

Risk-to-Benefit Relationship of Contralateral Prophylactic Mastectomy: The Argument for Bilateral Mastectomies with Immediate Reconstruction

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Background: The increasing trend of women with unilateral breast cancer to electively undergo contralateral prophylactic mastectomy in addition to treatment of the index breast has been controversial. The authors set out to better frame the risks and benefits of contralateral prophylactic mastectomy in the treatment of unilateral breast cancer by evaluating outcomes of a large, consecutive cohort of patients.

Methods: An institutional review board–approved review of a single-surgeon (N.T.) experience (2013 to 2018) was conducted of all consecutive patients with unilateral breast cancer treated with mastectomy and immediate reconstruction. Patient characteristics, surgical pathologic results, and 30-day complications were assessed. Outcomes of patients with unilateral cancer who underwent unilateral mastectomy versus bilateral mastectomy (with one breast being contralateral prophylactic mastectomy) were compared. Logistic regression models evaluated various risk factors for potential associations with positive pathologic findings in the contralateral prophylactic mastectomy specimen and/or postoperative complications.

Results: Of 244 patients, 68 (27.9 percent) underwent unilateral mastectomy and 176 (72.1 percent) underwent contralateral prophylactic mastectomy. Surgical pathologic results of the prophylactic breast revealed occult ductal carcinoma in situ or invasive cancer in 13 patients (7.3 percent) and lobular carcinoma in situ in eight patients (4.6 percent). Incidence of complications was similar between groups [unilateral mastectomy, 19.12 percent ($n = 13$); contralateral prophylactic mastectomy, 13.07 percent ($n = 23$); $p = 0.234$].

Conclusions: Immediate reconstruction for unilateral mastectomy and contralateral prophylactic mastectomy have similar complication risk profiles, among patients as a whole and between individual breasts. These findings contribute to our understanding of the clinical impact prophylactic mastectomy and reconstruction may have on optimizing the counseling among extirpative surgeons, reconstructive surgeons, and patients. (*Plast. Reconstr. Surg.* 144: 1, 2019.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

The use of contralateral prophylactic mastectomy in the treatment of unilateral breast cancer has become increasingly common in recent years.^{1,2} Among all women undergoing mastectomy for unilateral breast cancer, the

rate of contralateral prophylactic mastectomy has increased from approximately 5 percent to 20 percent since 1998.^{3–5} Despite this rise in popularity, contralateral prophylactic mastectomy remains controversial.^{6–8}

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Breast cancer patients are at an increased risk of developing a second primary cancer in the contralateral breast, with estimates of annual incidence ranging from 0.5 to 1 percent.^{9–15} Contralateral prophylactic mastectomy may therefore provide an oncologic benefit for some patients, especially those at particularly high risk of recurrence, including patients with a *BRCA1/BRCA2* gene mutation or a family history of breast cancer.^{16–19} Studies have identified fear of recurrence as the primary motivation for patients choosing to undergo contralateral prophylactic mastectomy.^{20,21} Patients cite relief of worry and decreased need for long-term surveillance as significant benefits of contralateral prophylactic mastectomy that ultimately improve their postoperative quality of life.²⁰ Moreover, contralateral prophylactic mastectomy may be less costly than lifetime surveillance of the contralateral breast.^{22,23} Contralateral prophylactic mastectomy may also provide an aesthetic advantage, as a desire for symmetry is commonly reported as a motivation for undergoing contralateral prophylactic mastectomy.²⁰ Access to immediate breast reconstruction increases this desire to achieve symmetry (especially among those undergoing implant-based reconstruction) and is strongly associated with an increased likelihood of choosing contralateral prophylactic mastectomy.^{9,24} All of these factors also correlate with published data suggesting that those patients belonging to a higher sociodemographic status tend to choose contralateral prophylactic mastectomy and immediate breast reconstruction at higher rates.

Despite the potential benefits, the overall merits of contralateral prophylactic mastectomy remain debatable. Many critics believe the rise in contralateral prophylactic mastectomy has resulted in the overtreatment of many patients.²⁵ Recent studies have concluded that for most breast cancer patients, the increase in long-term survival after contralateral prophylactic mastectomy is minimal at best.^{26–31} Patients who undergo contralateral prophylactic mastectomy for unilateral cancer also assume at least one additional, otherwise potentially avoidable, surgical site that is susceptible to complications.¹⁶ Some studies have concluded that contralateral prophylactic mastectomy causes significantly increased morbidity compared with unilateral treatment.^{8,32–34} As the probability of finding an occult malignancy in the prophylactic breast at the time of mastectomy is relatively low (roughly 1 to 2 percent),^{9,35,36} many surgeons find it difficult to justify contralateral prophylactic mastectomy, given the increased

risk of complications. In addition, despite a reduction in long-term surveillance costs, patients with unilateral cancer who undergo contralateral prophylactic mastectomy have been found to incur higher short-term health care costs.^{37–39}

Conflicting evidence and lack of consensus complicate the debate surrounding the use of contralateral prophylactic mastectomy. Because there are no absolute indications established for contralateral prophylactic mastectomy, physicians must have an in-depth and personalized discussion with each of their patients, carefully reviewing the advantages and disadvantages of contralateral prophylactic mastectomy versus unilateral treatment. As such, it is critical to provide physicians and patients with any information that may aid in this decision-making process. The purpose of this study was to better characterize the outcomes of contralateral prophylactic mastectomy, including complications and surgical pathologic findings, by conducting a review of a large cohort of single-surgeon patients.

