

The Role of Radiology in Detecting Prosthetic Breast Implant-Related Complications

O Papel da Radiologia na Monitorização das Complicações Relacionadas com as Próteses Mamárias

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Abstract

Given the growing number of breast implants, both for aesthetic and reconstructive purposes, it is imperative for the Radiologist, to know the different types of surgical procedures involved, as well as the various types of implants available. Several types of early or late complications can result from this. The prosthesis rupture represents one of the most frequent kinds of late complication and constitutes the foremost cause of its removal. Since its clinical manifestation may be absent in up to 50% of cases, Radiology plays a central role in its monitoring. In Portugal, MR surveillance is not recommended by the national health program. Ultrasound examination along with screening mammography is the usual preferred method.

Thus, although breast implants imaging constitutes a low percentage of the day-to-day care activity of a Radiologist, the knowledge of the different imaging findings in the multimodality imaging used is crucial for early diagnosis of these complications and to provide the best patient care possible.

Keywords

Breast implants; Capsular rupture; Breast augmentation; Breast reconstruction.

Resumo

Atendendo ao número crescente de utilização de próteses mamárias, quer na cirurgia mamária estética, quer reconstrutiva, é fundamental que o Radiologista conheça os diferentes tipos de procedimentos cirúrgicos envolvidos, bem como os vários tipos de próteses disponíveis. A colocação de próteses mamárias não é um procedimento inócuo. Vários são os tipos de complicações descritas, podendo ocorrer precocemente, habitualmente no período pós-operatório ou num período mais tardio. A rutura da prótese representa um dos tipos de complicações tardias mais frequentes e constitui a principal causa da sua remoção. Uma vez que a manifestação clínica da rutura protésica pode estar ausente em até 50% dos casos, a Radiologia desempenha um papel central no seu diagnóstico. Em Portugal, a vigilância por ressonância magnética destas complicações não é recomendada pela Direção Geral de Saúde, sendo apenas recomendada a realização complementar de ecografia aquando do estudo mamográfico de rastreio.

Assim, embora a avaliação de imagem das próteses constitua uma baixa percentagem da atividade diária de um Radiologista, o conhecimento dos diferentes achados de imagem nas diferentes técnicas utilizadas é crucial para o diagnóstico precoce destas complicações.

Palavras-chave

Próteses mamárias; Ruptura capsular; Mamoplastia; Reconstrução mamária.

1. Introduction

Initiated in the 19th century (Czérny),¹ breast-modifying surgery using synthetic material observed a significant progress in the 60s, with the development of silicone breast implants.² Whether for aesthetic or reconstructive reasons, the use of breast implants has been increasing. Currently, the breast enhancement mammoplasty is the aesthetical surgical procedure most commonly performed, with about 300,000 procedures performed in the US in 2016.³ The increase in the use of breast implants for breast reconstruction is directly related to the increase in the number of cases of immediate reconstruction, during the surgical procedure of the mastectomy.⁴ The radiologic evaluation of mammary implants constitutes a low percentage of daily care activity of a radiologist, so this

article aims to describe and illustrate the different types of complications and their translation in the various imaging techniques.

2. Surgical Procedure

The surgical technique, namely the type of incision and the plane of dissection, is individualized and performed according to the anatomy and the preferences of each patient, the experience of the surgeon and the type of surgery (aesthetic or reconstructive, primary or revision). In breast augmentation mammoplasty the different types of approach are: inframammary, periareolar, transaxillary or, rarely, transumbilical (Figure 1).

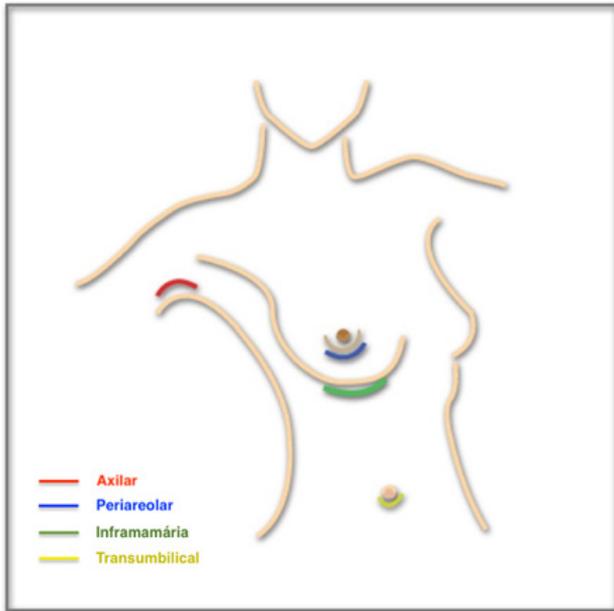


Figure 1 – Illustration of different types of incision.

The inframammary approach was the first to be described, allowing, like the inframammary and axillary incision, access to all dissection planes. This provides easy access, under direct visualization, facilitating the precise placement of the implant. However, given the surgical scar, new types of approaches have been developed. The periareolar approach followed, with the advantage of a potentially better scar from the aesthetic point of view. However, it only allows limited exposure of the surgical loca, so it is not advised in patients with small areolae as it may limit the placement of large volume implants and, due to the greater proximity to the ductal system, it is associated with an increased risk of infection. In the transaxillary approach the dissection can be performed either blindly or with the use of endoscopy. When performed blindly, it presents a greater risk of hematoma and nerve damage. The transumbilical access is used exclusively for the placement of saline implants. In this technique, the dissection of the prosthetic loca is technically demanding and may, as in the axillary approach, be performed by endoscopy or blindly.^{5,6}

Breast reconstruction is a commonly used surgical procedure after breast carcinoma mastectomy or prophylactic mastectomy in high-risk women.

The placement of implants is a reconstructive option that can be performed as an isolated technique (eg: skin sparing

mastectomy with immediate reconstruction with implants) or associated with other techniques such as:

- pedicled flaps (eg, myocutaneous flap of the *latissimus dorsi* muscle, myocutaneous flap of the *rectus abdominis* muscle - TRAM);
- free flaps (eg: deep inferior epigastric artery perforator flap - DIEP, free TRAM flap).

In breast reconstruction, the approaches vary according to the technique of tumor resection.

The technical description of these options goes beyond the objectives of this article, but its knowledge by the radiologist is essential for their correct interpretation.

Breast implants can be placed in several planes of dissection: retro-glandular, subfascial, retro-pectoral or in “dual-plane” (Figure 2).

The retro-glandular plane allows a less painful recovery, with greater ease of dissection. In order to achieve this, an amount of glandular tissue is required to cover the prosthesis in order to obtain better aesthetic results (Figure 3). In contrast, it is associated with a higher incidence of capsular contracture when compared to the other planes. The subfascial plane is a potential space between the pectoralis major and anterior serratus muscles and their corresponding fascia. This



Figure 3 – Pre and post surgery of breast augmentation mammoplasty with a retroglandular textured silicone implant placed by inframammary approach

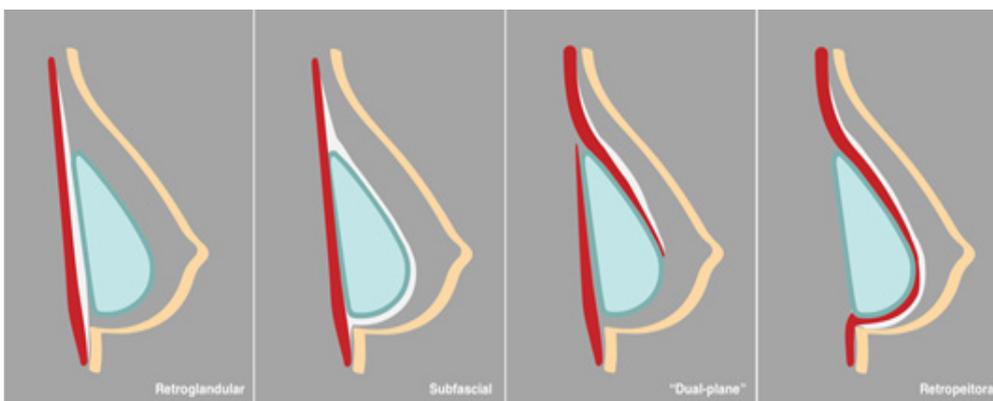


Figure 2 – Illustration of various dissection planes.

technique is similar to the retro-glandular one, granting, however, a greater coverage of the prosthesis. The retro-pectoral plane can be divided into totally submuscular, the least used considering the risk of incorrect positioning of the prosthesis, and the “dual-plane” in which the implant is covered by the pectoralis major muscle in the upper portion and by the mammary gland in the lower portion. This approach is usually used in cases where the subcutaneous tissue is scarce and in cases of capsular contracture revision mammoplasty, being associated with a more painful recovery. Compared with the retro-glandular approach there is a lower risk of capsular contracture.^{5,6}

3. Types of Implants

Various methods of breast modification have been described over time. The first reports describe the free injection of paraffin and, later, liquid silicone (Figure 4).

