Technique of Transanal Endoscopic Microsurgery (TEM)

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Early stages of rectal cancer, well and moderately differentiated, have a low rate of regional spread and therefore may be treated by conservative therapy.[1-3] Transanal Endoscopic Microsurgery (TEM) was introduced into clinical practice[4] by G. Buess in 1983. This technique allows for the local treatment of benign lesions and the early stages of rectal cancer through a modified rectoscope, yielding good exposure of the operative field with three-dimensional vision; mucosectomy and full thickness excision procedures can be performed. TEM benefits are the same as other minimally invasive techniques: less pain, reduced morbidity, faster recovery time, and an absence of skin scars. In the present paper, the authors report the technique and the results of the experience of 89 TEM procedures for the treatment of rectal tumors.

MATERIALS AND METHODS

The TEM procedure was performed according to the technique described by G. Buess.[5] A 12- or 20-cm-long rectoscope (external diameter 4 cm) was used (Wolf Company, Tuttlingen, Germany). The rectoscope was fixed to the operative field by a Martin arm, a supporting instrument with two joints which maintains an optimal position of the instrument inside the rectum. A working insert was connected with sealing elements to prevent gas loss when the correct position of the rectoscope was obtained in relation to the location of the lesion. The optical system consisted of a three-dimensional stereoscope with a bidimensional 40° angle lens connected to a video system.

An electrosurgical knife, a needle holder, forceps, clip applicator, and suction device (providing both suction and coagulation) were employed in the procedure. Recently, we used a new multifunctional instrument equipped with the functions of suction, rinsing, monopolar high-frequency coagulation and bipolar high-frequency dissection (ICC 350, ERBE Company, Tubingen, Germany).[6]

Water was automatically injected through the rectoscope so as to clean the lens and the operative field throughout the procedure. An endosurgical unit controlled carbon dioxide insufflation, dilating the rectum with a constant measurement of endoluminal pressure.

We used two different protocols for benign and malignant tumors. Each patient underwent routine laboratory tests, an accurate clinical examination, and pancolonoscopy with multiple macrobiopsies of the lesion to define histology and tumor grading.

We performed multiple biopsies of flat lesions with irregular margins and of recurrent tumors. The normal surrounding tissue was spotted with Indian ink and identified by a reference number to mark the free margin around the rectal tumor.

Endoluminal ultrasound (EUS) was performed in tumors located within 12

cm from the anus[7] (B&K Medical, Naerum, Denmark). Preoperative rigid rectoscopy was essential to measure the distance of the tumor from the anal verge and circumferential tumor spread. Moreover, it allowed us to define the feasibility of a TEM operation in tumors located beyond the rectal valves of Houston. The position of the patient (lithotomy, prone or lateral decubitus) for TEM was selected in relationship to the location of the tumor.

If clinical, endoscopic examination and histology were suggestive of a benign tumor restricted to the mucosa, as seen by endoluminal ultrasound (for lower tumors), a TEM procedure was performed without submitting the patient to other diagnostic procedures.

On the other hand, if a malignant lesion was suspected, the diagnostic protocol was finished with magnetic resonance imaging (MR), which we felt was a requisite to stage rectal carcinomas preoperatively, or by computerized tomography (CT).[8] We evaluated accuracy of transanal US, MR, and CT by adding up the number of correct diagnoses and reporting it as a percentage of total diagnoses made.

An orthograde lavage of the colon and short-term antibiotic prophylaxis (cephalosporin and metronidazole) were performed in all patients, preoperatively.

Given the local nature of the excision, it was essential to obtain informed consent and to warn the patient about the oncological aspects of this method and possible complications, such as bleeding, suture dehiscence, temporary gas and/or stool incontinence, and also the possibility of laparotomy with colonic resection or colostomy if deemed necessary.

TEM was usually performed under general anesthesia; regional anesthesia was employed in selected cases in relation to the physical status classification of the patient (ASA).

According to the preoperative diagnoses and staging, six groups of lesions were considered elegible for TEM treatment:

1. Sessile adenomas of the rectum and lower sigmoid colon within 25 cm from the anus.
2. Well- and moderately well-differentiated pT1 carcinomas of the extraperitoneal rectum.
3. Well- and moderately well-differentiated pT2 carcinomas, in patients over 75 years of age, in the extraperitoneal rectum, associated with radiotherapy.
4. pT2 or pT3 tumors, in patients at high risk for major surgery (ASA 3-4) of the extraperitoneal rectum, associated with radiotherapy.
5. pT2 or pT3 tumors in patients that refused an abdomino-perineal resection (APR), associated with radiotherapy.
6. Chronic rectal ulcerations, carcinoid tumors, and endometriosis.

