DIAGNOSIS BY ULTRASOUND OF RUPTURE OF MAMMARY IMPLANTS AND OTHER ASSOCIATED COMPLICATIONS: REVISION ARTICLE

DIAGNÓSTICO POR ECOGRAFÍA DE RUPTURA DE IMPLANTES MAMARIOS Y OTRAS COMPLICACIONES ASOCIADAS: ARTÍCULO DE REVISIÓN

Michel Hernández Restrepo[1]
Fredy Martín Cerquera Cabrera[2]
Jaime A. Ortega Santamaría[1]

Key words (MeSH)
Breast implant
Prostheses and implants
Breast
Ultrasonography, mammary

Palabras clave (DeCS)
Implantes de mama
Prótesis e implantes
Mama
Ultrasonografía mamaria

SUMMARY

The imaging diagnosis of the rupture of the mammary implant is a frequent consultation and a diagnostic challenge. The factors for occurrence can be related to the patient – reason for the implant, type of incision, location of the implant, age-or the implant itself-type, age of insertion, mark-. In the group of imaging techniques, the one with the best diagnostic performance is magnetic resonance; however, in most cases, the initial diagnosis tool is the ultrasound. The appearance of a normal silicone implant, through ultrasound, includes the visualization of well-defined margins of the cover, and the homogenous and anechoic silicone lumen. There are several imaging signs in the intracapsular rupture. The signs with the best performance are an increase in size of the space between the fibrous capsule and the external cover of the implant due to occupation of the extravasation liquid, as well as the complicated appearance of the implant lumen given by the staircase sign and the internal low-level echoes. The most reliable sign in the extra capsular rupture is the snowstorm sign. Other signs, such as peri-implant effusion and the irregular shape of the implant, are not reliable. Both types must be differentiated from *silicone bleeding,* which is a silicone exit or transudate through a capsule without evident rupture or another associated finding, due to a change in the permeability of the prosthesis cover, which increases its use over the years, most frequently in a span between 15 and 20 years.

RESUMEN

El diagnóstico imaginológico de la ruptura del implante mamario es una consulta frecuente y un desafío diagnóstico. Los factores para su ocurrencia pueden relacionarse con el paciente —razón de implantación, tipo de incisión, localización del implante, edad— o con el mismo implante —tipo, año de inserción, marca—. Dentro de las técnicas de imagen, la de mejor rendimiento diagnóstico es la resonancia magnética; sin embargo, en la mayoría de las ocasiones la herramienta de diagnóstico inicial es la ecografía. El aspecto por ultrasonido de un implante de silicona normal incluye la visualización de márgenes bien delimitados de la cubierta y el lumen de silicona homogéneo y anecoico. Existen diferentes signos imaginológicos

[1]*MD, radiologist. Hospital Universitario de la Samaritana, Bogotá, Colombia.*

[2]*MD, radiologist. Clínica Uros y Rayos X del Huila, Neiva, Colombia.*

en la ruptura intracapsular; los de mejor rendimiento son el aumento del tamaño del espacio entre la cápsula fibrosa y la cubierta externa del implante por ocupación de líquido extravasado, el aspecto complicado del lumen del implante dado por el signo de la escalera y los ecos internos de bajo nivel. En la ruptura extracapsular el signo más confiable es el signo de la tormenta de nieve. Otros signos, como el derrame periimplante y el contorno irregular del implante, no son confiables. Ambos tipos deben distinguirse del sangrado de silicona, un escape o trasudado de silicona a través de la cápsula sin una ruptura evidente u otro hallazgo asociado, debido a un cambio en la permeabilidad de la cubierta de la prótesis que aumenta con los años de uso de esta, siendo más frecuente entre 15 y 20 años.

Introduction

The imaging diagnosis of the rupture of the mammary implant is a frequent consultation and a challenge for the radiologist, taking into account the great popularity of the use of prosthesis for augmentation, as well as the great variety of utilized mammary implants.

There are several imaging techniques, for example, ultrasound, mammography and magnetic resonance; magnetic resonance has the best diagnostic performance (1-6). However, the ultrasound is the tool of initial diagnosis in most cases, given its high availability and low price (7-9); in addition, some specific conditions which contraindicate the performance of magnetic resonance must be considered, as well as the lesser availability of magnetic resonance in our medium (1, 10, 11). For these reasons, the ultrasound signs that are available for the diagnosis of intra- and extra-capsular rupture of the mammary implant must be known, as well as their operative characteristics which are described in the literature. In addition, cases of intra- and extra-capsular rupture will be described in our patients, as well as differential diagnosis with case studies.

There are several types of mammary prostheses: single-chamber, two-chamber and a special type, Becker expansions, which are used in mammary reconstruction according to its internal structure (12, 13) and its cover can be smooth or with texture. The content and the structure are characteristics which can confer different imaging appearances in the rupture of the implant.

Once the mammary implant has been placed, the body normally forms a fibrous scar or a capsule around the implant. When the fibrous scar is intact, many broken implants are included in the capsule, which we call intra-capsular. The extra capsular rupture results from an extrusion of silicone towards the adjacent tissues or tissues at a distance (1,12-17).

Even though the true incidence of rupture with implants is not known (18-20), taking into account the different types of generations of evaluated mammary prostheses in each one of the studies, as well as a lack of follow-up of asymptomatic patients, it seems that the incidence of rupture is directly related to the age of the implant and inversely, with the width of the cover of the elastomer; therefore, the risk with thin elastomers is greater (7,19). Risk factors associated to the rupture related to the patient have been proven, both with the implant and due to extrinsic factors.

There are different imaging signs in intra-capsular rupture; of all these, the complex internal appearance of the implant has the largest sensitivity (12,13,15,16,18,21-24). Other signs, such as peri-implant effusion and the irregular shape of the implant, are not considered reliable. (1,12,14,15,21).

The spectrum non-contained silicone includes a formation of granuloma, fibrosis, and migration. The extrusion of silicone which is confined the surface of the implant can primarily migrate to local sites, such as lymph nodes of the ipsi-lateral and axillary thoracic wall (7,12,13,18,25). Silicone may also migrate to more distal regions, such as the limb and the subcutaneous tissues of the abdominal wall (13).

The appearance of free silicone is variable. Its classical appearance has a highly echogenic pattern which is disperse and which reverberates echoes with a well-defined anterior margin, and loss of the posterior detail. This pattern has been described as a "snowstorm" sign. Occasionally, the echogenic noise is absent and it is replaced by an acoustic shadow with silicone, thus blocking sound transmission. The large to medium conglomerates of free silicone can be also observed as hypo-echoic masses, which are indistinguishable from cysts, and are surrounded by echogenic noise (13,15,26).

