



# Controversies in Robotics: Open Versus Robotic Radical Cystectomy

Rutveej Patel,<sup>1</sup> Julie Szymaniak,<sup>1</sup> Kushan Radadia,<sup>1</sup> Izak Faiena,<sup>1</sup> Michael Lasser<sup>2</sup>

## Abstract

Open radical cystectomy (ORC) remains the gold standard for treatment of muscle-invasive bladder cancer and certain cases of high-risk noninvasive bladder cancer. However, ORC is associated with significant morbidity, and there is promise of improved outcomes with the emergence of minimally invasive surgery. Because of the increased adoption of robotic radical cystectomy (RRC), we sought to review the current literature on the robotic approach. We explored the surgical techniques, perioperative and postoperative complications, oncologic and functional outcomes, and quality of life of patients with RRC versus ORC. Current data appear to favor RRC in perioperative outcomes and patient recovery, although RRC continues to be associated with longer surgical times and higher costs. Oncologic data are also promising, however data on long-term oncologic outcomes are insufficient. To date, there is evidence of similar functional outcomes between RRC and ORC continence, but there is a paucity of rigorous, standardized studies on health-related quality of life for continent versus incontinent diversion. Even as use of RRC steadily grows, there is a lack of consensus on the type of approach and urinary diversion that is optimal. We assessed the influence of surgeon experience on the totally intracorporeal urinary diversion and its feasibility to be widely adopted. We aimed to answer the question of whether there are significant benefits to RRC, and furthermore, of the effect of the approach on the choice of urinary diversion.

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## Introduction

Bladder cancer is the fourth most common cancer in America costing approximately \$3 billion in annual expenditure.<sup>1,2</sup> Muscle-invasive bladder cancer, and in certain clinical situations high-risk non-invasive bladder cancer, has been classically managed by open radical cystectomy (ORC). With the emergence of minimally invasive technologies, however, it has been demonstrated that minimally invasive surgery (MIS) has benefits of decreased blood loss, decreased post operative pain, a quicker recovery, and shorter hospital stay compared to open surgery.<sup>3</sup>

Between the years of 2001 and 2010, the United States performed approximately 7000 radical cystectomies annually.<sup>4</sup> With the potential benefits of minimally invasive surgery, robotic assisted radical cystectomy (RARC) has gained momentum as an increasingly

popular modality for the treatment of bladder cancer. Between the years of 2004 to 2010, the percentage of cystectomies performed via the robotic approach increased from 0.6% to 12.8%.<sup>1</sup>

Numerous case studies have reported the benefits of RARC including perioperative and postoperative outcomes such as a quicker return of bowel function and decreased surgical blood loss.<sup>5,6</sup> Nonetheless, ORC is still the gold standard of treatment for muscle-invasive and high-risk nonmuscle-invasive bladder cancer. With the increased adoption of RARC by urologists, there is a need to evaluate perioperative, functional, and oncologic outcomes of RARC and ORC. Herein, we present a nonsystematic review of the literature and compare outcomes of RARC and ORC.

## Methods

We performed a nonsystematic review of articles published in English indexed in the PubMed, Google Scholar, and EMBASE databases. We did not define a restricted range for publication date. We collected articles for inclusion during the period of January 1, 2015-March 1, 2015. We used the following key terms: “open versus robotic radical cystectomy,” and “robotic radical cystectomy.” We excluded all studies not indexed in either PubMed, Google Scholar, or EMBASE, and all studies not published in English. All

<sup>1</sup>Department of Urology, Rutgers Robert Wood Johnson Medical School, New Brunswick, NJ

<sup>2</sup>Department of Urology, Jersey Shore University Medical Center, Neptune City, NJ

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Address for correspondence: Rutveej Patel, MD, 1 Robert Wood Johnson Place, MED 584A, New Brunswick, NJ 08901  
E-mail contact: [rutpatel@gmail.com](mailto:rutpatel@gmail.com)

# Open Versus Robotic Radical Cystectomy

**Table 1** Perioperative and Postoperative Factors That Affect RARC and ORC

Factor	Reference	RARC	ORC	P
Mean Surgical Time, Minutes	Wang et al, 2008 <sup>3</sup>	390	300	.03
	Nix et al, 2010 <sup>7</sup>	252	210	<.0001
	Styn et al, 2012 <sup>8</sup>	454.9	349.1	<.0001
	Ng et al, 2010 <sup>9</sup>	357	375	.29
Estimated Blood Loss, mL	Wang et al, 2008 <sup>3</sup>	400	750	.002
	Nix et al, 2010 <sup>7</sup>	258	575	<.0001
	Ng et al, 2010 <sup>9</sup>	460	1172	<.0001
Transfusion Requirement, Units	Wang et al, 2008 <sup>3</sup>	0.5	2	.007
	Ng et al, 2010 <sup>9</sup>	1.42	3.65	<.0001
In-Hospital Stay, Days	Wang et al, 2008 <sup>3</sup>	5	8	.007
	Nix et al, 2010 <sup>7</sup>	5.1	6.0	.2387
	Styn et al, 2012 <sup>8</sup>	9.5	10.2	.36
	Ng et al, 2010 <sup>9</sup>	5.5	8	<.0001
Complication Rate, %	Wang et al, 2008 <sup>3</sup>	21	24	.3
	Nix et al, 2010 <sup>7</sup>	33	50	.2789
	Styn et al, 2012 <sup>8</sup>	66	62	.65
	Bochner et al, 2015 <sup>10</sup>	62	66	.66

Abbreviations: RARC = robot-assisted radical cystectomy; ORC = open radical cystectomy.

