Laparoscopic Total Mesorectal Excision
A Consecutive Series of 100 Patients

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Objective
To analyze total mesorectal excision (TME) for rectal cancer by the laparoscopic approach during a prospective nonrandomized trial.

Summary Background Data
Improved local control and survival rates in the treatment of rectal cancer have been reported after TME.

Methods
The authors conducted a prospective consecutive series of 100 laparoscopic TMEs for low and mid-rectal tumors. All patients had a sphincter-saving procedure. Case selection, surgical technique, and clinical and oncologic results were reviewed.

Results
The distal limit of rectal neoplasm was on average 6.1 (range 3–12) cm from the anal verge. The mean operative time was 250 (range 110–540) minutes. The conversion rate was 12%. Excluding the patient who stayed 104 days after a severe fistula and reoperation, the mean postoperative stay was 12.05 (range 5–53) days. The 30-day mortality was 2% and the overall postoperative morbidity was 36%, including 17 anastomotic leaks. Of 87 malignant cases, 70 (80.4%) had a minimum follow-up of 12 months, with a median follow-up of 45.7 (range 12–72) months. During this period 18.5% (13/70) died of cancer and 8.5% (6/70) are alive with metastatic disease. The port-site metastasis rate was 1.4% (1/70): a rectal cancer stage IV presented with a parietal recurrence at 17 months after surgery. The locoregional pelvic recurrence rate was 4.2% (3/70): three rectal cancers stage III at 19, 13, and 7 postoperative months.

Conclusions
Laparoscopic TME is a feasible but technically demanding procedure (12% conversion rate). This series confirms the safety of the procedure, while oncologic results are at present comparable to the open published series with the limitation of a short follow-up period. Further studies and possibly randomized series will be necessary to evaluate long-term clinical outcome in cancer patients.

Over the past 10 years, laparoscopy has become the gold standard for the surgical management of many digestive diseases, including benign colorectal pathologies. However, the oncologic safety of this approach is still controversial, so laparoscopic methods have been less widely applied to colorectal malignancy.

Excellence of surgical technique is of particular relevance in the treatment of rectal cancer. Routine excision of the intact mesorectum during resection of cancers of the middle and lower rectum has resulted in the lowest incidence of local recurrences ever reported.¹ These standards, established by Heald et al.,¹ are those against which any new technique must be evaluated. Many surgeons have therefore argued that given the current status of laparoscopic technology, the steep learning curve of colorectal laparoscopic procedures, and their uncertain oncologic efficacy, carcinoma of the rectum should be excised only by specialized colorectal surgeons using conventional techniques.²

At our institutions we started laparoscopic colorectal surgery at the beginning of 1992, considering tumors of the middle and lower rectum as a contraindication to this approach because of presumed technical difficulties in obtaining a radical dissection of the mesorectum. Having obtained a good experience with more than 100 laparoscopic colon resections with satisfactory clinical results and having successfully performed a few laparoscopic abdominoperineal resections with an excellent view during the pelvic dissection, in 1994 we decided to extend the routine use of the laparoscopic approach to tumors of the middle and lower
rectum by reproducing laparoscopically the so-called total mesorectal excision described by Heald et al.¹

**MATERIALS AND METHODS**

At the Second Surgical Department of University of Turin and the Surgical Department of Aosta Hospital, 607 nonrandomized consecutive patients underwent laparoscopic colorectal resections between June 1994 and June 2001. In this period, of 154 neoplasms located in the low and middle rectum, 100 (65%) were treated by laparoscopic total mesorectal excision (TME). The site of rectal neoplasm was defined according to the International Guidelines for Cancer Registrars³: 7 cm or less from the anal verge, low rectum; 7 to 12 cm, middle rectum. All patients treated in this period were included in a prospective study. The protocol was approved by the ethical committee of each collaborating institution, and patients gave informed consent. In the absence of specific contraindications to laparoscopy (e.g., severe cardiopulmonary disease, glaucoma), patients with tumors located in the low and middle rectum were selected for laparoscopic TME based on the following criteria: elective surgery, absence of occlusion, American Society of Anesthesiologists (ASA) status I to III. Neither morbid obesity nor prior pelvic surgery was considered a contraindication to laparoscopic TME. When the neoplasm at digital examination reached the anatomic anal canal or was fixed to the pelvic floor, the patient was excluded from the study and a laparoscopic abdominoperineal resection was performed. Therefore, all patients included in this study had a sphincter-saving procedure. Preoperative work-up consisted of clinical evaluation, total colonoscopy, computed tomographic scan, upper abdominal ultrasound, and endoscopic ultrasound. Patients preoperatively staged T3 or T4 without distant metastases were treated by preoperative radiochemotherapy (45 Gy during 4 weeks together with systemic 5-fluorouracil intravenous infusion) and were re-evaluated with clinical examination and computed tomographic scan 20 days after the completion of the treatment. Definitive inclusion in this study was decided at this point, excluding locally advanced tumor (i.e., T4 in the TNM classification⁴).