PATIENTS AND METHODS

An institutional review board–approved (Northwell Health Institutional Review Board) review of a single surgeon’s experience (N.T.) was conducted of all consecutive patients with unilateral breast cancer who underwent mastectomy and immediate reconstruction between April of 2013 and September of 2018. Patients who underwent both implant-based and autologous reconstruction were included. Exclusion criteria, for final statistical analysis, consisted of any patients who underwent bilateral prophylactic mastectomies (including those with genetic predisposition such as *BRCA*), bilateral mastectomies for bilateral disease, and/or delayed reconstruction. Patients were categorized according to unilateral mastectomy and reconstruction or bilateral mastectomy and reconstruction (i.e., one breast was a contralateral prophylactic mastectomy breast). The data were collected and stored through RED-Cap (Research Electronic Data Capture; Vanderbilt University, Nashville, Tenn.).

Electronic medical records were used to collect data on patient demographics, medical history, surgical history, and intraoperative course. Thirty-day postoperative complications were also recorded, including medical complications requiring readmission to the hospital and surgical complications requiring a return to the operating room. Complications included any instances of venous thromboembolism, pneumothorax, cellulitis, abscess,

and anemia requiring transfusions. Other analyzed complications included arterial insufficiency, venous congestion, hematoma, prosthesis removal, flap necrosis, and poor wound healing. Pathology reports were used to identify whether an occult malignancy or lobular carcinoma in situ was found in the prophylactic breast of patients who underwent contralateral prophylactic mastectomy.

Statistical Analysis

Using the data collected from this study review, multiple statistical analyses were performed. Descriptive statistics were calculated to summarize and compare patient characteristics between the unilateral mastectomy and contralateral prophylactic mastectomy groups. As appropriate, Fisher's exact or chi-square tests were used to determine significant differences in any categorical variables between groups; unpaired two-sided *t* tests or Mann-Whitney tests were used for continuous variables. Univariable analyses were performed to examine the association between patient characteristics and the development of postoperative complications or the presence an occult lesion in the contralateral prophylactic mastectomy breast. Those factors that were individually significantly associated with complications or occult lesions were then included in multivariable logistic regression models, along with the specific group comparison of interest (i.e., unilateral mastectomy versus contralateral prophylactic mastectomy), to examine their joint effects. A backward selection algorithm was then used to eliminate factors that did not contribute significantly to the models. The McNemar test was used to determine whether there was a significant difference in the development of complications between the index cancer breast and the contralateral prophylactic mastectomy breast (i.e., nominal paired data). The Cochran-Armitage exact test for trend was used to determine whether there was a statistically significant trend in the temporal pattern of complication rates throughout the duration of the study period (2013 to 2018). For all tests, values of $p < 0.05$ were considered statistically significant. All analyses were performed using SAS Version 9.4 (SAS Institute, Inc., Cary, N.C.).

RESULTS

Patient Characteristics

A total of 244 patients with unilateral breast cancer were identified, 68 (27.9 percent) of whom underwent unilateral mastectomy and 176 (72.1 percent) of whom underwent contralateral

prophylactic mastectomy. Of the 244 patients, 146 (59.8 percent) underwent autologous flap-based reconstruction and 98 (40.2 percent) underwent implant-based reconstruction. Patients who underwent unilateral mastectomy were significantly older than patients who underwent contralateral prophylactic mastectomy (unilateral mastectomy, 55.9 ± 9.4 years; contralateral prophylactic mastectomy, 52.4 ± 8.4 years; $p = 0.013$). All other demographic and clinical characteristics were similar between groups (Table 1). Patients with bilateral disease or those undergoing bilateral prophylactic mastectomies for genetic or familial reasons were excluded.

Surgical Pathology Results

Of the 176 patients who underwent contralateral prophylactic mastectomy, 13 individuals (7.4 percent) had an occult ductal carcinoma in situ or invasive cancer identified on pathologic examination of the prophylactic breast. Previously undiagnosed lobular carcinoma in situ was identified in eight subjects (4.6 percent). Univariable analyses were performed to examine several potential risk factors for an association with finding ductal carcinoma in situ/invasive carcinoma or lobular carcinoma in situ in the contralateral prophylactic mastectomy breast, including tobacco use, alcohol use, *BRCA* gene mutation, history of radiotherapy, and history of cancer. Ultimately, none of the variables tested were significantly predictive of an occult lesion.

