

Robot-assisted laparoscopic radical prostatectomy: initial experience with first 112 cases

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Abstract In this study we report our initial robot-assisted laparoscopic radical prostatectomy (RALRP) experience for organ-confined prostate cancer with the first 112 cases between August 2009 and January 2011. The mean age was 61 (46–76) years. Gleason scores ranged between 4 and 9, and the mean prostate volume was 38.7 (15–115) ml. The mean follow-up time was 8.1 (1–18) months. The mean operative time was 174.7 (75–360) min, and the mean estimated blood loss was 141 (60–800) ml. A nerve-sparing procedure was performed bilaterally in 79 cases and unilaterally in 15 cases. All the complications seen (8 out of 112 patients, 7.1%) were grade 1 and 2 according to the Clavien classification system. Postoperatively, five (4.4%) patients needed transfusion. Mean drain extraction time was 3.2 (2–15) days and mean hospital stay was 4 (2–18) days. The catheter was removed on postoperative day 8.5 (6–20). Surgical margin was positive in 13 (11.6%) patients. Forty-nine patients have 6 months and 30 patients have 12 months follow-up. The continence rate were 29.4, 64.2, 84.2, 91.1 and 96.6% immediately after catheter

removal and at 1, 3, 6 and 12 months, respectively. No anastomotic stricture or urinary retention was seen in the follow-up period. RALRP is a safe and feasible technique in the treatment of localized prostate cancer. Our initial experience with this procedure shows promising short-term outcomes.

Keywords Robotic surgery · Prostate cancer · Radical prostatectomy

Introduction

Retropubic radical prostatectomy (RRP) remains the gold standard for organ-confined prostate cancer. However, laparoscopic radical prostatectomy (LRP) and robot-assisted laparoscopic radical prostatectomy (RALRP) have become standards of care at many centers worldwide [1]. LRP and RALRP have been reported to decrease intraoperative blood loss, transfusion requirements, and length of hospital stay [2, 3]. Despite the advantages of minimally invasive surgery, LRP still requires a disappointingly long learning-curve [4–6].

Another major disadvantage of LRP lies in the two-dimensional vision of its optics. A third method has therefore been developed. RALRP has recently gained popularity as a less invasive treatment option for men with clinically localized prostate cancer. The da Vinci Surgical SystemTM robot (Intuitive Surgical, Sunnyvale, CA, USA) allows three-dimensional (3D) imaging, facilitates intracorporeal suturing, and provides better ergonomics for the surgeon, jointed instruments that more closely mimic the movements of the human hand and wrist and computer-assisted motion scaling to eliminate tremor. The disadvantage of RALRP is the complete loss of tactile feedback through the robotic

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interface, and the financial cost [1, 7, 8]. Herein, we report our initial experience with the first 112 cases.

Materials and methods

Between August 2009 and January 2011, 112 patients underwent RALRP by a single surgeon for organ-confined prostate cancer. We recorded patient age at the time of surgery, body mass index (BMI), preoperative prostate serum antigen (PSA) level, biopsy Gleason score and 2002 TNM stage, preoperative and postoperative parameters, and pathological data from the surgical specimen. Patients were excluded from this study if evidence was found of lymph node involvement during the preoperative work-up or if there were clinical signs of nonlocalized disease.

The patient was placed in the low lithotomy position. A five-port transperitoneal approach using a four-arm da Vinci[®] SI HD system was used to perform RALRP. Pneumoperitoneum was achieved by transperitoneal Veress needle technique if the patient had not previously undergone abdominal interventions; otherwise, we used the open Hasson access. The first 12-mm trocar was positioned by supra-umbilical skin incision and the others were placed under direct vision by the endoscope. The patient was positioned in the 30° Trendelenburg position with the arms tucked in. Five EndoWrist (Intuitive Surgical) robotic instruments were used: monopolar curved shears, Maryland bipolar grasper, Prograsp grasper and two large needle drivers. The 0° and 30° telescopes were used. All cases were performed transperitoneally with initial dissection of the seminal vesicles. After the incision of median umbilical ligaments and entrance to the space of Retzius, the symphysis pubis was identified and the extraperitoneal space was developed laterally until the vasa were identified. The endopelvic fascia (EPF) was opened using cold scissors and the levator ani fibres were swept laterally. Dissection proceeded towards the apex. The puboprostatic ligaments were divided and the notch between the dorsal venous complex (DVC) and urethra was exposed. The DVC was ligated using 0 Vicryl[™] on a CT-1 needle. Identification of the bladder neck was aided by moving the catheter balloon.