Clinical parameters analyzed included patient characteristics, operative variables, pathologic examination, and short-term and long-term outcomes. Analysis of patient characteristics included age and gender. Operative variables examined included length of operative procedure (from skin incision to the application of dressings) and conversion rate. Conversion to laparotomy was defined as unplanned incision or an incision made longer or earlier than planned. Pathologic examination included type (adenoma or adenocarcinoma) and stage of disease (TNM). Parameters recorded included number of lymph nodes harvested and longitudinal and radial margins of excision. Short-term outcomes included postoperative morbidity, 30-day mortality, and quality of life assessment by analgesic requirement. Long-term outcomes included tumor recurrence, disease-free survival, and overall survival for rectal cancer. Results were compared with literature data. Patients were followed up with physician examination, digital examination, serum carcinoembryonic antigen (CEA) assay, ultrasound of the liver, computed tomographic scan, chest radiograph, and colonoscopy. Every case of suspected local recurrence was histologically confirmed. Data were collected prospectively from the time of diagnosis using a custom-written computerized database.

**Surgical Technique**

All procedures were performed by surgeons experienced in colorectal surgery and laparoscopic advanced surgery (M.M., U.P.). The procedure was standardized before starting the protocol and was applied to all 100 patients. All patients were operated on under general anesthesia; an epidural catheter was inserted at the T8-10 level and removed 48 hours postoperatively. Intravenous antibiotics, such as second-generation cephalosporin and metronidazole, were administered before incision. The patient was placed on the operating table in a supine position; the legs were positioned in a 20° to 25° abducted position, only minimally elevated above the abdomen (a higher elevation may cause the surgeon’s hands to collide with the thigh when mobilizing the splenic flexure). Surgical devices used for the procedure were a 3CCD TV camera, a 30° angled scope, a high-flow insufflator (30 L/min) with a heating element, an adequate system of irrigation and aspiration, an ultrasound scalpel, and an operating table permitting forced placement in the Trendelenburg and anti-Trendelenburg positions. Five trocars were positioned after CO₂ pneumoperitoneum at 12 to 14 mmHg was induced using a Veress needle or the open technique. The position of the trocars is shown in Figure 1.

The first phase of the procedure consisted of a careful exploration of the peritoneal cavity, the liver, and the pelvis; the small bowel and the epiploon were placed in the right upper quadrant, out of the area of dissection. Using 5-mm bowel graspers through the left-sided port, the assistant held the sigmoid ventrally under traction and to the left. The peritoneal serosa was incised starting at the sacral promontory. A window was made between the mesocolon containing the arch of the inferior mesenteric artery (IMA) and the posterior plane covered by Toldt’s fascia, after which the left ureter and gonadal vessels were identified. Dissection then proceeded to the origin of the IMA, care being taken not to injure the sympathetic roots of the sacral portion of the aorta and the hypogastric plexus, which give rise to the superior hypogastric plexus located at the level of the sacral promontory. This phase of the procedure can be carried out using ultrasound scalpel or scissors. The IMA was divided 1 cm from the aorta after ligation with clips or LigaSure (Tyco Healthcare; Autosuture Co., U.S. Surgical Corp., Norwalk, CT).

