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SURGICAL ENDOSCOPY
and Other Interventional Techniques

Combining ultrasonic dissection and the Storz operation rectoscope

An effective new approach to transanal endoscopic microsurgery

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Abstract
Background: Transanal endoscopic microsurgery (TEM) allows a precise, full-thickness resection of rectal tumors anywhere within the rectum. Unfortunately, the standard TEM technique needs complex and rather expensive equipment, demands high skill, and is attended by bleeding and oozing that may be challenging. A modified TEM procedure combining the new Storz operation rectoscope and ultrasonic dissection has been developed to overcome the limitations of the original technique.
Methods: The Storz operation rectoscope features a 5-mm telescope combined with a single-monitor display. Standard laparoscopic instruments and the LCSC5 Ultracision Maniple are used for dissection and coagulation. Full-thickness resection is performed most often. Closure of the defect is accomplished by interrupted 3-0 polydoxanone sutures secured by extracorporeal slip-knots.
Results: Altogether, 18 TEMs have been performed according to the modified technique: 9 for malignant and 9 for benign lesions. The median operating time was 92.5 min for resection of malignant lesions and 40 min for resection of benign lesions. Two postoperative complications occurred: a bleeding and a partial dehiscence. The median follow-up periods were 35 months for malignant disease and 19.5 months for benign disease. No recurrence was observed.
Conclusion: For tumors located up to 15 cm from the anal verge, TEM with the Storz rectoscope and ultrasonic dissection is indicated. Despite the complication described, coagulation is optimal and ultrasonic scissors allow working in a fairly bloodless field. The overall costs of the equipment are significantly lower.

Key words: Transanal endoscopic microsurgery — Rectal tumors — Ultrasonically activated shears — Operation rectoscope

Transanal endoscopic microsurgery (TEM) is an effective procedure for the treatment of large sessile adenomas and early cancers of the rectum that allows a precise full-thickness resection of lesions under optical magnification [4, 13, 15, 22, 23]. Unfortunately, TEM needs dedicated and rather expensive instruments and equipment. Other limitations of the original procedure described by Buess [4] are the high skill that it requires, demanding closure of the defect with running sutures secured by silver clips, and the challenge to control bleeding, especially in lesions located in the midrectum.

A new operation rectoscope (Storz gmbh, Tuettlingen, Germany) that does not require specially designed instrumentation and equipment is now available off the shelf. Nevertheless, the technical characteristics of the Storz operation rectoscope, which is provided with a monocular optic system, required the development of a slightly different surgical technique. The use of ultrasonically activated devices for TEM performed through the Storz rectoscope offers the best option in terms of technology for dissection and ergonomics [15]. The TEM modified surgical technique as well as its indications and contraindications are described. Furthermore, preliminary data on both the efficacy of ultrasonically activated shears and the cost effectiveness of this new approach are reported.

Methods and materials

Technology for modified TEM

Ultrasound dissection technology consists of applying ultrasound to the tissues, allowing three effects that act synergistically; cavitation,

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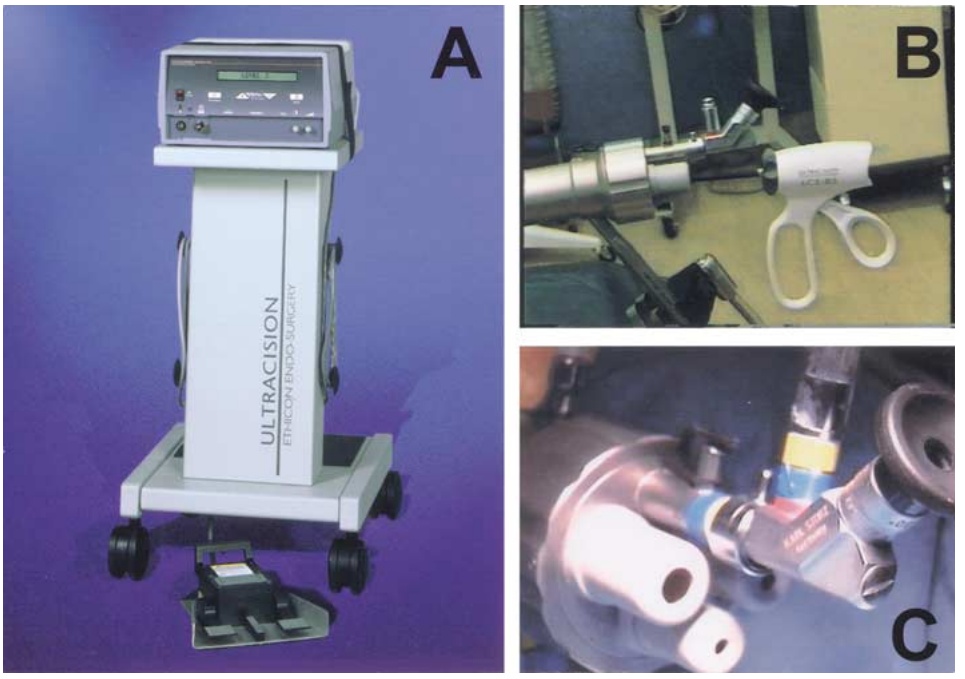

