenosis, atypical ductal hyperplasia, cyst formation and papillomatosis. To permit the precise pathological diagnosis of RS, excisional biopsy of the entire lesion is preferable to FNAB or core needle biopsy because of its pathological heterogeneity.
SCLEROSING ADENOSIS

Sclerosing adenosis is a form of fibrocystic change, and is a combination of adenosis and stromal sclerosis.\(^{(9)}\) Adenosis refers to epithelial and myoepithelial proliferation of the lobules. As a result of sclerosis which develops in the evolution of adenosis, the lobules become irregular and distorted. The mammographical appearances of sclerosing adenosis include microcalcifications, a circumscribed mass, discrete mass with ill-defined margins, spiculated mass, asymmetrical focal density, and focal architectural distortion.\(^{(9-11)}\) These findings cannot be differentiated from carcinoma, and biopsy is mandatory (Figs. 2–3). On US, sclerosing adenosis may appear as a focal acoustic shadowing without a mass configuration, well-circumscribed oval or lobulated contour, microlobulation and irregular mass or irregular mass with posterior acoustic shadowing.\(^{(11)}\)

DIABETIC MASTOPATHY

Diabetic mastopathy is an unusual form of stromal fibrosis with lymphocytic infiltration, and typically occurs in premenopausal women with longstanding type I diabetes mellitus.\(^{(12)}\) Rare cases of diabetic mastopathy have also been reported in association with type II diabetes mellitus and other autoimmune diseases.\(^{(13)}\) Patients present with solitary or multiple, non-tender, hard masses, suspicious for carcinoma. Further investigations with a mammogram shows a dense breast\(^{(13,14)}\) (Fig. 4a), and US shows an irregular hypoechoic mass with posterior acoustic shadow (Fig. 4b). Logan and Hoffman noticed marked acoustic shadowing, even more than what is normally seen in most carcinomas.\(^{(14)}\) FNAB shows a marked resistance to the in-and-out motion of the
needle, and yields sparse material which is inadequate for cytological diagnosis. It has been proposed that, in the right clinical setting, a negative FNAB is sufficient for diagnosing diabetic mastopathy.

Radiologists’ awareness of these findings may help avoid unnecessary surgical biopsy.

FAT NECROSIS

Fat necrosis is a nonsuppurative inflammatory process that often occurs as a result of blunt trauma, surgery, or radiation. However, not all patients present with a clear history of trauma. Fat necrosis is important both clinically and radiologically because it is often confused with carcinoma. The clinical manifestations vary from being asymptomatic, appearing only as a mammographical abnormality, to mobile or fixed hard masses mimicking carcinoma. Fat necrosis has a wide spectrum of mammographical appearances, including oil cyst, spiculated mass indistinguishable from carcinoma (Fig. 5a), calcifications of variable size and morphology, and localised skin thickening. US features of fat necrosis include a solid mass (round, oval

**Fig. 5** Fat necrosis in a 65-year-old woman who had history of breast implantation and a daughter with breast carcinoma. She presented with a palpable right breast mass. (a) Bilateral CC mammograms show an ill-defined mass (arrow) in the medial aspect of the right breast. (b) US image shows an irregular hypoechoic mass and a collapsed implant (arrows). FNAB showed no malignant cells but clinical findings and imaging were highly suggestive of malignancy. Excisional biopsy was performed. (c) Gross specimen shows a collapsed implant and a mass attached to the implant. (d) Photomicrograph of the excised mass shows spiculated border (arrows) of the mass with heavy infiltration of chronic inflammatory cells among fibrofatty tissue. The inflammatory cells include histiocytes and some lymphocytes (Haematoxylin & eosin, × 100).
or ill-defined) (Fig. 5b), anechoic mass with posterior acoustic enhancement, anechoic mass with posterior acoustic shadowing, cystic with internal echoes, cystic with mural nodule, and increased echogenicity of the subcutaneous tissues.\textsuperscript{(18,19)}

**SURGICAL SCAR**

A surgical scar is an area of fibrosis that is seen on mammogram as an area of architectural distortion, or an ill-defined or spiculated mass (Fig. 6a) mimicking carcinoma. History of previous biopsy and correlation of the biopsy site with the mammographically-seen lesion are helpful in the differential diagnosis. A surgical scar should be located in relative proximity to the incision site.\textsuperscript{(20)} Finding of a post-surgical scar in patients with breast cancer treated with conservation therapy may be suspicious of tumour recurrence. On mammography, a benign surgical scar looks different.
Fig. 8 Extra-abdominal desmoid tumour in a 47-year-old woman who presented with a left breast mass. (a) Bilateral CC mammograms show an area of architectural distortion (arrow) in the inner quadrant. (b) US image shows an irregular hypoechoic mass (arrow). FNAB showed no malignant cells but clinical finding and imaging were suggestive of malignancy. Excisional biopsy was performed. (c) Photomicrograph shows an infiltrative border (arrow) mass composed of benign spindle-shaped cells (Haematoxylin & eosin, ×100).

