Original Article

Surgical Treatment of Breast Cancer Among the Elderly in the United States

Amy K. Alderman, MD, MPH[1]; Julie Bynum, MD, MPH[2,3]; Jason Sutherland, PhD[4]; Nancy Birkmeyer, PhD[1]; E. Dale Collins, MD, MS[3,5]; and John Birkmeyer, MD[1]

BACKGROUND: Breast-conserving therapy (BCT) has emerged as the preferred treatment for most women with early stage breast cancer. However, there is concern for underuse in the elderly, with previously documented low rates of BCT and large variations in practice patterns. The authors' purpose was to examine patterns and correlates of BCT for breast cancer in the elderly US population. **METHODS:** The primary outcome was receipt of BCT. The 2003 to 2004 Medicare inpatient, outpatient, and carrier files were used to identify incident breast cancer patients and the American Medical Association to ascertain surgeon information. The primary independent variables were US state where treatment was performed along with patient and surgeon sociodemographic information. Multivariate logistic regression was used for the analyses. **RESULTS:** BCT was performed in 81.8% of patients (N = 20,032). Variation in use of BCT across states was low, ranging from 74.2% in Utah to 84.0% in New Mexico. Several factors were significantly associated with low use of BCT: advanced patient age (>85 vs <70 years: odds ratio [OR], 0.50; 95% confidence interval [CI], 0.42-0.59); comorbidities (>3 vs ≤3: OR, 0.26; 95% CI, 0.24-0.28), and low socioeconomic status (SES) (lowest quintile vs highest quintile SES: OR, 0.60; 95% CI, 0.52-0.68). Variation in use of BCT by surgeon was low, although female surgeons aged 40 to 49 years and ≥60 years had significantly higher use compared with younger men. **CONCLUSIONS:** BCT has become the primary management among elderly breast cancer patients. Despite earlier studies to the contrary, there is now little variation in BCT use among Medicare patients. ***Cancer* 2011;117:698–704.** © *2010 American Cancer Society.*

KEYWORDS: patterns of care, breast cancer, Medicare, mastectomy, breast-conserving therapy.

Breast -conserving therapy (BCT) has become the predominant surgical approach for most women with early stage breast cancer.[1,2] BCT compared with mastectomy has equivalent long-term survival,[3-5] is associated with less disfigurement, and has superior quality of life outcomes related to body image and sexual functioning.[6-9] As a result, BCT has risen steadily in the United States during the past couple of decades.

In contrast, the diffusion of BCT into clinical practice for elderly patients has been much slower and inconsistent.[10] Previous research suggests that BCT has been underused in the elderly. Only 14% of elderly breast cancer patients were treated with BCT in 1986, and this increased minimally to 15% in 1990.[10] The most recent study from 1996 found that less than half of elderly breast cancer patients undergo BCT with or without radiation.[11] Reasons for the underuse of BCT in the elderly are unclear. Low use of BCT has been correlated with rural healthcare settings,[11-14] treatment received in the southern and central United States,[12,15] and low patient socioeconomic status.[11,16] The influence of these nonclinical factors on the surgical treatment of breast cancer suggests that informed patient choice may not be fully optimized in this population.

Because many of the largest studies evaluating BCT use are now more than a decade old, we examined the surgical treatment of breast cancer in the elderly using a large national sample of Medicare patients. Our specific research questions were: 1) What proportion of elderly US breast cancer patients receive BCT?; 2) How much geographical variation exists in the use of BCT?; and 3) What nonclinical factors are correlated with the use of BCT?

Corresponding author: Amy K. Alderman, MD, MPH, Department of Plastic and Reconstructive Surgery, University of Michigan, 2130 Taubman Center, 1500 E. Medical Center Drive, Ann Arbor, MI 48109-0340; Fax: (734) 763-5354; aalder@umich.edu

[1]Department of Surgery, University of Michigan Medical Center, Ann Arbor, Michigan; [2]Department of Medicine, Dartmouth Medical School, Hanover, New Hampshire; [3]The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, New Hampshire; [4]University of British Columbia Centre for Health Services and Policy Research, Vancouver, British Columbia, Canada; [5]Department of Surgery, Dartmouth Medical School, Hanover, New Hampshire

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MATERIALS AND METHODS

Data Sources

Patient information was obtained from a 100% sample of MEDPAR (Medicare Provider Analysis and Review) and outpatient files and a 20% sample of the carrier files from the national Medicare database for the years 2003 to 2004. Data from the 2004 American Medical Association were used to obtain surgeon-level information. The institutional review board of the University of Michigan waived the requirement for informed consent.

