Learning objectives

· Describe the various causes of benign breast lesions that may mimic carcinoma on mammograms.

· Highlight the importance of an integrated approach to these lesions that includes clinical presentation, imaging and cytology/histology to reach the correct diagnosis and prevent unnecessary surgical intervention.

Background

Many benign breast lesions pose diagnostic challenges. It is important for radiologists to be familiar with these benign lesions to avoid unnecessary surgery or to plan the appropriate surgical procedure if needed.

Imaging findings OR Procedure details

The imaging features of many benign lesions may resemble breast cancer, and thus raise suspicion.

However almost all of them have characteristics that, if known by the radiologist suggest their diagnosis and in some cases allows the radiologist to act in a conservative manner either with a short imaging interval, or with a core biopsy and avoid excisional biopsy or even surgery.

We aim to present the subtleties and pearls that allow the presumptive diagnosis of these lesions with radiological-pathological correlation and an explanation of how they may mimic cancer.

<table>
<thead>
<tr>
<th>ABSCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Localized intramammary collection of pus formed by inflammatory disintegration of the breast tissue.</td>
</tr>
<tr>
<td><strong>Aetiology</strong></td>
</tr>
</tbody>
</table>
Cracks in the skin of the nipple areola complex either related to breast feeding or of unknown origin with subsequent infection, usually by a staphylococcus, of the breast tissue.

**Imaging Findings**

**Mammography**

Round or oval dense mass with ill defined or spiculated margins and associated distortion (Figure 1 on page ).

**Ultrasound**

Complex mixed-density, predominantly hypoechoic, partially cystic mass is usually present, often associated with posterior acoustic enhancement (Figure 2 on page ).

Associated mastitis can also be seen in the acute cases presenting as branching fluid collections beneath a thickened skin, likely to represent dilated lymphatics or breast oedema.

May appear solid when its contents are thick and abundant (Figure 3 on page ).

**MRI appearance**

T1WI - Round/oval hyperintense lesion compared to the parenchyma.

T2WI - Round/oval hyperintense lesion.

CET1 fat sat - No uptake of the inner aspect of the lesion but with strong enhancement of its wall.

**Rad-Path Correlation**

Infection of the breast tissue stimulates an inflammatory reaction that with the release of inflammatory mediators which is responsible for the circumscribed accumulate of pus surrounded by inflamed breast parenchyma.

Imaging reflects the stage of the inflammatory changes.

**Key Points**

The clinical history and physical exam provide the key.

Look for a history of lactating, and/or inflammatory changes in the skin; also for signs of systemic illness.

Do not forget that the breast is very tender.
The differential diagnosis is inflammatory cancer.

**CONTUSION / HAEMATOMA**

**Definition**

Blood in the breast tissue either dissecting along tissue planes (contusion) or in a collection (haematoma).

**Aetiology**

Trauma; post intervention.

**Imaging Findings**

**Mammography**

Contusion may appear as a subtle diffuse infiltration of the tissues producing architectural distortion with thickening of the breast trabeculations.

A haematoma presents as a well circumscribed lesion (Figure 4 on page ).

Other appearances may result from the presence of fat necrosis that occurs secondary to trauma or breast intervention.

**Ultrasound**

May present initially as water-density masses. However they can appear as complex cystic masses or even a hyperechogenic mass (Figure 5 on page ).

**MRI appearance**

The appearances change with the "age" of the haematoma. In subacute hematomas (the more frequently imaged) they have the same magnetic characteristics as an abscess (Figure 6 on page ).

T1WI - Round/oval hypointense lesion with a peripheral rim of high signal intensity.

T2WI - Round/oval hypointense lesion.

CET1fat sat - No uptake.

**Key Points**

The clinical history of previous trauma is the clue for the diagnosis.

Nevertheless a follow-up examination in six months should be performed to assure regression of the findings and confirm the original diagnosis.
It is unusual to have long-term sequelae of trauma to the breast and permanent architectural distortion is uncommon.

**RADIAL SCAR**

**Definition**

Also known as complex sclerosing lesion, for lesions greater than 1 cm in maximum diameter, an idiopathic process that produces a scarlike lesion.

