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Laparoscopic prostatectomy: A promising option in the treatment of prostate cancer

ABSTRACT

It is still too soon to know if a laparoscopic approach is as good or even better than open surgical radical prostatectomy, the gold standard. Early data seem to suggest lower intraoperative bleeding rates, less postoperative pain, shorter hospital stay, and similar rates of oncologic cure, return to potency, and urinary continence.

KEY POINTS

The best candidates have clinically localized prostate cancer (stages T1 and T2) and are age 70 or younger.

Relative contraindications include multiple lower-abdominal surgeries, morbid obesity, radiation treatment, and uncorrected coagulopathy.

Preliminary results suggest that the laparoscopic approach provides oncologic cure rates comparable to those of open surgery, as measured by tumor-free surgical margins.

Laparoscopic visualization of the anatomy is excellent. A generous urethral stump is obtained, and this, along with a water-tight anastomosis, allows for superior continence rates.

Evolving data suggest that the laparoscopic nerve-sparing technique offers potency rates similar to those of open surgical nerve-sparing prostatectomy.

A 62-YEAR-OLD MAN is found by his internist to have an elevated prostate-specific antigen (PSA) level of 5.7 ng/mL (normal < 4). Ultrasound-guided biopsy reveals a Gleason stage 7 adenocarcinoma of the prostate. He is continent and potent.

Options of watchful waiting, radiotherapy, brachytherapy, and surgery are discussed, and the patient opts for radical prostatectomy. Interested in minimally invasive options, he inquires about and undergoes laparoscopic radical prostatectomy.

The decade since the advent of PSA testing has witnessed an increase in the detection of early-stage cancers and an increased interest in further reducing the morbidity and functional sequelae of the open procedure. This has led to technical improvements in open radical prostatectomy and to the development of a laparoscopic approach.

The primary goal of treatment for prostate cancer that is confined to the prostate is complete excision of the cancer without compromising urinary continence and potency. The conventional approach, radical retropubic prostatectomy, offers high cure rates.

Is laparoscopic radical prostatectomy better than or as good as the standard surgery? In this article, we describe the laparoscopic technique and then examine the oncological and functional outcome data so far to see how they compare with those of open surgery.

TABLE 1

Laparoscopic radical prostatectomy: Intraoperative data

	GUILLONNEAU ²⁶	HOZNEK ⁹	BOLLENS ³⁰	RASSWEILER ¹⁸	TURK ¹⁷	STEINBERG ³²
No. of patients	350	200	50	100	125	150
Operating time, hours	3.6	3.5*	5.3	4.6	4.4	3.7
Blood loss, mL	354	Not available (NA)	680	NA	185	225
Percent needing transfusion	5.7	3.0	13.0	31.0	2.0	2.0
Percent converted to open surgery	2.0	0	2.0	5.0	0.7	0.8

*Excludes first 20 patients

■ BACKGROUND

Laparoscopic radical prostatectomy was initially explored by Scheussler et al in 1991,¹ but Guillonneau and Vallancien refined and validated the technique for efficient, day-to-day practice.²

Since then, various European teams have added to the overall experience with this technique (TABLE 1). At The Cleveland Clinic, we have been developing the technique so as to duplicate the outcomes of open radical retropubic prostatectomy. More than 350 patients have undergone laparoscopic radical prostatectomy at our institution to date, representing one of the largest single-institution experiences in the United States.

■ PATIENT SELECTION IS KEY

Proper patient selection is important. The best candidates have clinically localized prostate cancer (stages T1 and T2) and a low PSA level (<10 ng/mL), and are age 70 or younger. (Prostatectomy is generally not recommended in men over age 70 unless the life expectancy is 15 years or longer.) Relative contraindications include prior hormonal treatment (androgen blockade), multiple abdominal surgeries, morbid obesity, and uncorrected coagulopathy.

■ THE TECHNIQUE

Before the induction of anesthesia, the patient is given a parenteral antibiotic (a first-genera-

tion cephalosporin), and bilateral sequential compression devices are placed to prevent deep venous thrombosis.