Fig. 1. Technology for transanal endoscopic microsurgery. **A** The ultrasonic generator Ultracision (Ethicon EndoSurgery, Cincinnati, OH, USA). **B** The Storz operation rectoscope with the 5-mm LCSC5 Ultracision maniple. **C** The Storz rectoscope (diameter, 4 cm) features a 5-mm 30° forward oblique telescope connected to a three-chip camera.

coaptation/coagulation, and cutting. The ultrasonically activated devices use longitudinal mechanical waves with a frequency exceeding 20,000 cycles/s, which allow optimal dissection, minimizing bleeding from the divided tissue. Lateral energy spread is minimal, and the risk of distant tissue damage is lower than that of high-frequency electrosurgery. The ultrasonically activated 5-mm, curved-blade scissors (LCSC5; Ethicon EndoSurgery, Cincinnati, OH, USA) are a multifunctional instrument for grasping, dissection, and coagulation featuring a rotating shaft. The ultrasonic scissors are connected to the ultrasound generator (Fig. 1). The operation rectoscope (Karl Storz, Tuettlingen, Germany) (Fig. 1) consists of (a) the operating rectoscope tube, 40 mm in diameter, with a working length of 15 cm, a handle, and a LUER lock connector for smoke evacuation; (b) the obturator for use with the operating rectoscope tube during its insertion; (c) the working attachment for the operating rectoscope tube, with fixation for the telescope, one 5- to 12-mm and two 5-mm channels for instruments, including a silicone leaflet valve, sealing caps, and a LUER lock connector for insufflation; (d) the forward oblique 30° telescope with enlarged view, 5 mm in diameter, 21 cm in length, and provided with a 45° angled eyepiece and incorporated fiberoptic light transmission; and (e) the holding device to fix the operating rectoscope with a mounted video camera to the operating table, consisting of an articulated arm, the holder for the operating rectoscope with a hexagonal handle, and a radial setting clamp for fixation to the operating table. Standard laparoscopic grasping forceps, ultrasonic shears, and a needleholder are introduced through the sealing caps.

Surgical technique

Full-thickness resection with adequate margins of clearance is the technique usually performed for both malignant and benign lesions. Simple mucosectomy or partial-thickness resection may be performed for benign lesions or lesions located in the proximity of the anal sphincter and above the peritoneal reflection.

Besides the 5-mm ultrasonic scissors, only one 5- or 10-mm-laparoscopic grasping forceps is needed. Bowel preparation is achieved by administration of polyethyleneglycole the day before surgery. Patient positioning is similar to that described for the original Buess technique. The first step of the procedure is to identify the lesion and the correct positioning of the operation rectoscope. High-flow carbon dioxide (CO_2) insufflation is required, and endoluminal pressure is kept at 20 mmHg. The proper positioning of the rectoscope is of paramount importance for successful excision and suturing. Dissection usually is started at the right lower border of the tumor, leaving a 5- to 10-mm margin of clearance. The mucosa is held with the grasper at this level while the ultrasonic shears are activated to divide tissue. Ultrasonic dissection is continued all around the lesion layer by layer, reaching the perirectal fat (Fig. 2). The excision is completed by dissecting tissue behind the lesion. No bleeding or oozing usually occur, thanks to the optimal coagulation achieved by application of the ultrasonic scissors. Because of mist generation during the dissection maneuvres, the telescope often is removed to allow lens cleansing throughout this step of the procedure.