For some time, autologous transplant of adipose tissue has also been widely performed, however, given the associated risk of fat necrosis, the accuracy of lesion detection in the mammographic study was limited and so it was progressively abandoned.

In the 1960s, the first silicone implants were developed, which can be categorized into five generations. In parallel, saline implants were also developed, consisting of an inflatable envelope, which is filled with saline solution postoperatively.^{6,7} The knowledge of the different types of implants is fundamental in the interpretation of potential complications. The mammary implants can be classified according to their overall shape (anatomical or round), to the external surface (textured or smooth), the profile (high, medium or low), their content (saline or silicone) and the number of lumens (single or double).

The current silicone implants feature an external silicone elastomer shell filled with silicone gel. These can also be covered by a layer of polyurethane that is associated with a lower risk of contracture. Fifth generation prostheses

consist of a viscous silicone gel with high cohesiveness, being associated with a lower incidence of rupture.⁵ The most commonly used are those of single lumen, textured and filled with highly cohesive silicone gel.

4. Complications

Complications related to implants can be divided according to the time they take to be present.

4.1. Early complications

In the immediate postoperative period, complications related to the surgical procedure may lead to surgical reintervention. In this period, clinical evaluation plays a fundamental role, with imaging tests reserved to confirm clinical suspicion, to assess its extent and possibly to guide treatment. These complications include infection and hematoma.⁸

4.1.1 Infection

The rate of infection described after augmentation mammoplasty is 2-2.5% of the cases, slightly higher than in oncological surgery.⁹ The main related symptoms are pain, edema and erythema. Ultrasound may reveal the presence of an abscess, translated by the presence of a heterogeneous collection. In magnetic resonance imaging (MRI), findings such as skin thickening, interstitial edema, peripheral enhancement of the implant and peri-prosthetic collections suggest this diagnosis.

4.1.2. Hematoma

Hematoma formation often occurs in the immediate postoperative or post-trauma period. The mammographic study may show the presence of a well-defined hyperdense area, while the ultrasound study reveals the presence of a heterogeneous, multi-segmented collection (Figure 5).

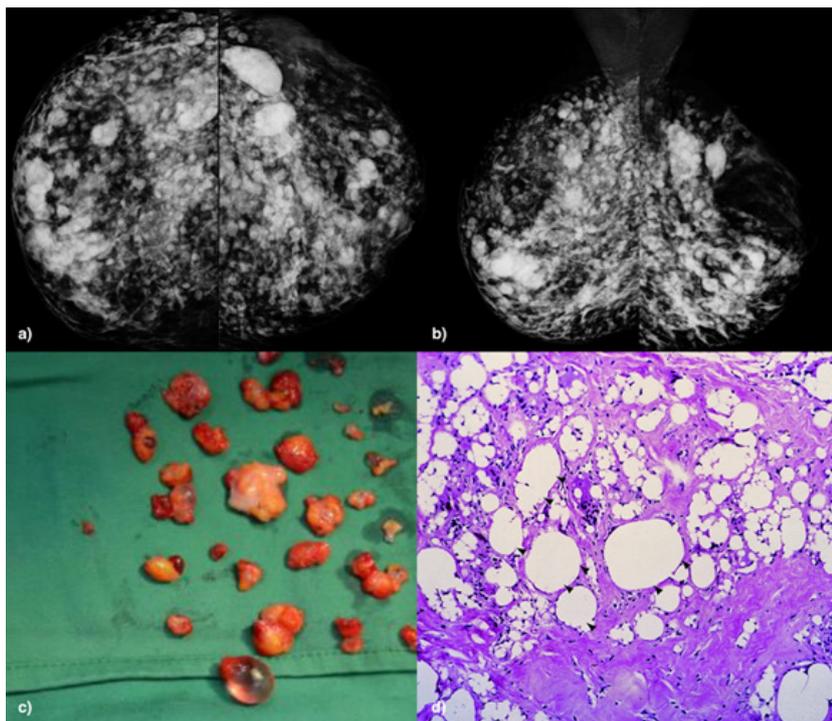


Figure 4 – A woman with a history of free silicone injection, showing the presence of multiple silicone granulomas (siliconomas), bilaterally, evidenced in the mammographic study (a and b), macroscopic (c) and histological (d) ones.

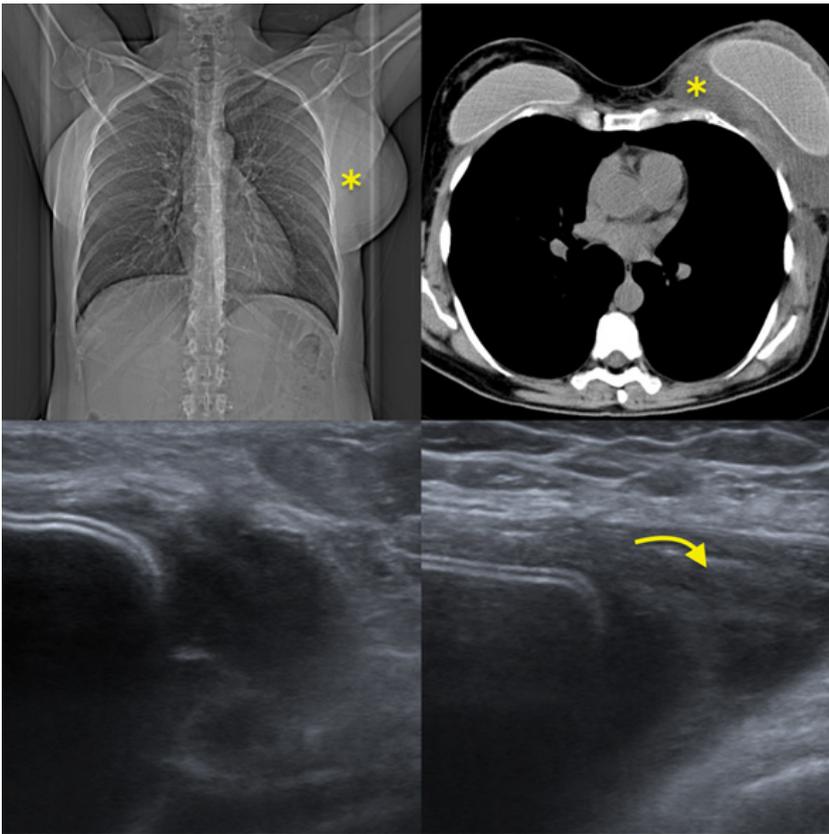


Figure 5 – A 46-year-old female submitted to augmentation mammoplasty, with markedly developed breast asymmetry during the postoperative period. The tomodensitometric study revealed the presence of voluminous periprosthetic collection (asterisk), translated in the ultrasound study by multiseptated collection suggestive of hematoma. An eco-guided drainage of this hematoma was performed, with a favorable evolution of the clinical picture.

