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DYNAMIC MANUSCRIPT

Transanal endoscopic surgery using a single access port: a practical tool in the surgeon's toybox

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Abstract
Background Large polyps and early carcinomas of the rectum may be excised with transanal endoscopic surgery (TES). Single-port techniques are emerging in the field of colorectal surgery and have been adapted to many colorectal procedures so far. In this article, we aimed to present our initial experience with TES using a single access port with its technical details.
Patients and methods Patients undergoing TES using a single access port between July 2010 and January 2013 were included in the study. Patient demographics, operative technique, and both operative and postoperative outcomes were evaluated and presented.
Results A total of 12 patients (ten males) were included in our study. The median age was 63.5 years (50–84), median American Society of Anesthesiologists (ASA) score was 3 (2–4), and median body mass index was 28.8 kg/m^2 (17.4–55.6). Median operating time was 79 min (43–261). Histopathological diagnoses were as follows: tubulovillous adenoma ($n = 6$), tubular adenoma ($n = 4$), adenocarcinoma ($n = 1$), and neuroendocrine tumor ($n = 1$). Five patients were sent home on the day of surgery and the median postoperative hospital stay was 1 day (0–38). Median estimated blood loss was 22.5 ml (5–150). A transient urinary retention was developed in one patient postoperatively, and two patients had postoperative bleeding. The first of these patients with a long history of anticoagulant usage had rectal bleeding 13 days after surgery, which was successfully managed with medical treatment. The second patient was morbidly obese, had multiple comorbidities, and had rectal bleeding on postoperative day 7 which was managed with local epinephrine injection. He suffered unrelated cardiac death on postoperative day 38.
Conclusions TES is safe and feasible when using a single port and in the standard laparoscopic setting. The single-port technique may play a major role in the widespread utilization of TES as a treatment for large adenomas and early rectal cancers.

Keywords Transanal endoscopic surgery · Single-port access · Rectal surgery

Transanal endoscopic surgery (TES) is a treatment option for polyps not amenable to endoscopic excision, and selected carcinomas of the rectum. Transanal endoscopic microsurgery (TEM) is the earliest and most common type of TES [1]. Benefits of TES include decreased postoperative pain, and shorter hospital stay and recovery time when compared with conventional transabdominal surgery. When conducted by experienced surgeons, a local excision resulting in tumor-free margins results in a satisfactory quality of life associated with minimal loss of anorectal function [2]. Buess et al. [3] were the first to design a

A full video describing the surgical technique and a poster including our preliminary results were presented at the Annual Meeting of the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES), Baltimore, MD, USA, 17–20 April 2013.

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special system for TEM, and went on to popularize this technique. The use of endoanal ultrasonography further improved preoperative assessment and treatment selection of rectal tumors for transanal endoscopic excision [4]. Close follow-up and advanced medical treatment strategies, including neoadjuvant chemotherapy and adjuvant radiotherapy, have provided satisfactory long-term oncologic outcomes after TEM surgery for early rectal cancer [5, 6].

The basic principles of both TEM and TES using a single access port are very similar. The special rectoscope of the TEM apparatus maintains CO_2 insufflation in the surgical field while also stabilizing instruments in a fixed panel [7]. In both procedures, all surgical instruments are inserted into a single hole and the surgeon performs the operation with the help of a videoendoscopic system. The colorectal surgeons performing TEM at our institution are also familiar with the single-port system, an emerging technique in colorectal surgery. In this article, we aimed to present our initial experience with TES using a single access port with its technical details.

Patients and methods

After obtaining approval from the Institutional Review Board, all patients who underwent TES using a single access port at the Department of Colorectal Surgery in the Cleveland Clinic Digestive Disease Institute were included in this study. Demographics, American Society of Anesthesiologists (ASA) score, body mass index (BMI), operative technique, operative time, postoperative complications, length of hospitalization, and histopathological findings were evaluated. All patients underwent full colonoscopy and endoscopic lesion biopsy to determine surgical strategy. Endorectal ultrasonography was used to evaluate rectal wall involvement of the lesions. Preoperative abdominopelvic computed tomography (CT) was also performed as part of the routine work-up to rule out distant metastasis in patients with cancer. Full bowel preparation was used preoperatively in case of a breach in the peritoneal layer in the course of the excision. Intravenous antibiotics and venous thromboembolic prophylaxis were given preoperatively.

