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Determining Breast Cancer Axillary Surgery Within the Surveillance Epidemiology and End Results-Medicare Database

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Abstract

Background—Use of sentinel lymph node biopsy (SLNB) is under-reported by cancer registries' "Scope of Regional Lymph Node Surgery" variable. In 2011, the Surveillance Epidemiology and End Results (SEER) Program recommended against its use to determine extent of axillary surgery, leaving a gap in the utilization of claims data for breast cancer research. The objective was to develop an algorithm using SEER registry and claims data to classify extent of axillary surgery for breast cancer.

Methods—We analyzed data for 24,534 breast cancer patients. CPT codes and number of examined lymph nodes classified the extent of axillary surgery. The final algorithm was validated by comparing the algorithm derived extent of axillary surgery to direct chart review for 100 breast cancer patients treated at our breast center.

Results—Using the algorithm, 13% had no axillary surgery, 56% SLNB and 31% axillary lymph node dissection (ALND). SLNB was performed in 77% of node negative patients and ALND in

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72% of node positive. In our validation study, concordance between algorithm and direct chart review was 97%.

Conclusions—Given recognized inaccuracies in cancer registries' "Scope of Regional Lymph Node Surgery" variable, these findings have high utility for health services researchers studying breast cancer treatment. J. Surg. Oncol. ß 2014 Wiley Periodicals, Inc.

Keywords

breast cancer; SEER-Medicare; axillary surgery

INTRODUCTION

Management of the axilla is a critical component of breast cancer care [1], but accurately determining the extent of axillary surgery in existing data sources has proven challenging. To date, the most reliable source of extent of axillary surgery has been cancer registry data.

To ensure the quality of collected data across cancer registries, strict data standards have been developed. The variable "Scope of Regional Lymph Node Surgery" was first introduced in 1998 and was defined as "the procedure of removal, biopsy or aspiration of regional lymph nodes performed during the initial work-up or first course of therapy" [2]. Examples of the available coding include: no regional lymph nodes removed, sentinel lymph node biopsy [only], 1–3 or >4 nodes removed, or sentinel lymph node biopsy in addition to other axillary surgery.

Unfortunately, in 2011, concerns were raised regarding the validity of the reported breast cancer "Scope of Regional Lymph Node Surgery" data [3]. Patterns of care studies utilizing cancer registry data revealed higher than expected rates of axillary lymph node dissection (ALND) versus sentinel lymph node biopsy (SLNB), triggering direct registry chart reviews where the ALND rate dropped from 29.4% to 10.4% [3]. These findings led directly to a collaborative effort between multiple cancer registry surveillance agencies, including the American College of Surgeons Commission on Cancer, the National Cancer Institute's Surveillance Epidemiology and End Results (SEER) Program, the Center for Disease Control and Prevention National Program of Cancer Registries, and the North American Association of Central Cancer Registries, to implement revised coding instructions for the "Scope of Regional Lymph Node Surgery" variable. Further, the recommendation to curtail the current research use of the variable was made.

A revised "Scope of Regional Lymph Node Surgery" variable was implemented in 2012. However, this variable will not be retroactively filled, meaning that accurate information regarding type of axillary surgery prior to 2012 (important for assessment of trends) will not be available through cancer registry data. This leaves a major gap in our ability to evaluate a variety of important health services research questions in breast cancer. We sought to fill this gap by developing an accurate classification of extent of axillary surgery for breast cancer using a combination of cancer registry and claims data.

METHODS

This study was approved by the University of Wisconsin Institutional Review Board.

We used cancer registry data from SEER linked with Medicare claims [4,5]. Patients with continuous Medicare coverage who underwent surgical treatment of stages I–III breast cancer from 2005 to 2007 were included in the analysis. Patients undergoing neoadjuvant chemotherapy were also included. Patients were excluded if they were enrolled in a Health Maintenance Organization (HMO) during the same time period. Additionally, patients were excluded if they were diagnosed with another malignancy 5 years before or after the date of breast cancer diagnosis, or if their first diagnosis of breast cancer was made after death (i.e., on autopsy or death certificate). Overall, 24,534 patients were identified. In this cohort, 26% were node positive.