Definitions

Types of prostheses

The single-chamber prostheses full of silicone are the most common prostheses. These prostheses consist of a cover of elastomer with silicone gel. The elastomer may be smooth or may have a texture (1,12,16,21). There are other single-chamber prostheses which cover is made of polyurethane, which are less used, given that a risk has been described with its use, since polyurethane metabolizes after the implant, and a known carcinogen called 2.4 toluene-diamine is produced (21). There are also two-chamber prostheses made up of silicone and a saline solution. This consists of an external compartment of saline solution and a larger internal compartment of silicone gel (13,16) (figure 1).

The expanders, on the other hand, are a lumen of external silicone and an expandable internal compartment of a saline solution. It is used in mammary reconstruction after mastectomy (13,21). The single-chamber prosthesis of saline solution has an external cover of silicone elastomer, filled with a saline solution. They usually have a valve which enables the adjustment of the size of the prosthesis (2,13).

On the other hand, there are two types of implants: sub glandular, located behind the gland and in front of the pectoralis muscle – associated to a greater number of complications- and retropectoral, located behind the pectoralis major muscle (22, 24) (figure 2).

Normal appearance of the implant

The width of the capsule normally varies between 1 to 1.5 mm. The appearance due to ultrasound of a normal silicone implant includes the visualization of well-defined margins of the silicone cover, the silicone lumen is homogenous and with an anechoic appearance. There is a smooth band of echoes in the anterior appearance, which represents a reverberation device. As part of the normal condition, vertical creases can be seen originating from the surface of the implant (12,13,16,27,28) (figure 3).

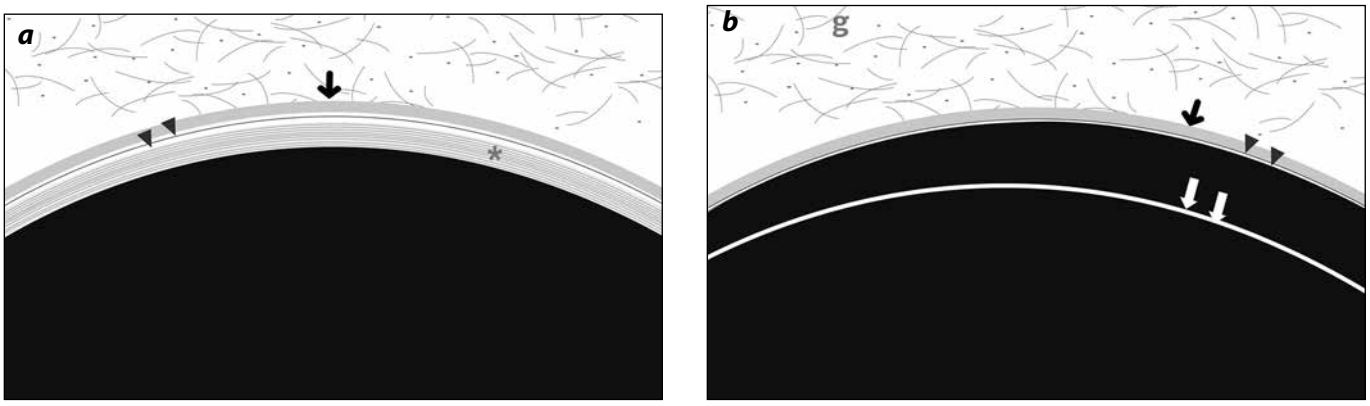

Figure 1. (a) Schematic representation of single chamber prosthesis. The glandular tissue is in the anterior location. Black arrow: external capsule. Points of the arrow: two echogenic lines of the external cover of the prosthesis. Asterisk: pectoralis muscle. A single compartment of silicone gel represented with the color black can be seen. (b) Schematic representation of the two-chamber prosthesis. g: anterior mammary glandular tissue. Black arrow: external capsule. Points of the arrow: two echogenic lines of the cover of the external compartment. White arrows: two echogenic lines of the cover of the internal compartment.

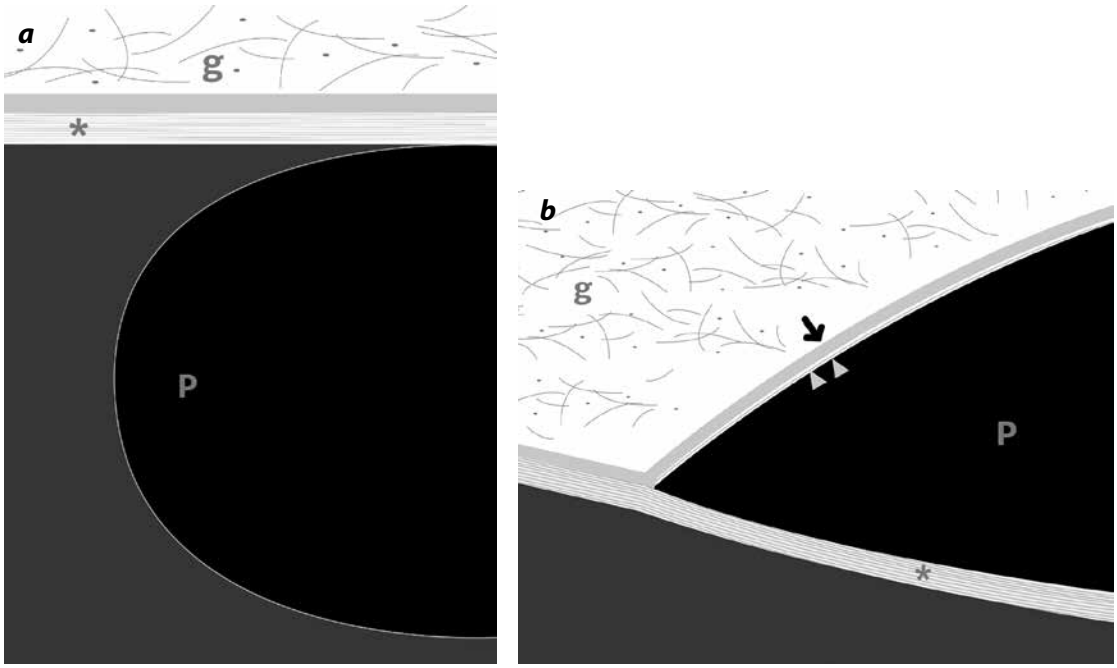

Figure 2 (a) Schematic representation of the retropectoral implant. g: fibro glandular tissue. Asterisk: pectoral muscle. P: mammary prosthesis. (b) Schematic representation of the sub glandular implant. g: fibro glandular tissue. Black arrow: external capsule. Points of the arrow: external cover of the prosthesis. Asterisk: pectoralis muscle. P: mammary prosthesis.