Postoperative Complications

All potential complications were recorded, analyzed, and included. Complications requiring a return to the operating room were analyzed separately from those not requiring a return to the operating room. Overall, the number of patients who developed at least one complication was statistically similar between the UM and CPM groups (19.12% versus 13.07%; $p = 0.234$; Table 2). Statistical analysis revealed that there was no significant difference in the occurrence of 30-day postoperative complications that required readmission to the hospital but did not require a return to the operating room, between the unilateral mastectomy and contralateral prophylactic mastectomy groups [unilateral mastectomy, 4.41% ($n = 3$); contralateral prophylactic mastectomy, 5.68% ($n = 10$); $p < 1.00$]. Patients who developed a complication were significantly more likely to have a history of dyslipidemia (46.2 percent versus 19.1 percent; $p = 0.03$) and had significantly higher body mass indexes (34.5 ± 6.8 kg/m² versus 29.0 ± 5.5 kg/m²; $p = 0.01$). No other clinical characteristics were

Table 1. Summary of Demographic and Clinical Characteristics for Unilateral Mastectomy and Contralateral Prophylactic Mastectomy Patient Groups

Characteristic	UM (%)	CPM (%)	<i>p</i>
Age, yr	55.93 ± 9.4	52.44 ± 8.4	0.013
BMI, kg/m ²	29.92 ± 5.3	29.01 ± 5.9	0.190
Obese (BMI >30 kg/m ²)	28 (42.42)	72 (40.91)	0.884
Type of reconstruction			0.885
Flap	40 (58.82)	106 (60.23)	
Implant	28 (41.18)	70 (29.77)	
Diabetes mellitus	8 (11.76)	19 (10.80)	0.822
Hypertension	29 (42.65)	59 (33.52)	0.185
Dyslipidemia	16 (23.53)	34 (19.32)	0.482
History of DVT/PE	1 (1.47)	0 (0)	0.280
Tobacco use*	22 (32.35)	47 (26.70)	0.429
Alcohol use	24 (35.29)	85 (48.57)	0.064
Mutation†			
History of radiotherapy‡	5 (7.35%)	23 (13.07)	0.266
History of cancer§	14 (20.59)	35 (19.89)	NS
History of breast cancer	12 (17.65)	33 (18.75)	NS

UM, unilateral mastectomy; CPM, contralateral prophylactic mastectomy; BMI, body mass index; DVT, deep vein thrombosis; PE, pulmonary embolism; NS, not significant.

*Current or former use.

†Any gene mutation associated with an increased risk of breast cancer, including but not limited to *BRCA1* and *BRCA2*.

‡Previous radiation therapy to any location.

§Personal history of cancer (any form), excluding the patient's most recent breast cancer diagnosis.

found to be predictive of complications not requiring a return to the operating room. Using multi-variable logistic regression, body mass index was again shown to be significantly associated with the development of such a complication (OR, 1.2; 95 percent CI, 1.1 to 1.3; *p* = 0.003) (Table 3). For every 1-unit increase in body mass index, the odds of having any medical complication was increased by 15 percent; for every 10-unit increase, these odds increased by 408 percent.

Similarly, there was no significant difference in the occurrence of 30-day postoperative complications that required a return to the operating room between the unilateral mastectomy and contralateral prophylactic mastectomy groups (unilateral mastectomy, 16.2 percent; contralateral prophylactic mastectomy, 8.5 percent; *p* = 0.104). Univariable analyses revealed that patients who developed such a complication were significantly more likely to have diabetes (30.8 percent versus 8.7 percent; *p* = 0.003), have received intraoperative blood products (38.5 percent versus 5.5 percent; *p* < 0.001), and have undergone autologous flap reconstruction (80.8 percent versus 57.3 percent; *p* = 0.02) (Table 4). Multivariable regression analysis showed that diabetes (OR, 4.1; 95 percent CI, 1.4 to 11.9; *p* = 0.01), receiving blood products (OR, 11.3; 95 percent CI, 3.9 to 32.7; *p* = 0.0001), and undergoing unilateral mastectomy (OR, 0.4; 95 percent CI, 0.1 to 1.0; *p* = 0.04) were significantly associated with the development of a complication requiring a return to the operating room.

