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TECHNICAL NOTE

A new technique of totally laparoscopic resection with natural orifice specimen extraction (NOSE) for large rectal adenoma

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Abstract There is no consensus about the best technique to use for the surgical treatment for large rectal adenomas. The advent of laparoscopic surgery has led to the development of several new methods for the treatment of gastrointestinal tumors. This study was designed to introduce an innovative technique of totally laparoscopic resection with natural orifice specimen extraction (NOSE) for large rectal adenomas and to assess the feasibility and safety of the technique. Between February 2011 and January 2014, we performed totally laparoscopic resection with NOSE on 18 patients with a large rectal adenoma. This new technique was successful in all 18 patients. The average size of the adenoma was 4.2 cm. Mean operation time was 108.4 min, and mean intraoperative blood loss was 36.6 ml. The mean time to passing of the first flatus was 2.3 days, and the mean postoperative hospital stay was 7.2 days. Only one patient needed analgesics after the operation. All patients were able to walk within the first 2 days. There were no cases of morbidity and recurrence. Totally laparoscopic resection with NOSE appears to be suitable for selected patients with a large adenoma located in mid- or low rectum.

Keywords Rectal adenoma · Natural orifice specimen extraction · Laparoscopy

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Introduction

Colorectal adenomas are benign lesions with the potential to transform into invasive carcinoma [1]. Autopsy studies reveal that 34–36.9 % of men and 28.7–32 % of women have rectal adenomas [2–4]. The incidence of rectal cancer can be reduced if premalignant adenomas are removed. Transanal endoscopic microsurgery (TEM) has been used for the treatment of rectal adenomas for about 30 years as an alternative to abdominal rectal resection and conventional transanal techniques [5]. Recently, techniques of endoscopic mucosal resection (EMR) and endoscopic submucosal dissection (ESD) have been developed, and both of them have been employed in some centers [6–10]. So far, there has been no consensus about what constitutes the best surgical treatment for large rectal adenomas. Conventional EMR cannot provide the en bloc resection for large adenomas. Incomplete or piecemeal resection may occur in up to 50 % of cases, which may lead to a high recurrence rate [11, 12]. ESD can allow en bloc resection of specimens, especially for lesions larger than 20 mm [13]. However, ESD which is associated with a steep learning curve, is technically more challenging and time-consuming than conventional EMR [14–17]. As a result, ESD has not been widely accepted by surgeons. Surgery-related mortality and morbidity account for the decreased usage of transabdominal resection. As the milestone of minimally invasive surgery, laparoscopy surgery, which is associated with lower mortality and morbidity, is evolving rapidly worldwide [18–20]. The novel technique of totally laparoscopic resection with natural orifice specimen extraction (NOSE) has been used for the treatment of rectal lesions in several centers. We have used an innovative NOSE technique for the treatment of large rectal adenomas for some selected patients since 2011. Here, this technique is introduced, and outcomes are analyzed.

Materials and methods

Between February 2011 and January 2014, we performed totally laparoscopic resection with NOSE for 18 patients with a large rectal adenoma. The present study conformed to the ethical standards of the World Medical Association Declaration of Helsinki. The National Cancer Center ethics committee, the ethics committee of Cancer Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, approved this retrospective study. Participants gave written informed consent for their clinical records to be used in this study. Patients' records were anonymized and de-identified prior to analysis. Definite diagnosis was made by colonoscopy with biopsy combined with magnetic resonance imaging (MRI) and transrectal ultrasound in all cases, and positron emission tomography/computed tomography (PET-CT) was also used for minority of patients. Physical examination, abdominal computed tomography (CT) scan, abdominal ultrasound and barium enema were routinely used for preoperative evaluation. Patients with malignant lesions and familial adenomatous polyposis coli were excluded from this study. Inclusion criteria were as follows: patients aged 18–75 years; rectal adenoma with a diameter >3.0 cm; sessile adenoma; lesion located in mid- or low rectum (4–10 cm distance from anal verge); body mass index (BMI) $\leq$ 28; and no history of anal surgery. Choice of this surgical procedure was strictly based on the patient's individual decision after providing informed consent concerning the method and risks of the procedure. The protocol was approved by the ethics committee of our hospital.

