Laparoscopic Pelvic Exenteration

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Tsuyoshi Konishi

Introduction

Pelvic exenteration is one of the most challenging procedures in gastrointestinal surgery. First, extended resection outside of total mesorectal excision (TME) often encounters massive bleeding from internal iliac vessels [1]. Second, the surgical view in the pelvis is often limited by fixed bulky T4 tumors. Third, transection of Santorini's dorsal venous complex and urethra is an uncommon but risky procedure which could lead to uncontrolled venous bleeding. A minimally invasive approach to pelvic exenteration could overcome these difficulties [2, 3]. Pneumoperitoneum under Trendelenburg position minimizes venous bleeding within the pelvis. Additionally, magnified laparoscopic views may provide better identification of vessels in the narrow pelvis occupied by large tumors, which may further reduce bleeding with meticulous dissection. When transecting Santorini's dorsal venous complex and urethra, bipolar forceps or vascular staplers under higher pneumoperitoneal pressure are useful in reducing the risk of bleeding. Understanding the anatomy outside of TME is mandatory to perform laparoscopic pelvic exenteration.

Outcomes of Laparoscopic Pelvic Exenteration in Literature

Although there have been some reports on the safety and feasibility of laparoscopic pelvic exenteration in the fields of urology and gynecology [4–6], data on colorectal malignancies are very limited (Table 28.1) and mainly from Japan where laparoscopic lateral pelvic lymph node dissection is commonly performed [7–10]. A case series that compared short-term outcomes of laparoscopic (n = 9) and open (n = 58) pelvic exenteration for colorectal pelvic malignancies [2] showed less blood loss (830 mL vs. 2769 mL), similar operative time (935 min vs. 883 min), and similar R0 resection rate (77.8% vs. 75.9%) in laparoscopic pelvic exenteration. Postoperative overall complication rate (66.7% vs. 89.7%) and major complication rate (0% vs. 32.8%) were lower in laparoscopic pelvic exenteration although the differences were not statistically significant. A larger series that compared laparoscopic (n = 13) and open (n = 18) pelvic exenteration for primary and recurrent colorectal malignancies [3] reported similar results, showing less blood loss (930 mL vs. 3003 mL),

Electronic supplementary material The online version of this chapter (https://doi.org/10.1007/978-3-030-18740-8_28) contains supplementary material, which is available to authorized users.

T. Konishi (✉)
Department of Gastroenterological Surgery, Colorectal Division, Cancer Institute Hospital of the Japanese Foundation for Cancer Research, Tokyo, Japan
e-mail: tkonishi-tky@umin.ac.jp

J. Kim, J. Garcia-Aguilar (eds.), *Minimally Invasive Surgical Techniques for Cancers of the Gastrointestinal Tract*, https://doi.org/10.1007/978-3-030-18740-8_28

Table 28.1 Published series of pelvic exenterations on colorectal malignancies

Author	Year	N	Operation time, min	Blood loss, mL	R0 resection rate	Overall complications	Major complications
Uehara K	2016	9	935	830	78	67%	0%
Ogura A	2016	13	829	930	100	62%	23%
Yang K	2015	11	565	547	N/A	36%	N/A

N/A not available

similar operative time (829 min vs. 875 min), and similar R0 resection rate (100% vs. 100%) in laparoscopic pelvic exenteration. Postoperative overall complication rate (61.5% vs. 83.3%) and major complication rate (23.1% vs. 44.4%) were again lower in laparoscopic pelvic exenteration although the differences were not significant. Although these studies are limited by selection bias due to the retrospective nature of the studies, the data supports safety and feasibility of laparoscopic pelvic exenteration with possible advantage in reducing intraoperative bleeding.

Anatomy of Pelvic Exenteration

Posterior Dissection

Posterior landmarks for pelvic exenteration are the same as TME, dissecting the avascular layer between the fascia propria of the rectum and sacral bone. If sacrectomy is required, then the proposed transection line of the sacral bone should be carefully determined on preoperative magnetic resonance imaging (MRI). The distance from the sacral promontory to the transection line should be measured, since it is the only landmark to determine the transection line during laparoscopic surgery.

