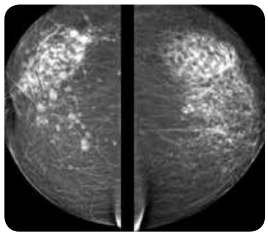

USE OF CONTRAST MAMMOGRAPHY IN THE DIAGNOSIS OF BREAST CANCER. OUR EXPERIENCE AND LITERATURE REVIEW

Utilidad de la mamografía con contraste en el diagnóstico del cáncer de mama. Nuestra experiencia y revisión de la literatura

Key words (MeSH)
Mammography
Breast neoplasms
Contrast media

Palabras clave (DeCS)
Mamografía
Neoplasias de la mama
Medios de contraste

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Summary
Mammography as a screening method has been shown to reduce mortality by early detection of breast cancer; however, in very dense breasts it is difficult to detect, so new methods of screening and diagnosis have been devised. Contrast enhanced spectral contrast mammography (CESM) is one of these methods that, with the use of contrast medium, facilitates the detection of suspicious lesions. We will briefly discuss the CESM technique and history, review its comparison with conventional mammography, and with a series of cases we will discuss its indications, advantages and disadvantages.

Resumen
La mamografía, como método de tamizaje, ha demostrado disminuir la mortalidad al detectar de manera temprana el cáncer de mama; sin embargo, en mamas muy densas se dificulta la detección, por lo que se han venido generando nuevos métodos de tamizaje y diagnóstico. La mamografía con contraste espectral (CESM) es uno de estos métodos que, con la utilización de medio de contraste, facilita la detección de lesiones sospechosas. Será tema de revisión de este artículo su técnica e historia, repasando su comparación con la mamografía convencional y con una serie de casos se expondrán sus indicaciones, ventajas y desventajas.

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Introduction

Mammography is considered a diagnostic screening method that allows early detection of breast cancer, and has been shown to reduce breast cancer mortality by 30% (1), but its sensitivity decreases from 90% to 48% in dense breasts (types C and D of the American College of Radiology (ACR)). This is due to the similarity between the densities of pathological lesions and normal fibroglandular tissue, which makes it difficult to diagnose malignant lesions, such as ductal cancers in situ and infiltrants (2). In addition, increased mammographic density is, in turn, an important risk factor for breast cancer, increasing its probability by up to 5.5 times (3). As a result, new modalities have emerged within digital mammography, such as tomosynthesis and mammography, with contrast dye enhancement (3).

Contrast enhanced spectral mammography (CESM) is a relatively new and alternative method to magnetic resonance imaging (MRI), the objectives of which are to evaluate the formation of new blood vessels (angiogenesis) and to increase the permeability of tumour tissues that are metabolically active and require a large amount of nutrients (3, 4). Although breast resonance imaging (MRI) is the gold standard method, CESM, in a diagnostic context, has a similar sensitivity to MR and greater specificity. CESM has good concordance in tumor size when compared to MR (5).

When comparing CESM with conventional mammography, the former is better for diagnosing malignant breast lesions (4). In patients referred to screening, CESM has higher sensitivity (100%) and specificity (87%), positive predictive value (76%) and negative predictive value (100%) than mammography, which has a sensitivity of 96%, specificity of 42%, positive predictive value of 39% and negative predictive value of 97% (6,7).

In this case series, the CESM technique and its indications will be further described, through case exposures, with their respective protocol. Its advantages and disadvantages will be concluded according to the experience of the authors.

History

Mammography with contrast media enhancement arises from the need for a less complex study than contrasted tomography of the breast. In the 1990s, digital subtraction angiography was used to try to differentiate benign from malignant lesions without the need for biopsy, but had the limitation of not differentiating lesions smaller than 2 cm. Subsequently, in 2000, sequential cuts were made by administering contrast material to obtain images that were then subtracted. It was concluded that enhancement increased sensitivity by allowing differentiation between malignant and benign lesions with false-positive lows. This study was known as temporal contrast enhanced mammography (TCEM). Due to the different problems presented by this study (duration of approximately 15 minutes, the highest dose of radiation, motion artifacts and single breast imaging), contrast enhanced spectral mammography (CESM), applied for the first time by Lewis and collaborators, emerged at this same time. CESM demonstrated increased sensitivity for the detection of malignant lesions and, in turn, decreased the problems of TECM, so that in the following years the development of this type of study was raised, devices (mammograms) were optimized adapted for this purpose and post-processing was improved (8).