All CPT and ICD-9 codes for breast or axillary surgery which occurred within 45 days prior to or 365 days after the date of breast cancer diagnosis were identified; this window for claims assessment allowed for consideration of sequencing of multiple axillary procedures (i.e., sentinel lymph node biopsy followed by an axillary lymph node dissection at a later date). As the relative proportion of patients with bilateral cancers is low in the SEER registry as a whole [6], we assumed all procedure claims to be associated with a single incident cancer. Although risk-reducing contralateral surgeries may have occurred, these would likely have had “less intensive” axillary surgery than the incident cancer side and would therefore not negatively impact the use of claims data to determine the extent of axillary surgery for the incident cancer.

Using the identified claims for surgery and the clinical variables in the registry data, an algorithm to classify patients as receiving an ALND versus a SLNB was created. To validate our final algorithm, we performed direct chart review of 100 breast cancer patients treated at our breast center between 2010 and 2013. The patients selected for chart review included a proportion of patients undergoing SLNB alone, SLNB followed by immediate ALND (during same procedure), SLNB followed by ALND at later date, and ALND alone to provide a broad range of scenarios upon which to evaluate the final algorithm. Axillary and breast procedures performed and the associated ICD-9 and CPT codes were collected. Additionally, the total number of lymph nodes removed was assessed. The definitive axillary surgery as determined by the final algorithm was then compared to the actual axillary surgery identified through chart review to assess concordance.

RESULTS

We initially attempted to classify scope of axillary surgery using both CPT and ICD-9 codes, taking into account date of surgery and “trumping rules” where presence of a code for ALND took precedence over a SLNB code. However, this algorithm overestimated the rate of ALND (57% of cohort), largely due to the non-specificity of the axillary surgery ICD-9 codes (i.e., no ICD-9 code specifically indicates a SLNB). However, even after reclassifying scope of surgery based only on CPT codes, rates of ALND were overestimated. After examining the observed combinations of axillary surgery CPT codes, we determined that

42% of patients had CPT codes for both a SLNB and an ALND; the most common CPT codes seen in combination with a SLNB code were “lumpectomy with ALND” (19162, 19302) and “modified radical mastectomy” (19200, 19220, 19240, 19305, 19306, 19307). However, when we examined the number of lymph nodes examined for each of these CPT code combinations, 55% of these patients had <5 lymph nodes examined, suggesting that these combinations are the source of the overestimation.

Based on these observations, we generated several rules utilizing CPT codes for axillary surgery (Medicare claims) and accounting for number of lymph nodes examined (SEER). The rules are represented in Table I. Using these rules, 13% of our cohort underwent no axillary surgery, 56% underwent SLNB and 31% underwent ALND. We further examined these rules by evaluating the number of lymph nodes examined (Table II). Overall, 77% of node negative patients received appropriate treatment with a SLNB and 72% of node positive patients underwent an ALND. We further examined those patients who were classified as undergoing an ALND without nodal metastasis. Seventy- nine percent of these patients had 8 lymph nodes examined. None of the patients with fewer than 8 lymph nodes examined had a CPT code for SLN mapping, suggesting that ALND was the correct classification for these patients. We also performed an analysis examining the assumption that patients with claims for both SLNB and ALND but with 7 or fewer lymph nodes removed would be classified as SLNB (Table III). Overall, 44% of patients with 5, 6, or 7 lymph nodes removed were classified as SLNB based on this assumption. Nodes were negative in 72% of these patients, supporting that the SLNB classification was appropriate for the majority.

The final algorithm was then validated by applying it to a sample of patients treated at our breast center. Our review of chart and billing data parallels the observations in the SEER-Medicare data with regards to the source of overestimation of ALND, with 54% of patients with a claim for “lumpectomy with ALND” (19162, 19302) or “modified radical mastectomy” (19200, 19220, 19240, 19305, 19306, 19307) also having a claim for a SLNB. This supports our rationale to use a combination of CPT codes and number of lymph nodes examined in our algorithm rather than relying on CPT codes alone. Of the 100 patient charts reviewed from our breast center, 52% underwent SLNB and 48% ALND as the definitive axillary surgery.