Its major significance resides in the difficulty of distinguishing from cancer in any available imaging.

May be associated with in situ carcinoma or even invasive cancer.

**Aetiology**

Unknown.

Some authors state that could be related to previous surgery or trauma; others suggest an inflammatory process or ischemia and infarction occurring in areas of proliferative changes.

**Imaging findings**

**Mammography**

The typical findings are of a "black star" (Figure 7 on page). presents as an area of architectural distortion with long spiculations radiating from a central nidus that is usually fatty or only slightly prominent (Figure 8 on page, figure 9 on page).

In 37% there can be microcalcifications associated.

They have a different appearance on orthogonal views (Figure 9 on page).

**Ultrasound**

Indistinguishable from breast cancer.

Irregular shaped hypoechoic, poorly defined tissue with variable amounts of posterior acoustic shadowing (Figure 10 on page).

**MRI appearance**

T1WI/T2WI - Stellate lesion with SI equivalent to the parenchyma, therefore only detectable when located within fat.
CET1fat sat - They usually have a slight to moderate contrast uptake (Figure 11 on page ).

**Rad-Path Correlation**

The gross specimen shows a chalky mass with connective tissue spicules radiating from a central nidus.

Histologically the nidus is distinguished by a predominant elastic tissue component with fibrosis. The surrounding ducts are distorted.

It is the distortion of the surrounding tissue that mimics breast cancer (Figure 12 on page , figure 13 on page).

**Key Points:**

Radial scar, although benign, is frequently indistinguishable from breast cancer on imaging.

Clinically a clue to its diagnosis is that despite its aggressive imaging appearance it is rarely palpable.

At imaging the presence of an architectural distortion with a fatty or discreet central nidus should raise the possibility of this diagnosis especially if the changes are more obvious on one mammographic view.

When diagnosed excisional biopsy should be performed as in 33% of cases they are associated with atypical ductal hyperplasia and tubular carcinoma.

<table>
<thead>
<tr>
<th>POST SURGICAL SCAR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Architectural distortion secondary to surgical intervention</td>
</tr>
</tbody>
</table>

**Aetiology**

Surgical procedure usually conservative.

**Imaging Findings**

Depend on the time of the post operative period and adjuvant radiation therapy which contributes to the degree of scarring.

**Mammography**

Spiculated architectural distortion (Figure 14 on page , figure 15 on page ).
In early stages a haematoma presenting as large spiculated mass can be present. In later stages if fat necrosis occurs calcium deposition or persistent scar can be present.

**Ultrasound**

Poorly defined area of acoustic shadowing immediately deep to the skin scar. No mass identified except if a haematoma is present (Figure 16 on page ).

**MRI appearance**

T1 and T2 WI - hypointense ill defined area. Architectural distortion with loss of the smooth and regular breast contour. Retraction of the remaining breast tissue may be present.

CET1fat sat - There is no enhancement following contrast medium (Figure 17 on page ).

**Rad-Path Correlation**

The main findings are the presence of fibrosis due to the healing process. Is this healing by fibrosis that causes the distortion seen on mammography and the dense shadowing seen on ultrasound

**Key Points**

- It is a planar phenomenon seen in only one projection; breast cancer is seen in both views
- Remains stable or resolves with time; cancer grows!

### DIABETIC MASTOPATHY

**Definition**

Fibrous proliferation of the breast originally described in association with type I insulin-dependent diabetes.

**Aetiology**

Autoimmune process

**Imaging Findings**

**Mammography**

Asymmetric increase density with ill-defined margins (Figure 18 on page ).
Ultrasound

Hypoechoic heterogeneous mass with ill-defined margins, with marked posterior acoustic shadowing (Figure 19 on page ).

MRI appearance

T1/T2 WI - hypointense area

CET1 fat sat - homogeneous low-enhancement with a gradual progressive course without a washout.

The time intensity curve is related to benign lesions of low vascularity. It is this characteristic that allows this technique to differentiate diabetic mastopathy from breast cancer.

Rad-Path Correlation

Histologically there is an increased density of fibroblasts in the stroma and lymphocytes are characteristically found collected around and in the walls of small blood vessels.