Until April 1994, we followed a cautious radiotherapy approach since previous reports on the effects of radiotherapy associated with TEM had not yet been published. In patients of the third, fourth, and fifth groups, we performed pre- and post-TEM radiotherapy with 2,500 and 3,200 cGy, respectively, divided over 4 weeks.[9]

Later, on the basis of our personal experience, we progressively increased the dose of pre-TEM radiotherapy from 2,500 cGy to 5,000 cGy (divided over 5 weeks) and reduced the postoperative dose (4 weeks after TEM) to 500–1,000 cGy in cases where we performed a large excision with intraoperative manipulation of the tumor.

TECHNIQUE

The position and the angle of the rectoscope inside the rectum was essential to the feasibility of TEM. Usually the rectoscope was positioned with an angle of 45 degrees in relation to the location of the polyp. In the case of tumors located near or beyond the valves of Houston, we inserted a flexible rectoscope into the rectum beyond the lesion and then, using this as a guide, we introduced the TEM rectoscope. After positioning the operative rectoscope, including the optics and surgical instruments, the resection began by marking a 1-cm safety margin around the rectal tumor using high-frequency coagulation spots (guided, in some cases, by the previous Indian ink marks).

Operative Options

1. Mucosectomy, removing the mucosa, including the polyp, from the inner circular layer of the muscolaris.
2. Partial wall excision, dividing the circular from the longitudinal muscle layer, for lesions located in the intraperitoneal part of the rectum in order to reduce the risk of a peritoneal breach.
3. Full thickness excision, for lesions located in the extraperitoneal rectum, including perirectal fat and adjacent lymph nodes.
4. Segmental resection, in cases of circumferential tumor growth.

In malignant tumors, the residual cavity was irrigated by a Mitomycin C solution (diluted in 200 cc of saline) and a povidone iodine solution.

The defect was then closed by a running suture of PDS 3.0 monofilament (Ethicon Endo-Surgery, Cincinnati, Ohio, code number Z 316), with a silver clip (Wolf Company, Tuttlingen, Germany) inserted at each end to avoid placing knots in a restricted space.

Specimen were fixed onto a corkboard immediately after resection to measure the extent of the lesion and safety margins.

In some cases, we performed four to six macrobiopsies on the margins and base of the tumor for a real-time histological examination in order to determine the completeness of the excision. In such cases, a definitive histological examination determined the grade of the tumor.

Each patient was examined 1 and 3 months after being discharged by a clinical examination, a digital rectal exploration, and rectoscopy. Succeeding follow-up dates were for adenomas (after 6 and 12 months), and then (once a year) clinical exploration, rectoscopy with multiple biopsies, and endorectal ultrasound; for carcinomas (every 3 months during the first 2 postoperative years) and then (every 6 months) clinical exploration, rectoscopy with multiple biopsies, endorectal ultrasound, MR, or CT.

CLINICAL CASES

Eighty-nine operations were performed in 84 patients from April 1992 by TEM in the Surgical Pathology Division of the University of Ancona and in the affiliated institution (Ini Canistro Hospital of L'Aquila, Italy). The average age was 64.5 years (range 36–95); the male to female ratio was 1:2.

The preoperative diagnoses of the 89 TEM cases were as follows :

- 56 adenomas (37 primitive, 16 recurrences or incomplete resections after other transanal procedures; 3 post-TEM recurrences)
- 30 carcinomas: *6 T1, *18 T2 , *6 T3
- 1 N2 squamous cell carcinoma of the anus
- 1 solitary rectal ulcer
- 1 rectal endometriosis

Seven high-risk patients were operated under epidural anesthesia.

RESULTS

Full thickness excision was performed in 83 cases (93.2%); only six patients

(6.7%) underwent a mucosectomy for benign lesions.

In seven cases (7.8%), the full thickness excision included, in tumors located in the intraperitoneal rectum, a portion of the visceral serosa; the peritoneal breach was stitched with a double suture layer. No postoperative complications were observed in these latter patients.

Operation time was related to learning curve and to the size of the excisional area and it ranged from 45 to 300 minutes, with an average of 108 minutes.

