Arab Journal of Urology (2012) **10**, 40–45

Arab Journal of Urology
(Official Journal of the Arab Association of Urology)

www.sciencedirect.com

MINI-REVIEW

Laparoscopic radical cystectomy

Amr Fergany *

Glickman Urological and Kidney Institute, Cleveland Clinic Q-10, 9500 Euclid Avenue, Cleveland, OH 44195, USA

Received 10 November 2011, Received in revised form 20 January 2012, Accepted 20 January 2012
Available online 21 February 2012

KEYWORDS

Laparoscopy;
Bladder cancer;
Radical cystectomy;
Outcomes

ABBREVIATIONS

(O)(L)RC, (open) (laparoscopic) radical cystectomy; LND, lymph node dissection

Abstract ***Objective:*** Laparoscopic radical cystectomy (LRC) has emerged as a minimally invasive alternative to open radical cystectomy (ORC). This review focuses on patient selection criteria, technical aspects and postoperative outcomes of LRC.

Methods: Material for the review was obtained by a PubMed search over the last 10 years, using the keywords 'laparoscopic radical cystectomy' and 'laparoscopic bladder cancer' in human subjects.

Results: Twenty-two publications selected for relevance and content were used for this review from the total search yield. The level of evidence was IIb and III. LRC results in comparable short- and intermediate-range oncological outcomes to ORC, with generally longer operative times but decreased blood loss, postoperative pain and hospital stay. Overall operative and postoperative morbidity are equivalent.

Conclusion: In experienced hands, LRC is an acceptable minimally invasive alternative to ORC in selected patients, with the main advantage of decreased blood loss and postoperative pain, as well as a shorter hospital stay and recovery.

Introduction

Bladder cancer accounts for 63,000 new cases and around 13,000 deaths annually in the USA, and 357,000 cases with 145,000 deaths worldwide annually [1]. Radical cystectomy (RC) with pelvic lymph node dissection (LND) remains the mainstay of curative efforts, with chemotherapy recently gaining a firm complementary role in addition to surgery. The operative goals of surgery (open RC, ORC, or laparoscopic RC, LRC) are to ensure negative surgical margins and an adequate LND [2]. Efforts to minimise patient morbid-

* Tel.: +1 216 4440414; fax: +1 216 4457031.
E-mail address: Fergana@ccf.org

Peer review under responsibility of Arab Association of Urology.
doi:10.1016/j.aju.2012.01.003

Production and hosting by Elsevier

ity from RC have coincided with the widespread adoption of laparoscopic techniques in urology, resulting in the development of LRC, which is rapidly becoming a viable treatment replacement for ORC. Significant worldwide experience has developed the technique from early single case-reports to significantly more mature series with reproducible techniques [3,4]. This review focuses on patient selection criteria, technical aspects and postoperative outcomes.

Patient selection

The selection of suitable patients for LRC is an essential step to ensure satisfactory outcomes. The selection process should reflect the surgeon's experience, with easier cases (thin patients with early tumours and with no previous surgery or radiotherapy) attempted initially, and more complicated cases introduced in a progressive stepwise manner. This approach should maximise surgeon's learning and experience, as well as minimise the problems of prolonged operative time, surgeon frustration and patient complications. Selection criteria should incorporate both patient and tumour characteristics.

Uncontrolled bleeding diatheses, intra-abdominal infections and ascites remain as general contraindications to laparoscopy, and probably to open surgery as well. Obesity is a relative contraindication, increasing surgeon fatigue and operative complexity due to the absence of tissue planes and heavier manipulation of the abdominal wall. Obese patients are more easily handled with robotic-assisted laparoscopic surgery [5].

Previous abdominal surgery also increases surgical difficulty. Surgical scarring can range from minor adhesions resulting from minor surgery e.g., an appendectomy or tubal ligation, to a complete absence of intraperitoneal operating space, as in multiple bowel surgery for colon cancer or Crohn's disease. A ventral hernia from previous surgery further complicates the decision making. Each patient's situation should be assessed, again taking into consideration surgeon's experience. Older patients with cardiac or respiratory compromise have traditionally been excluded from laparoscopic surgery, but recent reports showed low morbidity for such elderly patients [6].