Operative technique

The video that was used for the article was recorded from the operation of patient number 9 (table). This patient was brought to the operating room and, following anesthesia induction and endotracheal intubation, a Foley catheter was inserted. Patient positioning was determined according to the location of the rectal tumor, so that it could be endoscopically

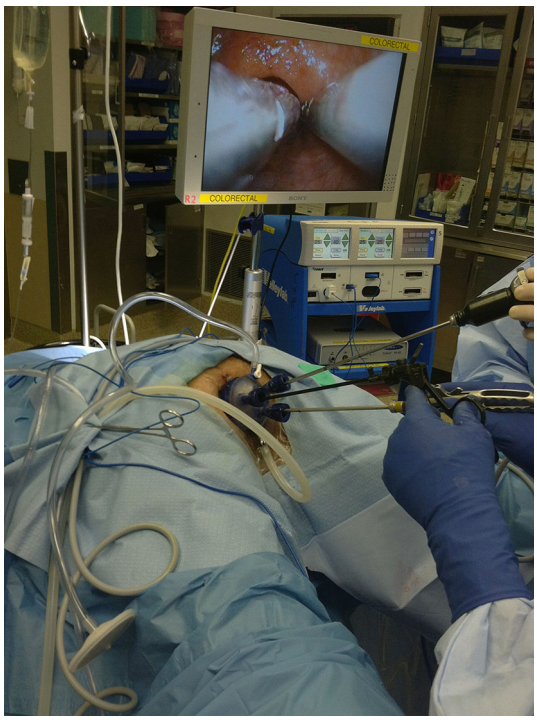

Fig. 1 Patient positioning during surgery

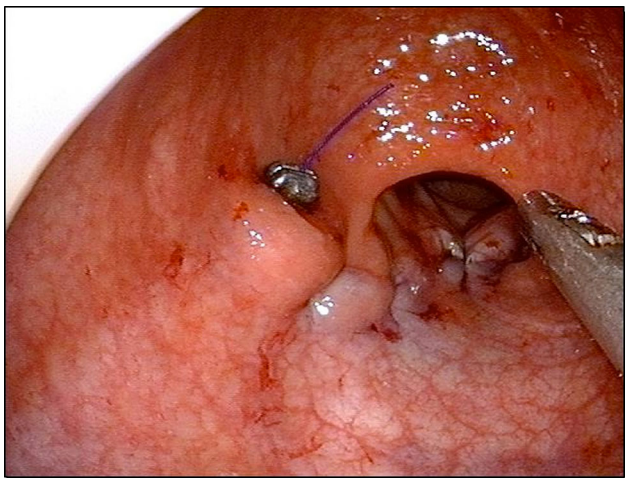

Fig. 2 Closure of the surgical field after excision

visualized in the 6 o'clock position for optimal excision (Fig. 1). The surgeon was located between the legs, and the camera assistant situated to the right of the surgeon. A single-port device (GelPOINT Path, Applied Medical, Rancho Santa Margarita, CA) was lubricated and inserted though the anus. Rectal CO_2 insufflation was established and a smoke evacuator was applied to the other side of the device. A 5 mm flexible-tip laparoscope (EndoEYE, Olympus, Orangeburg, NY) was used for visualization. The area to be excised was marked circumferentially with a hook cautery (video 1; see electronic supplementary material [ESM]). A 5 mm endoscopic grasper and a 5 mm vessel-sealing device or an