Our standard technique involves five transperitoneal ports (FIGURE 1). Once the operating telescope and instruments are in place in the abdominal cavity, the pelvis is entered through a peritoneal incision. The pelvic lymph nodes are dissected when indicated, as in patients with a PSA level of 10 ng/mL or higher, a Gleason score of 7 or higher, or a palpable tumor nodule. (We discontinue the procedure and close if the lymph nodes appear to be involved.) The dorsal vein—a potential source of major operative blood loss—is secured, then the prostate is dissected away from the bladder neck. The posterior plane of the prostate, anterior to the rectum, is entered, and the seminal vesicles are mobilized. The prostate is mobilized posteriorly and laterally. In the nerve-sparing procedure, the neurovascular bundle is meticulously dissected and preserved. Dissection is completed with the division of the urethra. The prostate is then entrapped in a bag and removed. Anastomosis of the urethra to the bladder is completed with meticulous, continuous sutures. The port sites are then closed, and the prostate is sent for analysis to determine the tumor status of the marginal tissue.

Cystography on the third postoperative day helps identify any leakage of contrast at the site of the urethrovesicular anastomosis. In most cases, no leakage is noted, and the Foley catheter is removed.

**Operative times
decrease
significantly
with experience**



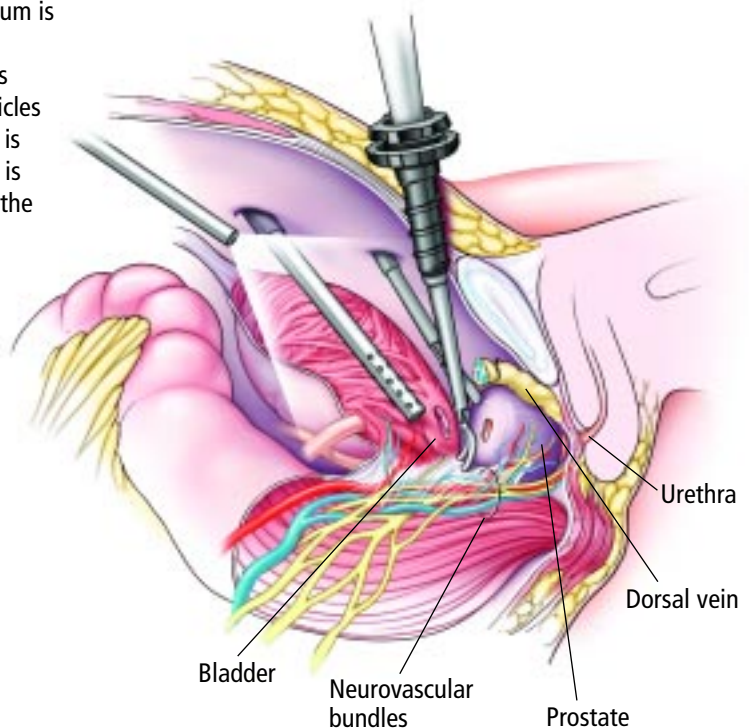
■ Laparoscopic radical prostatectomy

TECHNIQUE. The instruments are placed into the abdominal cavity via five transperitoneal ports. The pelvic peritoneum is entered. The pelvic lymph nodes are dissected when indicated. The dorsal vein is secured, and the prostate is dissected away from the bladder neck. The seminal vesicles that drain into the prostate are mobilized. The prostate is mobilized and is divided from the urethra. The prostate is then entrapped in a bag and removed. Anastomosis of the urethra to the bladder is completed.

ONCOLOGIC CURE RATES. Preliminary results suggest that the laparoscopic approach provides oncologic cure rates comparable to those of open surgery, as measured by tumor-free surgical margins in the prostate tissue. Positive surgical margin rates currently range from 13.8% to 26.4%—similar to rates for open prostatectomy.

URINARY CONTINENCE. The laparoscope permits excellent visualization of the anatomy, which in turn enables meticulous anastomosis of the urethra to the bladder, resulting in continence rates similar to those of open prostatectomy.

POTENCY. The nerve-sparing laparoscopic technique is performed without the use of electrocautery, to minimize the risk of nerve damage. It is still too early to know the long-term potency rates after the laparoscopic technique, but the results to date indicate that rates are similar to those of open prostatectomy.