Pelvic radiotherapy is common in patients with bladder cancer and might even predispose to the disease [7]. Scarring from pelvic radiation results in difficulty in dissection due to the absence of anatomical planes, and increases the morbidity of rectal injury if such injury occurs. Radiation to the prostate, uterus or rectum moderately increases the operative difficulty, but such cases can be attempted with advanced laparoscopic experience [8]. Salvage RC after bladder radiotherapy is significantly more difficult and should probably not be attempted laparoscopically.

Neoadjuvant chemotherapy has become the standard treatment for muscle-invasive bladder cancer in many centres; such treatment has no negative effects on the subsequent surgical procedure, LRC or ORC.

Tumour factors are also important selection criteria. LRC is ideally suited to organ-confined early-stage tumours without lymphadenopathy (Tcis, Ta, T1), particularly in the early phase of experience with LRC. Although large bulky tumours or tumours with lymphadenopathy are usually treated with primary chemotherapy, such patients occasionally present for surgery (e.g. non-urothelial histology). Laparoscopic management of large bulky tumours is not recommended. It is difficult to manipulate large tumours with laparoscopic instruments, and working space in the pelvis is decreased. This increases the possibility of complications and of significant blood loss. The potential need for the resection of adjacent involved organs also makes ORC more suitable for these cases.

Technique

Although surgical technique varies slightly in different centres, and between the sexes, several common principles are applied, as reported in most initial series [9–12]. A transperitoneal four- or five-port technique is used. The ports are arranged in a fan-shape across the lower abdomen, with the camera port placed 2.5–5 cm above the umbilicus to facilitate the cranial aspect of the lymphadenectomy (Fig. 1). Patients are placed in the low lithotomy position to facilitate access to the rectum, perineum and vagina in females. A steep Trendelenburg position is also necessary to allow the small bowel to fall from the pelvis for the duration of the case. The cystectomy portion of the procedure is performed initially at most centres, facilitating the subsequent LND. The posterior and lateral aspects of the bladder dissection are done first, leaving the anterior dissection, prostatic apex and urethra for the final steps. This prevents the bladder from falling backward into the pelvis, and obscuring the posterolateral planes. Bladder cancer is more common in men, resulting in a corresponding 75–80% predominance of RC in men [1,4].

Technique of male LRC

At the start of the case, adhesions of the sigmoid to the left pelvic side-wall need to be released in almost all cases, allowing the retraction of the sigmoid colon from the pelvis. Important landmarks to note in the pelvis are the ureters (most important), the medial umbilical ligaments, the vasa deferentia, and the urachus. A stepwise technique is followed in all cases and is described below.

Mobilisation of the ureters starts above the pelvic brim and is followed distally until the ureter passes on the medial aspect of the medial umbilical ligament.

The peritoneum overlying the medial umbilical ligament is opened superiorly until the anterior abdominal wall. The vas deferens crosses the ligament at the level

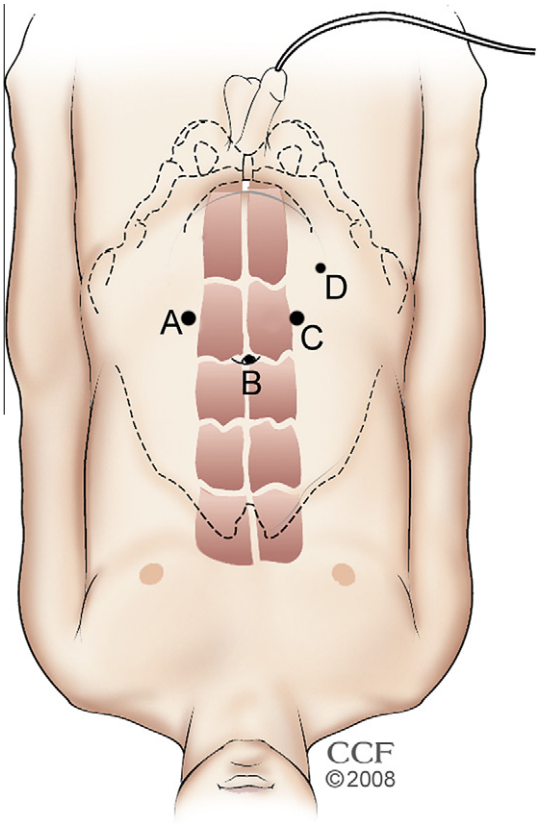

Figure 1 Port arrangement for LRC. A fifth port can be added in the left lower quadrant if needed. The camera port (B) can be moved to a supra-umbilical location to facilitate the proximal portion of an extended LND.

of the pelvic brim and can be clipped or cauterised and divided at this point.