Table 1 Patient and tumor characteristics

Patient	Age (years)	ASA score	Gender	Tumor diameter (cm)	Distance from AV (cm)	Comorbid factors
1	58	2	Male	3.5	6	None
2	84	4	Female	4	8	DM, CAD, HTN
3	66	3	Female	2	8	HL
4	53	3	Male	2.5	10	HTN, CMP
5	62	3	Male	1	9	HTN, HL, Hx of GI bleed
6	69	3	Male	3	10	AAA, HTN, HL
7	76	3	Male	4	6	DM, morbid obesity, CAD, MI
8	70	4	Male	4	9	HTN, Hx of esophageal Ca,
9	50	3	Male	0.5	12	Asthma
10	51	2	Male	5.4	5	Sleep disorder
11	65	2	Male	2	10	DM, HTN
12	74	3	Male	3.1	8	HTN, hypothyroidism, spinal stenosis, arrhythmia, sleep disorder

AAA abdominal aortic aneurism, *ASA* American Society of Anesthesiologists, *AV* anal verge, *Ca* cancer, *CAD* coronary artery disease, *CMP* cardiomyopathy, *DM* diabetes mellitus, *GI* gastrointestinal, *HL* hyperlipidemia, *HTN* hypertension, *Hx* history, *MI* myocardial infarction

electrocautery could be used to facilitate a full-thickness excision (video 2; see ESM). No articulating hand instruments were used during surgery. After complete removal of this lesion, the area was irrigated and checked for hemostasis. The excised lesion was oriented and pinned on a cork board to guide the pathologist. Rectal wall defect was closed with 2–0 polydioxanone (PDS) sutures continuously with the help of a 5 mm laparoscopic needle holder. The loose ends of the PDS were anchored using the silver bullets (video 3; see ESM). This step was followed by irrigation of the surgical field and there was no sign of incomplete closure (Fig. 2). The operation field was checked with rigid proctoscopy to ensure that the lumen was still patent and to check hemostasis once the CO_2 had been removed.

Results

Between July 2010 and January 2013, 12 patients (ten males) underwent TES using a single access port. Median age of the patients was 63.5 years (50–84), median ASA score was 3 (2–4) and median BMI was 28.8 kg/m^2 (17.4–55.6). Patient characteristics and tumor details are summarized in Table 1. Median operating time was 79 min (43–261). Ten out of 12 patients underwent a TES using a single access port directly since the lesions were not appropriate for endoscopic removal. However, colonoscopic removal was attempted in two patients. Histopathological diagnoses were as follows: tubulovillous adenoma ($n = 6$), tubular adenoma ($n = 4$), adenocarcinoma ($n = 1$) and neuroendocrine tumor ($n = 1$). Five patients were sent home on the same day as surgery and the median postoperative hospital stay was 1 day (0–38). Median estimated blood loss was 22.5 ml (2–150). One patient developed transient postoperative urinary retention which required a Foley catheter on postoperative day 1, and two patients had postoperative bleeding. The first of these patients with a long history of anticoagulant usage for coronary artery disease had rectal bleeding 13 days after surgery. The bleeding was successfully managed with medical treatment. The second patient was morbidly obese, had multiple comorbidities, and had rectal bleeding on postoperative day 7 managed with local epinephrine injection. He suffered unrelated sudden cardiac death on postoperative day 38.

Discussion

Currently, TEM is the most popular technique used for TES. Rectal tumors excised by TEM result in fewer surgery-related morbidities, better postoperative anorectal function, and a shortened postoperative recovery when compared with open or laparoscopic rectal resections [1, 2]. Frail elderly patients, patients who are otherwise not suitable candidates for a major rectal resection, and patients who categorically refuse radical rectal excision associated with permanent stoma creation for early-stage rectal cancer are candidates for TES [8]. Additionally, TES may also be used to excise sessile and large adenomas of the rectum in patients with any health condition. Using single-port access systems and laparoscopic instruments, transanal endoscopic resections have recently become more accessible to surgeons. Transanal endoscopic removal of a rectal adenoma using a single access port was first reported in 2010 by Atallah et al. [9]. This was