The specimen is retrieved by removing the working attachment. After the parietal defect is disinfected, the suture is started. Any kind of laparoscopic needleholder may be used, but coaxial needleholders are preferred. In contrast to the technique described by Buess [4], no running suture is performed. Closure of tissue defect is accomplished by interrupted 3-0 polidoxanone sutures secured by extracorporeal modified Roeder slipknots (Fig. 3). Knots are tightened by sliding one limb of the suture down with the needleholder. At this stage, the endoluminal pressure is reduced to 15 mmHg to ease tissue approximation, and the rectal lumen often is checked to avoid its inadvertent partial closure, especially during the suturing of large defects. The line drawings in Fig. 4 show, step by step, the newly developed interrupted suturing technique described earlier.

Results

The aforementioned technique has been used for 18 TEMs with the following indications: six adenomas, five ca (3 tumors limited to the mucosa, 2 tumors involving the submucosa) *in situ*/T1 tumors, three T2 rectal cancers, two anastomotic strictures, one carcinoid, and one familiar polyposis. Patients with T2 cancers underwent preoperative chemoradiation or postoperative radiation therapy. The operating time ranged from 30 to 360 min. The postoperative hospital stay ranged from 1 to 7 days, and the follow-up period ranged from 1 to 56 months. The differences in mean, median, and range of the aforementioned parameters between operations performed for malignant and benign diseases are shown in Table 1. No local recurrences were observed in either the malignant or the benign group of patients. Postopera-

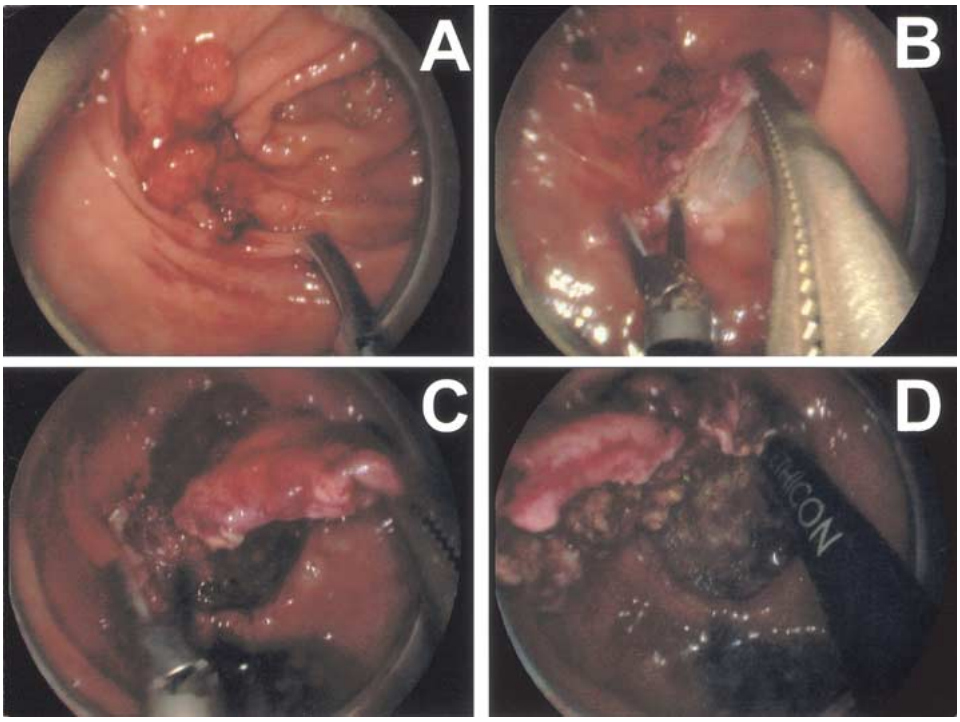

Fig. 2. Full-thickness resection of a villous adenoma (diameter, 2.5 cm) with severe dysplasia using the modified transanal endoscopic microsurgery technique. No other dissection instrument is usedbesides the ultrasonic (US) scissors during the whole procedure. **A** and **B** The US dissection is started. **C** The US dissection is continued at the basis of the polyp. **D** The full-thickness dissection is accomplished.

