Application of Laparoscopic Extralevator Abdominoperineal Excision in Locally Advanced Low Rectal Cancer

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Abstract

Background: When compared with conventional abdominoperineal resection (APR), extralevator abdominoperineal excision (ELAPE) has been demonstrated to reduce the risk of local recurrence for the treatment of locally advanced low rectal cancer. Combined with the laparoscopic technique, laparoscopic ELAPE (LELAPE) has the potential to reduce invasion and hasten postoperative recovery. In this study, we aim to investigate the advantages of LELAPE in comparison with conventional APR.

Methods: From October 2010 to February 2013, 23 patients with low rectal cancer (T3–4 N0–2 M0) underwent LELAPE; while during the same period, 25 patients were treated with conventional APR. The patient characteristics, intraoperative data, postoperative complications, and follow-up results were retrospectively compared and analyzed.

Results: The basic patient characteristics were similar; but the total operative time for the LELAPE was longer than that of the conventional APR group (P = 0.014). However, the operative time for the perineal portion was comparable between the two groups (P = 0.328). The LELAPE group had less intraoperative blood loss (P = 0.022), a lower bowel perforation rate (P = 0.023), and a positive circumferential margin (P = 0.028). Moreover, the patients, who received the LELAPE, had a lower postoperative Visual Analog Scale, quicker recovery of bowel function (P = 0.001), and a shorter hospital stay (P = 0.047). However, patients in the LELAPE group suffered more chronic perineal pain (P = 0.002), which may be related to the coccygectomy (P = 0.033). Although the metastasis rate and mortality rate were similar between the two groups, the local recurrence rate of the LELAPE group was statistically improved (P = 0.047).

Conclusions: When compared with conventional APR, LELAPE has the potential to reduce the risk of local recurrence, and decreases operative invasion for the treatment of locally advanced low rectal cancer.

Key words: Abdominoperineal Resection; Circumferential Margin; Extralevator Abdominoperineal Excision; Laparoscopy; Low Rectal Cancer

Introduction

Patients treated using conventional abdominoperineal resection (APR) tend to have a higher risk of local recurrence and lower survival when compared to those who receive low anterior resection.1–2 The well-established explanation has been the inadequate resection of the lesion in the APR, which usually creates a stricture at the levator muscle level.3–4 Extralevator abdominoperineal excision (ELAPE) or cylindrical abdominoperineal excision (CAPE) has been reported to effectively reduce high rates of bowel perforation and a positive circumferential resection margin (CRM) in conventional APR.5–6 With extended resection of the tumor, ELAPE or CAPE statistically decreased local recurrence and improved patient survival. In addition, the application of biological meshes for pelvic floor reconstruction after extended resection effectively reduced wound complications, simplifying the procedure.6–8 Therefore, ELAPE is gaining popularity for the treatment of low rectal cancer worldwide.

Laparoscopic surgery for colonic cancer has been an established alternative to traditional open colectomy,9 but remains controversial for rectal cancer due to concerns regarding its oncological safety. However, several prospective studies have confirmed the safety and efficacy of laparoscopy for the treatment of rectal cancer.10–12 Moreover, laparoscopic surgery provides short-term advantages, including lighter postoperative pain, better cosmetic effects, faster recovery of intestinal function, and shorter hospital stays.10–14 In this study, we aim to investigate the potential value of laparoscopic ELAPE (LELAPE), a combination of ELPAE and laparoscopy, for the treatment of locally advanced low rectal cancer, including a comparison to conventional APR.

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Methods

From October 2010 to February 2013, 23 patients with low rectal cancer (T3–4N0‑2M0) received LELAPE; while during the same period, 25 patients with locally advanced low rectal cancer were given conventional APR. Preoperative staging was conducted by magnetic resonance imaging (MRI) and/or endorectal ultrasonography. All tumors were located within 5 cm to the anal verge, and no distant metastasis or obstructions were observed. None of the patients had contraindications to general anesthesia or pneumoperitoneum, and the patient characteristics are listed in Table 1. Five patients in each group underwent neoadjuvant chemoradiotherapy, including 3 cycles of FOLFOX6 (oxaliplatin, 5-fluorouracil, and leucovorin), and 5 Gy × 5 Gy short-course radiotherapy. For these patients, MRI or endoscopic ultrasound was performed afterward to restage the tumor. All of the patients, except one in the APR group, regressed after neoadjuvant therapy, and no progression occurred (data not shown). The remaining patients refused neoadjuvant therapy due to cost concerns, a relatively early stage (T3 stage with no lymph node metastasis), patient choice, etc. The operations were performed mainly by two of the authors (DY and JJB).

