The role of ultrasound in the imaging assessment of the augmented breast. A pictorial review.

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Abstract

The imaging evaluation of the augmented breast is becoming more and more frequent in daily practice. Even if mammography remains the golden standard for breast cancer screening, ultrasound is used as a first step investigation in young symptomatic patients or as a screening tool in detecting pathology related to the implants. This pictorial essay reviews the indications and limitations of the imaging methods and illustrates the normal and pathological ultrasound findings in the augmented breast.

Keywords: ultrasonography, breast augmentation, implant complications

Introduction

The number of women with breast augmentation is continuously increasing. Breast implants are placed either for esthetic reasons or for reconstruction after mastectomy. Augmented or reconstructed breast with an implant has a specific pathology related to the implant, to breast tissue or to post surgical changes [1,2].

Imaging of patients with breast augmentation starts before the surgical procedure, with mammography, ultrasound (US), or both in order to avoid implant insertion in a breast with suspicious lesions or to document and assess the evolution of benign findings [3].

After the placement of the implant, imaging evaluation has two purposes: to detect in asymptomatic patients any suspicious lesion which could represent early-stage breast cancer, and to diagnose and evaluate the morphological changes of the breast or of the implant when the patients are symptomatic.

Mammography

In patients with breast augmentation, mammography has a lower sensitivity than in patients without breast implants because the radio-opaque implant, usually compressed together with the breast tissue, obscures the majority of the breast tissue [4] (fig 1).

Insufficient compression during mammography, as well as the additional views for a better evaluation of the breast tissue (Eklund technique) lead to an increased dose of irradiation in this group of patients [5-7]. Moreover, mammography is insufficient to assess the pathology related to the implant, especially the intracapsular rupture [8].

Fig 1. Mammography of a patient with retroglandular implants. The normal breast tissue is almost entirely obscured by the implants.
There are also some possible complications that might occur during mammography in the augmented breast [9]. Even if the risk of implant rupture during mammography is insignificant, it increases with implant age [8,9]. It appears that most patients with implant rupture after mammography had a prior asymptomatic rupture that becomes apparent and clinically symptomatic after the compression during mammography [10].

Even if improved technique is used, detection of early cancer might be impossible with mammography. In patients with a risk of developing breast cancer, a complementary imagistic method should be used to exclude malignancy (ultrasound or magnetic resonance imaging) [8,11].

**Magnetic Resonance Imaging (MRI)**

MRI, with its special sequences that can emphasize or suppress the silicon signal, is the method of choice for the evaluation of implant integrity. It can detect intracapsular or extracapsular rupture, silicon migration, radial folds, etc. MRI is not used as a screening tool and usually is indicated in certain cases where ultrasound raises the suspicion of pathology related to the implant [12,13].

**Ultrasonography**

US is indicated as first step examination in symptomatic patients with augmented breasts younger than 40 years of age, to evaluate the breast itself or to rule out pathology related to the implant. It is also used complementarily to mammography in patients older than 40 years of age, which present pathological findings on screening or diagnostic mammography [11,14]. All doctors who perform US on augmented or reconstructed breast with implant should be familiarized with normal and pathological findings that may appear early or late after surgery.

**Normal ultrasound appearance of the augmented breast**

The normal implant is an anechoic structure, with an echoic capsule (fig 2).

Sometimes, inside the implant, low density echoes may be seen [14] (fig 3).

After the placement of the implant, a fibrous capsule around the implant is formed. US, just like any other imaging technique is not able to distinguish the fibrous capsule from the capsule of the implant; these two entities are seen separately only when fluid effusion appears between them.

In the normal implant, echoic lines might be seen, parallel with the implant capsule. They are due to the reverberation artifact and should not be misdiagnosed as an intracapsular rupture (fig 4).

US should begin with the evaluation of the implant position. The implant can be placed retroglandular (or subglandular) or retropectoral. US, by showing the relation of the implant with the glandular tissue and retroglandular adipose tissue or with the pectoralis muscle can accurately specify the type of implantation. In retropectoral position of the implant, mammary gland is protruded anteriorly and can be entirely evaluated (fig 5).
When the implant is positioned retroglandular, the deep portion of the breast (retroglandular fatty tissue) lies under the implant and ultrasonography will have a reduced sensitivity in detecting small, deep located lesions (fig 6).

Radial folds are normal findings which appear as irregular contour of the implant capsule or as echogenic concave lines from periphery to the interior of the silicone implant. Prominent radial folds might be misdiagnosed as intracapsular rupture (fig 7).

In these cases, MRI is recommended to distinguish between normal radial infolding and intracapsular implant rupture [8].

