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ORIGINAL ARTICLE

Correlation of Specimen/Breast Volume Ratio to Cosmetic Outcome After Breast Conserving Surgery

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Abstract

Breast conserving surgery (BCS) is currently the standard of care for early breast cancer. One of the key determinants for the line of treatment in breast cancer is the size of the tumor in relation to the breast size. The aim of this study is to determine the effect of the ratio of the excised specimen to breast volume on the cosmetic outcome after conventional BCS. This is a retrospective study conducted on female patients with early stage breast cancer who underwent BCT at National Cancer Institute, Cairo University. The study included 41 patients with stage I and II breast cancer. Breast volume was calculated using mammography, and ratio of the specimen to breast volume was determined. This ratio was correlated with the cosmetic outcome using the BCCT.core software. Thirty-six out of the 41 breast cancer patients completed the study. Favorable outcome (excellent + good) was detected in 52.7% of patients, while 47.3% had unfavorable outcome (fair + poor). Breast volume, tumor site, patients' age, and weight did not seem to alter the cosmetic result. The only statistically significant factors affecting the cosmetic outcome were the specimen volume and the ratio of the specimen to the normal breast volume ($p = 0.006$ and 0.019 respectively). In order to obtain a satisfactory cosmetic outcome after conventional BCS, the ratio of the excised specimen to breast volume has to be seriously considered.

Keywords Breast conserving surgery · Breast cancer · Cosmetic outcome · Oncoplastic breast surgery

Introduction

Breast conserving surgery (BCS) is the mainstay of surgical management of early stage breast cancer. Conventional BCS is defined as removal of the primary tumor with an adequate safety margin and axillary staging [1].

Nowadays the main goal of breast cancer treatment is not limited to cure, but extends to maximizing the quality of life by improving the final cosmetic outcome. Thus, one of the aims of breast conserving surgery is to maintain an esthetically appealing breast [2].

The 1990s witnessed the introduction and propagation of oncoplastic breast surgery. The core of this novel specialty relies on incorporating principles of esthetic breast surgery into the initial planning of surgical resection. It entails various techniques of mobilization and reshaping of different dermoglandular subunits of the breast. The final goal is a good cosmetic outcome while maintaining oncologic safety [3].

One of the key determinants for the choice of treatment in breast cancer, both for oncologic and cosmetic outcome, is the size of the tumor in comparison with the breast size. A relative contraindication for BCS in general is a large tumor in a small-sized breast. This size/volume discrepancy between tumor and breast potentially results in a suboptimal cosmetic result. Such cases usually receive neoadjuvant chemotherapy for downstaging.

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However, the decision still remains subjective and there has been no standard quantitative evaluation concerning the critical tumor/breast ratio beyond which upfront breast conservative surgery is not favored [4].

On the other hand, there is a group of patients who are still candidates for breast conservation but would end up with a suboptimal cosmetic outcome if conventional breast conserving surgery is applied. This group would benefit from oncoplastic techniques.

This study is the first step of a larger project aiming to decide beforehand which patients are suitable for conventional breast conserving surgery and which would benefit from oncoplastic techniques based on the breast tumor ratio.

The aim of this study is primarily to examine the relationship between the cosmetic outcome and the volume of tissue resected and to estimate roughly the ratio beyond which larger volume excisions are more associated with unfavorable cosmetic outcome.

Patients and Methods

This is a retrospective study conducted at the National Cancer Institute, Cairo University, on female breast cancer patients who underwent BCS and radical whole breast radiotherapy.

All patients presenting to the breast clinic during the period from March till August 2018 to perform their first annual follow-up were invited to participate in the study.

Inclusion criteria were patients who underwent BCS for stage I and II breast cancer and have completed their adjuvant therapy.

Patients who underwent contralateral breast surgery, those who presented with local recurrence, or patients who underwent oncoplastic surgery or immediate breast reconstruction were excluded from the study.

Assessment Method

Bilateral mammography was done in both cranio-caudal and mediolateral oblique views. One step was added to the standard procedure which was measuring the cranio-caudal compression thickness in the normal breast using a ruler.

Immediately before mammography, patients were photographed using a digital camera in a frontal view with bare chest and abdomen with both arms beside the patient.

The breast volume of the unaffected (normal) side was calculated using the formula: $\pi/4$ (Width × Length × Compression Thickness) [5]. The width and height were obtained using the measurement set on the cranio-caudal mammography image in the picture archiving and communication system (PACS).

The photograph was analyzed using the Breast Cancer Conservative Treatment cosmetic results (BCCT.core©) software. The BCCT software provides a 4-point classification scale (excellent, good, fair, and poor) to determine the overall assessment of cosmetic outcome [6].

The specimen volume was used as an estimate of the breast defect volume. The excised breast specimen volume was calculated retrospectively based on the measurements listed in the pathology report, using the formula: $4\pi/3$ (abc), where a = length/2, b = height/2, and c = width/2 [7].

The ratio of the excised breast volume to the normal breast volume was calculated assuming that both breasts initially had the same volume. The specimen to breast volume ratio was correlated with the cosmetic outcome.

