Robotic-assisted laparoscopic extended pelvic lymph node dissection for prostate cancer: surgical technique and experience with the first 99 cases

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Abstract

BACKGROUND: To date, there is still a paucity of data in the literature on robotic-assisted laparoscopic extended pelvic lymph node dissection (RALEPLND) in patients with prostate cancer.

OBJECTIVE: To assess the technical feasibility of RALEPLND and to present our surgical technique.

DESIGN, SETTING, AND PARTICIPANTS: From April 2006 to March 2008, we performed RALEPLND in 99 patients prior to robotic-assisted laparoscopic radical prostatectomy. Indications for RALEPLND were a prostate-specific antigen (PSA) \( \geq 10 \) ng/ml or a preoperative Gleason score \( \geq 7 \).

The data were evaluated retrospectively. SURGICAL PROCEDURE: The transperitoneal approach was used in all cases. In order to gain optimal access to the common iliac bifurcation, the five trocars were placed in a more cephalad position than in patients undergoing radical prostatectomy without RALEPLND. After identification of important landmarks, the lymphatics covering the external iliac vein, the obturator lymphatic packet, and the lymphatics overlying the internal iliac artery were removed on both sides. MEASUREMENTS: The total lymph node yield, the frequency of lymph node metastases, and the complication rate. RESULTS AND LIMITATIONS: The median patient age was 64 yr (range: 45-78). The median preoperative PSA level was 7.7 ng/ml (range: 1.5-84.6). The median number of lymph nodes harvested was 19 (range: 8-53). In 16 patients (16%), we found lymph node metastasis. Complications occurred in seven patients (7%). CONCLUSIONS: RALEPLND is feasible, and its lymph node yield is well in the range of open series. The robotic-assisted laparoscopic approach in itself does not seem to limit a surgeon’s ability to perform a complete extended pelvic lymph node dissection.
Robotic-assisted laparoscopic extended pelvic lymph node dissection for prostate cancer: Surgical technique and experience with the first 99 cases.

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None

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Design, Setting and Participants: From April 2006 to March 2008 we performed RALEPLND in 99 patients prior to robotic assisted laparoscopic radical prostatectomy. Indications for RALEPLND were a prostate-specific antigen (PSA) ≥ 10 ng/ml or a preoperative Gleason score ≥ 7. The data were evaluated retrospectively.

Surgical procedure: The transperitoneal approach was used in all cases. In order to gain optimal access to the common iliac bifurcation the five trocars were placed in a more cephalad position than in patients undergoing radical prostatectomy without RALEPLND. After identification of important landmarks the lymphatics covering the external iliac vein, the obturator lymphatic packet, and the lymphatic’s overlying the internal iliac artery were removed on both sides.

Measurements: The total lymph node yield, the frequency of lymph node metastases and the complication rate.

Results and limitations The median patient age was 64 years (range 45 to 78). The median preoperative PSA level was 7.7 ng/ml (range 1.5 to 84.6). The median number of lymph nodes harvested was 19 (range 8 to 53). In 16 patients (16%) we found lymph node metastasis. Complications occurred in 7 patients (7%).

Conclusion: RALEPLND is feasible and its lymph node yield is well in the range of open series. The robotic assisted laparoscopic approach in itself does not seem to limit a surgeon’s ability to perform a complete extended pelvic lymph node dissection.
Introduction

Robotic assisted laparoscopic radical prostatectomy is an increasingly popular procedure throughout Europe and the United States. This is reflected by a rapidly increasing number of publications reporting various refinements of technique as well as functional outcomes and early oncological results [1-3]. Yet, ever since the initial reports by Guilloneau et al., robotic lymph node dissection in patients undergoing radical prostatectomy did not receive much attention in the robotic urological community [4]. This is in contrast to the ongoing debate concerning the extent of and the indication for a lymph node dissection in patients undergoing radical prostatectomy for prostate cancer [5-9]. There’s much confusion among different authors and centres concerning the terminology and the boundaries of the lymph node dissection [10,11]. However, increasing evidence supports an extended lymph node dissection in patients with prostate cancer once the PSA level is greater than 10 ng/ml or the Gleason score totals 7 or more. Likewise, recent data suggest renouncing a lymph node excision in low risk patients [5,6,12]. Data on conventional laparoscopic pelvic lymph node dissection in patients with prostate cancer are widely available [13-15]. Yet, none of the recently published studies included experience with robotic-assisted laparoscopic pelvic lymph node dissection. Thus, to date there is still a paucity of data in the literature on robotic-assisted laparoscopic extended pelvic lymph node dissection (RALEPLND) in patients with prostate cancer. The aim of this study was to assess the technical feasibility and to analyze our experience with RALEPLND. In addition, our surgical technique of RALEPLND is presented in detail in the complementary video.
Patients and methods

