ORIGINAL RESEARCH

THE ROLE OF CONTRASTED DYNAMIC MULTI-DETECTOR COMPUTERIZED TOMOGRAPHY IMAGING ON SURGICAL DECISION MAKING IN BREAST CANCER PATIENTS

Taner Yiğit[1], Ünsal Coşkun[2], Öner Menteş[1], Cengizhan Yiğitler[1], Bülent Güleç[1], Müjdat Balkan[1], Orhan Kozak[1], Turgut Tufan[1]

[1]Gülhane Askeri Tıp Akademisi, Genel Cerrahi AD, Ankara, Türkiye [2]Gülhane Askeri Tıp Akademisi, Rehabilitasyon Hastanesi, Ankara, Türkiye

ABSTRACT

Objective:. The success of surgical treatment of breast carcinoma depends mainly on prevention of local recurrence. Nowadays magnetic resonance imaging is being intensively used for the diagnosis of breast lesions. In this study we investigated the effect of the multi-detector computed tomography as an alternative to magnetic resonance in the evaluation of satellite breast cancer and the relation of the tumor margins with surrounding tissue, which plays an important role in local recurrence.

Methods: In an 18 months' period, 30 patients with breast cancer, for whom breast-conserving surgery was planned, were given a multi-detector computed tomography in the preoperative period.

Results: In two (10%) patients a very close correlation between the tumor and pectoral fascia was found; in three (15%) patients a satellite tumor focus was detected. It was also reported that one of these patients had both satellite lesions and a primary tumor-pectoral fascia connection. Four patients received a modified radical mastectomy in accordance with their informed consent.

Conclusion: Multi-detector computed tomography is a good alternative for magnetic resonance imaging in some cases and provides useful data in the determination of satellite tumor focus and the relation of the primary tumor to the pectoral fascia.

Keywords: Breast cancer, Multi-detector CT, Diagnosis, Treatment

MEME KANSERLİ HASTALARDA CERRAHİ TEDAVİNİN PLANLANMASINDA KONTRASTLI DİNAMİK MULTİ-DEDEKTÖR TOMOGRAFİ GÖRÜNTÜLEMENİN ROLÜ

ÖZET

Giriş: Meme kanserinin cerrahi tedavisinin başarısı temel olarak hastalık tekrarının önlenmesi prensibine dayanmaktadır. Günümüzde manyetik rezonans görüntüleme meme kanserinin tanısında yoğun olarak kullanılmaktadır. Buna karşın kapalı alan korkusu olan hastalara bu tetkikin uygulanmasında güçlükler ve kolay ulaşılabilirliğin kısıtlı olması manyetik rezonans görüntülemenin uygulanabilirliğinin sınırlamaları olarak karşımıza çıkmaktadır. Bu çalışmada bölgesel hastalık tekrarı gelişiminde önemli etkenlerden olan tümörün çevre yapılarla olan ilişkisi ve uydu tümör odaklarının varlığının incelenmesinde kontrastlı dinamik çok detektörlü tomografinin manyetik rezonans görüntülemeye alternatif olarak kullanılabilirliğini araştırdık.

Materyal Yöntem: 18 aylık dönem içinde meme kanseri tanısı konmuş ve meme koruyucu cerrahi planlanan toplam 30 hastaya kontrastlı dinamik çok detektörlü tomografi uygulandı.

Sonuçlar: İki hastada (10%) tümörün pektoral kas kılıfına çok yakın sonlandığı, üç hastada (15%) uydu tümör odağı varlığı tespit edildi. Bu hastaların birinde ise uydu tümör odağına ilave olarak pektoral kas kılıfına yakın sonlanma tespit edildi. Hastaların dördüne de aydınlatılmış onamları alınarak meme koruyucu cerrahi yerine modifiye radikal mastektomi ameliyatı uygulandı.

Tartışma: Kontrastlı dinamik çok detektörlü tomografi, seçilmiş vakalarda manyetik rezonans görüntülemeye iyi bir alternatiftir. Kontrastlı dinamik çok detektörlü tomografi ile ana tümörün pektoral kas kılıfına ile olan ilişkisi ve uydu tümör odakları hakkında yararlı veriler elde edilebilmektedir.

