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A Comparison of Extraperitoneal and Intraperitoneal Approaches for Robotic Prostatectomy*

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Abstract

Objectives—We compared oncologic and health-related quality-of-life outcomes among patients undergoing intraperitoneal or extraperitoneal robotic prostatectomy.

Methods—Of 215 patients undergoing robotic prostatectomy, the approach was intraperitoneal in 48 and extraperitoneal in 167. Cancer control was evaluated using margin status. Recovery after surgery and functional health was assessed using the Convalescence and Recovery Evaluation and Expanded Prostate Cancer Index Composite questionnaires, respectively.

Results—Positive surgical margin rates were similar between approaches (14% extraperitoneal, 10% intraperitoneal; $p=0.63$). Functional outcomes were slightly improved for those with the extraperitoneal approach (i.e., higher urinary irritation/obstruction scores at 3 months). The extraperitoneal group demonstrated higher activity (91.8 vs. 83.3, $p=0.03$) and cognitive scores (94.9 vs. 91.7, $p=0.04$) at 6 weeks as well as higher gastrointestinal scores at 2 weeks (94.2 vs. 90.8, $p=0.05$).

Conclusions—These data support efforts to broaden the adoption of the extraperitoneal approach for robotic prostatectomy.

Keywords

prostate cancer; robotic prostatectomy; extraperitoneal; intraperitoneal; CARE questionnaire; EPIC questionnaire

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INTRODUCTION

Robotic prostatectomy accounts for the majority of prostatectomies performed in the United States.¹ Although both robotic and open prostatectomies are associated with some degree of morbidity, the benefits of performing prostatectomies robotically center around decreased blood loss, shorter hospital length of stay, and improved ergonomics.²⁻⁵ Further, two population-based studies showed that robotic prostatectomies were associated with lower perioperative complications.^{2, 6} Even still, significant morbidity can occur from the robotic approach, including urinary incontinence, erectile dysfunction, and the need for salvage therapy.^{2, 6} With excellent survival rates achieved with a variety of prostate cancer treatments,^{5, 7, 8} efforts have focused on minimizing morbidity and improving patients' health-related quality-of-life.

Since its early adoption in 2000, the robotic prostatectomy has most commonly been performed intraperitoneally.^{5, 9, 10} The advantages of this approach, which is a departure from the traditional extraperitoneal approach, include easier access to the pelvis and fewer anatomical constraints. Potential disadvantages include bowel-related side effects and their implications for recovery, the exposure of the peritoneum to a possible urine leak, and the risks inherent with Trendelenburg positioning for a prolonged period.¹¹ For these reasons, some surgeons have adopted the extraperitoneal approach. Although the first extraperitoneal robotic prostatectomy was described in 2003,¹² only three studies have directly compared the extraperitoneal and intraperitoneal approaches.^{11, 13, 14} While peri-operative outcomes between these approaches appear to be similar, data on patient-reported functional outcomes are limited.¹⁴⁻¹⁷ Moreover, no study to date has specifically looked at surgical recovery after the extraperitoneal approach in a quantitative manner.

For these reasons, we undertook a study to better assess differences in patient-reported functional outcomes and surgical recovery between the extraperitoneal and intraperitoneal approaches. We evaluated patient recovery using two validated self-administered questionnaires: the Expanded Prostate Cancer Index Composite (EPIC) questionnaire and the Convalescence and Recovery Evaluation (CARE) questionnaire. These surveys are designed to measure prostate cancer-related health-related quality-of-life and short-term health status in the recovery period after abdominal and pelvic surgery, respectively.^{18, 19}

MATERIAL AND METHODS

Study Population

This is a prospective study of 215 consecutive patients who had undergone either an intraperitoneal (n=48) or extraperitoneal (n=167) robotic prostatectomy for clinically localized prostate cancer at our institution between September 2008 and June 2010. Patients in the study agreed to respond to a battery of self-assessment questionnaires, including the EPIC and CARE questionnaires. An array of demographics and disease-related data were prospectively collected and entered into our prostate cancer database for each patient.