Lateral Dissection

Lateral landmarks for pelvic exenteration are the lateral pelvic wall muscles, i.e., psoas, piriformis, and internal obturator muscles (Fig. 28.1). Simply, the steps of lateral dissection result in exposure of these muscles. Additionally, the internal iliac artery and vein are good landmarks to identify the visceral vessels that should be ligated. More anatomic details are available in the chapter on laparoscopic lateral pelvic lymph node dissection (LPLND).

Anterior Dissection

Anterior landmarks include the bladder, prostate, Santorini's dorsal venous complex, and urethra (Fig. 28.2). These landmarks should be exposed before dividing Santorini's dorsal venous complex and urethra.

Levator Muscle and Tendinous Arch

The levator muscles laterally attach to the internal obturator muscle, forming a tendinous whitish line named the tendinous arch (Fig. 28.2). If the tumor invades the levator muscle, extended wide resection of the levator muscle is needed, requiring dissection close to or on the tendinous arch (Fig. 28.3).

Patient Positioning and Port Placement

Patient position is essentially the same as that used in TME. Typically, the patient is placed in Trendelenburg position so that the small bowel, colon, and omentum are moved out of the pelvic surgical field by gravity. The degree of Trendelenburg position should be minimized because of long operative times.

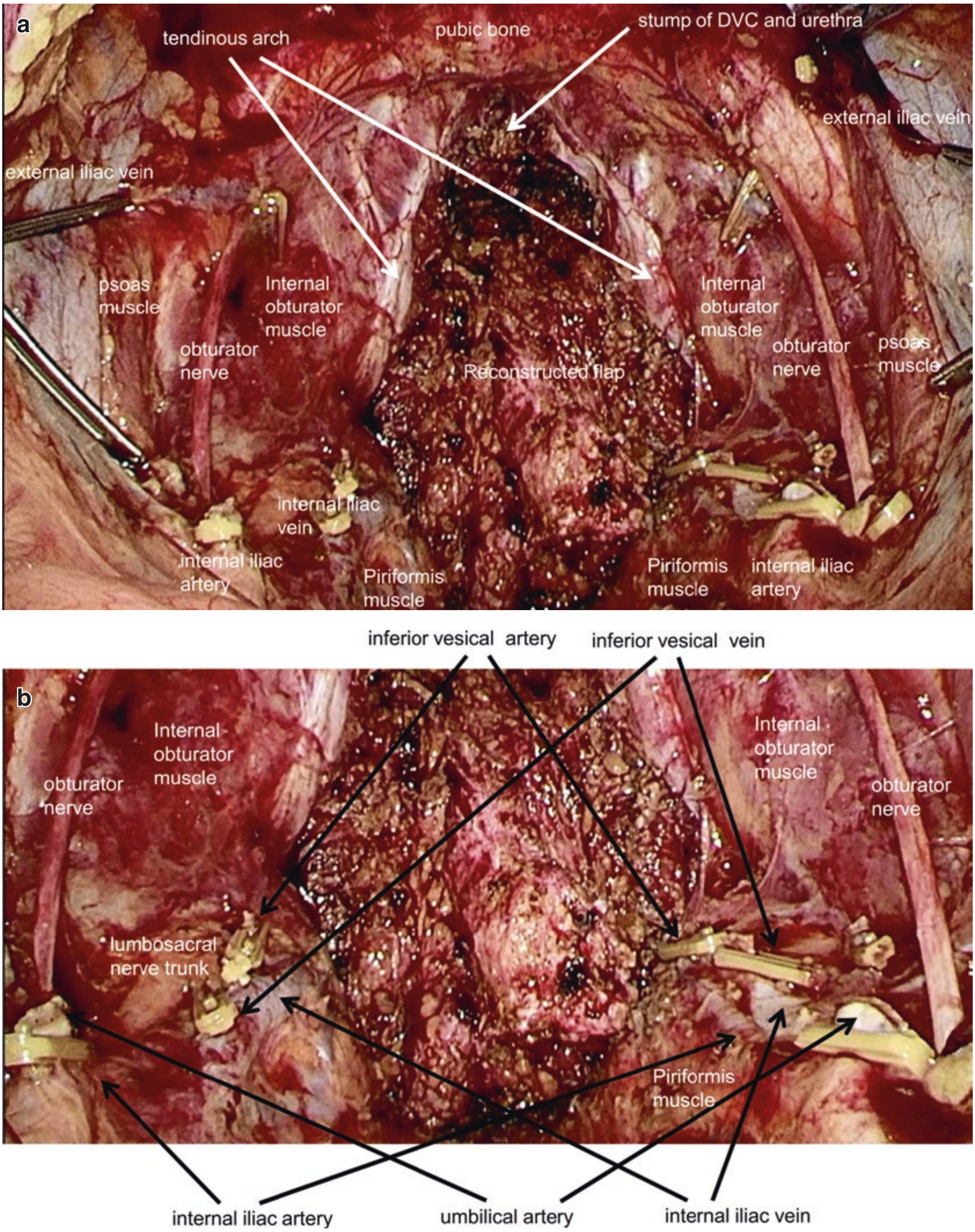

