CHAPTER 3

TECHNIQUE FOR
LAPAROSCOPIC AUTONOMIC NERVE PRESERVING TOTAL MESORECTAL EXCISION

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Abstract

With the introduction of total mesorectal excision (TME) for treatment of rectal cancer, the prognosis of patients with rectal cancer is improved. With this better prognosis, there is a growing awareness about the quality of life of patients after rectal carcinoma. Laparoscopic total mesorectal excision (LTME) for rectal cancer offers several advantages in comparison with open total mesorectal excision (OTME), including greater patient comfort and an earlier return to daily activities while preserving the oncologic radicality of the procedure. Moreover, laparoscopy allows good exposure of the pelvic cavity because of magnification and good illumination. The laparoscope seems to facilitate pelvic dissection including identification and preservation of critical structures such as the autonomic nervous system. The technique for laparoscopic autonomic nerve preserving total mesorectal excision is reported. A three- or four-port technique is used. Vascular ligation, sharp mesorectal dissection and identification and preservation of the autonomic pelvic nerves are described.
Introduction

To improve survival and to reduce the postoperative recurrence rates after surgery for rectal cancer, resection techniques have become more radical. Total mesorectal excision (TME) seems to improve results, but urinary and sexual dysfunction is a common consequence of rectal surgery for cancer\(^1\). Reported values for bladder dysfunction range from 8 to 54\% and for sexual dysfunction from 18 to 59\%\(^2\). Although in the open Dutch TME trial, no damage was reported in three quarters of the cases, the incidence of sexual dysfunction was at least one quarter (Peeters 2005, unpublished data, Congress: Dutch Colorectal theme).

Although nerve protection is common in surgery, relatively little attention is given to iatrogenic injury of the autonomic nerves in rectal surgery. The preservation of the pelvic autonomic nervous system is hampered by the fact that its nerves are not distinctly seen in the surgical field because of their subtile structures and to their location in a narrow pelvis.

Laparoscopic total mesorectal excision (LTME) has been shown to achieve oncological resection equivalent to that of open TME (OTME)\(^3\)-\(^5\). Moreover, LTME offers several advantages in comparison with OTME, including less postoperative pain, shorter duration of ileus, decrease in hospital stay and disability\(^4\), \(^6\), \(^7\). Laparoscopy allows good exposure of the pelvic cavity because of magnified view and seems to facilitate mobilisation of the rectum. The magnification may facilitate identification and preservation of the pelvic autonomic nerves.

In this paper, we describe the technique for laparoscopic autonomic nerve preserving total mesorectal excision (TME-ANP).

Patient selection

Only patients with advanced T3 and T4 rectal carcinoma, identified with MRI, are not operated laparoscopically. A T3 tumour was classified as advanced if the distance between the tumour and mesorectal fascia was <6 mm on MRI, as defined by Beets-Tan et al.\(^9\).

Because TME combined with short-term preoperative radiotherapy significantly decreases the incidence of local recurrence, all our patients receive preoperative radiotherapy\(^10\), \(^11\). A total dose of 25 Gy in five fractions during 5 days according to protocol is given.

For preoperative radiotherapy, reliable imaging is necessary to assess tumour stage. In a review by Beets-Tan et al., an accuracy of 71-91 \% is claimed for endoluminal MRI concerning T staging. The T-staging accuracy of endorectal ultrasonography varies between 69 and 97\%. Endorectal ultrasonography is very accurate for staging of superficial rectal cancer, but it is not as useful for staging of advanced rectal cancer\(^12\). The major limitations of all imaging techniques are understaging due to microscopic invasion and/or overstaging caused by inflammatory reaction. Therefore, the inclusion of cT1 or cT2 tumours in preoperative radiotherapy is unavoidable as long as staging procedures are not completely reliable. In the Swedish Rectal Cancer Trial as well as in the TME trial, preoperative radiotherapy actually had a positive effect on the local recurrence rate in patients with a TNM stage I tumour\(^13\), \(^14\).
Anaesthesia

Epidural catheters are placed preoperatively and activated with local anaesthetic. After induction of general anaesthesia, a nasogastric tube is inserted to reduce gastric distension, and a urinary catheter is inserted to decompress the bladder and to monitor urine production.

Operative positioning

The patient is placed in the modified lithotomy position. The legs are placed in padded, adjustable stirrups. The legs are positioned in a 20-25° abducted position. The thighs have to be at or lower than the level of the abdominal wall, and the legs are held almost straight. Higher elevation may cause difficulty in manoeuvring the lower abdominal instruments. The patient is positioned so that the pelvis is just above the gap at the lower end of the operating table. This allows the surgeon free access to the perineum for intraoperative endoscopy, pelvic manipulation, perineal resection or transanal anastomosis. The patient is placed on a beanbag for fixation. An operating table capable of steep Trendelenburg and reverse Trendelenburg positions and right and left rotation is advisable to gravitate the small bowel out of the operating field at various stages of the procedure. The right hand and arm are tucked, padded and protected at the patient’s right side. The left arm is extended and allows excess for intravenous infusion (Figs. 1 and 2).