The lateral plane of dissection is developed at this time, just lateral to the medial umbilical ligament, which is kept intact and used as a guide. This plane is avascular and provides a sound oncological cushion of perivesical fat on the lateral side of the urinary bladder. This plane is developed distally as the bladder is retracted medially until the pelvic floor muscle and the reflection of endopelvic fascia on the side of the prostate is seen. The endopelvic fascia can be opened at this time to expose the side of the prostate, or can be left for a later step in the operation. A similar dissection is done on the contralateral side.

The posterior plane between the seminal vesicles and prostate anteriorly, and the rectum posteriorly are developed. The peritoneum of the rectovesical cul-de-sac is opened, usually ≈2.5 cm above the lowest point. The author's preference is to make this incision between or at the level of the medial umbilical ligaments and ureters. A peritoneal incision in this location usually exposes the tips of the seminal vesicles which are retracted anteriorly, and the dissection follows the posterior surface closely, ensuring maximum safety for the anterior rectum. The attachment of Denonvilliers' fascia to the base of the prostate is encountered as a distinct layer here, and needs to be divided sharply to allow continued dissection between the prostate and rectum to the apex of the prostate (Fig. 2).

The posterolateral pedicles are now identifiable between the posterior and lateral planes of dissection. The ureters separate these pedicles into a lateral more vascular, and a posterior more neural pedicle (Fig. 3). The lateral pedicles can be divided with a laparoscopic stapler, or with an energised coagulating instrument like a Ligasure or harmonic scalpel. These instruments provide secure haemostasis for the pedicles and are re-useable, providing a more cost-effective option to the disposable staplers. In younger patients where an attempt at nerve-sparing is contemplated, the posterior pedicles are sharply divided between clips with cold scissors close to the lateral side of the seminal vesicle, with no thermal energy. If the endopelvic fascia has been opened previously, anterolateral retraction of the bladder allows the posterolateral pedicles to be divided at the base of the prostate, and the lateral prostatic attachments can be divided from the base to the apex until the lateral aspect of the urethra is reached. Neurovascular preservation can also be continued along the lateral aspect of the prostate.

The anterior attachments of the bladder are freed from the abdominal wall (Fig. 4), keeping all the perivesical fat around the bladder and following the medial umbilical ligaments to the umbilicus where the urachus is divided. This mobilisation opens the retropubic space, exposing the puboprostatic ligaments and the superficial branch of the dorsal vein, which is coagulated and divided. If the endopelvic fascia had not been previously opened it is opened at this time, and the muscular attachments of the prostate apex to the pelvic floor are

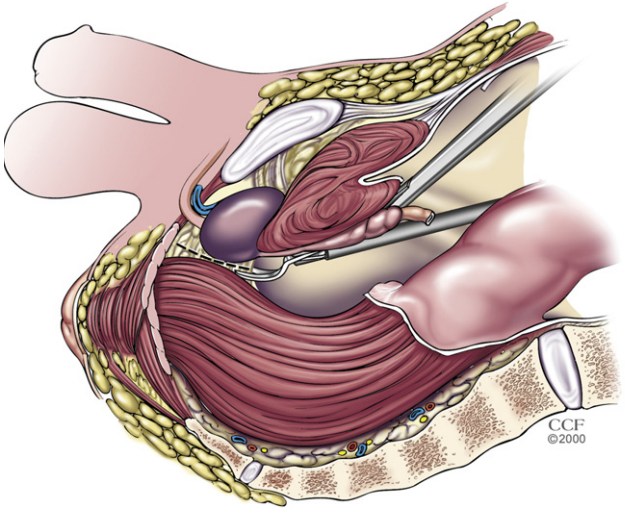

Figure 2 Lateral view showing the progression of dissection between the prostate and rectum. Denonvilliers' fascia is encountered as a distinct layer that needs to be divided sharply.