4.2. Late complications

In the medium / long term, complications specifically related to breast implants arise.

4.2.1. Capsular contracture

After the placement of a breast implant, there is a foreign body reaction, with the formation of a fibrous capsule at its periphery. When this fibrotic response is excessive, capsular contracture occurs, one of the most frequent complications.⁸ This occurs more frequently in retro-glandular prostheses (8.6%), with a smooth surface.¹⁰ Its diagnosis is mostly clinical, with breast distortion which can be associated with local pain and inflammation. The ultrasound study may demonstrate the fibrous thickening of the capsule, whereas the mammographic study may show its morphological alteration, as well as the presence of peri-prosthetic calcifications. The latter are not a pathognomonic finding of capsular contracture, being very often related to the age of the prosthesis.^{8,11}

4.2.2. Capsular rupture

4.2.2.1 Mammography

It is the most widely used imaging method in mammary evaluation, mainly as a screening method, and as such, may be the first method to identify a possible complication. For screening purposes, additional incidences of Eklund should be performed in order to displace the prosthesis.¹² Some isolated reports of rupture of the prosthesis after compression are described, however they are thought to be related to previous intracapsular ruptures.¹³

When compared to other imaging methods, mammography has the lowest sensitivity for detecting ruptures (11-69%). This is mainly due to the fact that the prostheses are extremely radiodense, preventing the evaluation of their

internal content and, as such, the diagnosis of intracapsular rupture.

First, the location of the prostheses should be recognized, followed by analysis of their contours (Figures 6 and 7).

The appearance of undulations, focal herniations, morphological asymmetry or periprosthetic calcifications are unspecific findings but may be the first evidence of loss of prosthesis integrity. These should lead to further examinations to continue the investigation of eventual rupture.^{12,14}

Although little sensitive in the detection of intracapsular rupture, the mammography is very useful in the detecting extracapsular silicone, represented by the presence of a high density asymmetry in the parenchyma (Figures 8 and 9).

In the absence of rupture history or revision of the prosthesis, the presence of silicone outside the outer capsule means the presence of extracapsular rupture and, by extension, intracapsular rupture. In these cases it is not mandatory to perform other imaging methods for diagnostic confirmation, except for the purpose of investigating the contralateral prosthesis prior to surgical intervention.^{14,15}

Sometimes the extracapsular silicone can simulate larger lesions, forming granulomas, which may have spiculated contours. In these cases, a high level of suspicion is necessary in order to avoid unnecessary biopsies (Figure 10).

The extracapsular silicone may also extend along the fascia of the pectoralis major muscle or subcutaneous tissue to the axillary lymph nodes. However, it should be noted that the isolated presence of enlarged axillary lymph nodes with evidence of silicone inside is not pathognomonic of extracapsular rupture. By the so-called gel bleeding effect, small unpolymerized silicone molecules are able to transpose the outer capsule over time and are consequently drained by the lymphatic system. Thus, the isolated presence of enlarged axillary nodes with increased density, justify the

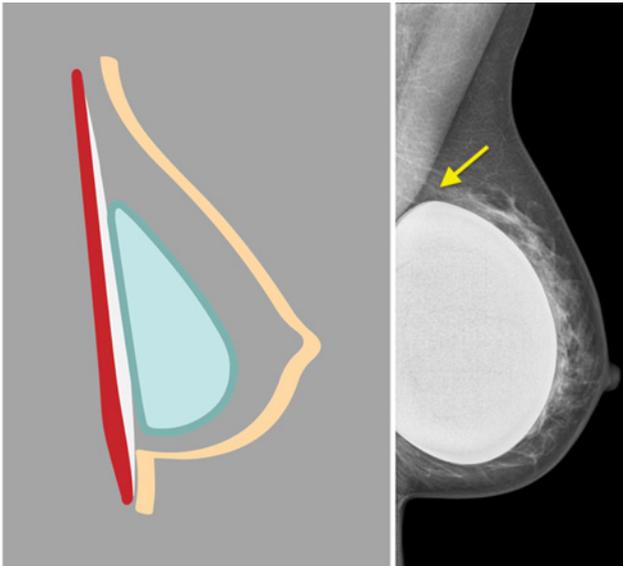


Figure 6 – Illustration and mammographic study on the mid-lateral-oblique incidence (MLO) demonstrating the presence of a silicone implant located in the subglandular plane, anterior to the pectoral muscle (arrow).

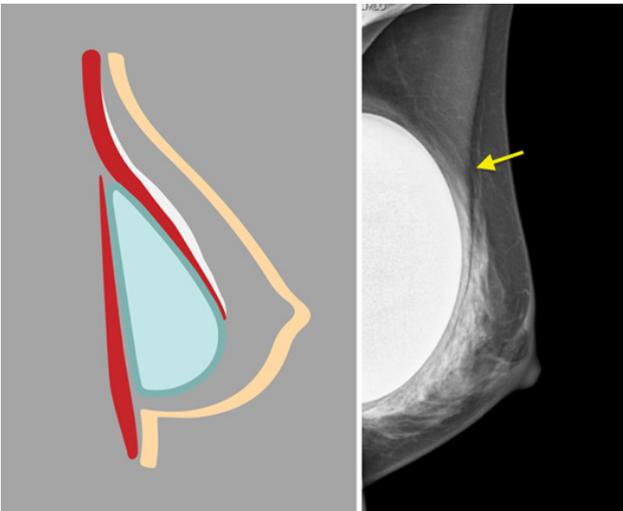


Figure 7 – Illustration and mammographic study on the MLO incidence of retromuscular silicone implant (arrow), in this case in “dual-plane”, only with partial dissection of the pectoralis major muscle.

complementary evaluation with ultrasound or MRI for the investigation of eventual rupture.¹⁴

4.2.2.2 Ultrasound

In Portugal, the ultrasound study is part of the mammary evaluation of women with breast implants, as mentioned in the DGS standard.¹⁶ Compared to mammography, it has a

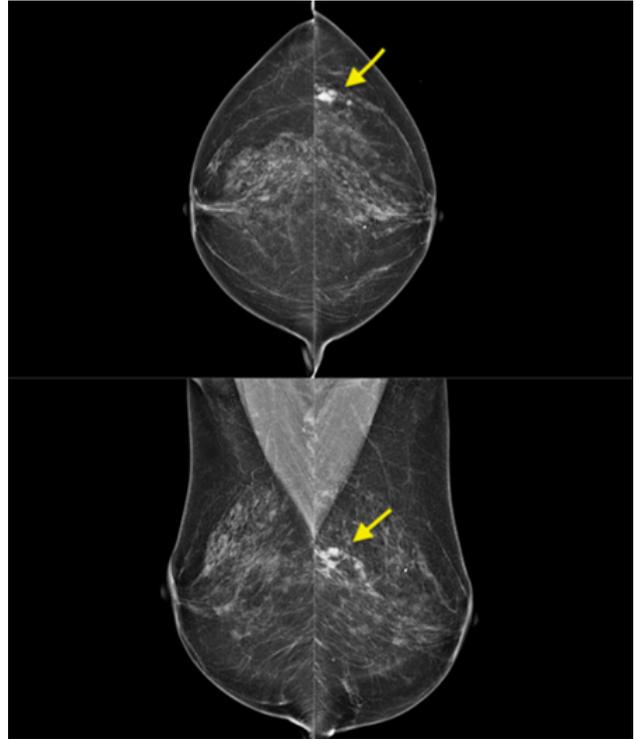


Figure 8 – A 75-year-old woman with a history of reduction mammoplasty with implant complications. The mammographic study revealed the presence of a high density asymmetry in the super-external quadrant of the left breast.

greater sensitivity in the detection of complications, being, however, inferior to MR (30-75%).^{14,17,18,19} This discrepancy can be explained by the fact that the ultrasound is operator-dependent and its execution varies with the technicians, general radiologists or radiologists differentiated in senology. The ultrasound study should be optimized for implant evaluation, with the selection of appropriate focus and depth. Its evaluation should be performed with a high frequency probe (7-15 Mhz), although a lower frequency may be useful in cases of larger implants.

