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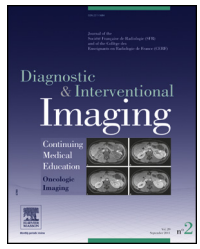

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Inflammatory breast disease: The radiologist's role

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Abstract Mastitis is the inflammation of breast tissue. From a pathophysiological point of view, mastitis reflects a variety of underlying etiologies. It can be due to non-infectious inflammation, infection (generally of bacterial origin) but can also be caused by inflammation resulting from malignant tumor growth. Mastitis always manifests clinically by three cardinal signs of inflammation, which are redness, heat and pain. Breast specialists examining women with mastitis should proceed as follows: first, it is important to distinguish between cancer-related and non-cancer-related breast inflammation, since their clinical presentation can be misleading. Cancer-related mastitis reflecting the presence of aggressive cancer is less commonly observed than other forms of mastitis but its diagnosis, which can sometimes be difficult, needs to be made, or excluded, without delay. Once cancer-related mastitis has been excluded, the causes of inflammation should be elucidated to enable rapid treatment and patient recovery.

Radiological presentation of inflammation

The breast is a superficial organ. The clinical signs of breast inflammation are therefore obvious. They include redness, heat and pain. The patient should be questioned as to how inflammation appeared, and notably whether it occurred suddenly or not. Any cases of inflammation that occurred progressively should be regarded as atypical. As is the case in the rest of the body, breast inflammation may be of infectious or non-infectious origin, but it can also be caused by breast cancer.

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Skin thickening is one of the signs that should be sought. Although clinical examination can often evidence skin thickening, radiological imaging enables detailed analysis of the thickness of the dermis and comparison between the affected and contralateral sides. Clinical examination alone is insufficient to adequately assess the extent of skin thickening or detect limited skin thickening. Mammograms reproducibly highlight cases of dermal thickening. Focal skin lesions are better visualized by digital tomosynthesis which provides images of cross-sections of breast tissue. The thickness of the skin can also be estimated adequately by ultrasound examination using a high frequency transducer (Fig. 1).

MRI also provides precise measurements of skin thickness. Radiological imaging highlights the changes to adipose tissue instigated by inflammation, as well as other signs of inflammation. Such changes are only very rarely detected using mammography or MRI. Ultrasound is very effective for detecting hyperechoic fat lobules that are typical findings [1] to look for inflammatory breast tissue (Fig. 2). The extent of the hyperechoic zones is variable and depends on the degree of inflammation.

Subcutaneous dilatation of lymphatic vessels is another cardinal sign of breast inflammation. Ultrasound performs well for visualizing this sign and reveals anechoic slits located at the interface between the dermis, which is generally thickened, and subcutaneous fat. Doppler ultrasound, which evidences the absence of flow (even low flow) within these structures, helps distinguish them from hyperemic blood vessels that are often associated with lymphatic vessel dilatation (Fig. 3).

Breast hyperemia, defined as increased vascularization of breast tissue, is also associated with inflammation [2]. Hyperemia can be evidenced by Doppler ultrasound which reveals an increased number of arterial and especially venous structures. Hyperemia is most visible in the superficial regions of the breast. Such hypervascularization can also be evidenced by MR angiography by comparing the vascular structures of both breasts (Fig. 4).

The possibility of lactiferous duct abnormalities should be investigated in patients with breast inflammation, because some inflammatory conditions are related to lactiferous duct involvement. Ultrasound images can reveal dilated, ectatic ducts with thickened walls and/or echoic contents. Ultrasound should be performed from the nipple towards peripheral zones following a radial pattern to detect possible abnormalities within each breast segment. Mammography is generally not of much help when examining lactiferous ducts, because the latter are not visible on mammograms. Sometimes however, the lactiferous ducts can be visualized by mammography in very dense or very fatty breasts and lactiferous duct abnormalities can be observed. MRI is an appropriate imaging modality for examining the lactiferous duct system due to its high spatial resolution and use of contrast. Indeed, the inflammatory involvement of lactiferous ducts can be determined by injection of contrast medium and assessing wall thickening (Fig. 5).

Radiologists examining patients with breast inflammation should take particular care to detect possible fluid collections. Initial fluid collections within the breast can be small and difficult to detect as they are only very slightly more hypoechoic than the neighboring breast tissue. They are practically always accompanied by hyperechoic changes to the surrounding fat. If a fluid collection is evidenced, its contents are generally found to be hypoechoic, but remain heterogeneous. Typically, it features a fluid-fluid level. The walls of fluid collections can appear as thickened or irregular and tend to spread to and dissect neighboring fat lobules (Fig. 6). Radiologists should search for possible fistula paths towards the skin or lactiferous ducts.

The axilla of patients with breast inflammation should be examined to determine possible lymph node involvement. Lymphadenopathy can be a reaction to inflammation or secondary to metastasis in patients with inflammatory breast cancer. Lymph nodes with regular cortical thickening, smooth borders and a visible central hilum generally reflect a benign condition. On the contrary, malignancy is characterized by focal or off-center cortical thickening combined with abnormalities of lymph node borders with infiltration of the adipose tissue and disappearance of the central hilum (Fig. 7).

Imaging techniques

As discussed hereafter, breast inflammation can arise from a variety of etiologies, some of which can be difficult to diagnose. Full use of breast imaging techniques is therefore crucial to ensure diagnosis is as precise as possible and subsequently to provide the patient with the most efficient treatment. To do this, it is advisable to make use of the whole range of diagnostic methods, without trying to cut expenses. Technically, the choice of modalities should depend on available human and technical expertise and the clinical setting that should take into account the patient's age.

Mammography

Mammography should be proposed to patients aged over 30 years presenting with breast inflammation. The imaging procedure should be adapted in each case to accommodate the pain experienced by patients with breast inflammation. An acceptable compromise must be found between the need for sufficient image quality and the pain caused to the patient by breast compression. Although mammogram quality can sometimes be suboptimal due to issues related to breast compression, the images obtained can provide crucial information for diagnosing and managing the patient's condition. Bilateral mammography should be performed in order to compare the healthy and affected breast. Indeed, the detection of specific details on the affected side involves comparison with the contralateral side and the unaffected side also needs to be screened for clinically undetected disease. Careful examination of mammograms is required to detect possible nodular zones, architectural distortion or microcalcifications. Even discreet details that do not generally raise suspicion may prove decisive for the diagnosis and management of breast inflammation. It can therefore be helpful to use enlarged images and digital tomosynthesis to visualize such details [3].