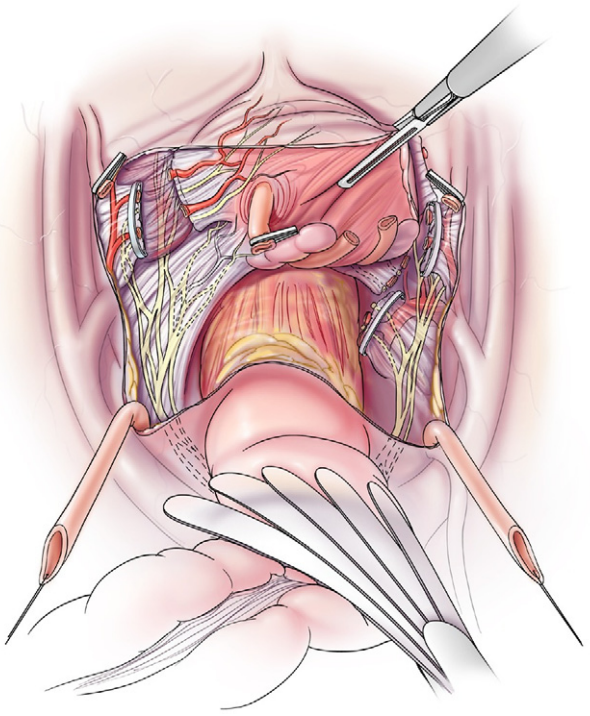

Figure 3 As related to the ureters, the bladder pedicles form a lateral vascular portion (shown divided on the left side), and a posterior portion containing fewer blood vessels and more nerve fibres. In this diagram, both ureters have been divided.

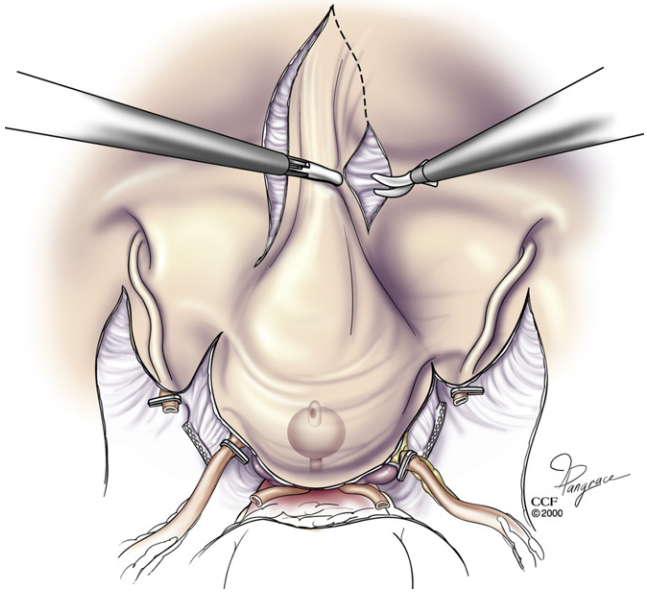

Figure 4 Bladder mobilisation from the undersurface of the anterior abdominal wall.

divided. The dorsal vein complex is controlled with a stitch passed between the complex and the anterior urethra. The puboprostatic ligaments and the dorsal vein complex are divided to expose the apex of the prostate (Fig. 5). Bleeding that occasionally happens from an

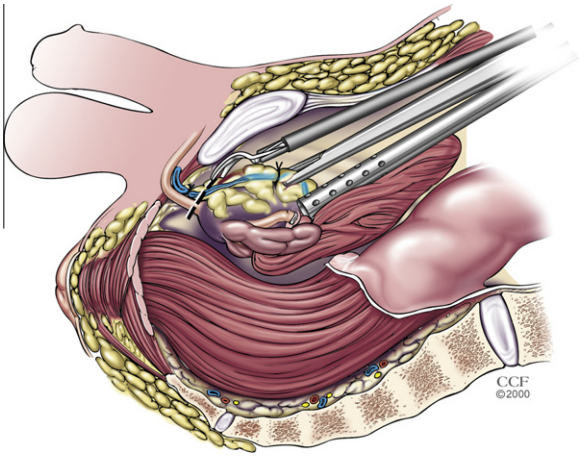

Figure 5 Division of the dorsal vein complex.

improperly controlled dorsal vein is addressed by a reinforcing suture placed after the dorsal vein complex has been completely transected, to avoid excessive bleeding from traction on a partially transected dorsal vein.

