Ann Surg Oncol
DOI 10.1245/s10434-011-2080-x

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – BREAST ONCOLOGY

Which Eligible Breast Conservation Patients Choose Mastectomy in the Setting of Newly Diagnosed Breast Cancer?

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ABSTRACT

Purpose. Breast conserving therapy (BCT) and mastectomy offer equivalent survival for women with newly diagnosed breast cancer (BrCa). Despite this, many women eligible for BCT elect mastectomy. Herein, we identify factors associated with choosing ipsilateral mastectomy instead of BCT when mastectomy is not required.

Methods. Between July 2007 and June 2010, 520 women with BrCa were treated by a single surgeon who prospectively documented patient eligibility for BCT. For patients who did not require mastectomy ($n = 392$), we evaluated associations between treatment choice and potential predictors using odds ratios (ORs) obtained from multivariable logistic regression models. P values ≤ 0.0029 were significant after correction for multiple testing.

Results. Of 392 women eligible for BCT, 106 (27%) chose mastectomy and 286 (73%) chose BCT. Multivariate analysis found an increased likelihood of electing mastectomy over BCT for patients with no comorbidities (OR 5.4; $P < 0.001$) and those with previous mastectomy (OR 23.2; $P < 0.001$). MRI and biopsy findings were associated with treatment choice because patients who had a second-site biopsy positive for cancer in the same quadrant as the index tumor were more likely to elect mastectomy compared with patients with no additional MRI abnormalities (OR 4.3; $P = 0.0027$). No association existed on multivariate analysis between choice of mastectomy and patient age, family history, or tumor stage.

Conclusions. One in four eligible BCT patients chooses mastectomy. Factors independently associated with choosing mastectomy over BCT include findings of second-site biopsy, previous mastectomy, and absence of comorbidities but not primary tumor characteristics. Further study into a patient's choice for mastectomy is warranted.

The percentage of women with breast cancer who pursue mastectomy over breast conservation therapy (BCT) is increasing despite the 1990 National Institutes of Health (NIH) Consensus Conference statement recommending BCT as the preferred surgical treatment for women with early-stage breast cancer.[1–12] The consensus panel based their recommendation on the existing data that there is no appreciable difference in overall survival between BCT and mastectomy.[13,14] Furthermore, they estimated that approximately 80% of women with newly diagnosed breast cancer are eligible for BCT. Not surprising, in response to this recommendation from the NIH, the percentage of women selecting BCT as their therapeutic choice increased steadily through 2004. Of interest, however, recent data suggest a return shift toward more women with newly diagnosed breast cancer electing mastectomy over BCT.[15,16]

The underlying reasons for the recent increase in mastectomy rates for women with newly diagnosed breast cancer are unclear. Authors of several retrospective studies propose a combination of factors, including patient age, ethnicity, genetic testing, increased use of preoperative breast MRI, level of patient involvement in the decision-making process, and an increased awareness and education about breast reconstruction.[15,17–19] Using our own patient data resources, we previously reported that age influences

Presented as a poster at the meeting of the Society of Surgical Oncology, San Antonio, TX, 2011.

First Received: 13 June 2011

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Published online: 06 October 2011

the preoperative workup of women with newly diagnosed breast cancer and that age may ultimately influence surgical decisions. Specifically, we observed that younger patients are more likely to pursue mastectomy, whereas older women are more likely to pursue workup of additional suspicious lesions and then choose BCT.[17]

The value of the data from existing studies notwithstanding, very few investigations have focused directly on examining which tumor characteristics, patient characteristics, and surgeon recommendations are associated with the choice of mastectomy over BCT when the patient is deemed eligible for BCT. Moreover, the existing studies in the literature that attempt to answer this question have been hampered by specific limitations, such as retrospective determination of eligibility for BCT, limited data on important covariates, and inclusion of data from multiple surgeons. Motivated by this, we harnessed data from our ongoing, prospective breast cancer surgical database and sought to evaluate which factors are associated with a woman's decision to choose mastectomy over BCT when a mastectomy is not required. Specifically, we hypothesize that a number of secondary factors influence the patient's surgical decision, including the presence of significant comorbid medical conditions, a personal history of breast cancer and/or mastectomy, family history of breast cancer, additional findings on preoperative imaging, the desire to avoid radiation therapy, concerns about the potential for additional surgery, and the desire for breast reconstruction.[20]