Outcomes

All outcomes were assessed at the patient level. We evaluated surgical margin status in all patients. Disease severity was characterized by pre-operative prostate-specific antigen levels and biopsy Gleason scores. Early recovery was assessed using the CARE questionnaire, which is a general instrument for measuring short-term recovery after abdominal and pelvic surgery designed to supplement procedure-specific instruments.¹⁹ CARE consists of 27 items, which are divided among 4 domains: activity, cognitive, gastrointestinal symptoms, and pain.¹⁹ Domain scores range from 0 to 100, with higher scores corresponding to a better health state; these scores can be combined to generate a composite score.¹⁹ CARE

demonstrates robust psychometrics, supporting its role for measuring health status after abdominal and pelvic surgery: CARE exhibits good internal consistency (Cronbach's α 0.66 for all domains) and test-retest reliability (94%).¹⁹ Patients completed the CARE questionnaire pre-operatively and at 2, 4, and 6 weeks post-operatively. Completion rates at 2, 4, and 6 weeks were 87%, 88%, and 87%, respectively.

Patient functional outcomes were measured using the 26-item EPIC survey, which is a robust questionnaire that assesses functional health status among prostate cancer patients.¹⁸ The self-administered survey specifically addresses urinary irritative symptoms, obstructive symptoms, and bother, as well as a broad spectrum of bowel, sexual, and hormonal symptoms. Each domain is scored from 0 to 100, with higher scores representing better health-related quality-of-life.¹⁸ The 26-item EPIC survey has demonstrated excellent psychometrics with good internal consistency (Cronbach's α 0.70) and test-retest reliability (r 0.69) for all domains.²⁰ To assess functional health after robotic prostatectomy, we specifically analyzed 5 domains: urinary incontinence, urinary irritation/obstruction, sexual, bowel, and hormonal. Patients completed the EPIC questionnaire pre-operatively and at their first office visit after catheter removal (i.e., 3 months post-operatively). A post-operative visit between 60 and 120 days was categorized as a 3-month follow-up. The completion rate at 3 months was 55%. Although patients may not have addressed all questions within a domain, patients with complete baseline responses and post-operative responses in any domain were evaluated.

Statistical Analysis

All instruments were self-administered and inferences were made cross-sectionally. Differences by surgical approach in quality-of-life domain scores and other continuous variables were tested using the non-parametric Wilcoxon rank-sum test, while chi-square tests were used for categorical variables. All analyses were performed using SAS v9.2 (Cary, NC) at the 5% significance level. Our Institutional Review Board approved the study protocol.

RESULTS

Patient characteristics, including age, disease severity, and pre-operative prostate-specific antigen levels, were similar between the intraperitoneal and extraperitoneal groups (Table 1). For peri-operative characteristics, the extraperitoneal approach was associated with decreased blood loss (125ml vs. 188ml, $p<0.01$), operative time (209 minutes vs. 310 minutes, $p<0.01$), and hospital length of stay (1.1 days vs. 1.5 days, $p<0.01$) compared to the intraperitoneal approach. Positive surgical margin rates were similar between the two approaches (10% intraperitoneal vs. 14% extraperitoneal; $p=0.63$).

Results from the CARE questionnaire are shown in Figure 1. Of note, the activity domain was similar between the intraperitoneal and extraperitoneal groups at 2 weeks (51.5 vs. 54.3, respectively ($p=0.47$)), but then demonstrated a relative increase among the extraperitoneal group at 4 weeks (72.8 vs. 78.3, respectively ($p=0.06$)) and 6 weeks (80.3 vs. 86.1, respectively ($p=0.03$)). Although patients undergoing the intraperitoneal and extraperitoneal approaches had similar cognitive domain scores at 2 weeks (84.4 vs. 88.8, respectively ($p=0.99$)) and 4 weeks (93.2 vs. 92.7, respectively ($p=0.94$)), these groups demonstrated different cognitive scores at 6 weeks (91.7 vs. 94.9, respectively ($p=0.04$)). Differences in gastrointestinal scores were seen between the intra- and extraperitoneal approaches at 2 weeks (83.5 vs. 90.7, respectively ($p=0.05$)), although these differences abated by 4 weeks (92.9 vs. 95.3, respectively ($p=0.20$)). No differences in pain scores were seen between the two groups at any point.