The knowledge of the normal ultrasound aspect of the breast implants is fundamental in their evaluation. These are externally delimited by a regular trilaminar line, which progressively molds to the loca created during the surgical procedure, forming radiating folds, which should not be mistaken for signs of intracapsular rupture. This outer trilaminar contour is formed externally by a hyperechogenic line, which represents the outer face of the fibrous capsule, an innermost line representing the inner face of the elastomer shell and an intermediate line that translates the interface of these two components (Figure 11).

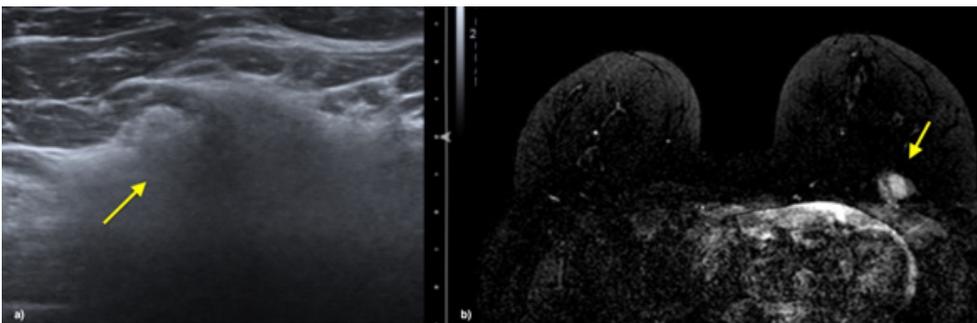


Figure 9 – A complementary ultrasound study (a), which demonstrated the presence of the “snowstorm” signal was performed, and the MRI (b) study revealed the presence of hypersignal in the selective sequence for the silicone. These findings are compatible with free silicone, these characteristics being described later in this article.

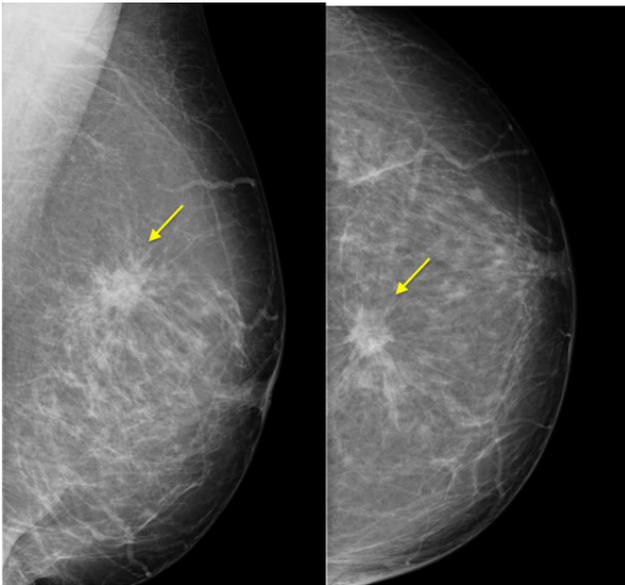


Figure 10 – Woman with a history of implants removal due to complication. The mammographic study revealed the presence of a suspicious lesion, with spiculated contours, and the biopsy result was negative. The MRI study revealed the presence of a non-capturing lesion, with a positive sign for silicone.

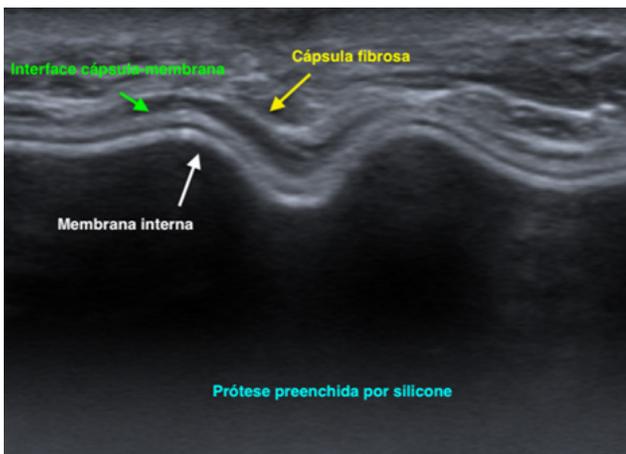


Figure 11 – Ultrasound study showing external trilaminar line of a silicone implant.

The demonstration of a regular trilaminar line during implant evaluation has, in the great majority of cases, a good correlation with its integrity.¹⁴

The ultrasound study of implants should include evaluation of their contours, their luminal content and the presence of free silicone or granulomas, both in the mammary parenchyma and axillary lymph nodes.¹⁵

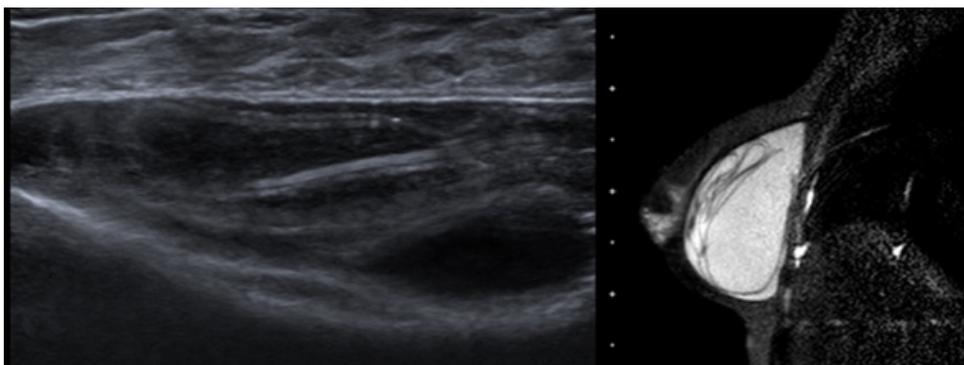


Figure 12 – A 40-year-old woman with a history of breast augmentation 12 years ago. The ultrasound study demonstrated the presence of several curvilinear lines inside the implant (ladder sign), in correspondence with the “linguini” sign in MRI, translating the presence of intracapsular rupture.

The most reliable sign of the integrity of the implant is the demonstration of an anechoic and homogeneous luminal content.¹³

The presence of several horizontal or curvilinear lines inside the implant, forming the stepladder sign, are the most reliable sign of intracapsular rupture, in which there is a greater collapse of the envelope, being equivalent to the sign of the “linguini” on MRI (Figure 12).⁸

Other signs such as the “lock sign” or the “subcapsular line” should also alert the radiologist to the presence of this type of rupture, representing earlier stages of the rupture. The lock sign occurs by expanding the apex of a radiating fold by extruding a small amount of silicone at this level. The sign from the subcapsular line represents a slightly posterior stage, where there is a greater accumulation of silicone in the space between the fibrous capsule and the inner membrane (Figure 13).

In the investigation of a possible rupture, potential pitfalls should have been taken into account. The presence of reverberation artifacts, with the presence of several echogenic lines parallel to the capsule-elastomer complex, should not be confused with the presence of rupture. This artifact is often conditioned by the excessive compression of the prosthesis, being eliminated with a softer compression.

The presence of a heterogeneous content may simulate the presence of rupture, especially in the 5th generation implants with silicon gel of high cohesiveness. Radial folds may also mimic this type of complication, however, since they represent only an invagination of the envelope, it is important to follow the path from the apex to the margin of the implant (Figure 14).

