The American Journal of Surgery 218 (2019) 712–715

Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

Variations in the utilization of immediate post-mastectomy breast reconstruction

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ARTICLE INFO

Article history:
Received 1 March 2019
Received in revised form
13 May 2019
Accepted 17 July 2019

This paper was presented at American College of Surgeons Clinical Congress 2018, Boston, Massachusetts.

Keywords:
Breast cancer
Mastectomy
Breast reconstruction
Disparities
Regional variations

ABSTRACT

Background: For female breast cancer (BC) patients undergoing mastectomy, post-mastectomy breast reconstruction (PMBR) confers significant psychosocial benefits and improved cosmetic outcomes. The objective of this study is to explore whether the utilization of PMBR varies by race, marital status, and geographical location of the patient.

Methods: Women ≥18 years old who underwent mastectomy for breast cancer diagnosed between 2000 and 2014 were eligible. Women with inflammatory BC, Stage IV BC diagnoses, and bilateral BC were excluded. Multivariable logistic regression, adjusting for patient and cancer characteristics, were used to assess the association between of race, marital status, and region on immediate PMBR utilization.

Results: 321,206 women were included and 24% underwent immediate PMBR (<4 months after mastectomy). Compared to white women, black and other non-white women (OR 0.67, 95% CI 0.65, 0.70 and OR 0.52, 95% CI 0.50, 0.53, respectively) were significantly less likely to receive PMBR. Additionally, women who were single (OR 0.72, 95% CI 0.70, 0.75) or no longer married (OR 0.84, 95% CI 0.82, 0.86) were significantly less likely to undergo breast reconstruction, compared to married women. Regional differences were also seen, with women in the Northeast (OR 2.11, 95% CI 2.05,2.17), Midwest (OR 1.53, 95% CI 1.48, 1.58) and South (OR 1.20, 95%CI 1.17, 1.23) all being more likely to undergo breast reconstruction compared to the West.

Discussion: Significant variations exist in the utilization of post-mastectomy breast reconstruction across race, marital status or geographical location of the patient. Further research is needed to elucidate these differences and identify areas for intervention to increase awareness, and access to reconstruction for all breast cancer patients.

Introduction

Breast cancer is the most commonly diagnosed malignancy and the third leading cause of cancer-related mortality among women in the US.[1] Currently, about 30%–35% of the breast cancer patients receive mastectomy for the primary tumor resection.[2,3] For locally advanced breast cancer, the proportion of patients receiving mastectomy may be as high as 59%.[4] The loss of a breast by mastectomy has profound psychological implications for the patient affecting their functional, social and sexual well-being.[5,6]

For patients who choose to undergo breast reconstruction after mastectomy, post-mastectomy breast reconstruction (PMBR) has been shown to improve the quality of life and restore a healthy body image.[7,8] PMBR is associated with improved cosmesis and can mitigate the psychosocial morbidity (anxiety, depression, body-image, self-esteem and sexual dysfunction) associated with mastectomy alone.[8–12] The increased awareness of the surgical safety as well as improvements in reconstructive options, cosmetic outcomes and patient education have all facilitated increased use of

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https://doi.org/10.1016/j.amjsurg.2019.07.025
0002-9610/

breast reconstruction in patients receiving mastectomy. In the last two decades, the utilization of breast reconstruction has rapidly expanded with some studies demonstrating more than a two-fold increase in PMBR rates.[13–15] Whether this increase in PMBR has been uniform across various sociodemographic subsets of the population, currently remains unclear. Thus, the objectives for this study were to assess 1) variations in utilization of immediate PMBR across race, marital status, and geographical location of the patient, and 2) impact of patient age on said variations in use of immediate PMBR.

Methods

Study design and population

The National Cancer Institute (NCI) Surveillance, Epidemiology, and End Results (SEER) Program registry was used to identify adult women (≥18 years old) with a new diagnosis of breast cancer between 2000 and 2014, and underwent mastectomy (subcutaneous [30], simple [40–49, 75], modified radical [50–59, 63], radical [60–62, 64–69, 73–74], or unspecified [80]). The SEER program prospectively collects de-identified information on individuals diagnosed with cancer from 18 registries across the United States, and covers roughly 30% of the population.[16] Women with inflammatory breast cancer diagnoses, undifferentiated or anaplastic cancer (Grade IV), metastases (adjusted AJCC 6th M1), bilateral involvement, unmeasured tumors (TX), no evidence of primary tumors (T0), large tumors (T4), and missing radiation information were excluded. The primary outcome of interest was the impact of race, marital status, and geographical location on receipt of immediate PMBR, defined as undergoing reconstruction within the first 4 months of mastectomy (measured using procedure codes 43–49, 53–59, 63–70, and 73–75).