Statistical Methods

Data was analyzed using IBM-SPSS win statistical package version 22. Numerical data was expressed as mean and standard deviation (SD), median, and range as appropriate. Qualitative data was expressed as frequency and percentage. Receiver operating characteristic (ROC) curve was created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings.

The TPR is also known as sensitivity, and the FPR is calculated by 1-specificity. For the present study, sensitivity was defined as the ability of the test to detect favorable cosmesis, while specificity was defined as the ability of the test to detect unfavorable cosmesis.

Patients

The study included 41 patients, 3 patients did not attend the scheduled mammography date, and 2 other patients refused to be photographed. Those 5 patients were excluded from the study. The remaining 36 patients complied fully to the study procedures.

The mean age of patients was 51.3 ± 10.6 years (range 31–75, median = 52.5). The mean body weight was 78.1 ± 10.4 kg with a mean height of 157.4 ± 7.6 cm. Body mass index (BMI) ranged from 24 to 46 with a mean of 31.9 ± 4.8.

The mean tumor size was 2.47 cm in maximum dimensions. Tumor sizes ranged from 0.4–4.8 cm in maximum dimensions. All patients had excised specimens with negative margins as confirmed by paraffin section examination. Only 11% of patients (4/36) had intraoperative positive margin detected by frozen section that required re-excision of extra safety margin in the same setting.

Among the studied patients, invasive duct carcinoma accounted for 80.6% of the breast histopathologies. Invasive lobular carcinoma was found in 13.8% of patients, while tubular and mucinous carcinoma accounted each for 2.8%.

Four out of 36 patients had diabetes mellitus (11.1%), while 5 patients had hypertension (13.9%). Only 6 patients (16.7%) received neoadjuvant chemotherapy while 75%

received adjuvant chemotherapy; the remaining 3 patients (8.3%) received both neoadjuvant and adjuvant chemotherapy. All patients received radical radiotherapy to the whole breast.

Thirteen (36.1%) underwent sentinel lymph node biopsy using patent blue. Five patients out of the 13 (38.5%) showed a positive sentinel lymph node for metastasis and completed axillary lymph node dissection in the same setting. Only 8 patients had negative sentinel node. On the other hand, 23 patients had an axillary dissection performed initially without a sentinel lymph node biopsy.

The upper outer quadrant was the most commonly involved quadrant, where 17 out of the 36 patients had their lesion (47.2%). The upper central quadrant (at 12 o'clock) was the second most common site with a percentage of 19.4%. The least quadrants involved were the lower outer and the lower inner quadrant which were involved in 16.7% of patients each respectively.

Results

The cosmetic outcome was initially classified into 4 groups based on the BCCT.core software©. Excellent cosmetic outcome was detected in 7 patients (19.4%), good in 12 patients (33.3%), fair in 12 patients (33.3%), and poor in 5 patients (13.9%).

The mean specimen volume for excellent cosmetic outcome patients was 121.5 ± 70.9 cc compared with 127.3 ± 92.2 cc in good category, 197.4 ± 128.3 cc in the fair, and 344.1 ± 62.2 cc in the poor cosmetic category ($p = 0.006$).

On the other hand, the mean excised specimen volume to the breast volume ratio was 7.2% in patients having excellent cosmesis, 9.9% in good, 15.2% in fair, and 15.6% in the poor cosmetic outcome ($p = 0.019$).

The specimen volume and ratio of the specimen volume to the normal breast volume were the only statistically significant factors affecting the cosmetic outcome ($p = 0.006$ and 0.019 respectively).

The different quadrant presentation did not affect cosmetic outcome ($p = 0.643$).

Other patient variables in relation to cosmetic outcome were found to be statistically insignificant. Age, weight, height, body mass index (BMI), and the normal breast volume did not show any statistically significant influence on cosmetic outcome, with p values of 0.946, 0.375, 0.770, 0.656, and 0.203 respectively.

Due to the relative small number of patients and for a better statistical analysis, the results were classified into 2 main groups: favorable and unfavorable cosmetic outcomes.

The favorable group included those patients with excellent and good cosmetic outcomes, while patients classified as unfavorable were those found to have fair or poor cosmetic outcomes.

Favorable outcome was obtained in 52.7% of patients, while 47.3% had unfavorable outcome (Fig. 1).

Receiver operating characteristic (ROC) curve was created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings. The area under the curve was 0.789 ± 0.079 with a p value of 0.003 (Fig. . 2).

The sensitivity of the test was defined as the ability of the test to detect favorable cosmetic outcomes which was 78.9%. The specificity was 58.8% which was the ability of the test to detect unfavorable cosmetic outcomes. The cutoff point was shown to be 14.6%.

The favorable group of patients summed up to 19 out of which 15 (79%) had a surgical specimen to breast volume ratio of less than 14.6%, while the unfavorable group had 7 (41%) out of 17 patients with the ratio less than the cutoff point. The difference between the 2 groups was statistically significant ($p < 0.002$).

