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Transanal natural orifice specimen extraction for laparoscopic low/ultralow anterior resection in rectal cancer

**Han FH et al.** Transanal NOSE for L-AR/TME

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**Abstract**

**AIM:** To investigate that whether the transanal approach of natural orifice specimen extraction is the better approach for rectal cancer resection, the authors present their surgical technique and short-term outcomes.

**METHODS:** A prospectively designed database of a consecutive series of patients undergoing laparoscopic low anterior resection for rectal cancer with various tumor–node–metastasis classiﬁcations from March 2011 to February 2012 at the First Affiliated Hospital of Sun Yat-Sen University was analyzed. Patient selection for transanal specimen extraction and intra-corporeal anastomosis was made on the basis of size of thepathology and distance of rectal lesions from the anal verge. Demographic data, operative parameters, and postoperative outcomes were assessed.

**RESULTS****:**None of these cases was converted to laparotomy. Respectively, there were 16 cases in low and 5cases in ultra-low anastomosis. Mean age of the patients was 45.4 years, and mean body mass index was 23.1 kg/m2. Mean distance of the lower edge of the lesion from the anal verge was 8.3 cm. Mean operating time was 132 min, and mean intraoperative blood loss was 84 mL. According to the principle of rectal cancer surgery, we had D2 lymph nodes dissection in 13 cases and D3 in 8 cases. Mean lymph nodes harvest was 17.8, and the positive lymph nodes was 3.4. Median hospital stay was 6.7 d. No serious postoperative complication occurred except for one anastomotic leakage. All patients remained disease free. Mean Wexner score was 3.7 at 11 mo after the operation.

**CONCLUSION****:** In our limited experience, transanal specimen extraction in totally laparoscopic low/ultralow anterior resection is feasible, safe, and oncologically sound for selected cases. Further studies with long-term outcomes are needed to explore the potential advantages of this technique.

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**Key words:** Transanal specimen extraction; Natural orifice specimen extraction; Laparoscopic anterior resection; Low/ultra-low anastomosis; Total mesorectal excision;

**Core tip:** Natural orifice specimen extraction (NOSE) is an emerging concept which has been recently applied to the field of rectal cancer resection. However, which is the better approach for rectal cancer remains controversial. In this paper, the authors present our surgical technique and short-term outcomes of transanal approach of NOSE in totally laparoscopic low/ultra-low anterior resection (L-AR) for the patients with rectal cancer. In our limited experience, the transanal approach of NOSE in L-AR for rectal cancer is feasible, safe, and oncologically sound.

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**INTRODUCTION**

The incidence of rectal cancer is higher in Asia comparing with western countries [1]. Technically, the resection of low rectal cancer may be one of the most difficult one among all colorectal surgeries.

At present, the traditional colorectal surgery has increasingly given way to laparoscopic anterior resection with total mesorectal excision (L-AR/TME). Evidence-based medicine has set forth that L-AR/TME is a feasible surgical approach for managing rectal cancer. There were similar results among in the recent short-term therapeutic effects, local recurrence rate and postoperative survival rate between laparoscopic surgery (LSC) and traditional open surgery for radical colon cancer[2]. Meanwhile, the mean estimated blood loss, discharge time after operation, and postoperative length of hospitalization were significantly reduced in the LSC[3]. However, the incision of the abdomen is still necessary in order to remove the specimens in LSC, which could cause incision infection and increase the incidence of incisional hernia[4].

The advent of natural orifice specimen extraction (NOSE) may be an effctive way to deal with the challenge. The NOSE is a feasible and safe technically to complete a radical colorectal cancer surgery by traditional laparoscopic techniques, and then remove the specimens through natural orifice[5,6]

Totally laparoscopic hemicolectomy has been implemented successfully by transvaginal access NOSE[7]. However, due to its innate limitations, the transvaginal approach NOSE is difficult to complete radical rectal cancer surgery, especially in low rectal cancer. Here we introduce a surgery technique which can complete the laparoscopic radical rectal surgery with total mesorectal excision (TME), then removing the specimen and performing anastomosis through the anus.

