Breast edema. A pictorial review with pathologic correlation.

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Learning objectives

To review the spectrum of entities both systemic and arising within the breast, which may present clinically with breast edema.

To illustrate imaging findings (mammogram, US and MR) of breast lesions presenting with this striking sign, providing clinical images and pathologic correlation.

To analize the specific management of those lesions, including imaging and interventional procedures.

To emphasize pitfalls, diagnostic difficulties and differential diagnosis.

Background

Breast edema and peau d'orange" sign of the breast are the common appearance of a broad spectrum of diseases ranging from breast lesions to systemic entities, and from benign to malignant lesions.

Recognizing imaging and clinical findings and the specific work-up for these patients is essential in diagnosis.

Findings and procedure details

1. *Clinical appearance*.

Breast edema usually involves both skin and breast parenchyma. Stromal infiltration and lymphatic obstruction with edema causes the so-called ***"Peau d'orange" sign.***

Macroscopic appearance of the breast is that of an orange peel (Fig. 1 on page 20), including:

Fig. 1: Fig 1. Breast edema appears with skin dimpling, a swollen pitted skin surface resembling an orange peel.
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- Skin thickening.
- Skin dimpling, a pitted skin surface.
- Erythema (red and warm skin), or pale colour.
- Tenderness and sometimes breast enlargement.

2. Pathologic appearance.

Cutaneous edema, "peau d´orange"skin, is the hallmark of fine-needle, core biopsy samples and specimens with breast edema. The edematous skin tethered by the sweat ducts which do not swell, causes the dimples (Fig. 2 on page 21).

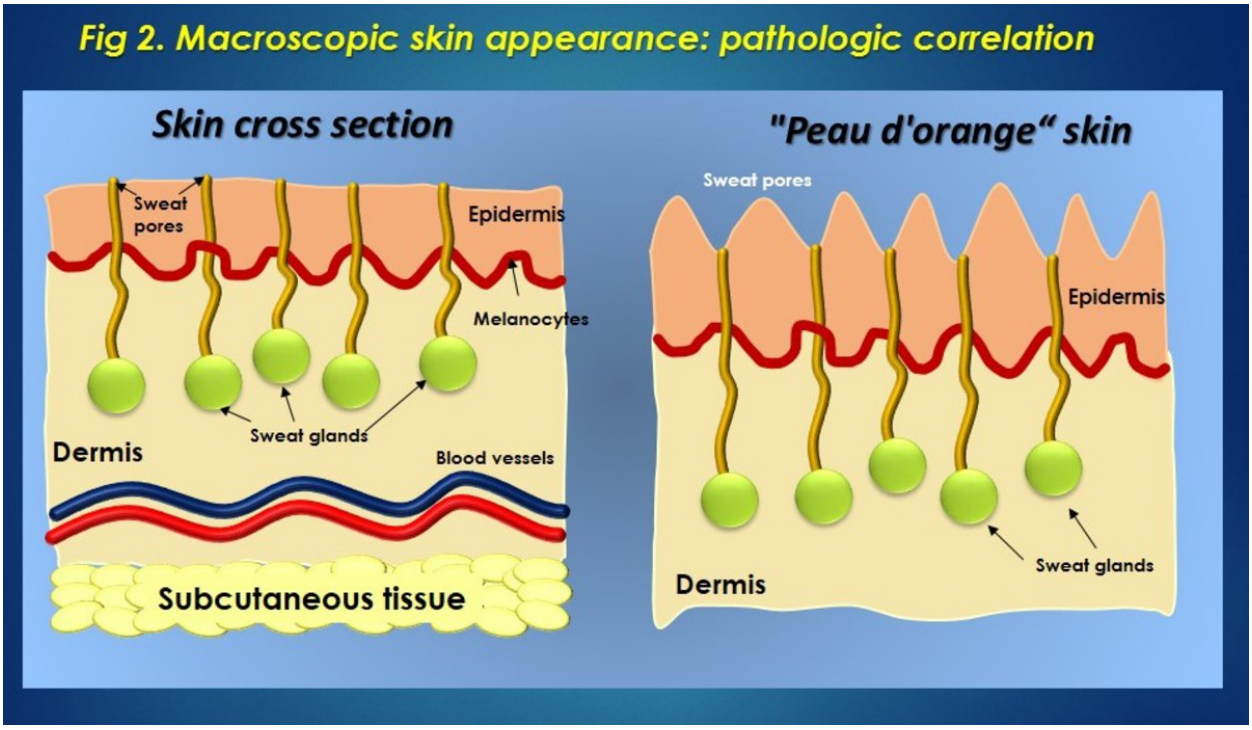

Fig. 2: Fig 2. Macroscopic skin appearance: pathologic correlation. Swelling due to cutaneous edema. The edematous infiltrated skin tethered by the sweat ducts that do not swell causes the dimples.
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

In edema from malignant causes, inflammatory carcinoma obstruction of lymphatics appears, the so-called **TUMOR EMBOLIZATION**. A cluster of neoplastic cells with the appearance of emboli appear within the lymphovascular drainage system, both in the epidermal and subdermal plexuses.

3. ***Imaging****.*

Breast edema may be depicted on different techniques. Key imaging findings are:

- **Mammogram**. Stromal trabecular coarsening and increased density. Skin thickening (more than 3 mm) (Fig. 3 on page 22).

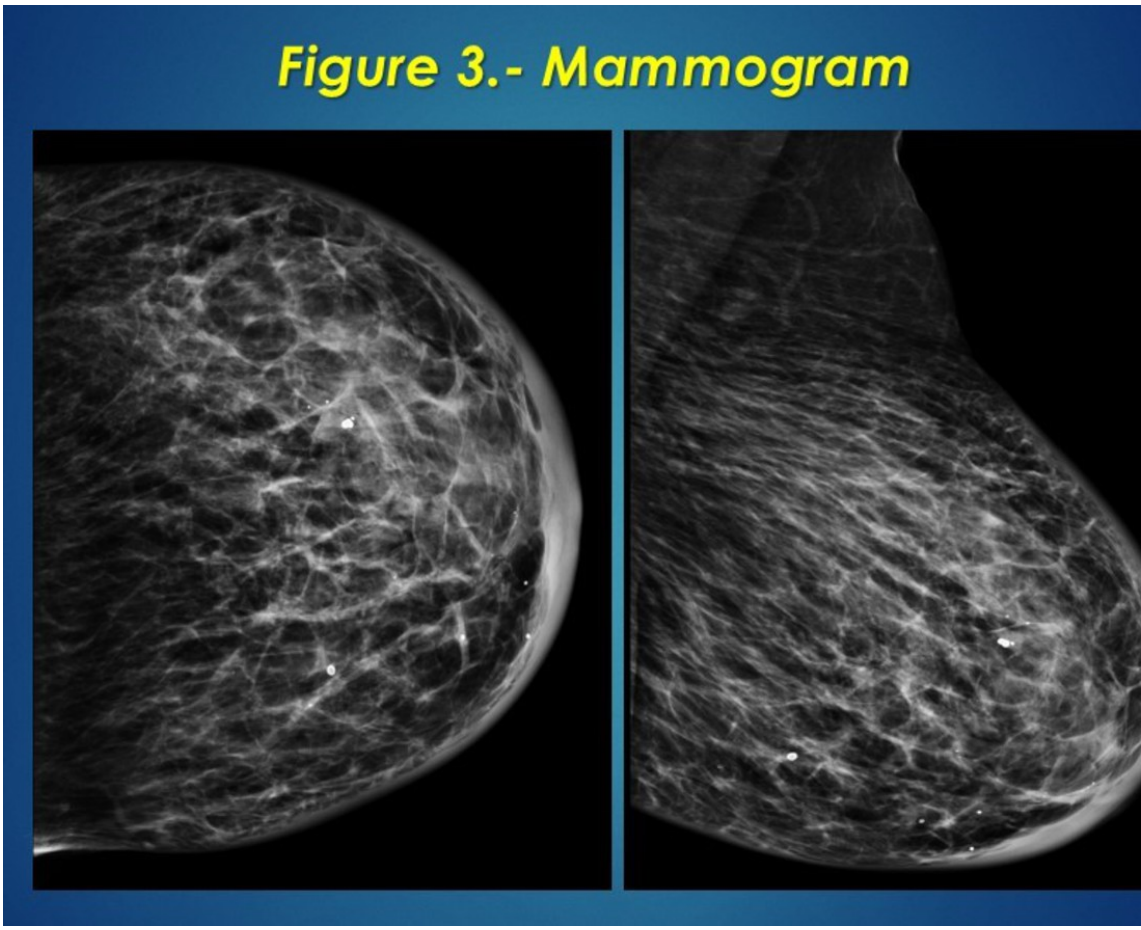

Fig. 3: Fig 3. Mammogram. Skin thickening, Stromal trabecular coarsening and increased density
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ ES

- **US**. Dilated lymphatic channels (anechoic tubular images) in the subdermal fat, parenchymal hypoechoic areas and shadowing (Fig. 4 on page 23).

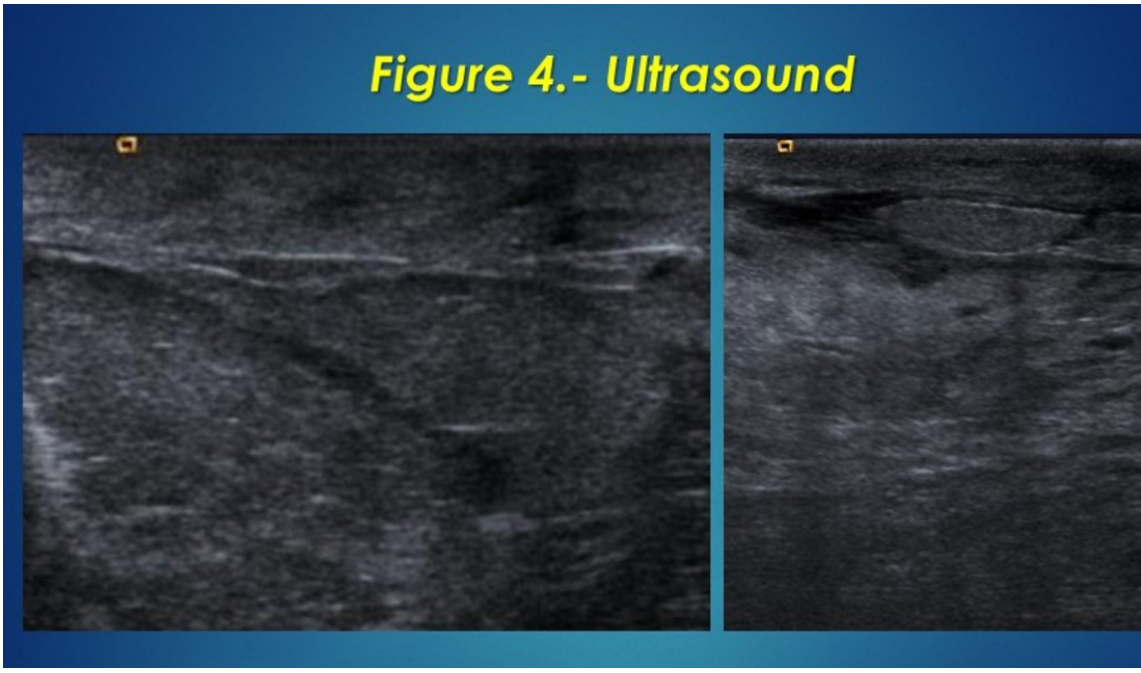

Fig. 4: Fig 4.US. Skin thickening ,anechoic tubular images in the subdermal fat (Dilated lymphatic channels), parenchymal hypoechoic areas and shadowing
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- **MR**. Skin edema appears as thickened T2 hyperintense skin, and hyperintense areas within breast parenchyma (Fig. 5 on page 24).

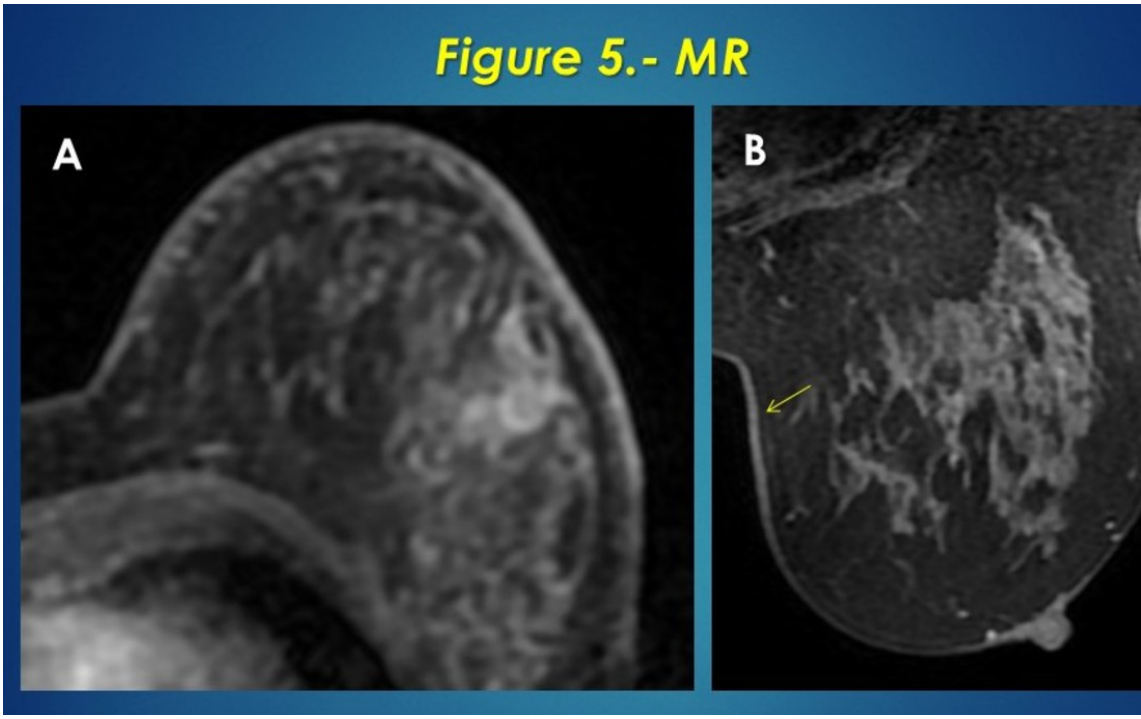

Fig. 5: Fig 5. MR. A T2-weighted axial image. Skin edema appears as thickened hyperintense skin. B Axial T2-w.Normal skin Slight enhancement (arrow)
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ ES

4. Presentation:

Lesions arising within the skin and systemic diseases present with similar clinical findings related to breast edema and "*Peau d´orange sign".* Presentation either unilateral or bilateral helps in differential diagnosis.