Fig. 9 Granular cell tumour in a 54-year-old woman who presented with a left breast mass for one year. (a) Cleavage view mammogram shows an ill-defined mass (arrow) in the medial aspect of the left breast. (b) US image shows an irregular hypoechoic mass. (c) Photomicrograph shows large tumour cells (arrow) with abundant granular cytoplasm (Haematoxylin & eosin, ×400). (Courtesy of Dr Alice Tang, Department of Radiology, North District Hospital, Hong Kong and Dr Gary MK Tse, Department of Anatomical and Cellular Pathology, Prince of Wales Hospital, Hong Kong.)
on the mediolateral oblique (MLO) and cranio-caudal (CC) views but a recurrent tumour always looks worrisome in both projections.\(^{(20,21)}\) On US, a surgical scar appears as an irregular hypoechoic mass with acoustic shadowing, similar to carcinoma. Finding of a hypoechoic tract connecting from the mass lesion to the thickened skin at the incision site (Fig. 6b) is helpful in diagnosis of a surgical scar. Magnetic resonance (MR) imaging with gadolinium enhancement is helpful in differentiating the scar from carcinoma. A scar is either avascular or hypovascular, whereas a carcinoma is hypervascular. However, both scar and carcinoma tend to enhance during the first 18 months after therapy. Fortunately, recurrent tumours rarely occur earlier than 18 months following adequate therapy.\(^{(21)}\)

**BREAST ABSCESS**

Breast abscess is common during lactation and the diagnosis is usually made clinically. Abscess in the non-lactating period is less common and more difficult to diagnose.\(^{(22)}\) Patients may not have clinical signs of inflammation, and imaging is usually performed to exclude malignancy. Mammograms show an ill-defined mass or an area of focal increased density with distortion (Fig. 7a). These findings cannot be differentiated from those of carcinoma. US is helpful in differentiating abscess from carcinoma. Abscess is usually seen as an ill-defined echogenic mass with central irregular hypoechoegenicity or septations with or without posterior acoustic enhancement, or a complex mass (Fig. 7b); while carcinoma usually appears as an irregular hypoechoic mass, with or without posterior acoustic shadowing.

**EXTRA-ABDOMINAL DESMOID TUMOUR**

Extra-abdominal desmoid tumour or fibromatosis is a benign infiltrative connective tissue tumour. The tumour occurs frequently from the aponeurosis of the rectus abdominis muscle. Fibromatosis of the breast is an extremely rare lesion that may arise from the mammary tissue or represent an extension of a lesion arising deep in the aponeurosis of the chest wall or shoulder girdle. Clinically, the patient presents with a palpable firm mass that is sometimes fixed to the pectoralis muscle or with skin retraction, a finding suggestive of malignancy.\(^{(23-25)}\) On mammography, fibromatosis appears as a spiculated mass (Fig. 8a) simulating carcinoma. On US, it manifests as an irregular hypoechoic mass with posterior acoustic shadowing (Fig. 8b) and resembles carcinoma. Therefore, biopsy is necessary for diagnosis.

**GRANULAR CELL TUMOUR**

Granular cell tumour is an unusual benign tumour originating from Schwann cells. The tumour often occurs in the tongue and many soft tissues of the body, but approximately 8% occurs in the breast.\(^{(23)}\)
Mammographic findings include round circumscribed mass, or irregular mass with ill-defined or spiculated margins (Fig. 9a) that is indistinguishable from a carcinoma. Microcalcifications are usually not present. A variety of US findings have been described, ranging from a circumscribed solid mass with posterior enhancement to a poorly-defined mass (Fig 9b) with acoustic shadowing. (23,26)

HAEMATOMA

Haematoma may result from blunt, surgical trauma, or in patients on anticoagulant therapy. (20) On mammograms, acute haematoma is seen as an ill-defined mass (Fig. 10a) which may mimic carcinoma. Knowing the clinical history and awaiting the passage of time can help in the differential diagnosis. Haematoma becomes well-defined as the lesion organises and decreases in size within weeks. On US, an acute haematoma is seen as a heterogeneous echogenic mass (Fig. 10b). With time, haematoma appears as a fluid collection with low-level echogenicity, fluid-fluid levels, or septations.