Surgical technique

Step 1: positioning the patient and placing trocars

The patient was placed in a modified lithotomy position. Four trocars were used in most cases, a 12-mm supraumbilical port was created to introduce the laparoscope, then pneumoperitoneum was created with a pressure of 14–15 mmHg, and the other three trocars were created in the right lower quadrant (12-mm port), right upper quadrant (5-mm port) and left lower quadrant (5-mm port), respectively. Then the patient was placed in Trendelenburg position in order to expose the sigmoid colon, rectum and inferior mesenteric artery.

Step 2: dealing with the sigmoid colon, rectum and inferior mesenteric vessels

Mobilization of the sigmoid colon and rectum and ligation of the inferior mesenteric vessels were performed laparoscopically. The mesorectum was dissected using an ultrasound scalpel. Then, the inferior mesenteric artery was ligated and cut using an Endoscopic Linear Cutter (Ethicon Endo-Surgery, Cincinnati, USA). The mesorectum was mobilized until 1 cm from the distal margin of the lesion.

Step 3: fixing an anvil head to the sigmoid colon

The rectal lumen was disinfected using several iodophor disinfection cotton balls which were held by a long Babcock grasper. About 5–10 cm proximal to the adenoma, a 1.0-cm-long incision was made on the sigmoid colon wall with an ultrasound scalpel (Fig. 1a). A suture was tied to the anvil head, then the anvil head which was held by a long Babcock grasper was inserted in the sigmoid lumen through the anus and rectum. The suture line was pulled out through the 1-cm incision (Fig. 1b), and then the colon was transected in close proximity to the incision using a linear stapling device (Fig. 1c). A small hole remained on the proximal end of sigmoid colon through which the suture was pulled until the anvil was in optimal position for the anastomosis (Fig. 1d).

Step 4: transecting the rectum

The mesorectum around the lesion was dissected using an ultrasound scalpel. Then the distal stump was held by a long Babcock grasper which was inserted transanally and pulled out from anus. The intestinal mucosa around the adenoma was disinfected, and a 4-cm longitudinal incision was made on the rectal wall about 2 cm above the adenoma (Fig. 2). The dissected mesorectum was pulled out through the incision. Although the distal mesorectum had been dissected, we were still afraid that some dissected mesorectum might have been left behind during the procedure of eversion. Making an incision and pulling out the mesorectum ensure complete mobilization. This maneuver was especially useful for patients with thick mesorectum and patients with a low rectal lesion. Then, a CONTOUR® stapler (Ethicon Endo-Surgery, Cincinnati, USA) was used to transect the distal rectum (Fig. 3a). The adenoma combined with a segment of the colon and rectum had been removed completely (Fig. 3b).

Step 5: anastomosis

The rectal stump was returned to the pelvic cavity, and the end-to-end colorectal anastomosis was completed laparoscopically. The status of the anastomosis was checked, and washout of abdominal and pelvic cavity was performed.

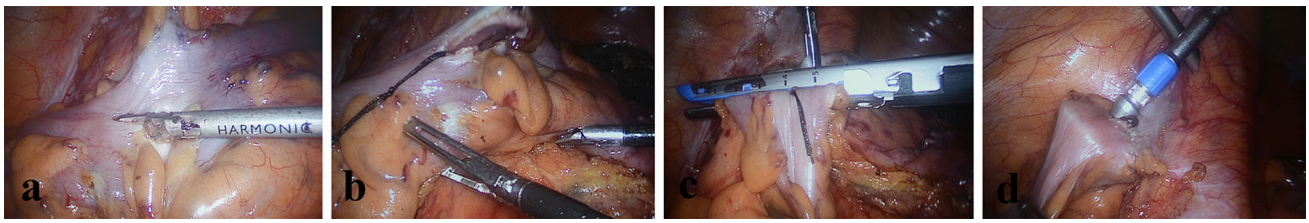

Fig. 1 Procedure of setting an anvil head in the proximal colon stump. **a** Making a small incision on the sigmoid colon wall with an ultrasound knife; **b** pulling out the suture line which was tied to the anvil head from the small incision; **c** transecting the proximal colon in close proximity to the upper pole of the incision with a linear stapling device; **d** pulling out the suture line further through the residual hole on the sigmoid stump; and fixing the anvil head in the proximal colon stump

Fig. 2 Making a 4-cm longitudinal incision located about 2 cm above the adenoma on the rectal wall and pulling out the mesorectum from the incision which can ensure that there is no mesorectum remaining in the bare area

