Laparoscopic Pelvic Lymph Node Dissection in the Staging of Prostate Cancer

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Abstract

Background: Men with localized prostate cancer who present with high risk features may benefit from determination of pelvic lymph node status by a laparoscopic lymph node dissection prior to definitive therapy.

***Methods*:** One hundred eighty-nine men with a median age of 69 years (range 49–80) with T1–T3 prostate cancer had a laparoscopic pelvic lymph node dissection (LPLND) prior to definitive therapy (radiation or surgery). All patients had a negative bone scan and a computerized tomography of the pelvis prior to the LPLND. In addition, all patients also underwent a seminal vesicle biopsy (SVB) in order to determine the presence of T3c disease. Prostate-specific antigen (PSA) ranged from 1.6–190 ng/mL (median 11 ng/mL) and was > 10 ng/mL in 56.6%, Gleason score was $\geq$ 7 in 46.7%, and 67.8% had clinical stage T2b–T3a.

***Results*:** Of the 189 patients who underwent an LPLND, 22 (11.6%) had a positive dissection. Between 1 and 51 nodes (median 9) were removed per dissection. PSA, clinical stage, Gleason score and SVB results all significantly influenced node findings. Positive nodes were encountered in 26.5% of those with a PSA > 20 ng/mL ($p=0.0002$), in 16.4% with stage T2b–T3a ($p=0.003$), in 20% with Gleason scores 7–10 ($p=0.0006$) and in 38% of men with a positive SVB ($p<0.0001$). Logistic regression analysis with PSA, Gleason score, clinical stage and the results of the SVB demonstrated that a positive SVB was the most significant predictor of node positivity. The overall transfusion rate was 1% (2/189) and median hospital stay was one day. The complication rate for the LPLND was 9% (17/189).

***Conclusion*:** The LPLND is an effective and efficient means of detecting positive pelvic lymph nodes in patients with localized prostate cancer. It should be considered a necessary diagnostic modality in all appropriate patients who may be candidates for curative therapy.

Key Words: Laparoscopy, prostate cancer, pelvic lymph node dissection, lymphadenectomy.

Introduction

Prostate cancer is the most common non-skin malignancy in men; approximately 317,000 new cases occurred in 1996 (1). The American Cancer Society estimates the lifetime risk for developing prostate cancer to be 1 in 5. The most likely explanation for the increase in the number of new cases is the aging male population and the widespread use of prostate-specific antigen (PSA) testing (2, 3).

Improvements in both diagnosis and treatments have also coincided with the increase in the number of new cases of prostate cancer. Application of new technology has provided a means of improving diagnostic accuracy in those patients who are at risk for extra prostatic disease, thus permitting better identification of those patients who would benefit most from curative therapy.

The field of minimally invasive technology has also advanced to include assessment of pelvic lymph nodes in those patients with prostate cancer who may be at high risk for lymph node metastases. Previously, when a patient with localized prostate cancer was a candidate for curative therapy, he was offered an open pelvic lymph node dissection as a means of determining if micrometastases were present. This open dissection was done either at the time of radical retropubic prostatectomy or prior to either perineal prostatectomy or radiation therapy. The laparoscopic pelvic lymph node dissection (LPLND) has mostly replaced the need to perform an open dissection in those patients at risk for pelvic lymph nodal disease (4–11). Herein we describe our technique, review our results and describe our indications for performing an LPLND in men with localized carcinoma of the prostate.

Materials and Methods

One hundred eighty-nine men with a median age of 69 years (range 49–80) with T1–T3 prostate cancer had an LPLND prior to definitive therapy (radiation or surgery). The patients were staged by the TNM system and all had negative bone scan and computerized tomography of the pelvis prior to the LPLND. In addition, all patients also underwent a seminal vesicle biopsy (SVB) to determine the presence of T3c disease. The technique and indications for an SVB have been previously reported (10, 11). Prostate-specific antigen (PSA) ranged from 1.6–90 ng/mL (median 11 ng/mL) and was > 10 ng/mL in 56.6%. Gleason score was $\geq$ 7 in 46.7% and 67.8% had clinical stage T2b–T3a disease (Tables 1–3).