**MATERIALS AND METHODS**

After obtaining approval from the institutional ethics committee and written informed consent from the patients, 21 cases with rectal adenocarcinoma underwent the procedure from March 2011 to February 2012. All cases of clinical preoperative diagnosis of rectal cancer disease confirmed by electronic endoscopic colonoscopy, pathology biopsy, endosonography, and staged by specialized oncologists at our center, and preoperatively managed following the guideline from the National Comprehensive Cancer Network (NCCN). All operations were performed by a single surgeon who is proficient in various laparoscopic colorectal procedures and laparotomy at our institute.

The cases with tumor stage T4, tumor covered over half of the circumference of the rectum, metastasis found in liver or lung in the preoperative imaging assessment or BMI over 28 were excluded in our study.

Three cases in which (TNM) classiﬁcations as T3 that were comfirmed by endosonography, magnetic resonance imaging (MRI) and computed tomography (CT) examination, who all had received three cycles of chemotherapy prior to surgery. Radiotherapy followed by resection surgery was conducted as established by national guidelines. The feasibility of the operation was reappraised at two weeks after the treatment. All of three cases had experienced the symptom was reliving and the tumour was downsizing, and with limited side-effects of neoadjuvant chemotherapy.

The day before the operation, all patients underwent the systemic bowel preparation, and the use of prophylactic antibiotics.

***Surgical procedure***

**Laparoscopic phase:** The patient was positioned in modiﬁed lithotomy position, and the abdomen is then insufﬂated with 10–12 mmHg Carbon Dioxide. Four ports are used as following procedure. First port is a 12-mm blunt-tip for a laparoscope that is placed in the umbilicus using the minilaparotomy technique. The second to fourth ports are a 10-mm surgeon’s operating port in the right lower quadrant, two 5-mm ports respectively in the right middle abdomen and left lower quadrant.

Mobilization of the colon, lymph node dissection, and excision of the mesentery are performed laparoscopically in the usual manner. Detail steps are as following. Firstly, the sacral promontory is separated by ultrasonic scalpel (Harmonic ACE, Ethicon Endo-surgery, LLC) from the right side of the rectum. Secondly, the inferior mesenteric artery is ligated at its point of pedicle from the aorta with large or oversized Hem-o-lock before the tumor is mobilizing. The arterial and venous I-III branches of sigmoid are cut off while the marginal artery of the proximal colon is preserving. The next, the inferior mesenteric vein is ligated at corresponding height. We mobilized the splenic flexure in two cases in which there are tensions in the anastomosis. Thirdly, the posterior mesorectal fascia is identified and the dissection is extended to the level of the sacral promontory in the avascular plane. Then the rectum is fully dissociated to the levator ani muscle plane as far as possible along the Denonvillier’s fascia. The fragment of the distal rectum which is in 2 cm above the tumor is clamped with a detachable clip.

Among the above steps, we must be pay attattion to preservation of inferior hypogastric nerves as far as possible.

**Perineal phase:** The anus is gently dilated till it can accommodate four fingers. A home-made anus dilator and fine silk traction sutures are placed in the proximal lip of the exposed mucosal edge in a vertical orientation, in order to everting the anus and exposing the rectum (Figure 1A and B). The level of intended transaction must be maintaining a margin 2 cm at minimum distal from the tumor[8]. After irrigated the rectum with 1 liters diluted povidone-iodine solution, we sutured two parallel circle-purse-string with 2-0 prolene lines in distal rectal wall through the anus under direct vision as following: the upper one must be maintain a margin 1-1.5 cm at minimum distal from the tumor, while the lower another is in 1 cm above the dentate line in the rectal mucosa. Between two circle-purse-strings, a full-thickness rectal circumferential dissection is extended using ultrasonic scalpel. At this point, the peritoneal cavity is extended circumferentially as far cephalad as possible, and then joined the perinea and laparoscopic dissection planes thoroughly.

The stump of proximal rectosigmoid was exteriorized through the dilated anus and the opened stump of distal rectum (Figure 1C). With a purse string forceps clamped the section of the colon in which must maintain a margin at minimum 10 cm above the tumor. The proximal colon was transected under direct vision. After a purse-string sutured and put the anvil shaft into it (Figure 1D), the stump of proximal colon was pushed back gently to peritoneal cavity. The purse-string suture was tied to the anvil shaft before connecting it to the center shaft of the circular stapler (Ethicon Endo-surgery, Johnson&Johnson, China). After tighten up the lower circle-purse-string, the anastomat is put into the anus (Figure 1E), the instrument is then fired to creating end-to-end coloanal anastomosis in usual manner[9]. The next, an air test is undertaken through the anus, and reinforced stitching with bioabsorbable suture if it was necessary. A pelvic drain is inserted.