Anahtar Kelimeler: Meme kanseri, Çok detektörlü CT, Tanı, Tedavi

İletişim Bilgileri:
Taner Yiğit
e-mail: yigittaner@yahoo.com
Gülhane Askeri Tıp Akademisi, Genel Cerrahi AD, Ankara, Türkiye

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INTRODUCTION

Breast cancer (BC) occurs in more than 8% of women during their lifetime and this ratio continues to increase [1,2]. Thus, it is one of the major causes of death among women 40-55 years of age [3,4]. Despite the advantages in both diagnostic tool and treatment strategies, the mortality rates of BC still remain significant. Currently, the overall survival rate is 73% at five years and 59% at 10 years [2].

While mastectomy was formerly the mainstay of treatment, today breast-conserving surgery (BCS), which offers nearly similar survival rates, is extensively used. Even if disease-free and overall survival rates are nearly similar, local recurrence rates are higher after BCS than after mastectomy[5-7]. Many factors such as the patient's age, tumor size, pregnancy, collagen vascular disease, resection margin, satellite tumor focus, tumor nature, axillary lymph node involvement, tumor grade, mononuclear cell infiltration, were reported as accounting for local recurrence in previous studies [8-12]. Among the factors listed above, resection margin and satellite tumor focus are unique factors which can be controlled during the preoperative period.

In this prospective study, we aimed to evaluate the potential role of contrasted dynamic multi-detector computed tomography (MDCT) as an additional imagining modality in the detection of occult satellite tumors in the targeted breast tissue and the relationship of the tumors with surrounding tissue and pectoral fascia. All of these are important regarding local recurrence in patients with a diagnosis of BC. Furthermore, we also evaluated the effect of the contrasted dynamic MDCT on the treatment planning of breast cancer.

PATIENTS AND METHODS

The study comprises all patients who applied to the breast clinic between September 2003 and February 2005 either for routine breast checkups or for a breast mass diagnosed by self-examination. Among these patients, women who were diagnosed with BC by physical examination, ultrasonography (USG), mammography and pathological analysis were identified as potential candidates for BCS and were recruited for the study. Candidacy of the patients for BCS was determined using four major criteria; a) physical examination, b) laboratory tests (USG, mammography and pathology), c) patient's choice d) surgeon's experience.

All patients were given a thorough physical examination at the time of first admission.The dimensions of the lesion, condition of the contra lateral breast and both axilla were noted along with a detailed patient history. All patients were given bilateral breast and axillary USG and mammography as a standard procedure for screening. Patients with a suspicious malignant breast lesion were reevaluated with focused USG and also given a fine needle aspiration biopsy (FNB) or open biopsy. Patients given and diagnosed with open biopsy were excluded from the study in order to prevent possible side effects of the procedure on the contrasted dynamic MDCT results. Patients having T1-T2 tumor and candidates for BCS were assigned to the study group. Patients' preference of treatment as to which operation they wanted was determined after giving detailed information concerning complications, recurrence and disease-free-overall survival rates, and effect on their quality of life after surgery and radiotherapy following the BCS. According to these data, patients who selected mastectomy were excluded from the study. Finally, patients with T1 and T2 tumors, who chose BCS, were included in the study and all data of these patients including age, USG, mammography, MDCT and FNC results, tumor size, histology, localization and TNM classification were recorded.

All patients who were recruited for the study were given a contrasted dynamic MDCT two days before the surgery. Patients were examined before and after the contrast injection. Patients who were known to have an allergic reaction for contrast dye were not given the contrasted dynamic MDCT and were also excluded from the study. Before the contrasted images of the breast tissue were made, plain images were collected. Using an MDCT scanner (Picker, MX Twin, Israel) set for 1-mm collimation and a pitch of 5.5, we scanned our patients from the level of the axilla to the lower edge of the breast. Patients were asked to hold their breath four times both before and 1, 3, and 8 min after an IV rapid bolus administration of nonionic contrast material. We infused 100 mL of nonionic contrast material (Ultravist [iopromid], Schering, Germany) at a rate of 3.0 mL/sec. The data were reconstructed at 0.6 mm increments. Patients underwent MDCT in the supine position because it allowed surgical

simulation on three-dimensional data displays. After reconstruction, the images were transferred to a workstation. Multiplanar reconstructions (axial, coronal, and sagittal) and maximal intensity projections were used for the evaluation of tumors. One radiologist reviewed all detected lesions for morphologic features and time-density curve patterns. All detected lesions were classified as either mass or nonmass enhancing lesions. For mass lesions, margin, shape and enhancement patterns were evaluated. Irregular contour and shape, early contrasting and washout were assigned as malignancy criteria.