Key Points

Search for history of insulin dependent diabetes.

May mimic lobular carcinoma especially on US.

CEMRI is the best technique to differentiate between benign and malignant aetiology.

Recurrent and bilateral in 63% of cases; therefore a previous positive biopsy enable these masses to be followed closely with ultrasound avoiding surgical excision.

However new masses should be critically evaluated as breast cancer can co-exist with benign lesions.

FAT NECROSIS

Definition

Benign inflammatory process

Aetiology

Trauma or surgery.
The traumatic event results in the release of fatty substances into the breast stroma leading to an inflammatory response.

**Imaging findings**

They reflect the pathophysiology.

**Mammography**

Acute setting: spiculated mass with architecture distortion (Figure 20 on page [ ], figure 21 on page [ ])

Skin thickening and retraction may also be present.

Latter findings include oil cysts with rounded, centrally radiolucent lesions possibly with bizarre/dystrophic or rim calcifications (Figure 22 on page [ ]).

**Ultrasound**

Great variability.

The most frequent appearance is of an hyperechoic area with small anechoic "cysts" within (Figure 23). on page

**MRI appearance**

T1WI: SI equivalent to parenchyma.

Possible susceptibility artefacts from previous surgical intervention.

Oil cysts present as hyperintense round lesions.

T2WI: Ill defined hyperintense areas due to reactive oedema.

Oil cysts present as round lesions with central fat equivalent SI.

CET1 fat sat:

Early phase of fat necrosis - localized, poorly circumscribed moderate increase uptake.

Late phase of fat necrosis - no enhancement is present unless an inflammatory component is present.

**Rad-Path Correlation**

Histologically is recognised as a sterile inflammatory process with fat filled macrophages and foreign body giant cells surrounded by interstitial infiltration of plasma cells secondary to saponification of fat by means of blood and tissue lipase (Figure 24 on page [ ]).
Key Points

Clinical history of previous traumatic or surgical event is important but is not invariable.

The typical changes with follow-up confirms the diagnosis.

Calcifications with lucent centers equals oil cysts and do not require biopsy.

<table>
<thead>
<tr>
<th>FOCAL FIBROSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
</tbody>
</table>

Focal area of fibrous tissue in the breast.

**Aetiology**

Uncertain.

Some theories include selective hormonal stimulation of the fibroelastic tissue of the breast or the end result of an inflammatory process or just a normal involutional change.

**Imaging Findings**

**Mammography**

Can present as a well-circumscribed mass or as an ill defined lesion.

Less commonly it can present as a developing area of asymmetric density, architectural distortion and a spiculated mass (Figure 25 on page , figure 26 on page ).

**Ultrasound**

Well circumscribed, hypoechoic solid mass, with lobulated or ill-defined margins (Figure 27 on page ).

**MRI appearance**

Indistinguishable from breast tissue in all sequences (Figure 28 on page ).

No enhancement present.

**Rad-Path Correlation**

Histologically they are isolated areas of abundant fibrous stroma with decrease or obliteration of ductal and lobular elements. There is no association with cancer.

Key Points
Focal and isolated area of fibrous tissue.

Without distinctive clinical or imaging findings.

If there is clinical concern biopsy should be performed to exclude malignancy.

**SCLEROSING ADENOSIS**

**Definition**

Adenosis is a common benign lesion of the breast representing an enlarging of the lobule secondary to a benign proliferation of the acini. If combined with distortion is called sclerosing adenosis.

**Aetiology**

Unknown. There is an idiopathic proliferation of the acini (adenosis) with excessive fibrosis (sclerosis) accompanying this adenosis.

**Imaging Findings**

**Mammography**

It presents mainly as round and punctuate or amorphous microcalcification, namely as a cluster or as diffuse calcifications.

It can also be associated with a nodule or a spiculated mass / parenchymal distortions (Figure 29 on page ).

**Ultrasound**

This entity is not usually visible. However they can produce shadowing by attenuating and scattering the beam.

A cluster of tiny cysts with or without calcium may be present (Figure 30 on page ).

**MRI appearance**

Unknown findings (no reported literature) (Figure 31 on page ).