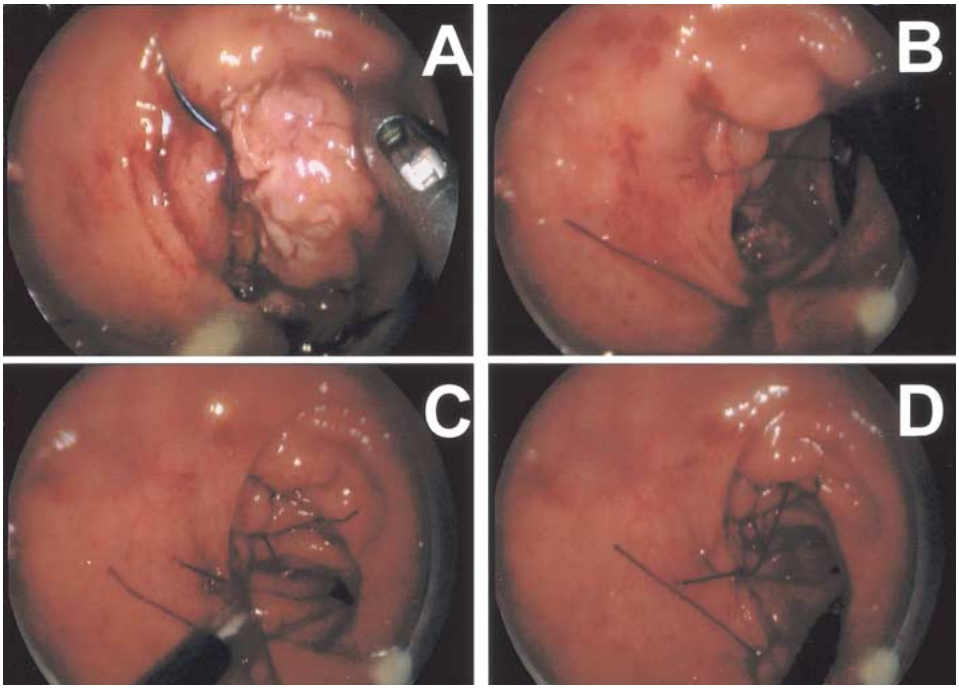

Fig. 3. Closure of the parietal defect according to the modified suturing technique: **A** The first stitch (3-0 polydoxanone monofilament with the small half (SH) needle) is passed. **B** An extracorporeal modified Roeder slipknot is tightened with the standard needle-holder. **C** and **D** The interrupted suture is accomplished.

tive complications occurred in two patients (11 %) who had undergone TEM, respectively, for rectal adenoma and anastomotic stricture: a bleeding and a partial dehiscence. Both complications occurred on postoperative day 6. The postoperative bleeding required rectal suturing, whereas the partial dehiscence was treated conservatively.

The overall costs of the procedure are low, including those for the technology used and strictly dedicated to TEM (e.g., cost of the ultrasonic shears [430 Euro*.]) as well as amortization of the costs for the Storz operation rectoscope, the enlarged-view 30° telescope, and the articulated arm. The total costs for the procedure were 6,000 Euro*

*The figures reported concern costs for the mentioned technology in Italy such as the purchase contracts of San Giovanni–Addolorata Hospital.