4.1. Bilateral:

Systemic diseases: They may also be unilateral in the dependent breast.

- Congestive heart failure,

- Central venous obstruction (Superior vena cava syndrome),

- Dermatosis.

4.2. Unilateral:

Non-mammary origin:

- Surgery,

- Radiation,

-Poor lymphatic drainage due to benign or malignant axillary lymphadenopathy (lymphoma, venous obstruction),

-Dermatosis (scleroderma, angioedema, Churg-Strauss syndrome).

Mammary origin:

- Mastitis-abscess,

- Inflammatory, locally advanced and superficial breast cancer

5.Pathologic entities

5.1. Systemic diseases.

Breast edema involving both skin and parenchyma appear, but no bresat tumor is found.

- **Congestive Heart failure.**

Bilateral breast edema may be due to congestive heart failure, usually in patients with diffuse edemas involving both feet and dependent areas. It may be unilateral or asymmetric, if the patient lies on lateral decubitus (Fig. 6 on page 24).

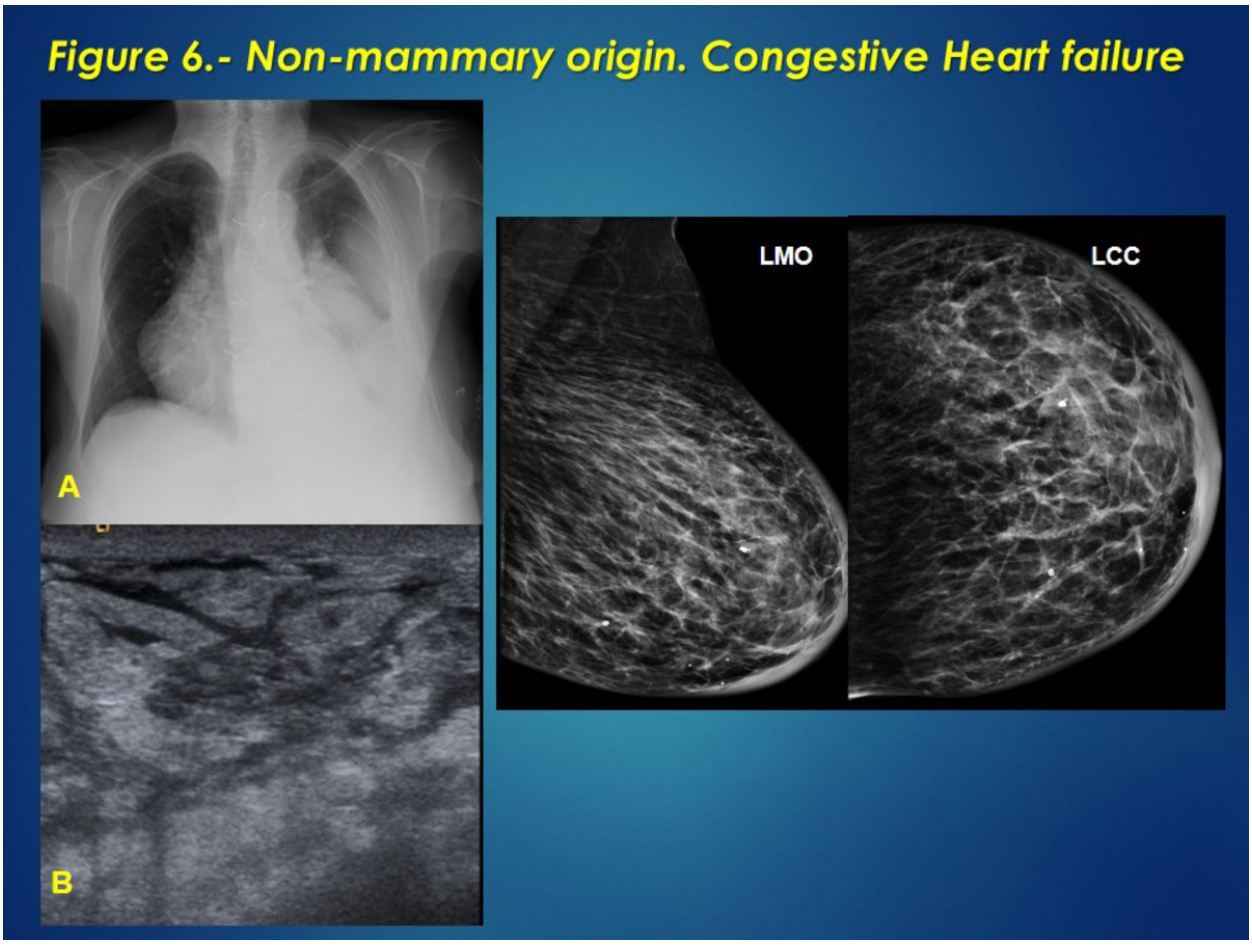

Fig. 6: Fig 6. Non-mammary origin. Congestive Heart failure. 81 yo woman with congestive heart failure. A:Plain chest film depicts signs of congestive heart failure. B: us. C: Mammogram
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- ***Superior vena cava syndrome.***

Superior vena cava syndrome causes edema in the upper region of the thorax including both breasts due to impaired venous return, but unilateral venous occlusion may also appear as an asymmetric or unilateral *edematous breast* (Fig. 7 on page 25).

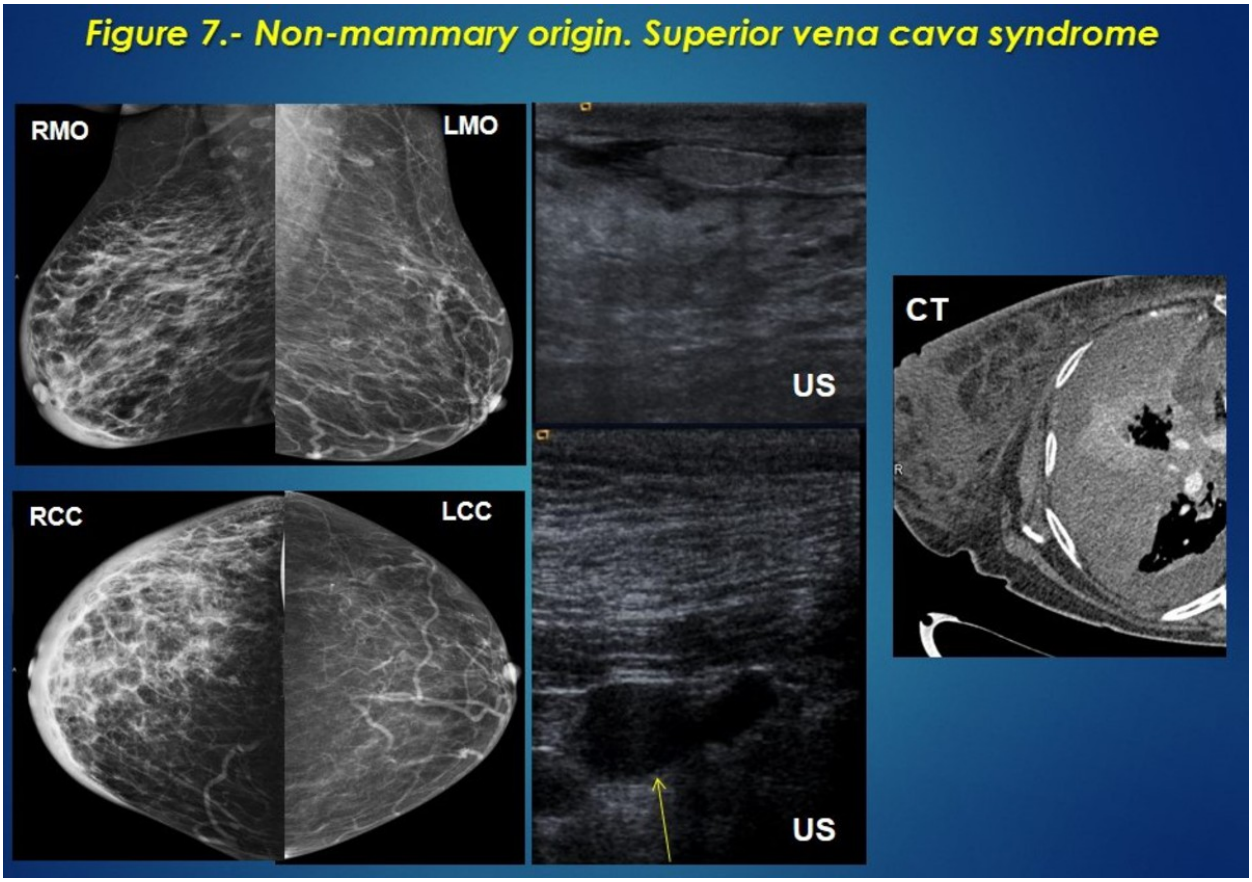

Fig. 7: Fig 7 Non-mammary origin. Superior vena cava syndrome. Right breast peau d´orange in a patient with intense edema due to compression of cava vein by lung cancer and occlusion of right subclavian vein
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- **Dermatosis.**

Different dermatosis may present with skin edema and areas of breast ¨peau d´orange" skin, either focal (morphea, anular erithema), or diffuse (scleroderma, angioedema) (Fig. 8 on page 26).

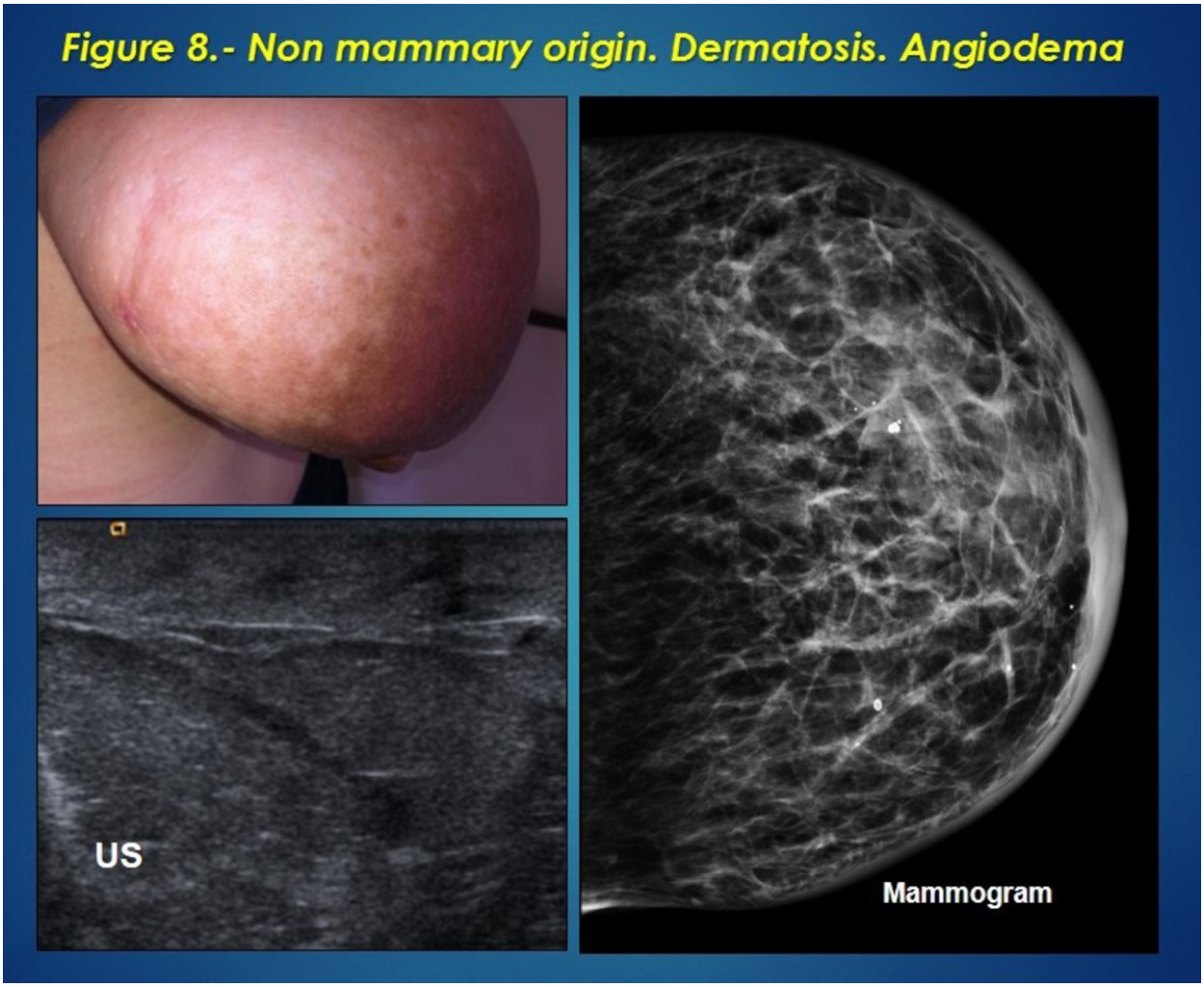

Fig. 8: Figure 8. Angioedema causes diffuse edema involving the breast and including the skin. Mammograms can depict unilateral global increased density, and US may show the characteristic skin thickening.
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- Morphea, is the focal form of scleroderma. Initially an indurated, erythematous painful plaque is depicted on the skin which becomes more fibrotic, with central depigmentation with time.

- Angioedema causes diffuse edema involving the breast including the skin. Mammograms can depict unilateral global increased density, due to diffuse edema, and US may show the characteristic skin thickening, but breast mass is not found.

5.2. Local entities.Only the breast appears involved.

5.2.1.Non-mammary origin.

- ***Surgery.***

Acute changes after surgery cause edema, either focal or diffuse (Fig. 9 on page 27).