Patients' candidacy for BCS was reevaluated according to contrasted dynamic MDCT results. Patients with a satellite tumor requiring large breast tissue excision and / or patients with a lesion which was related to the pectoral fascia were designated as patients who were not eligible for BCS. These groups of patients were also informed about the potential risks of BCS under these conditions and they were prepared to undergo mastectomy with their informed consent. Accuracy of the contrasted dynamic MDCT results was controlled by retrospectively comparing these data with excision materials' pathology results.

Primary outcomes of this study were finding a ratio of the patients who were given MDCT and diagnosed having additional tumor with/or pectoral muscle infiltration to the total number of cohort who were recruited to the study. Hereby, we aimed to investigate of the accuracy of MDCT in protection to the patients from local recurrence. All steps of this study design were approved by the Gulhane Military Medical Academy Human Subject Review Committee and meet the guidelines of this governmental agency.

RESULTS

Thirty elegible patients were identified and recruited for the study. The mean age of the patients was 46.7 (range 33-66) years old.

All patients were reported as having one solid lesion in their breast detected by USG and mammography. Malignancies in all patients were diagnosed using FNB. According to the FNB results, three (10%) patients had infiltrative lobular carcinoma, two patients (6.6%) had infiltrative ductal + infiltrative lobular carcinoma (mixed type) and 25 (83,4%) patients had infiltrative ductal carcinoma (Fig. 1).

Clinical TNM classification of the patients revealed that 11(36.6%) patients had T1N1M0 tumors, six (20%) patients had T1N2M0 tumors, five (16.7%) patients had T2N0M0 tumors, three (10%) patients had T2N1M0 tumors and five (16.7%) patients had T2N2M0 tumors (Fig. 2).

Mean tumor size was 21.7 (range10-40) mm.The tumor was localized in the upper outer lobe in 17(56.6%) patients, lower outer lobe in 4 (13.3%) patients, lower inner lobe in 2 (6.6%) patients and upper inner lobe of the left breast in 7 (23.5%) patients.

Contrasted dynamic MDCT results revealed that 2 (6.7%) patients had a tumor with a very close margin or connection to the pectoral fascia (Fig.3), 3(10%) patients had a satellite tumor, which had not been noticed in the USG and mammography during the preoperative period (Fig. 4) (Table-I). One of these two patients with pectoral connection also had satellite tumor focus. Detailed specifications of those four patients have been given in table. (Table-II) Finally, these 4 (13.3%) patients who seemed to have contraindication for BCS were given a modified radical mastectomy (MRM) with their informed consent.

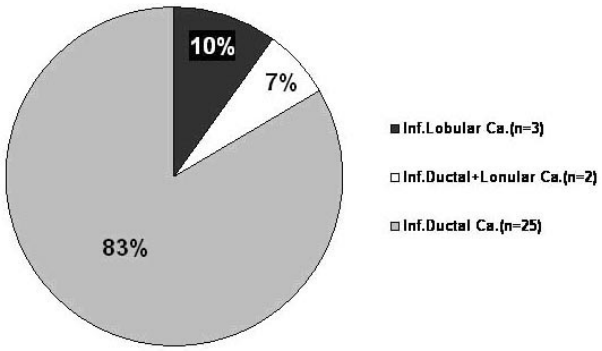

Fig. 1: Distribution of the tumor according the pathological classification.