Next was the identification, dissection, and cutting of the
inferior mesenteric vein under the duodenojejunal flexure. Following the avascular plane in front of Toldt’s fascia and posterior to the mesocolon, the splenic flexure was routinely completely mobilized to obtain a proximal colonic segment long enough for a tension-free colorectal anastomosis at the level of the pelvic floor. Before starting pelvic dissection it is important to locate, at the level of the sacral promontory, the cleavage between the parietal layer (presacral fascia) of the pelvic fascia and the visceral layer that underlines the mesorectum. This space is practically avascular. By preserving the parietal layer, one avoids the risk of injuring the superior hypogastric plexus and the left and right hypogastric nerves (sympathetic). Posterior dissection was carried out using ultrasound forceps, facilitated by pneumodissection. The peritoneum was then incised along the right side of the rectum down to the anterior reflection (retroversical in males, retrovaginal in females). The incision was completed on the left side of the pelvis where the hypogastric nerve is found as well as the ureter, which must be identified and followed along its course. Next was the anterior dissection between the rectum and Denonvilliers’ fascia in males, and between the rectum and the posterior vaginal wall in females. In males, if the tumor was located on the anterior wall of the rectum, Denonvilliers’ fascia was removed for purposes of oncologic radicality, even at the risk of damaging the urogenital nerves. Laterally, descending towards the pelvic floor, the middle rectal artery was found. This vessel was sectioned between clips or coagulated with an ultrasound scalpel, not at its origin but in its intermediate portion to preserve the pelvic plexus. Posteriorly the rectosacral ligament was incised at the level of the fourth sacral vertebra. This incision gives access to the muscular plane of the pelvic floor. Dissection proceeded posteriorly and laterally until circumferential mobilization of the bowel was accomplished (Fig. 2). To verify the location of the tumor and the distance between its inferior margin and the line of resection, simple rectal exploration may suffice. Otherwise, rectoscopy is performed. Division of the rectum was carried out with a linear endoscopic stapler inserted through the right iliac fossa trocar. During the first part of our experience we used a 30-mm linear stapler; more recently we used a 45-mm Roticulator stapler. During this step the assistant pushed from below on the perineum to elevate the pelvic floor to avoid an oblique transection of the rectum. Recently the availability of Roticulator linear staplers improved this maneuver. Proximal section of the vascular arcade was performed laparoscopically before specimen extraction to identify the level of proximal section of the colon, thus avoiding subsequent problems of tension or blood supply. The anastomosis was fashioned with a mechanical circular stapler PCEEA (Tyco Healthcare), usually

Figure 1. Trocar positions for laparoscopic total mesorectal excision; dotted lines represent possible sites of minilaparotomy. The numbers represent the size of trocars (5 or 10 mm).

Figure 2. Laparoscopic view at the end of total mesorectal excision before division of the rectum.
31 mm and occasionally 28 mm in diameter, according to the double-stapled technique, extracting the specimen and the descending colon through either a right lower quadrant or a transverse minilaparotomy in the suprapubic area. The length of the minilaparotomy depended on the size of the tumor and the mesorectum: mean incision length was 5.2 (range 4–7) cm. The descending colon was transected, the specimen removed, and the anvil of the circular stapler placed into the lumen of the proximal colon. A wound protector was always used at this time. In performing laparoscopic TME, the surgeon’s hand is never inserted into the abdomen. After re-establishing the pneumoperitoneum, the PCEEA (Tyco Healthcare) stapler was inserted transanally under laparoscopic guidance, and subsequently an end-to-end colorectal anastomosis was fashioned with a double-stapled technique (Fig. 3). When the distal clearance of the inferior margin of the tumor was at the level of the surgical anal canal, or in a narrow pelvis where a transverse stapled section was sometimes impossible, the technique of choice was to perform a rectal mucosectomy and a true coloanal anastomosis, executed manually from below, removing the specimen by the anal verge. This technique was used in 15% of cases.

A protective ileostomy was performed at the end of the procedure, depending on the surgeon’s technical evaluation of the quality of the anastomosis.

### Statistical Analysis

All analyses were performed using BMDP Statistical Software (University of California, Berkeley, Los Angeles, Oxford, ©1992 by BMDP Statistical Software, Inc.). Chi-square tests were used to compare proportions. Actuarial survival was estimated with the Kaplan-Meier method, and the evaluation of differences between the groups was performed with the log-rank test. We considered as significant $P < .05$. The survival data are expressed as a probability (percentage), with 95% confidence interval.