Short-term functional outcomes were measured at 3 months using the EPIC questionnaire (Figure 2). For the urinary irritation/obstruction domain, scores differed for the intra- and extraperitoneal approaches at 3 months (67.1 vs. 78.5, respectively ($p=0.03$)). The intraperitoneal and extraperitoneal cohorts demonstrated similar scores for urinary incontinence (51.1 vs. 56.0, respectively ($p=0.68$)), sexual domain (25.0 vs. 39.5, respectively ($p=0.07$)), bowel domain (74.1 vs. 82.7, respectively ($p=0.31$)), and hormonal domain (72.2 vs. 79.3, respectively ($p=0.80$)).

DISCUSSION

In comparing convalescence among patients undergoing either an intraperitoneal or extraperitoneal robotic prostatectomy, the extraperitoneal approach was associated with higher activity and cognitive scores at 6 weeks and higher gastrointestinal scores at 2 weeks based on the CARE questionnaire. We observed similar rates of positive surgical margins and at least as good functional outcomes (i.e., higher urinary irritation/obstruction scores at 3 months) with the extraperitoneal approach.

The extraperitoneal robotic approach, which aims to recapitulate the traditional approach, was first described in 2002.¹² Potential advantages of this approach include decreased risk of bowel complications, containment of blood or urine in the extraperitoneal space allowing for tamponade, and minimal Trendelenburg positioning since the peritoneum acts as a natural retractor for the bowel and bladder.^{11, 12, 21–23} Surgeons learning the extraperitoneal approach who are already adept at using the robot will likely not confront a steep learning curve. In fact, operative times may improve with the extraperitoneal approach due to decreased time needed to create the perivesical working space.¹¹ Potential disadvantages compared to an intraperitoneal approach include a smaller working space, difficulty accessing the pelvis, and tension on the vesicourethral anastomosis.¹¹

To date, three studies have directly compared the extraperitoneal and intraperitoneal approaches for robotic prostatectomy.^{11, 13, 14} These studies demonstrate that the extraperitoneal approach is feasible with no differences in peri-operative outcomes. However, two of these comparisons involved a relatively small number of patients (i.e., 80 and 55 patients) and did not assess patient-reported outcomes. The most recent study did look at functional outcomes in 155 patients who had undergone an extraperitoneal robotic prostatectomy and found that post-operative pain scores were lower and recovery of continence was faster compared to the intraperitoneal approach.¹⁴ In addition to the parameters evaluated in this study, however, we assessed urinary irritative/obstructive symptoms, bowel and hormonal domains, and recovery of activity and cognitive levels after surgery.

Implementing the extraperitoneal approach aims to improve health-related outcomes without compromising cancer control. Initially, there was a concern that the extraperitoneal approach would involve a small working space without good access to the prostate, thus making the dissection of the prostate more tedious and potentially compromising the surgical margin status. However, by using finger dissection and a balloon dilator as well as having well-defined port placements to allow adequate range of motion of the robotic arms, the working space is quite manageable, and the prostate can be dissected freely without having to retract the bowel.¹¹ Among the extraperitoneal and intraperitoneal approaches, our positive surgical margin rates were comparable ($p=0.63$) at 14% and 10%, respectively. These rates are consistent with those reported in the literature.^{13–15, 17, 24} As our data matures, biochemical recurrence rates will provide additional feedback on the surgical quality of the extraperitoneal approach.

In addition to surgical margin status, evaluating patient-reported outcomes is useful in comparing these two approaches. Although these outcomes are well-reported in general,^{25, 26} our study is the first to use both the EPIC and CARE questionnaires in this setting. A few studies have reported adequate erectile function after the extraperitoneal approach as measured by the Sexual Health Inventory in Men questionnaire and have evaluated continence by reporting the need for pads.^{14–17} However, no studies have described patient-reported outcomes related to bowel, hormonal, or surgical recovery after the extraperitoneal approach.

In this light, we compared patient recovery after the extraperitoneal and intraperitoneal approaches using the CARE questionnaire. No differences in activity level were demonstrated at 2 weeks ($p=0.47$), but by 6 weeks, patients undergoing the extraperitoneal approach reported higher activity levels ($p=0.03$) than those undergoing the intraperitoneal approach. We posit that, although similar incisions are made for the two approaches, staying extraperitoneal may quicken recovery and lessen discomfort, resulting in higher activity levels at 6 weeks. The improvement in cognitive scores at 6 weeks ($p=0.04$) is an interesting finding that may directly relate to the increase in activity level. This observation warrants further investigation. Gastrointestinal recovery followed a different trend; recovery appeared faster with the extraperitoneal approach at 2 weeks ($p=0.05$), but then abated at 4 and 6 weeks. Although an ileus is likely to resolve by 2 weeks, residual gastrointestinal effects of intraperitoneal manipulation may linger.