The anterior bladder neck was divided using the monopolar scissors and monopolar cautery until the catheter was identified within the bladder. The full thickness of the posterior bladder neck was divided in the midline using monopolar cautery. The fascia overlying the vas was incised and then extended to the vas and seminal vesicles (SVs). The fourth arm was used to retract the distal end of the vas and SVs anteriorly, thereby tenting up the posterior layer of Denonvillier's fascia. This layer was incised close to the base of the SVs using cold scissors and perirectal fat was identified. Blunt dissection of this posterior space

allows a safe plane to develop between prostate and rectum and also exposes the lateral pedicles of the prostate. The pedicle was thinned out using blunt dissection to allow its ligation using Hem-o-Lok clips. A nerve-sparing dissection was offered to previously potent patients [sexual health inventory for men (SHIM) score >16] without palpable disease or radiological evidence of extracapsular extension. The interfascial or intrafascial plane in the posterolateral groove was developed using a cautery-free technique until the apex and urethra were visualized. The ligated DVC was then divided using monopolar scissors. The lateral pillars were sharply incised and the anterior wall of the urethra was divided using cold scissors.

The resected prostate was placed in a laparoscopic retrieval bag for later removal. A continuous suture was used for the anastomosis. Two 18-cm 3/0 Monosorb sutures on 26-mm CT-2 needles were tied together with ten throws. Both sides of the sutures were passed through the bladder neck from outside in at 5 and 7 o'clock, respectively. One continued in an anti-clockwise manner while the other suture continued clockwise until the 12 o'clock position is reached. Before tying the sutures a new 22 Ch Foley catheter was placed. Both sides of the urethra were tied together at the 12 o'clock position. The bladder was filled with normal saline to test the anastomosis. A drain was placed through a lateral port site. The specimen was retrieved through the midline camera port following undocking of the robot.

Results

The preoperative clinical characteristics of the patients are shown in Table 1. Mean patient age was 61 (46–76) years and mean BMI was 29 (20–35) kg/m². Mean preoperative PSA level was 8.9 (1.3–33) ng/ml. Mean preoperative Gleason score was 6.4 (4–9), and mean prostate volume was 38.7 (15–115) ml. Perioperative data are listed in Table 2. Mean robotic console time was 174.7 (75–360) min, and the mean estimated blood loss was 141 (60–800) ml. A nerve-sparing procedure was performed bilaterally in 79 cases and unilaterally in 15 cases. Six patients underwent pelvic lymph node dissection. Postoperatively, five (4.4%) patients needed transfusion.

Mean drain extraction time was 3.2 (2–15) days and mean hospital stay was 4 (2–18) days. The catheter was removed on postoperative day 8.5 (6–20). We observed one serosal injury of the sigmoid colon which was recognized intraoperatively and closed primarily using a two-layer technique. After surgery, the patient had no adverse effects from the injury.

