Surgeon Characteristics and Variations in Treatment for Early-Stage Breast Cancer

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Hypothesis: Adherence to National Institutes of Health consensus statement recommendations for early-stage breast cancer will vary by surgeon characteristics.

Design: Secondary data analysis using the Surveillance, Epidemiology, and End Results national tumor registry linked with Medicare claims data. Logistic regression was used to analyze data on a cohort of 1045 surgeons who operated on 9449 Medicare patients with early-stage breast cancer.

Main Outcome Measure: Care adherent to the 1990 National Institutes of Health consensus statement recommendations.

Results: Surgeon age and specialty were not associated with adherent care overall, nor among breast-conserving surgery or mastectomy subgroups. Patients of higher-volume surgeons were significantly more likely to undergo adherent care overall because of greater use of lymph node dissection among women who received either breast-conserving surgery or mastectomy. Patients of female surgeons and surgeons with a medical school affiliation were less likely to undergo adherent care overall, which was related to greater use of breast-conserving surgery and lesser use of lymph node dissection among patients who underwent breast-conserving surgery.

Conclusions: Several surgeon characteristics are significantly associated with variations in breast cancer treatment received. These results warrant further investigation into the association between these surgeon characteristics and cancer care outcomes.

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While the goal of consensus statements is to improve the quality of medical care, this has not always proven to be the case. For example, lack of adherence to the National Institutes of Health (NIH) consensus statement on treatment for early-stage breast cancer has been observed. In fact, adherence to recommendations actually declined in the first 5 years after the statement was issued in 1990, from 88% in 1983 through 1989 to 78% by the end of 1995. The decrease in adherence was largely attributable to receipt of breast-conserving therapy omitting lymph node dissection (LND) and/or radiation therapy (XRT).

What patient or physician factors relate to quality of care? Several patient factors have been associated with lesser adherence to NIH recommendations, including older age, lower socioeconomic status, and receipt of breast-conserving surgery (BCS) for initial therapy. Relatively little is known about whether, and to what extent, physician factors are associated with less adherent care. In 1 study of older women cared for by surgeons in Boston, Mass, patients of female surgeons were more likely to receive “definitive treatment,” defined as primary treatment with either modified radical mastectomy or BCS followed by axillary LND and XRT, or systemic adjuvant therapy with chemotherapy and/or hormonal therapy. In 2 other survey studies, older surgeons, male surgeons, and surgeons in solo practice were less likely to report concurrence with the NIH consensus statement recommendations, but actual care practices were not assessed.

In this article, we report on the relationship between surgeon characteristics and receipt of breast cancer care in a population-based, geographically diverse sample of older women. The benchmark by which we measure the quality of breast cancer care is the NIH consensus statement on early-stage breast cancer, the standard current at the time of the study. We focus on surgeon age, sex, specialty, and board certification, as well as surgeon volume of breast cancer operations and academic status, as previous investigators have found these factors to be related to 5-year survival for patients with breast cancer.
DATA SOURCES

SEER-Medicare Linked Database

This data source links the National Cancer Institute’s population-based Surveillance, Epidemiology, and End Results (SEER) tumor registry data to Medicare claims data. SEER collects data from 11 population-based tumor registries covering approximately 14% of the US population. Our study included subjects from the SEER sites of Connecticut; Detroit, Mich; Iowa; New Mexico; Utah; and Atlanta, Ga. Incident cancers in persons residing within the coverage areas are determined from hospitals, offices, and some freestanding centers. For each subject with an incident breast cancer, information is abstracted regarding demographics, extent of disease, and initial therapy. For 94% of persons 65 years and older, SEER information has been linked to Medicare claims data. This study used the Medicare Part B surgeon claims records to determine the surgeon performing the definitive breast cancer operation and to supplement the SEER information on receipt of radiotherapy. The SEER-Medicare database has been identified by the Institute of Medicine as one of the few population-based data sources available for analyses of the quality of cancer care. The combination of clinical and demographic data with health care records collected over time makes it a valuable resource for studying cancer-related care in the elderly population.