### RESULTS

Between June 1994 and June 2001, 154 neoplasms located in the low and middle rectum underwent surgical treatment. Fifty-four (35%) patients were excluded from the study: 29 abdominoperineal resections, 12 locally advanced tumors nonresponsive to preoperative radiochemotherapy, 9 nonelective palliative surgical procedures, and 4 specific anesthesiologic contraindications to laparoscopy (two patients with glaucoma, one with bullous emphysema, one with severe cardiac insufficiency). Laparoscopic TME for neoplasms sited in the low or middle rectum was performed in 100 patients. Indications for laparoscopic procedures were 13 adenomas (13%) and 87 adenocarcinomas (87%). The distal limit of rectal neoplasm averaged 6.1 (range 3–12) cm from the anal verge. There were 62 men and 38 women with mean age 63.5 (range 28–89) years. The ASA status of the patients were 60 ASA I, 22 ASA II, and 18 ASA III. Mean body mass index was 24.2 (range 17–38); 19 patients (19%) were obese (body mass index $>30$). Mean operative time was 250 ± 31.2 (range 110–540) minutes. Twelve (12%) were conversions to laparotomy: locally advanced tumors in nine cases, technical difficulties in two cases (one case of difficulty in transecting the distal rectum), and severe obesity (body mass index 36) in one case. A protective stoma was performed in 47 cases (47%).

Concerning short-term outcome, the mean time for complete patient mobilization was 1.9 (range 1–5) days, for passing flatus 2.9 (range 1–10) days, and for passing stools 3.3 (range 1–10) days. The mean postoperative stay was 16.6 ± 9.7 (range 5–104) days.

The 30-day mortality was 2%: one case of intestinal infarction in an elderly patient on postoperative day 4, and one myocardial infarction on postoperative day 2. The overall postoperative morbidity was 36% (36/100). Complications related to anastomotic leakage clinically diagnosed occurred in 17 patients and were treated in 9 cases with diverting stomas, in 6 cases with surgical or radiologic drainage, and in 2 cases with prolonged total parenteral nutrition. Although statistically not significant, a higher anastomotic leakage rate was observed when a diverting stoma was not performed: 25.5% (12/47) versus 9.4% (5/53). Furthermore, the leakage rate was higher in patients...
treated with preoperative chemoradiation: 21% (8/38) versus 12.5% (9/72). The leakage rate was not influenced by sex, morbid obesity, or prior pelvic surgery. Nine patients had transitory urinary and bladder dysfunction (prolonged up to 3 months in two cases). Three patients required postoperative blood transfusion. There were three cases of prolonged postoperative ileus, treated medically in two cases and surgically in one case. There were four infections of the minilaparotomy incision site. No general complications such as pulmonary or cardiac were observed if the case of fatal myocardial infarction is excluded. A total of 10 reoperations have been performed: 9 stomas to treat fistulas and one intestinal debridement in a case of prolonged postoperative ileus.

Concerning the quality of life assessment, no patient required narcotics for postoperative pain control. Parenteral nonsteroidal analgesics (ketorolac) were required in 27% of cases only up to postoperative day 2. Routinely, epidural local anesthetics (bupivacaine) were administered for 48 postoperative hours.

There was no case of tumor involvement of the distal or radial margin; in three cases (one adenoma and two adenocarcinomas), the distal margin was less than 2 cm (0.7, 1.3, and 1.6 cm respectively). Average distal clearance was 3.4 ± 1.1 (range 0.7–11) cm on the fixed specimen. Median number of lymph nodes harvested was 12.8 (range 6–93). Of 87 adenocarcinomas, the stage of rectal cancer according to the TNM classification was stage I in 20 patients, stage II in 29, stage III in 30, and stage IV in 8. The conversion rate was significantly higher in oncolgically advanced cases: stage I, 0%; stage II, 7% (2/29); stage III, 17% (5/30); and stage IV, 37.5% (3/8). No patient was lost to follow-up.

