Is Robot Assistance Affecting Operating Room Time Compared with Pure Retroperitoneal Laparoscopic Radical Prostatectomy?

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Abstract

Purpose: To compare operating room times between retroperitoneal robot-assisted laparoscopic radical prostatectomy (RALRP) and pure retroperitoneal laparoscopic radical prostatectomy (LRP).

Patients and Methods: From March 2007 to April 2008, 288 patients underwent an extraperitoneal LRP in our institution. Eighty-three LRPs were performed with robot assistance using the da Vinci® Surgical System (RALRP) whereas 205 pure LRPs were performed. Operating room times were compared between the two groups.

Results: Both groups were statistically equal concerning age ($P = 0.95$), body mass index ($P = 0.52$), prostate-specific antigen level ($P = 0.40$), prostate volume ($P = 0.49$), clinical stage ($P = 0.11$), and Gleason score on biopsy ($P = 0.57$). Total operating room time was not significantly different between the two groups (223.6 vs 215.7 minutes in LRP and RALRP groups, respectively; $P = 0.23$). Mean patient installation was longer in the RALRP group (33.2 vs 24.0 minutes, $P < 0.01$). Mean operative time was significantly shorter by about 20 minutes in the RALRP group (145.6 vs 164.7 minutes, $P < 0.01$). Mean estimated blood loss was significantly lower in the RALRP group (469 mL vs 889 mL in the LRP group, $P < 0.01$). No statistical differences were observed regarding hospital stay, bladder catheterization, and complication rate between the two groups.

Conclusion: Occupation times of the operating room are equivalent during pure retroperitoneal LRP and RALRP. For a trained team performing four procedures per week, the use of the robot for LRP with no lymph node dissection decreases actual operative time at the expense of an increase in installation time, compared with pure laparoscopy.

Introduction

LAPAROSCOPIC RADICAL PROSTATECTOMY (LRP) is a validated treatment modality for localized prostate cancer. Development of minimally invasive surgery was driven in Europe and the United States in some centers that were able to report considerable experience. A lower blood loss and transfusion rate were demonstrated as the main advantages of laparoscopic surgery. Improved cosmesis and shorter convalescence may contribute to increase patient acceptance of surgical procedures and its resultant side effects. No significant difference in oncologic results has been found in further series compared with open surgery. Functional results of continence and potency appeared comparable with those obtained with use of an open approach.

LRP is a technically demanding procedure and has a learning curve estimated at 50 to 70 patients. This learning is explained by the two-dimensional vision with acquisition of different anatomic perspectives, loss of some freedom of motion, and hand-eye coordination. These difficulties and the emergence of robot assistance to improve precision and accuracy of anatomic dissection led American laparoscopic urologists to develop the technique of robot-assisted LRP (RALRP). Most RALRP reference centers completely abandoned pure LRP, and few studies compared both procedures from a single institution.

The advantages of the laparoscopic approach and minimal access seem to remain in robot-assisted surgery. RALRP may consume more operating room time than pure LRP because of a delay to prepare the robot. To date, there are no data in the
literature on total duration of a RALRP including preparation of the robot, entrance of the patient in the operating room, skin to skin operation, and exit of the patient from the operating room.\(^{9,10}\)

Pure LRP and RALRP continue to be performed at the same time in our laparoscopic referral center. We decided to compare operating room time, including docking, anesthesia, and operative times between the two procedures and during the same period.

**Patients and Methods**

A total of 288 patients underwent an extraperitoneal LRP between March 2007 and April 2008 in our institution. A total of 83 LRPs were performed with robot assistance using the da Vinci\textsuperscript{\textregistered} Surgical System, whereas 205 pure LRP were performed during the same period. Two experienced surgeons (CCA, LS) performed pure LRP. The RALRPs were performed by one surgeon (ADLT) who had surgical experience with LRP. The learning curve of robot assistance concerned the first patients. The robot was installed by the same trained team of assistants.

Data were collected prospectively, including preoperative clinical and biologic characteristics, operative data, and short-term postoperative complications. Times in the operating room, including strictly operative time, anesthetic induction time, patient installation (time between intubation and skin incision) and release times, and total operating room time, were systematically recorded prospectively for all patients in dedicated software.

**Patient characteristics**

Mean age was 62.9 years (range 42.9–81.7 ± 7.0 yr). Mean prostate-specific antigen (PSA) level was 8.5 ng/mL (range 0.4–80.0 ± 6.9 ng/mL). The mean body mass index (BMI) was 26.3 (range 16.3–38.3 ± 3.7). Clinical stage T1c was predominant in 82.1% of patients. Digital rectal examination was abnormal in 17.9% of patients. Gleason score on biopsy was 6 or lower in 17.9%; Gleason score was 7 and 8 in 33.1% and 2.9%, respectively.

