Association between Surgeon and Hospital Characteristics and Lymph Node Counts From Radical Prostatectomy and Pelvic Lymph Node Dissection

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OBJECTIVE To assess whether surgical approach and hospital characteristics independently determine the number of lymph nodes (LNs) removed from prostate cancer patients undergoing radical prostatectomy (RP) and pelvic LN dissection (PLND).

METHODS Using the National Cancer Database, we identified all surgically treated patients diagnosed with pretreatment intermediate- or high-risk prostate cancer from 2010 to 2011. The primary outcome was the number of LNs retrieved at the time of RP. Generalized estimating equations were used to assess for differences in the adjusted number of LNs retrieved after accounting for patient and hospital characteristics and surgical approach.

RESULTS Overall, 35,876 patients were diagnosed with intermediate-risk (61.2%) and high-risk (38.8%) prostate cancer and underwent RP and PLND.On multivariate analysis, open RP and high-volume and academic hospitals were independently associated with greater LN counts compared with robotic-assisted RP and medium or low and community hospitals, respectively (all P <.001). After adjusting for patient and hospital variables, higher adjusted LN counts were observed for open RP compared with robotic-assisted RP (7.1 vs 6.1; P <.001). Adjusted counts were also higher for high-volume hospitals compared with medium- or low-volume hospitals (7.8 vs 5.9; P <.001), and academic compared with community hospitals (7.3 vs 5.6; P <.001).

CONCLUSION Among patients with aggressive prostate cancer treated with RP and PLND, retrieval of LN counts varied by surgical approach and hospital characteristics. UROLOGY 85: 890–895, 2015.

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Prostate cancer remains the most commonly diagnosed male malignancy with an estimated 240,000 incident cases each year.[1] In the prostate-specific antigen (PSA) screening era, lymph node (LN) metastasis can occur in up to 20% of patients with a high Gleason score, locally advanced disease, or a greater number of cores positive on prostate biopsy.[2,3] Clinical practice guidelines universally recommend pelvic LN dissection (PLND) at the time of radical prostatectomy (RP) for patients with intermediate- or high-risk disease because of the high risks of disease progression and cancer-specific mortality among patients with pelvic LN metastasis.[4-8]

PLND facilitates more accurate staging and guides treatment decisions in regard to more rigorous surveillance or the need for secondary therapies.[9] However, the anatomic borders of an optimal PLND have yet to be established.[10] As a consequence, the number of LNs retrieved at the time of surgery has been put forth as a

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measure of surgical quality based on several studies, suggesting greater LN yields can improve the detection of LN metastasis and survival.[11-16] However, concerns about the adequacy of the number of LNs harvested at RP and PLND among patients with clinically aggressive prostate cancer have been raised.[17,18] At present, it is unknown to what degree the number of LNs harvested at RP and PLND varies by surgical approach or hospital characteristics. Addressing these key questions will elucidate modifiable factors in clinical care that patients, surgeons, and key stakeholders can use to improve the quality of care for surgically treated patients with prostate cancer. We therefore sought to assess the differences in LN counts among prostate cancer patients undergoing RP and PLND and identify which factors were associated with higher LN counts in a population-based cohort from 2010 to 2011. We also aimed to assess whether the number of LNs retrieved at RP and PLND was associated with greater detection of LN metastasis.

METHODS

Study Population

We used data from the National Cancer Database hospital-based cancer registry jointly sponsored by the American Cancer Society and the American College of Surgeons. To identify the patient population, we selected patients aged 40-80 years with a primary diagnosis of pathologic nonmetastatic prostate cancer who underwent RP and PLND (n = 97,731). Patients were excluded if the surgical approach was unknown (n = 2794), coded as endoscopic or laparoscopic surgery without robotic assistance (n = 4341), lacked primary tumor stage (n = 3603) or PLND status (n = 102), or had unknown number of LNs examined (n = 1293). We also excluded patients when PLND status was undetermined because of conflicting recorded number of LNs (n = 404).