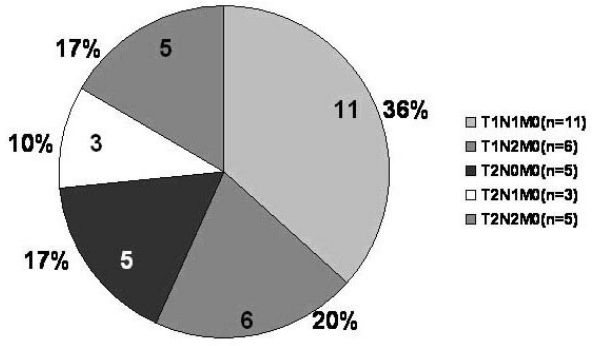

Fig. 2: Distribution of the tumor according the TNM classification

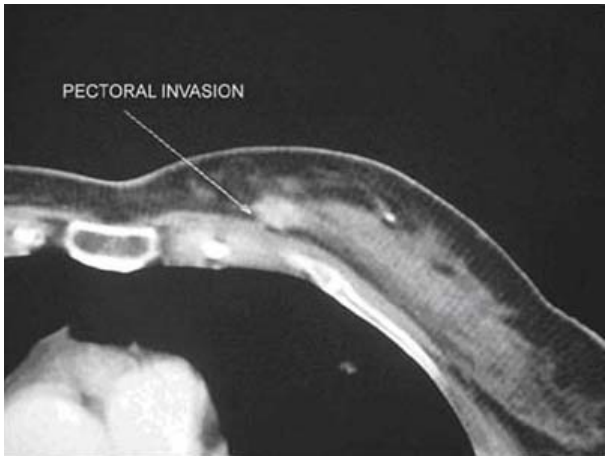

Fig. 3: Pectoral invasion of the primary tumor.

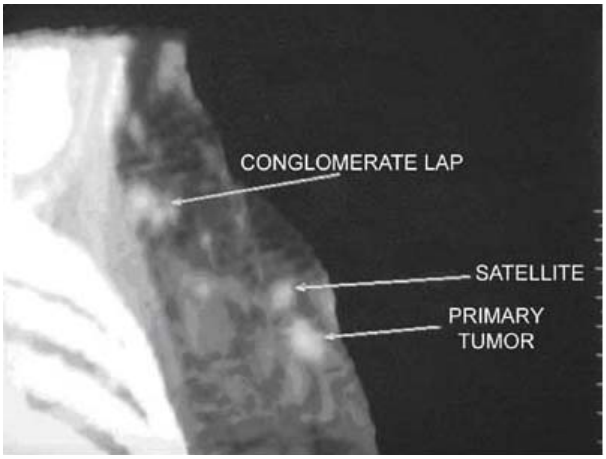

Fig. 4: Conglomerate LAP and satellite tumor.

Table 1: Primary tumor and axillary assessment results according to the contrasted dynamic MDCT

Single lesion	Satellite lesion	Pectoral Invasion	Satellite lesion + Pectoral Invasion
26(%86.7)	2(%6.7%)	1(3.3%)	1(3.3%)

Table II: Detailed specifications of patients diagnosed satellite tumor and pectoral invasion detected with MDCT

	Patient 1	Patient 2	Patient 3	Patient 4
Age	35	35	48	40
Tumor Localization	Upper outer	Upper outer	Upper outer	Lower inner
Satellite	No	Yes	Yes	No
Pectoral invasion	Yes	Yes	No	Yes

Patients who had abnormal findings in contrasted dynamic MDCT and who were given MRM were reevaluated during the postoperative period using pathology examination results. Two pectoral fascia connections and two satellite tumors, noticed in contrasted dynamic MDCT, were confirmed with pathology results. As for other satellite tumor focus, it was not confirmed by pathology. But this patient also had a pectoral fascia involvement, which was identified by contrasted dynamic MDCT and further confirmed by pathology examination.

DISCUSSION

Surgical treatment of breast carcinoma has improved in recent decades. While mastectomy has been the historical mainstay of surgical treatment of stage-I and stage-II BC for decades and although mastectomy continues to be appropriate for some patients, nowadays many authors recommend BCS for surgical treatment of BC. Clinical trials have revealed that overall and disease-free survival rates are equal or nearly equal for mastectomy and BCS with postoperative radiotherapy.[5-7,13,14]

BCS has advantages in helping the patient retain a better body image, better sexual condition and less negative effect on a patient's emotional state. It also offers better quality of life [15,16]. Although it has many advantages, local recurrence rates have been reported as 3-17% after the BCS and 2-10% for mastectomy [7]. Even local recurrence rates have been reported higher than for mastectomy with similar rates for distant metastasis. Overall mortality and BC specific mortality rates have already been reported [17].