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FIGURE 1

■ OUTCOMES MEASURED

At our institution, we have attempted to duplicate the outcomes of conventional open surgery by adhering to strict oncological surgical principles. We believe that the magnified laparoscopic visualization and decreased blood loss have the potential to improve surgical outcomes.

We measure the success of the procedure according to three types of outcome:

- Operative and perioperative complications
- Oncological outcome
- Functional outcome, ie, urinary incontinence and potency.

Results are compared with those of other reported series and with the results of conventional open surgery.

■ OPERATIVE AND PERIOPERATIVE COMPLICATIONS

Operating time

Lengthy operating times have often been reported for laparoscopic radical prostatectomy. However, times have been shown to decrease with experience.

In our first 50 cases, the average time of operation was 5.4 hours, and the average time for the last 10 cases in that series was 3.7 hours. Currently, our average time

TABLE 2

Outcome after laparoscopic radical prostatectomy

	HOZNEK ⁹ , OLSSON ²⁷ , KATZ ³¹	GUILLONNEAU ^{2,8,26,28}	STEINBERG ³²	RASSWEILER ¹⁸	TURK ¹⁷	BOLLENS ³⁰
Complications						
Major	NA*	3.7%	3.3%	NA	NA	4%
Minor	NA	14.6%	6.6%	NA	NA	30%
Total	6%	17%	10%	NA	14%	34%
Continence						
Pads per day	0	0	0	0	0-1	0
Percentage of patients	78.4%	85.5%	94%	78%	86%	85%
Months after surgery	12	12	6	6	6	6
Potency						
With unilateral nerve-sparing	50% at 12 months [†]	51% at 2-12 months [†]	NA	30% [‡]	NA	NA
With bilateral nerve-sparing	88% at 12 months [†]	74% at 2-12 months [†]	NA	NA	NA	67% at 6 months [‡]
Percent undergoing nerve-sparing	NA	NA	NA	NA	59% [‡]	NA

*Not available

†Spontaneous erections

‡Intercourse

**The
laparoscope
facilitates
urethro-
vesicular
anastomosis**

ranges from 2 hours to 3 hours. Guillonneau and colleagues³ reported times of 4.6 hours in their first 50 cases, 4 hours in the next 50, and 3.4 hours in the last 140 cases.³ Comparable data from other large series are seen in TABLE 1.

Intraoperative blood loss, transfusion rates

High intraoperative blood loss and transfusion rates are common problems of prostate surgery. Reports of open prostatectomy series have reported blood loss of 500 mL, 1 L, or more.^{4,5} During laparoscopy, excellent visualization of the dorsal venous complex and a tamponade effect from the 15-mm Hg pressure of the carbon dioxide pneumoperitoneum minimizes blood loss.

In our first 50 patients, average blood loss was approximately 300 mL and resulted in blood transfusion in only 1 patient. Data from 1,228 patients from six European centers⁶ showed an average blood loss of 488 mL, with a transfusion rate of 3.5%. Other experienced laparoscopic urologists have also reported blood losses of less than 400 mL (TABLE 1).

Other perioperative complications

Our rates of major and minor complications were 6% and 14%, respectively.⁷ Guillonneau et al⁸ reported a review of 567 patients, with a 3.7% major and a 14.6% minor complication rate (TABLE 2). Hoznek et al⁹ reported a 3.2% complication rate in their last 94 cases. These rates compare favorably with those of open surgery. For example, Yao and Lu-Yao,¹⁰ in a pooled analysis of 101,604 open procedures, reported overall complication rates of 26.3% to 31.3%, depending on hospital surgical volume.

Conversion to open surgery

The rate of conversion from laparoscopic to open surgery remains low (0 to 5%) in most larger series,^{6,7,11} but some centers had a high conversion rate in their early experience.¹²

Postoperative recovery time

As with other laparoscopic procedures, laparoscopic radical prostatectomy has the potential to decrease treatment-related morbidity, allowing patients to recover faster. In our last 50 cases, the average hospital stay was 39



hours,¹³ and after hospital discharge only 2 (4%) required narcotic analgesics.⁷ By 2 weeks after surgery, 68% of patients reported that they could return to work. Hattori et al¹⁴ reported a mean time to “full convalescence” of 23 days after surgery.