Table 2. All Complication Rates for Unilateral Mastectomy and Contralateral Prophylactic Mastectomy Patients

	UM	CPM	<i>p</i>
Total no. of patients	68	176	
Patients with at least one complication	19.12% (13)	13.07% (23)	0.234
DVT/PE	1.47% (1)	2.27% (4)	
Breast cellulitis	1.47% (1)	2.84% (5)	
Abdominal cellulitis	0% (0)	2.27% (4)	
Breast abscess	2.94% (2)	0.57% (1)	
Abdominal abscess	0% (0)	0% (0)	
Anemia requiring blood transfusion	0% (0)	1.14% (2)	
Pneumothorax	0% (0)	0.57% (1)	
Flap loss	1.47% (1)	0.57% (1)	
Breast hematoma	8.82% (6)	3.98% (7)	
Abdominal hematoma	0% (0)	0.57% (1)	
Tissue necrosis/poor wound healing	2.94% (2)	1.70% (3)	
Removal of tissue expander	0% (0)	0.57% (1)	

UM, unilateral mastectomy; CPM, contralateral prophylactic mastectomy; DVT, deep vein thrombosis; PE, pulmonary embolism.

Among those who underwent contralateral prophylactic mastectomy, complication rates were found to be similar between the index and the prophylactic breasts. Of all medical complications that could be attributable to a single breast (i.e., breast cellulitis or breast abscess), 1.1 percent occurred in the index breast and 1.7 percent occurred in the prophylactic breast (*p* = 0.6). Among surgical complications, 5.7 percent occurred in the index breast and 4.6 percent occurred in the prophylactic breast (*p* = 0.4).

Table 3. Multivariable Logistic Regression for Factors Associated with the Development of at Least One Complication Not Requiring a Return to the Operating Room

Characteristic	<i>p</i>	OR	95% CI
BMI	0.003	1.151	1.049–1.263
Procedure (UM vs. CPM)	0.361	2.020	0.432–9.981

BMI, body mass index; UM, unilateral mastectomy; CPM, contralateral prophylactic mastectomy.

Table 4. Multivariable Logistic Regression for Factors Associated with the Development of at Least One Complication Requiring a Return to the Operating Room

Characteristic	<i>p</i>	OR	95% CI
Diabetes mellitus	0.011	4.053	1.379–32.707
Received intraoperative blood products	<0.001	11.290	3.897–32.707
Procedure (UM vs. CPM)	0.043	0.377	0.147–0.970

UM, unilateral mastectomy; CPM, contralateral prophylactic mastectomy.

Patterns of complication rates over time were analyzed to determine whether there was a statistically significant trend over the course of the study period (April of 2013 through September of 2018). Among both the unilateral mastectomy and contralateral prophylactic mastectomy patients, there was no significant trend over time with respect to medical or surgical complications (Table 5).

DISCUSSION

The increasing trend of patients with unilateral breast cancer undergoing contralateral prophylactic mastectomy demands our continuous evaluation of the risk-to-benefit balance of this treatment option. The choice to undergo bilateral mastectomy is controversial, with distinct advantages and limitations. Among the subjects included in this study, a previously unidentified invasive neoplasm or lobular carcinoma in situ was found in the contralateral prophylactic mastectomy breast of 7.4 percent and 4.6 percent of patients, respectively. Furthermore, it was determined that there was no statistically significant difference in the development of complications between patients who chose to undergo unilateral mastectomy versus contralateral prophylactic mastectomy. These are important findings that may add to the current fund of knowledge regarding the safety and efficacy of contralateral prophylactic mastectomy.

Table 5. Temporal Patterns of Complications*

Year	Complications		
	UM (%)	CPM (%)	All Patients (%)
2013	3 (33.33)	0 (0)	3 (21.43)
2014	0 (0)	3 (15.00)	3 (8.57)
2015	5 (29.41)	6 (12.77)	11 (30.56)
2016	4 (30.77)	6 (12.77)	10 (16.67)
2017	1 (7.69)	8 (15.09)	9 (13.43)
2018	0 (0)	0 (0)	0 (0)
<i>p</i> †	0.732	0.847	0.771

UM, unilateral mastectomy; CPM, contralateral prophylactic mastectomy.

*Presented as the no. (%) of patients with at least one medical or surgical complication.

†Calculated using the Cochran-Armitage trend test.

Various factors have been shown to influence a woman’s decision to undergo contralateral prophylactic mastectomy. Perhaps the most notable advantage of contralateral prophylactic mastectomy is the peace of mind it can afford patients with unilateral breast cancer. Multiple, large studies have demonstrated that fear of recurrence either in the index breast or in the prophylactic breast is one of the principal driving factors for women to electively undergo contralateral prophylactic mastectomy.⁹ Agarwal et al. found that the desire for breast symmetry is another factor associated with patients who choose to pursue contralateral prophylactic mastectomy with bilateral reconstruction,²⁴ along with a family history of breast cancer, recurrence in the index breast, and preoperative magnetic resonance imaging testing.^{9,40–42} Finally, studies have shown that those patients interested in immediate reconstruction are more likely to undergo contralateral prophylactic mastectomy in the hopes of achieving greater symmetry.⁹

The Society of Surgical Oncology has published criteria for considering the use of contralateral prophylactic mastectomy, listing reconstructive issues, such as symmetry and/or balance as a consideration.⁴³ Geiger et al. reported that patients who underwent contralateral prophylactic mastectomy were more likely to undergo breast reconstruction than patients who did not undergo contralateral prophylactic mastectomy,⁴⁴ whereas others have reported that use of reconstructive surgery was the strongest factor associated with patients undergoing contralateral prophylactic mastectomy on multivariable analysis.⁹ Not only is symmetry a driving factor, especially with implant-based reconstruction, but so too is the single-opportunity ability to undergo autologous tissue transfer.