In 2011 it was approved by the FDA for the management of lesions of difficult decision with ultrasound and conventional mammography, thus stimulating the development of better technologies in mammography equipment (8,9).

CESM is a technique based on the attenuation of radiation when it passes through different materials, such as iodine and soft tissues (2,5,6). This is done by obtaining two images: a low energy image with information similar to that of a conventional mammography (with 26-31 kVp) and a high energy image (45-49 kVp). With the acquired information, an internal reconstruction algorithm is carried out, which subtracts the images of the parenchyma that does not enhance and the recombined image is delivered where the iodine enhancement areas are highlighted. In this way, it is possible to obtain two images for each projection of both breasts, for a final total of 8 images.

Materials and methods

With prior informed consent and patient assessment, at the time of the study a trained technician obtained peripheral intravenous access in the antecubital fossa. The patient was given a dose of 1.5 ml/kg of iodinated contrast material, intravenously by means of an injector at a rate of 2 ml/s.

The equipment used for the study was a digital GE Senographe Essential mammogram. After 8 minutes of contrast medium administration and once the patient was relaxed and comfortable, the suspicious and non-suspect breasts were studied. Two images per breast were obtained: a high and a low energy projection, simultaneously (figure 1).

The interpretation of the study is based on the enhancement of the mammary parenchyma and the enhancement of iodine uptake lesions. This parenchyma enhancement is affected by the density of fibroglandular tissue. Although the intensity of this enhancement is influenced by the hormonal state, it is more stable in CESM, compared to MR, which allows the patient not to have the need to schedule the study according to her menstrual cycle (10).

Consideration should be given to the presence of artifacts, such as the "breast on breast" artifact, and those generated by movement (figure 2).

Currently, there is no lexicon in the BI-RADS third edition, for the enhancement of fibroglandular parenchyma and nodular images in CESM, so MR descriptors are used, such as nodular and non-nodular. The greater the intensity, the greater the risk of malignancy (11). The association with other findings, such as multifocality and bilaterality (12), is also taken into account (figure 3).

Indications for contrast enhanced spectral mammography

The CESM in our institution had a variety of applications according to its indications (table 1).

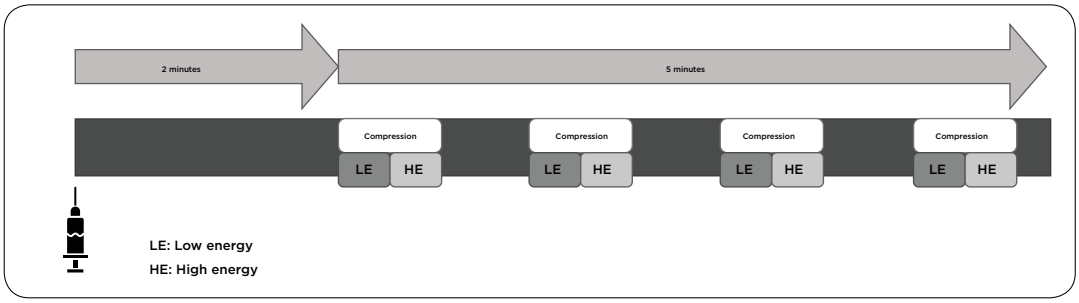

Figure 1. Two minutes after the administration of iodinated contrast dye, the non-suspect breast is compressed followed by the suspect breast, starting with the craniocaudal projection and then the oblique projection. Two images are obtained per breast, one of high energy and one of low energy.