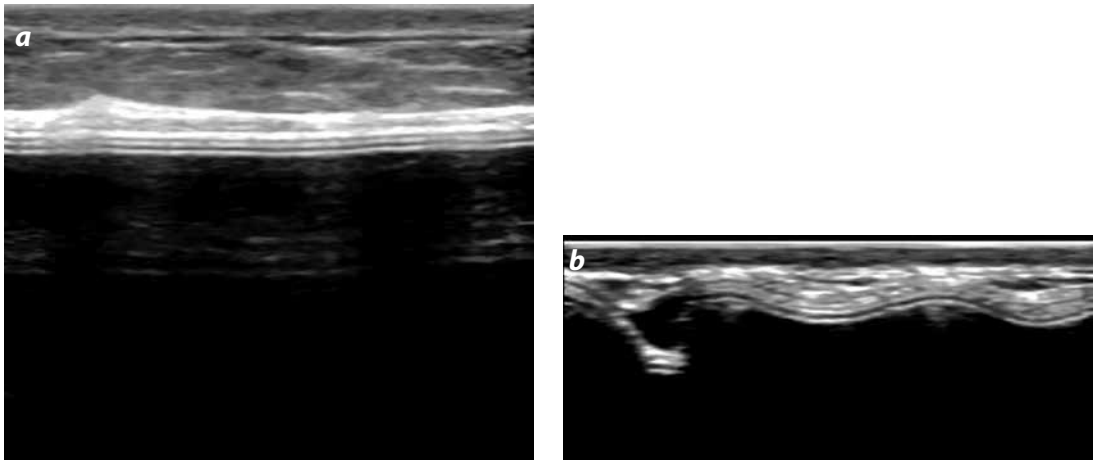

Figure 3. (a and b) Mammary ultrasound with high-frequency lineal transducer. Normal appearance of the mammary prosthesis. We can see its well-defined anterior margin, the anechogenic and homogenous internal appearance. As part of the normal condition: smooth reverberation device subjacent to the external cover, as well as the presence of radial creases in these cases, anterior and posterior, which come in contact with the respective covers of the prosthesis.

In the case of single-chamber implants, there is a slight degree of separation between an echogenic line which represents the capsule and a double echogenic line which represents the external cover of the prosthesis (12) (figure 4).

In two-chamber implants, the most important challenge is to recognize the two compartments, if not enough data is available regarding the type of implant being used. In this case, the use of the velocity of sound phenomenon to identify the presence of two-chamber implants enables to differentiate the filler material with a base in the presence of absence of the ultrasound device, created by a slower velocity of sound through the silicone gel (997 m/s through the silicone gel compared to 1,540 m/s through the soft parts).

Given the slowdown or reduction of velocity of sound of silicone, the thoracic wall which is posterior to the silicone gel implant appears to be deeper than what it actually is. When one examines the edge of the implant in such a way that it extends halfway throughout the field of vision, the apparent depth of the thoracic wall which is deep to the implant can be compared to the depth of the thoracic wall which is peripheral to the edge of the implant. If the implant has an external compartment of saline solution and an internal silicone compartment, there will be a step in the thoracic wall in the edge of the implant, and the thoracic wall will appear to be deeper behind the implant than in the its periphery (13) (figure 5).

A useful method to perform this distinction is to count the number of echogenic lines. A double echogenic line represents each cover. The two-chamber implants have two covers and a capsule. Therefore, they must be represented by five echogenic lines. The most superficial line represents the superficial face of the capsule, the two intermediate lines represent the surface of the external cover, and the two internal lines represent the surface of the internal cover (13).

Part of the evaluation of the prosthesis includes the visualization of its posterior wall. This area can be more clearly visualized when low frequencies are used (5 MHz) which reduce the reverberation device.

Risk factors and clinical presentation

There are several risk factors related to the patient: reason of the implant, type of incision, location of the implant, local or systemic symptoms; in addition, related to the implant: such as the year of insertion of the implant, age of the implant, type of implant and company which designed it. In addition, there are extrinsic factors, such as direct trauma to the implant, capsulotomy, mammographic compression and radiation (19). Another risk factor is retro glandular position, Baker III and IV contractures, and symptoms such as a burning pain (1) (table 1).

Table 1. Classification of capsular contracture by Baker

Classification of capsular contraction by Baker	
I	Soft, imperceptible contracture
II	Indurated, normal appearance
III	Indurated, slight deformity
IV	Indurated, express deformity and pain

The symptoms and clinical signs are not specific and include chest pain, a burning sensation, a sensation of nodularity or mammary masses, as well as different degrees of contractures, deformities and asymmetries to the physical examination. Up to 6% of cases show asymptomatic ruptures. It has been proven that broken implants are those which last the longest with patients. The approximate average duration is 13.4 years. This period seems to shorten in reconstruction implants, when compared to augmentation implants (12-15).

Imaging findings and operative characteristics

Most ruptures are contained without extension beyond the fibrous capsule. Extra-capsular dissemination of silicone has been reported in between 11 and 23% of cases (19). The concept of intra-capsular rupture faced with extra-capsular rupture is valid in patients who have single-chamber or two-chamber silicone gel implants. However, this concept is irrelevant in patients with single-chamber saline implants. The rupture of saline implants is associated with the complete or immediate collapse of the cover and its surrounding fibrous capsule is easily recognizable by the patient and the doctor, and is evident in the ultrasound and mammography (13) (figure 6).

The fibrous capsule is intact in intra-capsular ruptures, and it is broken in extra-capsular ruptures. Both types must be differentiated from the so-called silicone bleeding which results from a silicone escape or transudate through a capsule, without evident rupture or another associated finding, due to a change in the permeability of the cover of the prosthesis which increases with the number of years of actual use; it is most frequent between the ages of 15-20 (1,13-15).

A complicated internal appearance is a better sign in intra-capsular rupture. DeBruhl and collaborators described the ladder sign, where several horizontal and parallel echogenic lines are observed inside of the lumen of the implant (1.12-16, 29, 30). This sign, however, can also be seen in the silicone bleeding and in patients with serious capsular contractures, which produce a foliation of the implant capsule. As part of the complicated internal appearance, low-level internal echoes are included, with an appearance which is similar to the bleeding of the endometriomas (figure 7).

In the intra-capsular rupture, the gel is extravased to the space between the fibrotic capsule and the external cover of the implant, giving way to an anomalous widening of the space between the capsule and the cover (figure 8) (finding which leads to the "ladder" sign in the ultrasound, or "linguini" or "sub-capsular line" in the resonance and in the ultrasound, which is the final stage) (24,31-33).

In the complete or almost-complete collapse, the separation can be sufficiently large so that the collapsed cover is located with so much depth that it will be impossible to visualize it with 10 MHz frequencies transducers. Only one echogenic line will be provable, representing the intact peri-implant capsule. The double echogenic line will be too deep to be proven without the use of low frequency transducers and greater field depth (13).