Fig. 28.1 Laparoscopic views (**a**) distant view of pelvis; (**b**) magnified view of ligated vessels after completion of pelvic exenteration. The patient underwent V-Y flap reconstruction using the gluteus maximus muscle. All the visceral branches from the internal iliac vessels were ligated at the root. DVC, dorsal venous complex

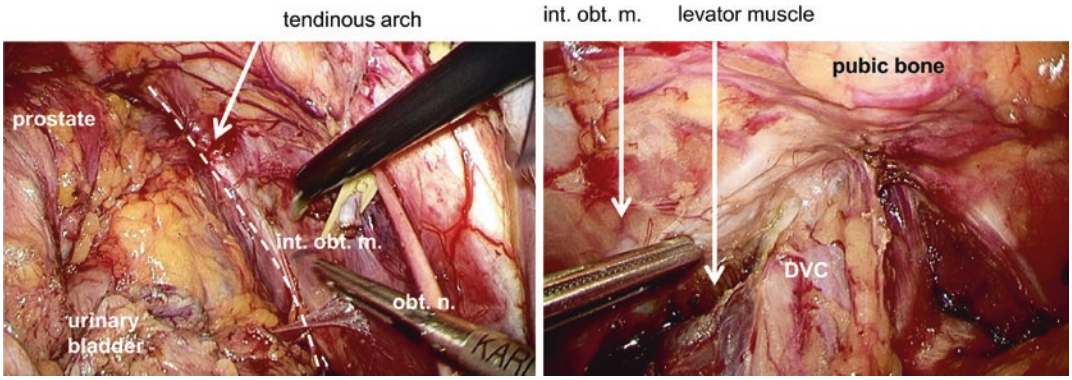

Fig. 28.2 Anterior anatomy around the prostate. Left, intraoperative view after exposure of levator muscle lateral to the prostate. Right, intraoperative view after exposure of Santorini's dorsal venous complex

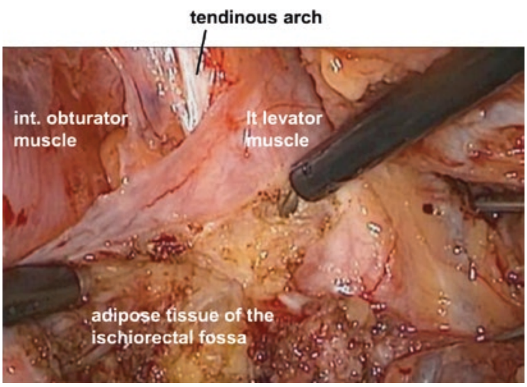

Fig. 28.3 Laparoscopic dissection of the levator muscle. If the tumor invades the levator muscle, extended wide resection of the levator muscle is needed, dissecting close to the tendinous arch. Adipose tissue of the ischiorectal fossa is exposed after dissecting the levator muscle

Typical port placement is described in Fig. 28.4. We typically place one 12-mm camera port at the umbilicus, one 12-mm port in the right lower quadrant, and three 5-mm ports in the right middle, left lower, and left middle quadrants. An additional port may be placed in the lower midline for handling a large fixed tumor or to use linear staplers to divide Santorini's dorsal venous complex and urethra. At least one 12-mm port is to be used so that gauze can be quickly inserted in case of bleeding.