Instrumentation

A 30° laparoscope is used. Beside a cameraport, one or two 10-mm ports are introduced and another 12-mm port to admit the endostapler device. Rarely, another 5-mm port is used for suction or bowel retraction. The following laparoscopic instruments are essential in our setting:

1. Two endoscopic Babcock bowel grasping clamps
2. Ultrasonically activated scissors
3. Suction irrigation device
4. Linear stapling device
5. Endoscopic clip applicator
6. Curved scissors

Positioning of the surgeon and assistants

A set-up with two video monitors is used. One is placed at the patient’s left side, and the other is placed at the patient’s right side. The surgeon and assistant stand on the patient’s right side, and the nurse is positioned between the patient’s legs. An optional second assistant stands on the left side of the patient (Fig. 1).
Fig. 1  Position of the patient seen from above. S Surgeon, IA first assistant, 2A (optional) second assistant, AN anaesthesiologist, N nurse, V video screen

Fig. 2  Position of the patient seen from lateral. The legs can be lifted in case of an abdominoperineal resection
Operative technique
We used three or four ports: one for the 30° laparoscope, which is held by the assistant, two for the operating surgeon and another one for the assistant. Pneumoperitoneum is created using an open technique through a horizontal infraumbilical incision, and a 10-mm port is placed for the laparoscope. Two additional 10-mm ports are placed to allow flexibility in camera and instrument positioning. One port is placed in the right anterolateral position and one on the left anterolateral position.

A 10- to 12-mm port is placed in the right lower quadrant lateral to the epigastric vessels to permit entry of the endostapler in a later phase of the operation (Fig. 3). At the end of the procedure, the right lower quadrant port site is enlarged laterally so that no bleeding of the epigastric vessels will occur. Rarely, a fifth 5-mm trocar is placed in the left lower quadrant for additional retraction or concomitant suction.

The assistant holds the laparoscope with his right hand. The surgeon introduces an endoscopic Babcock with his left hand through the right anterolateral port and with his right hand the ultrasonically activated scissors through the 10- to 12-mm port in the right lower quadrant.

Once all the ports are placed, an initial laparoscopy is performed, and the abdomen and pelvis are assessed for metastatic disease. Only when the identification of the tumour is in doubt, intraoperative colonoscopy is performed. Placement of a noncrushing clamp or the unloaded endoscopic stapler across the distal ileum or colon prevents small bowel and colon distention during colonoscopy.

Dissection of the vessels
Once the peritoneal cavity and liver have been inspected for metastases, the patient is placed in steep Trendelenburg position and rolled to the right.
The omentum is placed superiorly above the colon and onto the liver and stomach, and with use of a closed endoscopic Babcock clamp, the small bowel is placed in the right upper quadrant.

Sometimes, the small bowel is difficult to remove from the lower abdomen because of adhesions between the small bowel and pelvic structures. Any adhesions therefore must be freed at an early stage. Sometimes, the peritoneal reflection at the ileocecral corner has to be opened to create more mesenteric length, and the small bowel will fall in the upper abdomen.

In female patients, the uterus is fixated to the anterior abdominal wall using a percutaneous suture with a straight needle. The stitch should pass through the skin and be tied over a piece of gauze to protect the skin and as a reminder to the surgeon to replace the uterus at the end of the procedure.

Using the 10-mm endoscopic Babcock clamp through the left-sided trocar, retraction of the sigmoid to the left facilitates the identification of the vascular trunk, inferior mesenteric artery and concomitant sigmoidal veins. The surgeon applies counter traction to the retroperitoneum using his Babcock grasper, and the retroperitoneum is incised caudal to the right of the vascular trunk, starting at the sacral promontory. At that level, the superior hypogastric plexus (SHP) is at risk. The main trunk of the SHP is most often slightly shifted to the left of the midsagittal plane across the abdominal aorta and its bifurcation. Using sharp dissection, the mesenteric vessels are swept ventrally, and the SHP and sympathetic hypogastric nerves at the sacral promontory are identified and left in place dorsally. Dissection then proceeds cephalic to the origin of the vascular trunk. The mesenteric artery and vein are identified, skeletonized and ligated separately using endoscopic clips introduced via the right lower quadrant port site. If the mesentery is thick or fatty, transillumination can be helpful.

**Pelvic dissection**

The next phase of the operation is the pelvic dissection and rectal mobilisation according to TME principles.

