

EUS-Guided Therapy in Rectal Tumors and Other Fields of Minimal Invasive Surgery

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The Principles of Minimal Invasive Surgery (MIS)

In conventional surgery, access to the body cavity is achieved by opening widely the thoracic or abdominal wall. These incisions are necessary to get a adequate exposure and to introduce the surgical instruments. Various endoscopic procedures have been developed over the past 40 years to substitute open surgery with endoscopic techniques. Wittmoser (1) has developed a series of techniques for such thoracic operations such as a vagotomy or sympathectomy. Semm (2) developed systems for laparoscopic surgery in gynecology and Buess for rectal surgery (3) and esophageal surgery (4). These techniques have been incorporated under the name Endoscopic Surgery or Endoscopic Microsurgery. Wickham (5) finally suggested the definition Minimal Invasive Surgery (MIS). An explosion of this new surgery started in 1987 when Mouret performed the first laparoscopic cholecystectomy in Lyon. In 1991, this procedure is already being performed by thousands of surgeons worldwide.

The Scope of MIS

According to Cuschieri (6), the MIS techniques are subdivided into 6 groups (Table 1).

Table 1

Minimal invasive surgery approaches:

- laparoscopic
- thoracoscopic
- endoluminal
- perivisceral endoscopic
- intraarticular joint surgery
- combined procedures

Laparoscopic procedures

Laparoscopic operations are expanding rapidly in general surgery. A number of different procedures have been brought into clinical practice in the last two years:

- Cholecystectomy.

- Vagotomy using different techniques.
- Closure of perforated duodenal ulcers.
- Myotomy in achalasia.
- Appendectomy.
- Resection of small bowel and colon.
- Adhesiolysis.
- Hernia repair.
- Laparoscopic nephrectomy.
- Exploration of the main bile duct.
- Round ligament lift and fundoplication for gastroesophageal reflux.
- Drainage in peritonitis.

Thoracoscopic procedures

The thoracic cavity allows good access. After collapse of the lung, optimal overview for different surgical procedures is achieved:

- Resection of bullae and pleurectomy on recurrent pneumothorax.
- Myotomy of the esophagus.
- Limited lung resection.
- Thoracoscopic esophagectomy.
- Truncal vagotomy.
- Sympathectomy.
- Thymectomy.

Endoluminal procedures

Extended endoluminal operations using flexible endoscopes will have a great future, but, at present, the only technique that allows a complete endoluminal operation to be performed is transanal endoscopic microsurgery. With this technique, resection of the whole rectal wall with segmental resection and circular end-to-end anastomosis can be performed.

Perivisceral procedures

The adnexa area of some organs is not a performed space, but consists of connective or fatty tissue. In perivisceral procedures, dissection plane has to be created artificially during the surgical mobilization.

A typical perivisceral operation is the endoscopic microsurgical dissection of the esophagus (EMDE) (7).

Advantage of MIS

Clinical trials (8) confirm our experience (Table 1) that postoperative pain is significantly reduced compared to conventional surgery.

Postoperative restriction of movements is reduced, so that patients are mobile shortly after surgery. In the USA, patients who undergo endoscopic cholecystectomy leave the hospital on the first postoperative day, whereas the hospital stay in Tübingen is three days postop.

MIS reduces the wound infection rate, the rate of postop adhesions and such complications related to postoperative immobilisation such as thromboembolism and pneumonia.

Critical Points in MIS

The MIS techniques known today have some important restrictions compared to conventional surgery:

- Stereoscopic vision is only possible in transanal endoscopic surgery. Laparoscopic interventions have to be performed under monocular vision.
- The handling of the instruments is restricted by the instrument ports, so that, for example, the direction of the needle in suturing cannot be achieved easily.
- Tactile sense in conventional surgery is often important for discriminating such structures as vessels or nerves, for example, or estimating the infiltration of a tumor into the surrounding tissue.

Ultrasound Techniques in MIS Today

Because intraoperative judgement of local situations in minimal invasive procedures is limited, an accurate preoperative assessment is essential. The information has to be much more precise than for conventional surgery and indications for MIS must often depend on a correct ultrasound diagnosis. Three different situations are example-fied:

1. The local treatment of pT1 rectal cancer according to Hermanek's definition (9) is well accepted. Patients with pT2-tumors still require a radical operation, local excision and preoperative irradiation might be combined in the future.

Because of such tissue reactions as scarring and inflammation, the radical operation following local excision is difficult.

Preoperative examination should therefore precisely discriminate between pT1 and pT2 tumors so that reoperation is not necessary. Endoluminal ultrasound of rectal tumors is the only diagnostic possibility to assess in-

tramural infiltration in tumors that cannot be reached by the palpating finger.

A combined laparoscopic-rectoscopic sigmoidectomy is nowadays possible. Even in this case, a close preoperative EUS assessment is mandatory in order to get exact information concerning the depth of infiltration into the bowel wall.

2. For the first time, the development of endoscopic microsurgical dissection of the esophagus (EMDE) offered the possibility of dissecting the tumor while keeping the esophagus in direct visual contact, without opening the thorax.

The restricted space during the perivisceral dissection makes resection of large tumors in the upper esophagus difficult since the trachea and bifurcation cannot be precisely visualized and tumor infiltration is difficult to evaluate. Preoperative assessment of localization and depth of penetration is crucial in order to choose the appropriate technique and operative strategy.

EUS is the only diagnostic tool which provides precise information of wall infiltration, so that stage-orientated operation will not be possible in the future without such a preoperative examination (10, 11).