For most of the procedure, the surgeon operates from the right side of the patient. The surgeon may operate from the left side when dissecting the right pelvic sidewalls, including the psoas muscle, internal obturator muscles, and obturator canal.

Step-by-Step Procedures of Pelvic Exenteration (Video 28.1)

In this chapter, the procedures are described for the pelvic phase after mobilization of the sigmoid colon and ligation of the inferior mesenteric vessels have been completed.

Posterior Dissection

The presacral avascular space is widely opened and sharply dissected caudally to reach the levator muscle in the same manner as that with TME.

Isolation and Division of the Left Ureter

The left ureter is identified and taped and isolated distally. Connective tissue and small vessels that envelop the ureter should be carefully preserved to prevent postoperative ischemic stricture and hydroureter. At its entry point to the bladder, the ureter is ligated with a clip and divided (Fig. 28.5). Note that length of the left ureter should be maintained long enough to reach the right-sided ileal conduit.

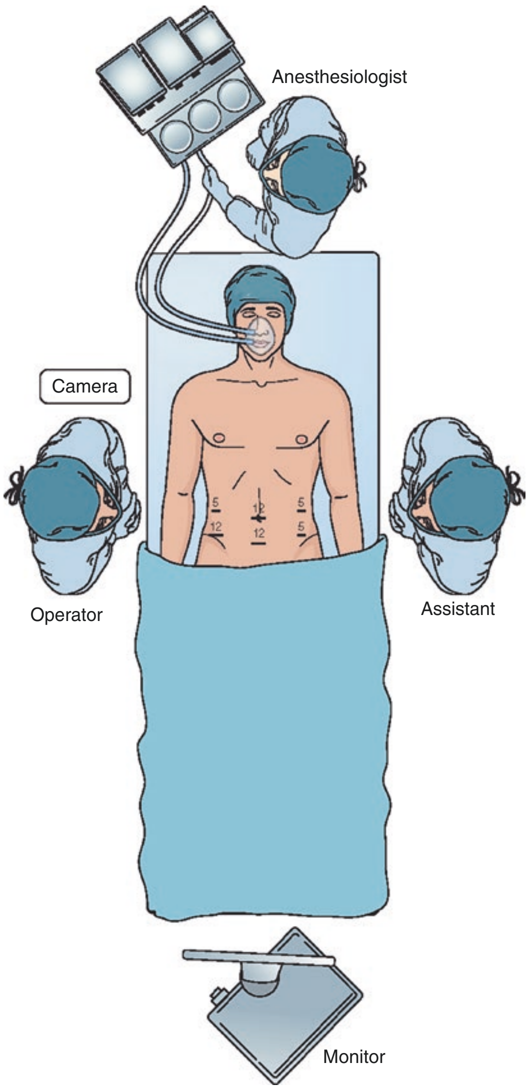

Fig. 28.4 Trocar/port positions and operating room setup for laparoscopic pelvic exenteration. Trocar positions are similar to the positions for total mesorectal excision. The lower midline 12-mm port is optional for handling large, fixed tumors or for using staplers when dividing Santorini's dorsal venous complex and urethra

Insertion of a Ureteral Catheter

The distal end of the left ureter is extracted from the left lower port and a ureteral catheter is inserted under direct vision (Fig. 28.5). The catheter is connected to a bag and kept out of the abdominal cavity during the procedure so that the urine volume for the left kidney can be monitored.