All rectal tumors were completely excised. The histological findings were:

- 50 villous adenomas: 40 mild and moderate dysplasias, 10 severe dysplasias
- 36 adenocarcinomas: 9 pT1 carcinomas (4 preoperatively staged as an adenoma); 20 pT2 (2 preoperatively staged as an adenoma) and 6 pT3 (one preoperatively staged as a T2 carcinoma); in a T2 tumor which underwent preoperative radiotherapy, the pathologist was not able to find residual neoplastic cells in the specimen removed by TEM
- 1 squamous cancer of the anal canal (pT1 N2: palliative resection)
- 1 rectal endometriosis
- 1 solitary rectal ulcer

Twenty-three patients with rectal cancer underwent transanal ultrasound: two cases were understaged (8.6%) and two overstaged (8.6%). CT was performed in 11 patients and one patient was understaged (9%); the preoperative staging of the MR was correct in all 12 cases examined. All patients with adenocarcinomas, except for one N2 patient with squamous cancer of the anal canal, were preoperatively staged as N0, M0. In two cases, preoperative imaging demonstrated lymph nodes near the lesion (suspected to be metastases); these were identified and removed and histology results were negative for metastases in both.

In conclusion, in the authors' experience, the accuracy of transanal ultrasound, CT, and MR in determining rectal wall penetration of the cancer, compared to the morphological postoperative findings, was 82.8%, 91%, and 100%, respectively.

No operative complications were observed nor was any intraoperative and postoperative mortality noted.

Postoperative pain was minimal and patients were allowed a liquid diet on the first postoperative day after mucosectomy, on the third after full thickness excision, and on the fourth day after full thickness excision with suture of the serosa.

The average hospital stay was 5 days (range 3-12 days).

Major complications occurred in only one patient (1.1%): a recto-vaginal fistula that required reoperation. Minor complications occurred in 10 (11.2%) patients: 7 dehiscences of the suture line were observed between the 5th to 7th postoperative day (2 total and 5 partial), 2 stool incontinences in older patients (receded with physiotherapy), and 1 pulmonary microembolism.

The average follow-up time was 20 months for carcinomas (range 1-42) and 21 months for adenomas (1-44).

Recurrences were observed in 7 patients (7.8%), all between the 6th and 8th months of follow-up (2 pT2 adenocarcinomas and 5 adenomas); the recurrent cancers were treated with open surgery and TEM, respectively. The recurrent adenomas underwent TEM (3 cases) or endoscopic therapy (2 cases).

No recurrences were observed in the 22 patients treated by radiotherapy.

One patient (who underwent radiotherapy) developed multiple liver metastases in the absence of local recurrences and was treated with chemotherapy; another patient (who also underwent radiotherapy) developed a solitary pulmonary metastasis with no local recurrence and was operated on by lobectomy. Both patients are alive at 3 and 6 months of follow-up, respectively.

The overall survival rates for T1, T2, and T3 tumors were:

- T1: 100% (9/9; mean follow-up 21 months)
- T2: 95% (19/20; mean follow-up 20 months)
- T3: 83% (5/6; mean follow-up 18 months)

The overall survival rate for the 36 carcinomas (mean follow-up 20 months) was 94.4%: 2 patients (one 86-year-old [pT2, G2, no radiotherapy] and one 81-year-old [pT3, G2] underwent pre- and post-TEM radiotherapy) died from diffuse liver metastasis and peritoneal carcinosis after 2 and 1 year postsurgery, respectively.

DISCUSSION

Based on recent literature, local resection represents an ideal solution for sessile adenomas and it may also be used in selected cases of early rectal cancer.[1-3,4,9]

Traditional abdominal and perineal rectal resections are associated with substantial morbidity (20% to 30%) and mortality (5% to 10%), particularly for older and high operative risk patients.[10]

Tumors in the lower third of the rectum may be resected using a Park retractor but this technique results in poor exposure and can only be used for lesions near the anus.[11] Other approaches are the Mason and Kraske techniques; however, they are more invasive and have higher complication rates (10% to 15%).[12]

Rectal tumors may be treated locally by electrocoagulation,[13] endocavitary radiation,[14] laser vaporization, and cryotherapy.[15]

Transanal Endoscopic Microsurgery (TEM), for the local excision of rectal lesions, was introduced in 1983 by G. Buess.[4]

One of the most important advantages of TEM, compared to the other transanal approaches, is good exposure of the operative field with a magnified three-dimensional image, allowing for extremely precise dissection.[5]

The position and the angle of the rectoscope within the rectum are fundamental to TEM feasibility and permit a wide full thickness excision in large tumors located beyond the valves of the rectal mucosa.

The combination instrument (ICC 350, ERBE Company, Tubingen, Germany) allows rapid switching from the cutting to coagulation mode simply by activating a foot pedal. In cases of bleeding, suction and coagulation are quick; in addition, field visualization is better, with faster and safer excision.[6]

Elective indications for TEM are sessile rectal adenomas located within 25 cm from the anus and well- and moderately well-differentiated pT1 carcinomas in the extraperitoneal rectum.

Accurate preoperative staging of these lesions is fundamental and requires a specific diagnostic protocol of clinical examination, endoscopy with multiple macrobiopsies, endorectal ultrasound, and MR and/or CT.