By using two endoscopic Babcocks introduced through both the left-sided trocar as well as the right anterolateral trocar, the sigmoid is lifted ventrally to open the retrorectal space. The peritoneum is incised along both sides of the rectum down to the peritoneal reflection. The dissection is initiated posterior to the rectum at the level of the sacral promontory. The avascular presacral plane between the parietal and visceral pelvic fascia is dissected, and the hypogastric sympathetic nerves are identified travelling anterolaterally across the aortic bifurcation, approximately 2 cm medial to the ureters bilaterally. Sharp dissection continues posteriolaterally until the junction of the mesorectum and pelvic autonomic nerve plexus is encountered. The pelvic autonomic nerve plexus consists of the anterior parasympathetic sacral nerve roots from S2 to S4 and the hypogastric sympathetic nerves previously identified. At this level, the autonomic nerves must be carefully dissected from the mesorectum. This dissection takes place just medial to the pelvic autonomic nerve plexus by dividing all transverse fibres. Nerve branches and vessels going directly to the rectum are divided, whereas branches going deeper into the pelvis are left undisturbed. At the level of the
fourth sacral vertebra, just caudal of the anterior curve of the sacrum, the rectosacral ligament (Waldeyer's fascia) is divided sharply to avoid tearing the mesorectum. The angle of dissection proceeds in an anterior direction to the pelvic floor.

Anterior dissection of the peritoneum in the rectovesical or rectovaginal pouch is usually performed last. Retraction of the rectum out of the pelvis with an opened endoscopic Babcock clamp is usually helpful in finding the prerectal space. Anterior elevation of the prostate by the assistant in a male patient or of the posterior vaginal wall in the female patient helps to provide appropriate tissue tension for dissection. Dissection is anterior to Denovillier's fascia, exposing the seminal vesicles bilaterally in male patients. In female patients, dissection occurs in the rectovaginal septum.

Complete circumferential dissection to the pelvic floor is facilitated by transanal digital palpation with visual confirmation of the finger using the laparoscope.

Division of the rectum is performed at least 2 cm below the lesion. At this level, the mesorectum is dissected until the rectal wall is reached.

Through the right lower quadrant port, an endoscopic stapler is introduced. Under laparoscopic guidance, a 45-mm linear endoscopic cutting stapler is placed in a perpendicular angle to the rectal wall to encompass the bowel between the blades. Visualisation of the blades on the contralateral side of the rectum ensures that only rectum is incorporated into the blades. The distal rectum is transsected.

**Splenic flexure and left colon mobilisation**

To provide adequate length for anastomosing the sigmoid to the distal rectum, splenic flexure mobilisation is necessary in less than half of the patients. If necessary, the left mesocolon and the sigmoid mesocolon are dissected from medial to lateral, through the peritoneal window starting medial of the inferior mesenteric vein. The underlying retroperitoneal structures, including the gonadal vessels, left ureter and Gerota's fascia that are left dorsally.

Dissection is continued laterally to the peritoneal attachments of the left colon and sigmoid, and mobilisation is achieved by dividing the lateral peritoneal attachments along the white line of Toldt. If more length is needed, mobilisation of the splenic flexure is performed. Finally, the greater omentum is freed from the transverse colon edge toward the midline as far as necessary.

**Colorectal anastomosis**

Before releasing the pneumoperitoneum through the trocars, a Babcock is placed at the proximal rectum. The specimen is removed through the right lower quadrant port. After the incision of the right lower quadrant port site is enlarged, a wound protector is introduced. Routinely, no chemical washout solutions are used. Then the mobilised descending colon and sigmoid are luxated into the wound.

The sigmoid mesocolon is now divided extracorporally. The vascular trunk defines the level of transection. At the level of the proximal resection line, a colotomy is created, the anvil of the circular stapler is introduced and the colon is transected distally from the anvil. The bowel is then returned to the peritoneal cavity, and a pneumoperitoneum is re-established. The final stage of the operation is the creation of a side-to-end anastomosis with a circular stapler.
The stapler is inserted transanally and under direct laparoscopic visual control advanced to the distal staple line. The spike is extended through the rectal wall just adjacent to the distal staple line. The correct orientation is verified (i.e. no rotation) for the proximal bowel. The laparoscope is moved to the right of left lower quadrant port to best visualise the anvil and stapler head coming together. The anvil is grasped with an endoscopic Babcock clamp through the right anterolateral trocar and attached to the spike of the circular stapler. This locking action requires that the axes of the centre rod and the centre post be in a perfect line.

The anastomosis is visualised to assess for completeness or any defects. The tissue donuts created with the circular stapler are checked for completeness, and the distal donut is sent for histopathological examination.

