Laparoscopic Radical Prostatectomy: The Results

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Laparoscopic radical prostatectomy (LRP) is already a well-established, feasible, and safe alternative to the open approach for more than 10 years. Despite its steep learning curve and the dexterity needed on behalf of the surgeon, LRP evolved greatly over the last decade, taking advantage of the recent advances in laparoscopic and robotic equipment (especially the DaVinci System). During the course of time, the extraperitoneal approach to LRP gained more ground among laparoscopic surgeons, establishing the procedure as a viable, long-lasting, and constantly refined technique. The initial problems of insufficient long-term randomized prospective trials were surpassed over the last years, giving a boost to the technique, which was initially described as a "European virus with global potentials" [1, 2]. The results of LRP, presented in this chapter, are primarily divided in two categories: functional results, including postoperative continence and potency, and oncological results.

As with any surgical procedure, LRP has its own specific complications. The constant evolution of the technique, the evolving laparoscopic and robotic equipment, as well as the presentation of long-term prospective results would probably render LRP as the mainstay in urologic laparoscopic surgery for years to come.

Continence

Since the preliminary evaluations of the procedure and the short-term follow-up, as shown by Guilloneau et al. [3, 4], the postoperative continence results of LRP were more than encouraging. In a preliminary study of 28 cases, continence was assessed in 20 patients after 6 months and 18 patients had already been continent. In a later study, involving a larger number of patients, a continence rate of 73.3 % was reported in a 6-month follow-up period [5]. In that study, continence was evaluated more objectively, using the ICS questionnaire. Several other groups confirmed these encouraging preliminary results, reporting continence rates up to 84 % of the patients at 1 month after the procedure [6, 7].

Prospective studies showed that continence rates greater than 93 % could be achieved even if the catheter was to be removed as early as to 2–4 days after LRP. Nevertheless, urinary retention made recatheterization necessary in 10 % of the patients as Nadu et al. reported [8]. The group of Olsson et al. was the first to conduct a large prospective study regarding their urinary continence in patients who underwent LRP using questionnaires 1, 3, 6, and 12 months after the procedure. Totally, 56.8 % of the patients reported to be continent (described not only as the absence of need for pads but as the absence of any leakage at all). In addition, there was not a single patient out of the 228 patients of the study that was using more than one pad daily at 6 months after the procedure [9]. This was later confirmed by other groups, such as Link et al. reporting a continence rate of 93.4 % (using 0–1 pads daily) in a 12-month follow-up period utilizing the EPIC questionnaire, in an attempt to make the results more objective and less "interview dependent" [10]. Recently, it was proven by Milhoua et al. that the large prostate size (an objective factor) can be responsible for the delay of postoperative continence [11]. In addition, a surprising finding was that no factor pertaining to prostate cancer seems to be a predictor for postoperative continence. In that study, patient age and Charlson comorbidity index were the most important predicting factors [12].

When the Heilbronn technique was introduced by Rassweiler et al. [13–15], the first results were more than encouraging: out of 180 patients, 33 % were continent on discharge from the hospital, 74 % on the first 6 months, and 97 % after 12 months. Nevertheless, the steep learning curve

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A. Tewari (ed.), *Prostate Cancer: A Comprehensive Perspective*,
DOI 10.1007/978-1-4471-2864-9_57, © Springer-Verlag London 2013

of this technique was a major drawback preventing less experienced centers from employing it.

Reports from three investigating groups confirmed the positive results on continence, not only in a preliminary stage but also in significantly longer follow-up periods [16–18]. Salomon et al. reported continence rates of up to 97 % in the first year of follow-up, while Goeman et al. reported 91 % over a 2-year follow-up period. Functional results of LRP after transurethral resection of the prostate (TURP) were examined in the study by Menard et al. [17], and the functional results were compared to a group of patients undergoing LRP without previous TURP. Continence rates in the first group (the patients who underwent TURP before LRP) were approximately 10 % lower than the second group (86.9 % vs. 95.8 %) in a 2-year follow-up period, thus providing sufficient long-term evidence that LRP could achieve high continence rates in patients with previous prostatic surgery.

