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What Can Computed Tomography Scans of the Thorax Show after Breast Surgery?

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ABSTRACT

Background: Postoperative breast abnormalities after breast conserving surgery or modified radical mastectomy are frequently overlooked and inaccurately assessed or reported using multidetector computed tomography (MDCT). These inaccurate results may have legal ramifications for the clinicians, cause patients avoidable anxiety, and lead to additional unnecessary diagnostic follow-up testing and costs.

Methods: The patients with a history of breast cancer who had undergone breast-conserving surgery or modified radical mastectomy up to 6 months prior to undergoing a thoracic MDCT scan consented and enrolled in this study. These patients underwent a thoracic MDCT scan either because of respiratory or cardiac clinical symptoms or as part of breast cancer staging.

Results: Forty women were included in this study. Different postoperative breast changes observed on thoracic MDCT scans including fibrous scar tissue, fat necrosis, seroma, abscess, hematoma, and recurrent and residual tumor were described.

Conclusions: MDCT scans offer sufficient evidence in many postoperative cases to allow a confident diagnosis. General radiologists who review thoracic MDCT scans should know how to characterize breast lesions incidentally found on MDCT scans after breast surgeries. This information would enhance the value of the radiologist's report for appropriate case management.

Introduction

It is common to miss breast abnormalities in multidetector computed tomography (MDCT) or have them inaccurately reported, especially after previous breast surgeries. It is important for general radiologists to characterize breast lesions incidentally found on MDCT scans as benign, indeterminate, or sufficiently suspicious to justify further follow-up testing.

Breast changes and pathologies after surgery can be similar to malignancies.[1] Reporting these lesions as recurrent or residual tumor can cause unnecessary stress for patients after their recent treatment, or additional expensive diagnostic follow-up testing.[2,3] It may also have legal ramifications for the responsible surgeon or oncologist. Therefore, it is important to be familiar with the appearance of postoperative changes on MDCT scans. Obtaining an accurate medical history, including the time and type of any previous biopsy or surgery, is crucial for a correct MDCT scan diagnosis. Accurate description and classification of breast lesions detected on

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The purpose of this study was to familiarize the readers with the changes in the appearance of breast tissue after breast surgery on MDCT scans, with an emphasis on the ability of the MDCT scan to provide a correct diagnosis.

Methods

Written informed consent was taken from all enrolled patients. This study evaluated women with pathologically confirmed breast cancer who had undergone breast surgery (breast conserving surgery or modified radical mastectomy) and were still under observation by an oncologist or surgeon during their follow-up period. These women underwent a thoracic CT scan either because they showed clinical symptoms (respiratory or cardiac), or as part of breast cancer staging or to evaluate the progression of the disease.

The surgery was up to 6 months prior to undergoing a thoracic CT scan and the MDCT scans were taken using a 64 multidetector CT scanner (GE Healthcare) following the same protocol for all patients. Both unenhanced and contrast–enhanced scans were obtained, using a standard protocol, from the lung apices through the adrenal glands using the following imaging parameters: section thickness, 0.625 mm; pitch, 1.05–1.25; tube potential, 120 kV. Contrast-enhance CT was performed with the intravenous (IV) administration of 100 mL iopromide (Ultravist 300; Schering, Berlin, Germany) using a mechanical power injector at a rate of 2.0–3.0 mL/sec. The scanning was performed 50 seconds after the injection of the contrast medium. The imaging parameters were identical to those used for unenhanced CT scan. The images were obtained using a standard soft-tissue algorithm and a retrospective lung algorithm. The MDCT scans were reviewed by general radiologists. All the images were re-evaluated by the authors, and the images were reviewed only in transverse planes. Depending on the MDCT scan results, either a mammography examination with routine craniocaudal and mediolateral oblique projections, or an ultrasonography was performed for more in-depth evaluation and confirmation of the nature of the pathology visible on the MDCT scan. The mammography examination was performed using the Selenia direct digital mammography system (Hologic Inc.) and the ultrasonography examination was performed using a MyLab™ machine (Esaote, Genoa, Italy) with a linear array transducer (7.5–12 MHz; Esaote, Genoa, Italy).