Statistical analyses

Patient demographics and cancer characteristics were described using frequency tables and bivariate analyses. Multivariable logistic regression was used to assess the association between race, marital status, and region on immediate PMBR, after adjusting for age (modeled as a quadratic variable), invasive disease status, whether it was the patient's first cancer diagnosis, tumor grade, adjusted AJCC 6th T, adjusted AJCC 6th N, radiation status, endocrine receptor (ER) status, and progesterone receptor (PR) status. Interaction terms between race, marital status, and region with age (categorized as ≤40, 41–50, 51–60, 61–70, and >70 years old) were used to determine if the associations on immediate PMBR were consistent across age. All statistical analyses were performed using SAS 9.4 (SAS Inc., Cary, NC).

Results

Overall, 321,206 women were diagnosed with breast cancer and underwent mastectomy; of those 77,798 (24%) underwent immediate PMBR. The majority of the patients in both the groups had early-stage (AJCC 6th T1-T2, N0–N1) and estrogen/progesterone receptor positive (ER+/PR+) tumors (Table 1). On average, women undergoing immediate PMBR were younger than those that did not (mean age 51.6 years old vs. 62.3 years old, $p < 0.0001$). Additionally, women undergoing immediate PMBR were more likely to be white (76% vs 70%, $p < 0.0001$), married (70% vs 56%, $p < 0.0001$), and reside in the Northeast (21% vs 12%, $p < 0.0001$), compared to those that did not undergo reconstruction. Node-negative (AJCC 6th N0) were also more likely to undergo immediate PMBR (71% vs. 63%, $p < 0.0001$). No other meaningful differences across cancer characteristics (invasiveness, tumor size, ER/PR status, first cancer diagnosis) were seen.

Table 1
Distribution of patient and cancer characteristics across reconstruction status among women ≥18 years old, with new breast cancer diagnoses, and undergoing mastectomy procedures between 2000 and 2014, n = 321,206.

	PMBR 77,798 (24%)	No Reconstruction 243,408 (76%)
Age, in years, mean (SD)	51.6 (10.5)	62.3 (14.0)
Race/ethnicity, n (%)		
White	58,951 (76)	168,832 (70)
Black	6891 (9)	25,205 (10)
Other	11,799 (15)	48,908 (20)
Marital status, n (%)		
Single	10,111 (14)	31,594 (14)
Married/domestic partner	52,683 (70)	129,237 (56)
Divorced/separated/widowed	12,289 (16)	71,981 (31)
Missing	2715	10,596
Region, n (%)		
Northeast	16,320 (21)	29,878 (12)
Midwest	8991 (12)	23,164 (10)
South	18,495 (24)	57,181 (24)
West	33,992 (44)	133,185 (55)
Tumor grade, n (%)		
Differentiated (Grade 1)	13,836 (18)	42,965 (18)
Moderate differentiation (Grade 2)	34,583 (45)	106,395 (44)
Poor differentiation (Grade 3)	29,379 (38)	94,048 (39)
Invasive, n (%)	62,234 (80)	216,397 (89)
First cancer diagnosis, n (%)	64,185 (83)	197,221 (81)
ER status, n (%)		
Positive	58,601 (82)	172,047 (79)
Negative	13,231 (18)	47,057 (22)
Missing	5966	24,304
PR status, n (%)		
Positive	50,774 (72)	143,405 (67)
Negative	20,172 (28)	72,248 (34)
Missing	3165	27,755
Underwent radiation, n (%)	12,810 (17)	46,733 (19)
Adjusted AJCC 6th T, n (%)		
T1	37,128 (48)	110,354 (45)
T2	20,474 (26)	85,195 (35)
T3	4534 (6)	20,595 (9)
Tis	15,662 (20)	27,264 (11)
Adjusted AJCC 6th N, n (%)		
N0	55,272 (71)	154,187 (63)
N1	16,529 (21)	57,880 (24)
N2	4061 (5)	19,938 (8)
N3	1936 (3)	11,400 (5)

Abbreviations: IBR, immediate breast reconstruction; SD, standard deviation.

