ORIGINAL CONTRIBUTION

Transanal Endoscopic Microsurgery Resection of Rectal Tumors: Outcomes and Recommendations

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PURPOSE: Transanal endoscopic microsurgery provides a minimally invasive alternative to radical surgery for excision of benign and malignant rectal tumors. The purpose of this study was to review our experience with transanal endoscopic microsurgery to clarify its role in the treatment of different types of rectal pathology.

METHODS: A prospective database documented all patients undergoing transanal endoscopic microsurgery from October 1996 through June 2008. We analyzed patient and operative factors, complications, and tumor recurrence. For recurrence analysis, we excluded patients with fewer than 6 months of follow-up, previous excisions, known metastases at initial presentation, and those who underwent immediate radical resection following transanal endoscopic microsurgery.

RESULTS: Two hundred sixty-nine patients underwent transanal endoscopic microsurgery for benign (n = 158) and malignant (n = 111) tumors. Procedure-related complications (21%) included urinary retention (10.8%), fecal incontinence (4.1%), fever (3.8%), suture line dehiscence (1.5%), and bleeding (1.5%). Local recurrence rates for 121 benign and 83 malignant tumors were 5% for adenomas, 9.8% for T1 adenocarcinoma, 23.5% for T2 adenocarcinoma, 100% for T3 adenocarcinoma, and 0% for carcinoid tumors. All 6 (100%) recurrent adenomas were retreated with endoscopic techniques, and 8 of 17 (47%) recurrent adenocarcinomas underwent salvage procedures with curative intent.

CONCLUSIONS: Transanal endoscopic microsurgery is a safe and effective method for excision of benign and malignant rectal tumors. Transanal endoscopic microsurgery can be offered for (1) curative resection of benign tumors, carcinoid tumors, and select T1 adenocarcinomas, (2) histopathologic staging in indeterminate cases, and (3) palliative resection in patients medically unfit or unwilling to undergo radical resection.

KEY WORDS: Rectal tumor; Transanal endoscopic microsurgery; Local excision.

Local excision of benign rectal tumors offers several advantages, but the technique is used selectively for malignant tumors owing to less optimal oncologic outcomes.[1,2] The introduction of transanal endoscopic microsurgery (TEM) has sparked renewed interest in the local treatment of benign and malignant rectal tumors. Originally designed by Buess et al. in the 1980s,[3] TEM uses a 40-mm operating proctoscope, through which full-thickness excisions as high as 20 cm from the anal verge can be performed. TEM is currently used in more than 400 centers worldwide.[4] As experience with TEM is expanding, it is apparent that TEM is a safe procedure with less morbidity than radical surgery[5–7] and possibly better outcomes than traditional transanal excision (TAE).[4,8–10] TEM affords several advantages over TAE, including better visualization, higher likelihood of achieving clear resection margins,[10,11] lower recurrence rates,[9] and the ability to successfully excise more proximal tumors. Despite its introduction more than 20 years ago, TEM has been slow to gain widespread favor because of its high starting cost and limited caseload in nonspecialized centers.

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TABLE 1. Patients analyzed in recurrence analysis

	Benign tumors (n = 158)	*Malignant tumors (n = 111)*
Less than 6 months' follow-up	33	14
Previous resection	4	4
Known metastases at initial presentation		2
Underwent radical resection after TEM		8
Patients analyzed for recurrence	121	83

There is growing literature on comparison of TEM with radical excision and TAE. The majority of reports are focused on rectal adenocarcinoma. We have recently reported results from our institution,[10] comparing TEM with TAE for T1 and T2 adenocarcinoma, and we found that TEM provides a better quality resection with a higher incidence of clear margins.

Although TEM has an important role in resection of early rectal adenocarcinoma, we have found that it is equally important for the resection of benign tumors and other malignant pathology. The purpose of this study was to review a single institution's experience with TEM resections of both benign and malignant tumors. We hoped to confirm that TEM is a safe and efficacious method of excising both benign and malignant tumors and to clarify the role of TEM in the treatment of different types of rectal pathology.

METHODS

All patients undergoing TEM at the University of Minnesota-affiliated hospitals are documented in a prospective database. The current study is a retrospective review of all patients (n = 269) undergoing TEM from October 1996 through June 2008. We have recently reported results of select patients with T1 and T2 adenocarcinomas (n = 42) from this database.[10]

For recurrence analysis, patients with previous tumor excisions, metastatic disease at initial presentation, less than 6 months of follow-up, or undergoing radical resection immediately following TEM were excluded (Table 1). One hundred twenty-one patients with benign tumors and 83 with malignant tumors were included in the recurrence analysis. Recurrence time was calculated from the date of surgery to the first date recurrence was diagnosed.