Endoscopic extraperitoneal radical prostatectomy (EERPE) is a viable and feasible alternative to the traditional transperitoneal laparoscopic technique and is associated with encouraging results regarding continence [19–21]. The introduction of intrafascial nerve-sparing EERPE technique by Stolzenburg et al. showed that 71.7 % of the patients were continent already in the first trimester after the procedure. Moreover, the same group reported their experience with 2,400 EERPE cases and reported that 94.7 % of the patients were continent in the first year. Rozet et al. [22] demonstrated similar results, reporting a rate of 84 % continence (described as the complete lack of pad usage) and a 7 % rate of 1-pad usage daily during the first year of follow-up.

Several refinements of the LRP technique have been proposed in an attempt to improve early postoperative continence at catheter removal and at 3 months postoperatively. These modifications include bladder neck preservation, bladder neck suspension, and preservation of puboprostatic ligaments [23–25] and have been associated with controversial results among investigators. In general, continence results in LRP have associated with significant biases among investigators due to the lack of a uniformly accepted evaluation methods which would render the results of different techniques and investigators directly comparable.

Erection and Potency Results

The preservation of potency, described as the potential to have sufficient erectile function to achieve sexual intercourse, is a major factor regarding the quality of life of the patient undergoing LRP, especially in younger and more sexually active patients. The recovery of potency and the time in which it occurs after LRP depends on many factors, including age and preoperative potency despite the predominant factor of the preservation of neurovascular bundles (NVBs) of the prostate during the procedure [10, 26, 27]. Guilloneau et al. and Matin et al. recently proved that preservation of accessory pudendal arteries also helps recovery of spontaneous erections [28, 29].

The anatomy of the NVBs, especially their relation to the lateral pelvic fascia and Denonvilliers' fascia, was mapped and described after continuous investigation in cadaveric models [30]. The anatomic relation between the pelvic plexus ganglions and the seminal vesicles was also described in detail in the same study offering a "map" for the laparoscopic surgeon to understand the sensitivity of these ganglions to injury occurring during the dissection of the seminal vesicles. The improved visualization and magnification of the operative field offered by the laparoscopic camera in comparison to open prostatectomy is an important factor influencing the capability of the surgeon to perform nerve-sparing technique, thus increasing the potential for postoperative erections, especially in younger patients [30]. Also, a high incision or a "curtain dissection" of the lateral prostatic fascia may help visualize these elements better and is proved to improve the early postoperative potency rates [31]. In fact, it has been proven that the lateral prostatic fascias include nerve fibers which result in cavernosal vasoconstriction when stimulated [32]. However, the surgeon should take under consideration that during bilateral NVB preservation, the oncological outcome may be affected. Tumor sites may avoid detection, even though a meticulous observation may take place. Thus, some investigators recommend the preservation of the NVB contralateral to the tumor [21], while others report that NVB preservation does not affect the risk of positive surgical margins [33].

Preliminary results indicated that the preservation of one of the prostatic NVBs raised the potency rates while the preservation of both NVBs further improves the potency outcome. Early reports showed that non-nerve-sparing LRP (Pic 1) had potency rates up to 41 % which was comparable if not better when compared to the open approach (in the same study 30 %) [34]. When NVB preservation was considered (Pic 2), the potency rates improve even more. In the same study by Anastasiadis et al. potency rates were 44 and 53 % for unilateral and bilateral preservation, respectively (Figs. 57.1 and 57.2). When the age was taken into account, the rates were 72 and 81 % for unilateral and bilateral NVB preservation in patients younger than 60 years of age, respectively. Roumeguere et al. also reported that patients undergoing LRP had more spontaneous erections than those of the open approach [35].