Patient population

From April 2006 to March 2008 234 men underwent robotic-assisted laparoscopic radical prostatectomy in our department. In 99 of these patients we performed RALEPLND prior to robotic-assisted laparoscopic radical prostatectomy (RALRP). In two patients referred to our department for staging purposes only, we performed only RALEPLND without RALRP: The reasons were the bulky lymph node packets subsequently tested positive in the frozen section analysis in one case, while the second patient refused radical prostatectomy and opted for radiotherapy.

Indications for RALEPLND were either a PSA ≥ 10 ng/ml or a preoperative Gleason score ≥ 7. Patients with a clinical T3 tumor who opted for radical prostatectomy were included as well. Preoperatively, 79 patients (80%) underwent staging examinations with computed tomography (CT) or magnetic resonance imaging (MRI) of the abdomen and pelvis and/or bone scan. All preoperative diagnostics were negative for metastasis. Further patients’ characteristics are shown in table 1. Low-dose heparin was applied into the upper arm in order to prevent deep vein thrombosis.

Pathologic work-up to detect lymph nodes as well as lymph node metastases included direct visualization and palpation, and standard hematoxylin-eosin staining, respectively.

Statistical methods

Clinical information and pathological data were evaluated retrospectively with descriptive statistics.
Description of the surgical technique

The patients were placed in a 20-30° Trendelenburg position. The transperitoneal route was chosen in all patients undergoing RALEPLND on account of excellent working space. Using a three-arm Da Vinci® robotic system we routinely placed 5 trocars. All of these trocars were placed in a more cephalad position than in patients undergoing RALRP without RALEPLND in order to gain better access to the common iliac bifurcation (Fig. 1). The trocar for the robotic camera was placed in the midline sub-or supra-umbilical depending on how tall the patient was. Two 8 mm pararectus trocars for the robotic working instruments were placed on the left and right side slightly lower than the camera trocar. We placed two additional trocars that were used by a single assistant, usually one 5 mm trocar between the camera and right working trocar and a 12 mm trocar medial and cranial to the right anterior superior crest. In patients with a narrow pelvis we placed the trocar for the robotic camera 3-4 cm to the left of the umbilicus in order to gain additional space for the assistant trocars.

Identification of landmarks and peritoneal incision

As with any other procedure the RALEPLND has to proceed from one landmark to the next. Therefore, in the manuscript and especially in the DVD we highlight the specific landmarks that should be identified during the course of the dissection.

We use the boundaries of the lymph node dissection according to Bader et al and their recent modification by Mattei et al., proposing to include the common iliac region up to the ureteric crossing [5, 9, 13, 16, 17]. Special attention is paid to the careful dissection of the tissue medially to the internal iliac artery.

After mobilizing the right ascending and left descending as well as sigmoid colon if indicated, the lymphadenectomy is initiated. Of major importance is the identification of several important landmarks: Identification of the median and medial umbilical folds and the pulsation of the external iliac artery. Frequently, the vas deferens and the ureter are already
visible beneath the peritoneum. After identification of these landmarks the incision of the peritoneum starts laterally to the medial umbilical fold longitudinally along the external iliac vessels (Fig 2). Distally, the incision and dissection is carried out until the pubic bone is clearly identified (Fig. 3). Proximally, the peritoneal incision proceeds up to the crossing of the ureter over the common iliac artery (Fig 4). The vas deferens (Fig. 3) is cauterized and divided. After these steps, the cephalad and caudal boundaries of the lymph node dissection are defined.

*Dissection of the external iliac lymphatic packet*

The dissection of the external iliac packet starts distally with the division of the adventitia overlying the external iliac vein (Fig. 5). In doing so, the lymphatic tissue covering the external iliac artery remains untouched. The distal end of the packet is divided and secured with hemolock clips. The lymphatic packet is grasped and retracted in a cephalad and medial direction which allows for blunt and sharp dissection of the packet from the underlying vein. The dissection proceeds until the upper boundary, i.e. the ureter, is reached.