Concordance between the algorithm and chart review derived axillary surgery was 97%. Definitive axillary surgery was incorrectly identified by the algorithm in three patients. Both cases that were misclassified as undergoing SLNB when an ALND was actually performed had received neoadjuvant chemotherapy. In one patient, lymphoscintigraphy did not successfully map to the axilla and an ALND was subsequently performed; billing data did not capture the ALND. In the second patient, a SLNB was performed followed by an immediate ALND; however, as only seven nodes were retrieved this patient was errantly classified as having undergone a SLNB. The patient who was misclassified as having undergone ALND (when SLNB was actually performed) had claims for both an ALND and a SLNB (one of the combinations of codes observed to lead to overestimation of extent of axillary surgery). However, 8 lymph nodes were removed (5 SLN and 3 non-SLN) and she was therefore classified errantly as ALND (Table IV).

DISCUSSION

We have developed an algorithm using registry variables available within the SEER database and CPT procedures codes identified in claims data that can accurately classify the extent of axillary surgery for patients with stages I–III breast cancer. The extent of axillary surgery by the number of nodes examined and number of positive lymph nodes is in- line with what we would expect in clinical practice. Further, this algorithm has been validated in a sample of patients undergoing breast surgery within our breast center, with 97% concordance between the algorithm and direct chart review. Our algorithm appears to be robust across a variety of clinical situations, including patients undergoing SLNB alone, SLNB followed by ALND, and ALND alone. Three patients were misclassified using the algorithm. In one patient, billing data did not accurately reflect what operative procedures were performed; this is always a potential limitation of claims data. In another patient who had undergone neoadjuvant therapy, a low nodal retrieval was obtained with her ALND. As lower than average lymph node counts has been observed after neoadjuvant therapy in prior studies [7,8], this should be considered by researchers when applying this algorithm to patients receiving neoadjuvant therapy. The final patient had claims for both SLNB and ALND but 8 nodes removed (including 3 non-SLN nodes) and represents a true misclassification by the algorithm. However, the overall 97% concordance suggests that our algorithm is accurate enough to be used as a means of classifying extent of axillary surgery.

Some limitations to our analysis exist. First, we were not able to directly review charts in the SEER-Medicare sample to directly validate our algorithm. However, we did perform a validation on a sample of patients treated within our breast center with good concordance. Second, we chose not to include dates and order of procedures (i.e., did SLNB precede the ALND) in our algorithm. This allowed us to avoid issues regarding laterality of the procedure (always a question with breast cancer surgical claims data) and simplified our algorithm. Third, patients receiving neoadjuvant therapy may undergo SLNB at a variety of time points (before, after, or both before and after neoadjuvant therapy); this may introduce some inaccuracy to the algorithm which should be considered by researchers applying the algorithm to their particular research question. Finally, we made assumptions regarding the number of lymph nodes examined to classify between SLNB and ALND for patients who had CPT codes for both procedures. The most difficult procedure distinction was for those patients with 5, 6, or 7 lymph nodes examined (5% of our cohort). Given that the majority of these patients (72%) had negative lymph nodes and that the largest randomized controlled trial validating SLN reported a mean of 2.9 (SD 2.2) nodes removed [9], classifying these patients as having a SLNB was most appropriate. Patients with 5, 6, or 7 lymph nodes examined does represent the group with the greatest potential for misclassification; one option for researchers would be to exclude this relatively small patient group from analysis, depending on the particular clinical questions being investigated.

In this report, we have defined and validated a means of classifying extent of axillary surgery for breast cancer patients within the SEER- Medicare data. This algorithm is dependent on the availability of CPT codes through claims data, and unfortunately cannot be applied to other cancer registry databases, such as the National Cancer Data Base or SEER-

only data. However, these findings have high utility for health services researchers interested in studying breast cancer treatment using the SEER-Medicare data.