Complications were assessed according to the Clavien classification system. We observed complications in 8 out

Table 1 Preoperative data

Variable	Value
Patients (<i>n</i>)	112
Age (years)	61 (46–76)
BMI (kg/m ²)	29 (20–35)
PSA (ng/ml)	8.9 (1.3–33)
Prostate volume (ml)	38.7 (15–115)
Gleason score, <i>n</i> (%)	
≤6	77 (68.7%)
7	31 (27.7%)
≥8	4 (3.6%)

Table 2 Perioperative data

Variable	Value
Operative time (min)	174.7 (75–360)
Estimated blood loss (ml)	141 (60–800)
Complications	0
Blood transfusion (%)	5 (4.4)
Nerve sparing (<i>n</i>)	
Bilateral	79
Unilateral	15
Postoperative stay (days)	4 (2–18)
Complete continence (%)	
Immediate	29.4
1 month	64.2
3 months	84.2
6 months	91.1
12 months	96.6

of 112 (7.1%) patients in total. All the complications were minor complications (grades 1 and 2) and no major complications (grades 3, 4 and 5) were seen. One was prolonged ileus (0.9%) managed conservatively, two were fever and pain (1.8%) managed with antipyretic and analgesic drugs, and five patients (4.4%) needed a single unit blood transfusion.

Postoperative histopathological outcomes are shown in Table 3. Surgical margin was positive in 13 (11.6%) patients. The overall, pT2 and pT3 positive surgical margin (PSM) rates were 13 (11.6%), 8 (8.2%) and 5 (33%) respectively. The mean postoperative Gleason score was 6.5 (5–9).

49 patients have 6 months and 30 patients have 12 months follow-up. The mean follow-up was 8.1 (1–18) months. The rates for complete continence, defined as no use of pads, were 29.4, 64.2, 84.2, 91.1 and 96.6% immediately after catheter removal and at 1, 3, 6 and 12 months, respectively. No anastomotic stricture or urinary retention was seen in the follow-up period.

Table 3 Pathological data

Variable	Value
Pathological stage (<i>n</i>)	
pT2a	19
pT2b	30
pT2c	48
pT3a	6
pT3b	9
Postoperative Gleason score (%)	
≤6	53
7	55
≥8	4
Positive margins by stage (%)	
Overall	13 (11.6)
pT2	8 (8.2)
pT3a	3 (50)
pT3b	2 (22)
Positive lymph nodes (<i>n</i>)	0

Discussion

RALRP is an alternative surgical procedure for organ-confined prostate cancer, and has proven to be a safe and reproducible surgical treatment with low morbidity [9]. Binder and Kramer [10] performed the first robot-assisted laparoscopic prostatectomy in 2000 and since then it has become an increasingly popular treatment option. The advantages of robotic surgery include three-dimensional visualization, ×10 magnification, increased degrees of freedom, tremor filtration, absence of the fulcrum effect, motion scaling, and robotic wrist instrumentation. These technical innovations have the potential to temper the learning curve and make LRP a less technically challenging procedure [1, 7, 8, 11].

In the literature, there are various durations of operation in RALRP series, and it is therefore difficult to compare them because of different reporting variables. The mean operative duration for current RALRP series included in the review was 166.6 min, with a range of means of 105–236 min [11]. Patel et al. [12] reported their single surgeon experience of 1500 RALRP procedures. The mean operative time from skin incision to fascial closure was 105 min. They also showed a decrease in duration from 120 min in the first 300 cases to 105 min in the last 300 cases of the series. Badani et al. [13] reported their experience with a series of 2,766 RALRPs. The mean surgical (from Veress needle placement to skin closure) and mean console time were 154 and 116 min, respectively. The authors also reported that surgical time decreased from 160 to 131 min and console time from 121 to 97 min over the series. In our series, the mean robotic console time was

174.7 (75–360) min, a little longer than the series in the literature. This may be because of the small sample size of our study compared with the others. In their review study, Ficarra et al. [14] showed that RALRP was more time-consuming than open radical prostatectomy (ORP) in the earlier phase of the learning curve, but such differences disappeared with a larger cohort of robotic cases. Krambeck et al. [15] reported similar results to Ficarra et al. [14] in their RALRP and ORP series in terms of duration of the operation.