Nerve-sparing procedures were performed for preoperatively potent patients with T1 clinical stage and a PSA <10 ng/mL. A bilateral and unilateral nerve-sparing procedure was performed in 75.8% and 15.8%, respectively. Lymph nodes were sampled if the Gleason score was >7 (4 + 3) and/or the PSA level was >10 ng/mL. Pelvic lymphadenectomy was performed in 123 (44%) patients.

The surgical technique and the different steps of the surgery were the same between LRP and RALRP. Two continuous polyglactin sutures were used for the vesicourethral anastomosis. The urethral catheter was usually removed at 7 days after radical prostatectomy.

**Statistical analysis**

Preoperative oncologic and clinical parameters were compared between pure LRP and RALRP to assess the preoperative equivalence of both groups. Times in the operating room were compared between the two groups using SPSS 13.0 (SPSS, Chicago, IL) software. The qualitative data were tested using a chi-square test or the Fisher exact test as appropriate, and the quantitative data were tested using the Student \( t \) test.

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### Table 1. Patient Characteristics, Operative, and Postoperative Data

<table>
<thead>
<tr>
<th></th>
<th>LRP (n = 205)</th>
<th>RALRP (n = 83)</th>
<th>P values</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preoperative data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>62.9 (±7.4)</td>
<td>62.8 (±6.0)</td>
<td>0.95</td>
</tr>
<tr>
<td>BMI</td>
<td>26.3 (±3.6)</td>
<td>26.6 (±4.0)</td>
<td>0.52</td>
</tr>
<tr>
<td>PSA (ng/mL)</td>
<td>8.2 (±5.3)</td>
<td>9.2 (±9.8)</td>
<td>0.40</td>
</tr>
<tr>
<td>Prostate volume (ml)</td>
<td>47.4 (±26.2)</td>
<td>45.1 (±21.7)</td>
<td>0.49</td>
</tr>
<tr>
<td>Clinical stage T1c (%)</td>
<td>78.1</td>
<td>89.1</td>
<td>0.11</td>
</tr>
<tr>
<td>Gleason (%)&lt;6</td>
<td>61.9</td>
<td>69.1</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>34.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;7</td>
<td>4.1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Operative data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nerve sparing technique (%)</td>
<td>90.0</td>
<td>95.2</td>
<td>0.36</td>
</tr>
<tr>
<td>Lymph node dissection (%)</td>
<td>48.5</td>
<td>33.7</td>
<td>0.02</td>
</tr>
<tr>
<td>Blood loss (mL)</td>
<td>889 (±531)</td>
<td>469 (±380)</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Transfusion rate (%)</td>
<td>4.6</td>
<td>2.4</td>
<td>0.62</td>
</tr>
<tr>
<td><strong>Postoperative parameters</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>4.6 (±1.7)</td>
<td>4.4 (±2.5)</td>
<td>0.53</td>
</tr>
<tr>
<td>Bladder catheterization (days)</td>
<td>8.5 (±2.6)</td>
<td>8.1 (±1.9)</td>
<td>0.23</td>
</tr>
</tbody>
</table>

LRP = laparoscopic radical prostatectomy; RALRP = robot-assisted laparoscopic radical prostatectomy; BMI = body mass index; PSA = prostate-specific antigen.

The limit of statistical significance was defined as \( P < 0.05 \). Results were expressed as mean and range.

**Results**

**Preoperative data**

Both groups were statistically equal concerning age \( (P = 0.95) \), BMI \( (P = 0.52) \), PSA level \( (P = 0.40) \), prostate volume \( (P = 0.49) \), clinical stage \( (P = 0.11) \), and Gleason score on biopsy \( (P = 0.57) \) (Table 1). No statistical difference regarding the percentage of nerve-sparing techniques was observed between the two groups \( (P = 0.36) \). A bilateral nerve-sparing technique was performed in 74.2% and 79.5%, and a unilateral procedure in 15.8% and 15.6% in LRP and RALRP groups, respectively. Pelvic lymphadenectomy was performed more frequently in the pure LRP group \( (48.5\% vs 33.7\%, P = 0.02) \).

**Perioperative data**

Time results are shown in Table 2. Total operating room time was not significantly different between the two groups \( (223.6 \text{ minutes in LRP group and 215.7 minutes in RALRP, } P = 0.23) \). Times of anesthesia induction and patient release were equal in the two groups \( (17.3 \text{ vs 18.1 minutes, } P = 0.60; \text{ and } 16.7 \text{ vs 16.8 minutes, } P = 0.96, \text{ respectively}) \). Statistical difference was observed concerning time of patient installation and duration of surgical procedure. Mean patient installation was longer by 9 minutes in the RALRP group \( (33.2 \text{ vs 24.0 minutes, } P < 0.01) \). Mean operative time was shorter by 20 minutes in the RALRP group \( (145.6 \text{ vs 164.7 minutes, } P < 0.01) \).