Concerning long-term oncologic results, we evaluated 70 (80.4%) patients with a minimum follow-up of 12 months and a median follow-up of 45.7 (range 12–72) months. During this period 18.5% (13/70) died of cancer and 8.5% (6/70) are alive with metastatic disease (Table 1). The port-site metastasis rate was 1.4% (1/70); a rectal cancer stage IV presented with a parietal recurrence at the site of the 5-mm trocar positioned in the left flank 17 months after surgery. The locoregional pelvic recurrence rate was 4.2% (3/70): three rectal cancers stage III at 19, 13, and 7 postoperative months. Concerning distant metastases, there were 3 (4.2%) isolated lung metastases, 10 (14.2%) isolated liver metastases, and 3 (4.2%) multiple metastases (1 lung and liver, 1 lung and brain, and 1 lung and bone). No patient presented with simultaneous local and distant metastases. The survival rate and disease-free rate were evaluated using Kaplan-Meier statistical analysis (Figs. 4 and 5). The 5-year global survival rate was 74% and the disease-free rate was 63%. The 5-year survival rate for stage I was 92%, stage II 79%, and stage III 67%; no patient with stage IV disease was alive after 34 postoperative months (P < .01, log-rank test). The disease-free rate for stage I was 92%, stage II 79%, and stage III 42%; no patient with stage IV was disease-free after 34 postoperative months (P < .0001, log-rank test).

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Mts, metastases.

Table 1. EVENTS REPORTED DURING THE FOLLOW-UP OF 87 MALIGNANT CASES
DISCUSSION

The technique of TME for the treatment of cancer of the middle and distal rectum is increasingly recognized as a new benchmark of quality. Developed and popularized by Heald, this technique represents at present the gold standard, with a reported local recurrence rate at 5 and 10 years of 4% in curative cases and a 5-year tumor-free survival rate of 78%. TME is a difficult and time-consuming procedure associated with a clinical leak rate in the range of 10% to 16% and a postoperative complication rate up to 50%, but the optimal oncologic results make TME an acceptable risk for surgery of rectal cancer.

One of the most controversial areas of laparoscopic surgery has been laparoscopic resection for cancer, more specifically for colon and rectal cancer. There is evidence, albeit from nonrandomized studies, suggesting that the margins of excision of colorectal cancer achieved laparoscopically are comparable to those resulting from conventional resection. However, the appearance of several reports of early wound recurrence after laparoscopic resection for malignancy has led to the suggestion that the pattern of disease recurrence may be altered by the laparoscopic approach. Unfortunately, a series of elegant investigations in a variety of animal models have failed to reach a consensus: for every study in which tumor growth is facilitated by laparoscopy, there are at least an equivalent number suggesting that growth is attenuated or comparable.

Recently a few clinical series presented results of long-term follow-up of colorectal cancer patients operated on laparoscopically; the majority of these series present a small number of uncontrolled patients, but some have control groups, and two are randomized.

Controlled studies concluded that oncologic outcome at a minimum of 2 years is not compromised by the laparoscopic approach and there are no significant differences in terms of wound recurrence, survival, and tumor-free survival between open and laparoscopic colorectal resections. The same conclusions were reached by the prospective randomized trials by Lacy et al. and Milsom et al.

At present, only sporadic reports have specifically addressed the laparoscopic management of rectal cancer, and the majority of these are in fact dealing with laparoscopic abdominoperineal excision. To the best of our knowledge there are at present only two published clinical series of laparoscopic TME by anterior resection, reporting on 22 and 5 completed cases.

The present prospective study was designed to assess the feasibility and safety of laparoscopic anterior resection with TME for low and middle rectal lesions, transposing by the laparoscopic approach the technique described by Heald. Our results demonstrate that laparoscopic TME is feasible in the majority of patients undergoing an elective resection of middle and low rectal lesions. During the study period, only 16 patients were preoperatively excluded because they had specific anesthesiologic contraindications to laparoscopy (4 cases) or locally advanced tumor nonresponsive to preoperative radiochemotherapy (12 cases). The conversion rate of 12% compares favorably with the results of laparoscopic colon resections and is superior to the results of laparoscopic TME presented by Hartley et al. with a conversion rate of 33%. Hartley et al. did not exclude from the laparoscopic approach tumors preoperatively staged as T4 (12 cases in our series), while advanced cancer was the main cause of conversion in our series, with a statistically significant difference in the conversion rate depending on cancer stage. Therefore we believe it wise to exclude from the laparoscopic approach T4 cancer cases that do not respond to preoperative radiochemotherapy.