The presence of any signs suggesting intracapsular rupture should alert the radiologist to the eventual presence of associated extracapsular rupture. For this, the presence of free silicone in the mammary parenchyma, translated by the sign of the “snowstorm”, the most sensitive and specific signal of rupture on the ultrasound,¹⁴ should be investigated. This consists of a marked increase in echogenicity with loss of the parenchymal interface, conditioned by the dispersion of the ultrasonic beam caused by the silicone. The free silicon can still be absorbed by the lymphatic system, identifying the presence of this same sign in the axillary ganglia. As previously described, its presence is not diagnostic of rupture due to the existence of the gel-bleeding phenomenon, which is currently less frequent with the use of the latest generation silicone implants (Figure 15).

Depending on the amount of free silicone, it may form granulomas, the imaging spectrum of which can vary from an ultrasonographically simple cyst to a typical “snowstorm”

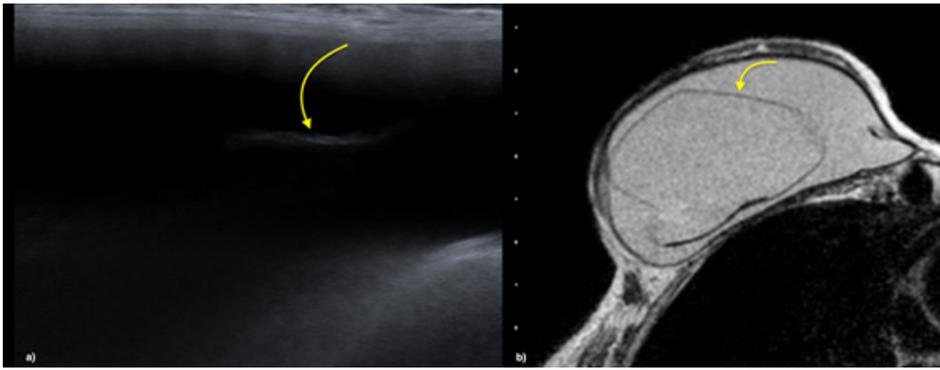


Figure 13 – An 85-year-old woman with a history of bilateral mastectomy for bilateral breast carcinoma and reconstruction with implants 20 years ago. In the ultrasound study (a) the loss of the usual trilaminar contour was verified, identifying the presence of the “subcapsular line” signal (arrow). The MRI study was consistent (b), revealing detachment of the internal membrane of the implant, being compatible with intracapsular rupture. This should not be mistaken with the presence of periprosthetic fluid, reason why it is crucial to evaluate the trilaminar line.

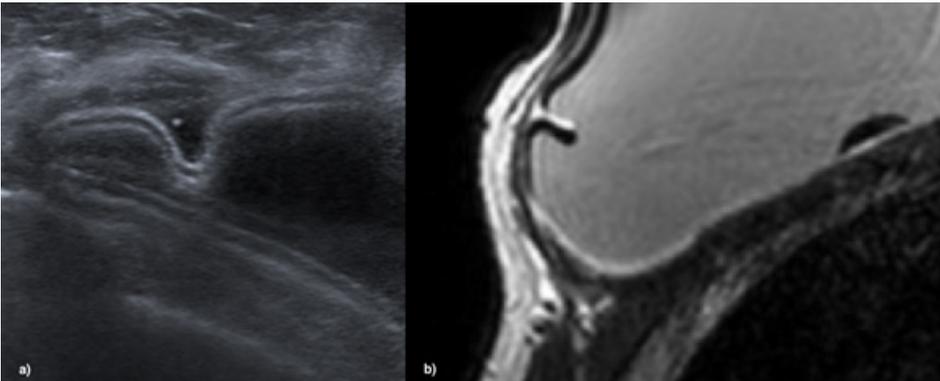


Figure 14 – Ultrasound (a) and MRI (b) showing the presence of a radiating fold.

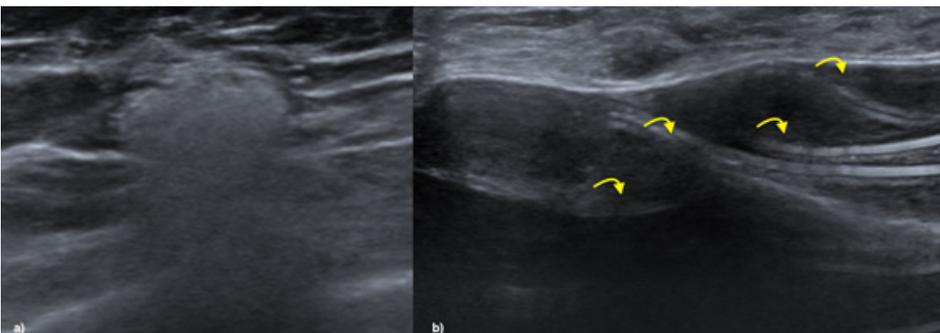


Figure 15 – A 40-year-old woman with a history of breast augmentation. The ultrasound study identified the presence of axillary ganglion with sign of the “snowstorm”, suggestive of extracapsular rupture, confirmed by the presence of the “ladder” sign in the homolateral implant, translating intracapsular rupture.

signal, or may present suspect ultrasound characteristics, resulting sometimes in a biopsy.

If the ultrasound findings are not categorical or if the evaluation has been impaired by the presence of granulomas related to previous ruptures, a complementary MRI study should be performed (Figure 16).

4.2.2.3 Magnetic Resonance

MRI is the most sensitive and specific imaging method for the detection of rupture, estimated at 72-84% and 85-100%, respectively.^{8,14}

This modality is used mainly in the evaluation of silicone implants, since the rupture of the saline implants in most cases is clinically evident and the fact that some expanders constitute a contraindication to its realization (Figure 17).

The study should be performed with a dedicated coil in an apparatus with a magnetic field of at least 1.5T, and its protocol should include selective sequences for the silicone. In these sequences, the silicone exhibits hypersignal while there is suppression of the water signal, the reverse being found in the sequences with silicone suppression. The acquisition should be performed in at least two orthogonal planes, in

order to allow a better distinction between complex radiating folds and early intracapsular ruptures. The administration of contrast is not necessary if the study is only directed to the evaluation of the integrity of the implants.²⁰

For the correct interpretation of the MRI study, knowledge of the usual aspect of implants and findings suggestive of complications is fundamental. To avoid potential diagnostic errors, the type of surgical approach and its date should be known for a better interpretation of early complications, as well as the existence or not of previous revision justifying the presence of free silicone related to previous ruptures (Figure 6).¹³

The evaluation implants by MR is contemplated in the last edition of BIRADS (5th edition), allowing a systematized evaluation and the standardization of the lexicon used.

The first step is to determine the type of implant (single vs double lumen) and its filling (silicone vs. saline). This latter distinction can be made in the T2-weighted sequences, since the saline implants exhibit hypersignal labeling, while the silicone imprints exhibit intermediate signal. In saline implants, a valve is usually present, usually located in subareolar topography. It is important not to confuse this

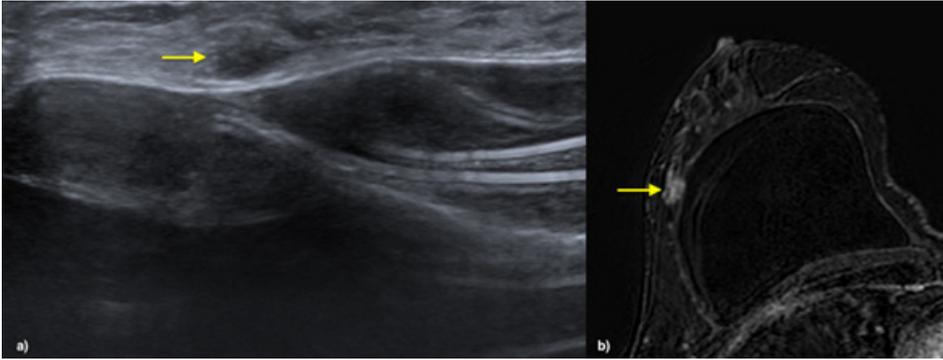


Figure 16 – The same ultrasound study (Figure 15) also revealed the presence of a nodule with indeterminate ultrasound characteristics, and a complementary MRI study was performed. In the study of MR (b), this presented enhancement after administration of contrast, and a directed biopsy was performed, which revealed that it was a foreign body granuloma.