In Table 3, analysis was stratified on lymph node dissection as an additional procedure. Statistical equivalences and dif-
laparoscopic radical prostatectomy; RALRP = robot-assisted laparoscopic radical prostatectomy.

Mean estimated blood loss differed significantly between the two groups and was lower in the RALRP group (469 mL vs 889 mL, P < 0.01). When only LRP and RALRP with lymph node dissection were studied, no statistical differences appeared. Mean operative time in the LRP and RALRP groups was 175.4 and 166.6 minutes, respectively (P = 0.50). In each group, total operating room time was equivalent (P = 0.30 and P = 0.53).

In the analysis of variance test separating RALRP, LRP, with and without lymphadenectomy, differences shown in Table 2 were maintained in four groups for patient installation and operative time (P < 0.01 and P = 0.01), whereas no difference was observed for total operating room time (P = 0.38).

In the LRP group, mean difference of operative time because of lymph node dissection was 15 minutes (175.4 minutes vs 160.0 minutes, P = 0.10). This difference was higher and significant in the RALRP group with an additional time of 30 minutes in case of lymph node dissection (166.6 vs 136.2 minutes, P = 0.01).

Mean estimated blood loss differed significantly between the two groups and was lower in the RALRP group (469 mL vs 889 mL, P < 0.01). No statistically significant difference was observed concerning transfusion rate despite a lower rate in the RALRP group (4.6% vs 2.4%, P = 0.62). No conversion to an open approach was necessary.

Postoperative data

Postoperative data are presented in Table 1. Mean hospital stay was 4.6 days and 4.4 days, and bladder catheterization time was 8.5 days and 8.1 days for the LRP and RALRP groups, respectively (P = 0.53 and P = 0.23).

The overall complication rate (Table 4) was not statistically different between the two groups regarding minor and major complications (8.3% vs 3.6%, P = 0.16).

Pathologic staging revealed 68% and 72.7% of pT2 cancers, 32.0% and 27.3% of pT3 or pT4 cancers in LRP and RALRP groups, respectively (P = 0.39).

Discussion

LRP is becoming standard in many departments for management of localized prostate cancer. LRP has achieved equivalence to open surgery with regard to midterm outcomes. The laparoscopic procedure combines the same oncologic results as open retropubic radical prostatectomy with benefits in terms of blood loss, convalescence, postoperative pain, and cosmesis. A learning curve is, however, necessary. RALRP is easier to learn even for a nonlaparoscopic surgeon. Recently, surgical competences were transferred to the performance of RALRP, essentially in the United States.

The advantages of the laparoscopic approach and minimal access seem to remain in robot-assisted surgery. Most RALRP reference centers completely abandoned LRP, and few studies compare both procedures from a single institution.

RALRP may consume more operating room time than pure LRP because of the preparation of the robot. Joseph and associates reported a mean total time, including anesthesia, installation, and release times, of about 30 minutes in the LRP group and of about 75 minutes in the RALRP group, but with no statistical analysis. Other previous studies reported only operative time from skin to skin, which was not representative of overall duration of operating room occupation per patient.

In previous series, no significant difference was observed for operative time during LRP or RALRP. Our results showed a significant decrease of operative time in RALRP with a mean gain of about 20 minutes (145.6 vs 164.7 minutes, P = 0.007). Interestingly, this gain appeared statistically significant only in the subgroup without lymph node dissection (P = 0.003) but did not reach significance when only radical prostatectomies with lymphadenectomy were considered (P = 0.50).

This result is noteworthy considering that one of the main interests of the robot-assisted procedure is intrafascial nervesparing prostatectomy in patients for whom no indication of lymphadenectomy is retained. Lymphadenectomy as an additional procedure increased operative time by about 15 minutes (P = 0.10) during pure LRP vs 30 minutes (P = 0.01) during RALRP. The lack of tactile feedback and, as a consequence, a more meticulous dissection close to vascular structures may be an explanation of this time difference.

Standard deviations of operative time and total operating room time were equivalent in the LRP group, which bore witness to the standardized and reproducible procedure (49.1 and 49.2). In RALRP, this dispersion index was higher.
Tables and Figures