In robotic laparoscopic surgery, intraoperative bleeding is generally a minor problem due to the elevated intra-abdominal pressure by CO₂ insufflation [9]. In addition, early identification and precise ligation of vessels facilitates the limitation of blood loss [11]. The mean estimated blood loss for the current RALRP series included in the review was 169 ml, with means of 103–609 ml [11]. Patel et al. [16] and Ahlering et al. [17] reported estimated blood losses of 75 and 145 ml, respectively. Also, many authors showed that RALRP was superior to ORP in terms of bleeding [14, 18, 19]. In our series, the mean estimated blood loss was 141 (60–800) ml and was comparable with the other robotic series.

The duration of hospitalization is an important component of convalescence after surgery [11]. The mean length of hospital stay (LOS) for the current RALRP series included in the review was 1.55 days, with range of 1–5.4 days [11]. In the report of Murphy et al. [20], mean LOS was 3.1 days and the mean duration of catheterization was 8.2 days. Kim et al. [21] reported that mean LOS was 6.5 days, the time to removal of the drain was 2.7 days and median time for the removal of the catheter was 7 days. In our series, mean drain extraction time and mean hospital stay were 3.2 (2–15) and 4 (2–18) days, respectively. Postoperative catheter removal time was 8.5 days with a range of 6–20 days. LOS was significantly lower after RALRP than ORP [14], as shown in many studies by different authors [15, 18, 22].

Surgical complications after radical prostatectomy (RP) have been documented in various previous series but few have used a standardized classification system [9, 13, 20, 23]. Clavien et al. [24] proposed a grading system for surgical complications in 1992, and modified it in 2004. The updated Clavien grading system has been used more frequently in recent publications for complications of RALRP [9, 13, 20, 23].

Hu et al. [23] reviewed their intraoperative complications and compared them with the series from Menon et al. [25] of 1,100 patients. Both series had a major intraoperative complication rate of <1%. The mean overall complication rate for RALRP series included in the review was 10.5%. We observed one serosal injury of sigmoid colon which was recognized intraoperatively and closed

primarily using a two-layer technique. After surgery, the patient had no adverse effects from the injury.

Complications were assessed according to the Clavien classification system. We observed complications in 8 out of 112 (7.1%) patients in total. All the complications were minor (grades 1 and 2) and no major complications (grades 3, 4 and 5) were seen. One was prolonged ileus (0.9%) managed conservatively, two were fever and pain (1.8%) managed with antipyretic and analgesic drugs, and five patients (4.4%) needed a single unit blood transfusion. These five patients had no perioperative bleeding, but on postoperative day 2 or 3 a decrease in haemoglobin concentration and ecchymosis around the port site was noticed and a CT scan performed. Hemorrhage from the port site was seen in all the cases; three originated from the assistant port site and the others from the left 8-mm trocar site. We always place the trocars under transillumination, and after the surgery instruments and trocars are removed under endoscopic vision and the trocar sites are checked for bleeding and visceral injury. However, we consider that these five complications were due to injury to the vessels not visualized even under transillumination existing on the abdominal wall, such as branches of the superior and inferior epigastric vessels, intercostal vessels (X and XI), subcostal vessels, and the ascending branch of the deep circumflex iliac artery [26].

In the series comparing open, laparoscopic and robotic technique, there are conflicting results [11]. Hu et al. [23] compared the complications between 358 LRP and 322 RALRP cases. They found a lower overall complication rate after RALRP than LRP (27.7% vs. 14.6%). Rozet et al. [27] reported their matched-pair analysis of 133 extraperitoneal RALRPs and 133 extraperitoneal pure LRPs, and concluded that RALRP had a higher overall complication rate (19.4% vs. 9.1%, $P = 001$). In most of the available published series comparing ORP and RALRP, similar complication rates were seen, as shown recently by Krambeck et al. [15] and Nelson et al. [22].

Hu et al. [23] reported a urinary leakage rate of up to 8%. Coelho et al. [28] showed that the anastomotic leakage rate decreased from 4 to 0.3% with the surgeon's experience. In our series we had no leakage after surgery, and assumed that this result was due to the long catheterization period (mean 8.5 days) compared with the other series.