American Medical Association Physicians’ Professional Database

To determine the characteristics of surgeons operating on cohort subjects, the American Medical Association (AMA) Physicians’ Professional Database (PPD) was used. The PPD includes demographic, educational, and current practice information on physician members and nonmembers of the AMA. Information on demographics, training, and board certification is obtained directly from primary data sources, such as residency programs, the American Board of Medical Specialties, and state licensing boards. Data on medical school employment comes from a triennial physicians’ directory. Among the variables collected, the number of breast cancer operations performed within the first 4 months of diagnosis by a given surgeon on SEER-Medicare patients is calculated. The surgeons operating on patients in this cohort were eligible to avoid selecting the surgeon who performed a biopsy rather than the definitive operation. Surgeons were excluded if their office ZIP code was outside of the SEER catchment areas, because their volume could not be accurately determined. These criteria resulted in a study cohort of 1045 surgeons, who operated on 9749 women between 1993 and 1996.

METHODS

FACTORS STUDIED

Patient Receipt of Care Adherent to NIH Consensus Statement Recommendations

Based on the NIH consensus statement on early-stage breast cancer, adherent treatment was defined as either BCS with XRT and axillary LND or mastectomy with LND. From here, we use the term “adherent care” to refer to care that follows the recommendations put forth in the NIH consensus statement. Secondary outcomes included receipt of LND determined separately for patients who underwent mastectomy and BCS and receipt of XRT among patients who underwent BCS. Receipt of LND was evaluated separately because of an increasing secular trend toward omission of LND in select cases. Surgical treatment and receipt of XRT were determined from SEER data. In unpublished analyses, we found the concordance of SEER and Medicare data to be 97% for type of initial surgery (BCS or mastectomy) and 96% for receipt of LND. To maximize case ascertainment for XRT, women were considered to have received XRT if either SEER or Medicare records indicated such treatment.

Surgeon Characteristics

The surgeon characteristics of age, sex, and board certification were determined from the AMA PPD. A surgeon was defined as “academic” if medical school employment was reported on the AMA physician survey or if the majority of the surgeon’s breast cancer operations were performed at a hospital affiliated with a major medical school. Surgeon volume was determined by counting the number of breast cancer operations performed within the first 4 months after diagnosis by a given surgeon on SEER-Medicare patients with any stage of incident breast cancer between 1993 and 1996 (ie, a broader cohort than the early-stage patients for whom adherence was determined). In the univariate analysis, surgeon volume was broken down into 5 groups with roughly equal numbers of surgeons in each; in the multivariate analysis, surgeon volume was analyzed as a continuous variable.

Patient Characteristics

Patient characteristics of age, year of breast cancer diagnosis, and SEER geographic site were determined from the SEER data. The median per capita income and percentage of high school graduates residing in the patient’s ZIP code were determined from US census data. This is a valid approach to estimating socioeconomic status when individual-level income and education are not available.

STATISTICAL ANALYSIS

The primary outcome was adherence with consensus statement recommendations, as defined earlier. The percentage of
patients undergoing adherent care was determined for the entire cohort and by surgeon age, sex, specialty and board certification, and volume. Similar percentages were determined for the secondary outcomes defined earlier. Univariate testing for significant differences in treatment received according to each surgeon characteristic was performed.

Multivariable logistic regression models were developed to determine those surgeon characteristics independently associated with receipt of adherent care, when simultaneously controlling for the patient-specific characteristics shown in prior work to be associated with adherent care. All models controlled for patient characteristics of age (modeled as linear and quadratic components), ZIP code per capita income, ZIP code education, and SEER site. To determine which surgeon characteristics had independent predictive value, we also constructed a model controlling for both patient characteristics and the other surgeon characteristics. Models also included 2-way and 3-interaction terms between the surgeon characteristics of volume, sex, and medical school affiliation. Estimates were calculated using the generalized estimating equations method, accounting for clustering of patients by surgeon. 

RESULTS

The 9449 women in the cohort were operated on by 1045 surgeons (Table 1). The mean surgeon age was 50.4 years, with 12% of the surgeons older than 65 years. Only a small number were female. The majority of the surgeons were board certified in general surgery or in a surgical subspecialty. About 30% were classified as “academic,” based on medical school employment or practice at a hospital with a primary medical school affiliation. The surgeons had widely varying volumes of patients. The mean surgeon volume over the 4 years of the study was 11 Medicare cases, or an average of 2.93 Medicare cases/year.

Overall, about three quarters of the 9449 women received care adherent to the NIH consensus statement (Table 2). Adherence varied substantially based on whether the initial therapy was BCS or mastectomy. Of the 4177 who underwent BCS, only 55% underwent adherent care, while of the 5272 women who underwent mastectomy, 91.9% did so.