Goeman et al. reported potency rates of 64 % (both NVBs preserved) at 2-year follow-up while 78.6 % of the patients younger than 60 years were potent [16]. Mariano et al. reported similar rates (61 %) in patients undergoing the bilat-

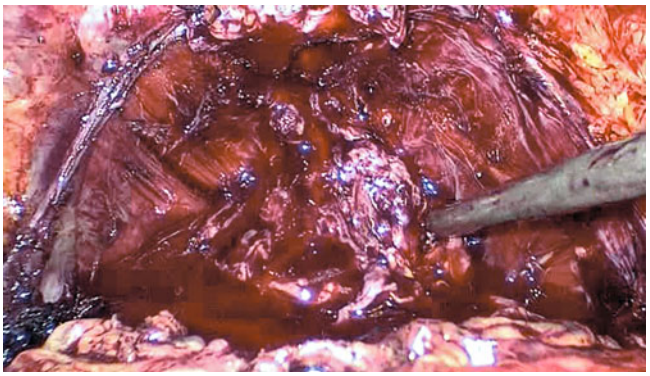

Fig. 57.1 Non-nerve-sparing technique has been used. The prostate has been removed, and there are no neurovascular bundles. The next step of the procedure is the performance of the vesicourethral anastomosis

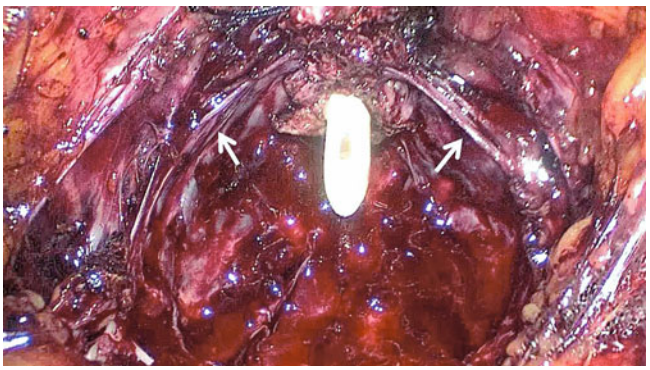

Fig. 57.2 Bilateral preservation of the neurovascular bundles has been performed (the prostate is removed). The *arrows* show the preserved neurovascular bundles

eral nerve-sparing LRP when their experience over a period of 10 years of performing LRP was evaluated [36]. Robotic-assisted LRP was reported to have similar potency rates: 62 % in the bilateral nerve-sparing approach at 12 months postoperatively [37]. In the extraperitoneal approach, the results were comparable: overall potency rates reported were 44 % in the unilateral nerve-sparing approach, while in bilateral NVB preservation, the rates were significantly higher reaching 72 % at 12 months after the procedure. In patients younger than 55 years of age, the respective rates reported were 50 and 84.9 % [21].

The dissection technique of the NVBs has been related to different outcomes. NVB preservation techniques include the excision of the prostate with its surrounding fascias without involving the NVBs (interfascial dissection) and the excision of only the prostate with preservation of the NVBs and surrounding prostate fascias (intrafascial dissection). The latter dissection method has been associated with improved erectile function as well as early postoperative continence in comparison to interfascial NVB dissection [38].

Erectile function is important for the quality of life of the patients undergoing radical prostatectomy [39]. The performance of bilateral intrafascial NVB preservation seems to be the most efficient in providing sufficient postoperative erectile function in preoperatively potent patients [38, 40]. The lack of a widely accepted approach in the evaluation of erectile function results in confusion and limited potential to compare results among different series.

Oncological Results

The main endpoint of oncological efficacy of LRP is the presence or absence of positive surgical margins. Other factors that should be taken into account in the evaluation are the postoperative PSA recurrence (described in literature as PSA > 0.2 ng/mL and confirmed by a second increase), the clinical progression, and progression-free survival [32, 41]. Even though prostate size, especially larger than 75 g, is a factor associated with fewer positive surgical margins, the latter observation should not interfere with patient selection for LRP. On the contrary, prostate sizes smaller than 30 g are associated with a higher rate of positive surgical margins. Considering the above, further studies with longer follow-up periods should be conducted in an attempt to draw positive conclusions [42, 43]. Preservation of the accessory pudendal arteries can be performed without compromising the oncological aspect, as it does not affect the risk for positive surgical margins [44]. On the contrary, techniques of nerve reconstruction, such as sural nerve grafting, increase the risk [45]. Finally, previous training in open or laparoscopic techniques does not seem to interfere with the oncological results of LRP [46].