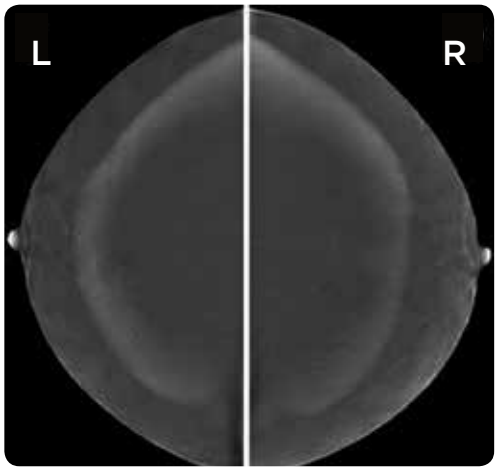

Figure 2. Cranio-caudal projections in which the artifact "breast on breast" is observed, which is a crescent that carries the contour of the skin, it is homogeneous, of low density, symmetrical in relation to a defect of attenuation of the X rays. In this case, the background enhancement of the glandular tissue is slight.

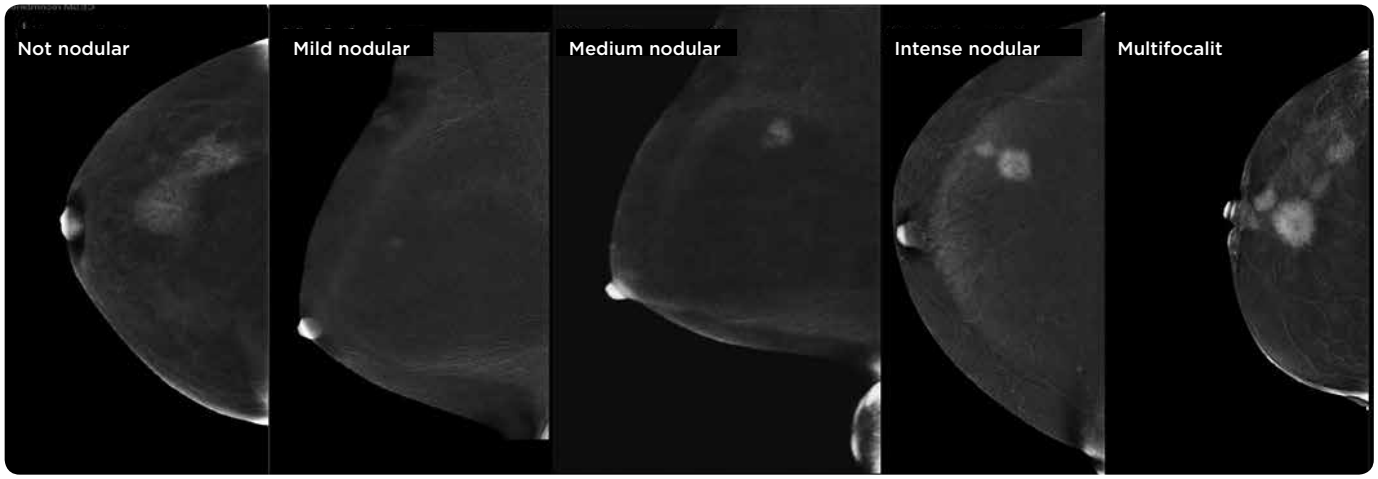

Figure 3. Types of enhancements in CESM. The greater the intensity, the greater the risk of malignancy, as well as the detection of multifocality.