RELATIONSHIP OF SURGEON CHARACTERISTICS AND ADHERENT CARE

There were no significant differences by age of surgeon in treatment received overall or in the BCS subgroup and borderline significance in the mastectomy subgroup (Table 2). Patients of female surgeons were about 10% less likely to undergo adherent care overall. This was attributable to 2 factors. First, the patients of female surgeons were more likely than the patients of male surgeons to undergo BCS (59.2% vs 42.9%; P<.001). Second, the patients of female surgeons who underwent BCS were less likely to undergo LND than patients of male surgeons. Although the patients of female surgeons who underwent BCS were more likely than the patients of male surgeons who underwent BCS to undergo XRT, overall adherence was lower for patients of female surgeons.

With respect to surgeon specialty, patients of surgeons without specific surgical training were less likely to be treated according to the consensus statement recommendations, especially for those undergoing BCS rather than mastectomy. Patients of academic surgeons were less likely to undergo adherent care overall. Similar to the situation with female surgeons, the patients of academic surgeons were more likely to undergo BCS, which led to lower overall adherence. Although the use of XRT after BCS was relatively high among patients of academic surgeons, it was more than balanced by a lower use of LND after BCS. There were significant differences in treatment based on surgeon volume among all subgroups. The percentage of patients receiving adherent care generally declined with lower surgeon volume of patients.

ADJUSTMENT FOR PATIENT AND OTHER SURGEON CHARACTERISTICS

To determine whether the results in Table 2 regarding the relationship of surgeon characteristics and adherent care were attributable to differences in the types of patients seen, we controlled for several patient characteristics (patient age, year of diagnosis, geographic site, ZIP code per capita income, and education). After adjustment for patient characteristics, neither surgeon age nor specialty was independently associated with adherent care or with receipt of the elements of adherent care (Table 3). Patients of female surgeons and academic surgeons were less likely to undergo adherent care overall, which, again, appeared to be related to greater use of BCS and lower use of LND among patients who underwent BCS. Medical school affiliation was associated with greater receipt of XRT within the BCS subgroup. No significant inter-
actions were found when 2-way and 3-way interaction terms between the surgeon characteristics of volume, sex, and medical school affiliation were evaluated.

Higher-volume surgeons were significantly more likely to have patients undergo adherent care overall, as well as have greater use of LND among women undergoing BCS, greater use of LND among women undergoing mastectomy, and a trend toward greater use of XRT among the patients undergoing BCS (Table 3). The odds ratio of 1.12 for association of surgeon volume and adherent care represents a 12% increase in the likelihood of adherent care for every doubling of the surgeon volume. For example, if all other factors were constant, one would expect that a surgeon performing 8 Medicare operations per year would have 12% greater rates of adherent care than a surgeon performing a mean of about 4 Medicare breast cancer operations per year.

**COMMENT**

Within the 5-year period after publication of NIH consensus statement recommendations for treatment of early-stage breast cancer, several surgeon characteristics were related to receipt of adherent care by patients. Patients with breast cancer were more likely to receive adherent care if treated by higher-volume surgeons and were less likely to receive adherent care overall if treated by female surgeons or surgeons with academic affiliations. The lesser level of adherence among female and academic surgeons appears to be primarily explained by higher use of BCS, coupled with lesser use of LND among patients undergoing BCS. In contrast, the patients of both female and academic surgeons who underwent BCS were more likely to undergo XRT, a difference that achieved statistical significance for the academic surgeons. Surgeon age was not related to adherence, and surgeon specialty was also not related to adherence after adjustment for patient characteristics.

Interestingly, similar patterns of care were seen for patients treated by female surgeons and academic surgeons. Both groups had lower rates of adherent care because of lower use of LND among patients who underwent BCS. The goal of consensus statements and clinical guideline development has been to “improve quality of care by decreasing inappropriate variation and expedite the application of effective advances to everyday prac-

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**Table 2. Relationship of Surgeon Characteristics to Patient With Breast Cancer Receipt of Adherent Care, and Components of Adherent Care***