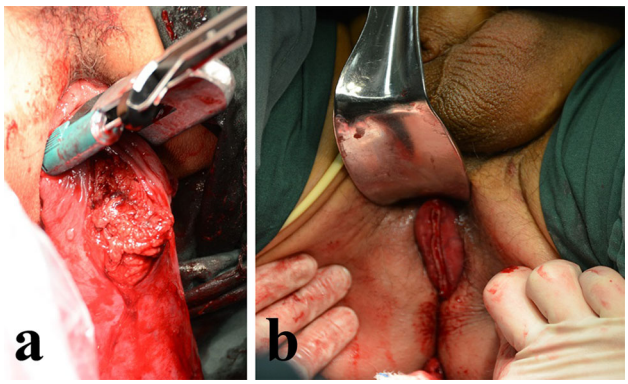

Fig. 3 Transection of the distal rectum with the CONTOUR® stapler. **a** Placing the stapler in the distal rectum at a distance of about 1 cm from the adenoma; **b** transecting the distal rectum

Follow-up

All patients were assessed for recurrence by performing clinical examination, abdominal ultrasonography, abdominal computed tomography scanning, colonoscopy and CEA every 3 months in the first 2 years after surgery, biannually for the next 3 years and then annually. The first day after surgery was the start of follow-up. The follow-up period ranged from 3 to 38 months with a median follow-up of 24 months, and the last follow-up was done in April 2014. No patient was lost to follow-up. The Wexner Continence Grading Scale [21] was used for evaluating anal continence, and the score was calculated after the patients' completion of a daily defecation questionnaire.

Results

We successfully completed totally laparoscopic resection with NOSE for all 18 patients. There were no conversions to conventional laparoscopic-assisted resection or open resection.

The mean age of patients was 56.6 years (range 48–69 years), mean body mass index (BMI) was 22.6 kg/m^2 (range 19.4–26.4 kg/m^2), mean size of adenoma was 4.2 cm (range 3.5–6.5 cm), and the mean distance from tumor to anal verge was 6.4 cm (range 4.0–9.5 cm). Tubular adenoma was confirmed in five cases by postoperative pathology, villous adenoma in seven cases, and tubulovillous adenoma in six cases. Severe dysplasia was found in 11 cases and moderate dysplasia in seven cases (Table 1).

The mean operation time was 108.4 min (range 90.0–125.0 min), and mean intraoperative blood loss was 36.6 ml (range 25.0–55.0 ml). The mean length of the distal margin was 1.3 cm (range 0.8–3.0 cm). For these 18 patients, the mean time to passing of the first flatus was 2.3 days (range 1–3 days) and mean postoperative hospital stay was 7.2 days (range 6–9 days) (Table 2).

Postoperative pain was rated by the patient on a subjective visual analog pain scale ranging from 0 to 10, with 0 representing no pain at all and 10 the worst pain imaginable. Pain was also assessed by a blinded investigator at 24 and 72 h after surgery. Patients experiencing unbearable pain were given analgesics. The pain scores at 24 h after surgery are shown in Table 2. No patient had pain at 72 h after surgery. None of the 18 patients used prophylactic

Table 1 Patient and tumor characteristics

Parameters	
Age, years, mean (range)	56.6 (48–69)
Gender	
Male	10
Female	8
BMI, kg/m^2, mean (range)	22.6 (19.7–26.4)
Tumor site, cases	
Mid-rectum	12
Low rectum	6
Tumor size, cm, mean (range)	4.2 (3.5–6.5)
Pathologic type, cases	
Tubular adenoma	5
Villous adenoma	7
Tubulovillous adenoma	6
Dysplasia, case	
Moderate	7
Severe	11

BMI body mass index

Table 2 Surgical outcomes

Outcomes	Mean (range)
Operation time (min)	108.4 (90.0–125.0)
Blood loss (ml)	36.6 (25.0–55.0)
Time to the first flatus (days)	2.3 (1–3)
Time to ambulation (days)	1.4 (1–2)
Hospital stay (days)	7.2 (6–9)
Pain score	3.6 (2–7)

analgesics postoperatively, 17 patients felt the pain slightly, and only one patient required analgesics after surgery. All 18 patients were able to walk within postoperative day 2. There was no mortality or morbidity during the period of hospital stay.

There were no new complications or recurrence during the follow-up period. No patient suffered from fecal incontinence postoperatively: The Wexner Score was 2 in five cases, 3 in eight cases, 4 in four cases and 6 in one case.

