Laparoscopic Colectomy: the Absolute Need for a Standard Operative Technique

E. Croce, M. Azzola, R. Russo, M. Golia, S. Olmi

ABSTRACT

Background: The aim of this study is to review our experience performing laparoscopic colon surgery and to present the operative technique as used and standardized by us.

Methods: From April 1992 to December 1996, 158 consecutive patients underwent laparoscopic colon surgery. There were 92 females and 66 males, whose average age was 66.7 years (range 31 - 92); 134 patients (84.9%) were operated on for carcinoma, and the remaining 24 (14.1%) for benign disease.

Results: There were 117 procedures completed laparoscopically out of 158 patients (74%); 103 colon resections (18 for benign disease and 95 for malignant disease), 7 Hartmann procedures, 3 for reversal of Hartmann's procedures, 1 rectopexy, and 3 ileotrasversostomies. Conversions were required in 41 out of 158 cases (25.9%); 19 of these cases, however, were converted to a laparoscopic-facilitated procedure. The most common causes for conversion were the presence of bulky tumors and/or tumors that contaminated adjacent structures (16/158), adhesions due to previous operations (8/158) or patient obesity (5/158). There were 31 complications (19.6%), 9 of which required re-operation. There was only one recurrence (0.9%) that manifested 15 months after the procedure, at both trocar and drainage sites, and with peritoneal carcinomatosis. This occurred in a patient with rectal neoplasia who suffered a perforation of the rectum during dissection, with bowel spillage. The average number of lymph nodes harvested in resected specimens was 12.8 (range 1-41), whereas the mean distance of the tumor from the proximal margin of resection was 11.5 cm (range 5-35), and from the distal margin 7.5 cm (range 1-25). The average operative time was 165 minutes (range 40-360), and the mean hospital stay was 9.2 days (range 6-40). There were three mortalities out of 158 patients (1.9%).

Conclusions: Laparoscopic colon resection for malignant lesions, performed with the highest respect for oncologic principles, has demonstrated that it is difficult to develop a barrier to wall and intraluminal recurrence. Recurrence, in our opinion, is caused by improper surgical technique. Therefore, neoplastic colon laparoscopic surgery must be the prerogative of selected and specialized centers.

Key Words: Laparoscopy, Colorectal tumors, Wall recurrence, Surgical technique of colon resections.

INTRODUCTION

In laparoscopic colorectal surgery, the adherence to radical principles of oncology has always been a controversial issue. The need for a standard procedure in laparoscopic colon surgery that follows the oncologic principles of traditional surgery is highlighted by the rise in recurrences at both trocar sites and the minilaparotomy through which the specimen is removed. We firmly believe that such recurrences are caused by improper surgical technique or by the lack of adequate theoretical and practical preparation by the surgeon.[4] Laparoscopic colon surgery requires considerable experience in the field of traditional colon surgery and a long learning curve. An excellent knowledge of laparoscopic technique, manual dexterity and technical maturity is required that is only acquired after having performed operations with increasing levels of difficulty.[8]

The main oncologic principles in performing a correct colon resection are summarized as follows:

1) Avoid touching the tumor (no-touch technique). As many have pointed out, this contact is responsible for intraperitoneal neoplastic dissemination.[3,4,7] Instruments, gloves and retractors may be infected with the tumor cells. As an increasing number of wall recurrences are recorded in the literature, it is clear that some surgeons perform a "touch technique."
2) First ligate the vascular pedicles.
3) Execute an adequate lymphadenectomy with the removal of the mesentery to the involved segment.[3,6]
4) Develop proper resection margins.[3,6]
5) Perform a minilaparotomy appropriate for the size of resected bowel in order to avoid "squeezing" the tumor. From a functional, clinical or cosmetic point of view, a 7-8 cm incision instead of a 3-4 cm incision is, in our opinion, of little importance when compared to the risk of wall recurrence.[5,7]
6) Protect the minilaparotomy site through which the

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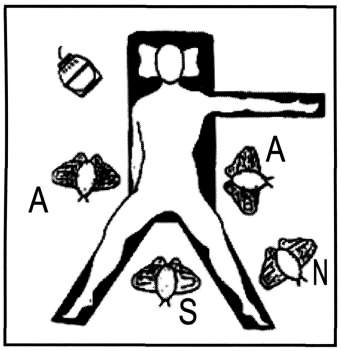

Figure 1. Position of patient and surgical unit during laparoscopic right hemicolectomy (S=surgeon; A=assistant; N=nurse).

