INTRODUCTION

Most clinical or subclinical breast lesions are benign and can be appropriately characterized by imaging studies. In addition, the introduction of BI-RADS classification for mammography, ultrasound (US) and magnetic resonance imaging (MRI) reports has made it possible to assign a predictive value of malignancy according to well-established morphological criteria.

When a lesion is detected, features such as irregular shape and spiculated margins on mammography, or posterior acoustic shadow and predominant vertical diameter on ultrasonography (US) have a high level of suspicion for malignancy. However, there are benign lesions that may have these imaging features. These lesions include:

- Radial Scar
- Carbon Granulomas
- Fat Necrosis
- Diabetic Mastopathy
- Sclerosing Adenosis
- Pseudoangiomatous Stromal Hyperplasia
- Granular Cell Tumor

All cases will require further mammography, ultrasound, MRI projections or different types of biopsy to arrive at a definite diagnosis. These findings together with the patient’s clinical data and history will allow for an appropriate management of the patient. Some of these lesions, though benign, require surgery, while others only require follow-up after diagnosis.

Anatomical and radiological correlation is essential to analyze this group of lesions and to define their management and follow-up.

In this pictorial essay we describe those lesions that in our practice showed images categorized as BI-RADS 4c and 5 according to the American College of Radiologists (ACR) with benign histologic findings.

Radial Scar (RS)

Radial Scar is a benign lesion of spiculated appearance, indistinguishable from carcinoma at imaging studies. From the pathologic viewpoint, it is part of a group of lesions known as complex sclerosing lesions. It has a fibroelastotic core towards which varying degrees of adenosis and fibrocystic changes converge (1). It has been reported in the literature that 28% of radial scars larger than 1 cm were associated with tubular carcinomas, ductal carcinoma in situ or other variants of invasive carcinoma (2). When RS is suspected, the appropriate approach is surgical biopsy, as it is necessary to evaluate the entire lesion in order to rule out a coexisting carcinoma.

Mammography typically shows an area of distortion with long spicules radiating from a radiolucent centre (Figures 1a and b). The lesion is often more evi-
Benign breast lesions

dent in one of the two mammographic views, either the craniocaudal or the mediolateral view. On US, it may appear as an area of distortion with posterior acoustic shadowing without a mass, or as a mass with ill-defined borders (3) (Figure 1c).

The presence of a radiolucent centre in a spiculated lesion should not lead to rule out the possibility of carcinoma, as the mammographic features of both lesions are similar.

Carbon Granulomas

Carbon granulomas occur when following percutaneous instillation of inactive carbon as a preoperative marker of impalpable lesions, carbon is not fully removed during surgery, generating a granulomatous reaction and resulting in mammographic and ultrasound findings suspicious for malignancy (4, 5).

Granulomas are small nodules that form as an inflammatory proliferative reaction. They are essentially composed of macrophages in association with necrosis, newly-formed vessels, fibroblasts and collagen. Inflammation subsequently recedes and granulation tissue becomes surrounded by dense scar tissue.

On mammography they appear as dense and irregular or poorly defined nodules (Fig. 2a), and on US they appear as hypoechoic, heterogeneous masses of irregular borders, with posterior acoustic attenuation (Fig. 2b).

History of preoperative marking may help in the diagnosis; however, because of the suspicious appearance of the lesion, it is essential to perform a biopsy to rule out malignancy. Figure 2 (c and d) shows fine needle biopsy findings (dark-pigmented fluid in the smears) and core biopsy specimens (cylinders of tissue stained with carbon pigment).
Fat Necrosis (FN)

Fat necrosis is a benign inflammatory process that occurs as a result of trauma or surgery and may mimic carcinoma on clinical examination or imaging studies. FN may be seen following blunt trauma, percutaneous biopsy, lumpectomy, reduction mammoplasty, breast reconstruction, implant removal as well as in patients with no evident history of trauma.

It may appear as an asymptomatic finding in a screening mammography or as mobile or fixed hard masses.

The mammographic appearance includes a postoperative oil cyst with or without peripheral calcifications (Fig. 3a), nodular opacity, asymmetrical density, skin and subcutaneous tissue thickening, dystrophic calcifications, pleomorphic microcalcifications simulating intraductal carcinoma and nodules of spiculated borders. The US appearance ranges from cystic lesions with echoes or small mural vegetations (Fig. 3b) or with small irregular mural vegetations (Fig. 3c) to ill-defined nodular lesions, with or without posterior acoustic shadowing or nodules of irregular shape that often lead to fine-needle aspiration biopsies, as they appear on mammography as dense nodular lesions of irregular shape and spiculated borders, mimicking malignancy (Fig. 4a, b and c). On MRI, fat necrosis has varying appearances depending on the stage of development and on the degree of fibrosis.

Fig 3: Fat necrosis: oil cyst (a) mammography: nodular lesion with radiolucent centre (*), calcified walls and partially spiculated borders (arrowhead). Skin scar marking with metallic wire; (b) ultrasound correlation shows cystic lesion of fine walls with hyperechoic small mural vegetation (*) and internal echoes (arrowhead); (c) in another patient ultrasound shows cyst with irregular small mural vegetations (*).