5 report authors used the same search methodology and came to a consensus on which articles were most relevant to the review. We concentrated on studies that compared surgical technique, functional, and oncologic outcomes, and quality of life assessment. A synopsis of relevant articles—including original research studies and reviews—was created and summarized in the this review.

## Surgical Comparison

Robotic assisted radical cystectomy (RC) might have certain benefits and disadvantages compared with ORC in terms of perioperative and postoperative complications. In a comparison of surgical time, traditionally robotic procedures are longer than open procedures. Wang et al showed that the mean surgical time for RARC was 390 minutes compared with 300 minutes for ORC ( $P = .03$ ).<sup>3</sup> Others also showed similar results in that RARC surgical time was longer than for ORC in their cohorts (252 minutes compared with 210 minutes;  $P < .0001$ ).<sup>7</sup> As shown in [Table 1](#), mean surgical time has been shown to be longer in RARC compared with ORC.<sup>3,7-10</sup>

During any surgical procedure, especially major surgical endeavors, minimization of blood loss is of paramount import. Wang et al showed a significant reduction in blood loss in RARC compared with ORC (400 mL compared with 750 mL;  $P = .002$ ) and a lower transfusion requirement (0.5 units compared with 2 units;  $P = .007$ ).<sup>3</sup> Ng et al demonstrated similar findings and showed a significant reduction in blood loss for RARC compared with ORC (460 mL compared with 1172 mL;  $P < .0001$ ) and a significant reduction in transfusion requirement (1.42 units for RARC compared with 3.65 units for ORC;  $P < .0001$ ).<sup>9</sup> Although multiple studies have revealed a diminished blood loss in RARC

compared with ORC, there is conflicting evidence for length of hospital stay after cystectomy. Multiple studies have shown a significant difference in hospital stay for RARC (5 days compared with 8 for ORC).<sup>3,9</sup> However, other groups have failed to identify this difference in length of stay ([Table 1](#)). Further studies are necessary to definitively show which modality of cystectomy results in decreased hospital stay.

During the postoperative period, readmission rates and complications from surgery are often analyzed. In a comparison of readmission rates between patients who received RARC and ORC, many studies have reported no significant difference. Styn et al reported a 28% readmission rate for patients who received RARC compared with 20% for those who received ORC ( $P = .25$ ).<sup>8</sup> Similarly, Ng et al did not find a significant difference in readmission rates between their robotic and open cohort.<sup>9</sup> In addition to no significant difference in readmission rates, studies have also found no significant difference in complication rates between the 2 modalities. Wang et al described no significant difference between RARC and ORC (21% compared with 24%;  $P = .3$ ).<sup>3</sup> The study classified minor complications as prolonged ileus in both cohorts. Major complications for the open group were classified as abscess formation and readmission for percutaneous drainage, wound dehiscence requiring an exploratory laparotomy, respiratory failure requiring reintubation, and postoperative myocardial infarction. The robotic cohort's major complication in this study were conversion to open, abscess formation for patients who were readmitted for percutaneous drainage, and an enterocutaneous fistula.<sup>3</sup> Nix et al reported similar results with no significant difference between complication rates of the 2 cohorts (33% complication rate for RARC compared with 50% complication rate for ORC;  $P = .2789$ ).<sup>7</sup> Their complications for the robotic group included ileus, urinary tract infection, deep venous thrombosis, acute renal failure, and an incarcerated inguinal hernia. The patients who received open cystectomies had complications including ileus, urinary tract infection, acute renal failure, urinary leak, dehydration, and death secondary to aspiration and myocardial infarction.<sup>7</sup> In addition, a recent randomized clinical trial consisting of multiple surgeons showed similar rates of perioperative complications among patients who underwent robot-assisted surgery versus open surgery. Using the 5-grade modified Clavien system, the robotic group had an overall complication rate at 90 days of 62% versus 66% for the open group ( $P = .66$ ). A subgroup analysis of grades 3-5 also yielded no significant difference.<sup>10,11</sup>

An analysis of perioperative factors revealed advantages of RARC with lower blood loss and transfusion requirement and a disadvantage of a longer surgical time compared with ORC. Postoperative outcomes such as length of hospital stay, readmission rate, and complication rate showed no significant difference between RARC and ORC. However, cost should be taken into consideration when choosing between surgical modalities. Traditionally, robotic surgery is more expensive than open surgery. Various institutional studies have performed cost analysis reviews to compare the cost of RARC versus ORC. Smith et al showed RARC to be more expensive than ORC by \$1640.<sup>12</sup> They found that cost was driven primarily by surgical time compared with length of stay, specifically the financial burden of the purchase and maintenance of the robot itself.<sup>12</sup> Contrary to this study, Martin

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