Lateral Pelvic Wall Dissection

The lateral dissection plane is essentially the same as laparoscopic LPLND [11, 12]. The peritoneum is widely opened toward the anterior of the bladder. The psoas muscle is identified behind the internal border of the external iliac vein. Dissection follows on the surface of the psoas muscle followed by the internal obturator muscle (Fig. 28.1a). The surface of these pelvic wall muscles is avascular and has minimal risk for bleeding. Anteriorly, the distal aspects of both umbilical artery and vas deferens are ligated and divided so that the lateral space is widely opened. The lymphatic chain from the inguinal nodes to obturator nodes is ligated behind the distal external iliac vein to prevent postoperative lymphorrhea. The obturator nerve is identified and isolated from obturator vessels and is preserved. Obturator vessels are ligated at the entry point into the obturator canal. Dissection continues on the surface of the internal obturator muscle down to reach the tendinous arch where the levator muscle attaches to the internal obturator muscle. Dissection proceeds anteriorly to expose the internal obturator muscle and tendinous arch, opening the paravesical (Retzius) space.

Dissection of the Dorsal Plane and Ligation of Visceral Branches

Before approaching the internal iliac vessels, the proximal sigmoid colon is retracted cephalad using a cotton tape tied around the sigmoid colon or an organ retractor to provide better working space in the pelvis. Thereafter, dissection follows the surface of the internal iliac artery and vein. Division of the visceral branches from the internal iliac vessels in laparoscopic pelvic exenteration is essentially the same as that in laparoscopic LPLND [11, 12]. Visceral branches are ligated and divided at the root, including the umbilical artery and vesical vessels (Fig. 28.1b). The proximal obturator vessels are also ligated and dissection follows the surface of the lumbosacral nerve trunk.

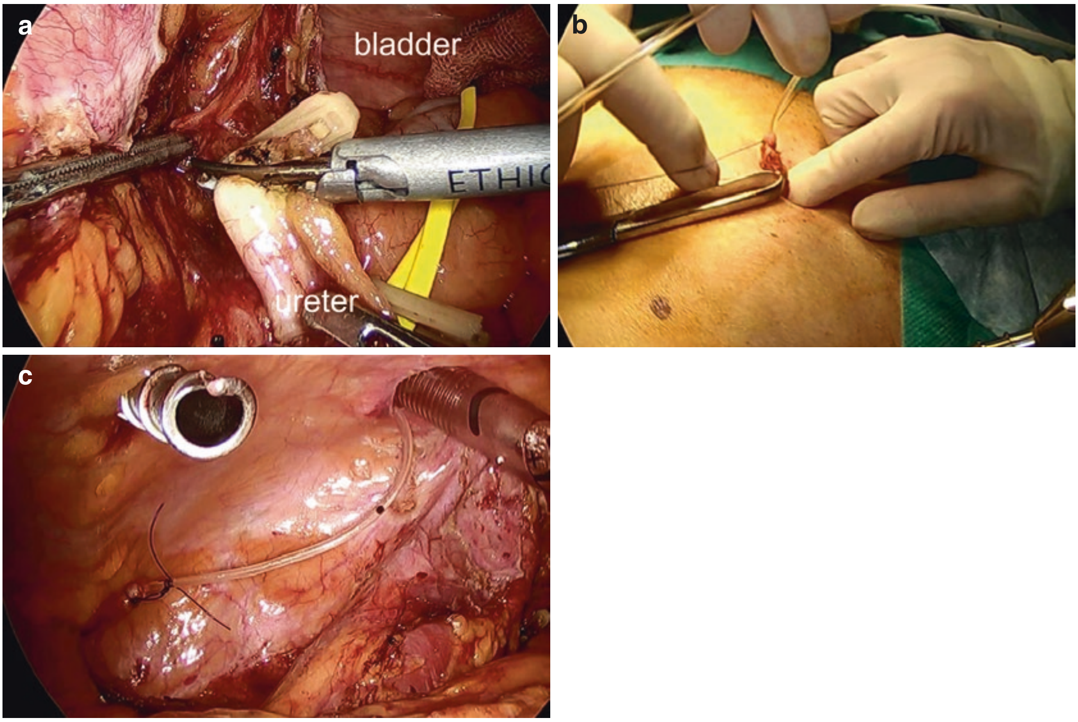

Fig. 28.5 (**a**) The ureter is ligated at the entry point to the bladder. (**b**) After extracting the ureter from a port site, a ureteral catheter is inserted under direct vision. (**c**) The catheter is connected to a collection bag so that the urine volume can be monitored during surgery

