Functional Results After Transanal Endoscopic Microsurgery

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PURPOSE: Compared with traditional operations, superior results after transanal endoscopic microsurgery (TEM) for rectal tumors have been demonstrated in terms of morbidity and mortality. However, no data were available on functional outcome after TEM. We, therefore, studied 42 patients who were undergoing TEM. METHODS: Patients were examined by anorectal manometry and participated in a standardized interview preoperatively and three months and one year after surgery. RESULTS: Anorectal function as assessed by manometry was impaired three months after surgery but improved again during the first postoperative year. In parallel, some patients complained of impaired continence or defecation disorders in the interview three months postoperatively. These functions improved during the first year after surgery, too. CONCLUSIONS: Correct comparison of our results with functional outcome after anterior rectal resection is impossible. We feel, however, that functional results after TEM are likely to be superior to those after anterior resection for rectal tumors. [Key words: Transanal endoscopic microsurgery; Rectal tumor; Anorectal function; Manometry]

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It is well established that resection of rectal adenomas is necessary because of the risk of carcinoma development.[1-3] For these benign tumors, complete local removal is an adequate and sufficient treatment.[4] Additionally, local resection is also indicated for T1 carcinomas with good or moderate differentiation (G1, G2), because in these "low-risk carcinomas" lymphatic spread is rare, with a rate of less than 5 percent.[5] This concept is justified because the transabdominal approach *per se* implies an operative mortality in the same range, not to mention the considerably higher risk in terms of morbidity.[6, 7] T1 carcinomas with poor differentiation (G3) and T2 carcinomas may also be excised locally if operative risk is otherwise severely increased. Generally, however, these tumors and advanced stages are resected by anterior resection with colorectal or coloanal anastomosis or by Miles' abdominoperineal excision.[8, 9]

Because of certain limitations of the traditional posterior approaches developed by Kraske,[10] Mason,[11, 12] and Parks,[13] Buess *et al.*[14] introduced a microinvasive technique for resection of rectal tumors *via* an operative rectoscope. This method is called "Transanal Endoscopic Microsurgery" (TEM).[15] Between 1989 and 1994, approximately 450 patients underwent TEM at our institution. It became readily apparent that TEM is superior to traditional posterior approaches, with a mortality of 0.3 percent and a complication rate of 5 percent.[16] However, no precise data were available on functional outcome after this type of surgery.

The aim of this study was to determine functional results after TEM concerning defecation and continence. Therefore, we prospectively evaluated 42 patients by anorectal manometry and a standardized interview before TEM and three months and one year after surgery.

METHODS

Patients

Fourty-two patients, 28 men and 14 women (mean age, 64.1 (range, 46–82) years) were studied. Histologic examination of excised tumors revealed a tubulovillous adenoma in all 42 patients. Tumor distance from the anal verge was 9.6 ± 3.4 (mean ± standard deviation; range, 2–18) cm. Excised area measured 21.8 ± 19.5 (range, 2–104.5) cm^2. Average duration of TEM was 89 ± 52 (range, 30–330) minutes. In 36 patients, the tumor was resected by full-thickness excision of the rectal wall. Six patients underwent tumor excision with the inner layers of the rectal wall only (four by mucosectomy and two by partial wall excision), as described by Buess *et al.*[14, 16] Observed complications included one patient with major hemorrhage from the suture line, which was managed endoscopically. In one patient, a local abscess oc-

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curred. The abscess was opened *via* the rectoscope and healed secondarily.

Surgical Technique

The method of transanal endoscopic microsurgery (TEM) has been described elsewhere in detail.[14-16] In brief, TEM is performed with an operative rectoscope (diameter, 40 mm); the rectal cavity is dilated by constant pressure gas insufflation; tumor resection is performed with microsurgical instruments that are introduced *via* the rectoscope. Stereoscopic vision of the tumor and surgical site is achieved by a telescope that permits up to sixfold magnification.

