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HOW I DO IT

Transanal Endoscopic Microsurgery for Rectal Neoplasms. How I Do It

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Abstract
Introduction Transanal endoscopic microsurgery (TEM) has revolutionized the technique and outcomes of transanal surgery, becoming the standard of treatment for large sessile rectal adenomas, and may represent a possible treatment modality for early rectal cancer.
Methods A full-thickness excision is made on the rectal wall down to the perirectal fatty tissue. The specimen is retrieved transanally. After the parietal defect is disinfected, the wound is closed with one or more running sutures secured with silver clips.
Results Peritoneal perforation during TEM is not associated with adverse short-term or oncologic outcomes. The postoperative morbidity rate ranges between 2 % and 15 %, and in most cases, complications can be conservatively managed. The local recurrence rate of large adenomas is about 6 %, and most recurrences can be safely re-resected by TEM. TEM represents an effective treatment for pT1 sm1 rectal malignancies, while pT1 sm2-3 and pT2 should be considered at high risk of recurrence if treated by TEM alone. Finally, TEM does not influence anorectal function or quality of life.
Conclusion TEM is a safe procedure and provides excellent functional and oncologic outcomes in the treatment of large sessile benign rectal lesions and selected early rectal cancers.

Keywords Transanal endoscopic microsurgery · Full thickness excision · Rectal adenoma · Early rectal cancer

Introduction

Rectal resection combined with total mesorectal excision[1] represents the gold standard for the surgical treatment of mid and low rectal cancers, with a 4 % local recurrence rate and a 78 % tumor-free survival rate at 10 years in patients with operable and non-metastatic rectal cancer[2].

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With increasing use of sphincter-sparing surgery, the need for an abdominoperineal resection (APR) in the treatment of rectal cancer has decreased during the last two decades. However, APR is mandatory in up to 30 % of cases,[3] and a temporary diverting stoma is performed in 50–100 % of sphincter-saving procedures[4]. In addition, radical rectal resection through an abdominal approach is burdened by significant postoperative morbidity,[5] including sexual and urinary dysfunction,[6–9] stoma-related complications, and changes in body image and depression due to the presence of a stoma[10].

The development of transanal endoscopic microsurgery (TEM)[11] during the last 30 years has led to the evolution of the treatment of rectal neoplasms. TEM has revolutionized the technique and outcomes of transanal surgery. While transanal local excision with retractors is associated with a high incidence of local recurrence particularly for tumors in the proximal rectum[12, 13], TEM affords the advantage of a less invasive transanal approach with low recurrence rates secondary to a more precise dissection due to enhanced visualization of the surgical field.

Currently, TEM represents the standard treatment modality for large rectal adenomas[14, 15] and a surgical option in selected early rectal cancers[16, 17]. Its potential role in the treatment of more invasive cancer in combination with neoadjuvant therapies is currently under evaluation[18–20].

In this report, we describe our technique of performing a TEM procedure for rectal neoplasm.

Indications

At our institution, indications for TEM include rectal lesions with a preoperative histological diagnosis of adenoma which are judged unsuitable for endoscopic removal and staged uT0 N0 by preoperative transanal endoscopic ultrasound (EUS) or adenocarcinomas preoperatively staged uT1 N0M0. More invasive or metastatic rectal cancers are treated by TEM with palliative intent only. Recently, after approval from the local Ethical Committee, we have expanded the indications for TEM to include in selected cases, and after informed consent of the patient, uT2 N0M0 adenocarcinomas treated by neoadjuvant radiotherapy with either down-staging or down-sizing of the lesion. Although inadvertent opening of the peritoneum is not to be considered an intraoperative complication, rectal lesions are considered suitable for TEM only when the proximal extent is located within 12 cm from the anal verge on the anterior aspect, 15 cm from the anal verge on the lateral walls, and 18 cm from the anal verge on the posterior wall.

Although technically challenging, circumferential full-thickness excision for benign lesions with an end-to-end anastomosis can be achieved by TEM (Table 1).