METHODS

This study was approved by the Mayo Clinic Institutional Review Board. Between July 2007 and June 2010, 520 patients with breast cancer were treated at our institution by a single surgeon (SAM) who prospectively documented in real time each woman's eligibility for BCT or necessity of mastectomy. Patients were considered eligible for BCT if they had a unifocal tumor generally less than 5 cm or multiple tumors within 5 cm of each other that were amenable to excision in a single specimen. Subjectively, the tumor-to-breast-size ratio was considered when determining eligibility for BCT. When patients presented with a large tumor relative to breast size or a tumor larger than 5 cm we offered neoadjuvant chemotherapy as a way to improve eligibility for BCT. We assessed patient choice for BCT or mastectomy in this setting preoperatively but after chemotherapy response was determined. Among the 520 women, 128 were deemed to require mastectomy and therefore were excluded from further analysis. The remaining 392 women were eligible for BCT and thus were included in this study.

To evaluate why some women chose BCT and others chose mastectomy, we performed retrospective review of a prospectively maintained database to identify only the data regarding potential predictors of treatment choice known to the surgeon and patient at the time of surgical decision making. Standard clinical and pathological parameters were collected, including patient age, race, personal and family history of breast cancer, breast density, detection method, preoperative MRI findings, previous surgeries for breast cancer, results of preoperative biopsies, tumor type and characteristics (imaging size, ER, PR, Her2 status, lymphovascular invasion), neoadjuvant chemotherapy, nodal stage, and the number of significant medical comorbidities. Significant comorbid conditions included coronary artery disease, end-stage renal disease, obstructive or restrictive pulmonary disease, history of solid organ transplantation, significant neurologic disease, the concurrent presence of additional nonskin cancer malignancy, and significant peripheral vascular disease.

As per the structure of our multidisciplinary breast center, patients with newly diagnosed breast cancer consult preoperatively with a breast health physician and nurse educator who reviewed an online tutorial regarding the diagnosis and treatment options. In addition, they review and give all patients a standardized manual of diagnostic radiologic and surgical procedures, preoperative and postoperative information, and basic information regarding radiation and adjuvant therapies. Within this setting, we offer preoperative breast MRI after an informed discussion regarding its advantages and disadvantages. The patient is then referred to the surgeon for discussion and surgical planning, and to the radiation oncologist for discussion of adjuvant radiation therapy and eligibility for whole breast, partial breast (either 3D conformal external beam or catheter-based brachytherapy), or hypofractionated regimens, all of which are offered at our institution. Finally, the patient is referred to the plastic surgeon for discussion of available reconstruction options and offered breast reconstruction, assuming that reconstruction is feasible and necessary. The patient completes each consult preoperatively to ensure a well-rounded understanding of all aspects of breast care and treatment; the multidisciplinary team then discusses each case at our weekly breast tumor board.

Patients deemed at elevated risk and those who meet criteria for genetic testing are referred preoperatively to our certified genetic counselor for discussion of risk and for BRCA or p53 testing. While over thirty women were identified during the timeframe of this study with a BRCA or p53 mutation or Cowden's disease, the unaffected mutation carriers and those women with a history of cancer but without current active disease were excluded from this analysis.