Study Cohort

Our study cohort included only female Medicare beneficiaries who were 68 years of age by January 1, 2003 and who were entitled to Parts A and B of Medicare for all of 2003 and 2004. This age limit was chosen so that prevalent cases could be removed by excluding from the cohort anyone with a breast cancer diagnosis or procedure in the prior 3 years. We excluded the 6% to 18% (depending on year and region) of Medicare patients enrolled in managed care plans, because these patients do not have complete claims data.

Our sample included incident breast cancer cases with or without radiation therapy and axillary lymph node dissection. We identified incident breast cancer cases in which surgical treatment was performed based on the diagnostic and procedural codes in Medicare claims. Distinguishing breast procedures performed for documented breast cancer versus diagnostic purposes required a detailed algorithm that we adapted from Nattinger's published work because of its high sensitivity and positive predictive value.[17] In summary, patients were screened as a possible case by having both of the following criteria: 1) a breast cancer procedure code for mastectomy or lumpectomy in the inpatient, outpatient, and/or carrier files; and 2) any claim with a breast cancer diagnosis. Patients were identified as a high likelihood case by meeting 1 of the following criteria: 1) radiation procedure code, 2) presence of 1 hospital stay with breast cancer as the principle diagnosis in the calendar year after the procedure date, or 3) 2 claims in either the carrier file or outpatient file 7 days apart that indicated a breast cancer diagnosis in the calendar year after the procedure date. Cases not selected as a "high likelihood" case were included in the cohort if there was >1 month of outpatient or carrier claims with a breast cancer diagnosis. We excluded prevalent cases by removing any patient who had a breast cancer diagnosis code or procedure code for lumpectomy or mastectomy in the prior 3 years. We also excluded anyone with a cancer diagnosis other than the breast (but excluding skin cancer) to eliminate those with metastatic disease of the breast.

Measures

Surgical treatment

Our primary dependent variable of interest was receipt of BCT. Women were considered to have received BCT if they underwent a segmental mastectomy, lumpectomy, quadrantectomy, tylectomy, wedge resection, excisional biopsy, or partial mastectomy. The cohort included women with or without lymph node dissection and with or without radiation therapy. Patients were considered as having a mastectomy if they had an International Classification of Diseases, 9th Edition or Current Procedural Terminology code for mastectomy, including simple, subcutaneous, modified radical, and radical mastectomy.

Independent variables

The independent variables included 1) patient sociodemographic characteristics (age, race, composite socioeconomic status value, US state), 2) patient clinical factors (Charlson score), and 3) surgeon characteristics (age and sex). Patient age was categorized as <70, 70 to 75, 76 to 80, 81 to 85, and >85 years. We dichotomized patient race into nonwhite and white. Patient comorbidity status was dichotomized into ≤3 and >3 Charlson score, and varying the cutoff to >2 did not significantly change the results.

We constructed a summary measure of socioeconomic status for each US Zip code using data on income, education, and occupation from the 2000 US Census, which was then linked to the patient's ZIP code of residence from the Medicare files. The individual variables chosen and methods for calculating the summary measure were based on previously developed methods.[18,19] Patients were sorted according to summary socioeconomic status score and then grouped into quintiles ranging from 1 (lowest) to 5 (highest).

Surgeon-level factors were obtained from the American Medical Association file. Surgeon age was grouped as <40, 40 to 49, 50 to 59, and >59 years. Surgeon sex was dichotomized (male, female).

Statistical Analysis

We first described receipt of mastectomy and BCT across all patients and surgeon-level factors. Pearson chi-square was used for the bivariate analyses between outcomes and

categorical independent variables. We also described the adjusted proportion of breast cancer patients treated with BCT by US state. Rates were adjusted for patient-level factors (age, race, comorbidity score, and socioeconomic status) and surgeon-level factors (age and sex). We excluded from the analyses states with $\leq$10 procedures for reporting to avoid unstable estimates of regional variation. We also excluded 157 cases for which we were unable to match surgeon-level to patient-level data.

We performed a multivariate logistic regression to evaluate patient-level and surgeon-level factors associated with receipt of BCT. Second order interactions were included in our regression based on our conceptual model. The Wald test and the likelihood ratio test were used to test the significance of individual predictive variables. The final multivariate model included those interaction terms significant at $P < .05$. All modeling reports odds ratios (ORs) and 95% confidence intervals (CIs). Analyses were performed with SAS version 9.2.