Preoperative Work-Up

The preoperative work-up includes clinical evaluation, complete colonoscopy to exclude synchronous colonic lesions, rigid proctoscopy to locate the lesion along the circumference and to measure the distance of the upper and lower limits from the anal verge, EUS to assess the level of invasion, pelvic magnetic resonance imaging to detect potential lymph node metastases, chest and abdominal computed tomography to exclude distant metastases, and serum carcinoembryonic antigen assay.

Because of the absence of a lymphadenectomy, accurate preoperative evaluation is essential to obtain satisfactory oncologic results with TEM. In particular, it is crucial to accurately evaluate the depth of tumor invasion and lymph node metastasis. Technological improvements in EUS probes have led to a progressive reduction in staging discrepancies from a rate of almost 50 % in the early 1990s to less than 15 % in the last 5 years. Due to an approximate 5 % risk of overstaging by EUS if there is a discrepancy between clinical evaluation (soft and mobile lesion) and EUS staging (uT2) for a large adenoma, we utilize TEM as the means to assess the exact diagnosis and depth of penetration.

Technique

Patient Preparation

All patients are asked to commence a low-fiber diet the week before TEM, and a rectal enema is performed 12 and 2 h preoperatively. Intravenous antibiotics, such as a second-generation cephalosporin and metronidazole, are administered before insertion of the proctoscope and continued for 24 h at 12-h intervals. Deep venous thrombosis prophylaxis is not administered.

Equipment

Prior to 2008, we routinely used the original Richard Wolf (Knittingen, Germany) TEM equipment. However, after 2008, we performed TEM with transanal endoscopic operation (TEO) instrumentation by Karl Storz GmbH (Tuttlingen, Germany), according to the standard technique described by Buess.[11] TEO instrumentation includes a 7 or 15 cm rectal tube which is 4 cm in diameter and has three working channels (12, 5, and 5 mm) for dedicated or conventional laparoscopic instruments, plus a 5 mm channel dedicated to a 30° 2D optic (Fig. 1). The proctoscope is connected to the operating table via a holding arm consisting of three joints and a single screw (Fig. 2). The system is used in combination with standard laparoscopic units. Camera imaging is projected on-screen, and insufflation is obtained by a conventional CO_2 thermo-insufflator which is connected to the proctoscope via a Luer lock connector. The shape of the tip of the proctoscope allows manipulation and suturing of the rectal wall on a 360° surface. Therefore, most patients are kept in a supine position, thereby reducing the need for time-consuming patient repositioning on the operating table.

Recently, single cases and small series of patients treated by TEM performed using equipment for single incision laparoscopic surgery (SILS) have been reported. There is a lower cost for the single disposable SILS equipment compared with each single reusable TEM proctoscope. However, no comparative studies aimed at evaluating the cost of TEM in high-volume centers over long periods of time have been published.

Table 1 Indications and outcomes of transanal endoscopic microsurgery

Indications		
Large adenomas judge unsuitable for endoscopic removal		
uT1 N0M0 rectal cancer		
Location		
Anterior rectal aspect (within 12 cm from the anal verge)		
Lateral rectal wall (within 15 cm from the anal verge)		
Posterior rectal wall (within 18 cm from the anal verge)		
Circumferential		
Perioperative outcomes	Rates	Treatment
Intraoperative peritoneal perforation	5.8 %	Suture with TEM equipment
Postoperative complications	6 %	
Bleeding	3.1 %	Blood transfusion
		Endoscopic hemostasis
Suture dehiscence	1.5 %	Antibiotics and total parenteral nutrition
Rectovaginal fistula	0.8 %	Transvaginal suture
Others	0.6 %	
Rectovesical fistula	0.2 %	Abdominal surgery
Urinary retention	0.2 %	Foley catheter
Major incontinence	0.2 %	Biofeedback
Mortality	0 %	
Long-term outcomes	Rates	Treatment
Local recurrence		
Adenomas	5.6 %	TEM/anterior resection
pT1 carcinomas		
sm1	0 %	
sm2-3	22.7 %	Anterior resection/APR
Distant metastases	0 %	

TEM transanal endoscopic microsurgery, *APR* abdominoperineal resection

Positioning of the Patient on the Operating Table

The TEM procedure is usually performed under general anesthesia. The patient is placed either prone or supine in order to keep the lesion as close to the 6-o'clock position as possible, even with lateral lesions. Different from what was originally described by Buess, we avoid placing the patient in the lateral decubitus position, as this is extremely difficult and the benefit is minimal. Patients with lateral lesions are usually placed in the supine position, unless the lesion is predominantly located in the right or left upper quadrant (i.e., 12- to 3-o'clock position or 9- to 12-o'clock position).