Local recurrence has a negative effect on a patient's quality of life. Furthermore, additional operation requirements make this clinical dilemma difficult to accept for the patient. In order to prevent local recurrence of the cancer, everything possible will be attempted according to the patient's wishes and, hopefully, such efforts will increase the patient's satisfaction with treatment. Multicentricity and positive or close resection margin are two important factors in the development of local recurrence. Patients with satellite tumors are poor candidates for BCS [16]. Satellite tumors usually require extensive resections and negatively affect cosmetic outcome. Additionally in case of misdiagnosis, satellite tumors cause local recurrence after BCS. Liberman et al.[18] reported that magnetic resonance imaging identified additional occult lesions in addition to the index breast lesion in 19(27%) of 70 consecutive women. Studies have shown unacceptably high false-negative rates for both USG and mammography, with detection of very few clinically occult carcinomas [19,20].

To minimize the risk of local recurrence, the surgical management of breast cancer relies on complete excision of the tumor with a margin of normal tissue [21]. The local recurrence rates at 5 years have been reported as between 2% and 24% for patients with invaded margins, 6%-16% with close margins,and 2%-7% with clear margins [22-24]. The initial surgical biopsy of breast cancer results with positive margins were between 45% to 54% of the patients [25,26]. Although Schmitt-Urlich et al [25] demonstrated that local recurrences could be virtually eliminated by adjusting the magnitude of the extension site boost dose to the relative degree of margin clearance, some authors claimed that with proper selection criteria, it may be safe to omit adjuvant radiotherapy in patients with adequate margins [27,28]. It is obvious that a clear margin is important in preventing local recurrence and intensive radiotherapy protocols. Additional diagnostic tools aim to identify any occult satellite lesions or penetration of the tumor to the deeper tissues (pectoral fascia) and are beneficial in preventing patients from local recurrence.

Recently magnetic resonance imagining (MRI) of the breast gained a role in clarifying uncertain cases (suspicious tumor focus which can not be identified with conventional techniques) after mammography and / or USG, and in detecting multifocal, multisentric, and bilateral breast cancers [29-32]. Nevertheless, a not negligible number of patients cannot undergo MRI examination due to certain contraindications, serious claustrophobic syndrome or lack of a machine. In this study we aimed to verify the diagnostic value of contrasted dynamic MDCT in patients with certain conditions listed above. Data obtained in this study revealed that 4 patients for whom a BCS was planned were not suited for this operation due to satellite tumor focus and /or close margin of tumor to the pectoral fascia. These 4 patients' operation strategies were changed from BCS to MRM. We think that by doing so we prevented our patients from local recurrence, which may have developed in the future. Bilateral thoracic wall examination capacity, suitability for easier approach to imaging-guided fine needle aspiration and hookwire localization are the other advantages provided by contrasted dynamic MDCT [33-35]. The main problem related to the use of contrasted dynamic MDCT in the diagnosis of BC is the X-ray exposure. A previous study, comparing the radiation doses delivered to the breast during conventional breast CT with those involved in mammography, revealed that for conventional CT the doses are almost 10 times higher than those administrated in standard mammographic examination [36]. In our opinion,this is sufficient reason to choose MRI over CT in the diagnosis of BC. On the other hand, extra X-Ray exposure of healthy breasts and lungs seems negligent in patients diagnosed with BC because these patients are usually going to have postoperative radiotherapy after having undergone BCS. Additionally, a study performed by Boone et al [37] in 2001 revealed that the total X-Ray dose in the CT performed with 80 kVp, 300 mAs and 5 mm slice are nearly equal with X-Ray dose in mammography performed to the 5 cm compressed breast tissue. They also reported that the X-Ray dose is one-third less in CT than when using mammography of a large breast, which is thicker than 5 cm with compression. Allergic reaction to the contrast agent used for CT is another side effect of the CT. But we believe that this possibility is not a contraindication for CT because it is not any higher in CT than in other radiological contrasted procedures.

In conclusion, contrasted dynamic MDCT offers valuable data in the determination of satellite tumor focus and the relation of the primary tumor to the pectoral fascia especially for patients with certain contraindications for MRI and claustrophobia and in case of absence of the MRI unit. We believe that MDCT is a good alternative to MRI in patients who are planning to have a BCS and requiring additional radiologic

imagining technique to clarify additional breast pathology and tumor characteristics before the preoperative period.

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