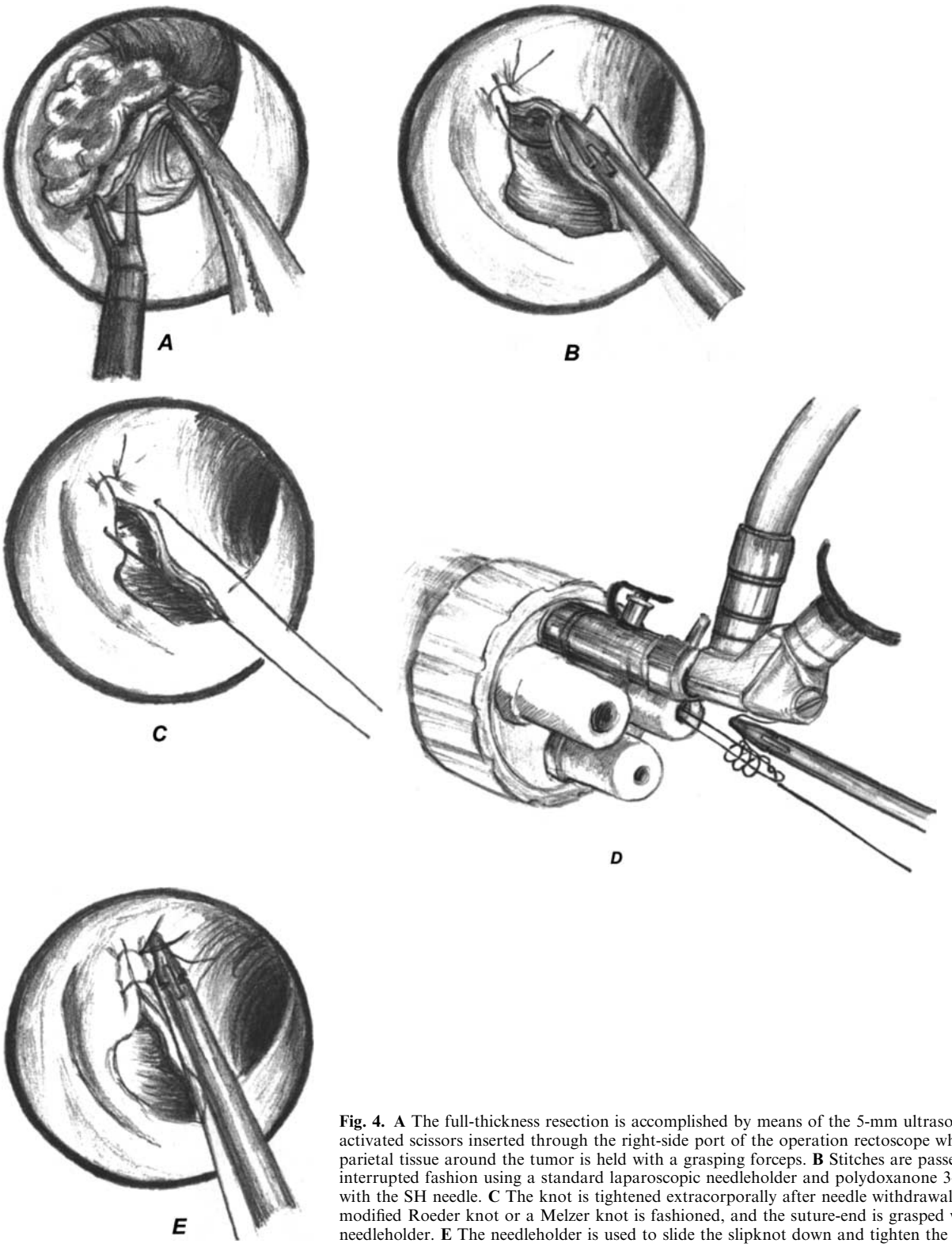

Fig. 4. **A** The full-thickness resection is accomplished by means of the 5-mm ultrasonically activated scissors inserted through the right-side port of the operation rectoscope while the parietal tissue around the tumor is held with a grasping forceps. **B** Stitches are passed in an interrupted fashion using a standard laparoscopic needleholder and polydoxanone 3-0 sutures with the SH needle. **C** The knot is tightened extracorporally after needle withdrawal. **D** Either a modified Roeder knot or a Melzer knot is fashioned, and the suture-end is grasped with the needleholder. **E** The needleholder is used to slide the slipknot down and tighten the suture.

Discussion

The treatment of choice for large sessile adenomas of the rectum up to the peritoneal reflection is a limited resection, usually performed transanally [8, 12, 18, 21, 24, 27, 32]. Local resections of benign rectal tumors may be performed according to standard transanal techniques such as the Parks' procedure [1, 2, 7, 17]. In such a case, the lesion must be located in the lower or middle rectum because of the difficulties reaching and properly dissecting higher lesions. Buess [4] introduced the transanal endoscopic approach for treating benign lesions located

