Original article

Comparative effectiveness of robot-assisted vs. open radical cystectomy

Nawar Hanna, M.D.[a,1], Jeffrey J. Leow, M.B.B.S., M.P.H.[a], Maxine Sun, M.P.H.[a],
David F. Friedlander, M.D.[a], Thomas Seisen, M.D.[a], Firas Abdollah, M.D.[b,2],
Stuart R. Lipsitz, Sc.D.[a], Mani Menon, M.D.[b], Adam S. Kibel, M.D.[a],
Joaquim Bellmunt, M.D.[c], Toni K. Choueiri, M.D.[c], Quoc-Dien Trinh, M.D.[a,*]

[a] Division of Urological Surgery and Center for Surgery and Public Health, Brigham and Women's Hospital/Dana-Farber Cancer Institute,
Harvard Medical School, Boston, MA
[b] Henry Ford Hospital, Vattikuti Institute of Urology, Center for Outcomes Research, Analytics and Evaluation, Detroit, MI
[c] Department of Medical Oncology, Dana-Farber Cancer Institute, Harvard Medical School, Brigham and Women's Hospital, Boston, MA

Abstract

Objectives: Over the past decade, robot-assisted radical cystectomy (RARC) has gained traction as an alternative to the conventional open approach open radical cystectomy (ORC). However, the benefits of RARC over ORC remain unclear. Our objective was to conduct a comparative effectiveness analysis between RARC and ORC using data from the National Cancer Data Base.

Materials and methods: Within the National Cancer Data Base, we identified patients with localized muscle-invasive bladder cancer who underwent RC between 2010 and 2013. Patients were stratified according to surgical approach: ORC vs. RARC. Intraoperative endpoints included: the presence of positive surgical margins, the performance of a pelvic lymph node dissection, and number of lymph nodes (LN) removed. Postoperative endpoints included: length of stay (LOS), 30- and 90-day postoperative mortality (POM) rates, 30-day readmission rate, and overall survival (OS). To minimize selection bias, observed differences in baseline characteristics between RARC vs. ORC patients were controlled for using weighted propensity scores. Binary endpoints and OS were assessed using propensity score-adjusted logistic and Cox regression analyses, respectively. POM was assessed using propensity score weighted Kaplan-Meier survival estimates at 30 and 90 days after RC.

Results: Of 9,561 patients who underwent RC, 2,048 (21.4%) and 7,513 (78.6%) underwent RARC and ORC, respectively. The use of RARC increased over time, from 16.7% in 2010 to 25.3% in 2013. With regard to intraoperative outcomes, RARC was associated with equivalent rates of positive surgical margins (9.3% vs. 10.7%, odds ratio [OR] = 0.86, 95% CI: 0.72–1.03; $P = 0.10$), higher rates of pelvic lymph node dissection (96.4% vs. 92.0%, OR = 2.30, 95% CI: 1.67–3.16; $P < 0.001$), higher median LN count (17 vs. 12, $P < 0.001$), higher rates of LN count above the median (56.8% vs. 40.4%, OR = 1.94, 95% CI: 1.55–2.42, $P < 0.001$). With regard to postoperative outcomes, receipt of RARC was associated with a shorter median LOS (7 vs. 8, $P < 0.001$), and lower rates of pLOS (45.0% vs. 54.8%, OR = 0.68, 95% CI: 0.58–0.79; $P < 0.001$). The 30- and 90-day POM rates were 2.8%, 6.7% for ORC, and 1.4%, 4.8% for RARC, respectively (hazard ratio [HR] = 0.48, 95% CI: 0.29–0.80, $P = 0.005$ and HR = 0.71, 95% CI: 0.54–0.93; $P = 0.014$). Finally, with a mean follow-up of 26.9 months, on IPTW-adjusted Cox regression analysis, RARC vs. ORC was associated with a benefit in OS (HR = 0.79, 95% CI: 0.71–0.88; $P < 0.001$).

Conclusions: Our large contemporary study found an increased adoption of RARC between 2010 and 2013, with more than 1 out of 4 patients undergoing RARC by the end of the study period. We found that RARC was associated with higher LN counts, shorter LOS, and

lower POM. Our results allude to potential benefits of RARC while we wait for more definitive answers from randomized trials. © 2017 Elsevier Inc. All rights reserved.