**Rad-Path Correlation**

Histologically there is proliferation of the ductules and lobules in the TDLU with both proliferation of the myoepithelial cells and epithelial cells.

There is stromal sclerosis involving half or more of the TDLU which is elongated, distorted and compressed by sclerosis (Figure 32 on page ).

**Key Points**
It occurs as part of a spectrum of proliferative abnormalities referred as fibrocystic changes.

It is a combination of proliferative adenosis and stromal sclerosis.

It is associated with a 1.5 - 2 increase in the Relative Risk of breast cancer.

Microcalcifications may be indistinguishable from DCIS/LCIS and biopsy with specimen radiography should be performed.

<table>
<thead>
<tr>
<th>MEDIAL INSERTION OF THE PECTORALIS MUSCLE OR STERNALIS MUSCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition and aetiology</strong></td>
</tr>
<tr>
<td>Both are anatomic variant.</td>
</tr>
</tbody>
</table>

**Imaging Findings**

**Mammography**

Triangular shaped opacity in the middle aspect of the breast posteriorly seen on the CC view only. It may be spiculated (Figure 33 on page ).

**Ultrasound**

Reveals a normal pectoralis muscle and excluding the presence of other masses.

**MRI appearance**

Makes a definitive diagnosis by exclusion of other aggressive masses.

As the patient is examined in the prone position the muscles fibres causing the "pseudo" mass are usually clearly seen. CT can also elucidate its origin (Figure 34 on page ).

**Key Points**

The pectoralis muscle is an important anatomic landmark indicating proper positioning of the breast in the MLO view.

As it is not generally view in the CC view its inclusion may create confusion. However its triangular shape, the presence on just one view and no clinical correlation makes the diagnosis of a normal variant. If doubt remains an MR will enable definitive diagnosis

<table>
<thead>
<tr>
<th>AXILLARY LYMPHADENOPATHY OF NON BREAST ORIGIN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong></td>
</tr>
<tr>
<td>Axillary lymphadenopathy secondary to infection or systemic inflammatory disease</td>
</tr>
</tbody>
</table>
Aetiology

Lymphoma

Systemic infections diseases eg toxoplasmosis, mononucleosis; pulmonary infectious eg tuberculosis

Systemic inflammatory conditions as rheumatoid arthritis or scleroderma.

Imaging Findings

Enlarged lymph nodes (>15 mm) in all modalities presenting with thickening of the cortex and loss of fatty hilum (Figure 35 on page ).

Key Points

Bilateral lymphadenopathy usually points to a systemic disorder rather than of breast origin.

Clinical history is the key to the diagnosis. Undertake a thorough review of the symptoms and search other sites for lymphadenopathy such as cervical and inguinal regions.

The following diagnoses although rare should also be considered in the differential diagnosis of an aggressive looking breast mass. However due to their rarity they are usually diagnosed when a biopsy is performed.

<table>
<thead>
<tr>
<th>GRANULAR CELL TUMOR</th>
</tr>
</thead>
</table>

Definition

Benign lesion formally called "granular cell myoblastoma".

Aetiology

Previously believed to originate from muscle, and although its progenitor cell is unclear, most now believe it is of neurogenic origin from the Schwann cells of peripheral nerves.

Although benign they can be locally infiltrative and at palpation may feel fixed to the surrounding tissues and even produce skin retraction.

Imaging Findings

Mammography

Mass with an irregular shape and infiltrative and spiculated margins (Figure 36 on page ).
**Ultrasound**

Hypoechoic solid mass with angulated margins a strong echogenic halo of the adjacent parenchyma and variable amounts of posterior acoustic shadowing (Figure 37 on page, figure 38 on page).

**MRI appearance**

T1WI - low to intermediate SI

T2WI - low to intermediate SI, both sequences with irregular shape and spiculated margins

CET1 fat sat - rim enhancement and heterogeneous enhancement

**Rad-Path Correlation**

Histologically they contain spindle cells and are distinguished by a characteristic granularity to the cell cytoplasm. These granules are periodic acid-schiff positive

**Key Points**

**They are mostly found in the upper aspect of the breast**

**Rare tumour more frequent in the head and neck**

**Its imaging presentation is variable from a round well circumscribed mass to an indistinct and spiculated lesion.**

**Calcifications are seldom present**

**ADENOMYOEPI THELIOM A**

**Definition**

Rare tumour characterized by the presence of both epithelial and myoepithelial cells

**Aetiology**

Unknown. Its origin is from myoepithelial cells.