With circumferential lesions, the patient is always positioned prone due to the higher risk of entering the peritoneal cavity and the consequent need to reduce the descent of small bowel loops into the surgical field while repairing the opening itself.

Surgical Technique

Step 1: Dissection

After insertion of the proctoscope, the lesion is identified and the proctoscope is fixed in the correct position. However, the position is adjusted throughout the procedure in order to ensure optimal visualization and access to the margins of the lesion. High-flow carbon dioxide (CO_2) insufflation is required, and endoluminal pressure is generally maintained at

Fig. 1 Long (*left*) and short (*right*) proctoscope with three working channels

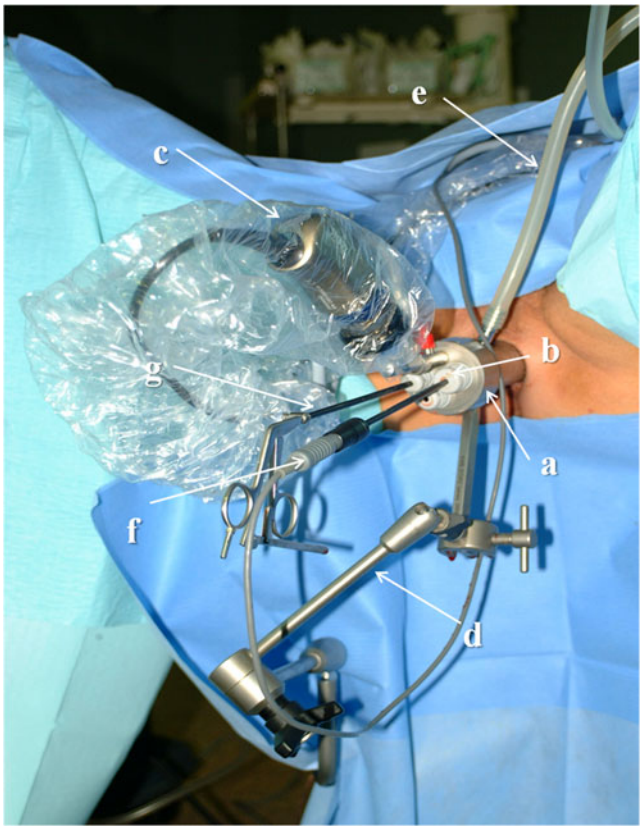

Fig. 2 TEO instrumentation in place. *a* Rectal tube; *b* working channel; *c* camera; *d* holding arm; *e* connector for CO_2 insufflation; *f* monopolar hook cautery; *g* grasper

8 mmHg, although, it might need to be increased up to 16 mmHg. Dissection is usually started at the right lower border of the tumor (Fig. 3a). A macroscopic margin of at least 5 mm from the neoplasm needs to be obtained with both benign and malignant lesions. Tumor excision is performed by monopolar hook cautery. In difficult cases, especially if a partial mesorectal excision is recommended for malignancy, ultrasonic shears (Johnson and Johnson Medical, Cincinnati, OH) or an electrothermal bipolar vessel sealing system (Valleylab, Covidien, Boulder, CO) may be helpful. Dissection is continued circumferentially around the lesion to the perirectal fat (Fig. 3b, c). Due to the uncertainty of the preoperative diagnosis and staging, full-thickness resection with adequate margins of clearance should be performed. The specimen is retrieved transanally and is pinned on a corkboard before fixation in 10 % buffered formalin in order to preserve the margins of normal mucosa surrounding the tumor. The specimen is analyzed by permanent section.

Step 2: Wall Defect Suturing

After the parietal defect is disinfected with iodopovidone solution, the rectal wall is always closed with one or more Maxon 3-0 (Codisan ® S.p.A.) running sutures secured with dedicated silver clips (Richard Wolf, Knittingen, Germany). These clips serve to anchor the suture in place, since knot-tying during TEM is challenging. As an alternative, the Endo Stitch™ single-use suturing device can also be used.