Martorana et al. proved that oncological results of LRP were similar to those of the open approach despite the limited experience of the group in LRP and the small number of patients (50 consecutive patients for each approach). It was also shown that the positive surgical margins were found in the same locations in both specimen groups [47]. These findings were confirmed later by Rassweiler et al. [15].

Salomon et al. reported positive surgical margins and 3-year progression-free survival rates to be 20.6 and 86.2 % in pT2 cases after LRP, respectively. These results were compared to the open approach in patients with PSA < 10 ng/mL. No significant differences were observed on the above comparison [48]. This was also confirmed later by Roumeguere et al. [35]. Ruiz et al. reported their results in 330 consecutive patients, who underwent either transperitoneal LRP ($n=165$) or extraperitoneal LRP ($n=165$). The overall surgical margins were 23 and 29.7 % ($p=0.8$), respectively. The respective figures were 13.0 and 17.0 % ($p=0.42$) in pT2 tumors and 43.6 and 44.7 % ($p=0.99$) in pT3 tumors. Nevertheless, an advantage of shorter operative time for the

extraperitoneal group was noted [49]. The same comparison was conducted by Erdogru et al. using match-pair analysis techniques, reporting similar overall rates: 22.6 % for the extraperitoneal group versus 20.7 % for the transperitoneal, approach [50].

Guilloneau et al. conducted a prospective study in 1,000 patients, reporting that 94 % of the patients with negative surgical margins and 80 % with positive surgical margins (overall rate 90.5 %) had progression-free survival for 3 years postoperative. Of these patients, stage pT2aN0/Nx (20.3 %) had a positive surgical margin rate of 6.9 %, whereas stages pT2bN0/Nx (57.2 %), pT3aN0/Nx (14.2 %), and pT3bN0/Nx (7.7 %) had rates of 18.6, 30, and 34 %, respectively. Main factors affecting the positive margin rate were Gleason score, clinical stage (TNM), pathological stage, and preoperative PSA [32]. Nevertheless, other investigators claim only Gleason score and pathological stage are of importance regarding biochemical progression [51].

Similar rates were reported by Rozet et al.: overall positive margin rate was 17.7%, 14.6 % for pT2 and 25.6 % for pT3 tumors [22]. The same group compared directly the "conventional" LRP with the robotic-assisted approach, reporting overall positive surgical margins rates of 15.8 % versus 19.5 %, respectively. Goeman et al. reported a 5-year progression-free survival rate of 78.8 %, with positive surgical margin rates of 17.9 % for pT2, 44.8 % for pT3, and 71.4 % for pT4a tumors using only the extraperitoneal approach [16]. The oncological outcome was improved over time in a larger recent study by Stolzenburg et al. [21]: overall rates for positive surgical margins were 16.4 %, 8 % for pT2 stage and 35.6 % for pT3 stage. Pavlovich et al. reported also positive surgical margin rates directly increasing alongside pathological stage: 8.2 % in pT2 and 39.3 % in pT3 cases. Biochemical progression-free survival rate in a 3-year follow-up period was 98.2 % for pT2 and 78.7 % for pT3 disease, and 94.5 % overall (PSA > 0.2 ng/mL confirmed by a second measurement is defined as biochemical progression/recurrence in the study).

In robotic-assisted LRP, Sharma et al. proved that even though the positive margin rates are similar to the "traditional" LRP technique, the learning curve can be longer than expected: in a prospective study for 500 patients who were operated by two surgeons, the overall positive surgical margin rate was 24.0 %, and the stage specific rates were 16.1, 30.4, 55.0, and 100.0 % for pT2, pT3a, pT3b, and pT4 pathological stages, respectively. Nevertheless, the last 50 patients for each surgeon were associated with improved oncological results. The positive surgical margin rates were 8.0 and 19.1 % (surgeon 1) and 12.9 and 23.5 % (surgeon 2) for pT2 and pT3a pathological stages, respectively [52]. In summary, the oncological outcome of LRP is directly comparable to all available radical prostatectomy methods. Experience seems to be important in the reduction of the positive surgical margins [52, 53].