Results

From November 2014 to November 2015, 40 women were enrolled in this study. Their median age was 48 years (range: 36–63 years). None of them were pregnant, or had contraindications for IV contrast, renal malfunction, or previous allergic reactions to IV contrast.

These 40 patients had a known history of breast cancer and had undergone previous breast cancer surgery: 29 underwent breast conserving surgery and 11 underwent modified radical mastectomy. In 32 patients, a thoracic MDCT scan was requested by their oncologist either as part of breast cancer staging or to evaluate the progression of the disease. The remaining 8 women underwent a scan because of respiratory or cardiac symptoms.

In 30 patients, postoperative changes with scar tissue without a detailed description or explanation of the type of the postoperative change were recorded in their thoracic MDCT scan reports by the general radiologist. However, in the remaining 10 women, an indeterminate mass, spiculated mass, cancer recurrence, or lymphadenopathy was reported. A more detailed evaluation using mammography and ultrasonography confirmed that only 2 of these 10 patients had tumor recurrence. The other 8 had a seroma, scar, hematoma, or fat necrosis.

Discussion

Mammography is currently the golden standard for breast cancer screening. Breast ultrasonography and magnetic resonance imaging (MRI) are the other preferred imaging methods for the detection and characterization of breast diseases, while MDCT scans are not considered the primary method to evaluate specific breast lesions. Sometimes breast lesions can be find in MDCT accidentally as it is done because of other reasons such as respiratory or cardiac problems. Incidental breast lesions detected on unenhanced or contrast-enhanced MDCT scans have been presented in a few previous articles where the authors evaluated the incidence, imaging MDCT scan appearance, and pathologic outcomes of the breast lesions detected on the MDCT scan.[1-8]

The advantages of MDCT are good contrast resolution, and providing cross sections and a large field of view.[9, 10] It is also helpful in dense breasts, or deep lesions near the chest wall with the possibility of chest wall involvement.[2,10,11]

A general radiologist should know how to detect and characterize breast changes observed on MDCT scans after surgery as either normal scar tissue, surgical complications (such as hematoma, fat necrosis, seroma, abscess), indeterminate, residual/recurrent tumor, or sufficiently suspicious lesions, which would justify further follow-up testing.

It can be concluded from the literature that in approaching the detected breast lesions on MDCT, it would be better to describe the shape (round, oval, irregular), margins (circumscribed, microlobulated and spiculated), Hounsfield units (characterized as air, fat, fluid or soft tissue), and pattern of enhancement (homogeneous, heterogeneous, rim enhancing, central enhancement, or enhancing internal septations).[1-12]

Residual/Recurrent tumor

Postoperative changes may mimic cancer. Previous studies suggest that irregular margins, shape and rim enhancement are the most important signs for malignancy on MDCT scans.[12, 13] Time-density curves, similar to enhancement curves on breast MRI, can also be used in MDCT scans, where the washout and plateau patterns are predictive of malignancy.[14] Studies have found that washout patterns on post contrast images have a high positive predictive value but lack high sensitivity and specificity.[13, 15] Overlapping tissues decrease on CT, with better demonstration of the border of tumors.[15] CT may also show a contralateral tumor.[11, 16, 17] Calcification is a frequent finding in the breast. Microcalcifications (smaller than 0.5 mm) are more likely to be malignant and are usually too small to be seen on a thoracic MDCT owing to the limited spatial resolution. Only larger calcifications can be seen on MDCT scans and are usually benign.[14]

In a case of potential tumor recurrence in this study, a mass with soft tissue Hounsfield unit and mild enhancement was seen in the midline of the left side with extension on the surface of the sternal body (Fig. 1).

A confirmatory ultrasound was carried out and showed a hypoechoic irregular border mass appearing to contain soft tissue (Fig. 2). A biopsy confirmed tumor recurrence. Another case of tumor recurrence demonstrated a malignant appearing lymph node (the same morphologic criteria as for the ultrasound were used) with a short axis of more than 10 mm without a fatty hilum in the right axilla. The patient had a history of previous breast conserving surgery, and malignant appearing lymph nodes were seen in the mediastinum simultaneously (Fig. 3).