Apical attachments of the prostate to the pelvic floor are divided, and the urethra is clearly identified. The urethral catheter is removed, and a clip is placed across the proximal aspect of the urethra to avoid spilling the bladder contents into the pelvis as the urethra is transected. If the ureters had not been divided previously, they are divided between clips and the distal margins are sent for frozen-section pathological evaluation. If an orthotopic urinary diversion is planned, the urethra is divided sharply at the apex of the prostate, the proximal urethra can be closed with a stitch, to be evaluated by frozen-section pathology after the specimen is extracted. The bladder is now free, and is placed immediately in an impermeable retrieval bag.

Technique of female LRC

LRC in the female follows a similar stepwise procedure.

Mobilisation of the ureters: in females the ovarian vessels are controlled alongside the ureter, allowing the ovaries to be mobilised medially.

Division of the peritoneum occurs along the medial umbilical ligament. The round ligament is encountered in place of the vas deferens and is divided.

The lateral plane is developed to the pelvic floor muscle in the same way. The endopelvic fascia is not opened as a separate step in females, particularly if a vaginal-sparing operation is planned.

The posterolateral pedicles are divided to expose the lateral side of the vagina.

The posterior fornix of the vagina is opened, guided by a sponge stick placed by an assistant in the vagina. Division of the vaginal wall proceeds distally, taking care to avoid excising excessive amounts of the vagina. This is avoided by staying close to lateral aspects of

the cervix and as anterior as possible on the lateral vaginal walls. Division of the vaginal walls proceeds as far distally as the bladder neck.

The anterior attachments of the bladder are mobilised similar to the male procedure.

The anterior urethral surface can be seen clearly after division of the dorsal venous complex. The distal end of the vaginal division is continued lateral to the urethra until the external meatus. The endopelvic fascia over the urethra and a small dorsal vein are divided, and the specimen is now free. In patients where an orthotopic diversion is planned, the lateral vaginal walls are divided to a level slightly above the bladder neck. The bladder neck is located by the position of the catheter balloon, and the bladder neck is transected at this location, leaving the urethral/anterior vaginal wall unit intact. The bladder neck is evaluated using frozen sections.

The vaginal is closed, typically using a clam-shell technique that retains a fairly wide (but shorter) vagina.

Numerous modifications to the female technique allow a less radical resection for low-stage disease. Such resection can spare the full length of the vagina, the ovaries (or one of them), and even the uterus.

Lymphadenectomy

After the cystectomy specimen is placed in an impermeable extraction sac, the lymphadenectomy portion of the procedure is performed. Nodal tissue is removed from the area surrounding the iliac vessels, between the genitofemoral nerve laterally, the node of Cloquet distally, and the obturator fossa medially. The proximal limit of dissection is variable among surgeons and institutions; it is our preference to limit the dissection to the midpoint or the origin of the common iliac artery, but a successful extended lymphadenectomy can be done laparoscopically with a proximal extent as high as the origin of the inferior mesenteric artery from the distal aorta [13–15]. Presacral nodes are also removed, and this is facilitated by adequate mobilisation of the sigmoid colon.

Urinary diversion

Considerable debate during the initial experience with LRC focused on the urinary diversion technique, whether an intracorporeal technique is more beneficial than an extracorporeal technique (through a mini-laparotomy). Although the intracorporeal technique is aesthetically superior, particularly in women, where a vaginal specimen extraction can be obtained, resulting in a truly 'incision-free' cystectomy, the intracorporeal technique results in a significantly longer operation and has been associated with a higher rate of bowel-related complications in initial series [16]. Although intracorporeal bowel surgery is becoming more frequently reported, particularly with robotic assistance, most surgeons prefer to construct the urinary diversion through a mini-laparotomy that is also used for extracting the surgical specimen. In cases where an orthotopic urinary diversion is being done, the neobladder is constructed extracorporeally, replaced inside the abdomen, and neobladder-urethral anastomosis is made laparoscopically as the final step of the procedure.