Statistical Analysis

Numerical variables were summarized with the sample median, minimum, and maximum. Categorical variables were summarized with number and percentage. The proportion of women choosing mastectomy over BCT was estimated along with an exact binomial 95% confidence interval (CI). Associations between choice of treatment (mastectomy vs. BCT) and potential predictors were evaluated using logistic regression models, where odds ratios (ORs) and 95%CIs were estimated. Single variable models were utilized in an exploratory analysis, and multivariable models were employed in the primary analysis, where any variable associated with choice of treatment at $P \leq 0.05$ in the single variable analysis was adjusted for in the multivariable analysis. Age at diagnosis, number of first-degree relatives with breast cancer, number of comorbidities, number of tumors, and tumor size were all considered as two-level or three-level categorical variables for easier interpretation of results in logistic regression analysis. A relatively large number of association tests were performed to evaluate associations with choice of treatment; to account for this and control the family-wise error rate at 5%, we utilized a Bonferroni adjustment for multiple testing, after which P values ≤ 0.0029 were considered statistically significant based on the 17 tests performed. Statistical analyses were performed using SAS (version 9.2; SAS Institute Inc., Cary, NC).

RESULTS

Median patient age in the cohort of 392 women was 65 (range 32–97) years, and median tumor size was 1.6 (range 0.1–7.8) cm. In general, we treat a high-risk medical population: 102 (26%) women had one significant medical comorbid condition, and an additional 116 (30%) women had two or more significant medical comorbidities. Furthermore, our population represents one at high risk for breast cancer: 107 (27%) women had at least one first-degree relative with a history of breast cancer, including 6 of 392 (2%) who had a documented BRCA mutation. These and other patient characteristics are listed in Table 1.

Preoperative imaging and tumor characteristics are listed in Table 2. Screening mammography detected the majority of cancers. All patients were offered preoperative breast MRI, but only 323 (82%) patients completed the examination, resulting in recommendations for additional workup or 6-month follow-up in 135 of 323 (42%). Additional biopsy of a suspicious lesion was performed in 83 of 323 (26%) of these patients, identifying additional cancer in 38 of 323 (12%) patients. The remaining 69 of 392 (18%) women did not have preoperative MRI for the following reasons: patient refused or deferred ($n = 40$), unable to tolerate examination ($n = 15$), contrast allergy or kidney disease with reduced GFR ($n = 8$), implantable pacemaker or bladder interstimulation device ($n = 6$). Women who did not have MRI were slightly older (median 68 vs. 62 years) but had a similar median tumor size (1.3 cm vs. 1.6 cm) and a similar number of medical comorbidities (median 1 vs. 1) compared to those who underwent preoperative MRI.

The surgical management of the entire population is detailed in Fig. 1. Of the 392 patients with a choice of treatment, 286 patients (73% [286/392]) chose BCT. The remaining 106 patients elected mastectomy (27%; 95%CI 23–32%) of which 13 (12%) had a history of contralateral mastectomy for the treatment of breast cancer and 6 (2%) had a known BRCA mutation at the time of cancer diagnosis. Of the 106 women who chose mastectomy, 55 (51.9%) patients had breast reconstruction. Of these, 54 patients pursued immediate reconstruction. One patient had delayed breast reconstruction. Bilateral mastectomy was performed in 45 women for bilateral cancer ($n = 1$) or because the patient elected contralateral prophylactic mastectomy (CPM $n = 44$). All six patients with a BRCA mutation underwent bilateral mastectomy for treatment of the index cancer and prophylaxis on the contralateral side.