Table 1. Operating time, postoperative hospital stay, and follow-up evaluation

	Median	Mean	Range
Benign lesions			
Operating time (min)	40	75.6	30–180
Postoperative stay (days)	2	3.2	1–6
Follow-up (months)	19.5	20.5	1–56
Malignant lesions			
Operating time	92.5	140.8	40–360
Postoperative stay (days)	4.5	4.5	2–7
Follow-up (months)	35	32.7	5–52

at any level in the rectum, improving the exposure of the tumor and allowing any kind of resection, from mucosectomy to full-thickness dissection of the wall, under optical magnification. The indications for local treatment of rectal tumors has been extended to selected cases of malignant lesions [11, 26, 28, 30], usually combining adjuvant or neoadjuvant radiation or chemoradiation therapy [3, 14, 19]. The results still are controversial, and there is no large randomized study that may prove the effectiveness of local treatment for rectal malignancy in terms of long-term survivals and local recurrences [10, 25]. Nevertheless, the results seem promising in the case of selected early cancers [11, 20, 25].

Among the procedures for local rectal resection, transanal endoscopic microsurgery certainly is the one that provides optimal control of the tumor, whatever the size, with reduced rates of postoperative complications and local recurrences [31]. The original technique described by Buess [4] needs the use of highly sophisticated and rather expensive appliances. Unfortunately, the number of patients referred to most centers for local treatment of rectal tumors is not very large. Small benign lesions usually are treated by snare resection, and sessile adenomas larger than 2 to 2.5 cm are uncommon, Furthermore, although large adenomas may contain focal areas of severe displasia and even infiltrating cancer, most endoscopists are used to treat them by multiple snare resections and seem not disposed to refer these cases to surgeons.

With the original TEM technique, bleeding control during the dissection maneuvres is achieved by monopolar high-frequency coagulation [9, 29]. With the introduction of the new quasi-bipolar dissection device, precision and quality of tissue dissection have been increased. Unfortunately, major bleeding cannot be controlled during quasi-bipolar dissection, and the operator has to switch to high-frequency monopolar electrosurgery and even change the high-frequency knife for a grasping forceps connected to the high-frequency generator [4].

Compared with the original technique, TEM with the Storz rectoscope and ultrasonic dissection is indicated for tumors located up to 15 cm from the anal verge and any lesions up to 10 cm in diameter, but not circumferential. The dissection is less fine and precise than those performed with the high-frequency knife or the quasi-bipolar knife, but oozing is minimal, with reduced lateral thermal effects. In fact, despite the complication described, coagulation is optimal and ultrasonic scissors allow the surgeon to work in a pretty bloodless field. Furthermore, the use of ultrasonic shears avoids continuous instrument change, thus improving the overall ergonomics of the procedure (see sequence in Fig. 3).

Conventional video endoscopic equipment is used. The camera is connected to the eyepiece of the telescope, and all personnel in the theater may watch the different phases of the operation on the screen. There is no stereoscopic view as provided by the stereoscopic telescope of the Buess system. The stereoscopic telescope offers superb three-dimensional images to the surgeon, but an additional teaching attachment is needed for the operation to be displayed on a monitor and followed by the assistant and the scrub nurse [6].

Our series of patients was too small to determine the actual rate of postoperative complications. Postoperative bleeding occurred in a patient in whom, besides a standard full-thickness resection of a villous adenoma, a mucosectomy without suture was performed for a small adjacent lesion. Bleeding from the site of mucosectomy occurred on postoperative day 6 and was treated by suturing the defect.

A short-term antibiotic prophylaxis combining metronidazole with a third-generation cephalospirine is used. Patients are kept fasting for 24 to 48 h after the operation, depending on the extent and type of resection, and usually are discharged after the first uneventful evacuation. In contrast to the original technique with the Buess system, segmental resections seem to be much more challenging with the Storz system, mainly because bayonet-type instruments are lacking, and no such resections were performed in our series.

Considering that overall indications for transanal endoscopic microsurgery are too limited to justify the use of expensive instrumentation in most surgical departments, the combination of the new Storz operation rectoscope with ultrasonic dissection may be an effective alternative. The overall costs are significantly lower than those for the procedure performed with the original Buess operation rectoscope and technique. The amount of the amortization costs depends on the number of procedures performed per year. Nevertheless, the rather low costs of the equipment are affordable by most surgical departments, disregarding the number of patients referred for TEM.

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