MEDIAL INSERTION OF PECTORALIS MUSCLE AND STERNALIS MUSCLE

The pectoralis muscle is seen in approximately 30% of cases on the CC view as a convex structure along the chest wall portion of the image. Occasionally, the medial portion of this muscle is seen as a triangular area of increased density in the medial aspect of the breast (Fig. 11), which may mimic carcinoma. (27,28) This focal area of asymmetric pectoralis muscle is included because of vigorous retraction of the breast and slight external rotation during positioning for the CC view. The sternalis muscle is another uncommon anatomical variant of the chest wall musculature that may appear as a focal density in the medial aspect of the breast on the CC view. (29) This muscle is present in approximately 8% of both males and females, and is of uncertain function.

AXILLARY LYMPHADENOPATHY

Axillary lymph nodes are frequently seen on the routine MLO view as well-defined masses containing a central or eccentric hilar fat. Abnormal axillary nodes are suggested by an increased nodal density and loss of hilar fat density. However, abnormality of the axillary nodes can occur from many causes, including lymphoid hyperplasia from acute and chronic infections, lymphoproliferative disorders (lymphoma and leukaemia), metastasis from primary breast carcinoma and non-mammary primary tumours. (30) On mammograms, it is difficult to differentiate between benign and malignant lymphadenopathy (Figs. 12–13). The presence of macrocalcifications indicates tuberculous infection. The presence of microcalcifications and
spiculated margins is suggestive of primary breast carcinoma metastasis to the axillary nodes.\(^\text{30,31}\) Migration of gold particles from the treatment of rheumatoid arthritis or migration of silicone from ruptured implants to axillary nodes may mimic calcifications in lymph nodes, therefore the clinical history is helpful in the differential diagnosis.

**CONCLUSION**

Many benign breast lesions may mimic primary breast carcinoma, hence causing diagnostic confusion. Mammographers should consider benign and systemic causes in the differential diagnosis when malignant-appearing lesions are encountered. Familiarity of these benign lesions and correlation with the patient’s clinical manifestations may help mammographers to decide whether or not to perform biopsy for certain conditions.

**REFERENCES**

**Question 1.** Concerning radial scar of the breast:
(a) It usually results from surgery. ☐ ☐
(b) Patients are usually asymptomatic. ☐ ☐
(c) A spiculated mass with central lucency is pathognomonic for radial scar. ☐ ☐
(d) Surgical excision should be performed in a lesion suggestive of radial scar because imaging is unreliable to differentiate it from carcinoma. ☐ ☐

**Question 2.** Concerning sclerosing adenosis:
(a) It is a form of fibrocystic change. ☐ ☐
(b) On mammography, it is seen as microcalcifications or a discrete mass. ☐ ☐
(c) It has variable US appearances. ☐ ☐
(d) Imaging is reliable to differentiate it from carcinoma. ☐ ☐

**Question 3.** Concerning diabetic mastopathy:
(a) It typically occurs in post-menopausal women. ☐ ☐
(b) It can occur in women with both type I and type II diabetes mellitus. ☐ ☐
(c) Mammography usually shows a spiculated mass. ☐ ☐
(d) Excisional biopsy can be avoided in women with a typical history, imaging findings, and FNAB which shows a marked resistance to in-and-out motion of needle. ☐ ☐

**Question 4.** Concerning breast abscess:
(a) Abscess occurring in the lactating period may not need an imaging study. ☐ ☐
(b) In non-lactating abscess, patients may present with a palpable lump without signs of inflammation. ☐ ☐
(c) Mammography cannot differentiate it from carcinoma. ☐ ☐
(d) US is more reliable than mammography in differentiating it from carcinoma. ☐ ☐

**Question 5.** Concerning axillary adenopathy:
(a) Normal axillary nodes are usually seen on the craniocaudal view mammogram. ☐ ☐
(b) Axillary adenopathy is suggested by an increased nodal density and loss of hilar fat. ☐ ☐
(c) Benign and malignant adenopathy may be similar on mammograms. ☐ ☐
(d) Breast carcinoma may present as axillary adenopathy without a palpable mass in the breast. ☐ ☐

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