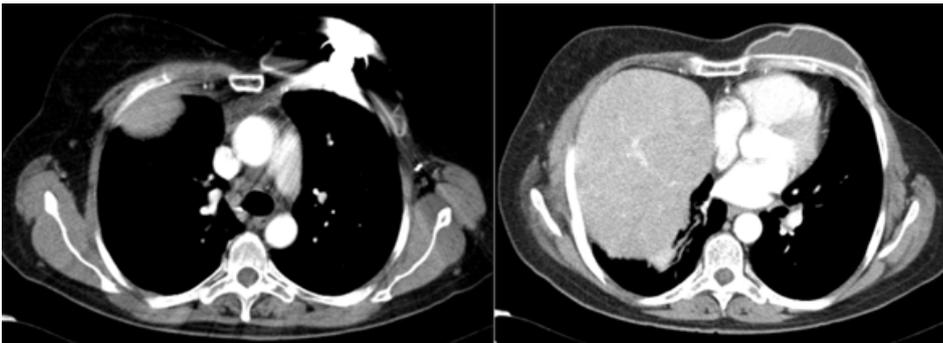


Figure 17 – A 47-year-old woman with a history of left mastectomy, showing an expander due to the presence of multiple artifacts at the level of her valve. The MRI study is contraindicated in some expanders, and its model should always be known before each exam. (<http://www.mrisafety.com/>).

valve with the markers used for its orientation during the surgical procedure (Figure 18).

Next, the location of the implants (retro-glandular vs. retro-pectoral) should be identified.

Its remaining evaluation includes its usual (oval) morphology, as an implant with rounded morphology may be a sign of capsular contracture.

The evaluation of its contours, defined externally by the fibrous capsule, is represented by a hyposignal-labeled line in T2. The presence of a small amount of peri-prosthetic fluid is common, especially in textured implants, resulting from the local inflammatory reaction to the foreign body.

The different types of irregularity of the contour must be distinguished from each other, since they may reflect quite different alterations. Radial folds are a rather frequent finding, translated by the presence of a perpendicular invagination of the inner membrane into the prosthesis, where the existence of an implant without at least one of these folds is very rare.



Figure 18 – MRI of 47-year-old woman submitted to left mastectomy in 2015, with symmetrization mammoplasty and placement of bilateral implants. In this sequence (T2) it is possible to verify the intermediate signal of the silicone of the implants and the presence of orientation markers (arrows).

These can be simple or complex, being one of the main pitfalls in the evaluation of eventual intracapsular rupture (Figure 19).

The undulations of the prosthetic contour are a finding with no pathological significance, resulting from the process of adapting a malleable implant to the surgical loca. Radial folds, as well as the presence of a small amount of peri-prosthetic fluid and contour curls constitute alterations in the normal spectrum of mammary implants (Figure 20).¹²

The presence of small protrusions or focal herniations are readily identified, and although do not diagnose rupture, they often occur simultaneously, as they translate areas of fragility of the fibrous capsule.

The presence of intracapsular rupture is more easily detected through this imaging method. The most reliable finding of this complication is the “linguini signal”, described by Gorczyca et al., in 1992, with a sensitivity and specificity of 96% and 77% respectively.²¹ This signal consists of a late stage of this type of rupture, associated with partial or total collapse of the elastomer shell. Imaging is represented by the presence of multiple hypointense curvilinear lines within the hyperintense contents of the implant (Figures 12 and 21).

As described in the ultrasound, there are two findings that represent earlier stages of this type of rupture, namely the locking signal (earlier) in which there is no associated collapse and the signal of the subcapsular (intermediate) line in which there may be minimal collapse of the casing. The “lock” results from the extravasation of silicone by the apex of a radiating fold, causing expansion of this region, which will later migrate into the intracapsular space, with a detachment of the inner membrane and forming the subcapsular line. The presence of some T2-weighted hypersignal foci inside the implant (“salad oil sign”) were also described as a sign suggesting this type of complication, although not a reliable signal as it may result from the injection of corticosteroids or antiseptics during the surgical procedure (Figure 22).

Extracapsular rupture may be associated with any degree of collapse, and the search for free silicone in topography

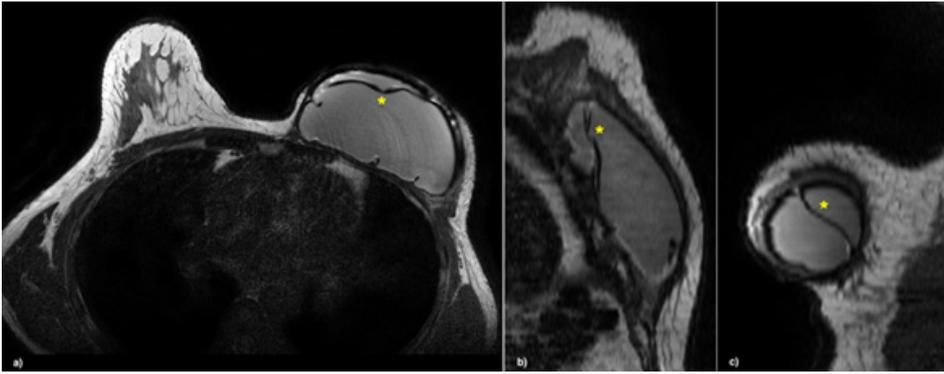


Figure 19 – A 38-year-old female with left mastectomy and reconstruction with a *Latissimus dorsi* flap and implants. The evaluation of the MRI study demonstrated the presence of what appeared to be the “sign of the subcapsular line” suggesting intracapsular rupture in the axial plane (a). Its evaluation in the other orthogonal planes (coronal (b) and sagittal (c)) revealed a pitfall, conditioned by the presence of a complex radiating fold.

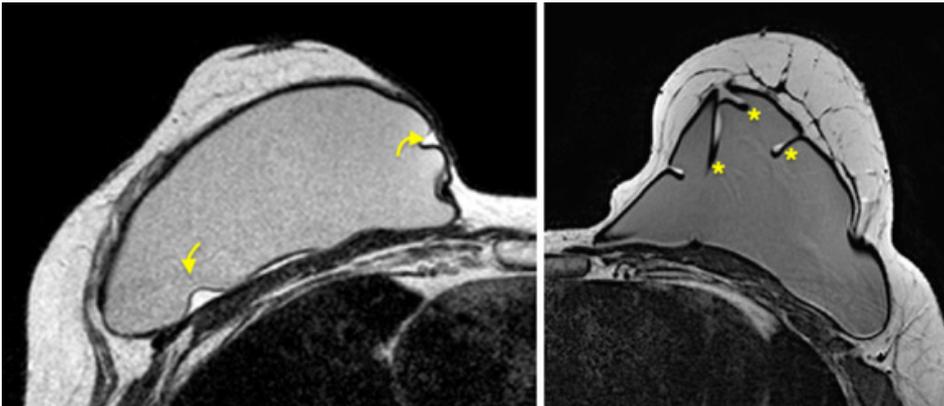


Figure 20 – Changes in the normal spectrum of mammary implants in the MRI study (T2-weighted sequence), namely the presence of undulations and minimal amount of periosthetic fluid (arrows) and the presence of radiating folds (asterisks).