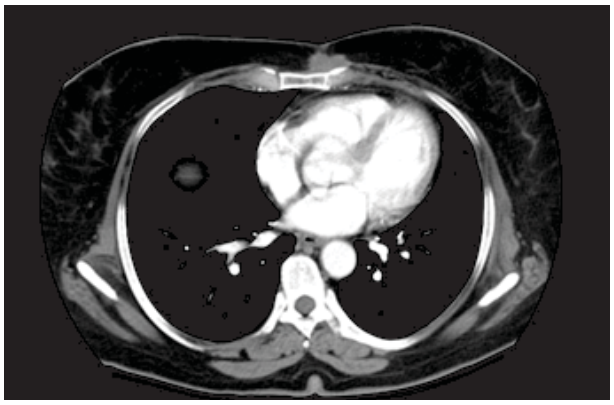

Figure 1. Axial contrast-enhanced MDCT scan showed a soft tissue mass with mild enhancement on the left side of the midline on the surface of the sternal body in a patient with previous left breast conserving breast cancer surgery.

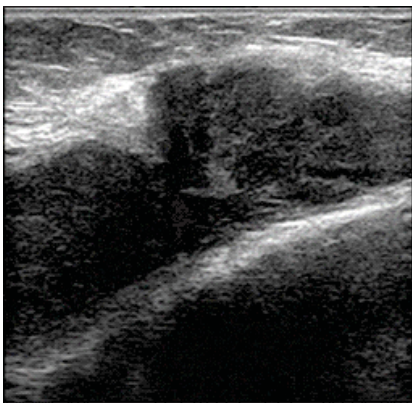

Figure 2. A confirmatory ultrasound showed a hypoechoic irregular border mass appearing to contain soft tissue, compatible with a visible mass on the MDCT scan; a biopsy confirmed the mass to be malignant, confirming the diagnosis of tumor recurrence.

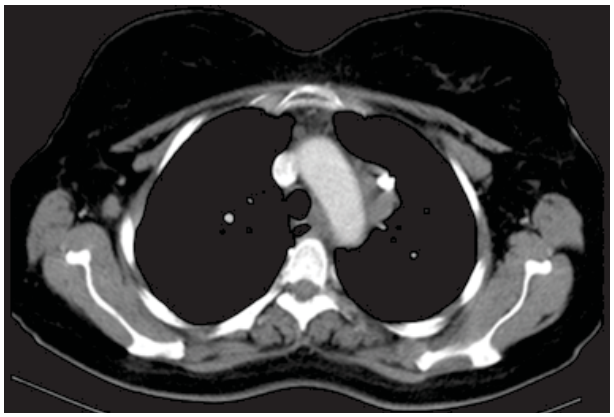

Figure 3. A 45-year-old woman with a previous history of right breast conserving cancer surgery presented with a few prominent lymph nodes in the right axilla and mediastinum, suggesting a malignancy.

Fibrous scar tissue

An accurate medical history, such as the time and type of any previous surgery, as well as signs and symptoms in the patient, such as feeling the presence of a mass and fever, are all important for a correct diagnosis. The presence of surgical clips on a MDCT scan is a good indicator of previous surgery. Normal scar tissue can show malignant features such as spiculated mass or tissue distortion but in the setting of previous surgery, these appearances are usually not a cause for concern.[18] Correlating prior surgery locations and opaque surgical markers are very important in differentiating a scar from cancer. Masses or lesions, especially when not exactly situated at the site of a prior surgery, should be regarded as suspicious. A malignancy will grow over time while any post-treatment change will remain stable or decrease over time. Figures 4 and 5 show examples of normal scar tissue.