Removal of occult neoplastic tissue in the contralateral prophylactic breast is another important

yet infrequently discussed potential benefit of contralateral prophylactic mastectomy. The rates of occult neoplasm in the prophylactic breast are usually reported at 1 to 2 percent, with some studies finding rates as high as 7 percent.⁴⁵ In a 2010 study of 2504 women with breast cancer, 1223 had mastectomies and 284 had delayed or immediate contralateral prophylactic mastectomy. Only eight of those 284 (2.8 percent) had occult neoplasm, and 50 of 284 (17.6 percent) had atypical ductal hyperplasia, atypical lobular hyperplasia, or lobular carcinoma in situ.⁹ Our study revealed that of the 176 consecutive patients who had contralateral prophylactic mastectomy, 7.4 percent had occult neoplasms (ductal carcinoma in situ, invasive lobular or ductal carcinoma) in the prophylactic breast, whereas another 4.6 percent had lobular carcinoma in situ. Such rates, even within the national average findings, support an oncologic benefit to contralateral prophylactic mastectomy. It should be noted that none of the patients who had diagnostic imaging before surgery had findings concerning for abnormalities in the prophylactic breast.

Using univariable analysis, none of the potential risk factors recorded in this study were found to be significantly predictive of finding an occult neoplasm or lobular carcinoma in situ in the contralateral prophylactic mastectomy breast. Some of the risk factors evaluated include those that may be traditionally associated with an increased risk of contralateral breast cancer, such as history of tobacco use, positive *BRCA* gene status, and previous history of breast cancer. Because none of these risk factors were found to be predictive of occult contralateral malignancy, the oncologic value of contralateral prophylactic mastectomy is underscored even in patients who do not fit the traditional profile of those who would otherwise stand to benefit from contralateral prophylactic mastectomy because of an already increased risk of developing a contralateral cancer. Patients of higher sociodemographic status tend to choose contralateral prophylactic mastectomy with immediate breast reconstruction. This—coupled with the fact that our institution is located in the geographic region with the largest percentage of patients seeking contralateral prophylactic mastectomy and immediate breast reconstruction—means that we are uniquely situated to analyze a large patient population undergoing said procedures. However, these are merely speculative reasons for our seeing a higher number of occult malignancies in contralateral prophylactic mastectomy specimens and do not necessarily connote a cause-and-effect relationship.

Despite the known benefits of contralateral prophylactic mastectomy, the potential disadvantages have made many providers skeptical of its use. However, the drawbacks of contralateral prophylactic mastectomy have been poorly reported in the existing literature. To date, only a handful of studies have concluded that contralateral prophylactic mastectomy results in an increased risk of postoperative complications compared with unilateral mastectomy for patients with unilateral breast cancer. In 2011, Crosby et al. found an equivalent risk of complications after mastectomy and immediate reconstruction in the index breast versus the prophylactic breast.¹⁶ They also concluded that among the contralateral prophylactic mastectomy patients who developed postoperative complications, nearly one-third may have avoided these complications by undergoing unilateral mastectomy only.¹⁶ Furthermore, patients who have undergone contralateral prophylactic mastectomy and experience reconstructive complications report lower satisfaction scores than those who choose only unilateral mastectomy and immediate reconstruction.⁴⁶

Similar to Crosby et al., our results indicate a similar rate of complications between the index and prophylactic breasts among patients undergoing contralateral prophylactic mastectomy. Logically, this would imply that by operating on two breasts instead of only one, contralateral prophylactic mastectomy is twice as risky as unilateral mastectomy. However, the data presented herein showed no significant difference in complication rates between unilateral mastectomy and contralateral prophylactic mastectomy patients. This suggests that undergoing mastectomy and reconstruction of the prophylactic breast in addition to the index breast does not necessarily result in a clinically significant increase in postoperative complications. Furthermore, this supports the idea that contralateral prophylactic mastectomy is a safe, reliable option for women with unilateral breast cancer.

Obesity and diabetes mellitus have been identified as independent variable risk factors for increased complications (both those that require a return to the operating room and those that do not) with all forms of breast reconstruction.^{47–52} This is consistent with previous outcomes articles regarding breast reconstruction. In addition, patients who required perioperative blood transfusions were more likely to develop a postoperative complication requiring return to the operating room. This study did intend to shed light on those patient factors that may place individuals at increased risk of poor surgical outcomes when undergoing either unilateral or bilateral breast reconstruction.