Complications

Guilloneau et al. demonstrated that vascular complications, including vessel injury, bleeding, and the formation of hematomas, represent a substantial percentage of the perioperative complications of LRP, namely, 89.4 % of all complications [54], with an incidence up to 6 % [55–60]. Hemorrhage from the inferior epigastric vessels the Santorini plexus, or the external iliac vein is a common intraoperative complication. It is commonly caused during trocar insertion, especially when done either without direct visual control or without carefully inspection of the abdominal wall before trocar insertion. Hemorrhage can be controlled, if not avoided, by using bipolar coagulation and/or clipping (if the vessel is damaged), suturing and "encaging" of the vessel in the abdomen wall (in the case of inferior epigastric vessel bleeding) or even direct tamponade of the vessel using the pneumoperitoneum gas pressure [55–60]. In the postoperative period, hematomas are also common: they can arise from the neurovascular bundles or epigastric vessels. Meticulous hemostasis prevents the latter complication.

Rectal and intestinal injury is another relatively common and very severe complication, which can be life-treating if not recognized immediately. Symptoms include vomiting, distension, fecaluria, and persistent abdominal pain. If not treated in time, intestinal injury can lead to leukocytosis and eventual septic shock. The surgeon must be alert that every patient presenting with persistent abdominal pain during the first few days or weeks after LRP or EERPE must be carefully examined to exclude an undetected intestinal injury. Its incidence is reported up to 9 % of the cases [55–60]. The way this complication can be avoided is not definite. Groups have reported the use of special devices such as intrarectal insufflation device enabling the surgeon to visualize the rectum during crucial stages of LRP [14]. Careful suturing of the site of injury and parenteric feeding for the next 3 days is the treatment of choice. Injury to the bladder is a complication mainly of EEPRE, due to the extraperitoneal nature of the technique. If detected intraoperatively, it can be corrected in single layer suturing [55].

Ureteral injuries, anastomotic leakage, or acute urinary retention can also be present. In these cases, if placing a mono-J catheter is not enough, the anastomosis can be strengthened with more sutures or revised with an endoscopic neoanastomosis, if not controlled properly. However, controlling intraoperatively whether the anastomosis is functional and watertight is of crucial importance. In some cases, early removal of the catheter can cause acute urinary

retention due to anastomotic stricture. In these cases, further catheterization can lead to a solution [54].

Concomitant pelvic lymphadenectomy is related to the formation of lymphoceles. The presenting symptoms vary from pelvic pain, to leg edema, hydronephrosis, deep venous thrombosis, and infection. Laparoscopic fenestration, sclerotherapy, or percutaneous drainage can be performed to manage this common complication. The incidence of the complication is approximately 4 % [55, 56, 58–60]. Other not so common complications may include gas embolism, obturator nerve injury and subsequent paralysis, catheter blockage, deep venous thrombosis, pulmonary edema, pulmonary embolism, perineal pain, pubic osteitis, and prolonged ileus (due to presence of urine in the peritoneum).

Most of these complications should ideally be prevented in the hands of an experienced surgeon. In addition, prompt recognition of the complication (especially intraoperatively) is important for the successful management of the incident. Delayed management of LRP complications may pose a serious threat to a trouble-free recuperation of a patient undergoing an otherwise minimally invasive surgical procedure or even may result in life-threatening conditions [55, 56, 58–60].

Conclusion

Laparoscopic radical prostatectomy has become a mainstay in the arsenal of the endoscopic/laparoscopic urologic surgeon. Its minimally invasive nature, combined with its potential to yield similar, if not better results when compared to the open approach, represents a significant advantage. Taking into account the constant refinements made in the technique by many groups of experienced surgeons around the world, the constant progress and development in the existing equipment, as well as the recent "invasion" of robotic assistance in the field, lead to the conclusion that the results of LRP will be constantly improved in the long run, making it a mainstream surgical procedure for years to come.

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