TABLE 1

Distribution of Patients Based upon Presenting Prostate-Specific Antigen (PSA) Values.

PSA Range ng/mL	n* (%)
0–4	14 (7.4)
4.1–10	68 (36.0)
10.1–20	58 (30.7)
> 20	49 (25.9)
Total	189 (100)

* n = number of patients

TABLE 2

Distribution of Patients by Gleason Scores.

Gleason score	n* (%)
2–4	28 (14.8)
5–6	71 (38.5)
≥ 7	90 (46.7)
Total	189 (100)

* n = number of patients

TABLE 3

Distribution of Prostate Cancer Cases by Clinical Stage.

Clinical stage	n* (%)
T1b	5 (2.6)
T1c	18 (9.5)
T2a	38 (20.1)
T2b	86 (45.5)
T2c	35 (18.5)
T3a	7 (3.8)
Total	189 (100)

* n = number of patients

T1b: > 5% of transurethral prostatectomy specimen containing cancer
T1c: PSA-detected tumor
T2a: less than ½ lobe involved
T2b: one lobe involved
T2c: both lobes involved
T3a: unilateral extension outside of prostate

The LPLND was performed under general anesthesia by one surgeon using the transperitoneal technique placing 4 trocars in a diamond pattern in the lower abdomen (10, 11). A

10mm trocar was placed just below the umbilicus after insufflation to 14mm Hg with CO_2. Two 5mm trocars and one 10mm trocar were then placed under direct vision lateral to the rectus fascia and just above the pubis, respectively. The table was then rotated, placing the operative side up, and the procedure was begun by incising the posterior parietal peritoneum overlying the common iliac artery caudal to just lateral to the umbilical ligament. The vas deferens was then isolated and divided between endoclips. This allowed access to the obturator space and the obturator and hypogastric nodal tissue. All of the tissue bounded by the underside of the external iliac vein laterally, the pubis caudally, the obturator nerve and vessels posteriorly, and the common iliac artery cranially was removed. This tissue was then sent for frozen section analysis (for clinically suspicious nodes) and for permanent section analysis. Patients were admitted following the node dissection and fed a regular diet the night of surgery. In most cases, patients were discharged the next day.

Differences in proportions were tested using the Pearson Chi square test. Logistic regression analysis was used to test the effect of multiple variables.

Results

Of the 189 patients who underwent an LPLND, 22 (11.6%) had a positive dissection. Between 1 and 51 nodes (median 9) were removed per dissection. PSA, clinical stage, Gleason score and seminal vesicle biopsy results all significantly influenced node findings. Positive nodes were encountered in 26.5% of those with a PSA > 20 ng/mL (p=0.0002), 16.4% with stage T2b–T3a (p=0.003), 20% with Gleason scores 7–10 (p=0.0006) and in 38% of men with a positive SVB (p<0.0001) (Table 4).

TABLE 4
Likelihood of Encountering a Positive Laparoscopic Pelvic Node Dissection.

Variable	Positive n* (%)	Negative n* (%)	p Value
PSA (ng/mL): 1–20	9 (6)	131 (94)	
> 20	13 (26.5)	36 (73.5)	0.0002
Gleason score: 2–6	4 (4)	95 (96)	
7–10	18 (20)	72 (80)	0.0006
Stage: T1b–T2a	1 (1.7)	60 (98.3)	
T2b–T3a	21 (16.4)	107 (83.6)	0.003
SVB: negative	6 (4)	141 (96)	
positive	16 (38)	26 (62)	< 0.0001

* n = number of patients

Prostate-specific antigen (PSA)
Gleason score, clinical stage
Seminal vesicle biopsy (SVB)

Logistic regression analysis using PSA, Gleason score, clinical stage and the results of the SVB as continuous variables demonstrated that only a positive seminal vesicle biopsy significantly predicted node positivity (Table 5).