<table>
<thead>
<tr>
<th>Surgeon Characteristic</th>
<th>All Patients (N = 9449)</th>
<th>BCS Subgroup (n = 4177)</th>
<th>Mastectomy Subgroup (n = 5272)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adherent Care†</td>
<td>P Value</td>
<td>BCS Use</td>
</tr>
<tr>
<td>All surgeons</td>
<td>75.5</td>
<td>.27</td>
<td>44.2</td>
</tr>
<tr>
<td>Age, y</td>
<td>&lt;.001</td>
<td>.001</td>
<td>45-76</td>
</tr>
<tr>
<td>Sex</td>
<td>76.2</td>
<td>.001</td>
<td>42.9</td>
</tr>
<tr>
<td>Specialty</td>
<td>68.2</td>
<td>.003</td>
<td>59.2</td>
</tr>
<tr>
<td>Specialty</td>
<td>74.9</td>
<td>.001</td>
<td>45.8</td>
</tr>
<tr>
<td>Specialty</td>
<td>76.4</td>
<td>.001</td>
<td>43.0</td>
</tr>
<tr>
<td>Specialty</td>
<td>80.9</td>
<td>.001</td>
<td>32.1</td>
</tr>
<tr>
<td>Specialty</td>
<td>74.5</td>
<td>.001</td>
<td>38.7</td>
</tr>
<tr>
<td>Academic affiliation</td>
<td>69.3</td>
<td>.001</td>
<td>53.8</td>
</tr>
<tr>
<td>No</td>
<td>78.8</td>
<td>.003</td>
<td>39.1</td>
</tr>
<tr>
<td>Volume of Medicare breast cancer operations in 4 y</td>
<td>&lt;.001</td>
<td>.001</td>
<td>43.8</td>
</tr>
</tbody>
</table>

Abbreviations: BCS, breast-conserving surgery; LND, lymph node dissection; XRT, radiation therapy.

*Values are expressed as percentages unless otherwise indicated. All P values from Pearson χ².
†Adherent defined as BCS with LND and XRT or mastectomy with LND.
In our study, it is possible that continuous upkeep of guidelines in the face of evolving familiarity to respectful disagreement, and the need for agreement with the consensus statement recommendations is in part be-
tween surgeon volume and breast cancer outcomes, it seems more likely that a phy-
sician volume-outcome relationship would be mediated by certain systems and processes of care rather than sur-

<table>
<thead>
<tr>
<th>Surgeon Characteristic</th>
<th>All Patients Adherent Care</th>
<th>BCS Subgroup Adherent Care (Both LND and XRT)</th>
<th>LND</th>
<th>XRT</th>
<th>Mastectomy Subgroup Adherent Care LND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgeon age (age–50)/10</td>
<td>0.97 (0.89-1.06)</td>
<td>0.85 (0.76-0.95)</td>
<td>0.92 (0.83-1.03)</td>
<td>0.89 (0.79-1.01)</td>
<td>1.04 (0.89-1.22)</td>
</tr>
<tr>
<td>Surgeon age (age–50)/10</td>
<td>0.98 (0.92-1.05)</td>
<td>1.07 (0.98-1.17)</td>
<td>1.03 (0.94-1.13)</td>
<td>1.03 (0.93-1.14)</td>
<td>0.92 (0.80-1.04)</td>
</tr>
<tr>
<td>Female (vs male)</td>
<td>0.67 (0.49-0.91)</td>
<td>0.68 (0.48-0.96)</td>
<td>0.70 (0.49-0.99)</td>
<td>1.04 (0.69-1.57)</td>
<td>1.23 (0.71-2.13)</td>
</tr>
<tr>
<td>Surgical specialty (vs general surgery, board certified)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thoracic/vascular surgery</td>
<td>1.06 (0.82-1.38)</td>
<td>1.21 (0.87-1.67)</td>
<td>1.18 (0.86-1.62)</td>
<td>1.28 (0.89-1.82)</td>
<td>0.73 (0.50-1.07)</td>
</tr>
<tr>
<td>General surgery, not board certified</td>
<td>1.22 (0.93-1.59)</td>
<td>0.84 (0.56-1.26)</td>
<td>1.04 (0.70-1.54)</td>
<td>0.77 (0.48-1.21)</td>
<td>1.50 (0.92-2.45)</td>
</tr>
<tr>
<td>Other</td>
<td>0.79 (0.51-1.23)</td>
<td>0.87 (0.55-1.38)</td>
<td>0.76 (0.46-1.25)</td>
<td>0.78 (0.40-1.52)</td>
<td>0.81 (0.39-1.68)</td>
</tr>
<tr>
<td>Academic affiliation (vs not)</td>
<td>0.71 (0.58-0.87)</td>
<td>0.73 (0.57-0.93)</td>
<td>0.62 (0.49-0.79)</td>
<td>1.34 (1.02-1.76)</td>
<td>0.94 (0.67-1.31)</td>
</tr>
<tr>
<td>Volume (log volume base 2)</td>
<td>1.12 (1.04-1.20)</td>
<td>1.13 (1.04-1.23)</td>
<td>1.12 (1.03-1.21)</td>
<td>1.10 (0.99-1.21)</td>
<td>1.16 (1.03-1.32)</td>
</tr>
</tbody>
</table>

*Adjusted for patient age, ZIP code level per capita income, ZIP code level education, and SEER site. Values are expressed as OR (95% CI).