Table 4. Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>No. in LRP group (%)</th>
<th>No. in RALRP group (%)</th>
<th>Management</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urinary infection</td>
<td>4 (2)</td>
<td>2 (2.4)</td>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td>Urinary sepsis</td>
<td>2 (1)</td>
<td>0 (0)</td>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td>Retention</td>
<td>3 (1.5)</td>
<td>0 (0)</td>
<td>Bladder catheterization</td>
<td></td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>1 (0.5)</td>
<td>0 (0)</td>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td>Pelvic hematoma</td>
<td>3 (1.5)</td>
<td>1 (1.2)</td>
<td>Medical</td>
<td></td>
</tr>
<tr>
<td>Minor complications</td>
<td>13 (6.3)</td>
<td>3 (3.6)</td>
<td>Reintervention</td>
<td>0.53</td>
</tr>
<tr>
<td>Postoperative bleeding</td>
<td>1 (0.5)</td>
<td>0 (0)</td>
<td>Long bladder catheterization</td>
<td></td>
</tr>
<tr>
<td>Anastomotic leakage</td>
<td>2 (1.5)</td>
<td>0 (0)</td>
<td>Colostomy</td>
<td>0.10</td>
</tr>
<tr>
<td>Rectal injury</td>
<td>1 (0.5)</td>
<td>0 (0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major complications</td>
<td>4 (2.0)</td>
<td>0 (0)</td>
<td></td>
<td>0.16</td>
</tr>
<tr>
<td>Totals</td>
<td>17 (8.3)</td>
<td>3 (3.6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LRP = laparoscopic radical prostatectomy; RALRP = robot-assisted laparoscopic radical prostatectomy.

Concerning total operating room time compared with operative time (49.1 vs 34.4). It testified to the reproducibility of the robot-assisted surgical technique, despite the learning curve.

Time and reproducibility may be gained concerning patient and robot installation. Surprisingly, the statistical difference between installation times only appeared when lymph node dissection was not performed. Installation time was expected not to be affected with the surgeons’ decision to perform lymph node dissection. The low number of patients undergoing lymph node dissection in RALRP could explain this lack of significance (28 patients, P = 0.08).

A limitation of our study is that the series included three surgeons and that patients were not randomized into one of the two surgical procedures. LRP was performed by two experienced surgeons who were already proficient in conventional and standardized laparoscopic procedures. RALRP was performed by a single surgeon with strong experience in pure extraperitoneal LRP, which can explain a short learning curve and the short operative time in RALRP. Schroeck and colleagues have also shown that the robot assistance learning curve did not negatively impact operative time. We considered that all laparoscopic procedures were performed by senior surgeons with no significant difference of surgeon experience and that the two groups could be directly compared.

The percentage of neurovascular bundle preservation was equivalent in both approaches. Lymph node dissection was more frequent during pure LRP, which introduces a bias for overall time analysis and could preclude definitive comparison. Analysis stratified on performance of lymph node dissection was realized in Table 3. Operative time analysis in the subgroup of surgeries without lymphadenectomy showed a stronger difference between LRP and RALRP. No difference appeared concerning overall operating room times between the two procedures, whether lymph node dissection was performed or not (P = 0.30 and P = 0.51). BMI and prostate volume as factors affecting operative times were strictly equivalent in both groups.

The main disadvantage of RALRP is the cost of installation and maintenance of the da Vinci system. The initial cost is about $1,500,000, and the annual maintenance cost is $140,000. Each RALRP has an instrument cost of $1500. It has been estimated that 75 cases are necessary per year at a mean operative time of 3 hours for the procedure to be cost-effective in the United States. In our study, mean operative time, including the surgical learning curve, was lower than this cutoff (145.6 minutes). Operating room times as a factor in overall length of stay become very important if an objective is cost reduction. Interestingly, the time lost during patient and robot installation was compensated for with time gained during surgical performance. Mean total operating room time was 215.7 minutes and was comparable with the pure laparoscopic procedure. An additional step in cost reduction would be to reduce patient and robot installation time to augment the gain of operative time during RALRP.

No significant differences were observed between pure LRP and RALRP regarding anesthesia time, patient release time, total operating room time, length of hospital stay, complication rate, or bladder catheterization. More complications appeared in the LRP group (8.3% vs 3.6%) but the difference did not reach significance. Most of these complications were minor, needing medical management only.

Mean blood loss was significantly greater during pure LRP (469 mL vs 889 mL, P < 0.01). This result has to lead to the concept that the da Vinci system may improve precision and accuracy of periprostatic dissection, thanks to three-dimensional vision and 6 degree fields (df) from the instrument tips. Menon and coworkers and Joseph and associates have shown the same results concerning blood loss. No difference appeared in the Montsouris series.

Mean blood loss in RALRP was greater during the learning curve and the 20 first procedures of robot assistance. For the last 50 patients, mean blood loss was significantly lower and in line with published values.

Conclusion

Occupation times of the operating room are equivalent during pure LRP and RALRP. For a trained team performing four procedures per week, the use of the robot for an LRP does not increase the duration of the procedure compared with pure laparoscopy.

Disclosure Statement

No competing financial interests exist.

References


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Abbreviations Used
BMI = body mass index
LRP = laparoscopic radical prostatectomy
PSA = prostate-specific antigen
RALRP = robot-assisted laparoscopic radical prostatectomy