Breast lesions originating from myopithelial cells are divided into 3 categories: myoepitheliosis, adenomyoepitelioma and myopithelial carcinoma.

**Imaging findings**

**Mamography**

Solitary breast mass, relatively well circumscribed (Figure 39 on page).
Ultrasound

Hypoechoic mass with irregular contours and spicular extensions (Figure 40 on page ).

MRI appearance

Not described

Rad-Path Correlation

Well circumscribed tumor composed of solid proliferation of myoepithelial cells around small epithelial lined spaces.

The majority are variants of intraductal papilloma but a small number appear to arise from lobular proliferation or adenosis.

Malignant transformation occurs rarely (Figure 41 on page ).

EXTRA-ABDOMINAL DESMOID TUMOR

Definition

These are rare lesions that may be associated with Gardner’s syndrome.

They are locally aggressive and require wide local excision.

Aetiology

Genetic or post-traumatic. Most are idiopathic.

Imaging findings

Mamography

Spiculated mass close to the pectoralis muscle

Ultrasound

Hypoechoic mass with variable amounts of posterior acoustic shadowing

MRI appearance

T1WI - Hypo to isointense mass

T2WI - heterogeneous hyperintense mass

CET1 fat sat - slow enhancement.
MRI is also useful to show chest wall involvement as this information is useful for surgical planning.

**Rad-Path Correlation**

Histologically they consist of hypocellular dense fibrous tissue that locally invades the adjacent muscle. The hallmark is the presence of bland-looking spindle cells organized into long sweeping and intersecting fascicles.

The differential diagnosis from fibrosarcoma can be difficult.

**Key Points**

The proximity to the chest wall and associated long projections radiating from them, thicker than the ones associated with cancer can suggest the diagnosis

**However due to its rarity a cancer must be excluded**

**ROSAI DORFMAN DISEASE**

**Definition**

Benign proliferation of histiocytes. Also known as sinus histiocytosis with massive lymphadenopathy.

**Aetiology**

Idiopathic

**Imaging findings**

**Mammography**

Mass lesion with ill defined contours and spiculated margins. Lymphadenopathy is always present (Figure 42 on page ).

**Ultrasound**

Hypoechoic mass, with angular margins and acoustic shadowing. Multifocality and skin thickening is present. Doppler studies reveal a highly vascularised mass (Figure 43 on page ).

Vascularised bilateral lymphadenopathy is also present.

**MRI appearance**

Breast mass with low SI at T1Wi and isointense at T2WI, with spiculated margins that enhances avidly (Figure 44 on page ).
Rad-Path Correlation

Histologically there is a polymorphous infiltrate of histiocytes, mature appearing lymphocytes and plasma cells surrounded by areas of fibrosis.

Key Points

Although rare the presence of a breast mass with aggressive features associated with marked internal vascularisation and multifocal skin thickening should suggest the diagnosis.

Biopsy is always required to diagnose this rare condition and exclude breast cancer.

PSEUDOANGIOMATOUS STROMAL HYPERPLASIA

Definition

Benign tumorous proliferation of breast stroma with a complex pattern of interconnected spaces incompletely lined by spindled myofibroblasts.

At histology it can be confused by a low grade angiosarcoma.

Aetiology

Unknown. Studies have shown a possible hormonal aetiology as these lesions are typically progesterone receptor positive and estrogen receptor negative.

Imaging findings

Mammography

Non calcified mass with well to ill-defined margins

Rarely spiculated (Figure 45 on page , figure 46 on page ).

Ultrasound

Well circumscribed hypoechoic mass.

It can present internal cystic spaces as my have acoustic enhancement or shadowing (Figure 47 on page ).

MRI appearance

T1WI fat sat - Heterogeneous mainly hyperintense with hypointense septa.