Another finding is the abnormal shape, which is defined as the presence of a smooth prominence or an irregular focal, poorly-defined or poorly-visualized margins, and peri-implant liquid collections. These findings have not shown a good diagnostic performance (12, 14, 15, 21). The extra-capsular gel which is extravased in the acute ruptures is usually anechogenic and tends to be echogenic in ruptures of greater evolution (figure 9). The

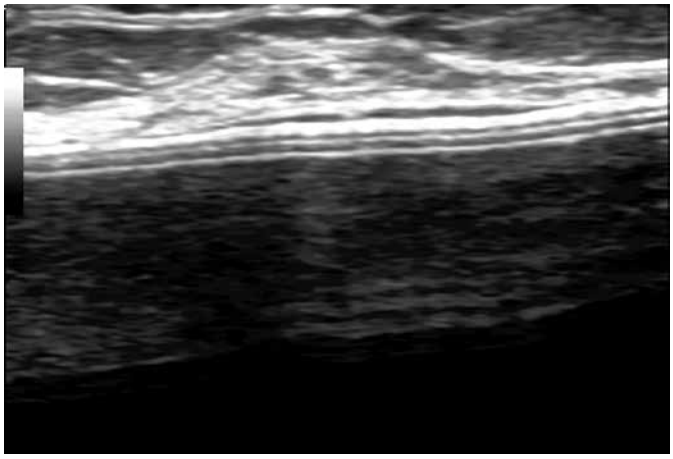

Figure 4. Mammary ultrasound with a high frequency lineal transducer. Normal appearance of mammary prosthesis. We observe three echogenic lines in the single-chamber prostheses which represent the fibrotic capsule and the two most internal ones to the external cover of the prosthesis.

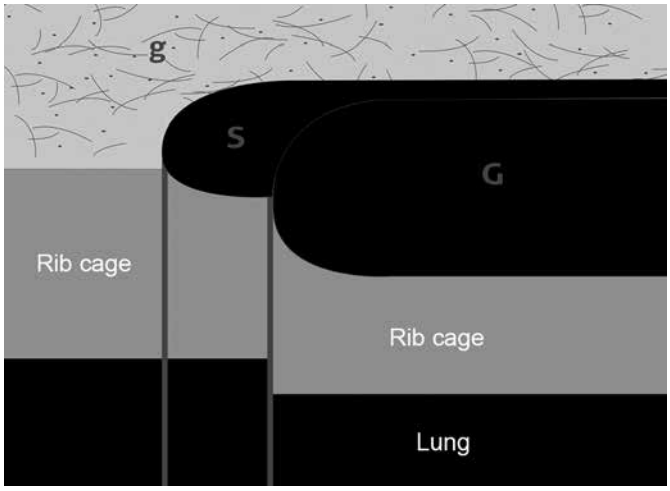

Figure 5. Schematic representation of the phenomenon of the velocity of sound in two-chamber prosthesis. g: fibro glandular tissue. G: compartment of silicone. S: saline compartment. If the implant has an external compartment of saline solution and an internal silicone compartment, there will be a step in the thoracic wall on the edge of the implant. The thoracic wall appears to be deeper behind the silicone compartment than in its periphery, due to slowdown of the sound in the silicone.

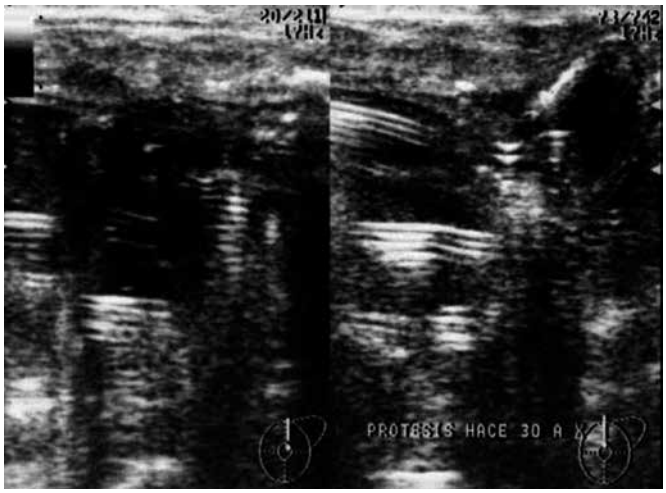

Figure 6. Mammary ultrasound with a high-frequency lineal transducer of a patient with a background of a mammary implant 30 years ago. An almost complete collapse of the mammary prosthesis can be seen; one can see an external and internal cover which are very proximal , as well as scarce irregular and echogenic internal material. These findings are related to intra- and extra-capsular rupture.

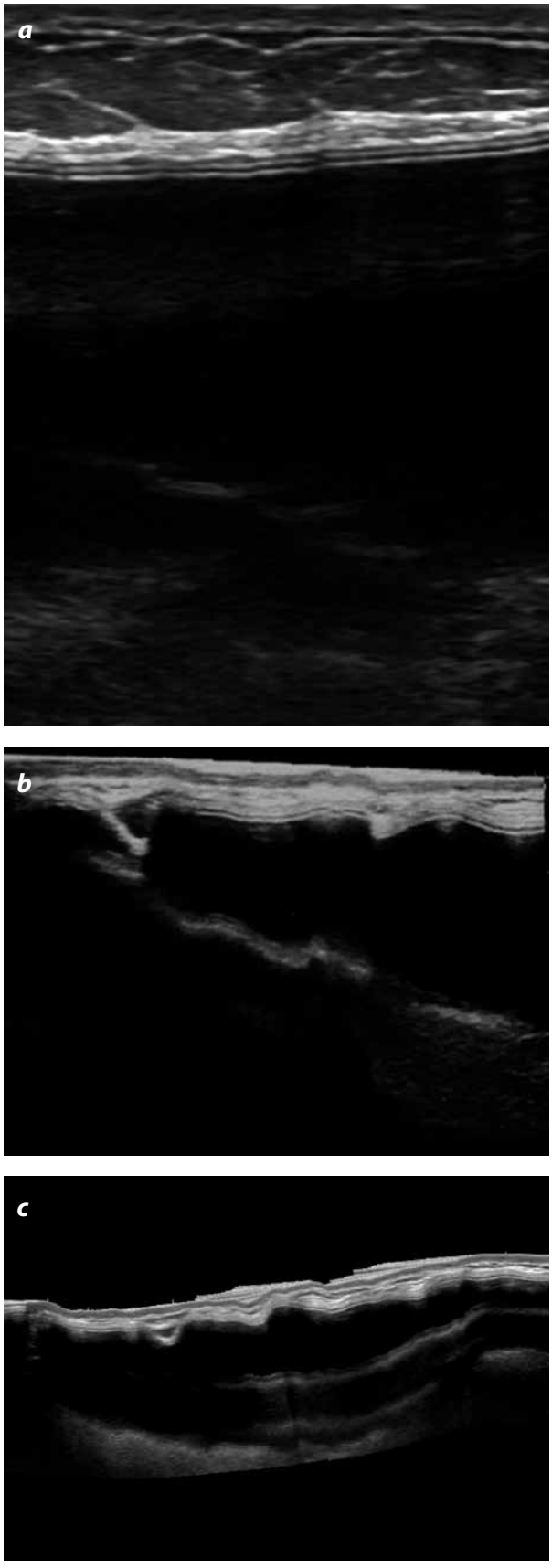

Figure 7. Mammary ultrasound with a high-frequency lineal transducer. Multiple horizontal and parallel echogenic lines can be seen inside of the lumen of the implant "ladder sign" (a, b), as well as the extended field image (c). These findings are compatible with intra-capsular rupture.