This study is not without limitations. This was a single-surgeon, single-institution study, with a relatively large number of subjects for a single surgeon, but overall a relatively underpowered study. Furthermore, the retrospective nature of the study lends itself to bias and significant difficulty in capturing actual historical events from chart notes written by various individuals over time (e.g., physician assistant versus surgeon versus scribe). An additional weakness of our study is the lack of patient-reported outcomes/satisfaction. These data were not pursued because a significant amount of literature and study (i.e., BREAST-Q) has been dedicated to this subject previously. Future studies conducted at multiple institutions and with an even larger number of participants would have greater power and provide more generalizable results. However, because these results were achievable by a single surgeon in his first 10 years in practice, this underscores the possibility for these procedures to be performed safely in all patients. A Cochran-Armitage test showed no significant trend in complication rates during the study period, which addresses the possibility that increased surgical experience over time might mask a higher complication rate at the beginning of the study period. The level of evidence provided by this study is also limited by its retrospective nature. Moreover, selection bias was minimized by the consecutive nature of the patients included. Randomized controlled studies in the future would be useful, but are inherently difficult to conduct because of logistic and ethical issues.

As more patients choose contralateral prophylactic mastectomy, risks and benefits need to be clearly delineated. This will not only help patients make the most informed decisions, but also guide the reconstructive surgeon. The findings presented in this study provide an updated perspective on the oncologic benefits and safety of contralateral prophylactic mastectomy in patients with unilateral breast cancer. Ultimately, the authors hope to use this knowledge to advise patients who wish to undergo contralateral prophylactic mastectomy that doing so would not incur an increased risk of complications compared with unilateral treatment. Finally, contralateral prophylactic mastectomy may in fact provide an oncologic benefit in a greater proportion of the breast cancer patient population than previous studies have estimated.

CONCLUSIONS

Among women with unilateral breast cancer who underwent contralateral prophylactic

mastectomy, an occult malignancy or lobular carcinoma in situ was identified in the prophylactic breast of 7.4 percent and 4.6 percent of patients, respectively. None of the potential risk factors examined, including *BRCA* gene status or personal history of breast cancer, were significantly predictive of an occult lesion in the contralateral prophylactic mastectomy breast. Among contralateral prophylactic mastectomy patients, postoperative complication rates were similar in the index and prophylactic breasts. Somewhat surprisingly, however, patients who underwent contralateral prophylactic mastectomy did not have an increased rate of overall complications compared with those who underwent only unilateral mastectomy. Ultimately, the authors hope the findings of this study will contribute to understanding the clinical impact of prophylactic mastectomy and immediate reconstruction and the controversial topic of contralateral prophylactic mastectomy.

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REFERENCES

1. Stucky CC, Gray RJ, Wasif N, Dueck AC, Pockaj BA. Increase in contralateral prophylactic mastectomy: Echoes of a bygone era? Surgical trends for unilateral breast cancer. *Ann Surg Oncol*. 2010;17(Suppl 3):330–337.
2. Habermann EB, Abbott A, Parsons HM, Virnig BA, Al-Refaie WB, Tuttle TM. Are mastectomy rates really increasing in the United States? *J Clin Oncol*. 2010;28:3437–3441.
3. Jagsi R, Hawley ST, Griffith KA, et al. Contralateral prophylactic mastectomy decisions in a population-based sample of patients with early-stage breast cancer. *JAMA Surg*. 2017;152:274–282.
4. Katz SJ, Hawley ST, Hamilton AS, et al. Surgeon influence on variation in receipt of contralateral prophylactic mastectomy for women with breast cancer. *JAMA Surg*. 2018;153:29–36.
5. Tuttle TM, Habermann EB, Grund EH, Morris TJ, Virnig BA. Increasing use of contralateral prophylactic mastectomy for breast cancer patients: A trend toward more aggressive surgical treatment. *J Clin Oncol*. 2007;25:5203–5209.