Surgical technique

Laparoscopic extralevator abdominoperineal excision

Under general anesthesia, the patient was first placed in the Trendelenburg position (30°) with the right lateral tilt (15–20°). The operator stood on the right side of the patient, the first assistant on the left, and the camera holder on the cranial side. The pneumoperitoneal pressure was set at 12 mmHg, and the port sites were placed as shown in Figure 1. In detail, a 10 mm trocar was inserted above the umbilicus as the observation site, a 12 mm or 10 mm main operating port was made about 5 cm below the umbilical level on the right midclavicular line, and a 5 mm assistant trocar was made at the umbilical level on the same line. At the planned site for a sigmoid colon stoma, a 5 mm trocar was placed at 2 cm above the pubic symphysis for assistance [Figure 1].

At first, the retroperitoneum was dissected at the sacral promontory to enter the left Toldt’s space and retrorectal space from the right side of the sigmoid mesocolon. The

Table 1: Patient characteristics

| Characteristics               | LELAPE (n = 23) | APR (n = 25) | P       |
|------------------------------|-----------------|-------------|---------|
| Male/female (n/n)            | 12/11           | 12/13       | 0.770*  |
| Age (years)                  | 57.3 ± 12.2 (27–86) | 56.8 ± 11.9 (33–84) | 0.877*  |
| Neoadjuvant therapy (n)      | 5               | 5           | 0.882*  |
| Distance to anal verge (cm)  | 3.00 ± 1.31 (0–5) | 3.00 ± 1.45 (0.5–5) | 1.000*  |
| Preoperative staging (n)     |                 |             |         |
| T1N0M0                       | 7               | 8           | 0.890*  |
| T1N1M0                       | 3               | 5           |         |
| T2N0M0                       | 9               | 9           |         |
| T3N0M0                       | 4               | 3           |         |
| Postoperative staging (n)    |                 |             |         |
| pT1N0M0                      | 4               | 5           | 0.482*  |
| pT1N1M0                      | 1               | 2           |         |
| pT2N0M0                      | 12              | 11          |         |
| pT2N1M0                      | 6               | 7           |         |
| Total operative time (min)   | 241.7 ± 48.6 (170–350) | 202.6 ± 57.0 (130–370) | 0.014'  |
| Operative time for perineal portion (min) | 43.5 ± 7.6 (30–60) | 41.2 ± 8.6 (30–65) | 0.328'  |
| Intraoperative blood loss (ml) | 149.1 ± 42.8 (100–200) | 186.0 ± 62.1 (100–300) | 0.022'  |
| Positive CRM (n)             | 1               | 7           | 0.028*  |
| Bowel perforation (n)        | 0               | 5           | 0.023*  |
| Recovery of bowel function (days) | 2.4 ± 0.9 (1–4) | 3.3 ± 0.9 (2–5) | 0.001'  |
| Postoperative hospital stay (days) | 14.8 ± 3.8 (9–29) | 17.6 ± 5.4 (10–40) | 0.047'  |
| VAS pain score at 24 h postoperatively | 3.8 ± 0.8 (3–6) | 5.0 ± 0.9 (4–8) | <0.001'  |
| VAS pain score at 7 days postoperatively | 3.6 ± 0.7 (2–5) | 4.2 ± 0.9 (2–6) | 0.019'  |
| Follow-up period (months), median (range) | 20 (12–34) | 22 (14–42) | 0.152'  |

*Chi-squared test; †Student’s t-test. LELAPE: Laparoscopic extralevator abdominoperineal excision; APR: Abdominoperineal resection; VAS: Visual analog scale; CRM: Circumferential resection margin.