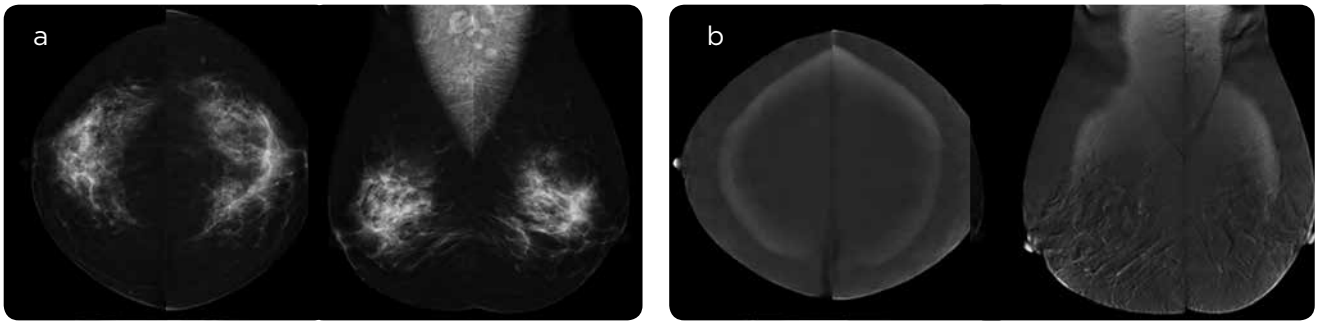

Figure 4. Female patient of 45 years of age, with dense breast, history of breast cancer in the family. Low energy projections in image (a) show heterogeneously dense breast tissue. High-energy recombinant images (b) demonstrate absence of suspicious enhancements. BI-RADS 1y is therefore assigned.

Table 1. Indications for contrast enhanced spectral mammography

1. Screening of high-risk patients: dense breast, carriers of BCRA1 and BCRA2 mutations, history of breast cancer in female first-degree relative (Figure 4).
2. Clinical or imaging suspicion of breast cancer: perform CEMS and not 2D mammography (Figure 5).
3. Multicentricity and multifocality assessment (figures 6 and 7).
4. Contraindications to performing MRs: ferromagnetic materials, pacemakers, allergy to gadolinium, claustrophobia, obesity (figure 8).
5. Evaluation of the response to neoadjuvant therapy (figure 9).
6. Investigation of occult primary.
7. Characterization of inconclusive findings by mammography and ultrasound.

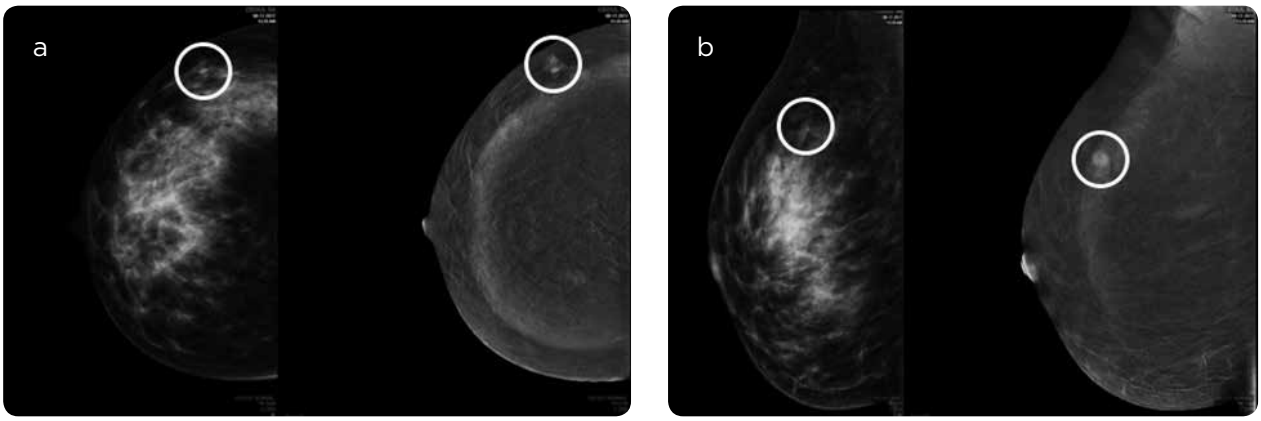

Figure 5. 31-year-old patient with palpable mass in right superoexternal quadrant. In the craniocaudal projections (a) and oblique projections (b), a nodule of darkened contours (circles) is observed in low energy projection, which had an intense enhancement in the high-energy projection suspected of malignancy. Biopsy: Infiltrating Ductal Carcinoma grade 2.