An analysis of the associations of patient and tumor characteristics with choice of treatment is shown in Table 3. In single variable analysis, choice of mastectomy over BCT was more common in patients with previous mastectomy (OR 9.85; $P < 0.001$), in patients with no comorbidities (OR 3.55; $P < 0.001$), in patients whose cancer was detected by a method other than mammogram (OR 2.02; $P = 0.0028$), and in patients who had multiple tumors (OR 2.57; $P < 0.001$). Choice of mastectomy over BCT was more common in younger patients (age range 30–49 years; OR [vs. $\geq$ 70 years]: 0.38 OR [vs. 50–69 years]: 0.42, overall $P = 0.008$), although this was a nonsignificant trend after adjustment for multiple testing. Preoperative MRI resulting in a second-site biopsy confirming an additional multifocal cancer (<5 cm from the index cancer) significantly increased the likelihood of choosing mastectomy (OR 5.03; $P < 0.001$) even though the patient had disease confined to one quadrant of the breast. In contrast, patients were no more likely to choose mastectomy over BCT after MRI if biopsy was performed and negative for second cancer or if 6-month follow-up MRI was recommended (Table 3). Interestingly, if preoperative MRI was not performed patients also demonstrated an increased likelihood of choosing mastectomy (OR 3.09; $P < 0.001$). The latter finding regarding patients who did not undergo MRI ($N = 69$) was unexpected, and therefore we explored the characteristics of this patient group in Table 4. A number of differences between the 41 patients who chose BCT with no MRI and the 28 patients who

TABLE 1 Patient characteristics and medical history

Variable	Summary ($N = 392$)
Age at diagnosis (year)	65 (32–97)
<30	0 (0%)
30–49	59 (15%)
50–69	202 (52%)
≥70	131 (33%)
Race	
Caucasian	354 (90%)
African American	13 (3%)
Hispanic	19 (5%)
Asian	2 (1%)
Other	4 (1%)
Number of first-degree relatives with breast cancer	
0	283 (73%)
1	86 (22%)
≥2	21 (5%)
No. of other relatives with breast cancer	
0	260 (67%)
1	81 (21%)
≥2	49 (13%)
Personal history of breast cancer, no prior mastectomy	16 (4%)
Personal history of mastectomy	17 (4%)
Known BRCA mutations	6 (2%)
No. of comorbidities	1 (0–6)

The sample median (minimum–maximum) is given for numerical variables. Information was unavailable for the following variables: number of first-degree relatives with breast cancer ($n = 2$) and number of other relatives with breast cancer ($n = 2$)

TABLE 2 Summary of imaging and pathologic characteristics

Variable	Summary ($N = 392$)
Neoadjuvant chemotherapy	10 (3%)
Detection method	
Mammogram	261 (67%)
Palpation	108 (28%)
Other	23 (6%)
No. of tumors (>1)	63 (16%)
Dense breasts	248 (67%)
Tumor size (cm)	1.6 (0.1–7.8)
<2	245 (63%)
2–5	135 (34%)
>5	12 (3%)
Type of breast cancer	
Ductal carcinoma in situ	75 (19%)
Infiltrating ductal carcinoma	284 (72%)
Infiltrating lobular carcinoma	27 (7%)
Other	6 (2%)
Grade	
Noninvasive	73 (19%)
Grade 1	104 (27%)
Grade 2	114 (29%)
Grade 3	101 (26%)
Lymphovascular space invasion	43 (11%)
ER status (positive)	327 (85%)
Her2/neu status (positive)	45 (14%)
Ipsilateral MRI and biopsy findings	
MRI: No abnormalities detected	188 (48%)
Abnormal MRI, no biopsy performed	52 (13%)
Abnormal MRI, biopsy: no cancer	45 (11%)
Abnormal MRI, biopsy: cancer	38 (10%)
No MRI performed	69 (18%)

Information was unavailable for the following variables: breast density ($n = 20$) ER status ($n = 6$), and Her2/neu status ($n = 65$ all of which were cases of ductal carcinoma in situ)

elected mastectomy with no MRI are evident. For instance, those who elected BCT were older (median 71 vs. 60 years) and had more comorbidities (>0: 73% vs. 57%), whereas those women choosing mastectomy were more likely to have their tumor detected by ultrasound or palpation alone than by mammography (50% vs. 32%), had a higher rate of previous mastectomy (29% vs. 2%), or sought simultaneous contralateral prophylactic mastectomy (39% vs. 0%).