Figure 1: Port sites of laparoscopic extralevator abdominoperineal excision.
inferior mesenteric artery (IMA) was dissected and divided at about 0.5 cm from its origin, and the lymph nodes at the root of the IMA were cleared. The left ureter and hypogastric nerves should be carefully exposed and protected. In accordance with the principles of a total mesorectal excision, the rectum was mobilized posteriorly down to the apex of the coccyx bone, and the anococcygeal ligament was divided. Anteriorly, the peritoneum reflection was cut open, and the rectum was separated as far as the exposure of the postvaginal fornix in females or the bilateral seminal vesicles in males. Laterally, the neurovascular bundles were divided at the same level with the anterior wall; while the pelvic autonomic nerves were carefully preserved during dissection. The sigmoid mesocolon was trimmed to the edge of the sigmoid colon and then divided with a laparoscopic linear stapler intracorporally. The end of the proximal colon was pulled out to create a colostomy at the lengthened trocar site; however, the sigmoid colon could also be pulled out through the lengthened incision and divided extracorporally. The pelvic peritoneum was not sutured.

The patient was then turned around into the prone jackknife position, the anus was closed with a double purse-string suture, and the perineal skin was incised from the coccyx to the perineum. Dissection followed the outer surface of the external sphincter muscle and the levator ani muscle, and the coccyx was removed according to the level of the tumor and guidance of the preoperative MRI. Posteriorly, the sacrococcygeal junction was divided to obtain access to the inner dissection plane; afterward, the levator ani was divided laterally close to its origin. Finally, the dissection was completed anteriorly with a meticulous preservation of the neurovascular bundles, the vagina, or prostate. If the visceral or parietal wall of the pelvic fascia is invaded by the tumor, some part of the prostate or the posterior wall of the vagina should also be excised. After the cylindrical specimen was removed, the pelvic reconstruction was performed with either human acellular dermal matrix (HADM) mesh (Ruian, Qingyuanweiye Bio-Tissue Engineering Ltd., Beijing, China) or acellular porcine small intestinal submucosa (Cook Medical). The procedure was completed with the placement of one drainage tube near the mesh and the closure of the ischiorectal fat and skin.

**Conventional abdominoperineal resection (open)**

Performed as described in the literature.[8]

**Follow-up**

Stage II patients with high-risk factors and Stage III patients received postoperative systemic chemotherapy with either FOLFOX6 or XELOX for duration of 6 months, including the period of preoperative chemotherapy, according to the NCCN guidelines (2013). Indications for postoperative radiotherapy were positive CRM, bowel perforation, and/or pT,N,M, and so on. There was no significant difference between the LELAPE group (9/23) and the APR group (11/25). Follow-up was arranged every 3 months for 2 years and 6 months thereafter. In addition, data from the last available follow-up visit were included in the analyses.

**Statistical analysis**

The statistical analysis was done using SPSS version 19.0 (SPSS Inc., Chicago, IL, USA). The measurement data were expressed as mean ± standard deviation and analyzed with the Student’s t-test. The enumeration data were analyzed with a Chi-squared test, and significance was defined as P < 0.05.

**Results**

The characteristics of the patients, tumors, and operations are summarized in Table 1. The age, sex distribution, distance to the anal verge, neoadjuvant therapy ratio, and pre- and post-operative tumor staging were all comparable between the two groups. The total operative time of the LELAPE group was much longer than that of the APR group (P = 0.014). However, the operative time for the perineal portion (reposition time not included) was comparable for both groups (P = 0.328). Patients in the LELAPE group had less intraoperative blood loss when compared with the conventional APR group (P = 0.022). In addition, a lower CRM positive rate was observed in the LELAPE group versus the APR group (4.3% vs. 28.0%, P = 0.028). In addition, there were fewer patients with bowel perforation in the LELAPE group (0 vs. 20.0%, P = 0.023). Moreover, patients receiving the LELAPE had a lower postoperative Visual Analog Scale score at both 24 h (P < 0.001) and 7 days (P = 0.019) after the operation, quicker recovery of bowel function (P = 0.001), and shorter postoperative hospital stays (P = 0.047).