Anorectal Manometry

No bowel preparation was used, and patients were studied in a semirecumbant position. An eight-channel, water-perfused manometry system (Arndorfer Medical Specialties Inc., Greendale, WI) and a standard catheter (ARM^{3}8 Standard Anorectal Catheter, Arndorfer Medical Specialties, see previously) were used. Signals were sensed by pressure transducers (Statham transducer, Modell P23XL, Spectramed Inc., Oxnard, CA) and transmitted *via* an A/D-converter (Combi-Interface, PC-Polygraf VIII, Synectics Medical, Frankfurt, Germany) to a personal computer. Data storage and evaluation were performed with dedicated software (Polygram Software, Version 4.21, Synectics Medical).

Maximum anal resting pressure (MRP) was determined by continuous pull-through (speed, 1 mm/s). Maximum squeeze pressure (MSP) was registered as well. To elicit the rectoanal inhibitory reflex (RAIR), increments of 10 ml to a maximum of 50 ml of air were insufflated into the anorectal balloon at a speed of 10 ml/s. Threshold for patient's first sensation was determined by rectal distention. Rectal compliance was assessed according to Sorensen *et al.*[17] at maximum tolerable volume.

Standardized Interview

Current status of anorectal continence before surgery and three months and one year postoperatively was protocolled by questions concerning 1) frequency of bowel movements, 2) involuntary loss of gas, liquid, and solid stool, and 3) use of sanitary pads. Additionally, 4) maximum time of voluntary postponement of a bowel movement at urge to defecate, and 5) ability to discriminate among gas, liquid, and solid stool were recorded.

Patients' answers to questions 2) and 4) were allotted to three preset categories: "always," "partly," and "never." For question 3), categories were "yes" and "no." Ability to defer defecation (Question 4) was classified by patients in terms of four possible answers: less than one minute, one to five minutes, five to ten minutes, and more than ten minutes of delay.

Data Analysis

Maximum squeeze and resting pressures were taken as the maximum value in one of eight manometry channels. To differentiate between patients having normal and impaired defecation patterns, answers were summarized as follows: perfect continence (answering "always") *vs.* incomplete continence ("partly," "never") for question 2) and perfect discrimination ("always") *vs.* impaired discrimination ("partly," "never") for question 5). The capability to defer bowel movements was classified into "more than five minutes" and "less than five minutes."

Differences between preoperative and postoperative results of anorectal manometry were assessed by Friedmann's test and, when statistically significant, by a subsequent Wilcoxon-Wilcox analysis. An exception was the results of the rectoanal inhibitory reflex, which were tested by Cochran's test and then by McNemar's test. Preoperative and postoperative data obtained by standardized interview were compared in the same way by Cochran's test and McNemar's test, with the exception of the parameter "frequency of bowel movements," which was assessed by Friedmann's test.

RESULTS

Anorectal Manometry

Values of anorectal manometry are given in Table 1. MRP was diminished three months and one year postoperatively compared with preoperative value ($P < 0.01$). No difference was observed between the two postoperative values. In contrast, MSP was reduced three months after surgery ($P < 0.05$) but not one year postoperatively. It was possible to elicit RAIR in 93 percent of patients preoperatively but only in 43 percent after three months ($P < 0.01$) and in 74 percent one year after surgery ($P < 0.05$). First sensation during intrarectal balloon distention occurred at lower volumes three months ($P < 0.05$) and one year ($P < 0.05$) after surgery compared with preoperatively. Rectal compliance was determined in the

Table 1.
Results of Anorectal Manometry

	Preoperative	3 Months Postoperative	1 Year Postoperative
Maximum anal resting pressure (mmHg; mean ± SD)	84.2 ± 32.1	71.7 ± 31.4*	69.1 ± 24.5*
Maximum squeeze pressure (mmHg; mean ± SD)	162.3 ± 66.7	137.5 ± 76.1†	167.6 ± 82.4
Presence of rectoanal inhibitory reflex (% of patients)	93	43*	74†
First sensation at rectal distention (ml; mean ± SD)	68.0 ± 45.6	54.4 ± 22.5†	47.5 ± 26.3†
Compliance (ml/mmHg; mean ± SD; n = 16)	8.0 ± 6.0	3.8 ± 1.8*	3.9 ± 1.3*

SD = standard deviation.
* $P < 0.01$ compared with preoperative.
† $P < 0.05$ compared with preoperative.