We successfully performed 16 cases in this way. Due to the low position of stump of distal rectum, we used manual anastomosis fashion in 5 cases (Figure 1F), and the protective loop ileostomy fashion was applied in these cases.

The intraoperative frozen biopsy which confirmed negative margins is applied in all cases. The mesorectal integrity[10] and circumferential situation[11] of the resection specimens was evaluated under micro and macro by the senior surgeon and the qualified pathologist, in order to ensuring that the tumor has been resected thoroughly. Mesorectal specimens were graded into 3 categories: complete (intact of mesorectum > 5 cm, while defect of mesentery < 5 mm), nearly complete (intact of mesorectum > 5 cm, while defect of mesentery > 5 mm), and incomplete (incomplete of mesorectum) categories. We defined it as positive margin if circumferential margin from the tumour is less than 2 mm in microscopy.

**RESULTS**

In this prospectively study, we were successfully performed the procedure in all cases, and no patient was converted to laparotomy. Respectively, there were 16 and 5 cases in low and ultra-low anastomosis. According to specimen macro assessment of TME, complete in 18 cases while nearly complete in 3 cases. What is more, circumferential resection margin were negative in all cases.

The mean maximum diameter of tumor is 4.6 ± 1.7 cm. According to the principle of rectal cancer surgery and no-touch isolation technique, we had D2 lymph node dissection in 13 cases and D3 lymph node dissection in 8cases.The postoperative course was unremarkable in the most of cases, with prompt return of bowel activity and short postoperative stay, except for one case was complicated by anastomotic leakage. Anastomotic leakage was confirmed by stools leaking from a drain. He was treated with nil per oral, decompression of the rectum by transanal drainage, and antibiotic infusion until the leak healed spontaneously. He was discharged on the 15th postoperative day.

According to NCCN guidelines, all cases in which the post-operation (TNM) classiﬁcations as T3/T4 or node-positive were underwent postoperative chemotherapy for 6-9 circles. The follow-up period ranged from 11 to 23 mo. Follow-up examinations were scheduled at 2 wk, 1, 2, 3, 6, 9, and 12 mo, and every 6 mo thereafter until 5 years. All patients underwent the CT of chest, abdomen, and pelvis every 6 mo and colonoscopy at 12 mo, but remained disease free. All of five patients, who underwent coloanal handsewn anastomosis with a diverting ileostomy, had received their ileostomies reversed at three to six mo after the operation, based on the diagnosis of free from tumor recurrence and anastomotic stenosis, which is confirmed by electronic endoscopic colonoscopy, barium enema examination, MRI, and CT examination. Anal continence was measured using the validated Wexner fecal incontinence scoring system (0 = perfect continence, 20 = complete incontinence). The mean Wexner score was 3.7 (range 0–5) at over 11 mo after the operation.

**DISCUSSION**

In the past 10 years, laparoscopic L-AR has been practiced at our institute according to the principle of TME for patients with low rectal cancer. Traditional large abdominal incision has been gradually replaced by small abdominal incision. L-AR benefits patients not only in cosmetology and postoperative rehabilitation, but also in reducing surgical interference, maintaining the immune function and homeostasis, achieving rapid recovery, and relieving patients’ psychological stress after surgery. However, L-AR is still considered as imperfect due to the requirement of a minimum 5-7 cm abdominal incision in order to remove specimen entirely. There are still some existing complications, such as abdominal incision infection, postoperative somatic pain, and incisional hernia[12]. According to the statistics of bulk of cases, wound infections occurred in 13.5% of patients after L-AR (2.7% trocar, 10.8% extraction sites), incisional hernias developed in 24.3% of patients, and extraction sites accounted for 85.7% of all wound complications[13].

In order to reduce the impact of incision in the L-AR to the body and eliminate the abdominal incision completely, the natural orifice translumennal endoscopic surgery (NOTES) is booming in recent years, in which incisional infection and incision hernia can be avoided and better cosmetic results can be achieved[14,15].