In addition to evaluating short-term health status during convalescence, functional outcomes were measured using the EPIC survey. At 3 months, outcomes were similar between the extraperitoneal and intraperitoneal approaches across all domains, except for the urinary irritation/obstructive domain, in which scores were higher for the extraperitoneal group ($p=0.03$). This suggests that functional outcomes in the short-term are at least as good with the extraperitoneal approach.

There are several limitations to our study. First, patients were not randomized to either the extraperitoneal or intraperitoneal approach, which introduces the possibility of selection bias based on either patient characteristics or surgeon preferences. This is corroborated by the finding that the extraperitoneal approach was associated with lower blood loss and shorter operative time. These factors could influence patient outcomes as well. However, the two cohorts had similar pre-operative demographics such as age, biopsy Gleason score, and prostate-specific antigen levels and a large proportion of the cases were performed by two experienced surgeons who used both the intra- and extraperitoneal approaches and had passed the steep part of the learning curve for both procedures. Second, this study specifically addresses short-term outcomes. While differences in the two surgical approaches are most likely to appear during this period, going forward, it will be important to analyze more long-term endpoints such as biochemical recurrence and complications. Nonetheless, compared to the intraperitoneal approach, the extraperitoneal approach had a similar positive surgical margin rate, which is an independent predictor of biochemical and local recurrence, and the development of metastasis.²⁷ Lastly, the response rate for the EPIC questionnaire was 55%. This is due to the fact that the EPIC survey was completed at the 3-month office visit. Many non-responders either rescheduled this visit or, if referred from an outside urologist, followed-up locally. However, the percent of responders in the extraperitoneal and intraperitoneal groups were similar, and there were no statistically significant differences between EPIC responders and non-responders for demographic or disease-severity measures (data not shown).

Despite these limitations, the findings from this study deserve consideration. Adopting the extraperitoneal approach may provide a way to improve recovery while maintaining

adequate cancer control and functional outcomes. A more rigorous assessment of short-term functional outcomes, for example at 1, 2, 3, and 4 weeks post-operatively, may better define the true differences between these two approaches. In addition, studies with longer follow up that evaluate biochemical recurrence rates and complication rates may help elucidate any differences in long-term cancer control as well as in functional and recovery outcomes.

CONCLUSION

In this study, positive surgical margin status and functional outcomes (i.e., sexual and urinary health) are similar when using either the extraperitoneal or intraperitoneal approach. The extraperitoneal approach is associated with improved convalescence as demonstrated by an increase in activity, cognitive, and gastrointestinal scores on the CARE questionnaire. These results support efforts to broaden the adoption of the extraperitoneal approach for robotic prostatectomy.

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ABBREVIATIONS AND ACRONYMS

CARE	Convalescence and Recovery Evaluation
EPIC	Expanded Prostate Cancer Index Composite

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Figure 1. Convalescence after robotic prostatectomy assessed by Convalescence and Recovery Evaluation (CARE), stratified by approach, in 4 domains: activity (A), cognitive (B), gastrointestinal (C), and pain (D)

Figure 2.
Recovery of functional health status assessed by Expanded Prostate Cancer Index Composite (EPIC) at 3 months

Table 1

Demographics and clinical characteristics of the study population

Characteristic	Surgical approach		p-value
	Intraperitoneal (n=48)	Extraperitoneal (n=167)	
Mean age, years (SD)	62.8 (6.8)	61.2 (7.0)	0.13
Race / Ethnicity			
% non-white	4.9	3.5	0.65
% Hispanic	-	4.1	0.34
Measures of socioeconomic class			
% married	97.6	91.0	0.31
% employed	53.7	62.1	0.37
% college graduates	70.7	70.3	>0.99
% income > 75K	68.3	53.8	0.11
Disease severity			
Biopsy Gleason score			0.15
6	31.3	42.8	
7	52.1	48.8	
8–10	16.6	8.4	
Preoperative PSA, ng/cc (SD)	7.5 (8.1)	6.3 (4.6)	0.53