Although these data favor a laparoscopic approach from the standpoint of patient recovery, there is still little objective evidence from prospective studies assessing quality of life after the laparoscopic procedure, and to date there has been no controlled study comparing the two approaches with respect to these outcomes. A prospective quality-of-life study is under way at our institution.

■ ONCOLOGIC OUTCOME

Surgical pathology

Prostate cancer is a multifocal disease with an average of seven distinct cancerous sites within each radical prostatectomy specimen.^{15,16} Any surgical procedure aimed at eradicating prostate cancer must completely remove the prostate gland. Then, the removed prostate tissue must undergo pathologic analysis to determine if the edges of the removed tissue (ie, the “surgical margin”) show evidence of tumor cells or not.

The positive surgical margin rate of our last 40 cases was 15%, with an isolated positive apical margin accounting for a majority of them. Other large laparoscopic series have positive margin rates ranging from 13.8% to 26.4%.^{3,9,17,18} These rates compare with larger, open prostatectomy series, implying that the laparoscopic approach is just as good as open surgery at removing all the tumor. For comparison, Lepor et al report¹⁹ a 19.9% positive margin rate in 1,000 open prostatectomy procedures.

Long-term outcome

Declaring “cure” of prostate cancer requires long-term follow-up. Currently available data are still quite immature. However, laparoscopic radical prostatectomy is likely to emerge as a sound oncologic alternative. Salomon et al²⁰ have reported a projected Kaplan-Meier biochemical (ie, PSA) recurrence-free likelihood of 84% at 3 years: 91% for organ-confined tumor, and 81% for pathological stage T3

tumors. Guillonnet et al showed that, in a subset of 250 patients who underwent the procedure, serum PSA levels remained less than 0.2 ng/mL.²¹ Finally, Nadu et al retrospectively analyzed all patients undergoing radical prostatectomy at their institution between 1988 and 1999 and identified no difference in short-term oncologic outcome between the open retropubic, perineal, and laparoscopic approaches.²²

■ FUNCTIONAL OUTCOME

Urinary incontinence

Urinary incontinence remains a cause of serious morbidity in a small number of patients after laparoscopic radical prostatectomy. Litwin and colleagues, using standardized questionnaires, found that only 61% of patients who underwent open prostatectomy returned to baseline urinary function by 1 year postoperatively.²³ In contrast, Walsh et al found that up to 95% of patients at 1 year after open prostatectomy described “urinary bother” as “no problem” or “small problem.”²⁴ Stanford et al reported that 18 months or more after open radical prostatectomy, 8.4% of men were incontinent.²⁵

Comparable results have been obtained with a laparoscopic approach. Guillonnet et al, in a survey of their first 133 patients with a follow-up of 1 year or more,²⁶ reported total continence (ie, no protection needed during day or night) in 85.5% of patients, with another 10.7% still wearing one pad every 24 hours. Five patients (3.8%) were classified as severely incontinent. Olsson et al²⁷ reported that by 6 months, 68.9% of patients wore no pads, and that no patient reported the use of more than one pad per day. In our experience, the urinary continence rate was 80% at 3 months and 94% at 6 months (TABLE 2).¹³

Potency

Similar variations in potency rates are seen in reports of open and laparoscopic prostatectomy.

Potency is a primary concern for men contemplating treatment for localized prostate cancer. The anatomical course of the cavernosal neurovascular bundles is well known, yet it is often difficult to preserve one

**In one study,
84% of patients
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TABLE 3

Potential advantages and disadvantages of laparoscopic radical prostatectomy

Potential advantages

Decreased intraoperative blood loss
Decreased time of Foley catheterization
Decreased postoperative pain
Short hospital stay
Earlier return to normal activities

Disadvantages

Steep learning curve for surgeon
Longer operative time
Lack of long-term data

or both nerves. In addition, sparing the nerves does not guarantee sexual potency.