RESULTS

Our sample included 20,032 breast cancer patients (18.2% with mastectomy and 81.8% with BCT). Of this sample, 18.9% of mastectomy-treated patients received radiation, and 49.5% of BCT patients received radiation. Table 1 displays the proportion of patients receiving BCT across the United States, adjusted for patient-level and surgeon-level factors. Minimal regional variation was found, with BCT use ranging from 74.2% in Utah to 84.0% in New Mexico. Other high-use states included Arizona (83.0%), New Hampshire (82.7%), Massachusetts (82.7%), and Montana (82.1%). Among the high-use regions, there were 24 states that were within 4% of each other. Comparatively low-use states included Mississippi (75.3%), Alabama (75.7%), South Dakota (77.0%), and Wisconsin (77.0%).

Table 2 describes receipt of BCT across patient clinical and demographic factors. Older, compared with younger patients, were significantly less likely to receive BCT. For example, 72.9% of patients >85 years of age received BCT compared with 85.9% of patients <70 years of age (OR, 0.50; 95% CI, 0.42-0.59). Presence of multiple comorbidities was associated with low use of BCT. Only 61.9% of those with a Charlson score >3 received BCT, compared with 87.4% of those with a Charlson score $\leq$3 (OR, 0.26; 95% CI, 0.24-0.28). In addition, patient socioeconomic status was associated with surgical treatment. Only 78.2% of patients in the lowest socioeconomic status quintile received BCT, compared with 86.3% of those in the highest quintile (OR, 0.60; 95% CI, 0.52-0.68). Patient race was not statistically associated with BCT use.

The sample included 9893 surgeons (8325 men and 1568 women). The mean surgeon age was 51.9 years for men and 46.0 years for women. Approximately 20% of the surgeons were <40 years of age, 1/3 were in their forties, 1/3 were in the fifties, and 20% were $\geq$60 years of age. The average number of patients per surgeon was 2.44 for female surgeons and 1.89 for male surgeons. Figure 1 displays the interaction of surgeon age and sex with the proportion of patients receiving BCT, controlling for patient age, race, Charlson score, and socioeconomic status. BCT use among surgeons was relatively similar. However, compared with surgeons <40 years of age, the proportion of patients receiving BCT was significantly lower among male versus female surgeons 40 to 49 years of age (80.3% vs 86.0%: OR, 0.72; 95% CI, 0.54-0.96) and among those $\geq$60 years of age (80.6% vs 91.3%: OR, 0.36; 95% CI, 0.17-0.76).

DISCUSSION

In this large population-based study using Medicare data from 2003 and 2004, we found that the overall use of BCT in the elderly was high (82%) and varied minimally from 74% to 84% across the United States. However, certain nonclinical factors were significantly associated with the use of BCT. Elderly patients who were more socioeconomically disadvantaged were significantly less likely to receive BCT. Surgeon characteristics were modestly associated with the use of BCT, with older female surgeons associated with the highest use.

These data suggest that BCT is now widely adopted for elderly breast cancer patients in the United States. Greater than 80% of elderly breast cancer patients in our sample received BCT, which is considerably higher than earlier reports of BCT use ranging from 12%-24% in the 1980s[12,20] to 15%-43% in the 1990s.[10,21] Geographical variations in the surgical care of elderly breast cancer patients also appear reduced. Our study found surprisingly little difference in the adjusted rates of BCT use across the United States, with only a 10% difference between the highest and lowest use state. In comparison, rates of BCT in the 1980s ranged from 3.5% to 21.2% across the United States.[12] Even as recently as 1995, the use of mastectomy in the elderly was found to vary by 4.7-fold across hospital referral regions, from 0.91 per 1000

Table 1. The Use of Breast-Conserving Therapy by US State Among Medicare Enrollees With Breast Cancer During 2003 to 2004