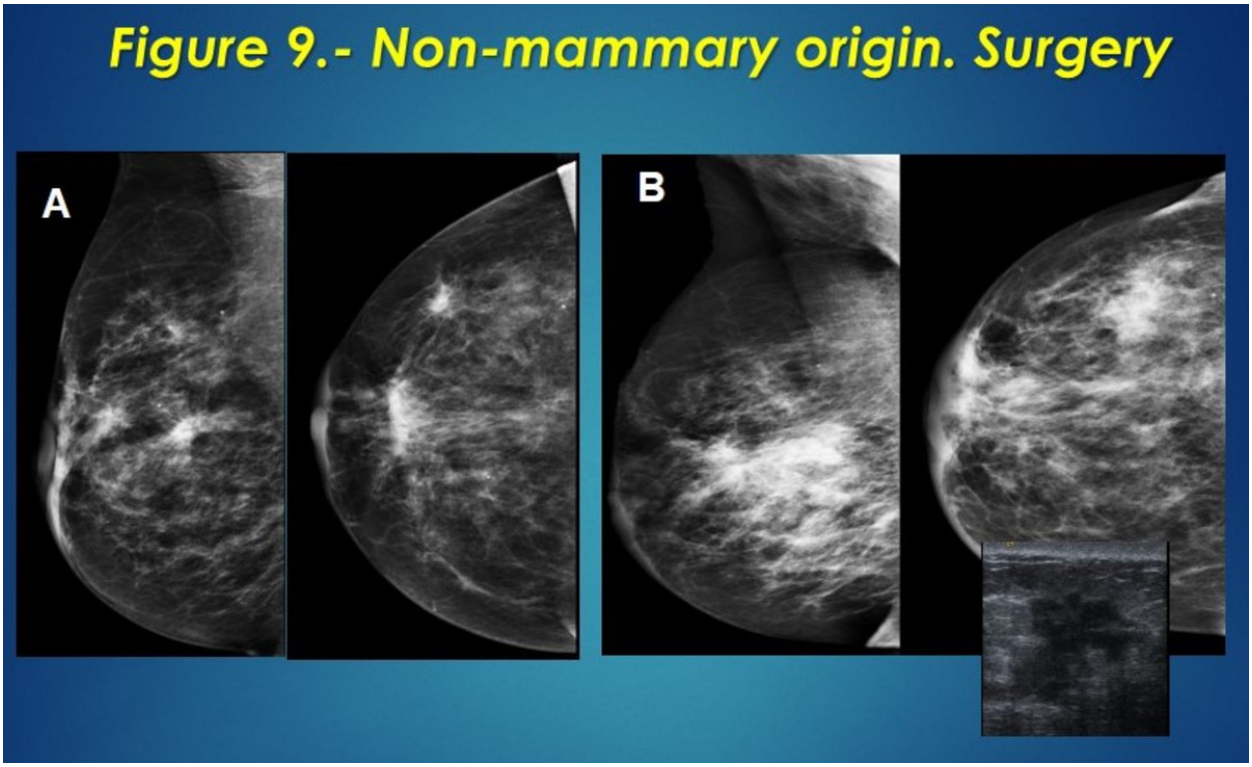

Fig. 9: Fig 9 Non-mammary origin. Surgery. A. 6 months after surgery skin thickness and edema are still present. B. One year later an increase in breast density, skin thickness and diffuse edema indicates tumor recurrence. On US a mass is depicted. ***References:*** Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

The key finding is that typically postsurgical changes become less visible during follow-up. On the contrary, be **aware of an increase in edema signs of the breast in follow-up examinations, which should rise suspicion on tumor recurrence.**

The treated breast (surgery, biopsy) may show skin enhancement on MR.

- **Radiation therapy.**

Changes may be either focal or diffuse depending on the extent of radiation field, typically with a linear border and a non-anatomic configuration

Both acute and chronic post-treatment changes cause increased skin thickness. "Peau d´orange" appears acutely due to skin edema (Fig. 10 on page 28).

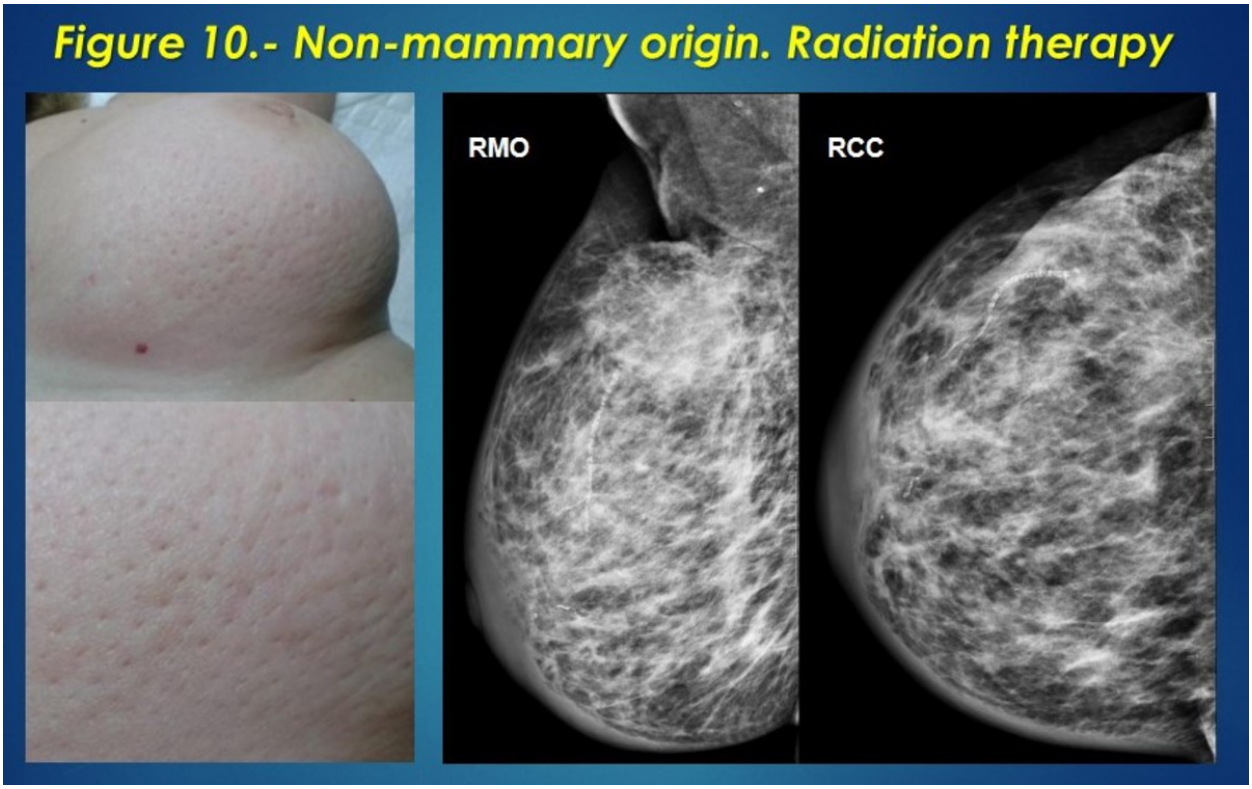

Fig. 10: Fig 10.- Non-mammary origin. Radiation therapy. Left breast peau d´orange in a patient with recent whole breast radiation therapy.
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES
Radiation induces granulation tissue leading to enhancement of the treatment field at both the parenchyma and the skin. On MR skin post-treatment enhancement after radiation may remain for 18 months.

5.2.2. Mammary origin.

- **Mastitis**

It is usually unilateral. Clinical findings are similar to non-mammary causes, but erythema and warm skin are usually present.

- ***Infectious***.

It is most often found in lactating women, but may also appear recurrently in smokers or women with ductal ectasia. Sometimes abscesses may appear (Fig. 11 on page 29).

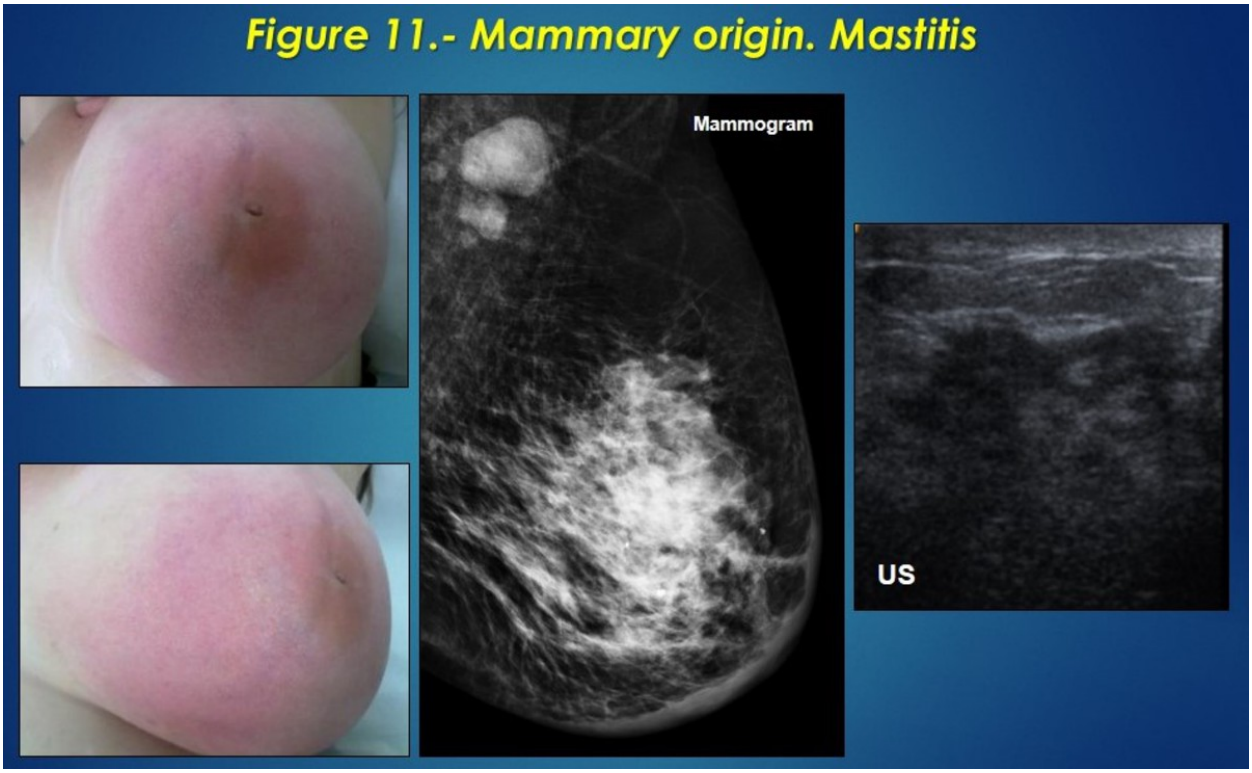

Fig. 11: Fig 11 Mammary origin. Mastitis. 41 yo woman with skin redness and tenderness. Thickened skin and axillary lymphadenopathy on mammogram and US. Infectious mastitis was diagnosed
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- Inflammatory non-infectious

Autoimmune or connective tissue disorders such as scleroderma, granulomatous mastitis (Fig. 12 on page 29).

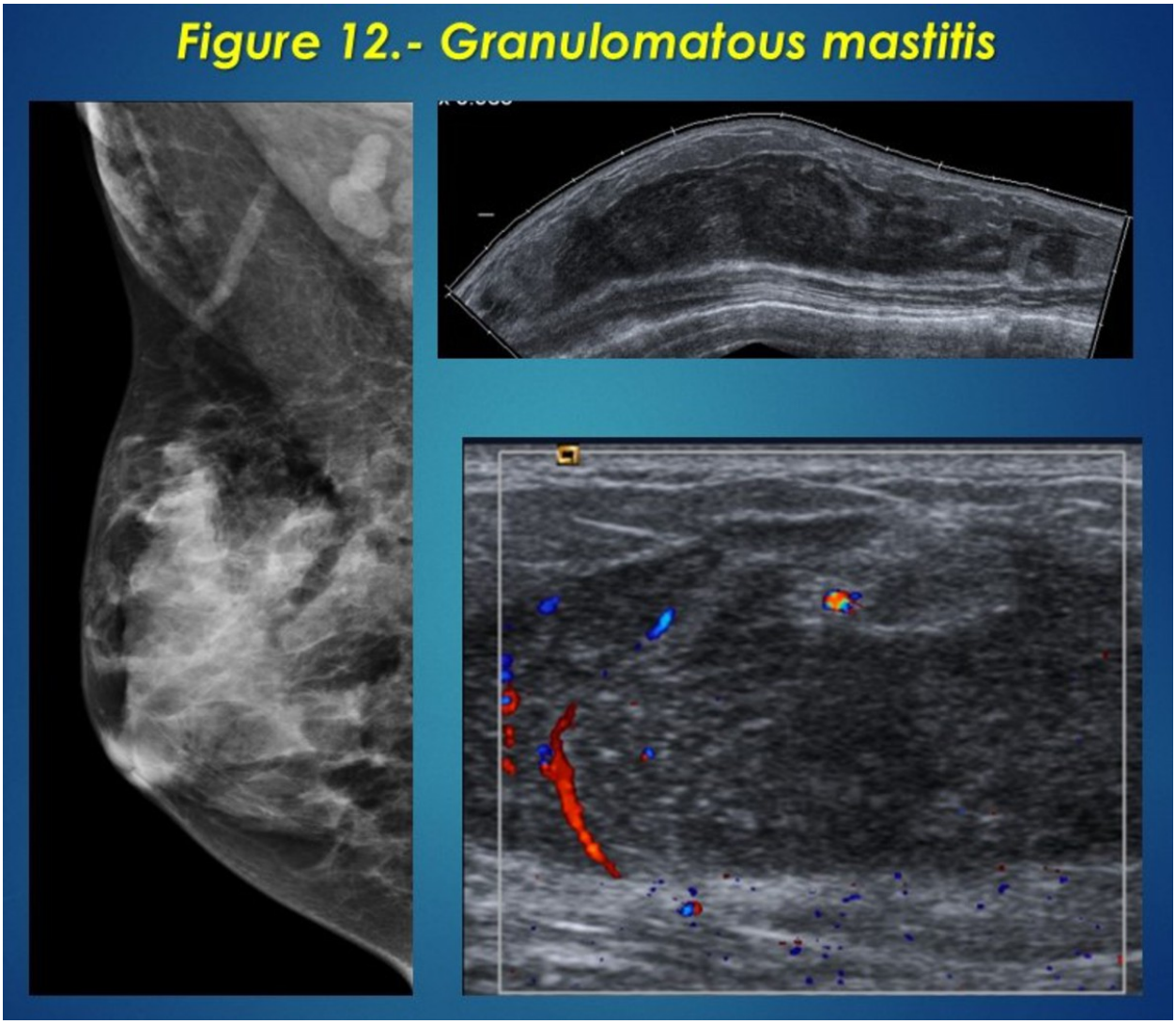

Fig. 12: Fig 12. Granulomatous mastitis
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- **Inflammatory breast cancer.**

It is a peculiar type of advanced breast cancer.

- Pathology. Invasion of the skin caused by tumor emboli within dermal lymph vessels appears clinically as skin erythema and edema (Fig. 13 on page 30).