After adjustment, black and other race women (OR 0.67, 95% CI 0.65, 0.70 and OR 0.52, 95% CI 0.50, 0.53, respectively) were still significantly less likely to receive immediate PMBR, compared to white women; however, black women were more likely to undergo reconstruction than other race women (OR 1.30, 95% CI 1.25, 1.35) (Table 2). Similarly, women who were single (OR 0.72, 95% CI 0.70,75) or no longer married (OR 0.84, 95% CI 0.82, 0.86) were also still less likely to undergo immediate breast reconstruction. Single women were also less likely to undergo reconstruction compared to women who were no longer married (OR 0.86, 95% CI 0.83, 0.89).

Regional differences also existed, with women in the Northeast (OR 2.11, 95% CI 2.05,2.17), Midwest (OR 1.53, 95% CI 1.48, 1.58) and South (OR 1.20, 95%CI 1.17, 1.23) all being more likely to undergo breast reconstruction, compared to those living in the West. Women in the Northeast were also more likely to undergo surgery compared to women living in the Midwest (OR 1.38, 95% CI 1.33, 1.43) and the South (OR 1.75, 95% CI 1.70, 1.81), and women in the Midwest were more likely to undergo immediate PMBR than those in the South (OR 1.27, 95% CI 1.23, 1.32).

Generally, the trends in decreased PMBR utilization among non-white women and single/no longer married women persisted

Table 2
Crude and adjusted odds of receipt of post-mastectomy breast reconstruction in breast cancer patients across race, marital status and geographical location.

	Crude		Adjusted[a]	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Race				
White	ref	–	ref	–
Black	0.78 (0.76, 0.81)	<0.0001	0.67 (0.65, 0.70)	<0.0001
Other race	0.69 (0.68, 0.71)	<0.0001	0.52 (0.50, 0.53)	<0.0001
Marital status				
Single	0.79 (0.77, 0.80)	<0.0001	0.72 (0.70, 0.75)	<0.0001
Married/domestic partner	ref	–	ref	–
Divorced/separated/widowed	0.42 (0.41, 0.43)	<0.0001	0.84 (0.82, 0.86)	<0.0001
Region				
Northeast	2.14 (2.09, 2.19)	<0.0001	2.11 (2.05, 2.17)	<0.0001
Midwest	1.52 (1.48, 1.56)	<0.0001	1.53 (1.48, 1.58)	<0.0001
South	1.27 (1.24, 1.29)	<0.0001	1.20 (1.17, 1.23)	<0.0001
West	ref	–	ref	–

across all age groups, although among women >70 years old a smaller difference between black and white women was seen, and among other race women a larger difference was seen among women 51–70 years old (Table 3). Across all ages, women in the Northeast were most likely to undergo immediate PMBR, compared to women in the West, although this difference became smaller as age increased. A similar pattern was seen among women in the Midwest and South, with the difference in immediate PMBR utilization decreasing as age increased; however, women >70 years old in both regions were less likely to undergo reconstruction compared to women in the West.

Discussion

Breast reconstruction continues to be utilized by only a small proportion of patients undergoing mastectomy for breast cancer, and is especially underutilized by minority populations and unmarried women. Furthermore, significant regional variation exists in the utilization of PMBR.

While the utilization of PMBR has increased since the implementation of Women's Health and Cancer Rights Act (WHCRA) in 1999 the U.S., the majority of breast cancer patients undergoing mastectomy still do not receive breast reconstruction.[13,17–19] Despite the well-documented psychological benefits and safety of breast reconstruction, current literature estimates that 50%–80% of breast cancer patients receiving mastectomy do not undergo PMBR.[20,21] Older age at diagnosis, a greater distance to a plastic surgeon, lower density of plastic surgeons available in the state, public health insurance coverage, non-white racial/ethnic groups and disparities in patient information as well as involvement in the decision-making process have been shown to contribute to a lower rate of breast reconstruction.[20,22–25]

While racial disparities in the oncologic surgery for breast cancer have been well documented[26–30]; this study demonstrates that disparities potentially also persist in the receipt of breast reconstruction as well. These differences may be due to a combination of system associated factors (e.g., distance to facility, financial concerns, out-of-pocket costs), physician associated factors (e.g., access to reconstructive surgeons, delayed access to reconstruction), or patient associated factors (e.g., lack of health insurance, personal preferences)[29,31]. The decision to undergo mastectomy with breast reconstruction is a complex one, with several factors contributing to it including the patient's comprehension of the risks and benefits of the procedure, combined with their personal preferences, at a time of great stress. Marital status of the patient has also been shown to influence the decision-making regarding PMBR, with married women being more likely to utilize reconstruction.[32] This may reflect the potential role of the patient's partner and support system in the decision to receive PMBR or increased ability for these women to pay for their surgery. Regardless, while it remains unclear whether racial and marital differences are reflective of disparities in access to treatment or differences in personal preferences, improved access to plastic surgeons and community-specific interventions should be developed to target women who are underutilizing PMBR, and remove any system and physician specific disparities that exist.