State	BCT, No.	% BCT, Unadjusted	% BCT, Adjusted for Patient Factors[a]	% BCT, Adjusted for Patient and Surgeon Factors[a]
Alabama	270	78.0	81.3	75.7
Arizona	215	80.8	83.2	83.0
Arkansas	169	71.6	79.9	80.0
California	1119	81.9	83.1	81.9
Colorado	167	80.3	83.3	81.3
Connecticut	297	91.4	83.2	79.9
Florida	1273	84.8	82.1	80.2
Georgia	406	76.7	82.3	80.2
Idaho	72	76.6	81.9	81.1
Illinois	825	84.4	82.3	81.3
Indiana	395	80.6	81.4	79.3
Iowa	241	77.7	81.5	77.4
Kansas	205	76.8	80.9	78.5
Kentucky	249	78.8	81.0	80.0
Louisiana	263	83.5	79.3	78.5
Maine	111	85.4	82.2	81.1
Maryland	336	84.4	82.1	78.4
Massachusetts	433	91.5	83.9	82.7
Michigan	734	86.9	82.6	80.3
Minnesota	275	76.8	82.3	79.0
Mississippi	169	70.1	79.5	75.3
Missouri	374	80.1	80.4	78.3
Montana	73	72.3	82.9	82.1
Nebraska	116	76.3	80.8	80.7
Nevada	68	76.4	81.1	79.2
New Hampshire	89	82.4	84.2	82.7
New Jersey	581	86.7	82.1	81.0
New Mexico	84	88.4	83.8	84.0
New York	1127	86.1	81.5	78.9
North Carolina	514	76.4	81.9	80.0
North Dakota	48	69.6	81.6	81.7
Ohio	716	82.8	81.1	80.3
Oklahoma	215	79.3	81.3	80.1
Oregon	167	83.1	83.9	80.7
Pennsylvania	787	83.0	80.3	78.8
South Carolina	278	81.5	81.1	77.2
South Dakota	50	74.6	80.7	77.0
Tennessee	320	77.5	80.3	79.2
Texas	868	75.4	81.1	79.4
Utah	82	77.4	84.2	74.2
Virginia	441	85.1	82.4	80.9
Washington	328	80.6	82.3	80.0
Wisconsin	133	82.6	80.9	77.0
Wyoming	400	78.9	81.1	79.1

BCT indicates breast-conserving therapy.

[a] Patient-level factors controlled for in the analyses include age, race, Charlson score, and socioeconomic status; surgeon-level factors that were controlled for include age and sex.

Medicare enrollees in Ormond Beach, Florida, to 4.26 per 1000 Medicare enrollees in Neenah, Wisconsin.[22] Reasons for the increased adoption of BCT in the surgical treatment of elderly breast cancer patients are unclear but can include patient preference, surgeon bias, and dissemination of knowledge. Furthermore, the increased use of BCT in the elderly may reflect accumulating knowledge that antiestrogen treatment provides similar survival and local control as radiation.[23] The reduced geographical variation in the surgical treatment of elderly breast cancer patients suggests that the clinical uncertainty of BCT has diminished among patients and physicians.

Table 2. Correlates of Use of Breast-Conserving Therapy for Breast Cancer[a]

Characteristic	Proportion of Breast Cancer Patients Treated With BCT, No. (%)	Adjusted OR[a]	95% CI[a]
Patient age, y			
68-70	1511 (85.9%)	1.00	—
70-74	4948 (85.5%)	1.01	0.86-1.19
75-79	4424 (83.1%)	0.85	0.73-1.00
80-84	2972 (78.1%)	0.62	0.53-0.73
>85	1720 (72.9%)	0.50	0.42-0.59
Patient race			
Nonwhite	1469 (79.8%)	1.00	—
White	14,106 (82.1%)	1.01	0.87-1.19
Charlson score			
<3	13,989 (87.4%)	1.00	—
>3	2343 (61.9)	0.26	0.24-0.28
Patient SES			
5th quintile (highest)	3301 (86.3%)	1.00	—
4th quintile	3200 (83.8%)	0.83	0.73-0.95
3rd quintile	3062 (80.1%)	0.65	0.58-0.75
2nd quintile	3069 (80.7%)	0.69	0.60-0.78
1st quintile (lowest)	2943 (78.2%)	0.60	0.52-0.68

BCT indicates breast-conserving therapy; OR, odds ratio; CI, confidence interval; SES, socioeconomic status.

[a] Logistic regression modeling the probability of a BCT versus a mastectomy. We omitted 157 cases due to the inability to link surgeons to patients. The model controlled for surgeon age and sex.

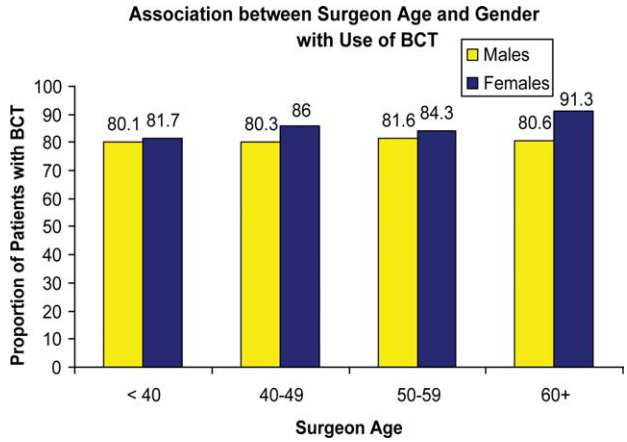

Figure 1. Adjusted proportion and odds ratios of receipt of breast-conserving therapy (BCT) are shown by surgeon age and sex, controlling for patient age, race, Charlson score, and socioeconomic status. The reference group is male surgeons <40 years of age. *Statistically significant at $P < .05$.