The database documented tumor characteristics (size, pathology, distance from dentate line), perioperative factors (operative time, blood loss, hospital stay), and complications. The tumor level was defined as the minimal distance of the lowest tumor edge from the anal verge measured on rigid proctoscopy. Specimen size was the cross-sectional area calculated from reported measurements made and recorded at surgery on the fresh specimen. The majority of cases (99%) were performed by a single surgeon (C.O.F.). Complications were documented by the operating surgeon or obtained by review of the electronic medical record, or both.

At our institution, TEM is offered with curative intent to patients with a preoperative diagnosis of benign tumor, T1 adenocarcinoma, or carcinoid tumor. More advanced adenocarcinomas were considered for TEM if the patient declined a radical resection.

All patients had an endoscopic biopsy before consideration of TEM. Patients with a tissue diagnosis of cancer underwent endorectal ultrasound (ERUS) for staging. Some patients had magnetic resonance imaging (MRI) in addition to ERUS before consideration for surgical resection. Recently, positive electron transmission computed tomography (PET-CT) was added to preoperative imaging to provide a baseline study and to rule out occult distant metastases.

TEM was usually considered curative if final pathology showed radical excision of benign tumors, T1 tumors without adverse features (poor differentiation, mucinous features, or lymphovascular invasion), and carcinoid tumors. Patients with T1 tumors with adverse features and T2–T3 tumors were usually offered radical excision following the TEM procedure. Some patients were considered for adjuvant therapy if histopathology demonstrated adverse features or tumor staging was T2 or greater. The final decision to administer adjuvant therapy was a result of surgeons' and patients' preference.

Procedures were performed under general anesthesia. The patient was placed according to the location of the bulk of the lesion: in prone jackknife for anterior lesions, in lithotomy for posterior lesions, and in lateral decubitus with 90 degrees hip flexion for lateral lesions. TEM was performed as previously described.[3] All malignant tumors were excised with an intention of full-thickness and a circumferential margin of 10 mm. Benign lesions were sometimes excised with partial thickness, especially over the sphincter, and sometimes with minimal margins. Primary closure was performed using a running suture and silver clips. A proctoscopic examination was performed at the end of every procedure to ensure that the rectal lumen was not compromised.

Patients were followed up at regular intervals with clinical examination and flexible sigmoidoscopy. Patients with malignancy underwent clinical examination, rigid proctoscopy, and ERUS every 4 months for the first 3 years, then every 6 months for a total of 5 years. For locally advanced tumors, PET-CT was ordered on a yearly interval. Local recurrences were defined as a biopsy-confirmed finding on clinical or endoscopic examination. Distant recurrences were identified with either routine computed tomography or PET-CT. Follow-up information was documented by the operating surgeon or obtained from review of the electronic medical record system. Additional

TABLE 2. Characteristics of TEM patients

	Benign tumors (n = 158)	*Malignant tumors (n = 111)*
Age, yr (range)	64 (30–92)	67 (26–94)
M:F, %	56:44	61:39
Tumor distance from anal verge, cm (range)	9.1 (2–15)	8.4 (4–14)*
Specimen size, mm^2	1552 ± 99	1280 ± 105
Operation time, min	84 ± 4	86 ± 4
EBL, mL	11 ± 3	17 ± 5
Hospital stay, days	1.9 ± 0.3	3.0 ± 0.6

Mean ± SEM.
*$P < .05$ vs. benign.

data on oncologic outcome were obtained through individual hospital's cancer registries.

Statistical Analysis

Data are expressed as mean with standard error, and $P < .05$ was considered statistically significant. Data sets were compared using two-sided Fisher's exact probability test or 1-way analysis of variance with post hoc Tukey multiple comparison test. All statistics were performed using Prism 4.0 (GraphPad Software, La Jolla, CA). The study was approved by the Institutional Review Board at the University of Minnesota.

RESULTS

Two hundred sixty-nine patients (Table 2) with varying tumor pathologies (Table 3) were included in the study. Patients with benign and malignant tumors were similar with respect to age, gender distribution, specimen size, operation time, estimated blood loss, and hospital stay. Malignant tumors had a shorter distance from the anal verge compared with benign tumors. Subgroup analysis of malignant tumor characteristics is shown in Table 4.