The laparoscope offers magnified visualization, with the potential for clear identification and handling of the neurovascular bundles, but it is still too early to know the long-term potency rates after nerve-sparing laparoscopic radical prostatectomy. Guillonnet al reviewed 73 patients who underwent either bilateral (46 patients) or unilateral (27 patients) nerve-sparing laparoscopic radical prostatectomy, with a follow-up from 2 to 12 months²⁸: an impressive 74% spontaneous erection rate was reported in the bilateral nerve-sparing group and 51% in the unilateral group. Bollens et al reported a 9-month potency rate of 75% in patients who were potent preoperatively.¹¹ Salomon and colleagues

described a potency rate of 40% at 1 month in patients who underwent a bilateral nerve-sparing procedure and 22.2% at 1 month in patients who underwent unilateral nerve-sparing procedure.²⁹

The emerging data with nerve-sparing laparoscopic prostatectomy are encouraging, and with further advances, it is possible that patients may obtain comparable potency outcomes and that they may do so earlier postoperatively.

■ EARLY DATA ARE PROMISING

Open radical retropubic prostatectomy remains the gold standard for the treatment of prostate cancer confined to the prostate gland. It offers a short operating time, short hospital stay, acceptable morbidity, excellent continence rates, and improving potency rates.

Laparoscopic radical prostatectomy is still a relatively new procedure, but it holds considerable promise. Potential advantages and disadvantages are summarized in TABLE 3. Early data on oncological cure and continence and potency rates appear encouraging. Follow-up data on recurrence based on PSA levels are comparable to those of open surgery in terms of oncological outcomes. The robust length of urethral stump routinely attained laparoscopically and the precise, watertight urethrovesicular anastomosis under magnified laparoscopic vision are likely to afford superior continence outcomes. The data on potency rates are early, but encouraging.



■ REFERENCES

- Schuessler W, Kavoussi LR, Clayman R, Vancaille TH. Laparoscopic radical prostatectomy: initial case report [abstract no. 130]. *J Urol* 1992; 147[suppl]:246a.
- Guillonnet al, Vallancien G. Laparoscopic radical prostatectomy: the Montsouris experience. *J Urol* 2000; 163:418-422.
- Guillonnet al, Rozet F, Barret E, et al. Laparoscopic radical prostatectomy: assessment after 240 procedures. *Urol Clin North Am* 2001; 28:189-202.
- Koch M, Smith JJ. Blood loss during radical retropubic prostatectomy: Is preoperative autologous blood donation indicated? *J Urol* 1996; 156:1077-1079.
- Shir Y, Raja SN, Frank SM, et al. Intraoperative blood loss during radical retropubic prostatectomy: epidural vs general anesthesia. *Urology* 1995; 45:993-999.
- Sulser T, Guillonnet al, Vallancien G, et al. Complications and initial experience with 1,228 laparoscopic radical prostatectomies at 6 European centers [abstract no. 615]. *J Urol* 2001; 165(suppl):150.
- Zippe CD, Meraney AM, Sung GT, Gill IS. Laparoscopic radical prostatectomy in the USA: Cleveland Clinic series of 50 patients [abstract no. 1341]. *J Urol* 2001; 165(suppl):326-327.
- Guillonnet al, Rozet F, Cathelineau X, et al. Perioperative complications of laparoscopic radical prostatectomy: the Montsouris 3-year experience. *J Urol* 2002; 167:51-56.
- Hoznek A, Salomon L, Olsson LE, et al. Laparoscopic radical prostatectomy, the Creteil experience. *Eur Urol* 2001; 40:38-45.
- Yao S-L, Lu-Yao G. Population-based study of relationships between hospital volume of prostatectomies, patient outcomes, and length of hospital stay. *J Natl Cancer Inst* 1999; 91:1950-1956.
- Bollens R, Bossche MV, Roumequere T, Damoun A, Zlott AR, Schulman CC. Laparoscopic radical prostatectomy: analysis of the first series of extraperitoneal approach [abstract no. 1354]. *J Urol* 2001; 165(suppl):330.
- Weber HM, Eschholz G, Gunnewig M, Krah XA, Benken N. Laparoscopic radical prostatectomy? Not for us! [abstract no. 616]. *J Urol* 2001; 165(suppl):150.
- Farouk A, Gill IS, Kaouk JH, et al. 100 Laparoscopic radical prostatectomies (LRP): learning curve in the United States. Unpublished data, 2002.