*Dissection of the obturator lymphatic packet*

The second region to be cleared from its lymphatic tissue is the obturator fossa. The most crucial step in this region is the identification of the obturator nerve (Fig. 6). Great care should be paid to avoid any injury to this nerve. The dissection is initiated at the angle between the external iliac vein and the pubic bone. Only after clear identification of the obturator nerve, the distal end of the packet is secured with hemolock clips and divided. The packet is dissected beneath the external iliac vein and proceeds to the pelvic side wall being the lateral boundary of the dissection. The proximal attachments of the packet are dissected using a combination of sharp and blunt dissection, always paying close attention to avoid any sharp, blunt or thermal injury to the nerve. Alternatively, it is possible to identify the obturator
nerve early in the course of the obturator dissection. When separating the external iliac artery and vein just distal to the bifurcation of the common iliac artery the obturator nerve becomes visible in its proximal course (Fig. 7). However, we perform this maneuver in any case at the end of the dissection of the obturator fossa to ascertain that all lymphatic tissue has been cleared out of this region.

Dissection of the internal iliac (hypogastric) lymphatic packet

The internal iliac artery is usually identified after the initial peritoneal incision. At the latest the bifurcation of the common iliac artery should be visible after the completion of the dissection of the external packet. Alternatively, following the medial umbilical ligament down to the pelvic floor will lead to the internal iliac artery. The fibrofatty tissue containing the lymphatics overlying the internal iliac artery and its obturator and especially the medial vesical branches is completely removed (Fig. 8).

The lymph node dissection is completed only after a careful inspection for bleeding and thoroughness of the dissection has been carried out. The lymph node packets from each region are removed and sent to the pathologist separately. Only packets that are too big to be removed through the 12 mm trocar are retrieved within a specimen bag. We have renounced to place drains.

Results

RALEPLND was completed successfully in all 99 patients. None of the cases had to be converted to open surgery. The median time to complete the lymph node dissection was 51 minutes (range 29 - 81). The median number of lymph nodes removed was 19 (mean 19.4, range 8 to 53). The left and right side accounted for an equal number of lymph nodes
retrieved. In 16 patients (16%) lymph node metastasis was detected (Table 2). In lymph node-
positive patients the median PSA level was 12.25 ng/ml (range 6.3 to 56). The number of
metastatic lymph nodes with regard to pathologic Gleason score and pathologic T stage are
shown in tables 2 and 3. In 9 patients (56%) only one lymph node was found to harbour a
metastasis. Table 4 shows the distribution of the removed lymph nodes and lymph node
metastases. Complications presumably associated with the RALEPLND occurred in 7 patients
(7%). We noted 1 lymphatic fistula at a port site, which closed spontaneously. Lymphedema
was observed in two patients: In one patient a bilateral lymphedema of the lower leg resolved
after physical therapy with supportive lymphatic drainage. The other patient showed
persistent unilateral lymphedema in the follow-up after 3 months. In two patients a
symptomatic lymphocele was treated conservatively. In two patients a lymphocele was
successfully drained percutaneously. The overall median blood loss for RALRP including the
extended lymph node dissection was 500 ml and two patients received blood transfusions (2
units per patient). However, the transfusions were not related to (excessive) bleeding
associated with RALEPLND but rather to bleeding during RALRP. No deep vein thrombosis
was recorded. In one patient a port site infection was successfully treated with antibiotics.
Discussion

With respect to our results with a median lymph node yield of 19 and the applied dissection template and surgical technique, we were able to demonstrate the feasibility of a sound robotic-assisted laparoscopic extended pelvic lymph node dissection (RALEPLND). Much has been written about dissection templates, indications and oncological outcome for extended and limited lymph node dissection in patients with prostate cancer [5-7, 9, 12, 18]. The lack of standardization in the terminology and the definitions of anatomic dissection boundaries make a comparison between published data difficult [6]. We chose a dissection template that was well defined by others, not only in order to facilitate comparison of the results, but also because good evidence is provided in the literature to support this dissection template [9, 16]. One important advantage of this dissection template is the preservation of the lymphatics overlying the external iliac artery thus decreasing the risk of lymphedema of the lower extremities [5, 15]. In this perspective a median lymph node yield of 19 is well in the range of the published data of the respected open series [5, 9, 12, 19]. Additionally, this yield is in line with the frequently quoted study by Weingärtner et al on cadavers considering a lymph node yield of 20 to be an accurate staging procedure [20].