There were 56 procedure-related complications (21%; Table 5). There was no difference in the frequency of complications occurring in resections for benign vs. malignant disease. Ten of 29 patients who had difficulty with urinary retention were discharged home with a Foley catheter. All patients had their catheters removed by postoperative day 7, and no patient had any further problems with urinary retention. Eleven patients had postoperative fecal incontinence that was new or worsened from their baseline status. All but 2 returned to baseline continence by 8 months of follow-up. Eight patients with fevers were treated with antibiotics and had no further complications. Some patients had prolonged hospitalization associated with underlying medical disease or medical complications, including pulmonary complications (5 patients) and cardiac complications (12 patients).

TABLE 3. Tumor pathology of TEM resections

Benign	158
Adenoma	156
Leiomyoma	1
Duplication cyst	1
Malignant	111
Adenocarcinoma	
T1	58
T2	26
T3	11
Carcinoid	15
Lymphoma	1

Two patients underwent exploratory laparotomy on postoperative day 1 because of symptoms and suspicion of anastomotic dehiscence. At laparotomy in both patients, there was no peritoneal contamination and air-leak tests under water were negative. The anastomoses were reinforced with sutures, and both patients were discharged home with no further sequelae. Another patient was readmitted several days after TEM with free air and leukocytosis and flexible sigmoidoscopy demonstrated a small wound dehiscence with a cavity that was draining into the rectum. This patient was treated with intravenous antibiotics and close observation and improved without surgical intervention.

Four patients developed postoperative bleeding requiring intervention. One patient had a suture line dehiscence causing bleeding, which was treated with cauterization in the office 2 weeks postoperatively. Two patients required blood transfusion while in the hospital, and both patients ceased bleeding without invasive intervention. A fourth patient required hospital readmission, but ceased bleeding without transfusion or invasive intervention. Two of the patients with postoperative bleeding were on systemic anticoagulation, and the anticoagulation was temporarily held until the bleeding ceased.

Follow-up time was 49.5 (range, 7–133) months for patients with malignant tumors and 24.6 (range, 6–128) months with benign tumors (Table 6). Some tumors recurred late, up to 84 months after the TEM procedure for adenocarcinoma. All 6 recurrent adenomas were treated endoscopically with repeat polypectomy or fulguration, or both. Of the 17 malignant recurrences, 8 (47%) underwent an excisional salvage procedure with curative intent: 5 underwent radical excision, 2 had repeated local excision, and 1 underwent a liver resection for an isolated hepatic metastasis (Table 7). Of the remaining 9 recurrences, 1 is awaiting radical excision following chemoradiation, 2 had repeat TEM as a palliative procedure, 2 received palliative chemotherapy, and 4 patients declined further treatment because of advanced age or medical comorbidities.

DISCUSSION

TEM is a useful technique for excision of rectal tumors, and as our experience has expanded, the indications for

TABLE 4. Characteristics of malignant tumors

	T1 (n = 58)	*T2 (n = 26)*	*T3 (n = 11)*	*Carcinoid (n = 15)*
Age, y	64.8 ± 1.7	70.7 ± 2.4	81.8 ± 1.8*	60.7 ± 4.2
Tumor distance from anal verge, cm	8.8 ± 0.3	7.4 ± 0.3+	8.4 ± 0.6	8.8 ± 0.4
Specimen size, mm^2	1201 ± 131	1853 ± 274+	1654 ± 284	503 ± 90†
Operation time, min	78 ± 5§	102 ± 9	128 ± 16	63 ± 8†
EBL, mL	7 ± 2	20 ± 8	81 ± 48‡	1 ± 0.6
Hospital stay, days	1.9 ± 0.3	6.4 ± 2.6+	2.8 ± 0.5	1.2 ± 0.3

Mean ± SEM.
*$P < .001$ vs. T1, carcinoid; +$P < .05$ vs. T1; †$P < .05$ vs. T2, T3; §$P < .01$ vs. T3; ‡$P < .05$ vs. T1, T2, carcinoid.

which we use TEM have evolved, as well. In our current practice, there are 3 general situations in which we offer TEM: (1) for curative resection of benign tumors, carcinoid tumors, and select T1 adenocarcinomas; (2) for histopathologic staging when there is a discrepancy between preoperative studies; and (3) for palliative resection of advanced adenocarcinomas in patients medically unfit or unwilling to undergo radical resection.