At this stage, the endoluminal pressure may be reduced to allow better compliance of the rectal wall. Suturing is performed with particular attention to the integrity of the rectal lumen. Therefore, when suturing large defects, a midline stitch to approximate proximal and distal margins is placed (Fig. 4). At the end of the procedure, patency of the rectum is carefully verified through the TEM proctoscope.

Post-operative Management

Patients are mobilized the same day as surgery. The urinary catheter placed at the time of surgery is removed 24 h after surgery (48 h if the anterior wall was involved). Postoperative analgesia is ensured by intravenous paracetamol for 24 h. Oral intake is allowed the day after flatus is reported.

Results

Perioperative Outcomes

Peritoneal perforation (PP) is a serious and challenging intraoperative event that may occur during TEM. It is

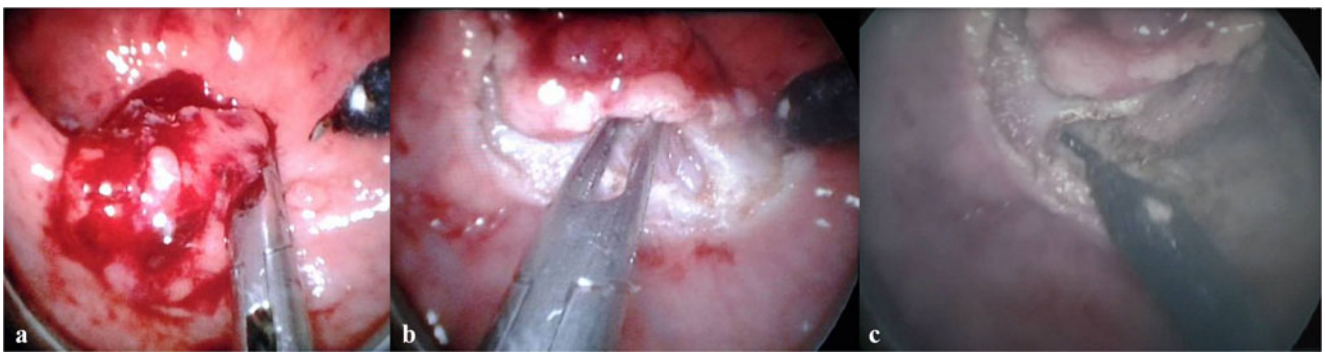

Fig. 3 Dissection of the rectal neoplasm

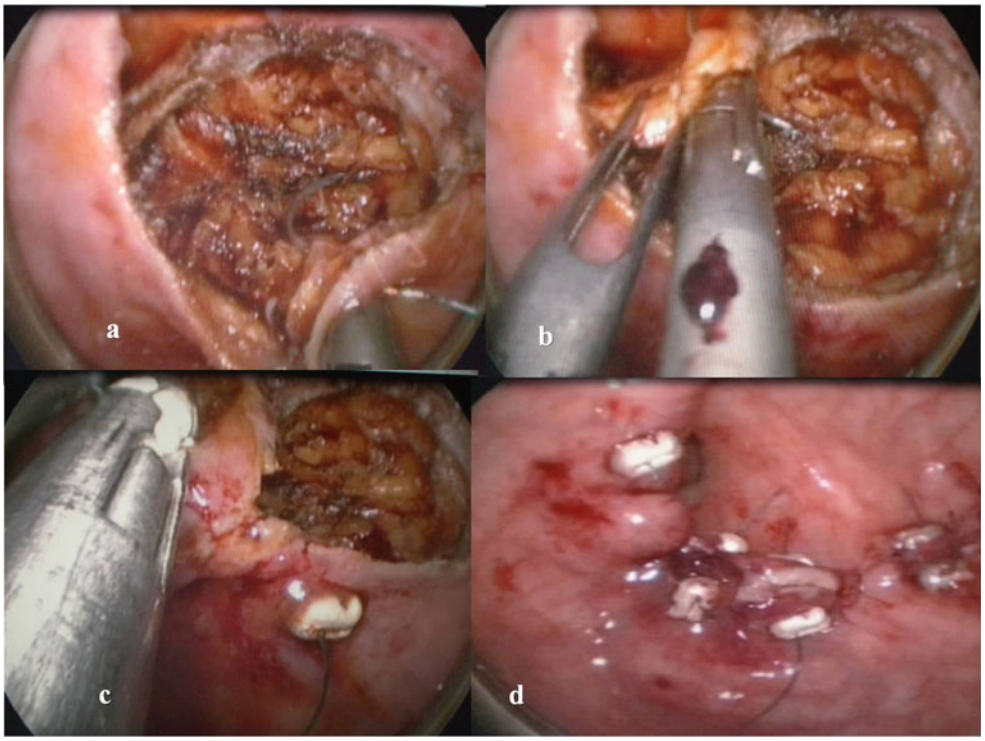

Fig. 4 Suture of the rectal wall defect

frequently reported as a complication, and therefore tumors of the upper rectum, especially those located on the anterior or lateral wall, are considered a contraindication to TEM. The learning curve and the case volume of the surgical center are two main factors that influence the treatment strategy adopted when PP occurs. Conversion to laparotomy is reported in 50–100 % of cases of PP in series with less than 100 patients, whereas it ranges between 0 % and 40 % in larger series.

We recently reported an overall PP rate of 5.8 % in 481 consecutive patients, with a trend toward a higher rate of PP over the last 4 years compared with the preceding period (8.5 % versus 4.3 %), reflecting the extension of indications to larger and more proximal lesions.[21] The extension of indications for TEM is derived not only from increased surgical experience and dexterity, but also from the use of the TEO instrument (Karl Storz GmbH) which, secondary to the particular shape of the tip of the proctoscope, allows manipulation and suturing of the rectal wall on a 360° surface. In addition, due to the discrepancy between preoperative and postoperative histology and staging, our policy is to perform a full-thickness excision, even with anterior wall lesions, in order to obtain a complete specimen and enable a correct pT staging.

No cases of pelvic sepsis or infectious complications after PP have been observed.