In multivariable analysis, only three variables remained independently associated with the choice of mastectomy over BCT. Choice of mastectomy was more common in patients with a history of mastectomy (OR 23.2; 95%CI 7.06–92.38; $P < 0.001$), in patients with no comorbidities (OR 5.41; 95%CI 3.08–9.83; $P < 0.001$), and was significantly associated with ipsilateral MRI and biopsy findings ($P = 0.0027$); choice of mastectomy was again more common in patients with preoperative MRI resulting in a second-site biopsy confirming an additional multifocal site of cancer (OR 4.25; 95%CI 1.68–10.92) and in women in whom no preoperative MRI was performed (OR 3.42; 95%CI 1.66–7.15).

DISCUSSION

Despite previously established NIH guidelines, 25% of women eligible for BCT are pursue mastectomy and the reasons for this are likely multifactorial.[15,21–23] We know very little about the specific group of women with newly diagnosed breast cancer who are candidates for BCT but who ultimately choose mastectomy. To our knowledge, there have been no prospective studies that have reported data regarding factors associated with selecting mastectomy when BCT is acceptable. As part of our ongoing

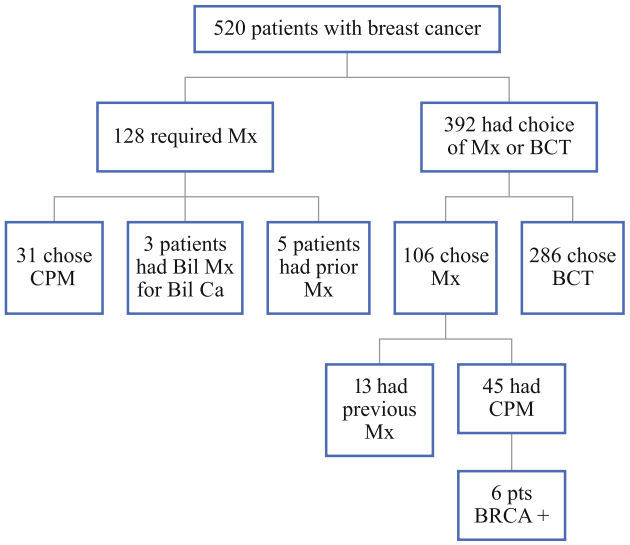

FIG. 1 Flowchart of 520 patients treated for new breast cancer. *Mx* mastectomy; *CPM* contralateral prophylactic mastectomy; *Bil* bilateral

breast cancer surgery database, we have prospectively documented which patients with breast cancer are candidates for BCT and which patients require mastectomy. Herein, we have used these data to identify potential factors to influence the decision to undergo mastectomy for breast cancer when a mastectomy is not required.

Our data suggest that the following strongly influence the decision for mastectomy in patients amenable to BCT: (1) personal history of mastectomy; (2) lack of significant comorbid conditions; and (3) preoperative MRI findings or lack of an MRI altogether. It is not surprising that patients with a personal history of mastectomy and a new diagnosis of breast cancer were significantly more likely to choose mastectomy over BCT ($P < 0.001$). The decision for mastectomy in these women may result from the anxiety produced by the diagnosis of a second breast cancer, which may evoke memories of their previous treatment. These women may seek mastectomy to limit their risk of local recurrence or to achieve cosmetic symmetry. Second, patients with major medical comorbidities more frequently chose BCT. Although breast surgery tends to be low risk, it is logical that more sickly patients favor less invasive surgery. BCT does not require general anesthesia and can be performed more quickly than mastectomy. Given that comorbidities tend to increase with age, this finding supports our previous data that older patients have higher rates of BCT compared with younger (presumably healthier) women.[17]