T2WI - heterogeneous, mainly hypointense.
CET1fat sat - Heterogeneous enhancement with hypointense septa and hypointense cystic areas. After 5h there is homogenous enhancement with only the septa remaining hypointense.

**Rad-Path Correlation**

Histologically they have a characteristic pattern of proliferation of myofibroblasts that creates slit-like spaces.

---

**TUBERCULOSIS OF THE BREAST**

**Definition**

Infectious disease more common in underdeveloped countries affecting women of reproductive age.

**Aetiology**

Mycobacterium tuberculosis

**Imaging findings**

Breast mass associated with skin retraction, at mammography.

US and MRI features are not described.

**Rad-Path Correlation**

Macroscopically presents as a solid lesion with a central area of caseous necrosis. Histologically the presence of caseous granulomas is the hallmark of the diagnosis.

Microbiology confirms the diagnosis.
Images linked within the text of this section:

**Fig.**: Right breast mammogram shows a 3 cm retro-areolar round mass with ill defined contours.

**Fig.**: Focused breast ultrasound shows a mass with internal mixed echoes and angulated superior margin (arrows) on the right aspect of the nipple. The mass shows posterior acoustic enhancement (star). At physical exam the breast skin was red and indurated. The patient was diabetic. Aspiration was performed and the presence of pus confirmed.
Fig.: In this breast abscess, the predominant sonographic features are those of a solid mass with internal mixed echoes. However, the presence of posterior acoustic enhancement (star) suggests a complex cystic internal nature rather than a solid one.
Fig.: MLO view of the left breast shows a well circumscribed retro-areolar mass (arrow). In the inferior aspect there are microcalcifications (inside circle). The haematoma was secondary to a mamotome breast biopsy of the cluster of microcalcifications.

Fig.: Focused breast US shows a complex cystic mass with posterior acoustic enhancement. A previous history of biopsy at this site and its imaging characteristic confirms the presence of a haematoma.
Fig.: Coronal view of left breast MRI of a haematoma at two different T1WI shows the presence of an isointense and low signal intensity mass in the retroaurolar area. Previous biopsy had been performed
**Fig.**: Diagram of the "black star" that is a characteristic mamogram presentation of a radial scar
Fig.: Mammogram of two surgical confirmed cases of radial scar shows a parenchymal distortion with long spicules radiating from a lucent central nidus on the mammogram on the left and from a denser nidus on the right.
Fig.: Mammogram of the right breast shows on the CC view a spiculated mass (inside red circle). The lesion is not definitively seen on the MLO view. Corresponding paddled views of those areas show in more detailed the spiculated borders of the lesion but only on the CC view (arrow).
Fig.: Ultrasound features of three different cases of surgically confirmed radial scars. In the three cases an hypoechoic ill defined area is present with acoustic shadowing. Although no definitive mass is seen breast cancer cannot be excluded.
**Fig.**: Contrast enhanced MRI shows an hypervascular focal area with ill defined contours and cluster enhancement in the outer aspect of the left breast (arrow). There is moderate initial contrast uptake with continuous increase in the signal intensity curve (benign type of curve). Biopsy confirmed the diagnosis of radial scar.
**Fig.**: Radiogram of the surgical specimen on the left with corresponding histology on the right. A central nidus of scaring (star) with entrapped benign glands (arrows) and radiating areas of fibrosis is seen, perfectly correlating with the imaging findings.

**Fig.**: High magnification of the central nidus of a radial scar clearly demonstrated the presence of elastosis or granular eosinophilic material in stroma (star) that is the hallmark feature of this condition.
**Fig.** Mammogram of the left breast shows two areas of parenchymal distortion. One of them located on the upper outer aspect (arrow) has associated skin retraction and corresponds to a previous lumpectomy for breast cancer. In the inner aspect of the breast there is spiculated mass without skin retraction that corresponds to recurrent breast cancer (open arrow).
Fig.: Post-operative scar after a wide local excision. A parenchymal distortion with skin retraction can be seen in the upper aspect of the right breast. A magnified view depicts a mass with spiculated border in the place of the previous surgery. Follow up after 3 years reveals stability of the scar supporting its benign etiology.