The frequency of the detected lymph node metastasis is not only related to the dissection template but also to the study population. Therefore, it depends on the indication for the lymph node dissection. Unfortunately, several authors use the terms low, intermediate and high risk in different ways, which again makes comparison between results difficult [5, 13, 15]. Basically, we chose to perform an extended lymph node dissection in intermediate and high-risk patients according to the definition of D’Amico et al [21]. We found lymph node metastases in 16% of our intermediate and high-risk patients. This frequency of detected metastases is similar to other recently reported results [13, 19]. Of note, 25% of all metastatic lymph nodes were detected in the area around the internal iliac artery. Although this frequency is lower than in other reports, these findings support the idea to include the area
around the internal iliac artery into the dissection template for extended pelvic lymph node dissection as pointed out by other authors [9, 22].

Typically, lymphocele formation is the most frequent complication associated with lymph node dissection [23]. In our series we noted symptomatic lymphocele formation in 5 patients. However, only in two patients lymphoceles needed to be drained percutaneously. It is of note that the frequency of these complications was similar to other reports although we placed no drains [5, 9, 13, 15]. Therefore, based on our results we question the need to place two drains in patients undergoing extended lymph node dissection, at least when choosing a robotic-assisted transperitoneal approach. Pelvic drain placement not only has been discussed to prevent lymphocele formation but also to prevent urinoma formation and postoperative hematoma. Two recently published articles addressed the issue of pelvic drainage after prostatectomy, concluding that pelvic drainage can be omitted in up to 90% of robotic assisted prostatectomies [24, 25]. In accordance with these two recently published articles we assessed the integrity of the vesico-urethral anastomosis intraoperatively in all patients of our series with a bladder filling with 50 - 100 ml saline. As no leakage was observed we renounced to place a pelvic drain. No other serious complications associated with RALEPLND were observed.

Another technical refinement is the separation of the external iliac artery and vein. The robotic-assisted dissection of lymphatic tissue at the proximal course of the obturator nerve is difficult due to impaired vision during retrograde dissection. Separation of the external iliac vessels allows for antegrade dissection and proper clearance of this region (Fig. 6). We routinely commence the procedure with the RALEPLND. With the robotic approach, tension on the medial umbilical ligament to ease dissection of the hypogastric region is no longer possible, once the bladder has been mobilized (“dropped”) completely. Tension to the medial umbilical ligament is of importance to dissect the lymphatic tissue in the hypogastric region. Therefore, we prefer to perform the RALEPLND before RALRP.
Several limitations deserve mention. An important caveat is not using a specimen bag to retrieve the lymph node packets as this could pose a risk for port site recurrence. Although a port site recurrence after laparoscopic radical prostatectomy in general is exceedingly rare in patients with intermediate and high risk features, it might be increased [26, 27]. Therefore, we strongly recommend using specimen bags. Outside of study protocols a single retrieval bag might suffice, as an assessment of lymph node metastases by different sites is not indicated. Another point is that certainly a learning curve is included in our results. All four console surgeons are familiar either with open extended pelvic lymph node dissection or laparoscopic lymph node dissection in patients with prostate cancer. However, two out of four surgeons were robotic novices and thus had no experience in robotic lymph node dissection. This is possibly reflected in the median lymph node yield of the first 50 patients being 16 compared to the second 49 patients where a median of 21 nodes were removed. Another limitation is the relatively small number of patients. However, the main purpose of this analysis was to assess the technical feasibility and the nodal yield of the intervention, but not to redefine indications and the extent of pelvic lymph node dissection in patients with prostate cancer.
Conclusion

In our experience RALEPLND is feasible and its lymph node yield is well in the range of open series. The robotic assisted laparoscopic approach in and of itself does not seem to preclude a complete extended pelvic lymph node dissection.