TABLE 5

Multivariate Analysis of Results of Seminal Vesicle Biopsy (SVB), Prostate-Specific Antigen (PSA), Gleason Score and Clinical Stage Compared to Lymph Node Dissection.

Variable	p Value
SVB	< 0.0001
PSA	0.07
Gleason Score	0.06
Clinical Stage	0.08

The length of time needed to perform an LPLND decreased significantly as more experience was gained with the procedure. The mean operative time was 1 hour and 15 minutes (range 15 minutes to 3 hours). Blood loss also significantly decreased with greater experience. The average blood loss was 30 cc with a range of 10–250 cc. In the first 50 patients, one unit of autologous blood was taken prior to the procedure. Two patients (4%) were given their unit back. In the next 139 patients, no autologous blood was taken and no patients received a transfusion. The overall transfusion rate was 1% (2/189).

A total of 17 (9%) complications occurred in these 189 patients (Table 6). The most common

TABLE 6

Complications Associated with Laparoscopic Lymph Node Dissection.

Complication	n* (%)
penile and scrotal edema	11 (5.8)
peripheral edema	5 (2.6)
urinary retention	3 (1.6)
obturator nerve palsy	2 (1)
pelvic hematoma	2 (1)
high inspiratory pressure	1 (0.5)

* n = number of patients

No patients required a laparotomy.

complication, occurring in 11 patients, was edema of the penis and scrotum. Two patients (1%) required readmission for infected pelvic hematomas. All node dissections were completed and no patients required a conversion to an open dissection. No patients required a laparotomy because of

complications. There were no deaths associated with the LPLND.

Discussion

Treatment for localized carcinoma of the prostate is dependent on the extent of disease at the time of diagnosis. Patients who appear to have clinically confined disease may be candidates for surgery (radical prostatectomy) or radiation therapy (external beam irradiation or interstitial therapy). Definitive therapy for patients with either T3c (seminal vesicle) or N+ (pelvic lymph nodes) disease may be only marginally beneficial (12–16). Thus, controlling the primary disease may not affect the subsequent development of distant metastases in these patients (17–22).

Prior to the advent of laparoscopic surgery, patients who presented with high risk features for nodal disease had to undergo an open retropubic lymph node dissection in order to confirm that they would be candidates for curative therapy. Pathologic confirmation of lymph node status was required because of the inaccuracy of radiographic staging. In a recent review of the results of CT scanning prior to radical prostatectomy in 173 patients, CT understaged 75% of the patients with positive nodes (23). CT scanning was found to benefit only those with a PSA of at least 20–30 ng/mL.

Because of the inadequacy of radiographic staging, a lymph node dissection was often done at the time of radical retropubic prostatectomy in those patients electing surgery as their treatment option. For those with a positive node dissection, the radical prostatectomy was often abandoned and the patient closed. Patients with high-risk disease experienced unnecessary surgery and morbidity if the nodes were positive.

In patients undergoing a node dissection followed by radical prostatectomy, the prostate is removed if the frozen section is negative. However, in up to 85% of the patients, the frozen section analysis of the nodal tissue at the time of the radical prostatectomy is falsely negative and a non-curative prostatectomy is performed (24–26). In these patients, where accurate determination of nodal status is critical, a minimally invasive surgical procedure could correctly identify those patients best treated with curative therapy and possibly prevent an unnecessary prostatectomy.

The surgical procedure used to remove the pelvic nodal tissue with laparoscopy has been found to be as effective as the open techniques. Data from centers performing laparoscopic pelvic node dissections have demonstrated similar results (number of nodes removed and node positivity) as the open retropubic pelvic lymph node dissection (4–11). Rukstalis et al. (27) performed LPLND on patients with clinically localized prostate cancer. In 20 patients, this was followed by an open lymph node dissection with removal of the remaining lymph nodes in the dissection area. Using this method, he found that the LPLND was able to remove 87–95% of the desired lymph nodes. In the present study, a median of 9 nodes was removed, data that are consistent with other reports in the literature.