PP does not seem to influence oncologic outcomes. With a median follow-up of over 4 years, all patients in whom a PP occurred during TEM for adenoma or pT1 rectal cancer are disease-free, with no sign of peritoneal seeding of adenomatous or cancerous tissue.

In line with previous studies that reported postoperative complication rates between 2 % and 15 %,[16] we observed an early postoperative complication rate of 7.7 % in our initial series of 300 patients[22] which decreased to 4 % in the following 200 patients, despite an expansion of the indications for TEM to include more complicated cases. No deaths occurred. In most cases, common local complications, such as bleeding and suture dehiscence, can be managed conservatively. Four patients developed rectovaginal fistulas; while all were successfully treated by transvaginal surgical suture, this highlights that special care should be taken when performing an anterior full-thickness resection in female patients (Table 1).

Oncologic Outcomes

Large Adenomas

Among surgical techniques, TEM represents a valid surgical alternative to conventional transanal surgery in the treatment of large rectal adenomas. TEM has the advantage of combining a less invasive transanal approach which has benefits in terms of postoperative functional outcomes and quality of life and low recurrence rates for adenomas and selected early rectal cancers due to enhanced visualization of the surgical field allowing precise dissection.

In our series of 293 rectal adenomas[23] over a median follow-up period of 110 (range, 12–216)months, the recurrence rate was 5.6 %, with more than 75 % of recurrences detected within 12 months after TEM (Table 1). Since over 75 % of recurrences occurred within the first 12 months, we suggest an intensive follow-up protocol including proctoscopy every 3 months for the first year, then every 6 months if there were positive margins at final pathology or the adenoma was ≥5 cm.

Adenocarcinomas

For over 20 years, TEM has been proposed for treatment of early rectal cancer. The depth of submucosal invasion for pT1 cancers is an important prognostic factor. Therefore, a precise evaluation of the depth of tumor invasion and lymph node metastases is crucial for the appropriate patient selection.

Our series of 48 pT1 patients demonstrated a significant difference in recurrence rates between pT1 sm1 (0 %) and sm2-3 (22.7 %)[24] (Table 1).