Despite the fact that all of our patients with rectal cancer receive preoperative radiotherapy, an ileostomy is not routinely performed. In patients with very low colorectal or colo-anal anastomoses, a loop ileostomy is performed. This can be performed with laparoscopic assistance and is placed in the right lower quadrant through the rectus abdominis muscle.

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The perineal phase by an abdominoperineal resection

In case of an abdominoperineal resection (APR), an omentoplasty is performed to prevent descending of the small bowel into the lower abdomen. If possible, closure of the peritoneum over the omentoplasty is performed.

The approach to this phase of the operation is identical to that required for open surgery. A non-suction drain is left behind in the perineal wound.

Constructing the colostomy by an abdominoperineal resection

After transsection of the bowel and removal of the specimen through the perineal wound, a Babcock is placed at the blind-stapled proximal end. This end can then be brought out to the left anterolateral port site. After the perineal and abdominal wounds are closed, the staple line is excised and the colostomy is fashioned in the standard manner.

Postoperative care

A diet of clear liquids is started on the first postoperative day and advanced to a normal diet as tolerated. Pelvic drains are removed on the third to fifth postoperative day depending on production. The urinary catheter is removed the day after the epidural catheter is removed.

Discussion

Laparoscopic resections for colon cancer seem to be equal in terms of tumour recurrence and cancer-related survival\textsuperscript{16, 17}. Whether the oncological safety of LTME is the same as for OTME remains to be seen, as long survival, local recurrence rates and the effects of adjuvant therapy are not known yet.
Next to the short-term benefits of LTME, another advantage of the laparoscopic approach is the improved visibility by magnification, angled optics and by good illumination of the operation field. Though this may facilitate identification and preservation of the autonomic pelvic nerves, Quah et al.\(^2\) described in a retrospective study a higher rate of male sexual and bladder dysfunction after laparoscopically assisted TME compared with OTME. This may be related to technical difficulties in the laparoscopic group. All patients with postoperative bladder or sexual dysfunction were operated on for either locally advanced rectal cancer or had low or abdominoperineal resections. As with all operations, success depends not only on surgical expertise but also on case selection. According to our protocol, patients with advanced T3 and T4 rectal carcinoma diagnosed on magnetic resonance imaging preoperatively are not operated laparoscopically. A tumour-free circumferential resection margin of at least 2.0 mm can be predicted with a high degree of certainty when the measured distance on MRI is at least 6.0 mm\(^{19}\). An advanced T3 tumour was defined when the MRI distance was less than 6.0 mm.

By pathological evaluation, a circumferential margin of <2 mm is associated with a risk of 16% of local recurrence within 2 years of operation, whereas patients with margins >2 mm have a risk of 5.8%\(^{18}\).

Rullier et al. reported in a prospective study that sexual function was preserved in 10 of 18 (56%) sexually active men after LTME. All these patients were operated on because of a low rectal carcinoma (5 cm from the anal verge) and received preoperative radiotherapy\(^{19}\).

Although there is some loss of tactile sensation with laparoscopic surgery, this sensation is not lost completely because this feeling is transmitted via the instrument to the hand of an experienced laparoscopic surgeon. However, a small rectal tumour may be difficult to identify without being able to palpate the rectum as in open surgery; this problem might be solved with an intraoperative colonoscopy and injecting dye at the site of the lesion, which can be seen at laparoscopy through the serosa.

As we use a linear endostapler, which is introduced via the right lower quadrant port, it is sometimes difficult to obtain a truly perpendicular staple line. To our opinion, a slightly oblique staple line will not increase the difficulty of creating an anastomosis using the circular stapler and thus jeopardize the integrity of the anastomosis. With the introduction of articulating endostaplers, a transverse staple line may be made easier.

Because of the smokeless nature of the ultrasonic energy and the associated minimal tissue trauma, we use ultrasonically activated scissors instead of diathermy. Its reliable hemostasis ensures that a clear dissection can be made in a dry surgical field\(^{20}\).

A disadvantage to LTME is a prolonged operating time\(^{4,21}\). Although operating time may be partially related to the learning curve associated with a new technique, most surgeons who perform LTME are well beyond this learning curve.

The operative cost of LTME is more expensive than OTME because of longer operating time and the use of additional laparoscopic devices. No cost-effectiveness studies of laparoscopic colectomy or LTME have been reported yet\(^{22}\).

The goal of rectal cancer treatment remains, next to oncological improvement, good quality of life. In our experience, the concept of preservation of the autonomic nerves during LTME seems feasible and might provide patients with an improved quality of life. However, randomized trials investigating functional outcome, like bladder and sexual function, are needed to verify the benefit of laparoscopic TME-ANP compared with OTME.
Reference list


Technique for laparoscopic autonomic nerve preserving total mesorectal excision