Our data indicate that TEM is safe and effective for both benign and malignant tumors. In comparing resections of benign with malignant tumors, the technical aspects of the operation were equivalent (Table 3). Malignant tumors were located slightly lower in the rectum compared with benign tumors, but the significance of this is unclear. Follow-up time for malignant disease was significantly longer than for benign disease, 49.5 vs. 24.6 months, which reflects a more stringent follow-up schedule for cancer patients.

The 5% recurrence rate we observed for benign tumors is comparable with the 3% to 11% range reported in the literature.[12–16] The 6 recurrent adenomas observed in our series were all treated with flexible endoscopic polypectomy with or without fulguration. One of the adenomas recurred a second time and underwent repeat endoscopic fulguration. Although the literature is heavily skewed toward reports of TEM for rectal cancers, the benefits of TEM for benign disease are equally significant.[17] The obvious advantage is avoidance of radical surgery for benign disease. TEM has advantages also over TAE, including an increased likelihood of clear margins, less specimen fragmentation, and lower recurrence rates.[11] Furthermore, more proximal tumors can be accessed with TEM. In this study, tumors up to 18 cm from the anal verge were included, and in other series, tumors extending to 20 cm have been included.[18]

Other benign pathology removed by TEM in this series included a leiomyoma and a mucosal duplication cyst. Both patients presented with submucosal tumors discovered on endoscopy and confirmed to be submucosal by ultrasound. Full-thickness excisions were accomplished without any difficulty, and no further treatment was warranted after final pathologic diagnosis. Submucosal tumors, in general, should be removed with a full-thickness excision because of the possibility of harboring malignant carcinoid.

Although rare, carcinoid tumors are being found with increasing frequency as a result of advancing technology and expertise with endoscopic screening. In some series, the rectum is the most common site of gastrointestinal carcinoid tumors.[19] Although endoscopic retrieval is possible, curative excision with clear margins is not always accomplished.[20] TAE is an effective means of resecting rectal carcinoids, with minimal morbidity and good long-term outcomes,[19,20] and only recently TEM has been used for this indication.[15,21–23] Our experience with rectal carcinoid tumors excised by TEM included 15 patients, all with tumors smaller than 2 cm in diameter. Of all malignant tumors, carcinoids appear to be the simplest to resect with TEM. The specimen size, operation time, and blood loss were significantly lower than some adenocarcinoma resections (Table 4). There was only 1 complication of urinary retention in the carcinoid group. In the 10 carcinoid

TABLE 5. Procedure-related morbidity after TEM

	n (%)
Urinary retention	29 (10.8)
Fecal incontinence or soiling	11 (4.1)
Fever	8 (3.8)
Suture line dehiscence	4 (1.5)
Bleeding requiring intervention	4 (1.5)

TABLE 6. Local recurrence rate and time according to tumor pathology

	n	*Local recurrence, n (%)*	*Time to recur, mo (range)*	*Follow-up time, mo (range)*
Adenoma	120	6 (5.0)	11.8 (7–24)	24.5 (6–128)
Leiomyoma	1	0		40
T1 adenocarcinoma	51	5 (9.8)	35.2 (7–84)	53.9 (7–133)
T2 adenocarcinoma	17	4 (23.5)	25.0 (9–61)	42.8 (9–116)
T3 adenocarcinoma	4	4 (100)	32.0 (8–73)	44.7 (8–73)
Carcinoid	10	0		42.9 (13–98)
Lymphoma	1	1 (100)	28	79

TABLE 7. Outcomes of recurrent adenocarcinoma

T stage	*Time to recur (mo)*	*Site of recurrence*	*Salvage procedure*	*Follow-up time after recurrence (mo)*	*Outcome*
T1	38	Local	TAE	64	Alive, FOD
T1	84	Local	LAR	35	Alive, FOD
T1	25	Local	TEM	70	Alive, FOD
T1	62	Liver	Liver resection	19	Alive with disease
T1	47	Lung, liver, spine	None	18	Died from disease
T1	7	Local	TEM	16	Died from disease
T1	22	Local	APR	19	Alive, FOD
T1	17	Lung	Declined	5	Alive with disease
T1	10	Pelvic node	None	4	Alive with disease
T2	61	Local	APR	47	Alive with disease
T2	13	Local	APR	11	Alive, FOD
T2	9	Local	TEM	27	Alive, FOD
T2	17	Local	Awaiting LAR	3	Alive with disease
T3	73	Local, liver	LAR	9	Died from disease
T3	31	Local	Declined	8	Died from disease
T3	16	Local	Declined	0	Died from disease
T3	8	Local, liver	Declined	2	Died from disease