Dissection of Autonomic Nerves

The dorsal plane of the lateral compartment is demarcated from the presacral space behind the mesorectum by the hypogastric nerve and pelvic nerve plexus. The nerves are divided by electrocautery, exposing the piriformis muscle. After dividing the S4 pelvic splanchnic nerve, the dissection reaches the levator muscle.

Dissection of the Levator Muscle

The levator muscle is incised and dissected from the abdominal cavity, and ischiorectal adipose tissue is exposed. The dissection line of the levator muscle is determined by the extent of tumor invasion. If wide resection of the levator muscle is required, the incision follows the tendinous arch without dissecting between the levator muscle and the mesorectum (Fig. 28.3). Anteriorly, the incision on the levator muscle can be either along the puborectalis muscle which attaches to the prostate (inside) or the tendinous arch (outside) according to the extent of tumor invasion.

Takedown of the Bladder and Anterior Division

The peritoneum is opened anteriorly to the bladder, and the paravesical space is opened from lateral to anterior, taking down the bladder. Takedown of the bladder should be awaited until this step to avoid having it interfere with the surgical view in the pelvis. At this point, Santorini's dorsal venous complex is exposed by incising the endopelvic fascia laterally to the prostate and dividing the anterior peri-prostatic adipose tissues using a thermal coagulation device. When dividing the dorsal venous complex, the pneumoperitoneum pressure is increased to 15 mmHg to compress the venous complex and minimize bleeding, and the urethral catheter is withdrawn.

Transection of the venous complex and urethra can be done using a thermal coagulation device, a linear stapler, or suturing method (bunching method). Pre-coagulation of the dorsal venous complex using the soft coagulation mode of the VIO system (Erbe) is useful to minimize venous bleeding before transecting the venous complex with a thermal coagulation device. After transection of the urethra, the anterior perirectal fat is exposed, and dissection continues anteriorly to the rectum.

Perineal Approach

The proximal sigmoid colon is divided using a linear stapler, and then the procedure proceeds to the perineal approach. We usually perform perineal dissection in the lithotomy position. After closing the anal canal with purse-string sutures, the perianal skin is incised and ischiorectal fat is dissected away to reach the dissection line from the abdominal cavity. From posterior to lateral to anterior, dissection continues guided by the fingers and a laparoscopic view from within the abdomen. After completion of this step, the specimen is removed through the perineal wound. The wound is washed with saline and closed primarily. Occasionally, the jackknife position is useful, e.g., in case of sacrectomy or flap construction using the gluteus maximus muscle.

Urinary Reconstruction and Ostomy

After restarting pneumoperitoneum following closure of the perineum, the right colon is mobilized and extracted from the urostomy marking site at the right lower quadrant or umbilical incision. An ileal conduit that is 20 cm in length and approximately 20–40 cm from the ileocecal valve is resected while preserving the blood supply. Ureters are guided to the urostomy site and anastomosed to the ileal conduit under direct vision. Finally, the urostomy is matured at the right lower quadrant, and the sigmoid colostomy is matured at the left lower quadrant. Finally, a drain catheter is placed in the pelvis.

Pros and Cons of Laparoscopic Pelvic Exenteration

The strengths of the laparoscopic approach for pelvic exenteration include reduced bleeding, better surgical views in the deep pelvis, and possibly decreased postoperative complications. Although laparoscopic surgery for bulky tumors may require big incisions to retrieve large surgical specimens, the advantages of the laparoscopic approach outweigh the cosmetic benefits. On the other hand, there are limitations to the laparoscopic approach. Manipulation using laparoscopic straight forceps is often difficult with a bulky, fixed tumor, occasionally requiring additional trocars to help access the deep pelvis with straight forceps.