3. Percutaneous ultrasound before laparoscopic operation in patients with former laparotomies. In such patients, the introduction of Verres' needle and trocars can be a hazardous procedure. Achieving CO₂ insufflation and the introduction of the endoscope without damaging the organs adherent to the abdominal wall is a crucial step during these operations. Free movement of the organs during deep breathing guarantees a complication-free trocar insertion into the respective areas.

Transanal Endoscopic Microsurgery as an Example for the Technique and the Potential Applications of MIS

The operative system was developed between 1980 and 1983 in cooperation with the Wolf company. The name of the technique (Buess, Theiss, Hutterer) reflects the co-workers active in development and clinical testing (12).

A rectoscope of 40 mm in diameter allows the use of four surgical instruments simultaneously. The stereoscopically exact visual field is achieved with a stereoscopic optic, a second optic being combined with a video camera (Figure 1).

The operation is performed under constant gas dilation, full thickness excision being the standard treatment for both adenomas and carcinomas. After excision of the tumor and controlling bleeding, the wall defect is closed with a transverse-running suture. In extended adenomas, segmental resection and end-to-end anastomoses are possible.



Figure 1

Table 2 Comparison of endosonographically assessed depth of infiltration (uT) with postoperative histological findings (pT) (in 66 patients).

uT	pT	pT0-1	pT2	pT3	pT4
uT0-1	(n = 46)		42	3	1
uT2	(n = 3)		1	2	
uT3	(n = 17)			3	14
uT4	(n = 0)				

Indication for Transanal Endoscopic Microsurgery

Sessile adenomas are the main indication for transanal endoscopic microsurgery. Pedunculated polyps might be an indication when large in size (3 cm), although they might cause severe bleeding following snare resection. The basic requirement for the indication in adenomas is that they can be visualized up to their upper end by using a rigid rectoscope.

The main problem in adenoma surgery is that macroscopically typical adenomas with preoperative histology of benignancy contain invasive cancer to a rate of 20%. We therefore perform EUS on all adenomas, but discrimination of early carcinomas is still not precise (13, 14, 15) (Table 2).

The indication for local excision of histologically verified cancer is given by pT1 low risk cancer according to Hermanek, because of their low rate of lymph node metastasis (approximately 3%). pT1 tumors constitute the optimal indication. Judgement of invasion is based on digital examination and clinical staging of tumors in the lower rectum as seen in complementary EUS. For discrimination, not only signs of infiltration, but also the echogenicity of the tumor is important.

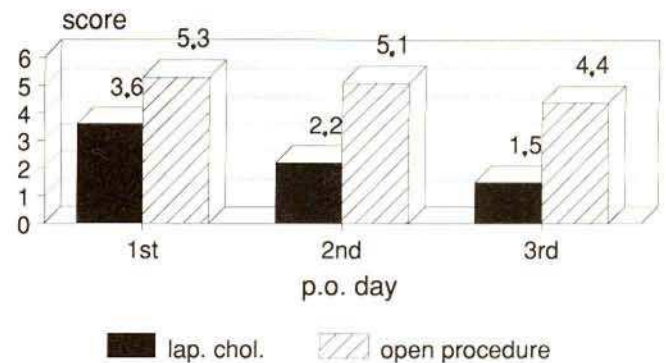


Figure 2: Postoperative pain, 3/90-7/91; n=100/30.

Perioperative Treatment

A perfect bowel preparation is essential to prevent perirectal infection. The standard preparation is 10 liters saline lavage. A single dose perioperative antibiotic prophylaxis is administered before starting the operation.

Anaesthesia can be regional in selected cases, but general anaesthesia is necessary in the majority of patients. The position of the patient on the operation table depends on the tumor localization. Postoperatively, the patients can get up immediately. Local pain is only present in cases of sutures at the level of the anal canal. Slight temperature rise for 2-3 days is typical and could be caused by contamination of the perirectal area. After extended local excision, tension on the suture line may occur and we may find temperatures up to 39 degrees and endoscopic signs of a breakdown of the suture line. Conservative treatment with prolonged infusions and antibiotics are mandatory. In 2% of the cases, a temporary colostomy is required because of sepsis.

Follow-up of Patients

In adenoma patients, we found a recurrence rate of 3%. They can be treated mostly by snare resection and not biopsy. We defined recurrence as an adenoma at the site of the previous lesion and adenomas distant to the operation site as new polyps.

Discussion

MIS is currently revolutionizing general surgery. New technologies are applied and the spectrum of surgical techniques is changing completely. This development has impacts on different fields: The patient has significantly less problems after surgery. He or she can get up early, has only minimal-postoperative pain and can be discharged from the hospital after only a few days (Figure 2). They can go back to work again very soon so that the overall costs of the operation to the social system are reduced significantly. As in all revolutions, conditions need time to be changed until the advantages are really effective. The rapid change happening at the moment requires:

1. Development of new instruments and new technologies to make MIS faster and safer.
2. Optimal training (16) for the education of surgeons. As in most new techniques and according to a typical learning curve, complications are more frequent at the time of introduction. To reduce these problems, we have established a teaching center at the University of Tübingen. Every week, 10 surgeons are trained in the new techniques using newly designed training systems based on phantoms. These systems consist of anatomical configured plastic organs. Dissection is performed mainly on tissues from the slaughterhouse which have been incorporated into these phantoms.
3. Pre- and intraoperative diagnostic tools have to be developed and improved to overcome the problems resulting from not opening the body fully. From this point of view, one of the most important aspects is the further development of EUS and related techniques. New US probes specially designed for laparoscopic use are going to be introduced into clinical practice. They will allow the surgeon to perform an intraoperative ultrasonography, thereby widening the spectrum of diagnostic laparoscopy. That will not only provide enhanced benefits in the laparoscopic assessment of tumor stage, but will also be an effective alternative to intraoperative cholangiography during endoscopic cholecystectomy.

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