followed by various reports of TES with increasing case numbers using similar platforms with acceptable outcomes [8, 10–15]. Furthermore, Lim et al. [16] showed that transanal endoscopic resection with a single access port is safe and feasible for patients with early rectal cancers, neuroendocrine tumors, and advanced rectal adenocarcinomas that responded to neoadjuvant treatment. In our series, we only had one patient with pT2 rectal adenocarcinoma; the majority of patients had multiple comorbid factors. We were able to perform full-thickness excision with clear margins of the large rectal lesions with TES using a single access port. Indications of TES using a single access port are not only limited to local excisions. It has been recently shown that fistula repairs and even proctectomy can be performed with TES using a single access port [17].

All operations in our series were performed using a single port access system and laparoscopic instruments under general anesthesia. However, it has been shown that general anesthesia is not necessary for TES [11]. Although the TEM technique has played an important role in the development of TES, it also poses technical and practical limitations. There are a number of disadvantages associated with the use of TEM apparatus, which include ergonomic difficulties caused by parallel instrument movements with very poor triangulation, which is easier to achieve with a single port for resecting lateral wall-located rectal lesions [13]. Secondly, the anal sphincter divulsion before insertion of the TEM rectoscope could cause transient or permanent fecal incontinence and negates the advantages of outpatient surgery [11]. Thirdly, the TEM system requires specific equipment and special training, which are not available in every center and are important factors that limit its widespread utilization [8]. However, previous studies have shown that TEM is cost effective when compared with conventional resection for the treatment of rectal adenomas and early rectal cancers [18]. TES using a single access port with standard laparoscopic instruments can make this approach much more accessible to many surgeons. This is especially important for many laparoscopic surgeons who have experience with conventional transanal surgery. While TEM is not part of the standard general surgery residency training, many surgeons are familiar with laparoscopic techniques. Therefore, TES using a single access port and regular laparoscopic insufflators and instruments can conveniently be utilized by general surgeons who have laparoscopic experience and an interest in transanal surgery.

Additionally, it has the potential to make the cost of TES even cheaper since it is performed with a conventional laparoscopic video system, which is widely available in most institutions. Recently, single ports specifically designed for TES have become available. The softer structure and smaller diameter of single-port devices may also cause less anatomical and functional anal canal damage when compared with the TEM rectoscope [12, 13]. It is notable that four patients in our series were discharged on the day of surgery and two were discharged on postoperative day 1. A postoperative hospital stay of less than 24 h has been described as '1-day surgery' [19], and TES using a single port has the potential to become one of the '1-day surgery setting' procedures. Currently, the largest series reporting the outcomes of TES using a single access port belongs to Albert et al. [20]. They published their early experience of 50 patients with no conversion due to a technical failure and satisfying results. Prospective studies are needed in order to verify these prospective benefits of TES using a single access port when compared with TEM.

During the procedure, we used a 5 mm vessel-sealing device and the same non-articulating hand instruments that are used in conventional laparoscopic procedures. A 5 mm flexible-tip laparoscope enables good visualization during surgery. Furthermore, 10 mm straight laparoscopes, articulating instruments [14] and a bipolar cautery may be utilized in TES using a single access port. However, the single-port setting does not provide stereoscopic visualization, an important characteristic of the TEM apparatus [9]. The type of operative instruments used may vary according to availability at a given institution, or surgeon preference.

In this study, we showed that TES using a single access port can be safely performed with non-articulating hand instruments. This application of single-port techniques may play a major role in the widespread utilization of TES as a treatment for large adenomas and early rectal cancers.