6. Hawley ST, Jagsi R, Morrow M, et al. Social and clinical determinants of contralateral prophylactic mastectomy. *JAMA Surg*. 2014;149:582–589.
7. Ceval Y, Alborno CR, Disa JJ, et al. A paradigm shift in U.S. breast reconstruction: Part 2. The influence of changing mastectomy patterns on reconstructive rate and method. *Plast Reconstr Surg*. 2013;131:320e–326e.
8. Osman F, Saleh F, Jackson TD, Corrigan MA, Cil T. Increased postoperative complications in bilateral mastectomy patients compared to unilateral mastectomy: An analysis of the NSQIP database. *Ann Surg Oncol*. 2013;20:3212–3217.
9. Yi M, Hunt KK, Arun BK, et al. Factors affecting the decision of breast cancer patients to undergo contralateral prophylactic mastectomy. *Cancer Prev Res (Phila.)* 2010;3:1026–1034.
10. Hislop TG, Elwood JM, Coldman AJ, Spinelli JJ, Worth AJ, Ellison LG. Second primary cancers of the breast: Incidence and risk factors. *Br J Cancer* 1984;49:79–85.
11. Yeatman TJ, Lyman GH, Smith SK, Reintgen DS, Cantor AB, Cox CE. Bilaterality and recurrence rates for lobular breast cancer: Considerations for treatment. *Ann Surg Oncol*. 1997;4:198–202.
12. McDonnell SK, Schaid DJ, Myers JL, et al. Efficacy of contralateral prophylactic mastectomy in women with a personal and family history of breast cancer. *J Clin Oncol*. 2001;19:3938–3943.
13. Chaudary MA, Millis RR, Hoskins EO, et al. Bilateral primary breast cancer: A prospective study of disease incidence. *Br J Surg*. 1984;71:711–714.
14. Schell SR, Montague ED, Spanos WJ Jr, Tapley ND, Fletcher GH, Oswald MJ. Bilateral breast cancer in patients with initial stage I and II disease. *Cancer* 1982;50:1191–1194.
15. Herrinton LJ, Barlow WE, Yu O, et al. Efficacy of prophylactic mastectomy in women with unilateral breast cancer: A cancer research network project. *J Clin Oncol*. 2005;23:4275–4286.
16. Crosby MA, Garvey PB, Selber JC, et al. Reconstructive outcomes in patients undergoing contralateral prophylactic mastectomy. *Plast Reconstr Surg*. 2011;128:1025–1033.
17. Garcia-Etienne CA, Barile M, Gentilini OD, et al. Breast-conserving surgery in *BRCA1/2* mutation carriers: Are we approaching an answer? *Ann Surg Oncol*. 2009;16:3380–3387.
18. Trainer AH, Lewis CR, Tucker K, Meiser B, Friedlander M, Ward RL. The role of *BRCA* mutation testing in determining breast cancer therapy. *Nat Rev Clin Oncol*. 2010;7:708–717.
19. Graeser MK, Engel C, Rhiem K, et al. Contralateral breast cancer risk in *BRCA1* and *BRCA2* mutation carriers. *J Clin Oncol*. 2009;27:5887–5892.
20. Buchanan PJ, Abdulghani M, Waljee JF, et al. An analysis of the decisions made for contralateral prophylactic mastectomy and breast reconstruction. *Plast Reconstr Surg*. 2016;138:29–40.
21. Rosenberg SM, Tracy MS, Meyer ME, et al. Perceptions, knowledge, and satisfaction with contralateral prophylactic mastectomy among young women with breast cancer: A cross-sectional survey. *Ann Intern Med*. 2013;159:373–381.
22. Mattos D, Gréer L, Reish RG, et al. Lifetime costs of prophylactic mastectomies and reconstruction versus surveillance. *Plast Reconstr Surg*. 2015;136:730e–740e.
23. Zendejas B, Moriarty JP, O’Byrne J, Degnim AC, Farley DR, Boughey JC. Cost-effectiveness of contralateral prophylactic mastectomy versus routine surveillance in patients with unilateral breast cancer. *J Clin Oncol*. 2011;29:2993–3000.
24. Agarwal S, Kidwell KM, Kraft CT, et al. Defining the relationship between patient decisions to undergo breast reconstruction and contralateral prophylactic mastectomy. *Plast Reconstr Surg*. 2015;135:661–670.
25. Katz SJ, Morrow M. Contralateral prophylactic mastectomy for breast cancer: Addressing peace of mind. *JAMA* 2013;310:793–794.
26. Portschy PR, Kuntz KM, Tuttle TM. Survival outcomes after contralateral prophylactic mastectomy: A decision analysis. *J Natl Cancer Inst*. 2014;106:pil: dju160.
27. Pesce C, Liederbach E, Wang C, Lapin B, Winchester DJ, Yao K. Contralateral prophylactic mastectomy provides no survival benefit in young women with estrogen receptor-negative breast cancer. *Ann Surg Oncol*. 2014;21:3231–3239.
28. Yao K, Sisco M, Bedrosian I. Contralateral prophylactic mastectomy: Current perspectives. *Int J Womens Health* 2016;8:213–223.
29. Yao K, Winchester DJ, Czechura T, Huo D. Contralateral prophylactic mastectomy and survival: Report from the National Cancer Data Base, 1998-2002. *Breast Cancer Res Treat*. 2013;142:465–476.
30. Wong SM, Freedman RA, Sagara Y, Aydogan F, Barry WT, Golshan M. Growing use of contralateral prophylactic mastectomy despite no improvement in long-term survival for invasive breast cancer. *Ann Surg*. 2017;265:581–589.
31. Kurian AW, Lichtensztajn DY, Keegan TH, Nelson DO, Clarke CA, Gomez SL. Use of and mortality after bilateral mastectomy compared with other surgical treatments for breast cancer in California, 1998-2011. *JAMA* 2014;312:902–914.
32. Eck DL, Perdakis G, Rawal B, Bagaria S, McLaughlin SA. Incremental risk associated with contralateral prophylactic mastectomy and the effect on adjuvant therapy. *Ann Surg Oncol*. 2014;21:3297–3303.
33. Goldflam K, Hunt KK, Gershenwald JE, et al. Contralateral prophylactic mastectomy: Predictors of significant histologic findings. *Cancer* 2004;101:1977–1986.
34. Chang EI, Chang EI, Soto-Miranda MA, et al. Evolution of bilateral free flap breast reconstruction over 10 years: Optimizing outcomes and comparison to unilateral reconstruction. *Plast Reconstr Surg*. 2015;135:946e–953e.
35. Murthy V, Chamberlain RS. Prophylactic mastectomy in patients at high risk: Is there a role for sentinel lymph node biopsy? *Clin Breast Cancer* 2013;13:180–187.
36. Nasser SM, Smith SG, Chagpar AB. The role of sentinel node biopsy in women undergoing prophylactic mastectomy. *J Surg Res*. 2010;164:188–192.
37. Deshmukh AA, Cantor SB, Crosby MA, et al. Cost of contralateral prophylactic mastectomy. *Ann Surg Oncol*. 2014;21:2823–2830.
38. Boughey JC, Schilz SR, Van Houten HK, Zhu L, Habermann EB, Lemaire V. Contralateral prophylactic mastectomy with immediate breast reconstruction increases healthcare utilization and cost. *Ann Surg Oncol*. 2017;24:2957–2964.
39. Billig JI, Duncan A, Zhong L, et al. The cost of contralateral prophylactic mastectomy in women with unilateral breast cancer. *Plast Reconstr Surg*. 2018;141:1094–1102.
40. Rosenberg SM, Sepucha K, Ruddy KJ, et al. Local therapy decision-making and contralateral prophylactic mastectomy in young women with early-stage breast cancer. *Ann Surg Oncol*. 2015;22:3809–3815.
41. Soran A, Ibrahim A, Kanbour M, et al. Decision making and factors influencing long-term satisfaction with prophylactic mastectomy in women with breast cancer. *Am J Clin Oncol*. 2015;38:179–183.
42. Alborno CR, Matros E, Lee CN, et al. Bilateral mastectomy versus breast-conserving surgery for early-stage breast cancer: The role of breast reconstruction. *Plast Reconstr Surg*. 2015;135:1518–1526.
43. Giuliano AE, Boolbol S, Degnim A, Kuerer H, Leitch AM, Morrow M. Society of Surgical Oncology: Position statement