No perioperative mortality occurred in either group; however, 15 patients (65.2%) in the LELAPE group and 11 patients (44.0%) in the conventional APR group developed postoperative complications, which was not statistically significant (P = 0.141). The incidences of urinary retention, perineal wound infection, perineal hernia, perineal serosa, intestinal obstruction, and parastomal herniation were comparable between the two groups [Table 2]. The occurrence of chronic perineal pain was significantly higher in the LELAPE group (P = 0.002), which may be related to the coccygeal resection [Table 3]. In the LELAPE group, patients with coccygeal resection suffered from more perineal pain than those with coccygeal preservation (62.5% vs. 14.3%, P = 0.033). The chronic perineal pain

**Table 2: Postoperative complications (n)**

| Complications               | LELAPE (n = 23) | APR (n = 25) | P    |
|-----------------------------|-----------------|--------------|------|
| Perineal discomfort          | 11              | 2            | 0.002|
| Urinary retention            | 6               | 3            | 0.212|
| Perineal wound infection     | 5               | 3            | 0.366|
| Abdominal wound infection    | 0               | 4            | 0.045|
| Perineal serosa              | 2               | 1            | 0.502|
| Perineal herniation          | 2               | 2            | 0.931|
| Intestinal obstruction       | 2               | 1            | 0.502|
| Parastomal hernia            | 5               | 3            | 0.366|
| Sexual dysfunction           | 9/15            | 6/16         | 0.210|

Chi-squared test. LELAPE: Laparoscopic extralevator abdominoperineal excision; APR: Abdominoperineal resection.
gradually disappeared in all patients 3 months after the procedure. Fifteen and 16 patients were sexually active before the operation in the two groups respectively, and 1 year later, the sexual dysfunction rate was comparable between the two groups (60.0% vs. 37.5%, \( P = 0.210 \)).

The median follow-up time was 20 months (range 12–34 months) in the LELAPE group and 22 months (range 14–42 months) in the conventional APR group. In the LELAPE group, two patients had local recurrence, three patients had liver metastases, and two patients had combined liver and pulmonary metastases. Local recurrence occurred in eight patients, liver metastases in six patients, and combined liver and pulmonary metastases in three patients in the conventional APR group. The difference in local recurrence was statistically significant (8.7% vs. 32%, \( P = 0.047 \)), while the metastasis rate was comparable (21.7% vs. 36%, \( P = 0.278 \)). Four patients (17.4%) in the LELAPE group and six patients (24%) in the conventional APR group died of tumor recurrence and metastasis, which had no statistical significance (\( P = 0.573 \)) [Table 4].

**DISCUSSION**

In conventional APR, inadequate resection of the lesion leads to a higher risk of positive CRM and intraoperative perforation, which are strong predictors of local recurrence. To resolve these problems and improve patient survival, ELPAE and CAPE emerged and have been proven to effectively reduce CRM involvement and bowel perforation. Taking into account the entire levator muscles and surrounding ischiorectal fossal fat, the specimen volume of ELAPE is much larger than that of APR. In our study, we found that the specimen from the conventional APR had a stricture at the levator muscle level, while the ELAPE created a more cylindrical shape with an extended resection. The most difficult portion of the perineal resection of low rectal cancer is the anterior wall of the rectum, but the jackknife position ensures direct visualization of the anterior wall and adjacent organs. With effective cooperation of an assistant, it is much easier to control blood loss, and obtain access to the right plane, protecting the prostate or vagina. In our series, patients in the LELAPE group had much less intraoperative blood loss when compared

with the conventional APR group (\( P = 0.022 \)). Han *et al.* reported that the median time for the perineal portion was significantly shorter in the cylindrical APR group than in the conventional group (32 vs. 46 min). In our study, the operative time for the perineal portion (reposition time not included) was comparable between the two groups (43.5 vs. 41.2 min, \( P = 0.328 \)). The operative time could be improved with practice; nevertheless, the total operative time of the LELAPE group was much longer than that of the APR group (241.7 vs. 202.6 min, \( P = 0.014 \)). This is partly due to the repositioning of the patient to the prone jackknife position (about 15 min). However, the end of the abdominal portion (colostomy) is usually performed simultaneously with the perineal portion in conventional APR. Marecik *et al.* performed a robotic cylindrical APR with a transabdominal levator transection in the modified lithotomy position in five patients, but the mean operative time was 343 min. Recently, Chi *et al.* reported LELAPE in a series of six patients for low rectal carcinoma with transabdominal levator transection without repositioning the patient. The mean

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**Table 3: Relationship between perineal pain and coccyx resection in LELAPE group (n)**

| Items       | With perineal pain | Without perineal pain | Total | \( P \)  |
|-------------|--------------------|-----------------------|-------|--------|
| Coccyx resection | 10                 | 6                     | 16    | 0.033  |
| Coccyx preservation | 1                 | 6                     | 7     | 0.023  |
| Total       | 11                 | 12                    | 23    |        |

Chi-squared test. LELAPE: Laparoscopic extralevator abdominoperineal excision.