Recently, transvaginal (posterior fornix incision) is the main approach of NOTES in most colectomy[16-18]. However, there are still some negative factors in low/ultra-low rectal cancer which hindered the use of transvaginal approach of NOTES. First of all, there are some existing technical shortcomings, such as lack of experience and technical complexity, additional adjacent organ injury, extended operation time and specialized equipment requirement that increased operation cost. Secondly, it is difficult to remove the large tumor specimens through the posterior vaginal fornix incision sometimes. Thirdly, there are many technical difficulties in proceeding TME in low (ultra-low) sphincter-preserving rectal cancer with transvaginal approach. Last but not the least, transvaginal approach of NOTES is applicable only to female patients, which is major hinder to popularize in clinical practice.

As a result, more and more surgeons try to find a new way as approach of NOTES in low rectal cancer. With regards to the applicability of NOTES in colorectal surgery field, transanal access of NOTES is intuitively the optimum one. First, rather than creating an opening through an otherwise healthy organ to perform the rectal anterior resection, the enterotomy is created through the diseased organ itself. Second, the enterotomy created is ultimately closed by incorporating into a standard colorectal anastomosis, which the surgery requirement regardless whether it is achieved *via* NOTES or standard surgery. Finally, the approach of NOTES could be anticipated to have substantial benefits over a standard transabdominal approach[19].

At present, transanal access NOTES in radical colorectal cancer surgery has completed successfully in animal model, but fewer surgeons put it into clinic practice, due to potential technical difficulties, such as intra-abdominal intestinal fecal contamination, increasing possibility of infection through colon lumen approach etc. All of these factors may affect the safety of the surgery. For example, clinical reports confirmed that common complications included wound infection (56.7%), septicemia (31.7%), and enterocutaneous fistula (16.7%) in patients who sustained penetrating colon injuries[20]. However, with the improvement in anatomical techniques and equipment, there are not only few transanal of NOTES for resection of rectum which were performed in vivo porcine model or fresh cadaver being reported[21], but also there have been several reports on laparoscopic-assisted transanal NOTES performed for left-sided colorectal resections[22] and sigmoidectomy[23]. Unfortunately, expensive equipment is fundamental to these studies, which is limits the clinical application of NOTES, especial in developing countries.

As a transition of NOTES, transanal approach of NOSE is an emerging concept which has been recently applied to the field of rectal excision. Darzia *et al*[24] describe a technique of totally laparoscopic left-sided colonic resection and transanal specimen delivery. Franklin *et al*[25] reported that laparoscopic colectomy in patients with stage III colorectal cancer is oncologically adequate. Fukunaga *et al*[26] performed a radical rectal cancer surgery which removing the specimens through the anus and avoided the abdominal incision. Transanal specimen extraction can also resolve the problems found in obese patients with short or hypertrophy mesentery, or deep abdominal wall, all of which have been challenged for the process of transabdominal specimen delivery[27]. It is convinced that transanal approach NOSE is technically feasible, and may be a bridge of the NOTES and the conventional laparoscopic approach for radical colorectal cancer surgery.

Our current experience has proven that transanal approach NOSE, combined with TME and LAR techniques in rectcal cancer, not only adapted to the principle of radical tumor resection, but also in line with the principle of management information systems. It has been introduced and demonstrated the feasibility in techniques and oncology principles by many surgeons[28]. The full use of the “necessary” trauma of the rectal stump can accurately determine the distal cutting edge of the rectum. Combination of the traditional laparoscopic techniques and removing the specimens through the natural orifice can minimize the surgical injury[29]. Traditional laparoscopic surgical techniques provides with large operation space, mature technology and broad vision, which can accurately dissect the mesorectal, pelvic visceral and parietal fascia. We can make sure that the inferior mesenteric artery is ligated at the root, in order to blocked the blood supply of tumor and venous drainage, and minimized the chance of metastasis. In the meantime, care is required to avoid any injury for the mesenteric arcades so that to guarantee adequate blood supply of the descending colon. The operation was followed the “holy plane”, which is placed between the pelvic visceral fascia and the rectal fascia propria, to the anterior of Denonvillier’s fascia. The mesorectum should be completely mobilized while preserving the pelvic autonomic nerve supply.