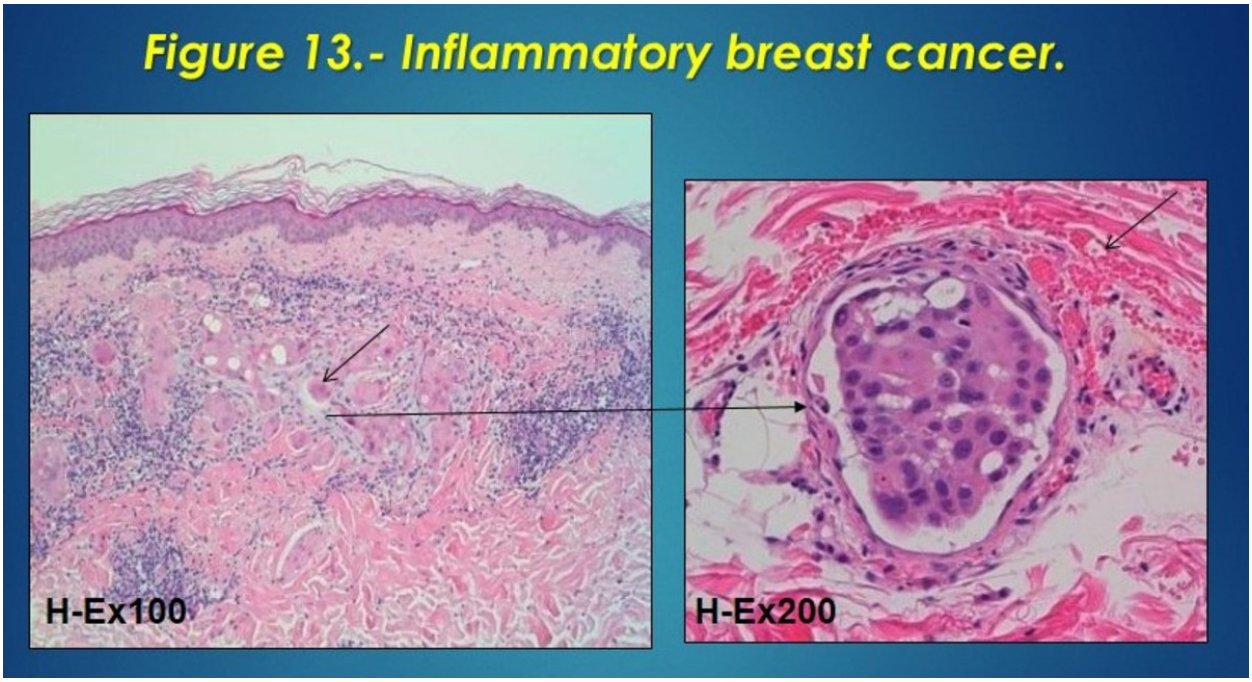

Fig. 13: Fig 13 Inflammatory breast cáncer. On H-E stains tumor cells emboli are found within dermal lymph vessels (arrows)
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

- **Diagnostic criteria:** Minimum criteria required for the diagnosis of inflammatory breast cancer include the following:

- Rapid onset of breast erythema, edema and/or *peau d'orange*, and/or
- Warm breast, with or without an underlying palpable mass.
- Duration of history of no more than 6 months.
- Erythema occupying at least one-third of the breast (Fig. 14 on page 31).
- Pathological confirmation of invasive carcinoma.

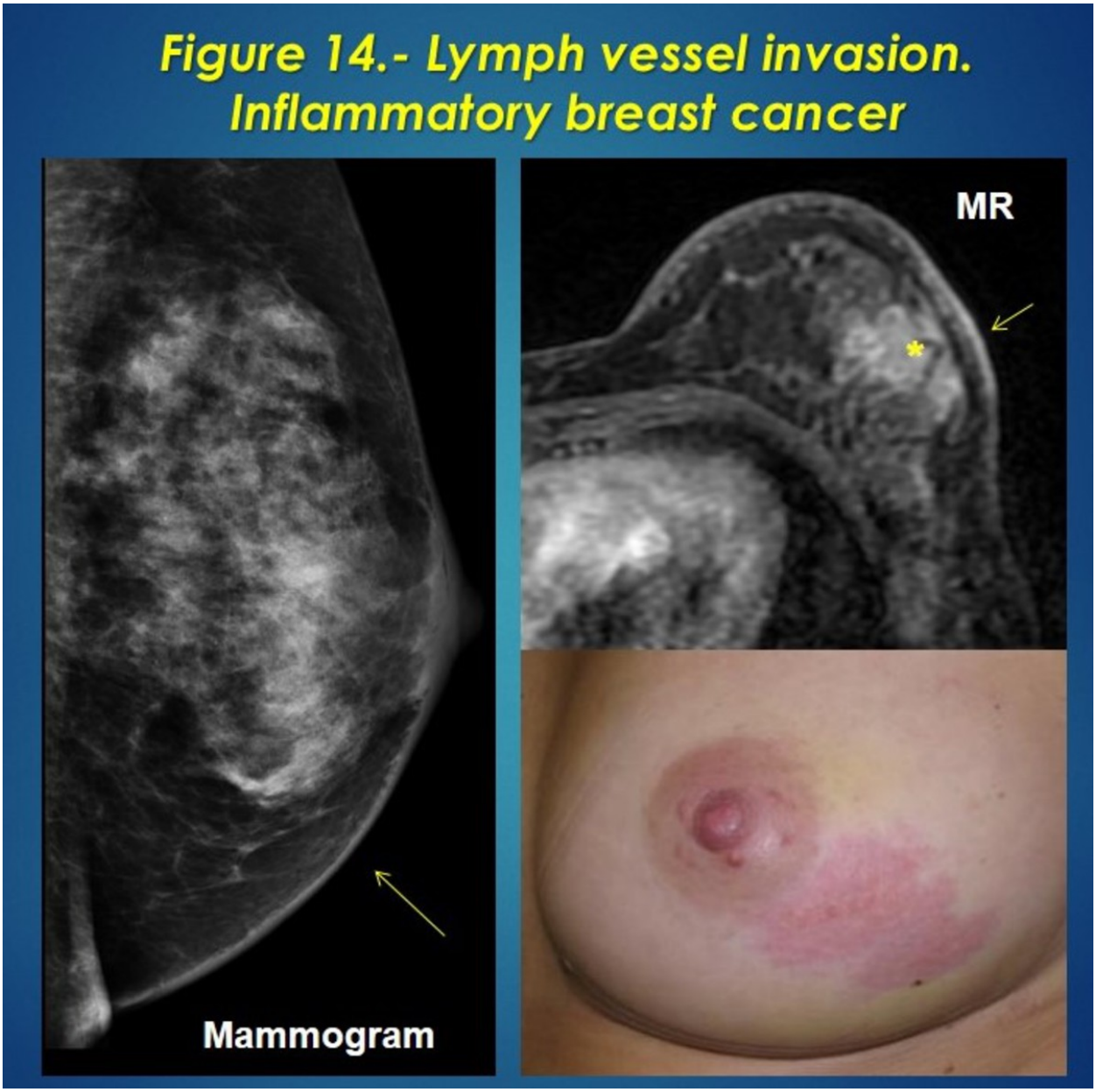

Fig. 14: Figure 14 Lymph vessel invasion. Inflammatory breast cancer. Clinically an area of skin redness is found. Mammogram. Increased skin thickness (arrow) and breast density . On MR T1+Gd an area of breast enhancement (*) and skin enhancement (arrow) are evident.
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- Imaging depicts increased skin thickness and a mass may be found, sometimes not under the area of skin involvement (Fig. 15 on page 32).

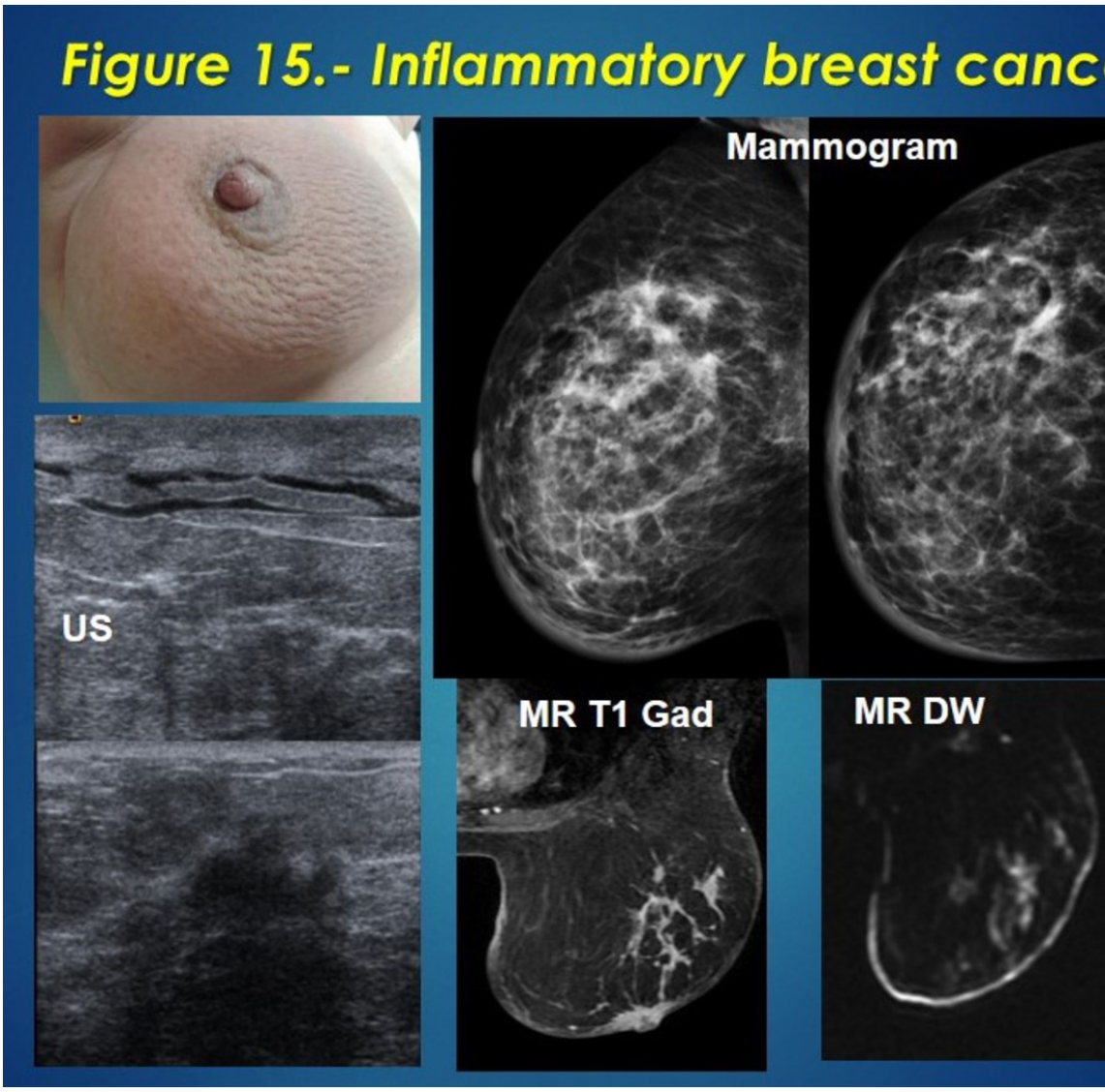

Fig. 15: Fig 15.- Inflammatory breast cáncer. Mammogram. Diffuse increased density of the breast with skin increased in thickness. A mass is depicted on US MR thickened skin and breast non-mass enhancement. High signal on diffusion weighted images
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ ES

- **Keys and tips to diagnosis:**

- The ***key*** to diagnosis of breast inflammatory carcinoma is presence of a breast mass, and frequently axillary lymphadenopathy also appear.

- ***Strict follow-up*** of inflammatory conditions of the breast until resolution may help in finding the mass when edema reduces.

- Remember that r***are cases of bilateral*** inflammatory breast cancer may appear.

6. Differential diagnosis (Fig. 16 on page 33).

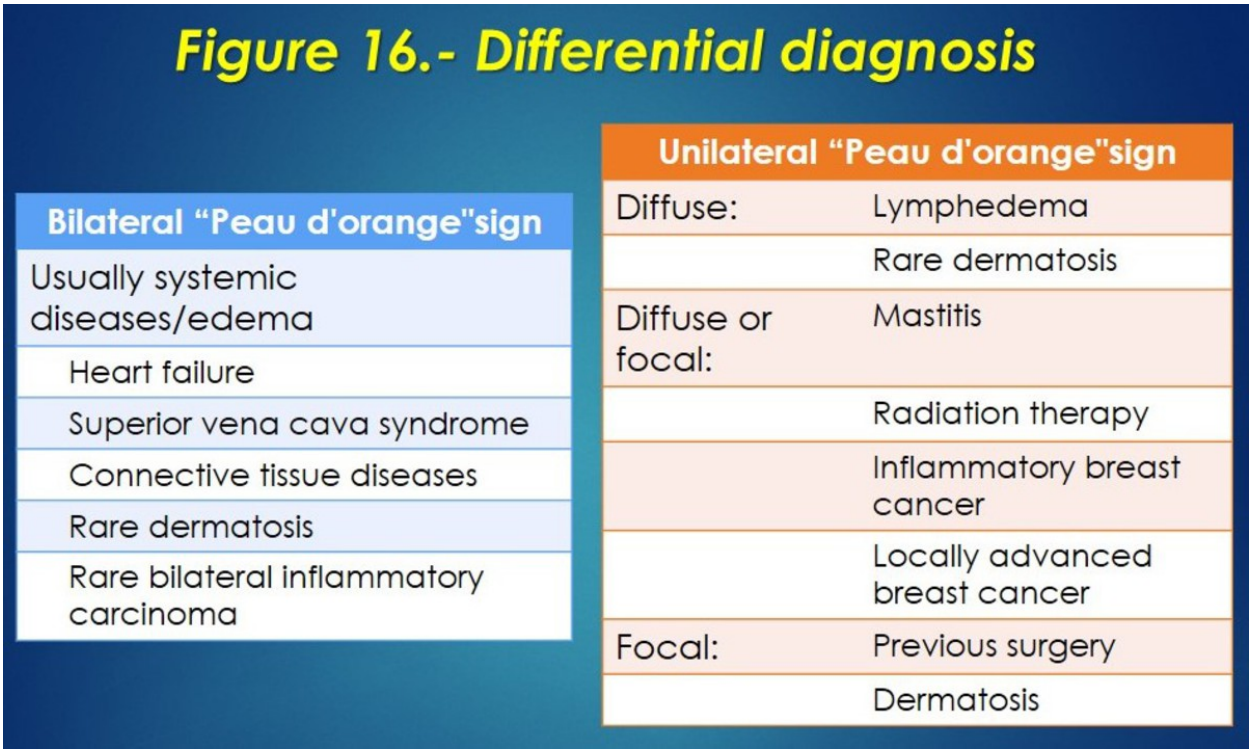

Fig. 16: Figure 16.- Differential diagnosis
References: Radiology, UCR de la CAM. Hospital Infanta Leonor - Madrid/ES

Based on clinical appearance the most frequent entities in differential diagnosis are:

6.1. Bilateral:

Systemic diseases.