Fig.: US of a post surgical scar shows a hypoechoic area of parenchymal distortion with ill defined borders and posterior acoustic shadowing. No mass was present. Core biopsy was performed (bottom image) that confirmed its benign aetiology.
**Fig.:** Patient with previous history of breast lumpectomy on the left breast presents at chest CT with spiculated soft tissue mass in the upper quadrants (arrow). A breast MRI of the same area shows the same findings of the chest CT of an parenchymal mass is the same signal intensity as the breast tissue on T1WI. Skin thickening is also seen due to radiotherapy treatment. Subtraction images (bottom row) show no uptake by the breast lesion consistent with post operative scar.
**Fig.**: Patient presented to the symptomatic clinic with a palpable mass in the outer quadrant of the right breast. Mammogram of the right breast shows very dense breasts with a slight increase in density in the upper outer quadrant (inside circle).
Fig.: Focused ultrasound of the upper outer aspect of the right breast shows an ill defined heterogeneous hypoechoic area (between callipers) with acoustic shadowing. Core biopsy was performed that confirmed the diagnosis of lymphocytic lobulitis/diabetic mastopathy.
**Fig.**: Right mammogram showing fat necrosis at a biopsy site. In the retro-areolar area there is an ill-defined, spiculated, mixed density mass (arrow). Magnified views show the presence of subtle fatty components.
**Fig.**: Fat necrosis secondary to breast reduction surgery. In the upper outer aspect of the left breast a spiculated mass with heterogeneous density is seen (arrow). The presence of fat within the mass is evident (small arrows) as well is its resolution with time nicely demonstrated in the follow up mammograms.

**Fig.**: Fat necrosis after breast reduction surgery. An ill defined, oval mixed density mass (arrows) is seen in the retroareolar area. Follow up after 1 year shows reduction on the
size of the mass with the presence of coarse calcifications. The fatty component is now smaller but its contours are more irregular due to scaring and fibrosis.

*Fig.*: Three different cases show the sonographic features of fat necrosis. In *A* a hyperechoic mass with central hypoechogeticity is present. This is the most common ultrasonographic appearance of fat necrosis. *B* and *C* show masses with heterogeneous texture although predominantly cystic with posterior acoustic shadowing. Shadowing is related to dystrophic calcifications.
**Fig.** Low magnification of histology of fat necrosis shows fat cells surrounded by inflammatory cells and fat filled macrophages consistent with sterile inflammatory process.
Fig.: Focal fibrosis. In the upper outer aspect of the left breast an area of asymmetry is present with lobulated and ill defined contours.
Fig.: A round mass with well defined borders was detected at screening mammogram.
**Fig.** The mass seen at the screening mammogram in figure 26 at ultrasound presents as a round hypoechoic mass with indistinct borders and posterior shadowing. A biopsy was performed (arrowhead) that revealed the presence of focal fibrosis.
**Fig.**: MRI of the previously described lesion on figure 26 and 27 reveals a well defined mass that does not enhance as shown in the subtraction image (top right image). MIP reconstruction does not show evidence of the mass. This finding is consistent with the absence of enhancement by the lesion.
Fig.: Focused US of the lesion seen in the mammogram of figure 29 shows an oval ill defined hypoechoic masslike lesion. The breast implant is noted (star). A core biopsy was performed (arrowhead) that revealed the presence of sclerosing adenosis.
Fig.: TOP ROW: T1WI and T2WI show an isointense lesion in the inner aspect of the right breast that corresponds to the findings of the mammograms and ultrasound. MIDDLE ROW: Subtraction images at early and late phase show the lesion enhancing less than the adjacent breast parenchyma. BOTTOM ROW: The intensity curve shows moderate initial uptake of the contrast with a continuous increase of enhancement (benign type curve).
Fig.: Histology of sclerosing adenosis at low magnification shows stromal sclerosis (star) and enlarged and distorted TDLU’s (arrows).