The role of TEM in the treatment of more invasive rectal cancer is controversial. One of the main disadvantages of transanal excision concerns the lymphadenectomy. The incidence of lymph node metastasis is very low for T1 sm1, but, for T1 sm2-3 and for T2, it increases up to 25 %. In these cases, especially T2 tumors, TEM alone does not represent an adequate therapy, being burdened by a significantly higher recurrence rate compared with abdominal surgery. Therefore, transanal excisions should be limited to those lesions previously staged as uT2 that demonstrate significant down-staging or down-sizing.

Functional Results

As TEM requires the transanal insertion of a 40-mm diameter rigid proctoscope with continuous endorectal CO_2 insufflation and full-thickness excision of a portion of the rectal wall, both gas and fecal continence may be compromised. In a series of 100 patients prospectively evaluated by standardized questionnaires and manometry[25], postoperative manometric values at 3 months were lower than at baseline but had returned to preoperative values at 12 months. Tumor size≥4 cm was the only factor that significantly (P=0.008) affected the rectal sensitivity threshold, the urge to defecate threshold, and the maximum tolerated volume at 3 months after TEM. A significant improvement was noted in various clinical and quality of life scores at 12 and 60 months.

Transient worsening of fecal continence and a higher rate of urgency are the reasons for a temporary reduction of quality of life; however, these completely resolve by 1 year. On the other hand, urological and sexual dysfunction that frequently occurs after abdominal surgery for rectal cancer is rare after TEM.

Conclusions

During the last three decades, TEM has been increasingly used in the treatment of rectal neoplasms. Designed as a means to excise benign rectal neoplasms with very low morbidity, the indications for TEM have since expanded to include malignant neoplasms that are histologically confirmed as pT1 sm1 carcinomas. At present, patients with T1 sm2-3 and T2 lesions should be treated with TEM only if they are enrolled in a clinical trial and in combination with neoadjuvant therapy. In line with these observations, accurate preoperative staging is essential for appropriate patient selection. Furthermore, TEM does not have long-term effects on anorectal function or quality of life. We feel that patients with a clear indication for TEM should be referred to specialized medical centers at which surgeons, endoscopists, gastroenterologists, and pathologists are experienced with the technique.

References

1. MacFarlane JK, Ryall RDH, Heald RJ. Mesorectal excision for rectal cancer. Lancet 1993; 341: 457–460.
2. Heald RJ, Moran BJ, Ryall RDH, Sexton R, MacFarlane JK. The Basingstoke experience of total mesorectal excision, 1978–1997. Arch Surg 1998; 133: 894–899.
3. Morris E, Quirke P, Thomas JD, Fairley L, Cottier B, Forman D. Unacceptable variation in abdominoperineal excision rates for rectal cancer: time to intervene? Gut 2008; 57: 1690–1697.
4. Huser N, Michalski CW, Erkan M, Schuster T, Rosenberg R, Kleeff J, Friess H. Systematic review and meta-analysis of the role of defunctioning stoma in low rectal cancer surgery. Ann Surg 2008;248: 52–60.
5. Hoerske C, Weber K, Goehl J, Hohenberger W, Merkel S. Long-term outcomes and quality of life after rectal carcinoma surgery. Br J Surg 2010; 97: 1295–1303
6. Morino M, Parini U, Allaix ME, Monasterolo G, Brachet Contul R, Garrone C. Male sexual and urinary function after laparoscopic total mesorectal excision. Surg Endosc 2009; 23: 1233–240.
7. Marijnen CAM, Kapiteijn E, van de Velde CJ, Martijn H, Steup WH, Wiggers T, Kranenbarg EK, Leer JW; Cooperative Investigators of the Dutch Colorectal Cancer Group. Acute side effects and complications after short-term preoperative radiotherapy combined with total mesorectal excision in primary rectal cancer: report of a multicenter randomized trial. J Clin Oncol 2002; 20: 817–825
8. Wallner C, Lange MM, Bonsing BA, Maas CP,Wallace CN, Dabhoiwala NF, Rutten HJ, Lamers WH, Deruiter MC, van de Velde CJ; Cooperative Clinical Investigators of the Dutch Total Mesorectal Excision Trial. Causes of fecal and urinary incontinence after total mesorectal excision for rectal cancer based on cadaveric surgery: a study from the Cooperative