**Table 4: Follow-up results (n)**

| Items          | LELAPE (n = 23) | APR (n = 25) | \( P \)  |
|----------------|----------------|--------------|--------|
| Local recurrence | 2               | 8            | 0.047  |
| Metastasis      | 5               | 9            | 0.278  |
| Death           | 4               | 6            | 0.573  |

Chi-squared test. LELAPE: Laparoscopic extralevator abdominoperineal excision; APR: Abdominoperineal resection.

**Figure 2**: (a) Specimen of laparoscopic extralevator abdominoperineal excision; (b) and conventional abdominoperineal resection.
operative time was 186.7 min. In our opinion, LELAPE with transabdominal levator transection was technically challenging. However, the prone jackknife position is still recommended because of the excellent exposure of the perineal structures, direct visualization of the operation field and convenient cooperation of the assistant.

One practical problem with ELAPE was the reconstruction of the pelvic floor after extended resection. Primary closure might lead to high rates of wound complication and perineal herniation, and reconstruction with a myocutaneous flap might be complicated and time-consuming. Recently, the application of biological mesh has provided a safe and easy alternative for pelvic floor reconstruction, thus gaining popularity. These biologic meshes include: HADM, acellular porcine small intestinal submucosa, cross-linked acellular porcine dermis, etc. In this study, we used either the HADM or acellular porcine small intestinal submucosa to reconstruct the pelvic floor. We found that both meshes were useful, and no significant difference was observed in postoperative complications (data not shown). Compared with myocutaneous flap reconstruction, biological meshes could simplify the perineal reconstruction, shorten operative time, and avoid flap-related complications.

The validity of laparoscopic treatments of rectal cancer has been evaluated in several randomized trials. Short- and medium-term results have been encouraging with respect to postoperative recovery, length of hospital stay, operative complications, and even oncological safety. In accordance with these reports, patients in the LELAPE group had less postoperative pain, shorter hospital stays, quicker recovery of bowel function and better cosmetic effects in the abdomen. In addition, it avoided abdominal wound infection [Table 2]. There were no significant differences in late morbidity, such as intestinal adhesions and parastomal herniation between the two groups. Our study suggested that LELAPE embodied the advantages of minimally invasive surgery, even with extended resection in the perineum.

Chronic perineal pain was the most common postoperative complication in the LELAPE group (47.8%). The patients felt pain in the operated sacroccocygeal region and had difficulty sitting for an extended amount of time. Eight patients (34.8%) required pain-relieving drugs. Han et al. suggested that the chronic pain may be related to the activation of the inflammatory cytokines at the mesh site, the coccyctectomy, the damage to the pudendal nerve, the wider excision of the levator ani muscles and ischiorectal fossa, and the suturing of the mesh itself close to the pelvic wall. We analyzed the relationship of perineal pain and coccygeal resection and found that coccyctectomy may be the main cause. Coccyx preservation significantly reduced chronic perineal pain occurrence [Table 3], and to reduce the postoperative chronic perineal pain, we suggest that the coccyctectomy should be avoided for anterior rectal tumors, where the chronic perineal pain tended to gradually ease over time. With regard to other complications, there were no significant differences between the two groups [Table 2].

Figure 3: (a) Pelvic reconstruction in laparoscopic extralevator abdominoperineal excision with human acellular dermal matrix; (b) or acellular porcine small intestinal submucosa.

Patients in the LELAPE group had a higher urinary retention and sexual dysfunction rate than those in the APR group, but the difference was not significant. From the superior hypogastric plexus, the hypogastric nerves to the inferior hypogastric plexus, the whole pelvic automatic nervous system should be carefully protected.

In conclusion, compared with conventional APR, LELAPE could reduce the risk of local recurrence, and additionally, decrease operative invasion for the treatment of locally advanced low rectal cancer. Randomized studies including additional cases are necessary for further evaluation.

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