TEM permits the removal of more invasive rectal tumors (pT2, pT3) in elderly and high-risk patients and in patients who refuse an abdomino-perineal operation. In such cases, we practiced a conservative approach with pre- and post-TEM radiotherapy (2,500 and 3,200 cGy, respectively).[16,17] Subsequently, according to randomized clinical trials reporting lower recurrence rates for rectal cancer treated with preoperative radiotherapy (4,500 cGy) and chemotherapy (5 FU, 350 mg/m^2/day),[18-22] we increased the dose of pre-TEM radiotherapy progressively to 5,000 cGy, divided over 5 weeks. In our experience, preoperative radiotherapy did

not cause suturing to be more difficult nor did it increase the risk of suture line dehiscence. Leaking suture lines occurred both in radiotherapy and non-radiotherapy patients, without statistically significant differences. Dehiscences occurred only in cases where there was significant tension on the suture line and healed by conservative treatment.

On the other hand, radiotherapy caused a higher tendency for bleeding during dissection, with an increased possibility of occlusion of the suction cannula, resulting in longer operative time.

TEM includes the following surgical excision techniques:

- mucosectomy
- partial wall excision in the intraperitoneal rectum to reduce the risk of a peritoneal opening
- full thickness excision in the extraperitoneal rectum
- segmental resection, in case of circumferential tumor growth

In our experience, we preferred a full thickness excision in 83 (93%) cases, as lesions preoperatively diagnosed as benign may have areas of T1 carcinoma. Moreover, when the rectal wall is widely mobilized, as after a full thickness excision, it was easier to perform the suturing, with less tension on the margins. In such cases, we preferred full thickness stitches.

A discrepancy between preoperative staging and definitive histology was noted only in seven lesions (7.8%), all understaged. Of these seven tumors, four were staged as pT1 postoperatively and the full thickness excision was considered curative. Thus, clinically significant understaging occurred only in three lesions (3.4%): two pT2 were falsely diagnosed as adenomas (reoperated low anterior resection)—we did not perform endoluminal ultrasound, as the distance of the lesions from the anus was more than 12 cm; one pT3 was staged as T2.

A peritoneal breach, which occurred in seven cases and which was sutured with double layer stitch by TEM, did not increase the postoperative complication rate.

The post-TEM complication rate was low, particularly when compared to other surgical techniques, such as low anterior resection or abdomino-perineal resection.[23]

One observed complication was dehiscence of the suture line, which occurred in wide full thickness dissections with subsequent tension on the suture line. In our experience, this happened in seven cases and was total only in two patients (who underwent preoperative radiotherapy with an excisional area diameter of 10 to 12 cm). The suture leak was only partial in five cases (25% to 30% of the suture line; two cases had been previously treated with radiotherapy). These complications healed by conservative treatment and the patients' quality of life was not affected. The clinical outcome of post-TEM suture dehiscence was more favorable than in patients with dehiscence after a low anterior resection. This may be explained by the more limited perirectal fat dissection that takes place with TEM (facilitating a more rapid healing of the dehiscence). We performed a subsequent double layer suture when excessive tension was present.

Buess reported few postoperative complications (5%) and a low recurrence rate (5%) in 317 patients who underwent TEM over a 8-year period.[4] He reported no lymph node metastasis in eight patients who underwent reoperation after pT1 lesions.

Two patients with recurrent pT2 cancer were observed and were treated by radiotherapy followed by an abdomino-perineal operation and by radiotherapy and TEM reoperation, respectively. Both are disease-free at present. Neither received radiotherapy before the first operation.

The overall survival rate of the 36 patients with carcinomas was 9.4% at a mean follow-up of 20 months.

Although the use of TEM in the treatment of T2 (20 cases) and T3 (6 cases) rectal cancers reported herein may be considered anecdotal, our preliminary data indicate a role for TEM associated with other therapeutic options (radio and chemotherapy) in the treatment of more invasive rectal cancer, like pT2. A randomized protocol concerning preoperative radio and chemotherapy and TEM versus traditional surgery has been designed and initiated at our institute; its results will be the subject of a subsequent report.

CONCLUSION

The advantages of TEM, compared to the other transanal approaches, are good operative field exposure with a magnified three-dimensional image (allowing for very precise dissection), minimal postoperative pain, a short hospitalization, fast recovery, and an absence of skin scars.

Disadvantages of TEM are the need for precise preoperative tumor staging, special training for the surgeon, and the high cost of the instruments.

TEM permits safe, full thickness removal of rectal tumors, with accurate suturing of the defect. In our cases, low morbidity and mortality together with a short hospital stay and a rapid return to normal activities were noted. STI

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