Seroma

Seromas may be seen after surgery on MDCT scans. A seroma will appear as a well-defined oval-shaped mass at the site of a previous mass resection (Fig.6). It will not always show low attenuation fluid density. Other associated postoperative tissue such as distortion, metallic clips, or air-fluid levels will help make a diagnosis. After IV contrast, a thin peripheral enhancement can be seen.[1,19]

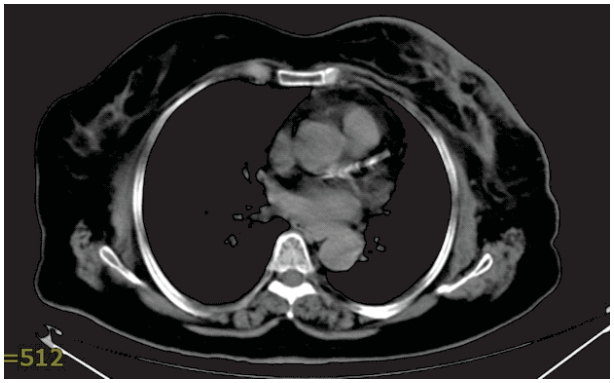

Figure 4. Thoracic MDCT scan without IV contrast. Postoperative changes, including skin thickening, tissue distortion, and fibrous scar in left breast are due to previous breast cancer conserving surgery.

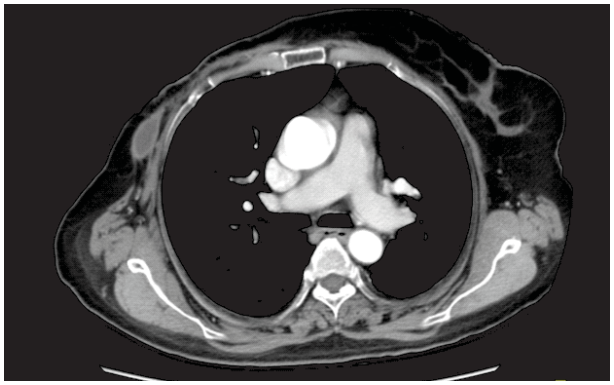

Figure 6. A patient with previous right breast mastectomy and axillary dissection presented with a mass in the lateral part of her scar tissue. A thoracic MDCT scan, performed as part of the cancer staging, showed an oval well-defined fluid density mass-shaped lesion with a thin rim of enhancement. A confirmatory ultrasonography indicated it was a seroma.

Hematoma

Breast hematomas may be seen after a biopsy or surgery. Their diagnosis needs to be correlated with whether the patient has a history of recent surgery or biopsy. A decrease in the size over time is a good diagnostic point about hematoma. When a hematoma becomes smaller, it changes to serous fluid and forms a seroma. There was no case of breast hematoma in this study, which may be a reflection of the time lapse between the previous surgery and the MDCT scan.[1,20]

Abscess

In breast surgery, abscess formation is not a common complication. Clinical history such as fever and lab tests including an elevated white blood cell count are important in proper diagnosis. An abscess can sometimes have a similar appearance to a hematoma on MDCT scans; in this context, clinical data can be essential for correct diagnosis.[1,20] None of the patients in this study showed an abscess on their MDCT scans.

Fat necrosis

Fat necrosis can manifest different imaging

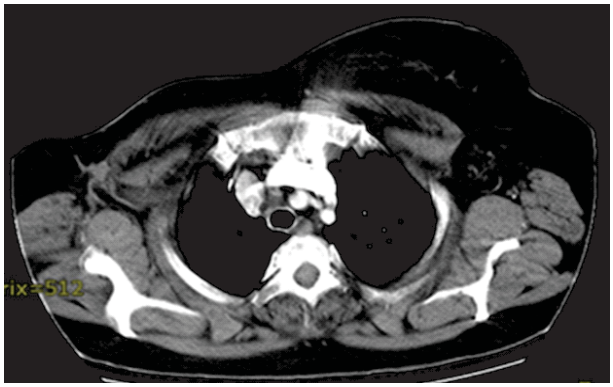

Figure 5. Thoracic MDCT scan without IV contrast. Spiculated soft tissue density in the right axilla of a patient who had axillary dissection. A confirmatory ultrasound showed scar tissue only in the axilla.