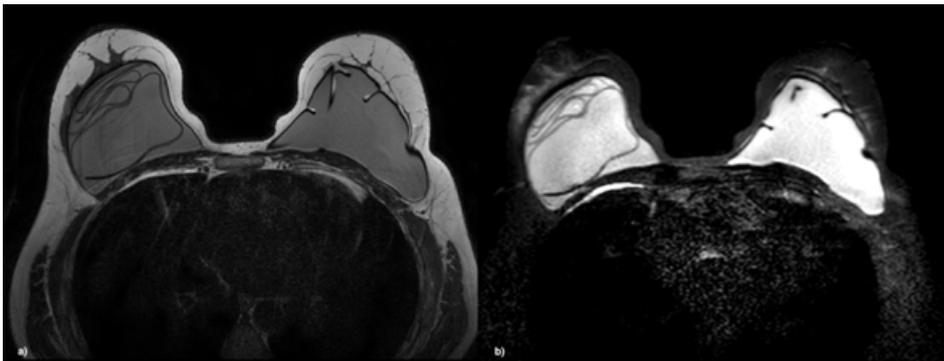


Figure 21 – MRI study revealing the presence of the “Linguini signal”, diagnosis of intracapsular rupture, evidenced in T2 (a) and selective sequence for silicone (b).

outside the fibrous capsule should be performed whenever an intracapsular rupture is detected. In MRI this is translated by the presence of foci with a signal identical to that of silicon in the sequences dedicated to its evaluation. When confluent, they may form silicone granulomas, which, like malignant lesions, may undergo growth and display enhancement after administration of contrast, being practically indistinguishable only by imaging techniques. In these cases, a directed ultrasound study should be performed in an attempt to identify the snowstorm signal, and in the absence of this, a biopsy should be performed. As with other imaging techniques, lymph nodes may also exhibit the same signal as silicone, but are not pathognomonic of extracapsular rupture (Figure 23).¹⁴

4.2.3 Adenomegalies in the internal mammary chain

The presence of adenomegaly in the internal mammary chain is a diagnostic challenge, especially in women with prostheses after oncoplastic surgery. These may result from a non-specific inflammatory process, translate the presence of extracapsular rupture or a lymph node metastasis. A study (Sutton et al) demonstrated the presence of adenomegaly in



Figure 22 – An 85-year-old woman with bilateral mastectomy due to bilateral carcinoma, with reconstruction with implants 20 years ago. The MRI study revealed the presence of bilaterally intracapsular rupture signs, to the right, translated by the presence of the “subcapsular line” sign (arrow) and left by the “linguini” and “salad oil” signs (arrow and asterisk respectively).

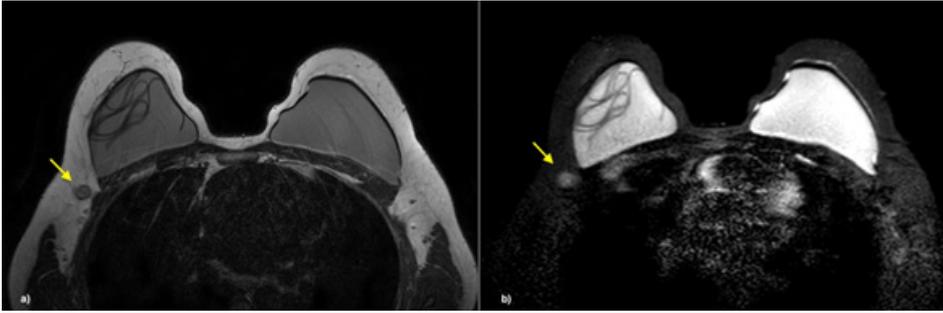


Figure 23 – MRI study of a woman with right intracapsular rupture (“linguini” sign), identifying axillary adenomegaly (arrow) in T2-weighted sequence (a), which shows hypersignal in the selective sequence of silicone (b) indicating coexistence of extracapsular rupture.

this lymphatic chain in up to one third of women with silicone implants. Of the 207 women with adenomegalies studied, only one of them revealed metastatic adenopathy. Thus, this finding should be classified as BIRADS 3, guaranteeing a short-term evaluation for 2 years, in detriment of the biopsy (Figure 24).^{6,22}

4.2.4 Large cell anaplastic lymphoma

It is a rare late complication, recently described in the literature, with an incidence between 1: 500 and 1: 3,000,000 in women with implants.²³ Its diagnosis is made, on average, 10 years after surgery. The systemic symptoms are rare and the clinic is non-specific. This entity usually translates into a peri-prosthetic effusion and / or mass, which can progressively progress to soft tissue injury. Ultrasound and MRI are the most sensitive imaging methods for its detection. Thus, the presence of “new” peri-prosthetic effusion after the postoperative period (1 year) should alert the radiologist to its diagnosis, suggesting the aspiration of the effusion and its laboratory analysis with flow cytometry.⁶

4.2.5 Complications related to reconstruction

Several types of complications may arise after oncoplastic surgery, their incidence being related to the timing of

chemotherapy and / or radiotherapy, as well as to the type of reconstruction. The early complications are similar to those observed after augmentation mammoplasty, adding cutaneous necrosis and dehiscence of the suture.²⁴ A complication frequently related to TRAM is fat necrosis, occurring in 15% of cases. Other complications include total or partial necrosis of the flap (0.3% and 2-6%) and abdominal wall herniation (Figure 25 and 26).⁶

4.2.6 Relapse / Surveillance

Breast implants are not related to the increased risk of breast cancer, however they may reduce the acuity of the usual screening methods.¹² Specific mammographic incidents such as Eklund, with removal of the prosthesis and isolated compression of the mammary parenchyma, aim to increase sensitivity in the detection of lesions in women with implants. MRI is, however, the best technique for its detection, explaining the fact that the MRI protocol in women with implants includes in most cases the dynamic post-contrast study, in order to increase its detection rate (Figures 27 and 28).

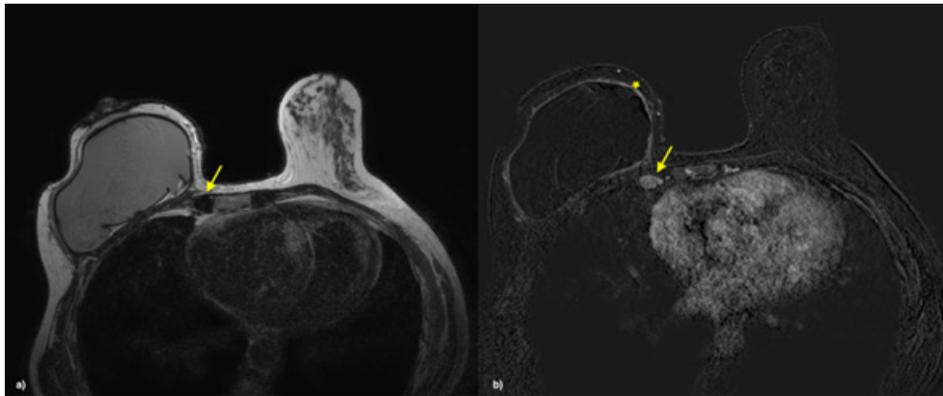


Figure 24 – A 46-year-old woman with a history of right-sided breast cancer with reconstruction with breast implant. The MRI study revealed the presence of adenomegaly in the right internal mammary chain (arrow), evidenced in the weighted sequence in T2 (a) and T1 after contrast (b). Concomitantly, there is an early and diffuse enhancement of the fibrous capsule (asterisk), in a probable relation with the underlying inflammatory process, thus explaining the reactive nature of the identified adenomegaly.

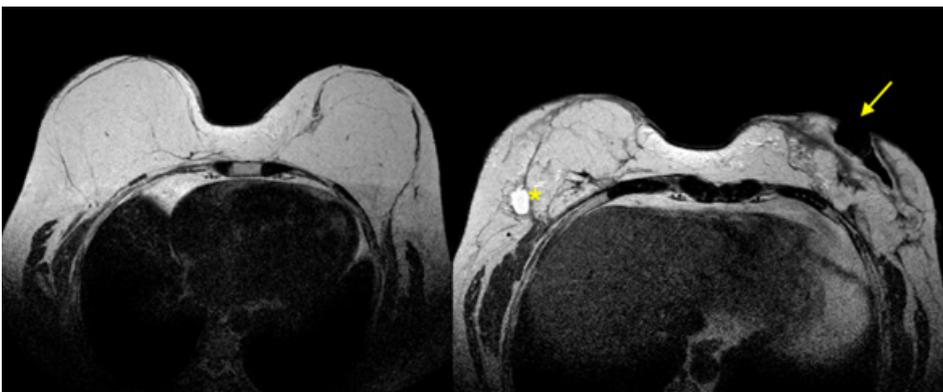


Figure 25 – A 55-year-old woman with a history of oncoplastic surgery with rectus abdominis muscle flap (TRAM). The MRI study revealed the presence of a small seroma on the right (asterisk) and the presence of cutaneous necrosis and dehiscence of the left suture (arrow).