Central venous obstruction (Superior vena cava syndrome).

Congestive heart failure.

Dermatosis.

Rare bilateral inflammatory breast cancer.

6.2.Unilateral:

Focal:

Surgery,

Dermatosis

Diffuse or focal

Mastitis-abscess,

Radiation

Inflammatory breast cancer

Diffuse

Lymphedema - axillary obstruction

Rare dermatosis,

7. Diagnostic work-up. Management.

Based on clinical and imaging findings we propose a diagnostic workflow on Fig. 17 on page 34.

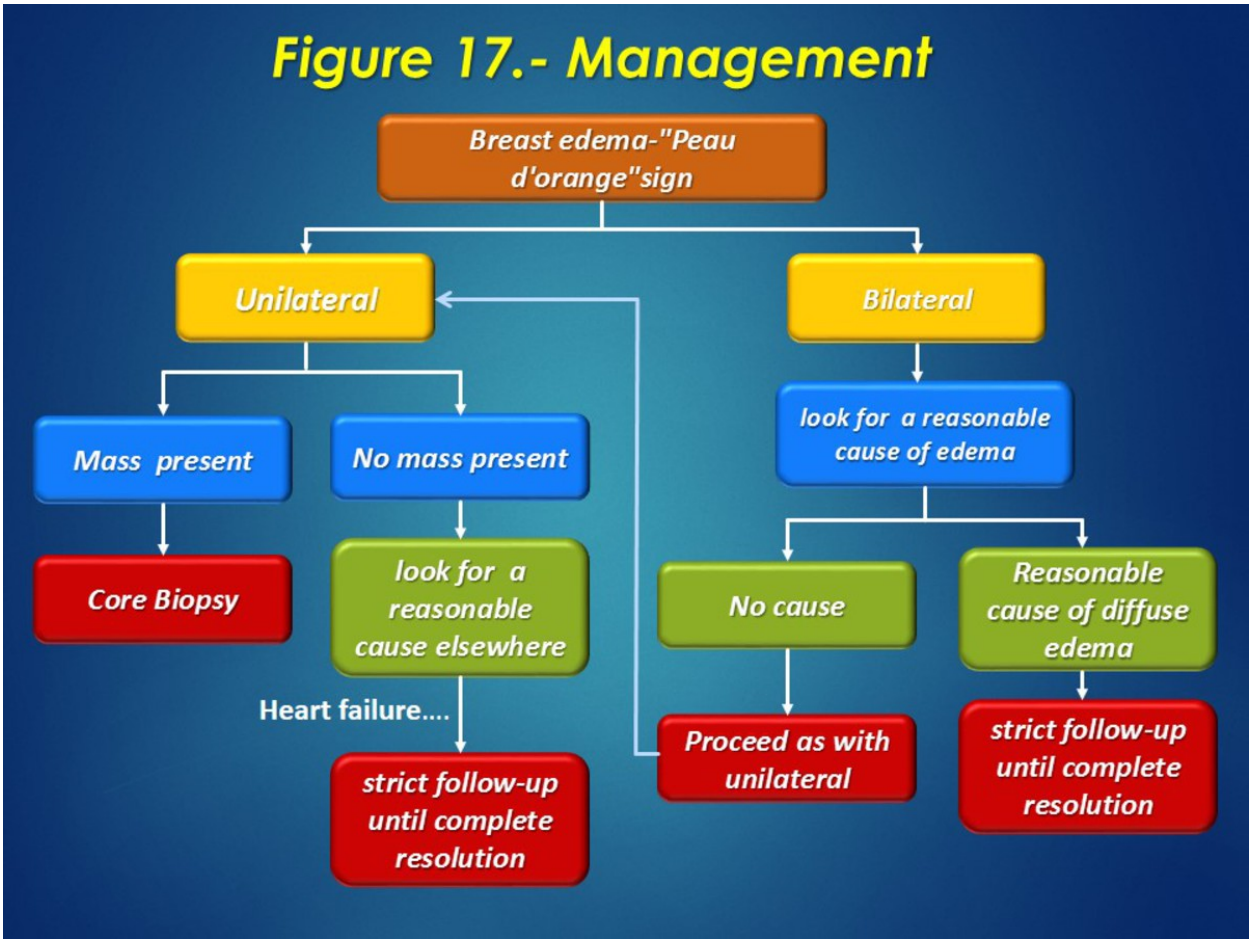

Fig. 17: Fig 17 Management
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Images for this section:

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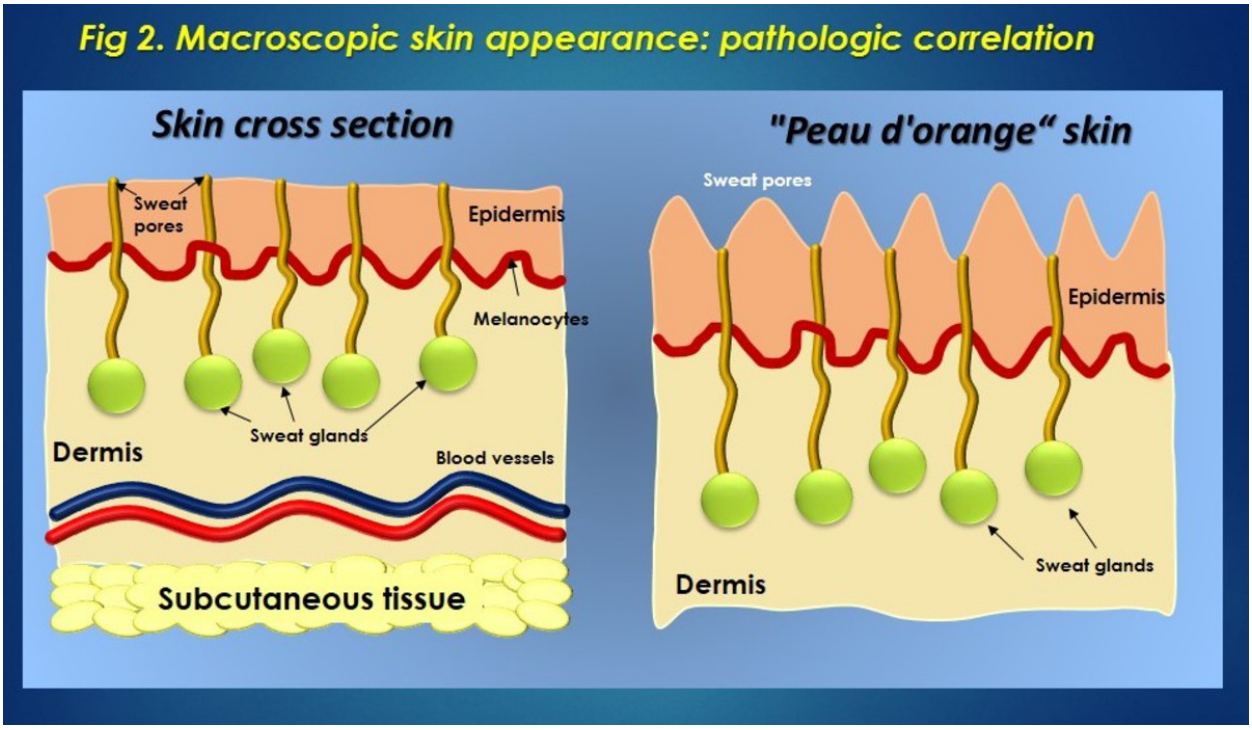

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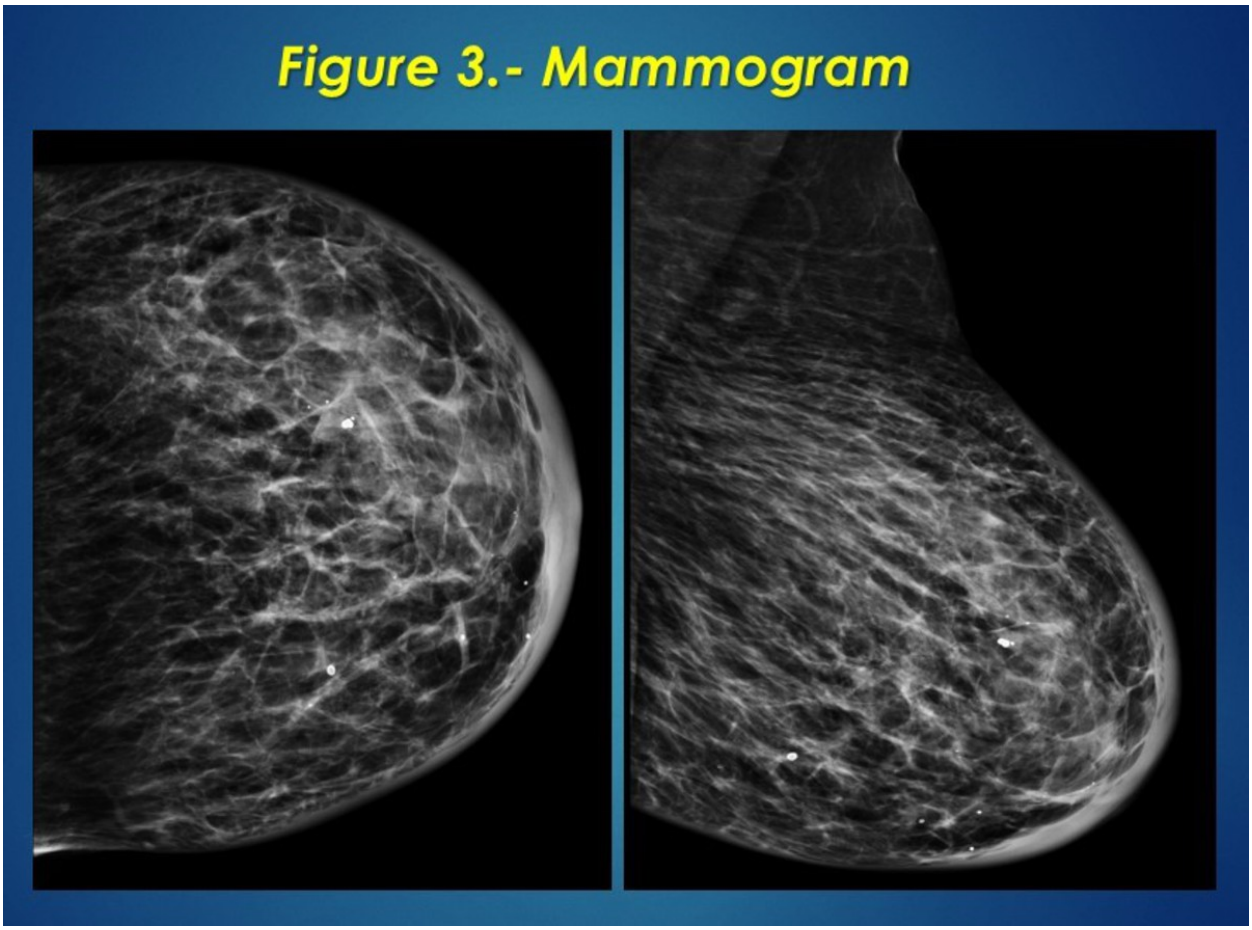

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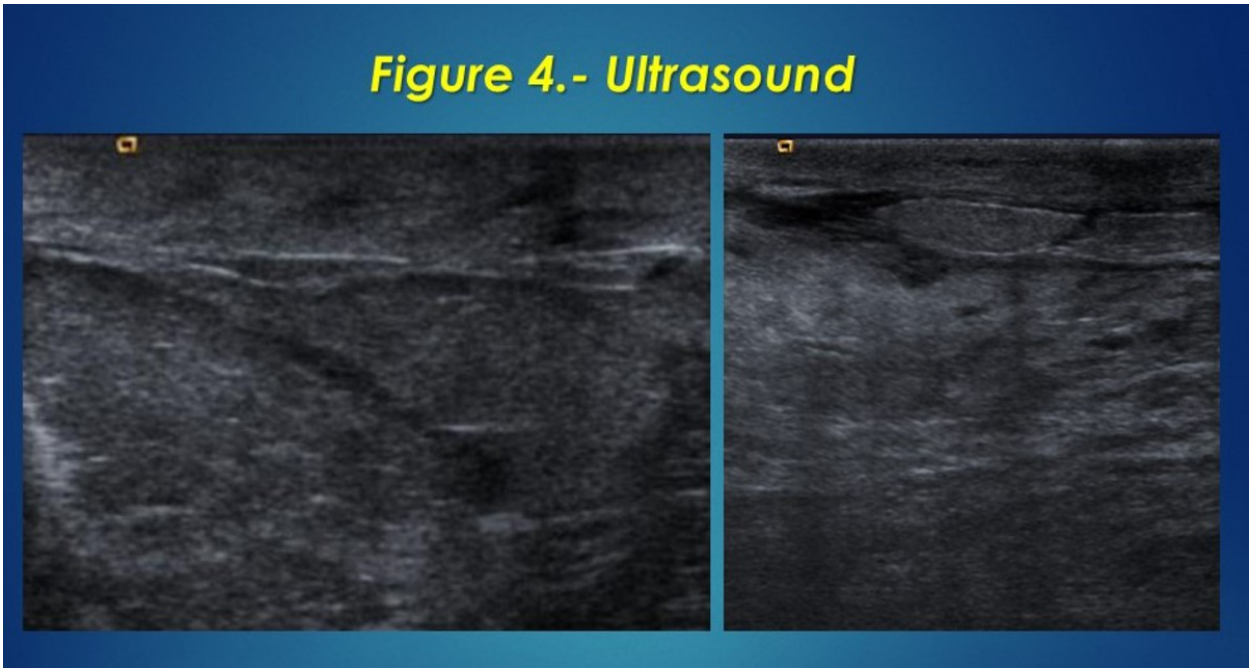