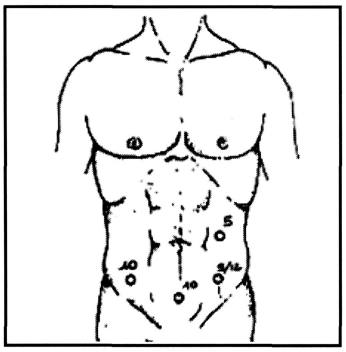

Figure 2. Trocar sites in laparoscopic right hemicolectomy.

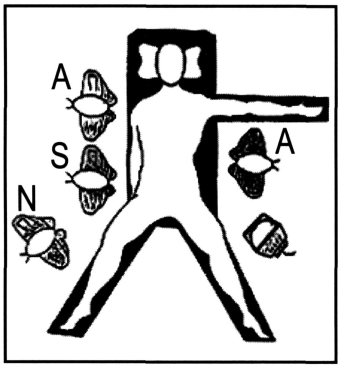

Figure 3. Position of patient and surgical unit during laparoscopic left hemicolectomy (S=surgeon; A=assistant; N=nurse).

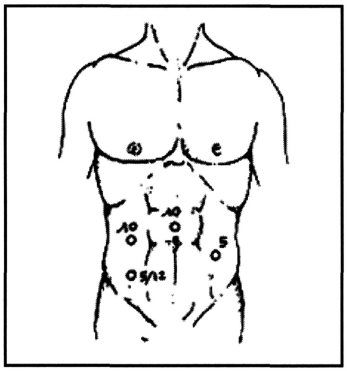

Figure 4. Trocar sites in laparoscopic left hemicolectomy.

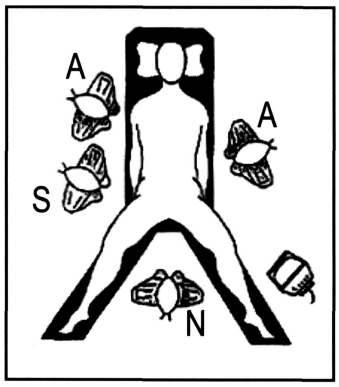

Figure 5. Position of patient and surgical unit during laparoscopic abdominoperineal resection (S=surgeon; A=assistant; N=nurse).

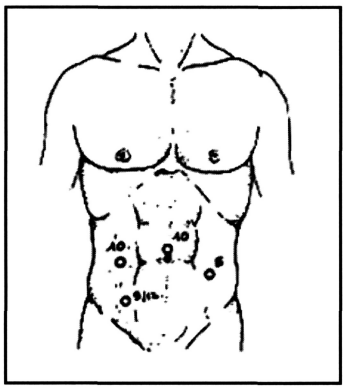

Figure 6. Trocar sites in laparoscopic abdominoperineal resection.

bowel is to be delivered with wall protectors, such as a 20-25 cm piece of transparent plastic bag used to cover the camera. When the neoplastic segment is inside this plastic tube, it is important to exteriorize it together with its bag, avoiding any contact with the abdominal wall. Also segregated are segments of the bowel that must be kept and that could "collect" tumoral cell inside the plastic bag.

We distinguish three kinds of laparoscopic colectomy:

1) Complete laparoscopic resections: when mobilization, ligation of the vessels and anastomosis are completed inside the peritoneal cavity and the specimen is removed through a minilaparotomy incision or transanally.
2) Laparoscopic assisted resections: when the bowel resection and the anastomosis are performed outside the peritoneal cavity through a small muscle-splitting incision of the abdominal wall. Mobilization, ligation of the vessels, and bowel dissection are completed inside the peritoneal cavity.
3) Laparoscopic facilitated resections: when laparoscopy is used only to mobilize the bowel; a small laparotomy is necessary to complete the procedure.

The most frequent operations for curative resection of colorectal carcinoma are: right hemicolectomy, left hemicolectomy, transverse resection, resection of the rectum utilizing the Miles procedure (for neoplasias less than 6 cm from the anocutaneous rim), and anterior rectocolonic resections.

MATERIALS AND METHODS

From April 1992 to December 1996 we performed laparoscopic colon surgery on 158 non-selected patients; 66 males and 92 females, with an average age of 66.7 years (range 31-92). One hundred and thirty-four patients (84.9%) were operated on for adenocarcinoma, and the remaining 24 (14.1%) for benign disease (1 cecal angiodysplasia, 1 rectal prolapse, 1 rectosigmoid endometriosis stenosis, 2 reversal of Hartmann's procedures, 13 sigmoid diverticulitis, 6 adenomas that could not be removed endoscopically).