After the anus is fully dilated, we used a home-made anus dilator and fine silk traction sutures to evert the anus and expose the rectum, then put a protective bag into anus. In the premise of protecting vascular nutrition, the region of specimen is fully free in the peritoneal cavity, then retrieval gentle from the anus.

According to the techniques in anus sphincter and microrelation, we precede a standard radical resection of rectal cancer. Even as the specimen is a relatively large one, for example, the hypertrophic mesorectum, can be remove smoothly from the fully dilated anus routinely without tearing in the rectum or damaging to the anal sphincter. The anus and rectum can be shrinking back to the normal diameter after operation (Figure 1H).

When the stump of proximal rectum was exteriorized through the dilated anus and the opened stump of distal rectum, we transected the proximal colorectum under direct vision[30]. After with 2/0 prolene intracorporeal purse-string sutures, we use the anastomat to create end-to- end coloanal anastomosis under usual manner. Although some researchs stated that J-pouch is superior to end-to-end reconstruction fashion for low rectal cancer[9,31], but the latter had received acceptable annal function in follw-up at six months in our study, due to the careful protection in anus sphincter, no tension and well blood supply in anastomotic stoma.

In order to prevent peritoneal seeding and trocar-site metastasis, we integrated the general rules for laparoscopic surgery, such as no-touch technique, appropriate resection margins, early bagging of resected specimen, and wound protection in our laparoscopic colorectal procedures. Comparing to the traditional laparoscopic techniques, it has good cosmetic results and reduced the chance of metastasis in abdominal wall without increasing complications[32].

Laurent *et al*[33] reported that the convertion rate of the laparoscopic radical resection for low rectal cancer is 15.5%. The convertion rate is higher due to the difficulties might be experienced in fixing colorectal, separating the pelvic, unexpected intraoperative bleeding, and failures in closure device or anastomosis. However, such difficulties can hardly jeopardize our treatment due to the elasticity and compliance in tissue while we apply the mature laparoscopic techniques to removing the specimens through the anus. With the full use of the “natural” orifice of the anus and rectum, the application of total laparoscopic rectal resection technique is feasible and safe. Such technique not only decreased abdominal surgery complications but also maintained the operation time and the cost of surgery as standard L-AR do. It also provides an important clinical significance of improving the traditional laparoscopic techniques.

However, the present surgical indications are limited for patients with the early cancer. Mesorectal invasion and tumor diameter above 6 cm is not included here due to the lack of large randomized controlled study for this procedure. The operation field is narrowed and the vision is not clear through the anal approach in some conditions, such as the narrow pelvis or huge tumor. Although there are applications of microsurgical resection techniques through the anus being reported[34], there is no specialized surgical instrument to complete the anus dilating, specimen removing and distal suturing. There is an urgency to develop better adapted tools such as a modified flexible transanal endoscopic platform, longer and more flexible dissecting instruments, and staplers and hemostatic devices to permit safe completion of these procedures without any transabdominal assistance. This technique is needs further regulation and improvement.

In our limited experience, transanal specimen extraction in totally laparoscopic low/ultralow anterior resection is feasible, safe, and oncologically sound for selected cases. The majority of patients have an acceptable functional outcome. Further studies with long-term outcomes are needed to explore the potential advantages of this technique.

**COMMENTS**

***Background***

The incidence of rectal cancer is higher in Asia comparing with western countries. Technically, the resection of low rectal cancer may be one of the most difficult one among all colorectal surgeries.

***Research frontiers***

At present, the traditional colorectal surgery has increasingly given way to laparoscopic anterior resection with total mesorectal excision (L-AR/TME). Evidence-based medicine has set forth that L-AR/TME is a feasible surgical approach for managing rectal cancer. There were similar results among in the recent short-term therapeutic effects, local recurrence rate and postoperative survival rate between laparoscopic surgery and traditional open surgery for radical colon cancer.

***Innovations and breakthroughs***

In their limited experience, transanal specimen extraction in totally laparoscopic low/ultralow anterior resection is feasible, safe, and oncologically sound for selected cases. The majority of patients have an acceptable functional outcome.

***Applications***

There is an urgency to develop better adapted tools such as a modified flexible transanal endoscopic platform, longer and more flexible dissecting instruments, and staplers and hemostatic devices to permit safe completion of these procedures without any transabdominal assistance. This technique is needs further regulation and improvement.