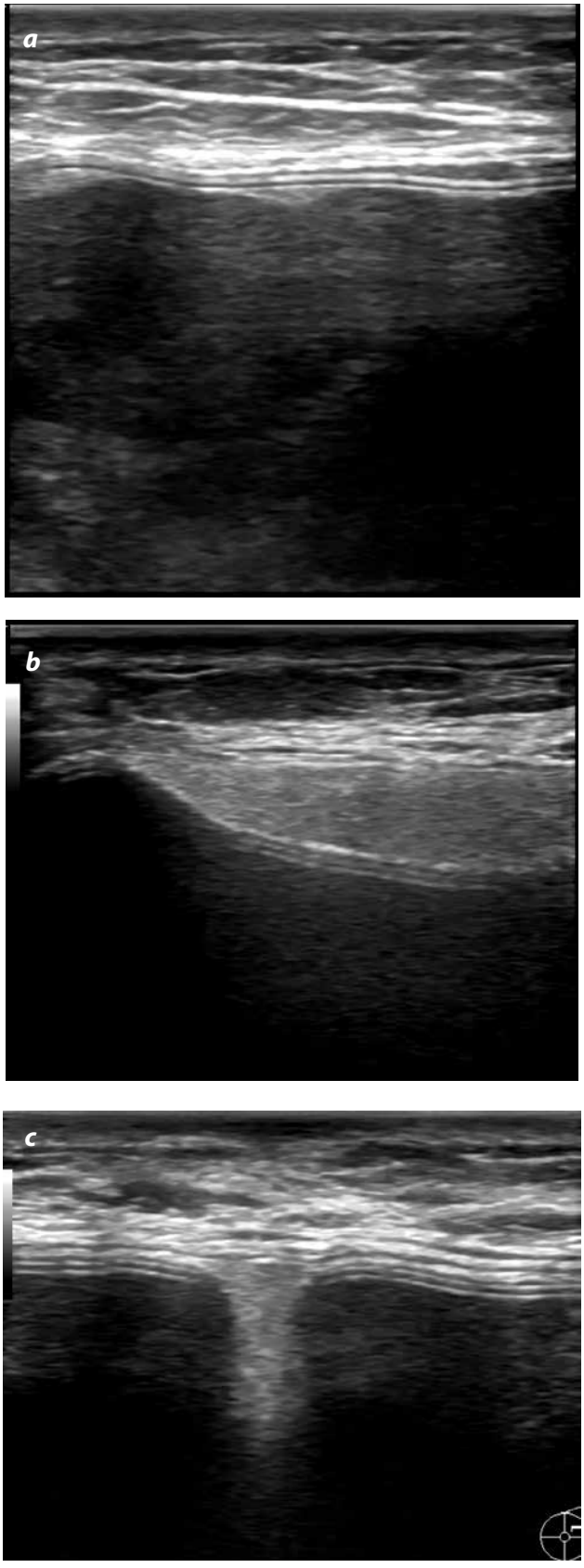

Figure 8. Mammary ultrasound with a high-frequency lineal transducer. (a) Complicated internal appearance due to multiple echoes in the lumen of the prosthesis. This finding is compatible with intra-capsular rupture (b, c). Gel which is extravased in the space between the spaces between the crease of the external cover of the prosthesis and the fibrotic external capsule is found. This finding is related to extra-capsular rupture.

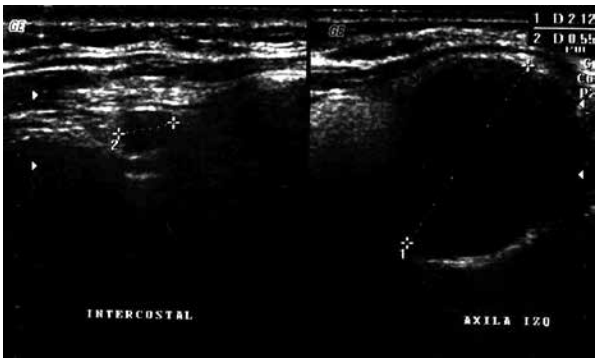

Figure 9. Sign of extra-capsular rupture. Silicone gel extravased in acute rupture with an anechogenic appearance in the internal mammary intercostal region and in the axillary region.

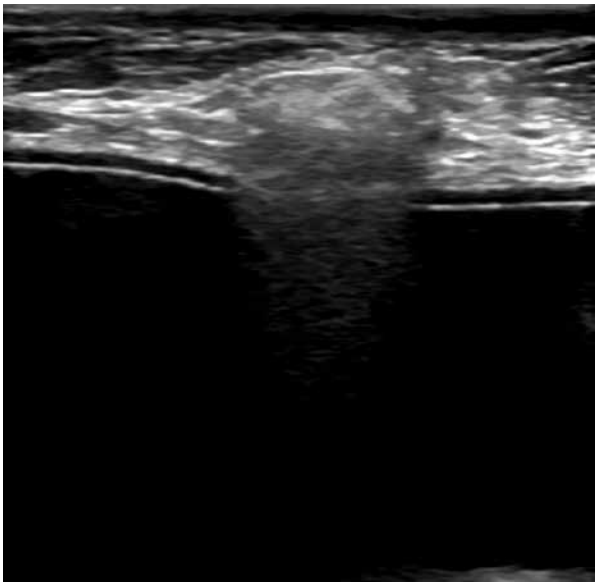

Figure 10. Mammary ultrasound with a high-frequency lineal transducer. Extra-capsular silicone gel extravased in the mammary parenchyma; represented in an intense and homogeneously hyper-echogenic node, with a round and well-defined anterior shape, which causes a dirty posterior shadow which darkens its posterior edge.