Table 2.
Results of Standardized Interviews

	Preoperative	3 Months Postoperative	1 Year Postoperative
Frequency of bowel movements/day (mean ± standard deviation)	1.8 ± 1.6	2.0 ± 0.9	1.9 ± 0.9
Continence for			
Flatus (%)	86	71	76
Liquid stool (%)	76	67	67
Solid stool (%)	95	93	95
Use of sanitary pads (%)	12	19	19
Ability to defer defecation for more than 5 minutes (%)	88	64*	79
Ability for sensory discrimination of stool (%)	5	74†	83

* $P < 0.05$ compared with preoperative.
† $P < 0.01$ compared with preoperative.

last 16 patients of the study. A persistent reduction three months ($P < 0.01$) and one year ($P < 0.01$) after surgery was observed.

Standardized Interview

Results of the interview are given in Table 2. Some patients already indicated preoperative incontinence for flatus (6 of 42 patients), liquid (10/42), and solid stool (2/42) and the need to use sanitary pads (5/42). These numbers were increased three months after TEM for all of the mentioned parameters, although the differences were not statistically significant. One year after TEM, the same number of patients was incontinent for solids as had been preoperatively, and the number of patients incontinent for flatus had slightly decreased compared with the amount three months after surgery. No improvement was seen, however, in the amount of patients using sanitary pads and in those incontinent for liquid stool. There was no difference in the frequency of bowel movements per day after TEM compared with preoperative values.

Preoperatively, 37 of 42 patients were able to defer a bowel movement more than five minutes when feeling an urge to defecate. Three months after surgery, 27 patients reported this capability ($P < 0.05$), and 33 patients reported this after one year (not significant). Preoperatively, 40 of 42 patients were able to discriminate rectal contents before defecation, whereas three months after surgery 31 ($P < 0.01$) were able to do so; one year postoperatively 35 patients (not significant) had an intact stool discrimination. Impairment of anal sphincter function did not

correlate with tumor location, excision technique, size, or radial position in the rectal cavity or with the occurrence of complications.

DISCUSSION

The technique of TEM and its mortality and morbidity have been described in detail elsewhere.[14-16] The present study focused on functional results after TEM in terms of defecation and fecal continence.

It is of note that even before surgery a substantial number of patients had impaired fecal continence. This may reflect the comparatively high prevalence of incontinence in the elderly or a disorder inflicted by the tumor itself. Although a slight decrease was documented after surgery, no statistically significant differences were seen in the number of patients reporting complete continence preoperatively and three months and one year after TEM. In parallel, the number of patients reporting the use of sanitary pads—a parameter readily revealing soiling—was increased after surgery. However, the difference did not reach statistical significance. Merely the amount of patients who were able to defer defecation more than five minutes was significantly reduced three months postoperatively. One year after TEM, however, a difference compared with preoperatively could no longer be detected.

In anorectal manometry, parameters demonstrated a reduction for MRP three months and one year after surgery. MSP was reduced three months but not one year after surgery. This reduction in MRP three months and one year after TEM indicates persistent damage to the internal sphincter. MSP was reduced three months after surgery, too, but not after one year. In contrast to anterior rectal resection,[18] operative damage to pelvic nerves is unlikely to account for this decrease in sphincter pressures after TEM because only the rectal wall is excised, and the pararectal tissues and structures remain untouched. However, significant dilation of the anal canal occurs during TEM because the operative rectoscope has a diameter of 4 cm.[16] Impact of anal dilation on sphincter pressures has been described previously when exerted digitally for treatment of anal fissures and hemorrhoids[19] or when imposed by the stapling instrument in anterior rectal resection.[20] Anatomically, the external sphincter consists of striated muscle. Apparently this type of muscle recovers from dilation after several months, whereas smooth muscle of the internal sphincter does not. Parallel to changes in MSP, the number of patients reporting impaired ability to defer defecation at urge was reduced three months but not one year after surgery. This complies with the concept that mainly action of the external sphincter enables patients to postpone defecation at urge.[21]