Patients were then stratified into low-, intermediate-, and high-risk groups from pretreatment clinicopathologic characteristics based on the D'Amico criteria.[19] Among the 10,787 patients (12.7%) having missing PSA and/or Gleason scores, these patients were classified according to information obtained from their clinical stage (if missing PSA and Gleason scores), clinical stage and PSA (if missing Gleason score), or clinical stage and Gleason score (if missing PSA).

Because the primary aim of this study was to assess the number of LNs obtained at RP and PLND for clinically appropriate patients, we elected to exclude patients who were diagnosed with low-risk prostate cancer (n = 34,523). Furthermore, we excluded patients who did not undergo a concomitant PLND at the time of RP (n = 14,795). This resulted in 35,876 patients in the final analytic cohort.

Primary Outcome and Patient and Hospital Covariates

The primary outcome of this study was the LN count retrieved from RP and PLND as a measure for surgical quality. A secondary outcome was the detection of LN-positive prostate cancer. Covariates used to test for associations in the number of LNs retrieved at PLND were the following: age at diagnosis, race, 2000 census tract annual median income, insurance status, geographic region, patient location (rural, metro, and urban), Charlson-Deyo comorbidity score, and pretreatment risk group grade.

We also evaluated surgical approach (open RP [ORP] vs robotic-assisted RP [RARP]), hospital academic status (academic vs community), and hospital volume. Classification of hospital academic status was made based on the cancer program category assigned by the Commission on Cancer for each facility. Academic Comprehensive Cancer Program facilities were classified as academic hospitals, whereas Comprehensive Community Cancer Program, Community Cancer Program, and other facilities were classified as community hospitals. To determine hospital volume, we calculated the total number of RPs at each facility over the 2-year period. High-volume hospitals were defined as those with the highest interquartile range (IQR). The remaining hospitals were categorized as medium- or low-volume hospitals for the remaining lower IQR. The IQR for hospital volume was 1-39, 40-84, 85-199, and ≥200. High node retrieval was defined as a dichotomous variable by categorizing the number of nodes retrieved into quartiles and designating high LN yields (≥9) as those in the fourth quartile, and low to medium yields for the remaining lower quartiles (range, 1-88).

Statistical Analysis

Bivariate associations of patient, facility, and cancer variables were tested by the Pearson chi-square test and the Wilcoxon rank-sum test where appropriate. We then constructed generalized estimating equations using the gamma distribution to identify hospital and treatment characteristics independently associated with number of LNs retrieved, adjusting for clustering at the hospital level. We also performed a similar generalized estimating equations analysis in a subset of patients with pelvic LN metastasis (pN1+) to test the association in the number of pelvic LNs harvested and patient, hospital, and surgical characteristics. To assess for factors associated with variation in the detection of LN metastasis, we also constructed a random-effects logistic regression analysis to test for associations between LN metastasis and LN counts, and patient, hospital, and surgical characteristics. To account for possible misclassification in risk stratification, we also performed a sensitivity analysis excluding patients with missing PSA and/or Gleason scores. To mitigate confounding owing to tumor risk variation among intermediate-risk patients, a separate sensitivity analysis was also performed by excluding patients with a PSA level <10 ng/mL. Stata SE, version 13.0 (StataCorp, College Station, TX) was used to perform all statistical analyses. A 2-sided P value of $P < .05$ was used to determine statistical significance.

RESULTS

A total of 35,876 intermediate- and high-risk patients with primary prostate cancer treated with PLND at RP were evaluated. As shown in Table 1, a majority of the patients were white (79.2%) and privately insured (60.6%). Approximately two-thirds of patients diagnosed presented with a PSA level ≤10 ng/mL (69.3%) or a Gleason score of 7 (66.9%). Only 1661 patients had node-positive disease (4.6%).

Overall, the median number of LNs retrieved at RP and PLND was 5 (IQR, 3-9). On bivariate analysis, the number of LNs retrieved varied significantly by surgical approach, hospital volume, and type of hospital among