1. Introduction

Bladder cancer is the sixth most common cancer in the United States with an estimated 76,960 new cases in 2016 [1]. Of those, 20%–30% will present with muscle-invasive disease. For these patients, radical cystectomy (RC) with extended pelvic lymph node dissection is considered the gold standard treatment [2]. However, this complex procedure is associated with high rates of perioperative morbidity and mortality, which in part may be attributable to the older age and multitude of comorbid diseases that typically characterize this patient population [3–5]. Since its original description, open RC (ORC) has remained the most frequently used approach for bladder extirpation. However, beginning in 2003, robot-assisted RC (RARC) has emerged as a minimally invasive approach to RC [6]. Over the past decade, RARC has slowly gained acceptance in the urology community, growing from 0.6% of cases in 2004 to 12.8% in 2010 [7]. This is in stark contrast to robot-assisted radical prostatectomy, which has seen a dramatic rise from 1.8% in 2003 to 85% in 2013 [8]. The rapid adoption of robot-assisted radical prostatectomy over open prostatectomy has been attributed to a combination of direct-to-patient advertisement, market competition, and debatably superior outcomes.

That said, the benefits of RARC over ORC remain controversial [9–12]. Bochner et al. [10] recently reported results from a prospective trial of 118 patients randomized to either ORC ($n = 58$) or RARC ($n = 60$) at a high-volume tertiary referral center, which found similar rates of complications, positive surgical margins (PSMs), lymph node (LN) yields, length of stay (LOS), and quality of life at 3 and 6-months postoperatively. In that study, the only benefit of RARC was lower intraoperative blood loss, but with significantly longer operative time and higher costs. When examining the comparative effectiveness of RARC vs. ORC at the population level, a large study of 36,773 patients did not find any differences in terms of postoperative major complications and mortality [7]. Additionally, comparable short-term oncological and health-related quality of life outcomes have been described for both procedures [13,14]. Regardless, the most evidence regarding the comparative effectiveness of RARC vs. ORC relies on reports from academic/high-volume centers with limited numbers of participating surgeons. As such, we use the National Cancer Data Base (NCDB) to perform a contemporary comparative effectiveness analysis of RARC vs. ORC in a large sample of patients of all ages comprising 70% of all cancer cases in the United States. Our hypothesis was that RARC in increasingly used and associated with some perioperative benefits.

2. Materials and methods

2.1. Data source

The NCDB is a joint initiative of the American College of Surgeons, Commission on Cancer, and American Cancer Society. Established in 1989, it serves as a comprehensive clinical surveillance resource for cancer care in the United States [15]. The NCDB compiles data from >1,500 commission-accredited cancer programs in the United States and Puerto Rico.

2.2. Patient population

We identified all patients who underwent RC for bladder cancer between 2010 and 2013 using *International Classification of Disease for Oncology, third edition* site codes (C67.0–C67.9). Treatment modality was recorded using the Facility Oncology Registry Standards manual. Cystectomy patients were identified using the surgery of the primary site codes 50, 60, 70, and 80 (total cystectomy, radical cystectomy, pelvic exenteration, and cystectomy not otherwise specified). Since 2010, the NCDB has recorded surgical approach in order to monitor patterns and trends in the adoption and usage of minimally invasive surgical techniques. Accordingly, patients were stratified according to surgical approach: ORC or RARC. Patients who underwent laparoscopic (nonrobot-assisted) and RARC converted to open approach were excluded. Patients with metastatic (American Join Commission on Cancer [AJCC] cM+) or clinical positive node (AJCC cN+) and those who received any form of radiation therapy were excluded. Finally, to fully evaluate the impact of surgical approach on postoperative outcomes, we excluded patients who received neoadjuvant chemotherapy. Following exclusions, 9,561 patients remained for further analyses (Fig. 1).

2.3. Covariates

Patient covariates included age, sex, race (White, Black, and Other), residence location (metropolitan, urban, and rural), and insurance status (private, Medicare/medicaid, and uninsured). Socioeconomic status variables were defined according to census tract median household income (adjusted according to 2012 inflation) and the percentage of