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REFERENCES

1. Fisher B, Bauer M, Wickerham DL, et al. Relation of number of positive axillary nodes to the prognosis of patients with primary breast cancer. An NSABP update. Cancer. 1983; 52:1551–1557. [PubMed: 6352003]
2. [January 31, 2012] National Cancer Institute Surveillance Program. 1998. http://seer.cancer.gov/manuals/EOD10Dig.3rd.pdf
3. National Cancer Data Base. [March 9, 2012] Scope of Regional Lymph Node Surgery: A Review of Data Validity, Revised Coding Directives, and Agency Transition Plans. http://www.facs.org/cancer/ncdb/scope-regional-lymph-node-surgery.pdf
4. Warren JL, Klabunde CN, Schrag D, et al. Overview of the SEER-Medicare data: Content, research applications, and generalizability to the United States elderly population. Med Care. 2002; 40:IV–3–IV-18.
5. Potosky AL, Riley GF, Lubitz JD, et al. Potential for cancer related health services research using a linked Medicare-tumor registry database. Med Care. 1993; 31:732–748. [PubMed: 8336512]
6. Hill TD, Khamis HJ, Tyczynski JE, et al. Comparison of male and female breast cancer incidence trends, tumor characteristics, and survival. Ann Epidemiol. 2005; 15:773–780. [PubMed: 16257362]
7. Neuman H, Carey LA, Ollila DW, et al. Axillary lymph node count is lower after neoadjuvant chemotherapy. Am J Surg. 2006; 191:827–829. [PubMed: 16720159]
8. Belanger J, Soucy G, Sideris L, et al. Neoadjuvant chemotherapy in invasive breast cancer results in a lower axillary lymph node count. J Am Coll Surg. 2008; 206:704–708. [PubMed: 18387477]
9. Krag DN, Anderson SJ, Julian TB, et al. Technical outcomes of sentinel-lymph-node resection and conventional axillary-lymph-node dissection in patients with clinically node-negative breast cancer: Results from the NSABP B-32 randomised phase III trial. Lancet Oncol. 2007; 8:881–888. [PubMed: 17851130]

TABLE I

Extent of Axillary Surgery Rules

Extent of axillary surgery	Rule
No axillary surgery	If there is no axillary surgery CPT code OR if no lymph nodes are examined
SLNB	If there is a SLN mapping (38792, 78195, 78800, 78801) and/or lymph node biopsy code (38500, 38525) AND no other axillary surgery CPT codes are present (regardless of number of nodes examined)
ALND	If there is an axillary surgery CPT code AND no SLN mapping (38792, 78195, 78800, 78801) and/or lymph node biopsy code (38500, 38525) is present (regardless of number of nodes examined)
SLNB	If there is a SLN mapping (38792, 78195, 78800, 78801) and/or a lymph node biopsy code (38500, 38525) AND ≤7 lymph nodes were examined (regardless of what other axillary surgery CPT codes may be present)
ALND	If there is any axillary surgery CPT code AND ≥7 lymph nodes are examined (regardless of what other axillary surgery CPT codes may be present)

TABLE II

Number of Nodes Examined, by Extent of Axillary Surgery

	Number of lymph nodes examined									
Treatment of the axilla	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 or more**	**Total (N)**
No axillary surgery	2,691	83	56	31	21	17	22	20	172	3,113
SLNB	0	3,990	3,454	2,299	1,415	884	636	482	592	13,752
ALND	0	130	119	119	154	186	185	206	6,570	7,669

SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

TABLE III

Classification of Extent of Axillary Surgery for Patients With 5, 6, or 7 Lymph Nodes Examined

	Number of lymph nodes examined		
	5	6	7
Classification	**N = 1,087**	**N = 843**	**N = 708**
Number classified as ALND[a]	186 (17%)	185 (22%)	206 (29%)
Number classified as SLN	884 (83%)	636 (78%)	482 (71%)
Number classified as SLN with claims for both SLN and ALND but ≤7 lymph nodes examined	447 node negative: 80%	384 node negative: 70%	327 node negative: 65%

SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.

[a]Classified as ALND because no SLN mapping and/or lymph node biopsy code present.

TABLE IV

Extent of Axillary Surgery as Defined by the Developed Algorithm Compared to Direct Chart Review

	Algorithm	
Direct chart review	**ALND**	**SLNB**
ALND	47	2
SLNB	1	50

SLNB, sentinel lymph node biopsy; ALND, axillary lymph node dissection.