The data from this study also demonstrate that not all patients need to have their lymph nodes

evaluated. While the overall node positivity rate was 11.6%, patients with low risk features were unlikely to have a positive dissection. Patients with PSA < 20 ng/mL, Gleason score < 7, lesions T2a or less or those with a negative SVB had only a 6%, 1.7%, 4% and 4% likelihood respectively of having a positive dissection. These patients can be adequately treated by either surgery or radiation, without the need for pathologic nodal assessment.

Those patients who present with high risk features should undergo a pelvic lymph dissection. Partin et al. (28) evaluated 1,058 men who had radical prostatectomy and open staging pelvic lymphadenectomy and reported 11% node positivity. Using this information, they were able to construct treatment algorithms based upon the pretreatment variables and assign probabilities of the likelihood of a positive node dissection.

The data from our study also yields similar probabilities. Patients who present with a PSA > 20 ng/mL, a Gleason score $\geq$ 7 or stage T2b–T3a had a 26.5%, 20% and 16.4% likelihood respectively of having a positive dissection. While the probabilities in the two studies are similar, there is one major difference. All of the patients examined in Partin's study had an open node dissection with or without prostatectomy (depending on the frozen section analysis). The patients in our study only had an LPLND and those with positive nodes did not have open surgery and subsequent radical prostatectomy or radiation. Consequently, 22 of our patients were spared an unnecessary treatment. A similar approach in Partin's study would have spared 111 patients the need for the additional surgery.

In addition to the pretreatment risk factors, PSA, Gleason score and stage, we also analyzed the contribution of the SVB. Patients with a positive SVB had a 38% likelihood of having a positive dissection. In fact, a logistic regression analysis revealed that the SVB was superior to the other variables in predicting for a positive pelvic lymph node dissection. These results were also confirmed by a study by Mukamel et al. (29) which found that 43% of patients with seminal vesicle involvement had pelvic nodal disease on open pelvic lymph node dissection. Vallancien et al. (30) also found that 50% of patients with positive seminal vesicle biopsies had positive pelvic lymph nodes. Thus, it appears that the result of the SVB is also an important prognostic variable.

The LPLND would not be a procedure that could be routinely offered if it were technically difficult to perform or if it were associated with a high complication rate. The data from this study indicate that the procedure can be performed with reasonable operative time and with low morbidity. The operative time ranged from 15 minutes to 3 hours. More than half of the cases were completed in less than 1 hour and 15 minutes, and no cases were terminated prematurely. The median blood loss was 30 cc and hospital stay was less than one day in more than half of the cases. These data demonstrate that the LPLND is a reasonable surgical approach that can be performed in a cost-effective and time-efficient manner.

In addition to the operative characteristics, we have also shown that there are few complications associated with the LPLND. The total complication rate was 9%, with the majority

of the complications being minor swelling and edema that resolved spontaneously. No patients suffered any permanent complications, and only 2 patients required readmission for an infected pelvic hematoma.

The complication rates in men undergoing open node dissections appear to be far greater than those associated with the LPLND. McCullough et al. (31) compared two groups of men having pelvic lymph node dissections and noted complications in those with node dissection alone as well as in those who had simultaneous radical prostatectomy. Twenty percent of those who had node dissection only and 30% who had both node dissection and prostatectomy had complications. Herr (32) also evaluated the morbidity of the node dissection in men undergoing simultaneous retropubic prostate seed implantation. He reported a 16% incidence of complications, which included wound infection, lymphocele and pelvic abscess.

We conclude that patients who present with a positive SVB, elevated PSA above 20 ng/mL, stage T2b or greater, or Gleason score $\geq$ 7 should be considered candidates for an LPLND. In such cases, the LPLND is an accurate and safe means of correctly identifying those patients with localized prostate cancer who would be the best candidates for curative therapy.

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