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Bladder Cancer

Perioperative Outcomes, Health Care Costs, and Survival After Robotic-assisted Versus Open Radical Cystectomy: A National Comparative Effectiveness Study

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Abstract

Background: Radical cystectomy is the gold-standard management for muscle-invasive bladder cancer, and there is debate concerning the comparative effectiveness of robotic-assisted (RARC) versus open radical cystectomy (ORC).

Objective: To compare utilization, perioperative, cost, and survival outcomes of RARC versus ORC.

Design, setting, and participants: We identified bladder urothelial carcinoma treated with RARC ($n = 439$) or ORC ($n = 7308$) during 2002–2012 using the Surveillance, Epidemiology, and End Results Program-Medicare linked data.

Intervention: Comparison of RARC versus ORC.

Outcome measurements and statistical analysis: We used propensity score matching to compare perioperative and survival outcomes, including lymph node yield, perioperative complications, and healthcare costs.

Results and limitations: Utilization of RARC increased from 0.7% of radical cystectomies in 2002 to 18.5% in 2012 ($p < 0.001$). Women comprised 13.9% versus 18.1% ($p = 0.007$) of RARC versus ORC, respectively. RARC was associated with greater lymph node yield with 41.5% versus 34.9% having ≥ 10 lymph nodes removed (relative risk 1.1, 95% confidence interval [CI] 1.01–1.22, $p = 0.03$) and shorter mean length of hospitalization at 10.1 (\pm standard deviation 7.1) d versus 11.2 (\pm 8.6) d ($p = 0.004$). While inpatient costs were similar, RARC was associated with increased home healthcare utilization (relative risk 1.14, 95% CI 1.04–1.26, $p = 0.009$) and higher 30-d ($p < 0.01$) and 90-d ($p < 0.01$) costs. With a median follow-up of 44 mo (interquartile range 16–78), overall survival (hazard ratio 0.88, 95% CI 0.74–1.05) and cancer-specific survival (hazard ratio 0.91, 95% CI 0.66–1.26) were similar.

Conclusions: RARC provides equivalent perioperative and intermediate term outcomes to ORC. Additional long-term and randomized studies are needed for continued comparative effectiveness assessment of RARC versus ORC.

Patient summary: Our population-based US study demonstrates that robotic-assisted radical cystectomy has similar perioperative and survival outcomes albeit at higher costs.

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1. Introduction

Currently, open radical cystectomy (ORC) is the gold standard management for muscle invasive bladder cancer [1]. However, even when performed by experienced surgeons, the procedure is associated with significant morbidity, including bleeding, incisional pain, and significant changes in fluid homeostasis due to prolonged exposure of the peritoneal surface [2]. The use of robot-assisted radical cystectomy (RARC) has grown in popularity with the goal of reducing morbidity [3,4].

Robotic surgery has been questioned due to concerns regarding oncological efficacy, higher costs, direct-to-consumer marketing, and prolonged learning curve. The first RARC series reported in 2003 by Menon et al [5] demonstrated its perioperative safety. Since then, several studies have examined oncologic outcomes with RARC [6,7]. However, these studies had limited follow-up and often lacked an ORC control group [4,6]. Moreover, these were largely single- and multi-institutional studies of early adopters at predominantly academic centers, and thus, the findings may not be generalizable beyond these provider characteristics. Given the dearth of population-based studies with cost valuations and long-term outcomes, we examined a nationally representative cohort to evaluate the safety and efficacy of RARC across a variety of surgeons and settings.

2. Patients and methods

2.1. Data source

We used the Surveillance, Epidemiology, and End Results Program (SEER) and Medicare linked data with follow-up through 2013. Linkage between the SEER registry and Medicare hospital and physician claims is achieved for more than 90% of patients [8]. SEER identifies 28% of all incident cancer cases in the USA, and Medicare insures approximately 97% of all Americans aged ≥65 yr. The study was approved by the Weill Cornell Medical College Institutional Review Board.

2.2. Study population

We identified patients with bladder urothelial carcinoma (UC) using International Classification of Disease for Oncology (ICD-O-3) site code 67.0-67.9 and histologic code 8120 or 8130. Among these patients, we included those who underwent radical cystectomy with International Classification of Disease, 9th revision (ICD-9) procedure code 57.7, 57.71, and 57.79 between 2002 and 2012 aged greater than 65 yr. We excluded patients with metastasis from UC or preoperative radiation therapy (Fig. 1).