Previous data on the influence of MRI on mastectomy rates are not consistent as Katipamula et al. and Pettit et al. found that MRI increases mastectomy rates,[15,22] while Dang et al. and Carpenter et al. found no change in mastectomy rates with the use of MRI.[24,25] Our data add to these inconsistencies in the literature, because it demonstrates having an MRI resulting in a documented second site of cancer or not having an MRI at all influenced a patient's choice for mastectomy. Clearly patients who have an MRI that leads to a second-site biopsy and diagnosis of a second cancer chose mastectomy more frequently. This finding is consistent with many prior studies that document that MRI changes surgical plans favoring either more extensive excision or mastectomy and has long been the concern with routine MRI usage.[26] However, in the context of this study these second cancers represent MRI only detected multifocal tumors <5 cm from the index lesion, not multicentric lesions in a separate quadrant leaving them still eligible for BCT. Although these women chose mastectomy, we lack data suggesting that their outcome is improved by this more aggressive surgery.

Interestingly, our data also demonstrate that the small subset of women not having MRI were more likely to choose mastectomy. This was an unexpected finding and appears to be counterintuitive. However, given that we offered all women who were seen between July 2007 and June 2010 an MRI, those who did not have an MRI represented a very select group in our population. Furthermore, when analyzing the 28 women who did not have an MRI who chose mastectomy, we found that these women more commonly had previous mastectomy or desired simultaneous CPM. It is likely that many had already decided for mastectomy based on a variety of other preoperative factors making the use of MRI futile. The likely explanation for our seemingly contradictory findings is that a woman's decision to choose mastectomy is likely a multifactorial one influenced not only by imaging but also by personal opinion and prior experiences.

Although not approaching statistical significance, patient age should not be overlooked as a potential factor in surgical decision making in patients with breast cancer. We found that choice of mastectomy over BCT was approximately half as common in patients aged 50 years or older compared with younger patients. The trend observed in this cohort of patients is consistent with our previous study, which demonstrated that younger women tended toward mastectomy and older women toward breast conservation.[17] The factors most influential in younger women's decisions for mastectomy may be related to increased awareness of reconstruction options, secondary experience through a family member with breast cancer, emphasis on risk reduction, or avoidance of future breast surgery. Further study evaluating the affect of age on choice of mastectomy over BCT is warranted.

The desire for breast reconstruction also has been hypothesized to influence the decision toward mastectomy in patients with a choice of surgical treatment. Although this may be true in some cases, it is clearly not the sole

TABLE 3 Associations of patient and breast cancer characteristics with choice of mastectomy over breast conserving therapy