- on prophylactic mastectomy. Approved by the Society of Surgical Oncology Executive Council, March 2007. *Ann Surg Oncol.* 2007;14:2425–2427.
44. Geiger AM, West CN, Nekhlyudov L, et al. Contentment with quality of life among breast cancer survivors with and without contralateral prophylactic mastectomy. *J Clin Oncol.* 2006;24:1350–1356.
 45. Mattos D, Gfrerer L, Ling IT, et al. Occult histopathology and its predictors in contralateral and bilateral prophylactic mastectomies. *Ann Surg Oncol.* 2016;23:767–775.
 46. Frost MH, Slezak JM, Tran NV, et al. Satisfaction after contralateral prophylactic mastectomy: The significance of mastectomy type, reconstructive complications, and body appearance. *J Clin Oncol.* 2005;23:7849–7856.
 47. Lin KY, Johns FR, Gibson J, Long M, Drake DB, Moore MM. An outcome study of breast reconstruction: Presurgical identification of risk factors for complications. *Ann Surg Oncol.* 2001;8:586–591.
 48. Kroll SS, Netscher DT. Complications of TRAM flap breast reconstruction in obese patients. *Plast Reconstr Surg.* 1989;84:886–892.
 49. Alderman AK, Wilkins EG, Kim HM, Lowery JC. Complications in postmastectomy breast reconstruction: Two-year results of the Michigan Breast Reconstruction Outcome Study. *Plast Reconstr Surg.* 2002;109:2265–2274.
 50. Paige KT, Bostwick J III, Bried JT, Jones G. A comparison of morbidity from bilateral, unipedicled and unilateral, unipedicled TRAM flap breast reconstructions. *Plast Reconstr Surg.* 1998;101:1819–1827.
 51. Garvey PB, Villa MT, Rozanski AT, Liu J, Robb GL, Beahm EK. The advantages of free abdominal-based flaps over implants for breast reconstruction in obese patients. *Plast Reconstr Surg.* 2012;130:991–1000.
 52. Hart A, Funderburk CD, Chu CK, et al. The impact of diabetes mellitus on wound healing in breast reconstruction. *Ann Plast Surg.* 2017;78:260–263.