Abbreviations: BCS, breast-conserving surgery; CI, confidence interval; LND, lymph node dissection; NIH, National Institutes of Health; OR, odds ratio; SEER, Surveillance, Epidemiology, and End Results; XRT, radiation therapy.

We have identified several surgeon characteristics associated with adherence to consensus statement recommendations. Surgeon characteristics are just one set of elements that contribute to the quality of care for patients with breast cancer. Surgeon volume, for instance, has been shown to be associated with better outcomes for patients with breast cancer. However, our study found that patients of higher-volume surgeons undergo care that is more adherent to consensus statement recommendations. This further underscores the importance of surgeon volume in the care of patients with breast cancer.

The association between volume of procedures performed by surgeons and cancer care outcomes is a current area of interest within the medical community. Evidence for the relationship between higher volume and better outcomes for cancer is strongest for relatively uncommon procedures, such as esophagectomy and surgery for pancreatic cancer. Nevertheless, 2 studies have now shown better 5-year survival for patients with breast cancer operated on by higher-volume surgeons. For some procedures, the volume-outcome relationship is attributed to better technical expertise of the surgeon. For breast cancer outcomes, it seems more likely that a physician volume-outcome relationship would be mediated by certain systems and processes of care rather than surgeon technical expertise. Our study finding that patients of higher-volume surgeons undergo care that is more adherent to consensus statement recommendations gives further credibility to the importance of surgeon volume in the care of patients with breast cancer.

Our measure of volume does have limitations. Our study is limited to women older than 65 years on whom information is available through Medicare claims. Women 65 years and older represent approximately half of incident cases of breast cancer and, assuming that the age distribution within a given surgeon’s practice reflects the incidence of breast cancer within the general population, surgeon volume would be approximately twice the Medicare volume as reported in our article. However, it is possible that some surgeons limit their treatment of Medicare patients, leading to artificially low Medicare volumes. If this practice is widespread, adherence to consensus statement recommendations may vary systematically if the full age spectrum were to be studied. However, our results are consistent with results of the other studies that are not limited to a Medicare population, suggesting this measure is valid.

Surgeon age has been a significant determinant in care received by patients with breast cancer in some studies but not in others. We do not confirm prior findings that older surgeons administer less adherent care. We are in agreement with Silliman et al that surgeon age is not a significant factor determining care received. We also did not find surgeon specialty/board certification as an important factor, but the small numbers of surgeons without general surgery certification likely limited our power to detect differences in their care.

Although we controlled for several patient characteristics known to be associated with breast cancer quality of care, the socioeconomic information available to us was community level (ZIP code level) rather than patient level. It is possible that there are patient selection biases for which we could not fully control.

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factors that influence quality of care.\textsuperscript{36} Care is also influenced by other patient, hospital, and systems characteristics. For example, receipt of postoperative XRT can be influenced by factors such as proximity to a radiation facility\textsuperscript{37} and patient socioeconomic status.\textsuperscript{3} However, such characteristics were not the focus of this study. At this time, it would be premature to make specific recommendations to patients with breast cancer regarding the type of surgeon they should be seeking. However, further study to evaluate systems improvements to facilitate quality of care for patients with breast cancer is warranted.

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Author Contributions: This study used the linked SEER-Medicare database. The interpretation and reporting of these data are the sole responsibility of the authors. Study concept and design: Gilligan, Sparapani, Laud, and Nattinger. Acquisition of data: Sparapani and Nattinger. Analysis and interpretation of data: Gilligan, Neuner, Sparapani, Laud, and Nattinger. Drafting of the manuscript: Gilligan. Critical revision of the manuscript for important intellectual content: Gilligan, Neuner, Sparapani, Laud, and Nattinger. Statistical analysis: Sparapani and Laud. Obtained funding: Nattinger. Administrative, technical, and material support: Gilligan.

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