Discussion

The final cosmetic appearance after BCS is affected by various factors with varying level of influence. The aim of this study is to determine the effect of excised specimen/breast volume ratio on the cosmetic outcome of conventional breast conserving surgery.

Patients with favorable cosmetic outcome had a mean ratio of 10.6% ± 6.5%, while the unfavorable group showed a mean ratio of 18.5% ± 10.4%. This difference was statistically significant with a p value of 0.002. The cutoff value calculated via ROC curve method was 14.6%, where excising a specimen more than 14.6% of the breast volume will likely give an unfavorable cosmetic outcome.

Seventy-nine percent of the patients with favorable cosmetic outcome had a ratio of less than 14.6% (the estimated cutoff), compared with only 41% of the unfavorable outcome group ($p < 0.002$).

The present study showed a strong correlation between the excised specimen/total breast volume ratio and the cosmetic outcome. Furthermore, it highlighted a possible cutoff ratio after which conventional BCS would not offer esthetically acceptable results.

The calculated cutoff value in the present study was 14.6%. The exact true ratio may mildly differ according to the number of patients in each study, the tool used for determining cosmetic outcome, and the measurement accuracy.

Earlier studies using subjective methods of cosmetic outcome measurement found that excising > 12% of the breast volume predicted a poor cosmetic outcome [8].

Fig. 1 Examples of favorable (left) and unfavorable (right) outcome

It is worth noting that the difference in the cutoff points between the various studies may be related to different methods of cosmetic assessment used.

Most researchers use subjective tools of outcome evaluation in the form of questionnaires completed by the patient and/or a panel of surgeons and nurses. Subjective evaluation remains the most widely used assessment tool despite the poorly reproducible results. The results may be influenced by the patient's culture and background and her psychological status.

An objective measurement may overcome this by excluding the human factors and standardizing most of the specific outcome criteria such as scar visibility, symmetry, and color match.

Similar studies using an objective assessment method further categorized the cutoff value for volume excision according to breast quadrants. Thus, an acceptable cosmetic outcome was achieved when the percentage of volume excised was less than 18% in the upper outer quadrant, 14% in the lower outer quadrant, 8% in upper inner quadrant, and 9% in the lower inner quadrant [9].

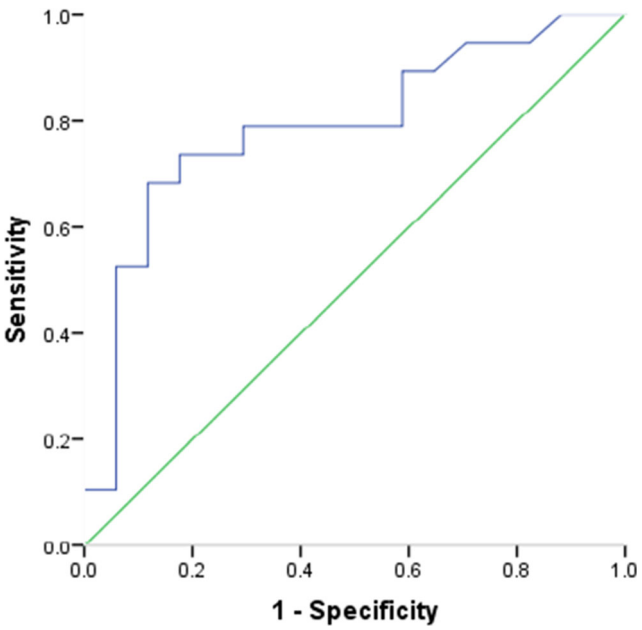

Fig. 2 ROC curve of excised specimen to breast volume ratio in relation to cosmetic outcome

The current study failed to elicit differences among different tumor sites. This can be attributed to the small sample size especially when distributed among different breast quadrants.

As mentioned before, this study is the first step of a larger project to help decision making in breast conserving surgery. A statistically significant correlation between volume of excision and cosmetic outcome was observed. A roughly estimated specimen/breast volume ratio of 14.6% was calculated beyond which unfavorable cosmetic outcome is more likely.

The next step will be a validation prospective study in which more refined measurements of the true breast volume and the tumor volume preoperatively will be sought using mammographic measurements. The calculated ratios will be correlated to cosmetic outcome and compared with the results observed in the current research.

Conclusion

Careful preoperative evaluation and patient counseling are the mainstay in determining the best surgical options for breast cancer patients. Accurate quantitative evaluation of breast/tumor ratio will help optimize surgical decision making for patients with early stage breast cancer. This would help in reaching the best cosmetic outcome and minimizing the negative psychological impact on patients.

Availability of Data and Materials Data are available from corresponding author upon reasonable request.

Authors' Contributions All authors contributed evenly to the publication of this research.

Compliance with Ethical Standards

Ethics Approval and Consent to Participate Approval of the ethical committee of the National Cancer Institute of Cairo University was obtained to perform this research.

Consent for Publication An informed consent for publication of personal and medical data was obtained from patients.

Competing Interests The authors declare that they have no competing interests.

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