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Original article

The effect of surgical approach on performance of lymphadenectomy and perioperative morbidity for radical nephroureterectomy

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Abstract

Objectives: To examine the effect of surgical approach on regional lymphadenectomy (LND) performance and inpatient complications for radical nephroureterectomy (NU) using a national administrative database.

Methods: The National Inpatient Sample (2009–2012) was used to identify patients who underwent NU for urothelial carcinoma. Cohorts were stratified by performance of LND. Covariates included patient demographics, comorbidity, hospital characteristics, hospital volume, performance of LND, surgical approach (open [ONU], laparoscopic [LNU], or robotic [RNU]), and complications. Multivariable logistic regression was used to identify factors associated with LND performance and complications.

Results: A weighted population of 14,059 (85%) without LND and 2,560 (15%) with LND was identified. LND was more common in RNU (27%) compared with ONU (15%) and LNU (10%) ($P < 0.01$). On multivariable analysis, when compared with ONU, RNU was associated with increased odds of LND performance (odds ratio [OR] = 1.9, 95% CI: [1.3–2.8]; $P = 0.001$), whereas LNU was associated with decreased odds of LND performance (OR = 0.6, 95% CI: [0.4–0.8]; $P = 0.004$). Multivariable analysis of risk factors for complications demonstrated lower odds of complications with RNU (OR = 0.6, 95% CI: [0.4–0.8]; $P = 0.001$), whereas performance of LND increased the risk of complications (OR = 1.3, 95% CI: [1.001–1.7]; $P = 0.049$).

Conclusions: When compared with ONU, RNU increased the odds of LND performance and had a lower inpatient complication rate, whereas LNU reduced the odds of LND performance and had no significant effect on inpatient complication rates. Performance of LND was independently associated with higher inpatient complication rates.

Keywords: Urothelial carcinoma; Upper urinary tract; Lymph node excision; Complications; Treatment outcome; Patterns of care

1. Introduction

Upper tract urothelial carcinoma (UTUC) is a relatively rare entity, with most of the tumors arising from the renal pelvis. As only 5% of urothelial neoplasms occur in the kidneys and the ureters, patterns of care and optimal management of UTUC are far less studied when compared with urothelial carcinoma of the bladder [1]. Multicenter studies of radical nephroureterectomy (NU) with regional lymph node dissection (LND) for UTUC indicate a 25% overall incidence of node-positive disease, with rates ranging from 6% to 35% depending on tumor stage and grade [2,3]. Based on extrapolation of data from patients undergoing radical cystectomy for bladder cancer, it is logical that proper diagnosis and management of LN metastasis in UTUC could improve patient outcomes. However, the practice of LND during NU for invasive UTUC has not been consistently adopted by urologists, likely because of a lack of prospective evidence supporting a cancer-specific survival benefit for LND and incomplete understanding of the optimal LND template [4].

Over the last decade, interest in minimally invasive surgical techniques for UTUC has grown. Laparoscopic (LNU), and more recently robot-assisted laparoscopic (RNU), techniques have been described as alternatives to the traditional open approach (ONU) [5]. There are 2 meta-analyses comparing LNU and ONU have supported

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oncologic equivalence; however, definitive conclusions cannot be made because most studies included in analysis were limited by short follow-up (<5 y) [6,7]. Both LNU and RNU appear to improve postoperative convalescence when compared with ONU [8,9]. A recent matched analysis compared 22 patients who underwent RNU and 22 patients who underwent LNU at a single institution, finding that patients undergoing RNU were more likely to undergo an LND and, when performed, median LN yields were higher for the robotic approach [10]. National trends in adoption of LNU and RNU in comparison with ONU and the effect of the various approaches on practice patterns for performance of LND have not been examined. Using the National Inpatient Sample, we evaluated the effect of surgical approach on LND performance and complication rates.

