Robotic Cystectomy

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KEYWORDS

• Laparoscopic • Robotic • Radical cystectomy • Intracorporeal urinary diversion

KEY POINTS

- Robotic-assisted radical cystectomy (RARC) is a technique and should complement, not substitute, oncologic principles.
- To date, randomized controlled trials have compared 117 RARCs with 122 open radical cystectomies, all of which underwent extracorporeal urinary diversions. These trials have shown lower estimated blood loss, lower blood transfusion rates, increased cost per operation and longer operative times with similar oncologic outcomes, length of hospital stay, and perioperative complications.
- The principal potential benefit of robotic cystectomy is avoidance of gastrointestinal complications by using intracorporeal urinary diversion. Observational studies are promising; however, prospective randomized trials have not studied this aspect.

INTRODUCTION

Robotic-assisted laparoscopic radical cystectomy (RARC) was first described in 2003,[1] predated by case reports of laparoscopic radical cystectomies in 1995[2] and intracorporeal ileal conduit urinary diversion (UD) 5 years later in 2000.[3] Robotic-assisted laparoscopic radical cystectomy (RARC) has been evolving over the last 15 years under close scrutiny, with the first prospective randomized controlled trial of robotic versus open radical cystectomy (ORC) performed in 2009[4] (**Fig. 1**). Since then, 4 additional randomized controlled trials have been completed and, to date, 3 have reported final results. More than 100 articles in the last 2 years and more than 300 articles in the last 5 years have been published on RARC. Given the abundance of literature, the utility of RARC should be well known and accepted or rejected based on scientific merit. Unfortunately, aside from technical feasibility, short-term oncologic outcomes, and intraoperative or perioperative characteristics, much is left unknown. This is partially because the quality and level of evidence for these published articles is extremely variable. In addition, the rapidly changing, nonstandardized periprocedural care pathways for patients undergoing radical cystectomy likely have as much influence, if not more, on periprocedural outcomes than the technique used.

Unlike open surgery, in which the technical components of the operation remain largely unchanged over time, multiple technologic advances in robotic platforms, instrumentation, and endoscopic training in residency are quickly evolving. This, along with the increasing understanding of disease biology, care pathways, and drivers of patient outcomes are likely to make the utility of a technique, in an ever-changing, multifaceted, disease-management decision tree, only a minor component. This article discusses the known benefits, limitations, and potential future refinements of the surgical technique, RARC.

ROBOTIC-ASSISTED LAPAROSCOPIC RADICAL CYSTECTOMY

Feasibility

Nix and colleagues[4] performed the first randomized controlled trial of RARC versus ORC. Twenty

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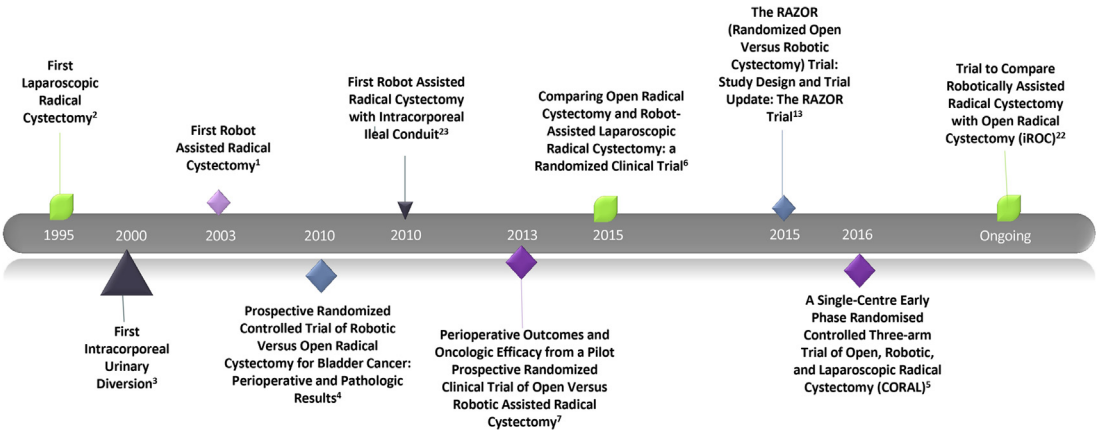

Fig. 1. Evolution of laparoscopic and robotic cystectomy. iROC, International Robotic Cystectomy Consortium.

subjects underwent ORC and 21 underwent RARC, with both groups receiving extracorporeal UDs (ECUDs). Subjects were well-matched in regard to clinicopathologic characteristics. The median operative time was 4.2 hours for RARC and 3.5 hours for ORC. Median estimated blood loss was 258 mL for RARC and 575 mL for ORC. Median time to flatus, bowel movement, and length of stay was 1 day shorter in the RARC arm. Oncologic outcomes were similar in both groups in regard to surgical margins, lymph node count, and pathologic stage.[4] This was the first study to support the safety, feasibility, and transference of oncologic principles with the RARC technique.

Three additional prospective randomized controlled trials on RARC have been completed.[5–7] A recent meta-analysis of these studies included 117 subjects undergoing RARC and 122 subjects undergoing ORC.[8] The meta-analysis revealed that RARC was associated with a longer operative time (17.25–122.12 minutes; $P = .009$) and 300 mL lower estimated blood loss per case (CI −414.66 to −184.99; $P = .00001$).[8] All other variables tested were not statistically different between the 2 groups, including length of hospital stay, time to flatus, time to oral diet, lymph node yield, and perioperative complications. Mortality rates and positive surgical margins were also similar between the 2 groups.[8] Despite the heterogeneity among the studies, the results of this meta-analysis support what has been shown in a plethora of retrospective reviews. One interesting factor identified is that, even at high volume centers, surgical technique is variable between surgeons and institutions.[8,9] As mentioned previously, a consistent factor throughout all these studies was the extracorporeal creation of the urinary conduit.

With the demonstration of the feasibility of RARC, its utilization has been steadily increasing. Leow and colleagues,[10] examined a private charge capture research database of more than 600 US hospitals and found that 0.6% of radical cystectomies were being performed using robotic assistance in 2004, increasing to 12.8% in 2010. In an analysis of the National Cancer Database, 26.3% of radical cystectomy subjects underwent minimally invasive radical cystectomy in 2010, which increased to rates of 39.4% in 2013.[11] Despite the lack of evidence for superiority, the prevalence of RARC is certainly increasing.

Oncologic Principles

The goals of minimally invasive and robotic-assisted cystectomy have been to reduce periprocedural morbidity and allow earlier return of normal activity while maintaining oncologic equivalence.[9,12] The Randomized Open Versus Robotic Cystectomy (RAZOR) trial, a multiinstitutional randomized study to compare ORC with RARC for oncologic outcomes, complications, health-related quality of life (HRQOL), pelvic lymph node count, cost, and morbidity, had accrued 306 of the proposed 320 subjects at last update in 2015,[13] with final data expected soon. To date, oncologic outcomes from a variety of studies have not been significantly different between RARC and ORC.[4–7,13]

The presence of positive soft tissue margins (PSMs) is a strong marker of poor prognosis, with 5-year disease-specific survival in the PSM cystectomy group of 32% compared with 72% for negative margins.[14] An analysis of 4410 ORC subjects found the overall incidence of PSM was 6.3% at 12 academic centers.[14] There was some heterogeneity of rates of PSM in RARC subjects