The association of advanced patient age and multiple comorbidities with low use of BCT is not unexpected. The use of mastectomy eliminates the need for postsurgical radiation therapy. Avoidance of radiation has benefits for the elderly and for those with a high health burden, especially those dependent on others for transportation. In addition, elderly compared with younger women may not have the same body image needs driving the choice for BCT.

Our results support Nattinger's previous finding that socioeconomic status, not race, is a significant correlate of BCT use.[11] The association between patient socioeconomic status and surgical breast cancer care has been well documented over the past 15 years[14,20,24-29] and raises concern that disadvantaged women are facing knowledge or financial barriers that influence their treatment decision. Potential reasons for relatively lower use of BCT include poor communication with surgeons,[30] inadequate information about treatment options,[31,32] difficulty with the decision-making process,[30,33,34] and/or financial barriers related to radiation, transportation, and time off work.[20,35]

Although we found differences in the use of BCT by surgeon factors, the clinical magnitude of these differences was relatively small. Reasons for sex-based differences in treatment can not be ascertained by our study. However, previous work by Katz et al has shown that surgeon preferences for surgery are strongly associated with perceptions about the relative treatment benefits related to quality of life.[36] Female surgeons, however, appear to be less inclined to favor 1 procedure over the other and less likely to view BCT as superior to mastectomy with regard to quality of life outcomes.[36] It is not surprising to find that male and female surgeons conceptualize the loss of a breast differently. The preferences of providers are at risk for being communicated to the patient. Fortunately, our study found minimal surgeon effect on BCT use, which suggests that surgeons across the United States minimize any personal bias in patients' surgical treatment decision making.

Limitations

Our findings should be interpreted in the context of some limitations. We did not have breast cancer stage information. However, we did find markedly increased rates of BCT in the elderly using the same population and methods as previous studies.[10,12] Therefore, stage should not be a significant confounder. The association between socioeconomic status and BCT use could be confounded by disease stage. However, a similar trend was found by

Gilligan et al using Medicare-Surveillance, Epidemiology, and End Results (SEER) data that controlled for disease stage.[11] We also found that the stage of breast cancer did not vary significantly across SEER-Medicare regions in the same time period after adjusting for patient sociodemographic factors and hospital volume. Therefore, we have no reason to believe that stage would vary across US states and be a significant confounder regarding geographical variations in BCT use. Stage of disease could also vary across surgeons; however, we have no reason to believe that disease stage would systematically vary by surgeon age and sex. There are also broader trends toward earlier diagnosis of breast cancer that could increase rates of BCT. However, the magnitude of the increase in BCT use that we found is too large to be explained by earlier cancer diagnosis. We used methods described by Nattinger et al to identify incident breast cancer patients in Medicare, which have a sensitivity of 80%, specificity of 99.9%, and positive predictive value of 93%.[17] We have no reason to suspect that any misclassification error would distort our findings. It should also be noted that the identification of surgeons in Medicare using unique physician identification numbers can be difficult and can potentially inappropriately aggregate data. In addition, the percentage of women with BCT identified as having radiation is lower than would typically be expected. This finding may be an artifact of the data files we used to identify radiation (carrier file), and is among the reasons we used addition definitional criteria to identify our sample. We were also dependent on US Census data to estimate patient socioeconomic status. However, any misclassification should be nondifferential and would minimize between-group variation.

Implications

Our findings have important implications for patient care and policy. Physicians, patients, and women's health policy advocates have spent considerable time and energy toward ensuring breast cancer patients' access to BCT. The high use of BCT and the decreased geographical variation in use suggests that evidence-based research has diffused into clinical practice for elderly breast cancer patients.

However, the influence of socioeconomic status on surgical care is concerning. Individual patients should be treated with a strategy that is best for them. This can be facilitated through shared medical decision making. One approach is to develop and deploy decision tools that physicians can use to educate patients about the risks, benefits, and long-term outcomes of all of the surgical options (breast conservation, mastectomy alone, and mastectomy with reconstruction). Decision tools may be particularly beneficial to patients of lower socioeconomic status and those overwhelmed by the cancer diagnosis or who may be intimidated by the healthcare system. Decision tools can improve patients' knowledge of surgical options in an unbiased, less pressured environment and have been associated with improved decisional quality for breast cancer care.[37] Decision tools can also be used to tailor interventions to match patient values.[38] Ultimately, the true measure of quality relies not on rates of BCT but the extent to which patients are adequately informed of treatment options and treatment decisions reflect patients' personal values.

CONFLICT OF INTEREST DISCLOSURES

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