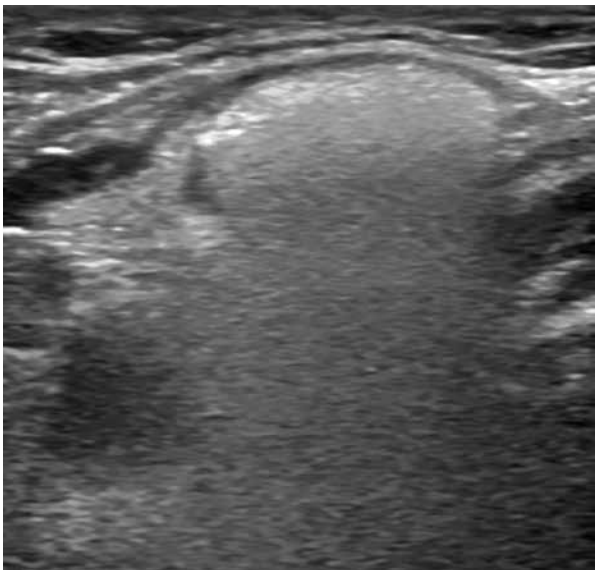

Figure 11. Mammary ultrasound with a high-frequency lineal transducer over the axillary region. A lymph is found which is increased in size and is infiltrated with silicone gel, which confers an echogenic appearance to its central hilum, with an associated posterior acoustic shadow.

spectrum of the non-contained silicone includes the formation of granuloma, fibrosis and migration.

The extravased extra-capsular silicone gel is rapidly covered by an inflammatory response which leads to the formation of a silicone granuloma. The classic ultrasound description of a silicone granuloma refers to a snowstorm appearance, represented in an intense and homogenously hyper-echogenic node, with a round and well-defined anterior shape, which causes a dirty posterior shadow which darkens its posterior edge. Harris and collaborators described this sign as "snowstorm". The study found that 100% of patients who had this sign presented an extra-capsular rupture. However, this was only seen in 23% of patients with rupture, therefore, its sensitivity is low (1,13,27,29,32,34) (figure 10).

Some extravased silicone gel collections have a complex cystic appearance. Others may appear as iso-echogenic solid nodes. The very old silicone granulomas may progress to a fibrotic phase of reaction to a foreign body, they might be mamographically spiculated and may cause an acoustic shadow in the ultrasound, which leads to suspicion of malignancy.

The variations in the appearance of silicone granulomas seem to be related to several factors, such as the size of the silicone drops, the quantity of fibrous reaction to the foreign body and the age of collection.

In the snowstorm pattern, granulomas with smaller silicone gel globules are produced, with a greater fibrotic reaction and to a foreign body. In the complex cystic aspect, silicone granulomas with larger globules are produced, with a lesser fibrotic reaction and to a foreign body. The large silicone gel globules transmit the sound as liquid. The smaller silicone gel globules intermix with the fibrotic reaction and to the foreign body, thus affecting the ultrasound beam in a larger manner (12,13).

The appearance of the silicone granulomas tend to change over time. The acute and large extravasations tend to show a complex cystic appearance. The following phase is an iso-echogenic node. The third phase is the classic snowstorm appearance. The last phase is the fibrotic phase. the snowstorm appearance is the most commonly visualized phase, followed by a complex cystic pattern, the iso-echogenic node and the fibrotic phase are the least observed ones (13).

The most frequent location of the silicone granulomas is the periphery of the implant, where the cover is thinner and the radius of curvature is lesser, which predisposes this portion of the cover to overload fractures (12,13).

After extrusion, the silicone primarily migrates to local sites, such as lymph nodes of the ipsi-lateral and axillary thoracic wall. When it migrates towards the armpit, it may compromise the brachial plexus, which secondarily leads to neuropathy (12,13) (figure 11).

When there is a rupture of the implant, macroscopic quantities of silicone might head through lymph channels towards the axillary lymphs and can be detectable through ultrasound. Silicone in the lymph nodes appears hyper-echogenic, starting with the hilum, and with time and depending on the quantity of silicone, it might head outside through the cortex. When the quantity of silicone increases in the lymph nodes, the echogenicity and the snowstorm shadow spread from the hilum outwards, reducing the apparent width of the hypo-echogenic cortex, making it harder to define the structure of a lymph node.

Silicone can also migrate to more distal areas such as the arm and the subcutaneous tissues of the abdominal wall. Silicone has been observed inside of the pectoralis muscle and the serratus muscle. The appearance of said collections is similar to the hyper-echogenic snowstorm-type silicone granulomas and only differs in its location (12,13,35).

Findings in two-chamber implants

The saline compartment of normal two-chamber implants is not usually very distended and the interior saline serum is not under pressure. In most cases there is not much saline serum and its pressure is so low that normal compression pushes the entire serum of the external compartment to the periphery of the implant. Immediately below the transducer, the internal and external covers would seem to come in contact with each other, even when the external cover is intact. In these cases, only through the exploration of the periphery of the implant can we prove that the external compartment contains saline serum and is not broken (12,13).

The echogenicity of the liquid in the external compartment is not useful to differentiate between single-chamber implants which are surrounded by effusion and two-chamber implants. Both peri-implant effusions and the saline serum inside the external compartment of the two-chamber implants tend to be anechogenic when they are new, and more echogenic with time (12).

The rupture of the external saline compartment is frequent and provable both by mammography and through an ultrasound. The broken images in the mirror which show the absence of sonic transmission of a saline serum type, with the absence of a step in the border of the implant on one side, constitute the best method to document the rupture of the external compartment. On the other hand, the recount of the number of echogenic lines and the identification of the absence of saline serum between the internal and external covers is a good method to diagnose rupture of the external compartment.

Other complications of mammary prostheses

An ultrasound is useful to identify acute and chronic complications of the implants, in addition to rupture. These include hematomas, seromas, abscesses and fat necrosis (13).

Hematomas and seromas

Acute hematomas and seromas are relatively frequent after placing the implants. They are especially associated with the expanders and reconstructive surgery, but they do not usually constitute diagnostic problems. Therefore, most infections of the implants occur in the immediate post-operatory period.

Acute hematomas are hype-echogenic with a cystic appearance. Liquid-debris levels are rapidly formed and the blood starts to coagulate until it is hyper-echogenic. Eventually, if the entire hematoma coagulates, the mass becomes solid. Lastly, in the chronic stages, the clot can be organized and show a more solid or a completely liquefied appearance. Acute seromas may have an appearance of simple cysts or may show thin partitions which represent fibrinous adhesions (13) (figure 12).

Infections and abscesses of the implant

Most infections of the implant immediately occur after the implant is placed or in the post-operatory period after explantation. A patient with an infected peri-implant effusion and with acute capsulitis will present acute tumefaction and increased sensitivity in the mammary, but normally without external inflammatory signs. The first ultrasound finding is a tension effusion, as opposed to a soft and compressible effusion. It can be the only finding during the first five to seven days. A few days later, the capsule will start to widen and fibrinous adherences appear in the effusion (figure 13). In this phase, the Doppler color tends to show sharp hyperemia in the thickened capsule (13).