Acknowledgments

We would like to thank Damina Balmer for her assistance in the preparation of the manuscript. We are deeply grateful to Stefan Schwyter for his excellent preparation of the illustrations and to René Senn for the ease in the post-production of the DVD. Last but not least we highly appreciate the voice-over on the DVD spoken by Kevin Horton.
References


### Tables

#### Table 1

**Patient characteristics**

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of patients</td>
<td>99</td>
</tr>
<tr>
<td>Median age, years (range)</td>
<td>64 (45 - 78)</td>
</tr>
<tr>
<td>BMI (range)</td>
<td>26.4 (19.8 - 34.3)</td>
</tr>
<tr>
<td>Median preoperative PSA, ng/ml (range)</td>
<td>7.7 (1.5 - 84.6)</td>
</tr>
<tr>
<td>Preoperative Gleason score, No (%) *</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2 (2%)</td>
</tr>
<tr>
<td>6</td>
<td>18 (18%)</td>
</tr>
<tr>
<td>7</td>
<td>64 (65%)</td>
</tr>
<tr>
<td>8</td>
<td>8 (8%)</td>
</tr>
<tr>
<td>9</td>
<td>5 (5%)</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Clinical T Stage, No (%)</td>
<td></td>
</tr>
<tr>
<td>cT1</td>
<td>66 (67%)</td>
</tr>
<tr>
<td>cT2</td>
<td>27 (27%)</td>
</tr>
<tr>
<td>cT3</td>
<td>6 (6%)</td>
</tr>
</tbody>
</table>

*Gleason score not available for 2 patient*
Table 2

Number of metastases according to pathologic Gleason score

<table>
<thead>
<tr>
<th>Pathologic Gleason score *</th>
<th>Number of patients, No</th>
<th>Number of patients with metastases, No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>95</td>
<td>16 (16%)°</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>69</td>
<td>5 (7%)</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>6 (55%)</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>4 (40%)</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No Gleason score determined</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

* Gleason score not available for 4 patients. In 2 patients because no prostatectomy was performed and in 2 patients because the patients received neoadjuvant androgen deprivation therapy by referring urologists.

° Percentage based on all 99 patients undergoing RALEPLND.
Table 3

Number of metastases according to pathologic T stage

<table>
<thead>
<tr>
<th>Pathologic T stage *</th>
<th>Number of patients, No</th>
<th>Number of patients with metastases, No (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>97</td>
<td>16 (16%)°</td>
</tr>
<tr>
<td>pT2a</td>
<td>13</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>pT2b</td>
<td>1</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>pT2c</td>
<td>56</td>
<td>5 (9%)</td>
</tr>
<tr>
<td>pT2a-c</td>
<td>70</td>
<td>6 (9%)</td>
</tr>
<tr>
<td>pT3a</td>
<td>15</td>
<td>4 (27%)</td>
</tr>
<tr>
<td>pT3b</td>
<td>12</td>
<td>6 (50%)</td>
</tr>
<tr>
<td>pT3a/b</td>
<td>27</td>
<td>10 (37%)</td>
</tr>
<tr>
<td>pT4</td>
<td>0</td>
<td>0</td>
</tr>
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</table>

* Pathologic T stage not available for 2 patients because no prostatectomy was performed.

° Percentage based on all 99 patients undergoing RALEPLND
Table 4

<table>
<thead>
<tr>
<th>Anatomic region</th>
<th>Total number lymph nodes</th>
<th>Metastatic lymph nodes</th>
<th>Exclusively metastatic in this region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal iliac (hypogastric)</td>
<td>329</td>
<td>5 (1.5%)</td>
<td>1</td>
</tr>
<tr>
<td>External iliac</td>
<td>597</td>
<td>6 (1.0%)</td>
<td>3</td>
</tr>
<tr>
<td>Obturator fossa</td>
<td>993</td>
<td>9 (0.9%)</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>1919</td>
<td>20 (1.0%)</td>
<td></td>
</tr>
</tbody>
</table>
Figures

Figure 1

A 12 mm trocar for the camera is placed to the left of the umbilicus (a). The 8 mm robotic trocars are placed pararectal on the right side and in a more lateral position on the left side (b, c). One assistant trocar (12 mm) is placed in a medial and cranial position of the anterior superior iliac spine (d). This trocar set-up provides additional working space for the second assistant trocar (5mm) between the camera and right robotic trocar(e).
Figure 2
Primary incision line and identification of landmarks (right side)

Figure 3
Identification of the pubic bone after dissection of the Retzius space (right side).
Figure 4
Identification of the right ureter and internal iliac artery, thus defining the proximal dissection boundary.

Figure 5
Starting point for the dissection of the lymphatics overlying the external iliac vein by dividing the adventitia overlying the external iliac vein.
Figure 6
Starting point for the dissection of the obturator lymphatic packet at the angle between the pubic bone and external iliac vein.

Figure 7
Identification of the obturator nerve at its proximal course after separating the external iliac artery and vein.
Figure 8

Overview after completion of the extended pelvic lymph node dissection.