No difference in frequency of bowel movements was observed three months and one year after TEM compared with preoperative value. At balloon distention, first sensation could be elicited with lower volumes, and lower rectal compliance was observed three months and one year after TEM, although the latter parameter was determined in only 16 patients. Rectal volume is likely to decrease after TEM because the tumor-bearing area of the rectal wall is excised. As the rectal wall heals, a scar develops that may entail retraction and thereby cause additional reduction of the rectal reservoir. In contrast to this concept, we did not see an increase in frequency of bowel movements after surgery that would be expected when rectal volume is decreased.[22] In anorectal manometry, however, compliance and first sensation with balloon distention was reduced after surgery, indicating a smaller rectal reservoir than before TEM. We conclude from these findings that a slight decrease in rectal volume occurs after TEM, which is, although manometrically detectable, without clinical relevance in most cases.

Three months after TEM, the number of patients reporting perfect sensory discrimination for rectal contents was reduced. One year after surgery, this number was still slightly decreased, although no longer statistically significant. This apparent recovery of sensory discrimination was paralleled in anorectal manometry; the number of patients with intact RAIR was decreased three months after surgery but increased again at examination one year postoperatively. According to early studies of Denny-Brown and Robertson,[23] RAIR is assumed to be a reflex that occurs within the rectal wall. Consequently, after anterior resection, this reflex usually is lost when the rectal wall is transsected.[20, 24, 25] With local tumor resection by TEM, RAIR is absent in approximately one-half of patients. This may be attributable to the varying extent of excision of the rectal wall. However, we could not find a correlation between loss of RAIR and extent or site of local resection of the rectal wall. In 13 cases, recovery from loss of RAIR occurred. This phenomenon has also been described following anterior rectal resection.[25] Possible reasons are reinnervation of neurons across the sutured rectal wall by dendrites or axons and conduction of electrical po-

tentials involved in RAIR by other cells, *e.g.*, smooth muscle cells.

Functional outcome after alternative procedures of local resection of rectal tumors (Kraske,[10] Mason,[11, 12] Parks[13]) has not been documented by adequate anorectal functional tests; therefore, comparison under these aspects is absolutely impossible. Another traditional approach for treatment of rectal tumors is the anterior rectal resection *via* a laparotomy. Functional results three months after this operation have recently been published from our own institution.[18] In a population of 55 patients, a significant increase of incontinence to flatus, frequency of bowel movements, and use of sanitary pads was observed three months postoperatively. Williamson *et al.*[26] reported similar results three months after anterior resection. Among their patients, there were still 29 percent with some degree of fecal leakage one year after surgery.

Correct comparison of functional outcome after anterior resection and TEM is impossible; lower morbidity and mortality after TEM compared with anterior resection already has been documented.[6, 7, 16] Therefore, it would be unethical to conduct a randomized study on functional results. Comparison of nonrandomized data is difficult, however, because anterior resection usually is performed in more advanced stages of malignant rectal tumors. In contrast, TEM is indicated for benign lesions and early stage carcinomas. These varying tumor stages imply a differing operative trauma, regardless of procedure chosen, with a likely influence on functional outcome. In our patient population, we did not see any significant changes in terms of continence for flatus, liquids, and solids, use of sanitary pads, or frequency of bowel movements up to one year after TEM. In contrast, alterations in terms of these parameters were evident after anterior resection.[18, 26] Thus, it seems evident that functional results are superior to anterior resection, although a precise comparison is not possible.

CONCLUSION

Transanal endoscopic microsurgery is likely to have advantages compared with alternative operative procedures not only in terms of morbidity and mortality but also as regards preservation of anal sphincter functions. We, therefore, highly recommend this technique for resection of rectal adenomas.

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