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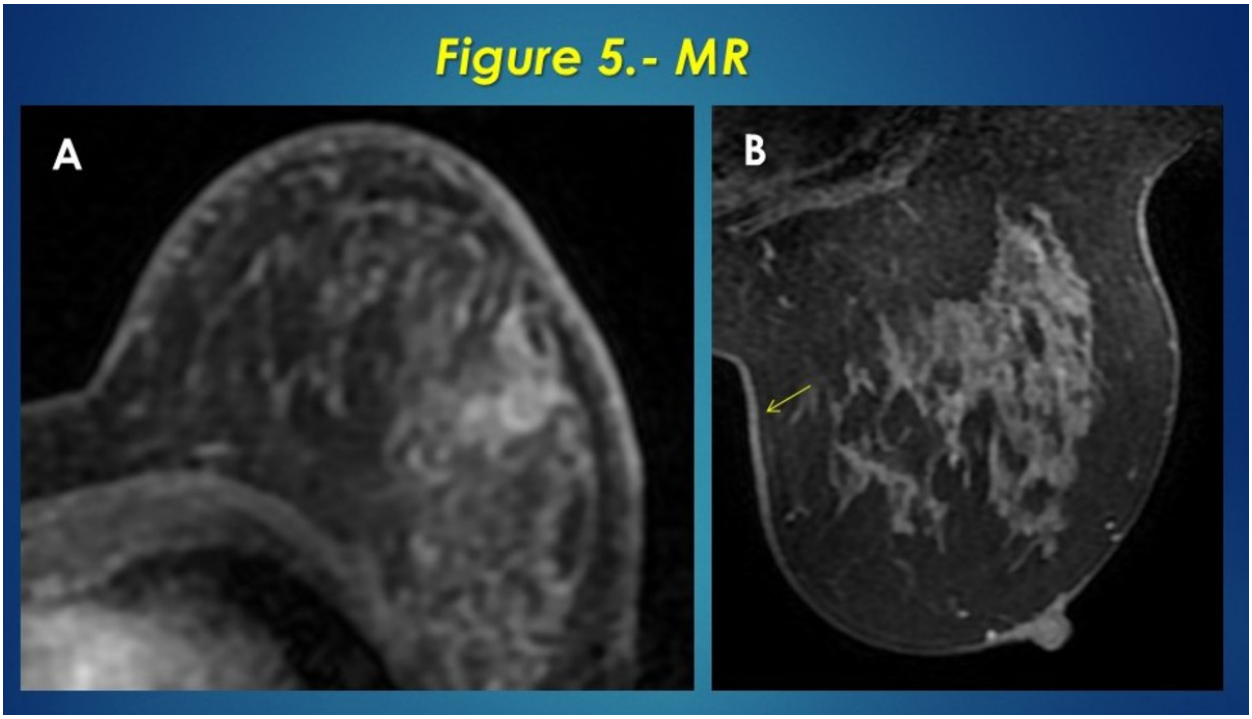

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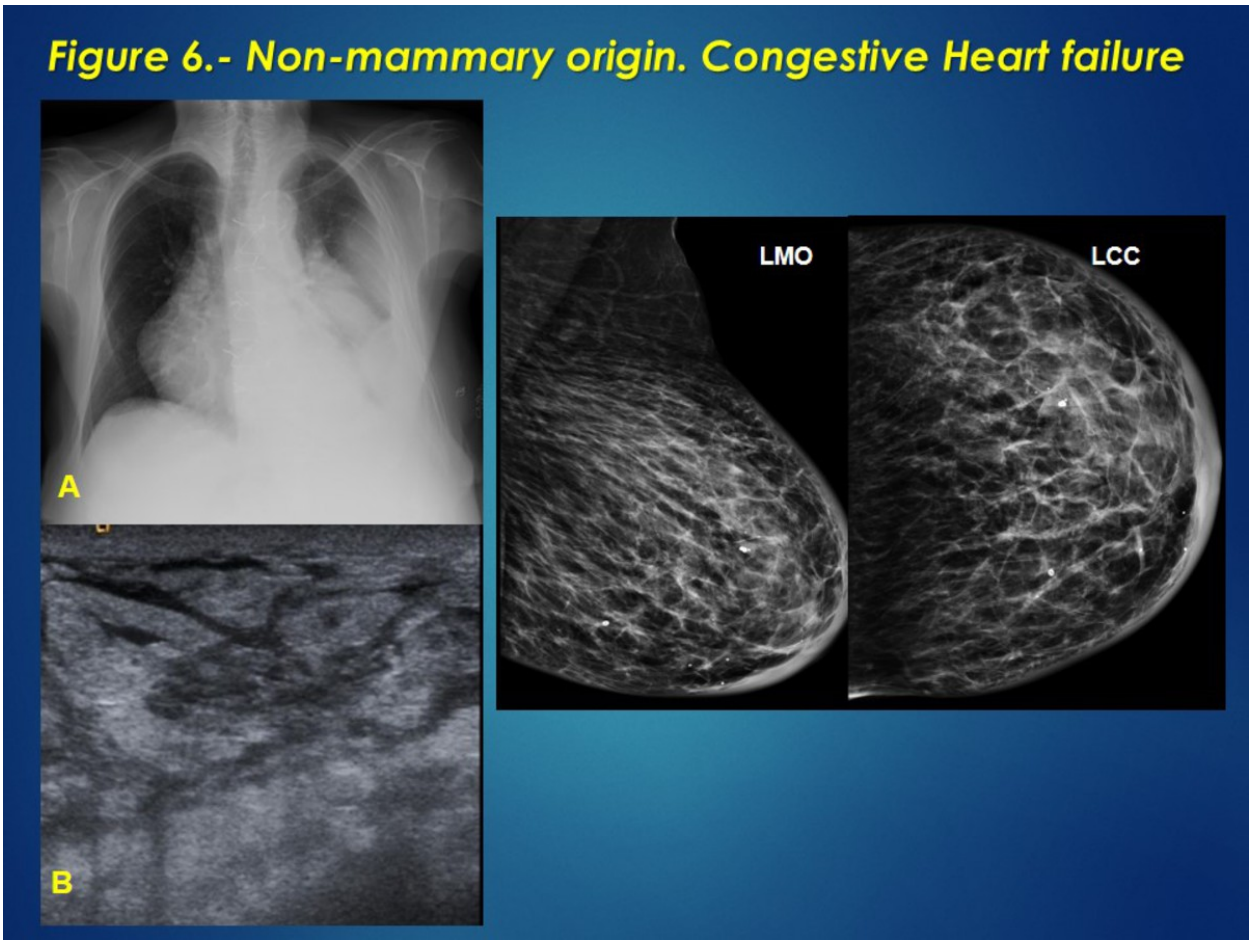

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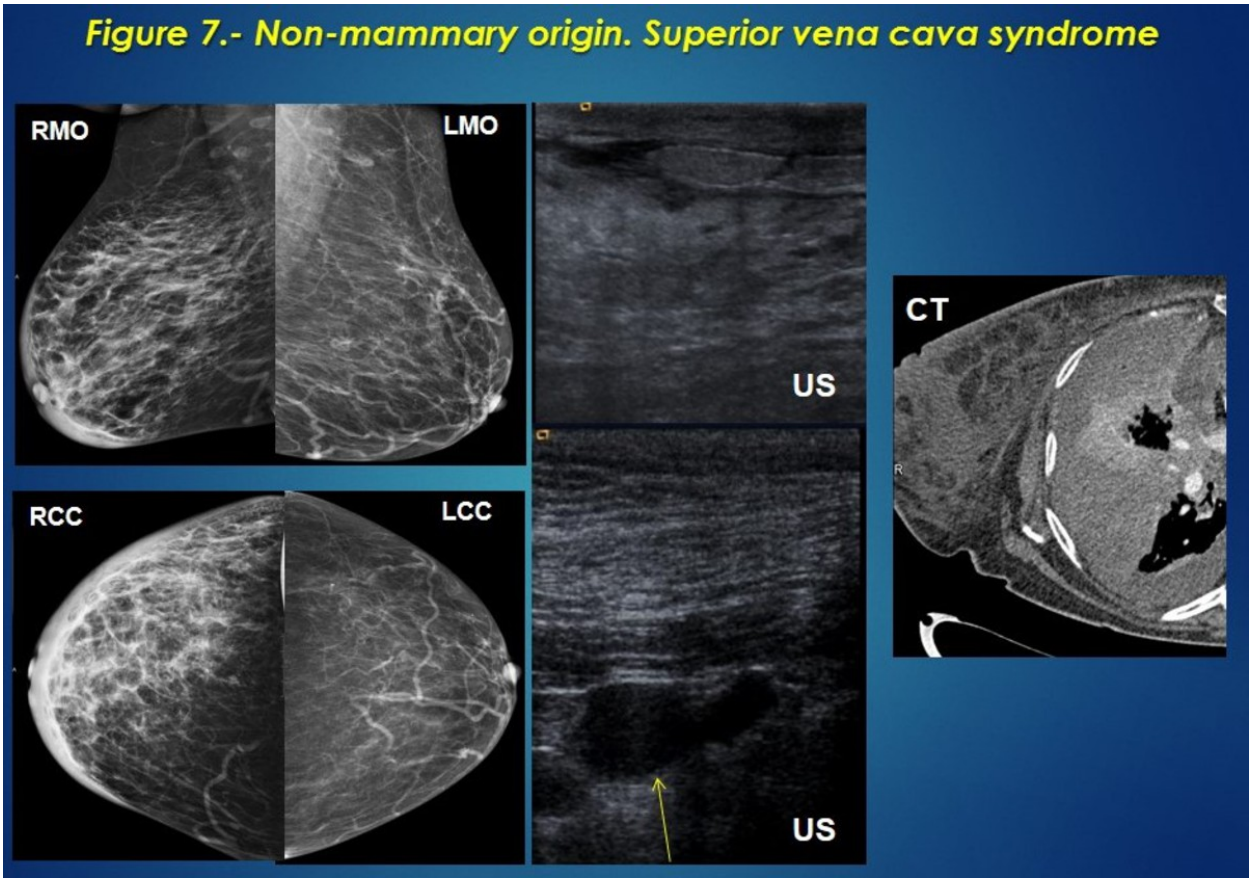

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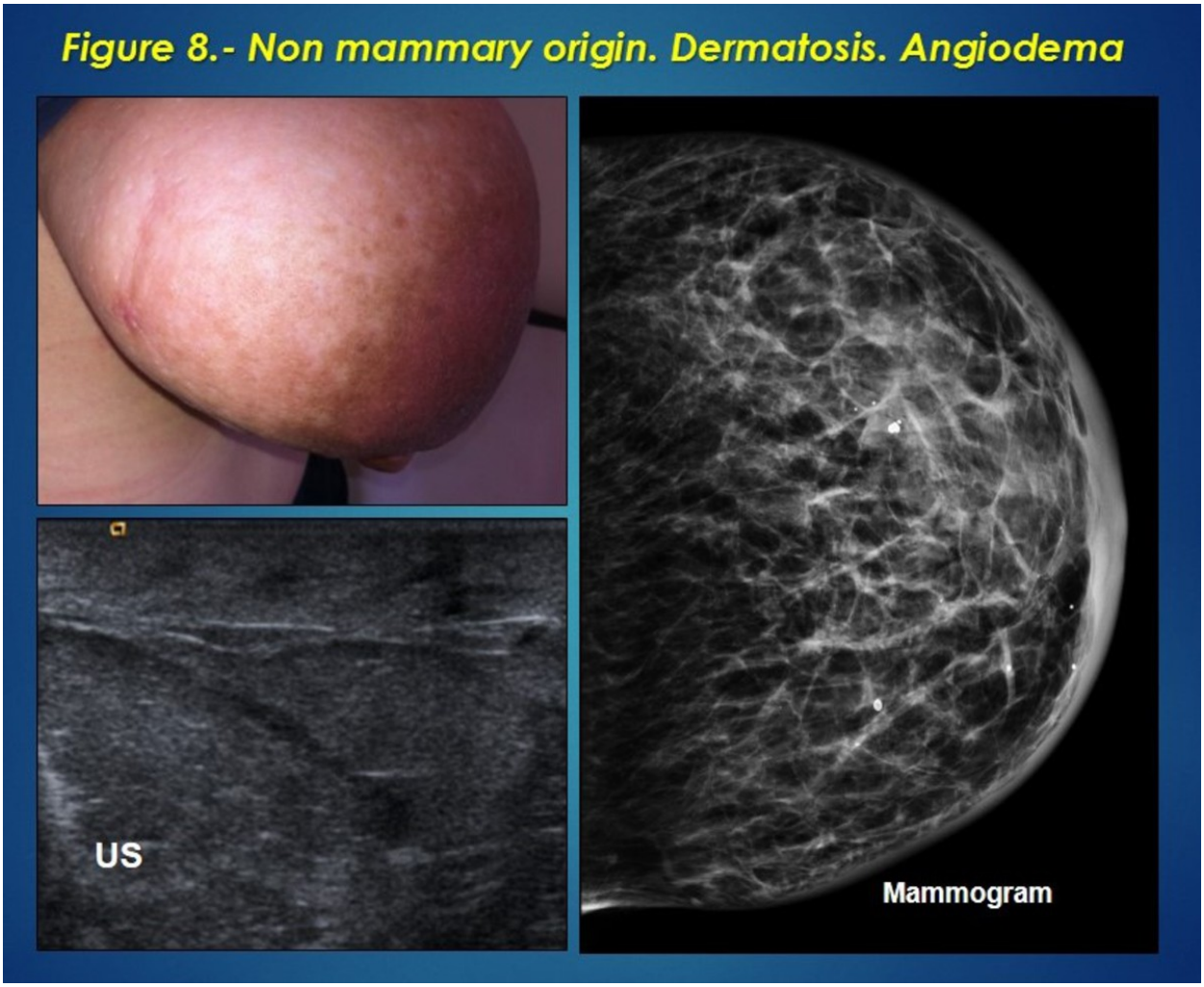