***Peer review***

This manuscript is interesting and highly innovative in colorectal surgical technique especially more in surgical than gastroenterological audience.

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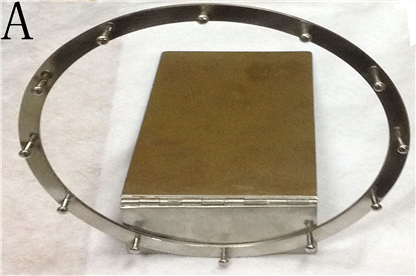
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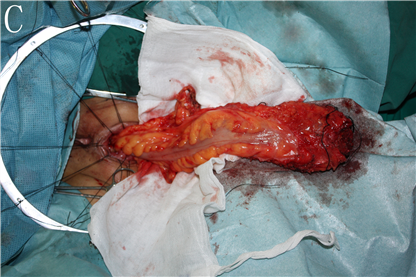
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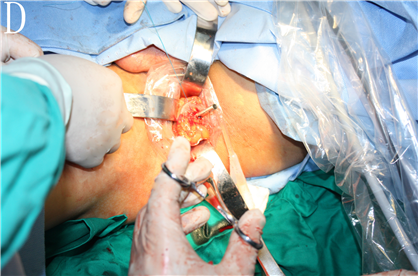
**P-Reviewers** Kirshtein B, Kim YJ, Leitman M, M’Koma A **S-Editor** Gou SX  **L-Editor E-Editor**

**Figure 1** **Surgical procedure.** A, B: Dilating anus with a home-made dilator in which of the bottom can be folded; C: Exteriorizing specimen through anus; D: Putting the anvil shaft into stump of proximal colon; E: Putting the the anastomat body into the anus; F: Manual anastomosis fashion was completed; G: The appearance of the anus postoperative; H: The appearance of abdominal wall three months after surgery.













**Table 1** **Patient demographic data**

|  |  |
| --- | --- |
| **Patient demographic data** | **Value** |
| Age (yr) | 45.4 ± 3.6 |
| BMI | 23.1 ± 2.8 |
| Sex (male/female ratio) | 12/9 |
| Mean Wexner score | 3.7 ± 1.6 |

Wexner Score was obtained in follow-up at six months. BMI: Body mass index.

**Table 2** **Intraoperative information**

|  |  |
| --- | --- |
| **Intraoperative information** | **Value** |
| Mean operation time (min) | 132 ± 85 |
| Mean intraoperative blood loss( ml)  Mean tumor diameter (cm) | 84 ± 15 |
| 4.6 ± 1.7 |
| Distance of lesion from anal verge (cm) | 8.3 ± 3.5 |
| Protective ileostomy | 5 (23.8) |
| Defecation time after operation (d) | 2.5 ± 1.4 |

**Table 3 Patient** **pathological parameters**

|  |  |
| --- | --- |
| **Item** | **Value** |
| **Pathological diagnose** |  |
| Well-differentiated | 10 |
| Poorly-differentiated | 7 |
| Myxoadenocarcinoma | 4 |
| Specimen macro assessment TME | 21 (radical resection) |
| Circumferential resection margin | 21 (Negative) |
| **Postoperative pathology**  Staging (TNM) |  |
| T1-4N0M0 | 7 |
| T1-2N1M0 | 5 |
| T3-4N1M0 | 6 |
| T3-4N2M0 | 3 |
| Lymph nodes harvest | 17.8±4.6 |
| Metastatic lymph nodes | 3.4±1.8 |

TME: Total mesorectal excision; TNM: Tumor node metastasis.

**Table 4** **Postoperative complications *n* (%)**

|  |  |
| --- | --- |
| **Postoperative complications** | **Value** |
| Length of hospitalization | 6.1 ± 2.7 d |
| Postoperative complications |  |
| UTI  Anastomotic leakage  Anastomotic bleeding  Incision infection  Intestinal obstruction | 1. (9.5)   1 (4.7)  0 (0.0)  0 (0.0)  0 (0.0) |
| Impotence  Fecal incontinence  Anal stenosis | 1 (4.7)  0 (0.0)  0 (0.0) |
| Total | 4 (18.9) |

UTI: Urinary tract infection. The data of fecal incontinence, impotence, and anal stenosis was obtained in one-year follow-up.