TAE, transanal excision; FOD, free of disease; LAR, low anterior resection; TEM, transanal endoscopic microsurgery; APR, abdominoperineal resection.

patients who underwent recurrence analysis, there were no recurrences after a mean follow-up period of 42.9 months. A Japanese series by Kinoshita and colleagues[21] is the largest reported group of rectal carcinoids excised by TEM. In their series, 27 patients with rectal carcinoid underwent successful TEM excision, and there was a 0% recurrence after a mean follow-up time of 70.6 months. Several other and smaller reports on TEM excision of carcinoid tumors have also reported no observed recurrences after TEM resection of carcinoid tumors in the rectum.[15,22,23]

The local recurrence rate (9.8%) for T1 adenocarcinomas in the current study is comparable with other series reported in the literature (0%–23%).[5,13,15,24–31] The follow-up time in our study was long (mean, 49.5 months), and it is noteworthy that some tumors recurred later than expected. Only 1 of the 5 local T1 recurrences had adverse features (lymphovascular invasion) on histopathology of the original resection specimen. Four T1 patients had a recurrence at distant sites, which may be a reflection of unrecognized nodal or metastatic disease at initial presentation.

We have recently compared results after TEM with TAE excision of T1 and T2 rectal cancers. We found that the quality of resection was better with TEM, as surgical margins were less often positive, whereas other outcome measures including 5-year overall and disease-free survival and local recurrence rates were equivalent between TEM and TAE.[10] In other reports comparing TEM with TAE, technical outcomes and long term outcomes were better with TEM.[4,8,11] The current study was not designed to compare TEM with other procedures but instead to review our overall experience with benign and malignant pathology. Slight variations in recurrence outcomes for T1 and T2 cancers between our recent study[10] and the present study are explained by differences in inclusion and exclusion criteria between the studies.

Our data emphasize that local excision alone is frequently inadequate therapy for T2 and T3 tumors, and 8 of 21 (38%) of these patients had recurrences in the present series. In previous TEM series, recurrence rates for T2 tumors have ranged between 6% and 80%.[5,12,27,30,32–37] Our recurrence rate after TEM in patients with T2 and T3 tumors can be compared with the 7 patients who underwent radical surgery 1 to 3 months after the TEM pathology report was obtained. Only 1 of these 7 patients (14%) developed a recurrence. Other authors have reported similar low recurrence rates with immediate radical resection of advanced adenocarcinomas.[38,39]

Management of patients with T2 rectal adenocarcinoma and T1 tumors with unfavorable characteristics is debated. Some advocate radical excision for these tumors, whereas others suggest a combination of local excision and adjuvant therapy. In our series, there were 5 T2 patients who received chemoradiation following TEM. Four of the 5 (80%) are alive and free of disease at last follow-up, whereas 1 developed a local recurrence. Others have reported favorable results in T2 patients receiving either radiation or chemoradiation therapy after TEM.[11,22,40]

An alternative approach to more advanced adenocarcinomas may be to apply neoadjuvant therapy, followed by local excision. Nair and colleagues[41] reported a recurrence rate of 16% after neoadjuvant chemoradiation, followed by transanal excision for T2 and T3 rectal cancers. Their overall 5-year survival was 84% in node-negative patients. Lezoche and colleagues[42] used preoperative radiotherapy, followed by TEM in ultrasound-staged T2 and T3 adenocarcinoma. Their cancer-specific survival at 90 months was 89%, with only a 5% local failure rate after a median

follow-up of 55 months. This same group reported earlier data on 35 T2 patients who underwent radiotherapy, followed by TEM.[33] They reported only 1 local recurrence after a median follow-up of 38 months and an 83% survival rate at 96 months. The aforementioned studies included both T2 and T3 tumors, and the study by Nair et al. also included some node-positive patients. The role of neoadjuvant therapy in T3 and node-positive rectal cancers is well established. The question that remains unanswered is the efficacy of neoadjuvant therapy in T2N0 rectal adenocarcinoma followed by local excision. This is best addressed in a clinical trial, and the American College of Surgeons Oncology Group trial Z6041 is currently underway to investigate this treatment strategy.