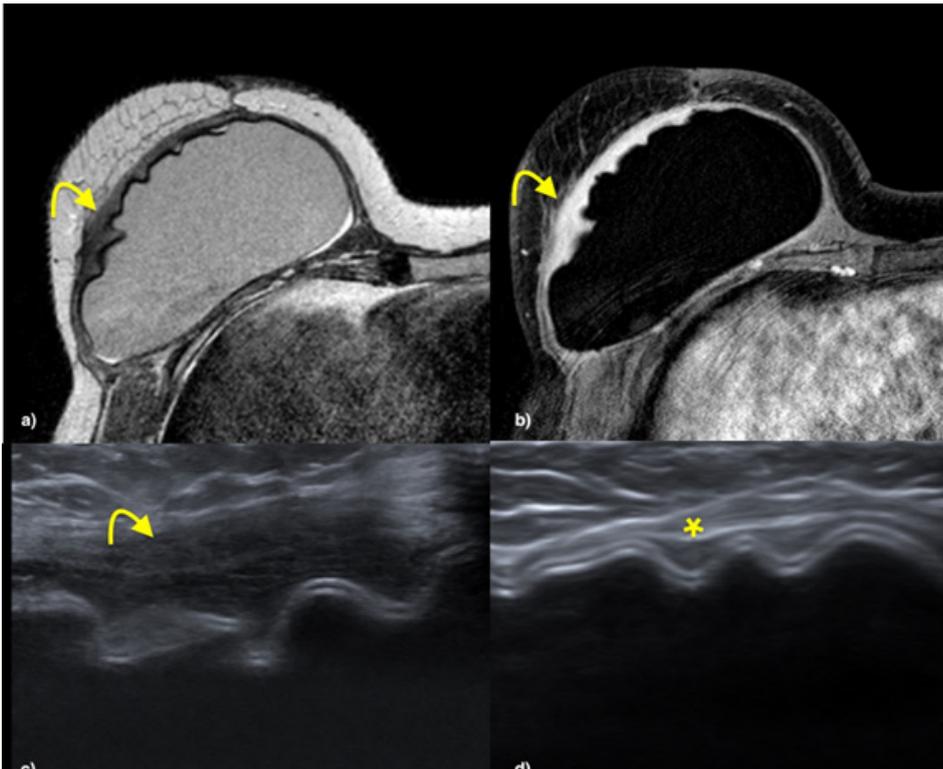


Figure 26 – A 42-year-old female with a history of breast carcinoma on the right with breast reconstruction with a *Latissimus dorsi* flap and implant. The MRI study demonstrated marked thickening of the muscle flap (a), with diffuse enhancement after administration of contrast (b) in relation to the local inflammatory process. The complementary ultrasound study (c) was concurrent, and a favorable clinical course was observed after antibiotic therapy and anti-inflammatory therapy, with disappearance of these findings in the ultrasound of control at 3 months (d).

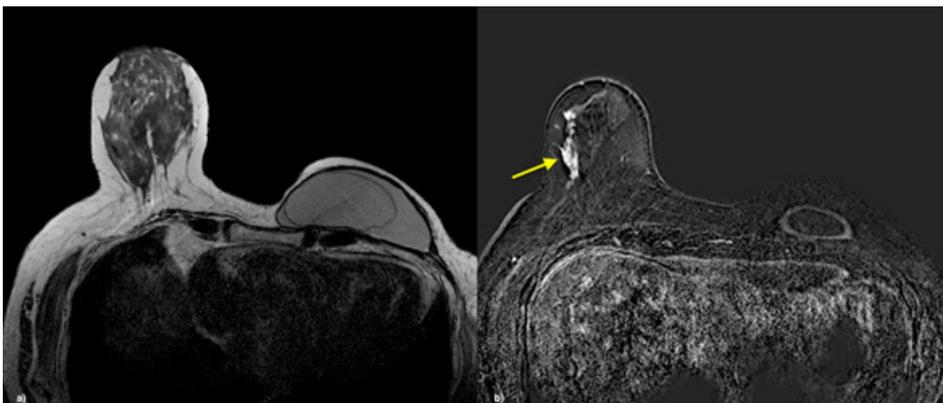


Figure 27 – A 71-year-old woman with a history of breast carcinoma on the left with breast reconstruction with a *Latissimus dorsi* flap and implant. In the MRI study, the presence of intracapsular rupture on the right was verified, identifying the signal of the subcapsular line (a). In the dynamic study after administration of contrast (b), a non-mass enhancement of the linear type was identified in the inferolateral quadrant of the contralateral breast, which after biopsy revealed a ductal carcinoma in situ.

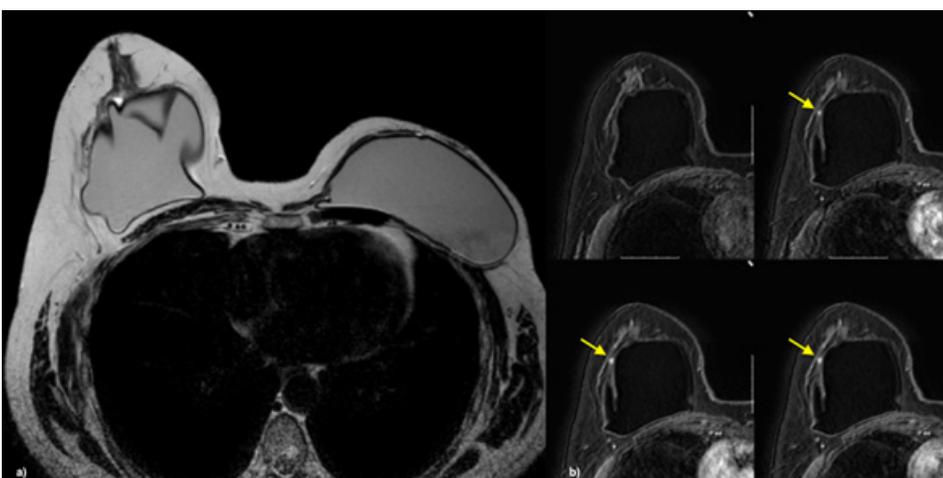


Figure 28 – Follow-up MRI in a left mastectomized woman with reconstruction with bilateral implants. Assessment of T2-weighted sequences (a) revealed no signs of prosthesis-related complications. However, in the post-contrast (b) dynamic study, the presence of a focus of enhancement was verified, which after a second-look ultrasound study and echoguided micro biopsy, an invasive ductal carcinoma was found.

5. Conclusion

With the exponential increase of women with breast implants in the last decades, it is therefore imperative to know the main associated complications and the advantages and limitations of each of the imaging techniques. Mammography has a limited role in its evaluation, and only the diagnosis of extracapsular rupture is possible. Ultrasonography allows a more detailed evaluation of the implant, namely regarding the possibility of intracapsular rupture. However, MRI is the technique with greater sensitivity and specificity in the detection and characterization of these complications. Thus,

given its nonspecific clinic, Radiology plays a central role in its monitoring, allowing early detection and better diagnostic and therapeutic guidance.

Abbreviations:

USA – United States of America
TRAM - Transverse rectus abdominis myocutaneous
DIEP - Deep inferior epigastric perforators
MR – Magnetic resonance
FDA - Food and Drug Administration
DGH – Directorate General for Health
CT - Computerized Tomography

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Protection of human and animal subjects: The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

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