Clinical Investigators of the Dutch Total Mesorectal Excision Trial. J Clin Oncol 2008; 26: 4466–4472
9. Hendren SK, O'Connor BI, Liu M, Asano T, Cohen Z, Swallow CJ, Macrae HM, Gryfe R, McLeod RS. Prevalence of male and female sexual dysfunction is high following surgery for rectal cancer. Ann Surg 2005; 242: 212–223.
10. Ho P, Law WL, Chan SC, Lam CK, Chu KW. Functional outcome following low anterior resection with total mesorectal excision in the elderly. Int J Colorectal Dis 2003; 18: 230–233.
11. Buess G, Hutterer F, Theiss J, Böbel M, Isselhard W, Pichlmaier H. A system for a transanal endoscopic rectum operation. Chirurg 1984; 55:677–680.
12. Sakamoto GD, MacKeigan JM, Senagore AJ. Transanal excision of large, rectal villous adenomas. Dis Colon Rectum 1991;34:880–885.
13. Mellgren A, Sirivongs P, Rothenberger DA, Madoff RD, García-Aguilar J. Is local excision adequate therapy for early rectal cancer? Dis Colon Rectum 2000;43:1064–1074.
14. de Graaf EJ, Burger JW, van Ijsseldijk AL, Tetteroo GW, Dawson I, Hop WC. Transanal endoscopic microsurgery is superior to transanal excision of rectal adenomas. Colorectal Dis 2011;13:762-767.
15. Casadesus D. Surgical resection of rectal adenoma: a rapid review. World J Gastroenterol 2009;15:3851-3844.
16. Suppiah A, Maslekar S, Alabi A, Hartley JE, Monson JR. Transanal endoscopic microsurgery in early rectal cancer: time for a trial? Colorectal Dis 2008;10:314-327
17. Wu Y, Wu YY, Li S, Zhu BS, Zhao K, Yang XD, Xing CG. TEM and conventional rectal surgery for T1 rectal cancer: a meta-analysis. Hepatogastroenterology 2011;58:364-368.
18. Lezoche E, Guerrieri M, Paganini AM, Baldarelli M, De Sanctis A, Lezoche G. Long-term results in patients with T2-3N0 distal rectal cancer undergoing radiotherapy before transanal endoscopic microsurgery. Br J Surg 2005;92:1546-1552.
19. Duek SD, Issa N, Hershko DD, Krausz MM. Outcome of transanal endoscopic microsurgery and adjuvant radiotherapy in patients with T2 rectal cancer. Dis Colon Rectum 2008;51:379-384.
20. Borschitz T, Wachtlin D, Möhler M, Schmidberger H, Junginger T. Neoadjuvant chemoradiation and local excision for T2-3 rectal cancer. Ann Surg Oncol2008;15:712-720.
21. Morino M, Allaix ME, Famiglietti F, Caldart M, Arezzo A. Does peritoneal perforation affect short- and long-term outcomes after transanal endoscopic microsurgery? Surg Endosc. 2012 Jun 21. [Epub ahead of print]
22. Allaix ME, Arezzo A, Caldart M, Festa F, Morino M. Transanal endoscopic microsurgery for rectal neoplasms: experience of 300 consecutive cases. Dis Colon Rectum 2009;52:1831-1836.
23. Allaix ME, Arezzo A, Cassoni P, Famiglietti F, Morino M. Recurrence after transanal endoscopic microsurgery for large rectal adenomas. Surg Endosc 2012;26:2594-2600.
24. Morino M, Allaix ME, Caldart M, Scozzari G, Arezzo A. Risk factors for recurrence after transanal endoscopic microsurgery for rectal malignant neoplasm. Surg Endosc 2011;25:3683-3690.
25. Allaix ME, Rebecchi F, Giaccone C, Mistrangelo M, Morino M. Long-term functional results and quality of life after transanal endoscopic microsurgery. Br J Surg 2011;98:1635-1643.