2.3. Exposure and study outcomes

Minimally invasive surgery (MIS) was determined by concurrent laparoscopic (ICD-9 54.21, 54.51) and robotic procedural codes (ICD-9 17.4, 17.42, 17.49). Patients without a concurrent code of MIS were considered to have undergone open surgery. Given the widespread adoption of robotic-assisted technique across the USA, almost all MIS cystectomies are performed robotically and thus the acronym RARC is used in this manuscript [9].

Overall and cancer-specific survival were defined as the time between index surgery and death or until December 2013. When death did not occur, patients were censored at the end of the study period. Overall

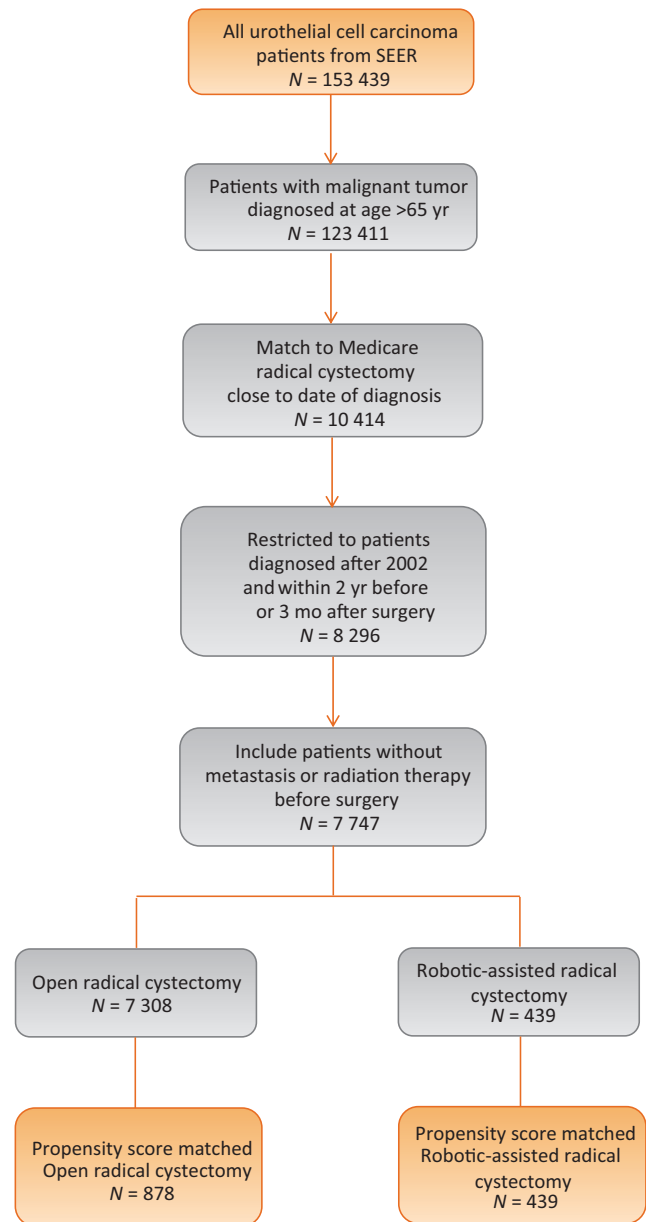


Fig. 1 – Patient selection process.
SEER = Surveillance, Epidemiology, and End Results.

survival was ascertained by occurrence of death from any cause. Cancer-specific survival was obtained from SEER. Additional outcomes included lymph node yield (LNY), in-hospital outcomes, 30-d readmissions (among patients discharged to home), and costs of care. In-hospital outcomes included death, major events (acute myocardial infarction, stroke, pulmonary embolism, and shock), respiratory complications, infection and sepsis, acute kidney injury, iatrogenic complications (procedure related laceration or bleeding), intensive care unit admission, blood transfusion, length of stay (LOS), and discharge disposition.

Costs of care were estimated and converted to 2012 dollars according to previously validated methods by summing Medicare reimbursements, coinsurance reimbursements, and patient-liability costs [10].

2.4. Independent variables

Patient characteristics included age, sex, race and ethnicity, marital status, socioeconomic status, residence, and smoking history. Smoking

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