When we consider all patients with tumors of the low and
middle rectum treated at our institutions during the study period, 75.8% (88/116) were successfully treated laparoscopically. Concerning mortality and morbidity, laparoscopic TME was characterized by results at least as good as those of open surgery. We report a 2% mortality and an overall morbidity of 36%, which compare favorably with a mortality ranging from 3% to 7%1–3 and a morbidity of 53%4 in open series. Whereas general morbidity is low after laparoscopic TME, the rate of anastomotic leakage in the present series was slightly higher than in open series: 17% versus 12% in the Heald et al. series1 and 16% in Carlsen et al.’s.5 The only consistent published clinical series of laparoscopic TME presents an even higher leakage rate of 19%.6–8 In our series there was a consistent but not statistically significant difference in leakage rate in patients who underwent preoperative chemoradiation (21% vs. 12.5%) and when a diverting stoma was not performed (25.5% vs. 9.4%). Therefore, in common with the majority of authors performing open TME,1,3 our policy is now to temporarily defunction all patients in whom TME has been undertaken.

The rate of general complications compares favorably with the published open series,7–11 there was only one cardiopulmonary complication in the present series (1%), an important feature in a population largely over 60 years of age. This fact is of particular relevance considering the mean length of laparoscopic TME (250 minutes), and particularly taking into account the procedures performed during the learning curve with an operative duration up to 540 minutes without any clinical consequences.

The postoperative course of laparoscopic TME was characterized by early mobilization, early restoration of bowel function, and low requirements for postoperative analgesics. These advantages of laparoscopic colorectal surgery have already been highlighted by many clinical series, both controlled and randomized.8,25,24,27 The prolonged mean hospital stay in this series is a consequence of the consistent rate of fistulas and of the characteristics of the Italian National Health Service, which does not allow early discharge.

Concerning oncologic results, Hartley et al.25 have shown that histologic assessments of laparoscopic TME resection specimens are encouraging and suggest that initial cancer clearance may be comparable to that which can be achieved using conventional methods. In the present series there were no cases of tumor involvement of the distal or radial margins. Three patients presented a distal margin less than 2 cm; nevertheless, these patients are disease-free at 21, 34, and 65 postoperative months.

The true assessment of the safety of laparoscopic TME in neoplasia must come from long-term follow-up studies of patients operated on by this technique. At present such results are not available in the literature. Nevertheless, if we consider the 70 laparoscopic TMEs in the present series with a minimum follow-up of 12 months and a median follow-up of 45.7 months, results are encouraging. There was a single case of port site metastasis (1/70 [1.4%]) in a stage IV patient, and this case occurred early in our experience; in the last 5 years no port site metastases occurred.

The overall local recurrence rate was 4.2% (3/70), well within the range of 3% to 13% reported in studies of open TME for rectal cancer.1,28–34 As local recurrences tend to occur during the first 24 postoperative months, we are confident that a longer follow-up will not significantly alter this result. All three recurrences occurred in stage III patients (2 T3N1 patients and 1 T2N1) (3/23 [13%]), while no recurrences occurred in the 40 patients with stage I and II disease. According to our protocol the two T3 patients received preoperative chemoradiation, while the other patient (T2) did not.

Concerning overall survival and disease-free survival, the mean follow-up of laparoscopic TME is too short to draw any conclusions. Nevertheless, the projected Kaplan-Meier 5-year overall survival and disease-free survival rates of laparoscopic TME are well within the range of published open TME series28–34 but fail to equal the exceptional results reported by Heald and Ryall35: disease-free survival for laparoscopic TME versus open TME stage I 92% versus 94%, stage II 79% versus 87%, and stage III 42% versus 58%.

We believe that laparoscopic TME can be improved both technically and technologically: during the study period, the advent of new technologies (i.e., ultrasonic scalpel, articulated stapler) and the increasing surgical experience resulted in a progressive optimization of the technique that we hope will be reflected in a further improvement of clinical results. Recently Pietrabissa et al.36 presented a short series of hand-assisted low anterior resection; it could be of some interest to evaluate the use of this device to shorten the learning curve of laparoscopic TME and perhaps to facilitate the anastomosis in selected cases.

We hope that large-scale randomized studies comparing laparoscopic and open resection for colon cancer currently ongoing on both sides of the Atlantic will provide evidence-based data on cancer-free survival in the near future. Unfortunately, all these studies exclude extraperitoneal rectal cancer. Specific results of laparoscopic treatment of middle and low rectal cancer are at present limited to sporadic reports. The present series provides the first consistent data showing that a surgeon experienced in colorectal and laparoscopic surgery can safely reproduce TME by the laparoscopic approach. Further studies and possibly randomized series will be necessary to evaluate quality of life benefits and long-term clinical outcome in cancer patients.

References