Fig.: A triangular masslike density is seen in the inner aspect of the left breast (arrow) in the CC view. No abnormality is seen in the MLO view. The morphology and location is typical for sternalis muscle.
Fig.: Chest CT shows the sternalis muscle (arrow).
Fig.: Axillary lymphadenopathy secondary to non hodgkin’s lymphoma. Patient presented to the breast clinic with discomfort underneath her right axilla. US showed multiple lymphadenopathy with internal vascularity. Non focused US of the ipsilateral breast ultrasound doesn't reveal any abnormality. Mammograms were normal except for the presence of right axillary lymphadenopathy. MRI of the breast is normal except for
the presence of axillary lymphadenopathy. Core biopsy of one of the lymph node reveals the presence of lymphoma.

**Fig.**: Screening mammogram shows a round mass with spiculated and ill defined borders in the superior aspect of the left breast (arrow).
**Fig.:** Ultrasound of the mass detected on mammogram (figure 36) shows a hypoechoic mass with ill defined borders and posterior acoustic shadow.
Fig.: An incidental mass on the breast of a male patient was detected on a chest CT (arrow). Mammograms of the left breast show a small mass with spiculated borders. Focused ultrasound examination reveals an area of marked acoustic shadowing corresponding to the mass seen in the mammogram. Note the similarities between both ultrasound exams (Fig 38 and 37).
Fig.: Screening mammogram of the left breast shows a round mass in the upper aspect of the breast. The findings are non specific and focused ultrasound is performed (Figure 40).

Fig.: Ultrasound shows an oval hypoechoic mass, with microlobulated contours (between calipers).
Fig.: The three slides show solid proliferation of myoepithelial cell around small epithelial spaces typical of this benign tumour.
**Fig.**: Mammogram shows a mass in the inner aspect of the left breast with spiculated and ill defined margins. Axillary lymphadenopathy (arrow) is also present.

**Fig.**: Ultrasound shows a hypoechoic, masslike lesions with ill defined borders and markedly vascular. Patchy skin thickening (arrow) overlying an ill defined vascularised hypoechoic mass is also seen.
**Fig.:** MRI of the left breast. At T1WI and T2 WI (a-d) a low signal intensity mass at T1WI (a, b) and isointense mass at T2 WI (c, d) corresponding to the mass seen at mammograms and ultrasound is present. The contrast enhanced images shows an avid enhancement by the mass (e-h), nicely demonstrated at the subtraction images (g, h). Internal fibrotic areas are also seen as low signal reticular areas at the subtraction images (g, h).
**Fig.:** Screening mammogram shows a lobulated mass in the lower inner quadrant of the left breast (arrow). The mass has indistinct margins.
Fig.: Screening mammogram reveals in the upper posterior aspect of the right breast (arrow). The mass is oval shaped and relatively well defined contours however the mass in only partially seen in the MLO view.
**Fig.**: Ultrasound of three different cases show PASH presenting as an oval, well defined mass. Its echogenicity can vary from hypoechoic, isoechoic and hyperechoic (a, b, c respectively).
**Fig.** An ill defined area of increased density in the upper outer quadrant of the right breast is seen. Located inferiorly and medially (arrows) a cluster of linear microcalcifications is also seen. An implant is also present.
Conclusion

The goal of imaging in breast pathology is to identify malignancy and distinguish it from benign conditions or even anatomic variants.

Benign breast lesions are common and sometimes assume an aggressive appearance.

Familiarity with the different diagnosis, imaging findings and pathological correlation is important, for high quality and safe patient care.

Personal Information

Ana Catarina Silva, M.D.
5th year Radiology Resident from Unidade Local de Saúde de Matosinhos, EPE, Portugal.
Current fellow at the Cambridge Breast Unit, at the Addenbrookes Hospital, Cambridge, UK.
Contact: acsilva.hph@gmail.com

References


Bilgen IG, Ustum EE, Memis A. Fat necrosis of the breast: clinical, mammographic and sonographic features.
Venta LA, Wiley EL, Gabriel H, Adler YT. Imaging features of focal breast fibrosis: Mammographic-pathologic correlation of noncalcified breast lesions.


Breast imaging companion (paperback) by Gilda Cardenosa, second edition.


Breast MRI by Elizabeth Morris and Laura Liberman. Springer.