Outcomes of LRC

Unfortunately there are no prospective randomised studies comparing ORC and LRC; there are many reports of initial experiences and small retrospective reports, but a comprehensive review is beyond the scope of this article. In a prospective non-randomised comparison of the operative morbidity of 38 LRC and 30 ORC, blood loss, transfusion rate, minor complications, mortality, opioid requirement, resumption of oral intake and hospital discharge were all significantly shorter in the LRC group [17]. The operation was significantly faster for ORC (221 vs. 152 min for the cystectomy portion), and there were two open conversions in the LRC group. Of interest in that study is that patients spent 4 days after LRC in an intensive-care unit, compared to 9 days after ORC. Porpigila et al. [18] reported no significant difference in operative time, blood loss or complications, with significantly less analgesic requirement and a shorter time to resumption of oral intake in the LRC than the ORC group. A retrospective comparison of the oncological outcome of 36 LRC to 34 historical matched controls undergoing ORC showed no difference between the groups in terms of 3-year overall, cancer-specific or recurrence-free survival, even when patients were divided into organ-confined (T1, T2) and extravesical (T3, T4) groups [19]. The median (range) follow-up for the LRC group was only 21 (3–56) months. Haber and Gill [3] reported on the intermediate-term oncological outcomes of 37 patients with a follow-up extending to 5 years. When five deaths from unknown causes were excluded, the 5-year overall and cancer-specific survival was 63% and 92%, respectively (58% and 68%, respectively, if the five deaths were assumed to be cancer-related). A disease-free survival rate of 67% at 3 years was reported in a study of 40 patients in whom 15% had pathologically involved lymph nodes. There were no major complications and one postoperative death [20]. Similar results were reported in 48 patients with 3-year cancer-specific survival rate of 73% and one postoperative death from sepsis [21].

The largest published study currently available reported the oncological outcomes of 171 patients with a median follow-up of 3 years [4]. All patients had an orthotopic ileal neobladder constructed extracorporeally. With impressive operative results of no open conversions or deaths, a median operating time of 325 min, and a median blood loss of 270 mL, pathological evaluation showed no positive surgical margins,

extravesical (T3, T4) disease in 34%, and positive lymph nodes in 22%. Local recurrence occurred in 5% of patients, while 14% had distant recurrence, and 1% had both local and distant recurrence. The 5-year overall, cancer-specific and recurrence-free survival rates were 74%, 81% and 73%, respectively, with a median follow-up of 37 months, and only 32% of patients completed 5 years of follow-up.

Future directions

Laparoscopic surgery continues to develop, and urologists have always been at the forefront of new technology. Robotic assistance has dominated recent developments in the laparoscopic field, allowing significantly more complex procedures to be performed with less difficulty. A significant advantage of the widespread use of robots is the renewed interest in intracorporeal urinary diversion, which could result in improved cosmesis and patient satisfaction with no increase in operative risk. LRC and urinary diversion have been performed successfully using a single-site approach [22], and such techniques continue to develop. Further details of these new developments are included in separate articles in this issue of the *AJU*.

Conclusion

LRC has become established as a viable and less invasive option to ORC in selected patients. Improved cosmesis, decreased postoperative pain and shorter recovery continue to make the technique attractive to patients and surgeons alike. Careful patient selection and advanced laparoscopic skill are required for optimal outcomes. Continued developments in the field of robotics and single-site surgery promise significant improvements over current techniques and outcomes.

Conflict of interest

None to declare.

References

[1] Parkin DM. The global burden of urinary bladder cancer. *Scand J Urol Nephrol Suppl* 2008;**218**:12–20.

[2] Herr HW, Faulkner JR, Grossman HB, Natale RB, deVere White MF, Sarosdy MF, et al. Surgical factors influence bladder cancer outcomes: a cooperative group report. *J Clin Oncol* 2004;**22**:2781–9.

[3] Haber GP, Gill IS. Laparoscopic radical cystectomy for cancer: oncological outcomes at up to 5 years. *BJU Int* 2007;**100**:137–42.

[4] Huang J, Lin T, Liu H, Xu K, Zhang C, Jiang C, et al. Laparoscopic radical cystectomy with orthotopic ileal neobladder for bladder cancer. oncologic results of 171 cases with a median 3-year follow-up. *Eur Urol* 2010;**58**:442–9.

[5] Moskovic DJ, Lavery HJ, Rehman J, Nabizada-Pace F, Brajtbord J, Samadi DB. High body mass index does not affect outcomes following robotic assisted laparoscopic prostatectomy. *Can J Urol* 2010;**17**:5291–8.