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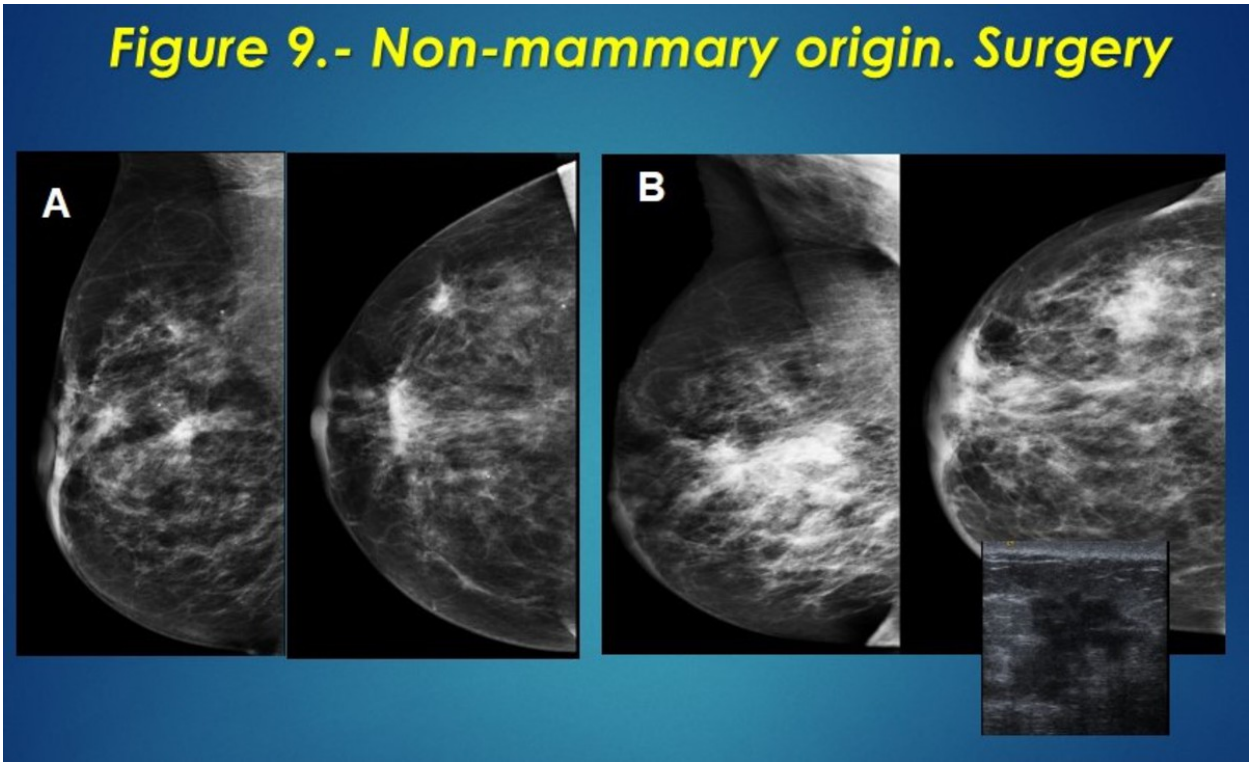

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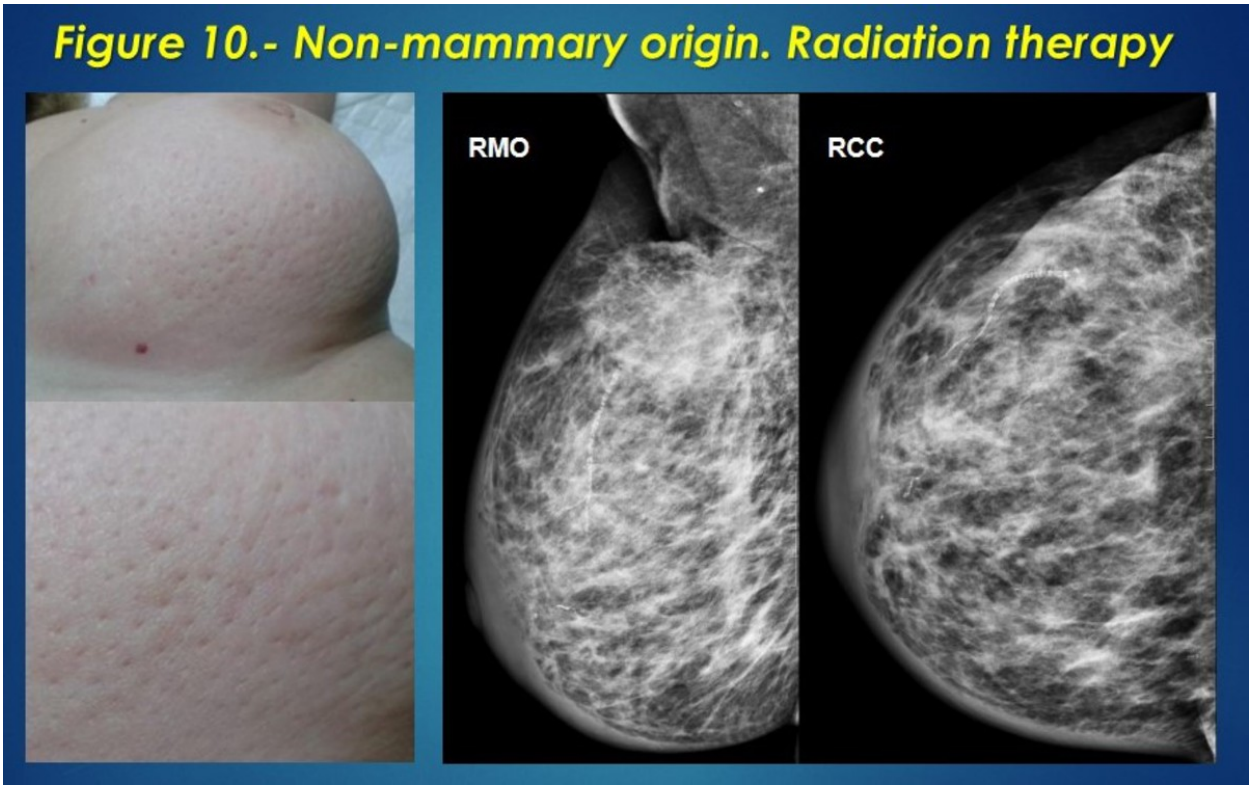

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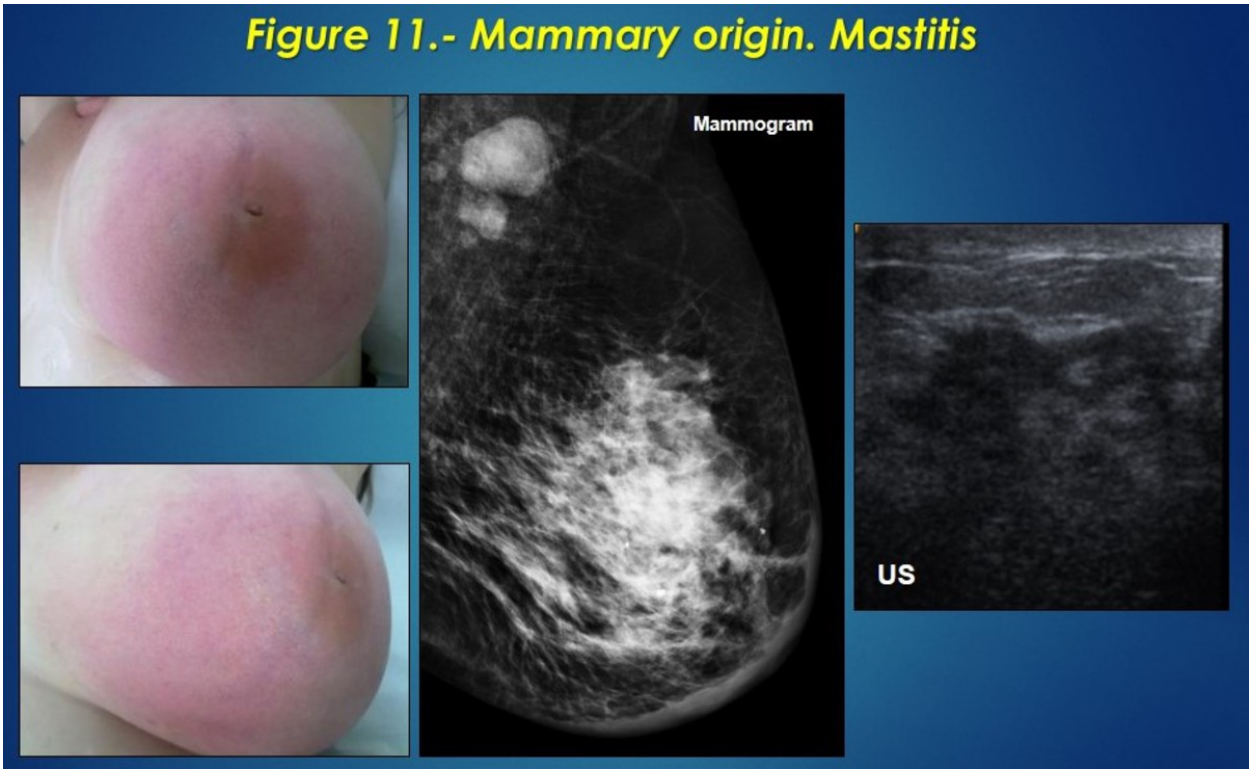

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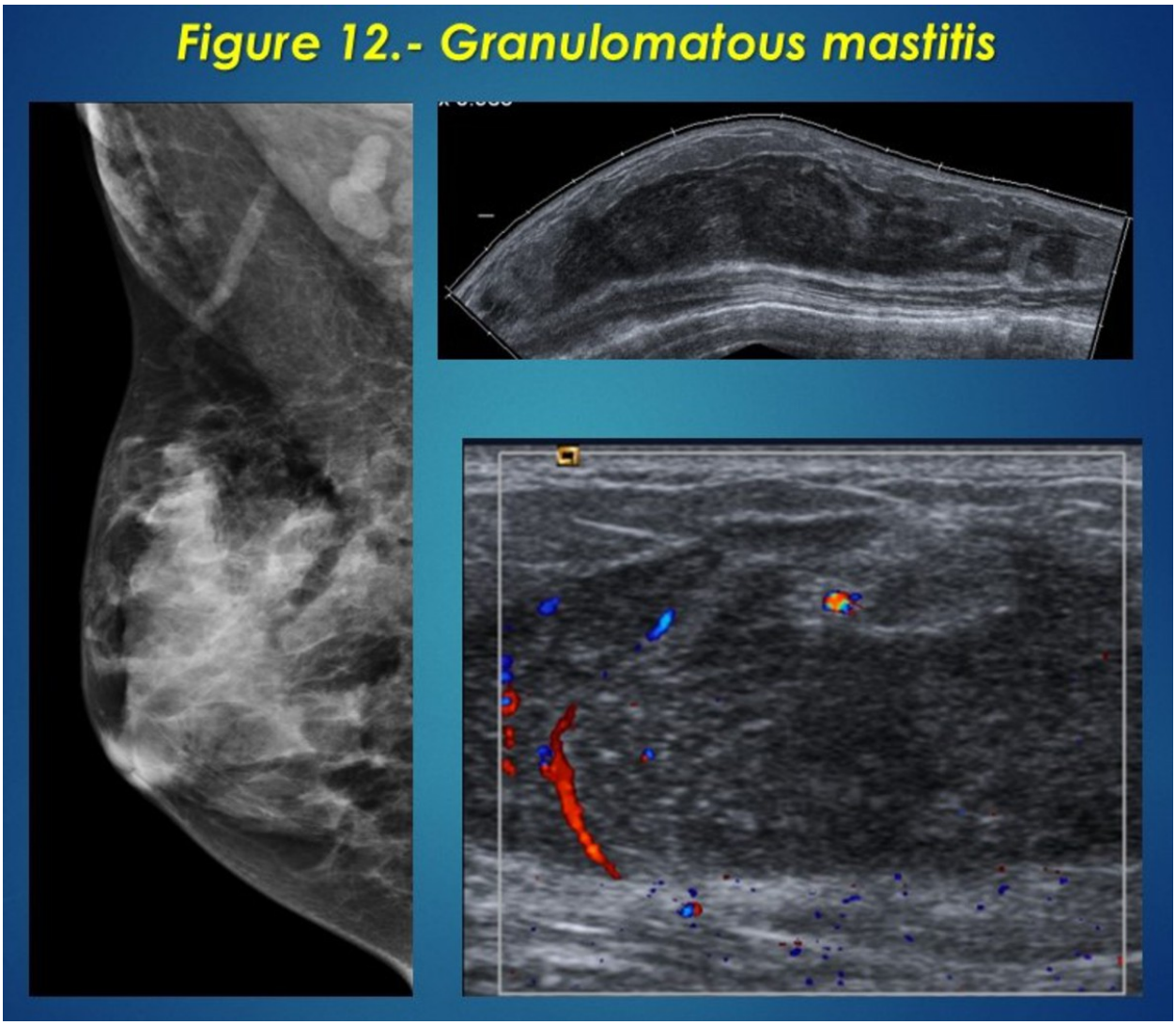
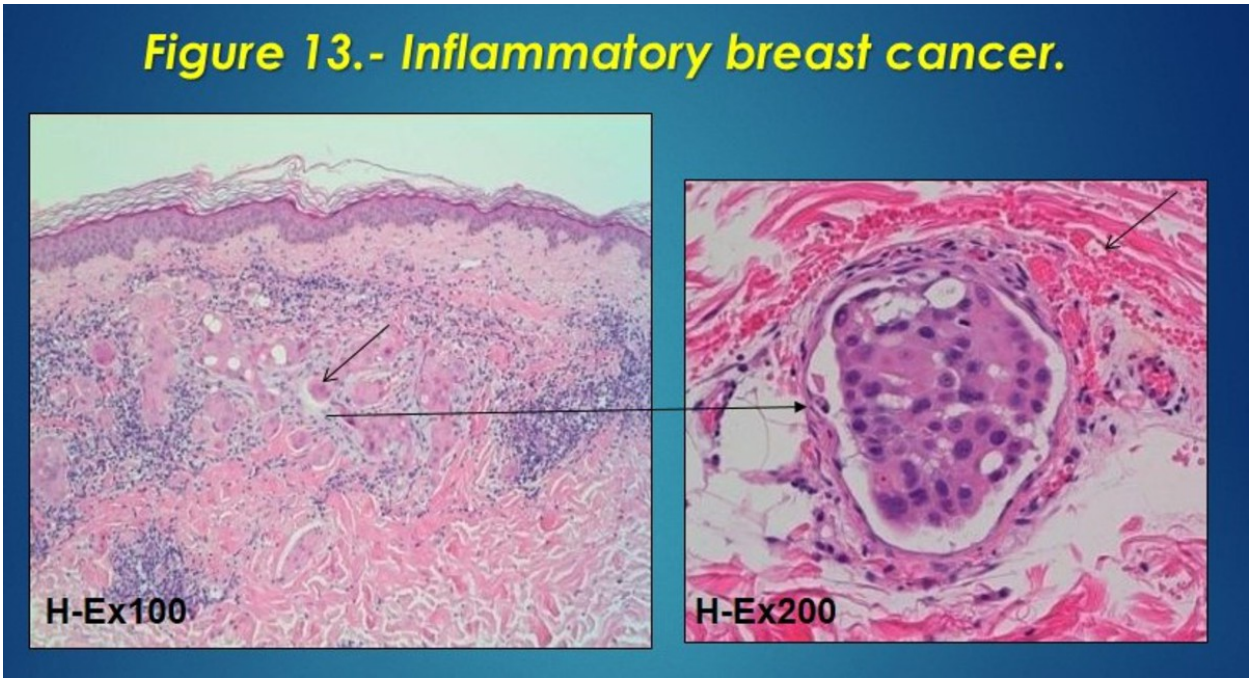