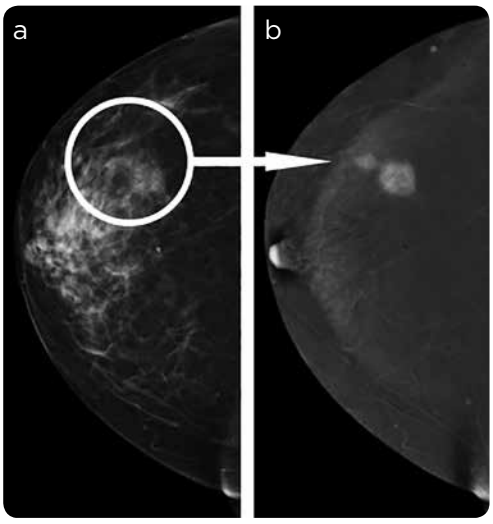

Figure 6. Patient of 66 years of age, with diagnosis of right breast cancer, in which we wanted to evaluate the multifocality. In craniocaudal projection of low energy (a), heterogeneously dense mammary parenchyma is observed with nodule of darkened contours in deep planes (circle). High-energy recombinant images (b) demonstrate intense nodular enhancement corresponding to the primary lesion, and adjacent focal enhancement is demonstrated: in relation to multifocality.

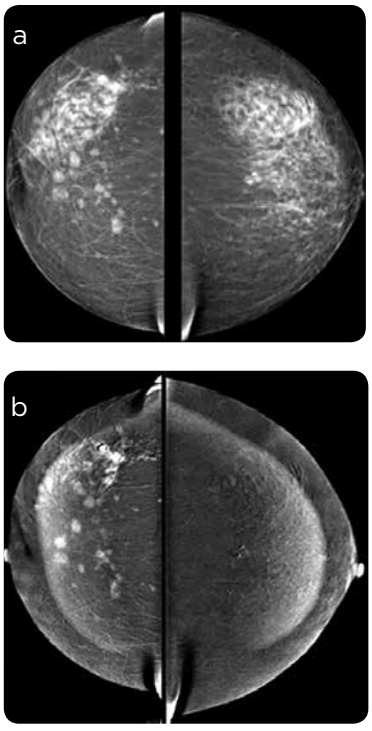

Figure 7. 54-year-old patient, with history of fibrocystic condition and fibroadenomas in right breast, in low-energy craneocaudal projection. a) Multiple well circumscribed oval and round nodular images are observed, which when evaluated in high-energy projection (b) present multiple intense nodular enhancements indicating multifocality. In the histological study it corresponded to a high-grade infiltrating ductal carcinoma with multifocality.

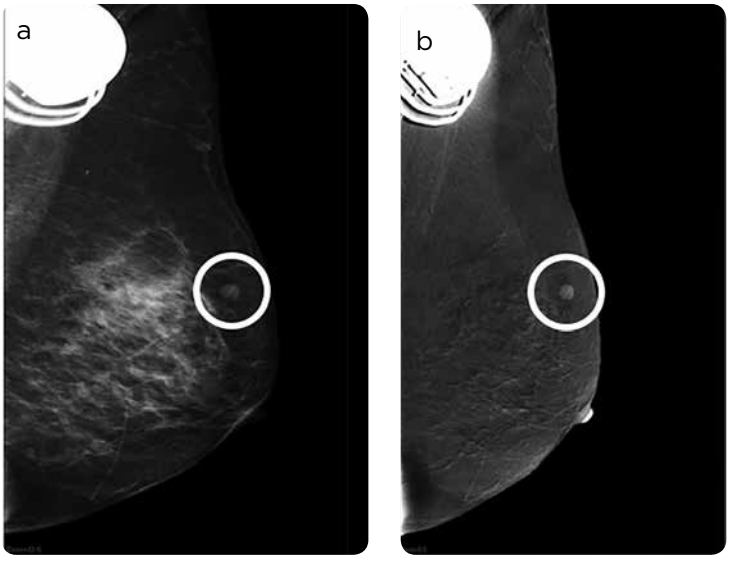

Figure 8. 77-year-old patient referred to MR for study of focal asymmetry in left breast SEC. Pacemaker holder. In low energy projection (a) the area of asymmetry in left SEC is observed only seen in the oblique projection, which in the high-energy projection had a slight contrast enhancement and the ultrasound complement corresponds to an intramamammary ganglion. BI-RADS 2 is assigned.