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References

1. Middleton PF, Sutherland LM, Maddern GJ (2005) Transanal endoscopic microsurgery: a systematic review. Dis Colon Rectum 48:270–284
2. Doornebosch PG, Gosselink MP, Neijenhuis PA, Schouten WR, Tollenaar RA, de Graaf EJ (2008) Impact of transanal endoscopic microsurgery on functional outcome and quality of life. Int J Colorectal Dis 23:709–713
3. Buess G, Hutterer F, Theiss J, Böbel M, Isselhard W, Pichlmaier H (1984) A system for a transanal endoscopic rectum operation [in German]. Chirurg 55:677–680
4. Akasu T, Kondo H, Moriya Y, Sugihara K, Gotoda T, Fujita S, Muto T, Kakizoe T (2000) Endorectal ultrasonography and treatment of early stage rectal cancer. World J Surg 24:1061–1068
5. Ramirez JM, Aguilella V, Valencia J, Ortego J, Gracia JA, Escudero P, Esco R, Martinez M (2011) Transanal endoscopic

microsurgery for rectal cancer: long-term oncologic results. Int J Colorectal Dis 26:437–443
6. Lezoche E, Guerrieri M, Paganini AM, Feliciotti F (2002) Long-term results of patients with pT2 rectal cancer treated with radiotherapy and transanal endoscopic microsurgical excision. World J Surg 26:1170–1174
7. Buess G, Becerra-Garcia F, Misra MC (2008) Instruments for transluminal laparoscopic surgery or "NOTES". Minim Invasive Ther Allied Technol 17:331–335
8. van den Boezem PB, Kruyt PM, Stommel MW, Tobon Morales R, Cuesta MA, Sietses C (2011) Transanal single-port surgery for the resection of large polyps. Dig Surg 28:412–416
9. Atallah S, Albert M, Larach S (2010) Transanal minimally invasive surgery: a giant leap forward. Surg Endosc 24:2200–2205
10. Khoo RE (2010) Transanal excision of a rectal adenoma using single-access laparoscopic port. Dis Colon Rectum 53:1078–1079
11. Michalik M, Bobowicz M, Orlowski M (2011) Transanal endoscopic microsurgery via TriPort Access System with no general anesthesia and without sphincter damage. Surg Laparosc Endosc Percutan Tech 21:308–310
12. Matz J, Matz A (2012) Use of a SILS port in transanal endoscopic microsurgery in the setting of a community hospital. J Laparoendosc Adv Surg Tech A 22:93–96
13. Lorenz C, Nimmesgern T, Back M, Langwieler TE (2010) Transanal single port microsurgery (TSPM) as a modified technique of transanal endoscopic microsurgery (TEM). Surg Innov 17:160–163
14. Canda AE, Terzi C, Sagol O, Sarioglu S, Obuz F, Fuzun M (2012) Transanal single-port access microsurgery (TSPAM). Surg Laparosc Endosc Percutan Tech 22:349–353
15. Ragupathi M, Vande Maele D, Nieto J, Pickron TB, Haas EM (2012) Transanal endoscopic video-assisted (TEVA) excision. Surg Endosc 26:3528–3535
16. Lim SB, Seo SI, Lee JL, Kwak JY, Jang TY, Kim CW, Yoon YS, Yu CS, Kim JC (2012) Feasibility of transanal minimally invasive surgery for mid-rectal lesions. Surg Endosc 26:3127–3132
17. Atallah S, Albert M, Debeche-Adams T, Larach S (2013) Transanal minimally invasive surgery (TAMIS): applications beyond local excision. Tech Coloproctol 17:239–243
18. Maslekar S, Pillinger SH, Sharma A, Taylor A, Monson JR (2007) Cost analysis of transanal endoscopic microsurgery for rectal tumors. Colorectal Dis 9:229–234
19. Dionigi G, Rovera F, Boni L, Dionigi R (2008) Video-assisted hyroidectomy performed in a one-day surgery setting. Int J Surg 6(Suppl 1):S4–S6
20. Albert MR, Atallah SB, deBeche-Adams TC, Izfar S, Larach SW (2013) Transanal minimally invasive surgery (TAMIS) for local excision of benign neoplasms and early-stage rectal cancer: efficacy and outcomes in the first 50 patients. Dis Colon Rectum 56:301–307