**US appearance of the pathological conditions in the augmented breast**

The pathology of the augmented breast can be grouped in two types: implant-related and mammary gland-related. The implant related pathology can appear early or late after surgery and the breast tissue pathology can be specific for augmented breast or non-specific (can appear unrelated to breast augmentation) [1,15] (fig 8).

US can detect early post-operative changes, like edema, fluid collection or infection.

**Early complications**

Edema of the surrounding tissue appears on ultrasonography as hyperechoic, thickened tissue with small effusions which appear as anechoic, elongated structures through adipose lobules and Cooper’s ligament [14] (fig 9).

Fluid collections can be due to seromas and hematomas. The difference between these two entities is easily seen on ultrasonography, seromas appearing homogeneously anechoic while hematomas appear anechoic or hypoechoic, with internal floating echoes due to the presence of clots [14,16] (fig 10).

Anyway, small peri-implant seromas, with no signs of tension, appearing early after surgery and located more frequently in the parasternal area are considered normal [14] (fig 11).
Preformed fluid collections, in time, may infect and transform into abscesses. In these cases, ultrasound findings will be that of a fluid collection with increased echogenicity, thickened walls and increased peripheral signal on Doppler US [14] (fig 12).

**Late complications**

Capsular contracture is a clinical diagnosis; imaging may not be able to diagnose it, but sometimes ultrasound findings might confirm, with the presence of capsule thickening, an increased number of radial folds or abnormal spherical shape of the implant [8,11,16].

One of the most frequent complications of breast implant is capsular rupture, which is correlated with implant age and type of implant [10]. It can be extracapsular, when the implant shell as well as the fibrous, surrounding capsule are ruptured, allowing the intracapsular content to get in the surrounding tissues or it can be intracapsular, when only the implant shell ruptures, falling within the implant, while the outer, fibrous shell remains intact [9].

According to Juanpere et al [1], clinical examination diagnoses less than 50% of implant ruptures, but a negative US is highly predictive for implant integrity (91%) [17]. According to Chung et al, when US is negative, the probability of rupture is estimated at 16% and when US is positive for implant rupture, the probability rises to 79.7% [18]. The value of US in diagnosing implant rupture depends also on the age of the implant and clinical presentation of the patients. Symptomatic patients with implants older than 10 years have an estimated prevalence of rupture estimated at 64%. If US is positive, the probability of rupture increases to 94%, so no other imaging evaluation is needed. In asymptomatic patients, if US is positive, confirmation with MRI is indicated [19].

When saline implants are ruptured, the saline content extravasates outside the implant and the surrounding tissue will absorb it; US findings will be a decreased volume of the implant which will appear smaller compared with the contralateral breast [20].
In extracapsular rupture of silicon implants, the free, extravasated gel outside the implant shell has a typical US appearance. It is intense hyperechoic, with a “snow storm” appearance [14] (fig 13).

In intracapsular rupture, the implant shell falls inside the implant and will appear as echogenic lines within the normally anechoic silicone (“step ladder” sign) [8,14] (fig 14).

The silicone gel can also migrate in the breast tissue and/or in the lymph nodes through an intact capsule, with the formation of a foreign body reaction (granulomas or siliconomas). They are recognized on US also by the “snow storm” appearance localized within homogeneous, hyperechoic nodules, with well-circumscribed, rounded anterior margin and posterior ill-defined shadowing [8,14] (fig 15).

Late seromas might occur in 1-2% of the cases after breast augmentation [20]. They are more frequent in the textured implants due to a synovial metaplasia of the capsule. Ultrasonography shows the fluid collection around the implant, in the intracapsular space with the linear echogenic implant shell being continuous and intact (fig 16).

US is also essential in biopsies, for image guidance in breasts with an implant, in order to avoid implant puncture.

Conclusions

With all its disadvantages, mammography is still the method of choice for screening and for the detection of microcalcifications in augmented breasts as the benefits of detecting clinically asymptomatic breast cancer, in early stages, are superior to possible complications of the method [21].

US is useful in clinically symptomatic patients, younger than 40 years of age, as a first step examination or as a screening tool for detecting pathology related to the implant. It should also be used complementarily...
to mammography to further evaluate mammographic changes or to increase the sensitivity of mammography in high risk patients [22]. US findings are more sensitive when correlated with a clinical examination and history of the patient. The limitations of the US technique are that it is operator dependent and sometimes artifacts, such as reverberation and attenuation, partially may lead to confusions with implant pathology. When US and mammography findings are inconclusive, MRI examination is indicated.

Conflict of interest: none

References