Variable	Single variable analysis		Multivariable analysis	
	OR (95%CI)	*P*	OR (95%CI)	*P*
Age at diagnosis (year)		0.008		0.12
30–49	1.00 (reference)		1.00 (reference)	
50–69	0.42 (0.23–0.77)		0.55 (0.27–1.11)	
≥70	0.38 (0.19–0.73)		0.46 (0.21–0.99)	
Race (Caucasian)	2.1 (0.91–5.71)	0.084	2.09 (0.79–6.35)	0.16
No. of first-degree relatives with breast cancer (≥1)	0.76 (0.45–1.26)	0.29	0.9 (0.49–1.63)	0.74
Personal history of breast cancer, no prior Mx	0.9 (0.25–2.64)	0.85	2.18 (0.55–7.36)	0.23
Personal history of mastectomy	9.85 (3.39–35.66)	<0.001	23.2 (7.06–92.38)	<0.001
No. of comorbidities (none)	3.55 (2.23–5.73)	<0.001	5.41 (3.08–9.83)	<0.001
Neoadjuvant chemotherapy	3.41 (0.63–63.28)	0.18	2.32 (0.39–44.25)	0.44
Detection method (non-mammogram)	2.02 (1.28–3.21)	0.0028	1.36 (0.76–2.41)	0.29
No. of tumors (>1)	2.57 (1.47–4.5)	0.001	1.5 (0.72–3.07)	0.28
Dense breasts	1.48 (0.9–2.51)	0.13	1.19 (0.65–2.23)	0.57
Tumor size (cm)		0.34		0.58
<2	1.00 (reference)		1.00 (reference)	
2–5	1.39 (0.87–2.22)		1.27 (0.72–2.22)	
>5	1.54 (0.4–5.08)		1.81 (0.37–7.77)	
Type of breast cancer		0.3		0.33
Infiltrating ductal carcinoma	1.00 (reference)		1.00 (reference)	
Infiltrating lobular carcinoma	1.92 (0.85–4.32)		2.17 (0.76–5.99)	
Ductal carcinoma in situ	1.01 (0.57–1.8)		1.05 (0.52–2.08)	
Grade		0.31		0.82
Noninvasive	1.00 (reference)		1.00 (reference)	
Grade 1	0.81 (0.4–1.63)		1.04 (0.46–2.34)	
Grade 2	1.02 (0.52–2.00)		0.88 (0.4–1.94)	
Grade 3	1.44 (0.75–2.84)		1.26 (0.55–2.93)	
Lymphovascular space invasion	2.66 (1.38–5.08)	0.0036	1.53 (0.67–3.42)	0.30
ER status (negative)	1.53 (0.83–2.75)	0.17	1.38 (0.68–2.74)	0.37
Her2/neu status (positive)	1.44 (0.73–2.77)	0.29	1.43 (0.63–3.17)	0.39
Ipsilateral MRI and biopsy findings		<0.001		0.0027
MRI: No abnormalities detected	1.00 (reference)		1.00 (reference)	
Abnormal MRI, no biopsy performed	1.67 (0.8–3.37)		1.83 (0.81–4.03)	
Abnormal MRI, biopsy: no cancer	1.29 (0.56–2.79)		1.27 (0.51–2.96)	
Abnormal MRI, biopsy: cancer	5.03 (2.41–10.62)		4.25 (1.68–10.92)	
No MRI performed	3.09 (1.68–5.69)		3.42 (1.66–7.15)	

Estimated odds ratios (ORs), 95% confidence intervals (CIs), and *P* values result from logistic regression models. Multivariable models were adjusted for all variables with $P \leq 0.05$ in single variable analysis (age at diagnosis, previous mastectomy, number of comorbidities, detection method, number of tumors, lymphovascular space invasion, and ipsilateral MRI and biopsy findings). After Bonferroni adjustment for multiple testing, $P \leq 0.0029$ was considered statistically significant. Odds ratios are interpreted as the multiplicative increase in the odds of choosing mastectomy corresponding to the given characteristic

driving factor in our population because only half (55/106, 51%) of the women who chose mastectomy had breast reconstruction. From our data, it is difficult to determine whether knowledge of reconstruction alone influenced a patient's choice of surgical treatment.

Our study has several important limitations. First, our analysis is based on a single institution and single surgical oncologist experience and may not accurately reflect patients in the general population. The limitation of a single-surgeon experience lies in the fact that both surgeon training and surgeon gender have been linked previously to the type of surgical procedure performed in patients with breast cancer. Not surprisingly, surgical oncologists tend to perform more BCT.[27] Data on surgeon gender and choice

TABLE 4 Characteristics of patients not having MRI

Variable	No MRI, chose Mx ($N = 28$)	No MRI, chose BCT ($N = 41$)
Age at diagnosis (year)	60 (34–87)	71 (40–97)
Race (Caucasian)	27 (96%)	40 (98%)
No. first-degree relatives with breast cancer ($\geq$1)	6 (21%)	12 (29%)
Personal history of breast cancer, no prior mastectomy	2 (7%)	1 (2%)
Personal history of mastectomy	8 (29%)	1 (2%)
No. of comorbidities (>0)	16 (57%)	30 (73%)
Neoadjuvant chemotherapy	0 (0%)	0 (0%)
Detection method (non-mammogram)	14 (50%)	13 (32%)
No. of tumors (>1)	5 (18%)	4 (10%)
Dense breasts	16 (70%)	15 (42%)
Tumor size	1.5 (0.1–6.0)	1.2 (0.1–4.0)
Type of breast cancer (infiltrating ductal carcinoma)	18 (64%)	25 (61%)
Grade ($\geq$2)	18 (64%)	20 (49%)
Lymphovascular space invasion	5 (18%)	4 (10%)
ER status (positive)	19 (73%)	37 (93%)
Her2/neu status (positive)	4 (15%)	1 (3%)
Chose contralateral prophylactic mastectomy	11 (39%)	0 (0%)