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14. **Hattori R, Ono Y, Gotoh M, Yoshikawa Y, Ohshima S.** Laparoscopic radical prostatectomy via a retroperitoneal approach for localized prostatic cancer [abstract no. 752]. *J Urol* 2001; 165:182.
 15. **Bastacky SI, Wojno KJ, Walsh PC, et al.** Pathological features of hereditary prostate cancer. *J Urol* 1995; 153:987–992.
 16. **Walsh PC.** Editorial comment: Minimally invasive treatment of prostate cancer. *J Endourol* 2001; 15:447–448.
 17. **Turk I, Deger S, Winkelmann B, Schonberger B, Loening SA.** Laparoscopic radical prostatectomy: technical aspects and experience with 125 cases. *Eur Urol* 2001; 40:46–52.
 18. **Rassweiler JJ, Sentker L, Seemann O, Hatzinger M, Stock C, Frede T.** Heilbronn laparoscopic radical prostatectomy, technique and results after 100 cases. *Eur Urol* 2001; 40:54–64.
 19. **Lepor H, Ferrandino M, Nieder AM.** The intraoperative and postoperative complications following radical retropubic prostatectomy in a consecutive series of 1,000 cases [abstract no. 1347]. *J Urol* 2001; 165(suppl):328.
 20. **Salomon L, Hoznek A, Saint F.** Oncologic results of 100 consecutive laparoscopic radical prostatectomies [abstract no. 1442]. *J Urol* 2001; 165(suppl):351.
 21. **Guillonneau B, Cathelineau X, Doublet JD, Vallancien G, Menon M.** Short-term oncological follow-up results of laparoscopic radical prostatectomy in prostate cancer with PSA
 22. **Nadu A, Salomon L, Saint F, et al.** Radical prostatectomy: Is there a “best” oncological approach? [abstract no. 1452]. *J Urol* 2001; 165(suppl):354.
 23. **Litwin MS, McGuigan KA, Shpall AI, et al.** Recovery of health-related quality of life in the year after radical prostatectomy: early experience. *J Urol* 1999; 161:515–519.
 24. **Walsh PC, Marschke P, Ricker D, et al.** Patient-reported urinary continence and sexual function after anatomic radical prostatectomy. *Urol* 2000; 55:58–61.
 25. **Stanford JL, Feng Z, Hamilton AS, et al.** Urinary and sexual function after radical prostatectomy for clinically localized prostate cancer: the Prostate Cancer Outcomes Study. *JAMA* 2000; 283:354–360.
 26. **Guillonneau B, Cathelineau X, Doublet JD, et al.** Laparoscopic radical prostatectomy: the lessons learned. *J Endourol* 2001; 15:441–446.
 27. **Olsson LE, Salomon L, Nadu A, et al.** Prospective patient-reported continence after laparoscopic radical prostatectomy. *Urol* 2001; 58:570–572.
 28. **Guillonneau B, Cathelineau X, Doublet JD, Vallancien G, Menon M.** Prospective assessment of functional results after laparoscopic radical prostatectomy [abstract no. 614]. *J Urol* 2001; 165(suppl):150.
 29. **Salomon L, Olsson LE, Hoznek A, et al.** Continence and potency after laparoscopic radical prostatectomy [abstract no. 1597]. *J Urol* 2001; 165(suppl):390.
 30. **Bollens R, Bossche M, Roumeguere T, et al.** Extraperitoneal laparoscopic radical prostatectomy, results after 50 cases. *Eur Urol* 2001; 40:65–69.
 31. **Katz R, Salomon L, Hoznek A, et al.** Patient reported sexual function following laparoscopic radical prostatectomy. *J Urol* 2002; 168:2078–2082.
 32. **Steinberg A, Gill I, Farouk A, et al.** 150 Laparoscopic radical prostatectomies (LRP): learning curve in the United States [abstract]. *Can J Urol* 2002; 9:1665.

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