Another limitation is the management of major bleeding. The internal iliac vessels, presacral venous complex, and Santorini's dorsal venous complex may cause massive bleeding if injured. Increasing pneumoperitoneum pressure to 15 mmHg can compress the vein and reduce venous bleeding. Thermal coagulation devices are also useful for hemostasis in case of venous bleeding. Use of a laparoscopic linear stapler for dividing major vessels or the dorsal venous complex can also minimize bleeding.

Currently, laparoscopic pelvic exenteration is indicated for very select patients by a small number of surgeons. However, with more advanced knowledge of pelvic anatomy through laparoscopic extended resections, the procedure will be more commonly performed and accepted by laparoscopic colorectal surgeons. Further studies are needed to assess the long-term oncologic safety of this procedure.

References

1. Ike H, Shimada H, Yamaguchi S, et al. Outcome of total pelvic exenteration for primary rectal cancer. Dis Colon Rectum. 2003;46:474–80.
2. Uehara K, Nakamura H, Yoshino Y, et al. Initial experience of laparoscopic pelvic exenteration and comparison with conventional open surgery. Surg Endosc. 2016;30:132–8.
3. Ogura A, Akiyoshi T, Konishi T, et al. Safety of laparoscopic pelvic exenteration with urinary diver-

sion for colorectal malignancies. World J Surg. 2016;40:1236–43.
4. Kanao H, Aoki Y, Hisa T, Takeshima N. Total laparoscopic pelvic exenteration for a laterally recurrent cervical carcinoma with a vesicovaginal fistula that developed after concurrent chemoradiotherapy. Gynecol Oncol. 2017;146(2):438–9.
5. Kaufmann OG, Young JL, Sountoulides P, Kaplan AG, Dash A, Ornstein DK. Robotic radical anterior pelvic exenteration: the UCI experience. Minim Invasive Ther Allied Technol. 2011;20(4):240–6.
6. Martínez A, Filleron T, Vitse L, Querleu D, Mery E, Balague G, Delannes M, Soulie M, Pomel C, Ferron G. Laparoscopic pelvic exenteration for gynaecological malignancy: is there any advantage? Gynecol Oncol. 2011;120(3):374–9.
7. Akiyoshi T, Nagasaki T, Ueno M. Laparoscopic total pelvic exenteration for locally recurrent rectal Cancer. Ann Surg Oncol. 2015;22(12):3896.
8. Mukai T, Akiyoshi T, Ueno M, Fukunaga Y, Nagayama S, Fujimoto Y, Konishi T, Ikeda A, Yamaguchi T. Laparoscopic total pelvic exenteration with en bloc lateral lymph node dissection after neoadjuvant chemoradiotherapy for advanced primary rectal cancer. Asian J Endosc Surg. 2013;6(4):314–7.
9. Nagasaki T, Akiyoshi T, Ueno M, Fukunaga Y, Nagayama S, Fujimoto Y, Konishi T, Yamaguchi T. Laparoscopic abdominosacral resection for locally advanced primary rectal cancer after treatment with mFOLFOX6 plus bevacizumab, followed by preoperative chemoradiotherapy. Asian J Endosc Surg. 2014;7(1):52–5.
10. Yang K, Cai L, Yao L, Zhang Z, Zhang C, Wang X, Tang J, Li X, He Z, Zhou L. Laparoscopic total pelvic exenteration for pelvic malignancies: the technique and short-time outcome of 11 cases. World J Surg Oncol. 2015;13(1):301.
11. Konishi T, Kuroyanagi H, Oya M, Ueno M, Fujimoto Y, Akiyoshi T, Yoshimatsu H, Watanabe T, Yamaguchi T, Muto T. Lateral lymph node dissection with preoperative chemoradiation for locally advanced lower rectal cancer through a laparoscopic approach. Surg Endosc. 2011;25(7):2358–9.
12. Konishi T, Kuroyanagi H, Watanabe T. Combined resection of the iliac vessels for lateral pelvic lymph node dissection can be safely performed through laparoscopic approach. Ann Surg Oncol. 2011;18(S3):237.