Fig. 12: Fig 12. Granulomatous mastitis



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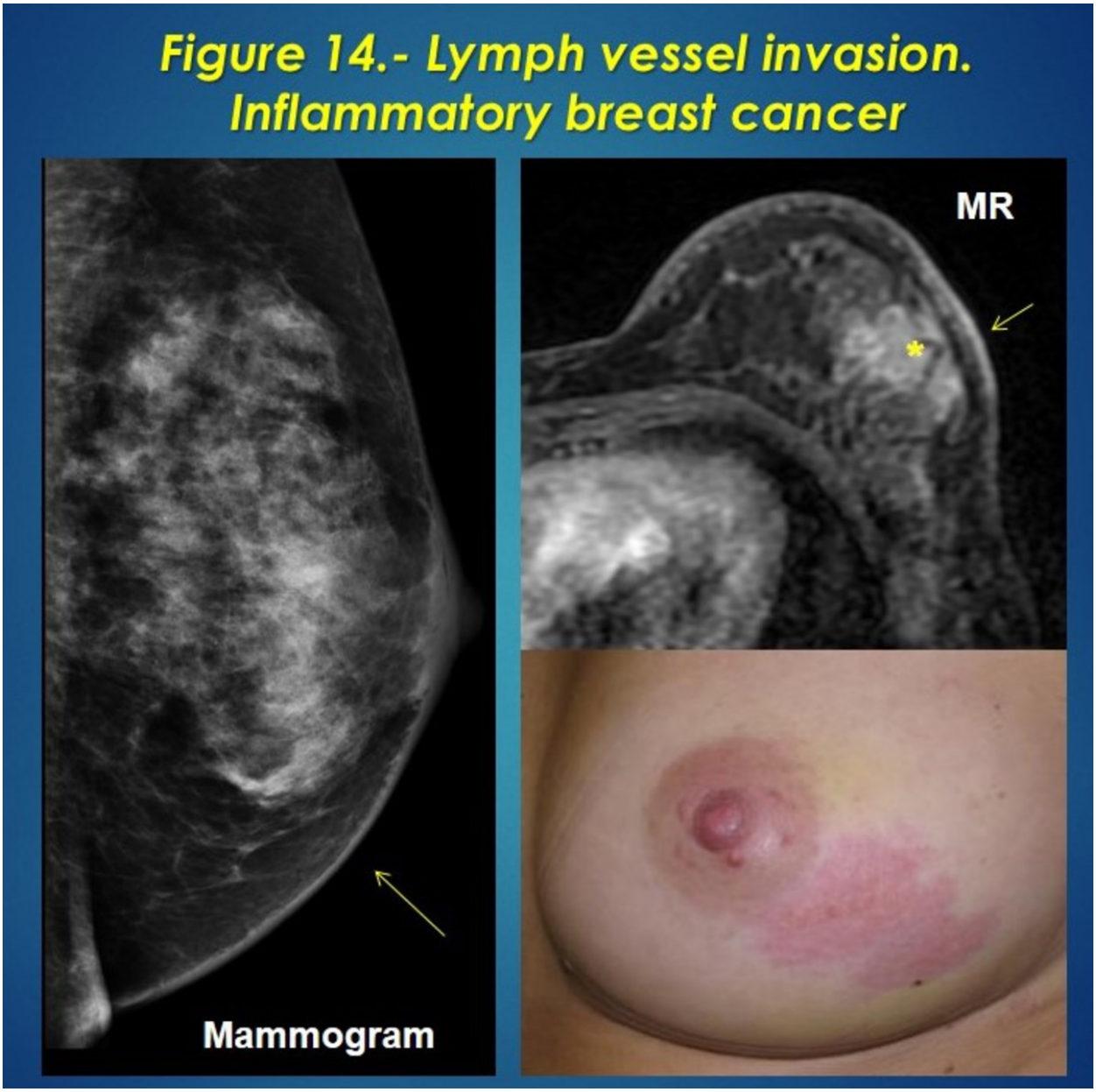

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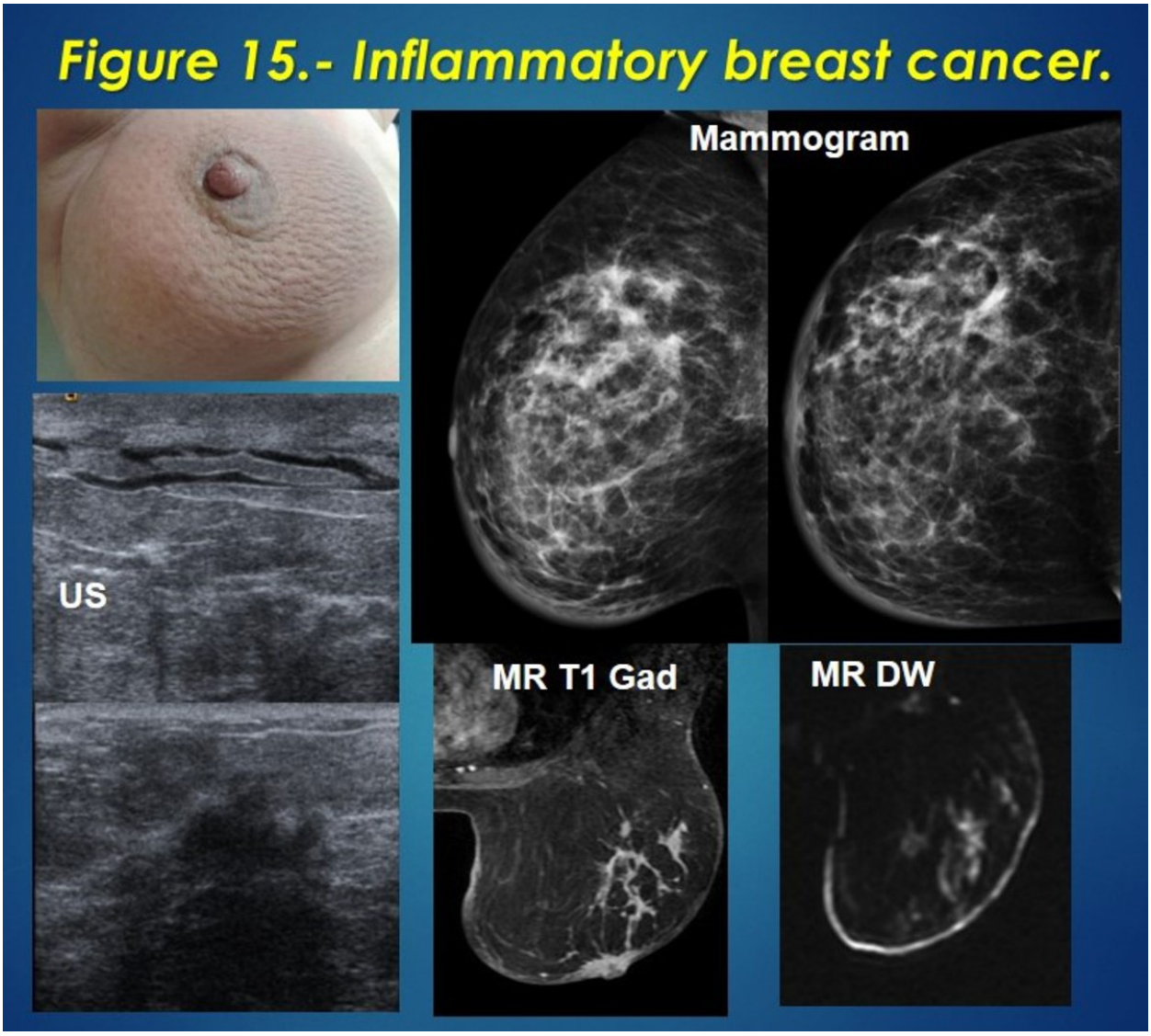

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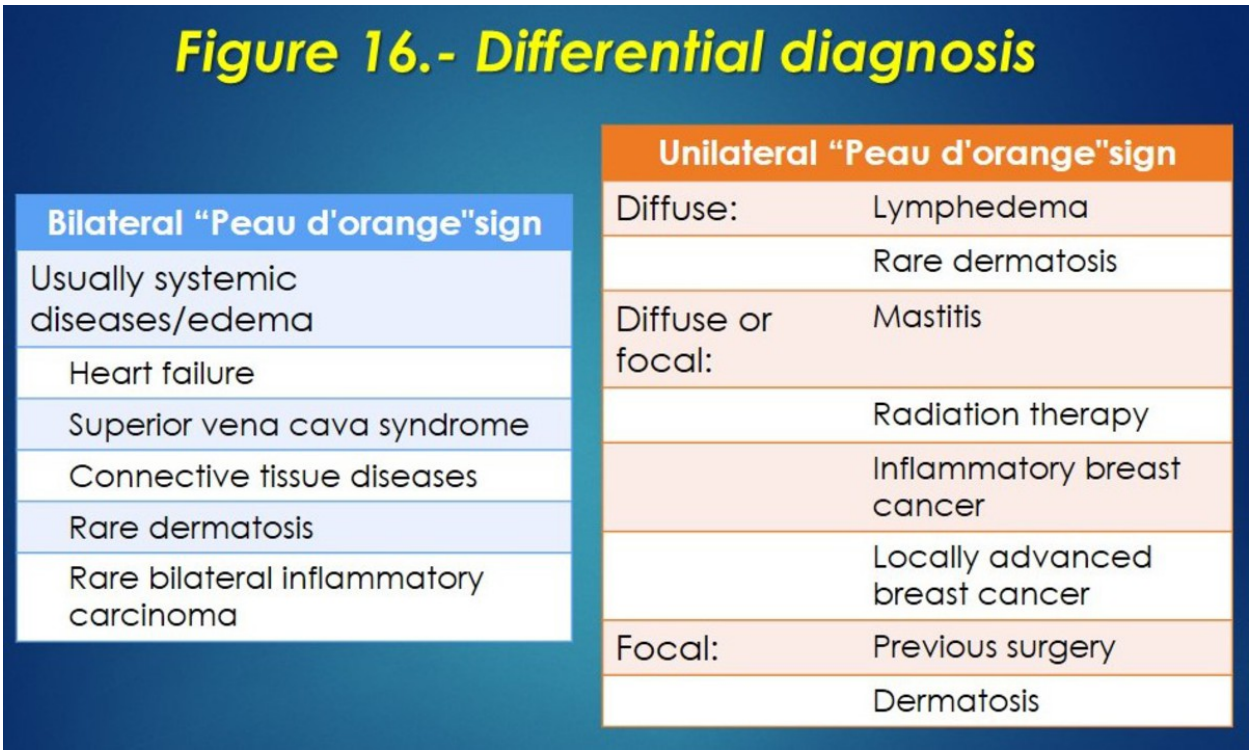

Fig. 16: Figure 16.- Differential diagnosis

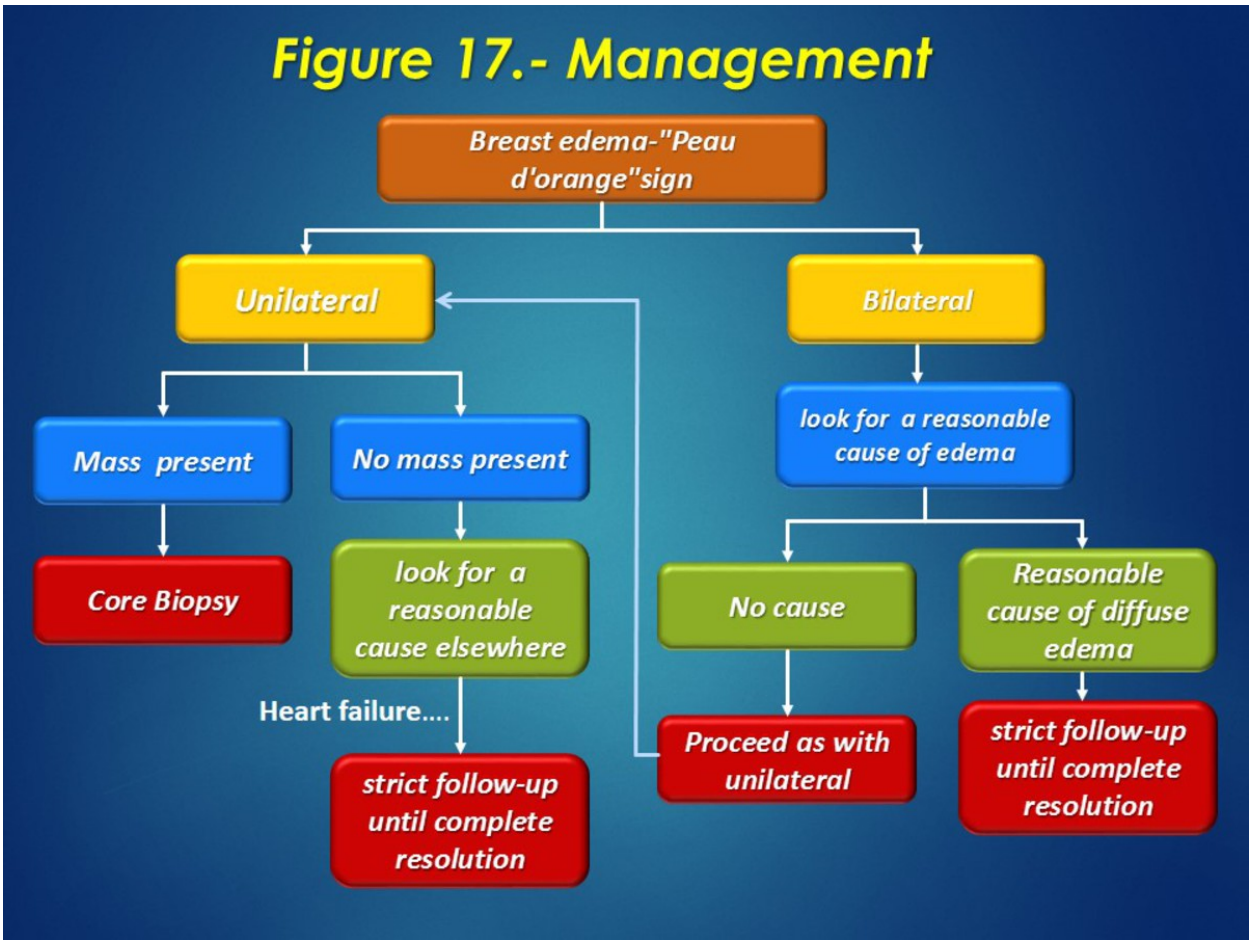

Fig. 17: Fig 17 Management

Conclusion

Radiologists should be aware of **breast edema**, as it is a common sign for different entities, systemic pathologic conditions and breast diseases, both benign and malignant.

Knowledge of those entities may lead to surprising and helpful diagnosis made by breast radiologists, sometimes of unexpected lesions other than breast diseases.

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