Discussion and Conclusions

The ultrasound study is perhaps the first diagnostic tool that must be used in patients who present a suspicion of rupture of the mammary implant, due to its low cost, the minor pain of the technique, high availability and absence of radiation in its use. It is also useful when resonance is contraindicated. An ultrasound enables an evaluation of other possible differential diagnoses. In addition to this, many more patients are evaluated with an ultrasound to study the palpable node or a mammographic abnormality than with a magnetic resonance. These facts confirm the importance of being familiar with the ultrasound findings of the rupture of mammary prostheses.

Each one of the findings has a different appearance in all the imaging techniques, according to the generation of prosthesis that is being evaluated, as well as the time of evolution of the rupture (17). The ultrasound findings of the intra-capsular rupture which have the best performance are an increase in the size of the space between the fibrous capsule and the external cover of the implant due to occupation of the extravased liquid, the complicated appearance of the lumen of the implant given by the ladder sign, and the internal low-level echoes. The most reliable sign in extra-capsular rupture is the snowstorm sign (1,12,13,15,21,27,36-38).

An ultrasound enables to easily find the distance migration of extruded migration, which might extend to thoracic and axillary lymph nodes, as well as to the brachial plexus, the pectoralis and serratus muscle, and to the soft tissues of the abdominal wall, and even the lower limbs (6,12,13,29-44). The peri-implant liquid and the poorly-defined shapes are not reliable signs of a rupture of the mammary implant.

The group of studies does not include any which clearly confirms the role of magnetic resonance as a gold standard, taking into account that there are biases in the selection of the type of the prosthesis generation evaluated in the performed studies. Most studies evaluate symptomatic patients, where greater sensitivity has clearly been proven (72-94%) (33,43,45-49). A study which compares the performed ultrasound with high-resolution transducers could be performed, taking into account the type of prosthesis generation and the manufacturing company. This study could also include both asymptomatic and symptomatic patients in order to achieve better conclusions regarding the operative characteristics of these two techniques.

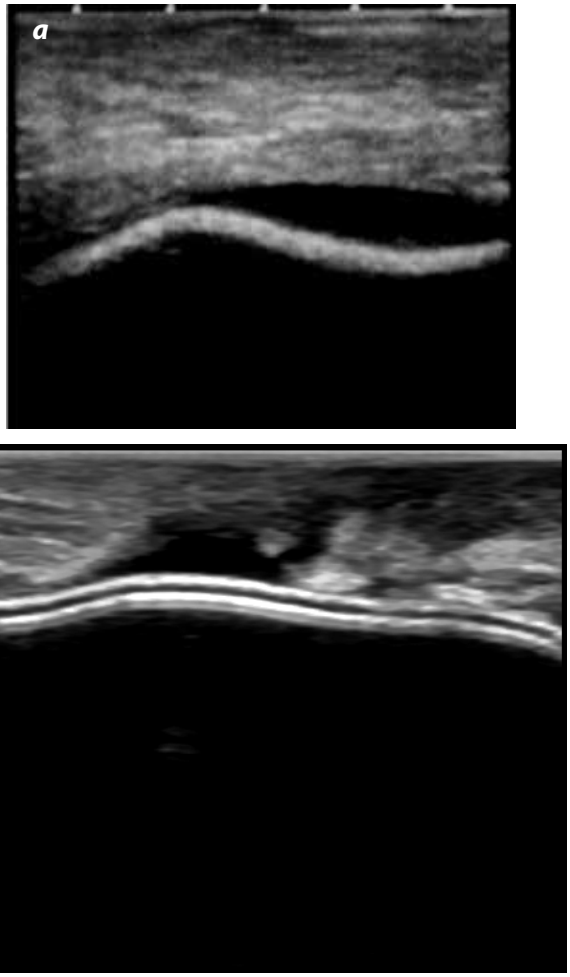

Figure 12. Seromas after a recent implant. Mammary ultrasounds with high-frequency lineal transducer. (a) Limited anechoic peri-implant effusion can be seen in a patient without other rupture findings. (b) Small quantity of anechoic liquid anterior to the fibrotic external capsule related to a seroma and an edema of the associated subcutaneous cellular tissue; these findings were observed in patients with a short implant evolution time, who did not present signs which could suggest rupture.

Figure 13. There is a well-defined peri-implant collection of thickened walls with septa inside, related to an abscess.

Lastly, there are no universal guides for the follow-up of patients with mammary implants due to esthetic reasons, and also due to mammary cancer. One must take this into account if the study has a diagnostic or screening objective. One must also consider how it can affect the patient. An initial ultrasound and mammography can be suggested, followed by a resonance, taking into account that the first two techniques can detect non-visible findings due to resonance, such as micro-calcifications (41,43,50).