In robotic series, general conversion rates to open were reported between 0 and 1.1% [23, 29, 30]. Fischer et al. [9] reported their conversion rates due to robotic malfunction or intraoperative complication and found that robotic arm failure was experienced in 1% of the patients. This was 0.08% in the series of Coelho et al. [28]. No open conversion was seen in both series and all the procedures were finished laparoscopically. In our series, no open or laparoscopic conversion was required.

Irrespective of the surgical approach, tumor stage, volume of disease, high preoperative PSA value, and a high Gleason score have all been shown to be predictive of a positive surgical margin (PSM) after surgery [31]. The recent review of RALRP by Ficarre et al. [32] stratified the published data by pathological stage and found the PSM rate to vary from 5.7–27% for those with stage T2 disease to 26–40% for those with stage T3a and 27–67% for those with stage T3b disease. The overall PSM rate varied from 2 to 36%.

Coelho et al. [11] reported their review study results for RALRP series. Pathological stage distribution was 72.4% for pT2 and 21.9% for pT3 tumors. RALRP had a mean overall PSM rate of 15.2% (range of means 9.3–33%). The mean PSM rate for pT2 and pT3 tumors was 9.6% and 37.1%, respectively [11]. Smith et al. [33] reported that the PSM rate was relatively higher in a high-risk group of patients whose clinical stage was higher than T3.

There are also reports that the PSM rate decreased as surgeons gained experience. Atug et al. [34] evaluated 140 consecutive patients who underwent RALRP by the same surgical team. The patients were divided into three groups based on the time of surgery: group I, group II and group III comprised the first 33, the second 33 and the last 34 cases, respectively. The PSM rates were 45.4%, 21.2% and 11.7% for groups I, II and III, respectively. The difference between the groups was statistically significant ($P = 0.005$), showing lower PSM rates with increasing surgeons' experience.

Patel et al. [29] published their experience after 500 cases. They reported a PSM rate of 13% in the first 100 cases and 8% in the last 100 of the series. In our series, the surgical margin was positive in 13 (11.6%) patients. The overall, pT2 and pT3 PSM rates were 11.6%, 8.2% and 33%, respectively.

There are many conflicting study results for the comparison of PSM rates between open, laparoscopic and robotic techniques. A review study reported by Parsons et al. [19] showed no significant differences in overall risk or incidence of PSM rates between ORP and LRP or RALRP.

Continence rates between RP series vary widely because of differences in data collection methods and follow-up periods. In the review study of Coelho et al. [11], continence rates for RALRP series varied between 13.1–38%, 23–82.5%, 47–93%, 54–97.1% and 70–97% (range of means) for immediately after catheter removal and 1, 3, 6 and 12 months after RALRP, respectively [11].

Rocco et al. [35] published their results after posterior reconstruction technique in ORP [35] and LRP [36], and reported quicker recovery of urinary continence with both approaches.

In their nonrandomized, prospective study, Tewari et al. [3] compared the results of 100 ORPs and 200 RALRPs, and showed that RALRP provides earlier continence

recovery than ORP (median 160 days vs. 44 days; $P < 0.05$). The same group also described an anterior and posterior reconstruction technique (total reconstruction) during RALRP and reported the continence results. The total reconstruction group had continence rates of 38%, 83%, 91% and 97% at 1, 6, 12 and 24 weeks, respectively. The continence rate was significantly lower in the control group than in the total reconstruction group. They concluded that the total reconstructive procedure is a safe and effective way of achieving an early return to continence after RALRP.

In our series, continence was defined as no pad or at most one safety pad usage. Our continence rates were 29.4%, 64.2%, 84.2%, 91.1% and 96.6% immediately after catheter removal and at 1, 3, 6 and 12 months after surgery, respectively.

Conclusion

Radical prostatectomy remains the gold standard for organ-confined prostate cancer. RALRP is a safe and feasible technique in the treatment of localized prostate cancer. RALRP continues to evolve, which may lead to further improvements in oncological and functional outcomes. Our initial experience with this procedure shows promising short-term outcomes.

Conflict of interest None.

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