[6] Guillotreau J, Gamé X, Mouzin M, Roche JB, Abu Anz S, Doumerc N, et al. Laparoscopic radical cystectomy in elderly patients with bladder cancer. Feasibility and evaluation of morbidity. *Prog Urol* 2010;**20**:204–9.

[7] Brenner DJ, Curtis RE, Hall EJ, Ron E. Second malignancies in prostate carcinoma patients after radiotherapy compared with surgery. *Cancer* 2000;**88**:398–406.

[8] Fergany AF, Moussa AS, Gill IS. Laparoscopic cystoprostatectomy for radiation-induced hemorrhagic cystitis. *J Endourol* 2009;**23**:275–8.

[9] Gill IS, Fergany A, Klein EA, Kaouk JH, Sung GT, Meraney AM, et al. Laparoscopic radical cystoprostatectomy with ileal conduit performed completely intracorporeally: the initial 2 cases. *Urology* 2000;**56**:26–9.

[10] Abdel-Hakim AM, Bassiouny F, Abdel Azim MS, Rady I, Mohey T, Habib I, et al. Laparoscopic radical cystectomy with orthotopic neobladder. *J Endourol* 2002;**16**:377–81.

[11] Türk I, Deger S, Winkelmann B, Schönberger B, Loening SA. Laparoscopic radical cystectomy with continent urinary diversion (rectal sigmoid pouch) performed completely intracorporeally: the initial 5 cases. *J Urol* 2001;**165**:1863–6.

[12] Denewer A, Kotb S, Hussein O, El-Maadawy M. Laparoscopic assisted cystectomy and lymphadenectomy for bladder cancer: initial experience. *World J Surg* 1999;**23**:608–11.

[13] Finelli A, Gill IS, Desai MM, Moinzadeh A, Magi-Galluzzi C, Kaouk JH. Laparoscopic extended pelvic lymphadenectomy for bladder cancer. Technique and initial outcomes. *J Urol* 2004;**172**:1809–12.

[14] Shao P, Meng X, Li J, Lv Q, Zhang W, Xu Z, et al. Laparoscopic extended pelvic lymph node dissection during radical cystectomy: technique and clinical outcomes. *BJU Int* 2011;**108**:124–8.

[15] Ghazi A, Zimmermann R, Al-Bodour A, Shefler A, Janetschek G. Optimizing the approach for lymph node dissection during laparoscopic radical cystectomy. *Eur Urol* 2010;**57**:71–8.

[16] Haber GP, Campbell SC, Colombo Jr JR, Fergany AF, Aron M, Kaouk J, et al. Perioperative outcomes with laparoscopic radical cystectomy: 'pure laparoscopic' and 'open-assisted laparoscopic' approaches. *Urology* 2007;**70**:910–5.

[17] Guillotreau J, Gamé X, Mouzin M, Doumerc N, Mallet R, Sallusto F, et al. Radical cystectomy for bladder cancer. Morbidity of laparoscopic versus open surgery. *J Urol* 2009;**181**:554–9.

[18] Porpiglia F, Renard J, Billia M, Scoffone C, Cracco C, Terrone C, et al. Open versus laparoscopy-assisted radical cystectomy. Results of a prospective study. *J Endourol* 2007;**21**:325–9.

[19] Ha US, Kim SI, Kim SJ, Cho HJ, Hong SH, Lee JY, et al. Laparoscopic versus open radical cystectomy for the management of bladder cancer: mid-term oncological outcome. *Int J Urol* 2010;**17**:55–61.

[20] Gillion N, Xylinas E, Durand X, Ploussard G, Vordos D, Allory Y, et al. Mid-term oncological control after laparoscopic radical cystectomy in men: a single-centre experience. *BJU Int* 2011;**108**:1180–4.

[21] Hemal AK, Kolla SB, Wadhwa P, Dogra PN, Gupta NP. Laparoscopic radical cystectomy and extracorporeal urinary diversion: a single center experience of 48 cases with three years of follow-up. *Urology* 2008;**71**:41–6.

[22] Kaouk JH, Goel RK, White MA, White WM, Autorino R, Haber GP, et al. Laparoendoscopic single-site radical cystectomy and pelvic lymph node dissection: initial experience and 2-year follow-up. *Urology* 2010;**76**:857–61.