Discussion

Transabdominal resection for rectal adenomas has been gradually replaced by new techniques such as TEM, EMR and ESD [22–24]. Avoiding bowel resection and some operation-related morbidity is the goal for patients with rectal adenomas. However, there is no consensus about what constitutes the best surgical treatment for large rectal adenomas. Adenoma size is a risk factor for malignancy [25]. Patients with large rectal adenoma who choose an ESD/EMR must be aware that they may require a second procedure if the final pathology report demonstrates invasive cancer [26].

Laparoscopy as a kind of minimally invasive approach has been used for the surgical treatment of colorectal tumors. As laparoscopic instruments have been developed and surgical experience has accumulated, several new laparoscopic surgical methods such as single incision laparoscopic surgery (SILS), natural orifice transluminal endoscopic surgery (NOTES) and NOSE have been proposed and recommended [27–32]. In our hospital, totally laparoscopic resection with NOSE has been used for patients with rectal cancer or large rectal adenoma since 2011. Advantages of this technique include less pain, less intraoperative blood loss, faster recovery of intestinal function, less complications and good cosmesis [33, 34]. TME principles were followed during totally laparoscopic resection with NOSE, so that negative margins could be guaranteed. There were no patients with positive margins in our study. Nevertheless, a positive margin rate of 17 % has been reported in patients with adenomas who underwent TEM [5], while in ESD, R0 resection was obtained in only 74 % of patients [35]. Conventional EMR cannot provide en bloc resection for large adenomas. Adenoma size might influence the operative outcome. In a series of 293 large rectal adenomas treated by TEM, 21 % of adenomas with a diameter $\geq$5 cm had positive margins, while 9 % of adenomas <5 cm ($p = 0.047$) [8]. Positive margins and adenoma size are two independent risk factors for recurrence after surgery. Different recurrence rates have been reported. Barendse et al. [10] published a systematic review on the safety and effectiveness of EMR and TEM for large rectal adenomas, including 20 prospective and non-prospective case series employing EMR and 48 employing TEM with similar follow-up periods. Local recurrence rates were assessed in 3890 patients (1030 EMR and 2860 TEM). Early local recurrence in the EMR and TEM series was 11.2 and 5.4 %, and late recurrence rates were 1.5 and 3.0 % in EMR and TEM, respectively. Another study, conducted by Barendse et al. [9], showed that in TEM and EMR patients, early recurrence rates were 10.2 % and 31.0 % ($p < 0.001$) and late recurrence rates were 9.6 and 13.8 %, respectively. In our study, there was no recurrence during follow-up period regardless of the small sample size. However, we think the greatest benefit for patients with a large rectal adenoma who undergo totally laparoscopic resection with NOSE is that there is no need to worry about the efficacy of the operation: The possibility of reoperation is reduced significantly no matter whether a lesion is benign or malignant, because TME is performed during the operation.

Visceral obesity is the main reason for failing to perform this innovative technique. Abdominal CT and BMI combined with laparoscopic exploration are used to evaluating the severity of obesity and verifying the possibility of an obese patient being treated with totally laparoscopic resection with NOSE. It is our opinion that patients with a BMI of 28.0 kg/m^2 or more may not be good candidates for this technique. In a previous study which we designed [31], we attempted to perform totally laparoscopic resection with NOSE for a rectal cancer patient with the BMI of 30.2 kg/m^2, but we failed to extract the specimen from the anus because of the thick mesentery tissue. One point must be clarified: 28.0 kg/m^2 is not the cutoff BMI for this innovative technique, it is not uncommon that some patients with a BMI $\geq$ 28.0 kg/m^2 have the thin mesentery tissue. Size of adenoma is not associated with the completion of the technique due to the flexibility of lesion.

As we described, the anvil head is inserted into the sigmoid lumen through the anus and rectum where the lesion is located. We think this procedure is not suited for the treatment of invasive cancer. The anvil head may be contaminated by tumor cells if treating invasive cancer and these exfoliated tumor cells may lead to a high risk of implantation metastasis.

The shortcomings of this study include the small sample size and a lack of adequate comparison with EMR, ESD and TEM as regards short- and long-term outcomes.

Conclusions

Totally laparoscopic resection with NOSE appears to be suitable for selected patients with a large adenoma located in mid- or low rectum.

The safety and feasibility of this technique need to be verified in larger series.

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Conflict of interest The authors declare that they have no conflict of interest.

Ethical standard The National Cancer Center ethics committee, the ethics committee of Cancer Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China.

Informed consent A waiver of consent was obtained from the ethics committee of Cancer Hospital.

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