Fig 4: Fat necrosis subsequent to percutaneous breast biopsy. Sixty-five year-old patient with a history of vacuum-assisted biopsy of the right breast with 11-Gauge needle. Right mammography 18 months after puncture, focused on the area of previous biopsy: (a) CC view; (b) MLO view. Both views show a dense nodular lesion of irregular shape and spiculated borders (arrows). (c) Ultrasound: nodule of irregular shape with ill-defined borders (arrow) and US attenuation (*).
Benign breast lesions

Lesions are usually hyperintense on T1 because of their fat content, and their enhancement may be identical to that of carcinoma (10-11), with a peripheral irregular enhancement surrounding an avascular centre. The presence and degree of enhancement depend on the intensity of the inflammatory process accompanying this lesion; with the amount of enhancement being larger in the early phase of the inflammatory process, when there is increased vascularization.

Sclerosing Adenosis
Sclerosing Adenosis is a proliferative lesion of the breast that forms part of the so-called fibrocystic changes; it is a combination of epithelial and myoepithelial hyperplasia and stromal fibrosis. It is generally subclinical, although it may appear as a palpable area with increased consistency, with varying appearances on imaging studies. The most common appearance is a cluster of heterogeneous microcalcifications on mammographic exams. Other forms of appearance include a circumscribed mass, mass with ill-defined margins and spiculated mass (12, 13) (Fig. 5a and b). On US, sclerosing adenosis may appear as an area of posterior attenuation with or without a mass. In all cases, biopsy is mandatory to rule out malignancy.

Pseudoangiomatous Stromal Hyperplasia (PASH)
PASH is a benign lesion that generally occurs in premenopausal women or postmenopausal women on hormone therapy.
Histologically, it is a proliferation of the breast stroma forming pseudovascular spaces, which must be differentiated from low-grade angiosarcoma.

It may be incidentally found in microscopic examination of up to 23% of biopsy specimens (14), or, more rarely, it may occur as a nodule. In these cases, it appears as a nodule indistinguishable from a fibroadenoma or as a nodule of irregular shape with or without US attenuation (Fig. 6a and b).

The diagnosis by percutaneous biopsy, in the absence of clinical suspicion, is sufficient to permit the follow-up of these lesions with imaging studies (35).

Diabetic Mastopathy (DM)

Diabetic Mastopathy is a rare inflammatory lesion that occurs in premenopausal women with longstanding insulin-dependent type I diabetes.

Histologically, it consists of lymphocytic lobulitis with predominance of B cells associated with stromal fibrotic changes.

Patients present with solitary or multiple palpable masses, which in some cases appear in both breasts. Clinically, these lesions mimic invasive carcinoma. On mammography, DM appears as ill-defined asymmetric tissue densifications without microcalcifications (Fig. 7a). US shows irregular nodules or poorly defined hypoechoic areas, both with marked US attenuation (Fig. 7b) and consistent palpable focal masses (16, 17). The diagnosis of DM by core biopsy in this imaging and clinical setting is sufficient in the absence of other associated suspicious findings, and allows the follow-up of these lesions.

Granular Cell Tumor (GCT)

Granular Cell Tumor is an unusual benign tumor that rarely involves the breast. The reported incidence is 1/1000 breast carcinomas.

This tumor is assumed to have a neural (Schwann cell) origin. Histologically, the tumor is made up of sheets of polygonal cells with abundant eosinophilic granular cytoplasm.

GCTs occur more commonly in middle-aged, premenopausal women, but a few cases have been reported in men. A higher incidence has been reported among the black population (18).

A GCT may occur on the surface or deep below the skin, and it is more often located in the inner quadrants. Clinically, it resembles invasive carcinoma.
When located superficially, GCTs may cause skin retraction and in deep location, they may be fixed to the pectoral fascia.

Mammographic findings include dense circumscribed or irregular nodules, sometimes spiculated, without microcalcifications (Fig. 8a and b).

On ultrasound, GCTs appear as round or irregular hypoechoic solid nodules of heterogeneous echotexture (19). They may have a peripheral hyperechoic halo (Fig. 8c).

When GCTs cause ultrasound attenuation, their appearance resembles that of carcinomas.

The diagnosis may be performed by core biopsy, and the histologic differential diagnosis includes apocrine carcinoma and granulomatous histiocytic lesions.

The treatment for GCT is complete surgical excision with adequate margins.

CONCLUSION

Radiologists should be familiar with the imaging features of benign lesions which, because of their appearance, may mimic carcinoma in diagnostic tests.

Knowledge of these benign lesions will enable radiologists to suggest an adequate diagnostic and follow-up algorithm, so that unnecessary invasive procedures may be avoided in many cases.

References

11. Solomon B, Orel S, Reynolds C, Schnall M. Delayed development of enhancement in fat necrosis after breast conserva-
15. Hargaden G, Yeh ED, Georgian-Smith D et al. Analysis of the Mammographic and Sonographic Features of pseudo-