Referencias

1. Berg W, Caskey C, Hamper U, et al. Diagnosing breast implant rupture with MR imaging, us and mamography. Radiographics. 1993;13:1323-36.
2. O'toole M, Caskey C. Imaging spectrum of breast implant complications: mammography, ultrasound, and magnetic resonance imaging. Seminars in ultrasound, CT, and MRI. 2000;21:351-61.
3. Venta L, Salomón C, Flisak M, et al. Sonography signs of breast implant rupture. AJR. 1996;166:1413-9.
4. Caskey C, Berg W, Anderson N, et al. Breast implant rupture: Diagnosis with us. Radiology. 1994;190:819-23.
5. Tejas S. Current uses of ultrasound in the evaluation of the breast. Radiol Clin N Am. 2003;41:841-56.
6. Caskey C, Berg W, Hamper U, et al. Imaging spectrum of extracapsular silicone: correlation of us, MR, mammography, and histopathologic findings. Radiographics. 1999;19:39-51.
7. Stavros AT, Rapp LC, Parker HS. Ecografía de la mama. Madrid: Marbán; 2006. p. 199-275.
8. Debra MI. Los requisitos: radiología de la mama. Edición en español. Barcelona: Elsevier España; 2005. p. 251-78.
9. Kopans DB. Breast imaging. 3rd ed. Philadelphia: Lippincott Williams and Wilkins; 2007. p. 643-68.
10. Hallet LR. Breast, implant rupture. eMedicine Radiology. 2008;1-15.
11. Medeiros A, Ferreira A, Smialowski E, et al. Evaluation of the rupture of silicone breast implants by mammography, ultrasonography and magnetic resonance imaging in asymptomatic patients: correlation with surgical findings. Sao Paulo Med J. 2004;41-47.
12. Papadia A, Menada MV, Ragni N, et al. Extended field of view and three dimensional ultrasound imaging of silicone breast implant lesions. Ultrasound Obstet Gynecol. 2007;29:360-1.
13. Sastre G, Rojas R, Roja R, et al. Revisión de implantes mamarios con metodología mamográfica y ultrasonográfica. Rev Argent Radiol. 2005;69:107-12.
14. Gori R. Evaluación ultrasonográfica de la mama con implantes. Rev Arg Ultrason. 2007;6:273-8.
15. Sagi L, Lyakhovitsky A, Barzilai A, et al. Silicone breast implant rupture presenting as bilateral nodules. Clin Exp Dermatol. 2009;34:99-101.
16. Di Benedetto G, Cecchini S, Grassetti L, et al. Comparative study of breast implant rupture using mammography, sonography, and magnetic resonance imaging: correlation with surgical findings. Breast J. 2008;14:532-7.
17. Stavros T, Rapp C, Parker S. Sonography of mammary implants. Ultrasound Quart. 2004;20:217-60.
18. Gorczyca DP, Gorczyca SM, Gorczyca KL. The diagnosis of silicone breast implant rupture. Plast Reconstr Surg. 2007;120:49-61.
19. Yang N, Muradali D. The augmented breast: pictorial review of the anormal and unsual. AJR. 2011;196:451-60.
20. Azavedo E, Boné B. Imaging breast with silicone implants. Eur Radiol. 1999;9:349-55.
21. Ikeda DM, Borofsky HB, Herfkens RJ, et al. Silicone breast implant rupture: pitfalls of magnetic resonance imaging and relative efficacies of magnetic resonance, mammography, and ultrasound. Plast Reconstr Surg. 1999;104:2054-62.
22. Beekman WH, Hage JJ, Taets van Amerongen AH, et al. Accuracy of ultrasonography and magnetic resonance imaging in detecting failure of breast implants filled with silicone gel. Scand J Plast Reconstr Surg Hand Surg. 1999;33:415-8.
23. Beekman WH, van Straalen WR, Hage JJ, et al. Imaging signs and radiologist jargon of ruptured breast implants. Plast Reconstr Surg. 1998;102:1281-9.
24. Chung KC, Greenfield ML, Walters M. Decision-analysis methodology in the work-up of women with suspected silicone breast implant rupture. Plast Reconstr Surg. 1998;102:689-95.
25. Brown SL, Silverman BG, Berg WA. Rupture of silicone breast implants: causes, sequelae, and diagnosis. Lancet. 1997;22:1531-7.
26. Goodman CM, Cohen V, Thornby J, et al. The life span of silicone gel breast implants and a comparison of mammography, ultrasonography, and magnetic resonance imaging in detecting implant rupture: a meta-analysis. Ann Plast Surg. 1998;41:585-6.
27. Lorenz R, Stark GB, Hedde JP. The value of sonography for the discovery of complications after the implantation of silicone gel prostheses for breast augmentation or reconstruction. Rofo. 1997;166:233-7.
28. Juanpere S, Perez E, Huc O, et al. Imaging of breast implants a pictorial review. Insights Imag. 2011;2:653-70.
29. Palmon LU, Foshager MC, Parantainen H, et al. Ruptured or intact: what can linear echoes within silicone breast implants tell us?. AJR Am J Roentgenol. 1997;168:1595-8.
30. Ahn CY, DeBruhl ND, Gorczyca DP, et al. Comparative silicone breast implant evaluation using mammography, sonography, and magnetic resonance imaging: experience with 59 implants. Plast Reconstr Surg. 1994;94:620-7.
31. McNamara Jr M, Middleton M. Ultrasound of breast implants and soft tissue silicone. Ultrasound Clin. 2011;6:345-68.
32. Huch RA, Kunzi W, Debatin JF, et al. MR imaging of the augmented breast. Eur Radiol. 1998;8:371-6.
33. Hold P, Shabana A, Pilbrow W, et al. How should we investigate breast implant rupture. Breast J. 2012;18:253-6.
34. Netscher DT, Weizer G, Malone RS, et al. Diagnostic value of clinical examination and various imaging techniques for breast implant rupture as determined in 81 patients having implant removal. South Med J. 1996;89:397-404.
35. Kulber DA, Mackenzie D, Steiner JH, et al. Monitoring the axilla in patients with silicone gel implants. Ann Plast Surg. 1995;35:580-4.
36. Reynolds HE, Buckwalter KA, Jackson VP, et al. Comparison of mammography, sonography, and magnetic resonance imaging in the detection of silicone gel breast implant rupture. Ann Plast Surg. 1994;33:247-55.
37. Weizer G, Malone RS, Netscher DT, et al. Utility for magnetic resonance imaging and ultrasonography in diagnosing breast implant rupture. Ann Plast Surg. 1995;34:352-61.
38. Rosculet KA, Ikeda DM, Forrest ME, et al. Ruptured gell-filled silicone breast implants: sonographic findings in 19 cases. AJR Am Roentgenol. 1992;159:711-6.
39. Park AJ, Walsh J, Reddy PS, et al. The detection of breast implant rupture using ultrasound. Br J Plast Surg. 1996;49:299-301.
40. Berg WA, Caskey CI, Hamper UM, et al. Single and double lumen silicone breast implant integrity: prospective evaluation of MR and US criteria. Radiology. 1995;197:45-52.
41. Samuels JB, Rohrich RJ, Weatherall PT, et al. Radiographic diagnosis of breast implant rupture: current status and comparison of techniques. Plast Reconstr Surg. 1995;865-77.
42. Liston JC, Malata CM, Varma S, et al. The role of ultrasound imaging in the diagnosis of breast implant rupture: a prospective study. Br J Plast. 1994;47:477-82.
43. Harris K, Ganott M, Shestak K, et al. Silicone implant rupture: detection with us. Radiol. 1993;187:761-8.
44. Levine R, Collins TL. Definitive diagnosis of breast implant rupture by ultrasonography. Plast Reconstr Surg. 1991;87:1126-8.
45. Colombo G, Ruvolo V, Stifanese R, et al. Prosthetic breast implant rupture: imaging pictorial essay. Aesth Plast Surg. 2011;35:891-900.
46. DeBruhl ND, Gorczyca DP, Ahn CY, et al. Silicone breast implant: us evaluation. Radiology. 1993;189:95-8.
47. Barloon Tj, Young DC, Bergus G. The role of diagnostic imaging in women with breast implants. Am Fam Physician. 1996;54:2029-36.
48. Netscher DT, Weizer G, Malone RS, et al. Diagnostic value of clinical examination and various imaging techniques for breast implant rupture as determined in 81 patients having implant removal. South Med J. 1996;89:397-404.
49. Chung KC, Wilkins EG, Beil RJ Jr, et al. Diagnosis of silicone gel breast implant ruptured by ultrasonography. Plast Reconst Surg. 1996;97:104-9.
50. Basetti E, Pediconi F, Candreva R, et al. Breast prosthesis. Managment of patients after plastic surgery. J ultrasound. 2011;14(3):113-21.

Address

Fredy Martín Cerquera Cabrera
Hospital Universitario de la Samaritana
Carrera 8 # 0-55 Sur
Bogotá, Colombia
fcerquera25@hotmail.com

Received for evaluation: November 29, 2012
Accepted for evaluation: February 19, 2013