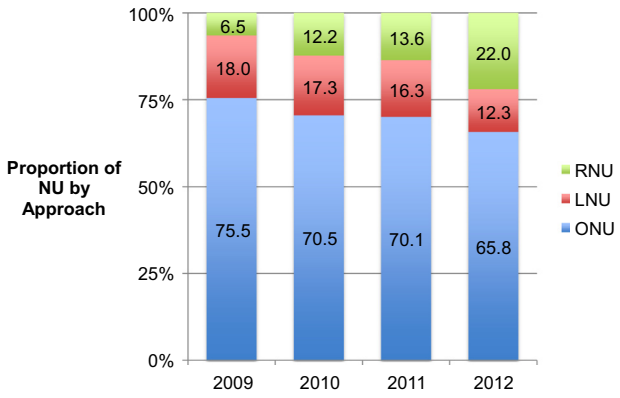

Fig. Surgical approach for radical nephroureterectomy from 2009 to 2012. Over time, there was an increase in the proportion of cases performed with robot assistance, with reductions in both laparoscopic and open cases ($P < 0.001$).

2. Materials and methods

The U.S. Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) database is the largest all-payer inpatient database in the United States, representing the inpatient experience of a 20% stratified probability sample of American nonmilitary, nonfederal hospitals [11]. The NIS was queried for patients who underwent NU for a renal pelvis or ureteral neoplasm between 2009 and 2012. A survey-weighted design allowed for population-level estimates of national trends and incidence rates. Institutional review board approval was not required, as the NIS does not include identifiable patient information.

All patients with a primary diagnosis of renal pelvic or ureteral neoplasm who underwent NU were identified using International Classification of Disease Ninth revision (ICD-9) diagnostic and procedure codes (Supplementary Table S1). Patients with missing age ($n = 1$), younger than 18 years ($n = 3$), or with metastatic disease ($n = 13$) were excluded. ICD-9 procedure codes for performance of regional LND and surgical approach (ONU, LNU, and RNU) allowed construction of cohorts.

Demographic information included age, sex, race, and primary insurance type. Equally sized age tertiles were generated for intergroup comparison and logistic regression. Hospital setting (urban or rural), teaching status, and hospital volume were examined. Annual hospital NU volume (any approach) was determined and divided into tertiles (low: 1–2 cases/y, intermediate: 3–7 cases/y, and high: ≥8 cases/y). Comorbidity was calculated using the Elixhauser method, which has been shown to compare favorably to other well-validated comorbidity scores [12]. The Elixhauser comorbidity score was also divided into tertiles. Outcomes assessed included length of stay, inpatient mortality, and complications, as described previously [13]. Hemorrhagic complications included the receipt of blood transfusion during the inpatient stay. Prolonged length of stay of ≥7 days represented the 75th percentile of the entire study cohort. *No specific staging information is available in the NIS.*

Stata 13.1 (StataCorp, College Station, TX) was used for statistical analyses with survey weighting. The chi-square test with Rao-Scott correction was used for comparison of categorical variables [14]. Multivariate logistic regression was performed to identify patient, hospital, and surgical factors associated with performance of LND and to identify risk factors for any postoperative inpatient complications. A 2-sided $P < 0.05$ was considered significant for all statistical tests.

3. Results

A total of 16,619 patients were included for analysis. The use of ONU, LNU, and RNU approaches evolved over time from 2009 to 2012, as shown in the Fig. Specifically, the use of RNU increased (6% of all cases in 2009 to 22% in 2012), whereas the use of ONU (76% to 66%) and LNU (18% to 12%) declined ($P = 0.001$).

Baseline patient demographics and hospital characteristics by performance of LND are shown in Table 1. The median age of the entire cohort was 72 years (interquartile range [IQR]: 64–80). Patients 67 years and younger were more likely to undergo LND (18%, $n = 998$) when compared with patients 78 years and older (12%, $n = 620$; $P < 0.001$). Hospital characteristics were significantly different between the groups, with LND dissection more common in teaching hospitals (19% vs. 8%, $P < 0.001$), intermediate-volume hospitals (16%), and high-volume hospitals (20% vs. 11% for low volume, $P < 0.001$). Patients undergoing RNU were more likely to undergo LND (27%) when compared with ONU (15%) and LNU (10%, $P < 0.001$). There were no trends in performance of LND over time ($P = 0.4$).

Inpatient outcomes by performance of LND are shown in Table 2. On univariate analysis, there was no difference in the rate of intraoperative complications ($P = 0.6$) or