The sample median (minimum–maximum) is given for numerical variables. Information was unavailable for the following variables: breast density ($n = 10$), ER status ($n = 3$), and Her2/neu status ($n = 12$)

of surgery are mixed; however, as some suggest training and female gender is linked more closely to BCT, whereas others find female gender associated with very aggressive surgery, especially contralateral prophylactic mastectomy when undergoing ipsilateral mastectomy.[23,28] Although we acknowledge these specific limitations, the value of a single-surgeon experience should not be underestimated because the tumor-breast size ratio, ability to remove multifocal lesions successfully, and ultimate cosmetic results are frequently subjective determining factors for eligibility for BCT especially in T2 tumors. True patient eligibility for BCT based on these variables may be difficult to assess retrospectively or standardize such subjective assessments across different surgeons. Additionally, Hawley et al. report that greater patient involvement as opposed to shared or surgeon-directed decision-making processes resulted in higher rates of mastectomy across all races and ethnicities.[19] Degree of patient involvement could not be standardized amongst multiple surgeons either. A single-surgeon experience controls for these more subjective variables.

Second, as a tertiary referral center we treat women at high risk for breast cancer, which may sway patient decision making toward mastectomy. It also is not surprising that the minority of patients with a known BRCA mutation and an index cancer chose mastectomy with contralateral prophylactic mastectomy. Third, the majority of our patients present to our institution already having had an MRI or are offered one before surgical consultation. The data from the preoperative MRI may bias a woman's surgical decision, especially if the MRI results in recommendations for additional imaging or biopsy. The psychological impact of additional suspicious lesions on MRI and the need for additional workup before definitive surgery may impact a woman's perception and therefore her decision-making process. Fourth, although our sample size of 392 women was not diminutive, we must still acknowledge the possibility of type II error. We cannot conclude that a true association with treatment choice does not exist for a given variable simply because a significant association was not identified in this study. Finally, whereas all patients were prospectively determined to be candidates for BCT or mastectomy, the true motivations for patients' choosing one therapy over another, including the hardships associated with radiation therapy treatments, were not documented. It is important to acknowledge that all aspects of radiation care are offered at our institution, including accelerated partial breast and hypofractionated regimens. In an attempt to limit these potential hardships, the radiation oncologist discusses these options with all patients before surgery.

In conclusion, approximately 25% of patients amenable to BCT choose mastectomy. Our data suggest that the decision for mastectomy in patients with breast cancer amenable to BCT is not entirely influenced by clinicopathologic characteristics or standard prognostic factors. Preoperative MRI may play a role but does not appear to be the sole contributing factor in the decision for mastectomy.

Additional prospective studies are required to evaluate further other potential influential factors in a woman's decision-making process to choose mastectomy, such as the desire to avoid radiation therapy, patient anxiety, and previous patient experiences with other family members or friends and their breast cancer diagnosis and treatment. We also believe that investigation into other internal patient features, such as socioeconomic status, education level, and patient personality, is warranted, because these could be significant contributing factors to the patient's decision-making process. Improving our understanding of the characteristics associated with selecting mastectomy over BCT (when BCT is acceptable) will help to advance our ability to appropriately counsel patients with newly diagnosed breast cancer and ultimately continue to improve long-term patient satisfaction.

DISCLOSURES The authors report no conflicts of interest and this manuscript is not under consideration for publication elsewhere.

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