The long-term results of salvage therapy for local recurrence have been modest. In the present study, 5 of 8 (62%) patients who underwent salvage procedure for cure were alive and free of disease at last follow-up. This is in accordance with previous experience. We have previously reported on 24 patients undergoing a salvage operation after failed TAE of T1 or T2 rectal adenocarcinoma.[1] After a mean follow-up of 2.9 years, only 50% of these patients were free of tumor. In a subsequent follow-up, we reported on 29 patient who underwent TAE of stage I rectal cancer and developed local recurrence.[43] These patients underwent salvage radical surgery, and 59% were free of disease after a mean follow-up of 39 months.

With advancing imaging techniques, we have been seeing more discordance in staging between different modalities. We routinely perform endorectal ultrasound for all rectal malignancies, but many patients are nowadays also undergoing MRI to determine tumor resectability. Several patients in this series had discordance between biopsy results, MRI, and endorectal ultrasound staging. Patients in this situation were offered TEM only if discordant staging would affect the next step in treatment. The final pathology then determined the next stage of treatment following our usual protocol.

In addition to resection for cure, TEM was used for palliation in patients with locally advanced tumors who were medically unfit or refused to undergo radical resection. All adenocarcinomas, except for T1 carcinomas with favorable histologic features, were counseled to undergo radical resection or adjuvant chemoradiation therapy, or both. Six patients with T1 adenocarcinoma with adverse features, 14 T2, and 5 T3 patients refused any further adjuvant therapy or radical resection following TEM. As expected, these patients had worse outcomes in terms of recurrence. Two patients with local recurrences underwent repeat TEM for palliation. There were 2 patients with metastatic disease at initial presentation who also underwent palliative resection with TEM. Although TEM is clearly not curative in these situations, it does offer a minimally invasive dubulking procedure, thus avoiding the immediate and long-term morbidity associated with radical resection.

In the current series, we observed a 21% morbidity rate with urinary retention (10.8%) being the most frequently reported complication. There was not a significant difference in complication rates between benign and malignant resections. Other series of TEM resections have reported comparable complication rates (4%–28%).[5,6,11,22,30,35,44] The TEM complication rate is still far lower than the approximately 50% rate reported with radical excision.[5,6] We did not count entry into the peritoneal cavity as a complication, because we and others have found that the defect can be easily repaired with no significant increase in morbidity.[22,29,45,46] Two patients developed significant abdominal pain and pneumoperitoneum on abdominal radiograph after intraperitoneal entry at the procedure. Both underwent exploratory laparotomy in the immediate postoperative period because of suspicion of anastomotic dehiscence and leak. There was, however, no obvious dehiscence, and air-leak tests were negative in both patients. The anastomotic suture line was reinforced, and both patients were discharged to home without further sequelae 2 to 3 days later. In retrospect, perhaps these 2 patients could have been managed without laparotomy. There were 18 other patients who had intraperitoneal entry and had uneventful postoperative courses. The majority of complications we observed were self-limited, and we did not find any significant long-term complications, such as anovaginal fistulas or rectal stenoses, which have been reported by others.[11,44]

Postoperatively, we observed a deterioration of the rectal continence function in 11 of 269 patients (4.1%). The continence function returned to baseline in 9 of these patients after 4 to 8 months of follow-up. The insertion of the 40 mm operating proctoscope may potentially affect postoperative continence. In a previous study, Cataldo et al.[47] examined change in continence in 39 patients undergoing TEM and found that number of bowel movements, urgency, Fecal Incontinence Severity Index, and Fecal Incontinence Quality of Life surveys were unchanged following TEM resection.

In conclusion, TEM is a safe and effective procedure for benign and malignant rectal tumors. It provides good long-term outcomes when used for benign tumors, select T1 adenocarcinomas, and carcinoid tumors. When used for adenocarcinoma, careful selection of T1 tumors with favorable prognostic indicators is paramount to minimizing the risk for recurrence. TEM can be a useful adjunct for more advanced tumors, either to confirm pathologic diagnosis before definitive therapy or for palliation in patients unfit or unwilling to proceed with radical excision. As the treatment of rectal cancer continues to evolve, TEM may find an even broader role as both a diagnostic and therapeutic tool.

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