Table 3
Effect of race, marital status, and region on immediate PMBR, stratified by patient age.

	≤40 years old OR (95% CI)[a]	41–50 years old OR (95% CI)[a]	51–60 years old OR (95% CI)[a]	61–70 years old OR (95% CI)[a]	>70 years old OR (95% CI)[a]	p-value
Race						
White	ref	ref	ref	ref	ref	–
Black	0.68 (0.62, 0.75)	0.69 (0.65, 0.73)	0.64 (0.60, 0.68)	0.67 (0.62, 0.73)	0.82 (0.70, 0.95)	0.05
Other race	0.59 (0.55, 0.63)	0.58 (0.55, 0.61)	0.49 (0.47, 0.52)	0.46 (0.43, 0.49)	0.56 (0.49, 0.64)	<0.0001
Marital status						
Single	0.85 (0.80, 0.91)	0.72 (0.68, 0.75)	0.69 (0.66, 0.73)	0.68 (0.63, 0.73)	0.74 (0.64, 0.85)	<0.0001
Married/domestic partner	ref	ref	ref	ref	ref	–
Divorced/separated/widowed	0.83 (0.75, 0.92)	0.88 (0.83, 0.93)	0.84 (0.80, 0.88)	0.78 (0.75, 0.82)	0.56 (0.52, 0.60)	<0.0001
Region						
Northeast	2.32 (2.14, 2.52)	2.40 (2.28, 2.52)	2.23 (2.12, 2.35)	1.85 (1.74, 1.97)	1.29 (1.16, 1.43)	<0.0001
Midwest	2.12 (1.91, 2.34)	1.92 (1.80, 2.04)	1.51 (1.42, 1.61)	1.22 (1.13, 1.31)	0.76 (0.67, 0.86)	<0.0001
South	1.35 (1.25, 1.45)	1.38 (1.32, 1.45)	1.24 (1.18, 1.30)	1.04 (0.99, 1.10)	0.75 (0.68, 0.83)	<0.0001
West	ref	ref	ref	ref	ref	–

Abbreviations: CI, confidence interval; OR, odds ratio; ref, reference.
[a] Adjusting for region, race, marital status, year of diagnosis, age (treated as a quadratic variable), cancer grade, radiation treatment status, invasive disease, first cancer diagnosis, ER status, PR status, adjusted AJCC 6th T, and adjusted AJCC 6th N.

Significant regional variations in immediate PMBR also exist, with women in the Northeast being most likely to undergo reconstruction, and then the Midwest, South, and West. While it is difficult to determine whether these differences are due to availability of healthcare facilities and reconstructive surgeons or due to cultural differences remains to be seen, although based on this analysis these differences are not due to differences in regional demographics (e.g. age, race). Improved understanding of the healthcare utilization patterns among different regions, and why these patterns differ, may be critical to increasing breast reconstruction uptake across the entire US.

This study is not without limitations. The SEER registry only captures breast reconstruction that occurs within four months of the primary oncologic surgery, which we have defined as immediate breast reconstruction.[20] Therefore, we were not able to identify women who underwent reconstruction >4 months after mastectomy. Additionally, 7477 (2%) of patients had <4 months follow-up and were not reported to undergo reconstruction. It is likely that some of these patients had immediate PMBR after they were lost to follow-up and were therefore misclassified. However, due to our large sample size this misclassification would have a minimal effect on the analyses. Finally, no information on the patient-physician decision making progress is available in SEER, and we were unable to assess why patients did not undergo PMBR. Future research should look into whether receipt of PMBR varies across reconstruction type and whether this underutilization of PMBR is due to patient choice or due to lack of access to reconstructive surgery services.

Conclusion

Significant variations exist in the utilization of immediate postmastectomy breast reconstruction across race, marital status, and geographical region in the US. Further research is needed to elucidate why these differences exist and identify areas for intervention to increase awareness and access to reconstruction for all breast cancer patients.

Funding sources

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest

None of the authors have any disclosure relevant to the material in this paper.

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