features sometimes indistinguishable from malignant lesions that warrant biopsy. Central fat with rim enhancement is its typical feature (Fig. 7). Other signs of postoperative changes accompany fat necrosis most of the time.[18, 20] Fat necrosis-related calcifications, including rim, coarse, or dystrophic calcifications, are typically benign. Fat necrosis can be associated with smaller, irregular, polymorphic, clustered calcifications but almost all calcifications visible on MDCT scans are benign and are only visible due to their size.[1]

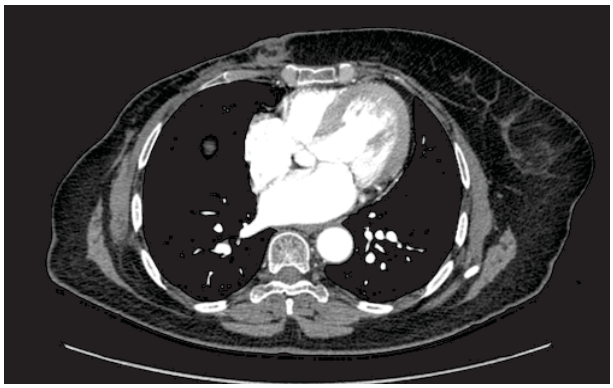

Figure 7. Thoracic MDCT scan with IV contrast in a patient with a previous right mastectomy. A complex mass containing fat components suggestive of fat necrosis in the medial part of the scar tissue can be observed.

Breast reconstruction

Breast reconstruction after a mastectomy may be performed using implants, autologous tissue, or both (Fig. 8). Occasionally, reduction mammoplasty is required for the contralateral breast in order to maintain symmetry and esthetics.

In certain circumstances, the placement of a tissue expander to expand the skin is required prior to breast prosthesis implantation. Different types of implants, which differ according to their content (saline or silicone) and number of lumens, may be used. Fibrous tissue usually develops around the implant.

Implant complications, including intracapsular or extracapsular rupture, silicone granuloma formation,

and capsular contracture, cannot be adequately evaluated on a thoracic MDCT scan. However, certain imaging signs, such as thickening of the fibrous capsule, infolding, tenting and irregularity of the prosthesis, irregular capsular contour with peri-implant calcification, and the presence of fluid collections around the implant, can be suggestive of those complications.[14] Therefore, if these imaging signs are observed on the MDCT scan, it is recommended to perform additional imaging, such as breast MRI, for better evaluation of the implant.

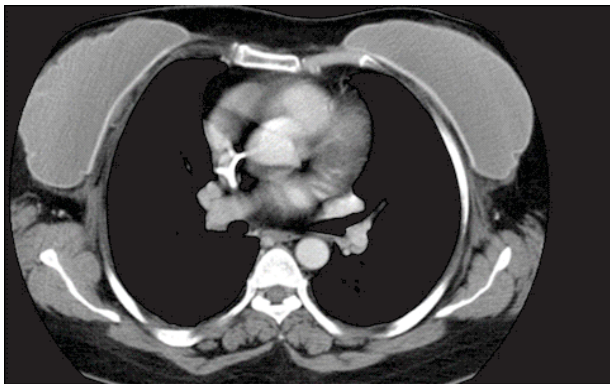

Figure 8. Thoracic MDCT scan of a 42-year-old woman with a history of bilateral mastectomy who recently underwent breast augmentation surgery using implants.

In conclusion, breast tissue should be scrutinized on MDCT scans as well as other types of images. Residual and recurrent tumors as well as benign postoperative changes including fibrotic scar, seroma, hematoma, abscess, and fat necrosis can be diagnosed correctly using MDCT, or can at least be proposed as a differential diagnosis; moreover, if needed, other appropriate imaging methods may be suggested in MDCT scan reports for confirmation. Knowing the important features of the appearance of breast tissue after surgery on MDCT scans allows the radiologist to report them well, and plays an important role in the proper management of the patient.

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