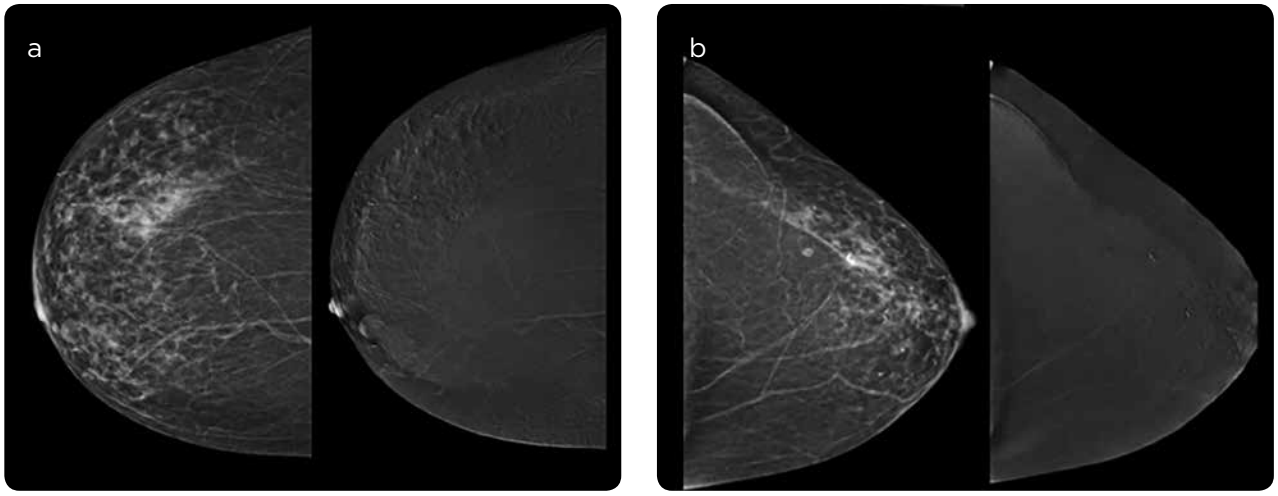

Figure 9. 66-year-old patient. History of quadrantectomy and neoadjuvant therapy of left breast for cancer. In craniocaudal (a) and lateral mid oblique (b) projections the absence of abnormal enhancements in the high-energy projections was demonstrated. BI-RADS 2 is assigned.

Results

The implementation of contrast enhanced spectral mammography (CESM) in our institution has been well accepted by the medical team, which has had satisfactory results in screening, diagnosis and patients in follow-up response to treatment. It is a technique that is easy to implement and to inform, with several years of validation in Europe and which is part of the One Stop Clinic for the timely diagnosis of breast cancer. It has the advantage of being easy to access, partly known by patients and inexpensive with respect to MR (13). It is a useful tool in the study of patients with screening recall, assessment of unilateral or bilateral findings, annual assessment of high-risk patients with dense breasts, which allows the detection of invasive carcinoma and multifocality. When suspicious nodular enhancements are found, a multimodal evaluation with second-look ultrasound is performed to locate the lesion and perform a biopsy, only using MR for comparisons of the findings.

Discussion

The CESM has the advantage of being easy to access, quick to carry out and to inform. It has a similar sensitivity to MR, with a good correlation of tumor size with histology and helps determine if there is tumor multifocality. Among its disadvantages is the use of ionizing radiation with a false negative rate of 4 to 8% given by low-grade in situ neoplasms with little vascularity. It also has the impossibility of properly evaluating the armpit and costal fence. Contraindications include renal failure, known allergic reactions to iodine and pregnancy. Its use in breast prosthesis is limited, so the use of breast magnetic resonance is preferred in these cases (14). Currently, it is an easy technique to perform, should be preferred in the screening of high-risk patients and is a tool in places where it is not possible to perform MR.

Conclusion

Diffusion Mammography with contrast dye enhancement is a very useful method in breast cancer screening, as it is a more sensitive

method than mammography for the diagnosis of invasive breast cancer. MR remains the method of choice, but when compared to CESM, CESM is cheaper, faster, and with similar sensitivity for the diagnosis of invasive breast cancer.

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