All patients underwent complete blood tests (including CEA in neoplastic patients), thorax X-ray and EKG. More specific examinations included barium enema (necessary for a morphologic study of the colon), colonoscopy, and, subsequently, echographia, abdominal and pelvic CT scan in the case of neoplastic pathology. The patients were placed on a clear liquid diet two days before surgery, and given a dose of magnesium sulfate the day before surgery to expel any fecal residue. Patients received third-generation cephalosporin antibiotic, intravenously or intramuscularly, during pre-anaesthesia, 4 and 12 hours after the procedure.

The administration of antibiotic was protracted if the patient's postoperative condition required it.

OPERATIVE TECHNIQUE

It is important to highlight some of the drawbacks associated with a laparoscopic approach in performing rigorous surgical technique. Besides the difficulties inherent in execution of a complex operation, the main problem of laparoscopic vision is a reduced field of view which can mislead the surgeon in identification of pedicles and structures. It is important, therefore, to identify particular reference points that guide the surgeon in performing the different operations. Experience has taught that for the right colon these reference points are the superior mesenteric pedicle, the middle colic artery and the right genito-ureteral pedicle. For the left colon they are the right iliac artery, the anterior aortic plane, and the duodenum-jejunal angle, whereas for the rectum they are the vesicolodeferential complex in the male, the vaginal peritoneal reflection in the female, and the floor of the pelvis.

RIGHT COLECTOMY

In video-laparoscopic right hemicolectomy the specimen must be removed through a minilaparotomy incision. For this reason, although it is possible to construct the ileocolic anastomosis laparoscopically, it is advisable to perform the anastomosis extracorporeally, using the minilaparotomy site for extraction of the specimen and segments that have to be anastomosed. This makes the procedure easier and can reduce operative time. If one performs the anastomosis extracorporeally, the localization of its site must take into account cosmesis and the cutaneous incisions for trocar insertion, the mobility of the visceras that must be anastomosed outside the abdominal cavity, and the easiest way in which the anastomosis can be accomplished. The minilaparotomy incision is identified by bringing to the abdominal wall the bowel proposed for the site of the anastomosis.

The patient, under general anesthesia, is positioned in a supine position with legs apart. The monitor and laparoscopic instruments are placed behind his head, on the patient's right side. The operating surgeon is positioned between the legs of the patient, the second surgeon to the right of the operator, and the camera operator on his left **(Figure 1)**.

After induction of pneumoperitoneum 15 mm Hg, a 10 mm trocar is inserted in the upper midline, and a laparoscopic exploration of the abdomen performed in order to choose the most suitable procedure and position of the remaining trocars. Two 5/12 mm trocars are placed in the left and right iliac fossa, and a 5 mm trocar in the left flank, which makes a total of four trocars **(Figure 2)**. The transverse colon is lifted and the region examined down to the ileal loop. The superior mesenteric artery is identified, and the posterior peritoneum incised on its salience. The ileocolic and right colic arteries are secured and dissected between clips or extracorporeal non-absorbable knots. The middle colic artery, last ileal loop and cecum are dissected and mobilized. The opening into the right parietocolic gutter is begun from the ileocecal valve and continued upward, remaining in the avascular fascia of Told. The ureter and the third segment of the duodenum is visualized. During this dissection, even if performed in an avascular plane, injury may occur to the iliac vessels. Bulky tumors and adhesions can hamper the correct definition of structures. The colon is retracted medially, and detachment from the right flexure completed. The distal ileal loop, after mobilization, is dissected with aid of a 30 mm intestinal stapler (Endo GIA 30 Auto Suture, U.S. Surgical Corp.), which can be used to divide the bowel and mesentery. The ileocolic segment and transverse colon are mobilized, delivering the protected specimen through a transverse muscle-splitting minilaparotomy incision in the right hypochondrium. An ileocolic, side-to-side extracorporeal anastomosis is performed with continuous monolayer suture, using a slow-absorption thread. After suturing the mesentery defect, the bowel is placed back into the peritoneal cavity and the pneumoperitoneum reinsufflated. The results of the procedure are assessed laparoscopically, and, if necessary, suture of the mesentery completed. Most authors advise against performing the anastomosis intracorporeally, because of its long execution and avoidable technical difficulties. The operation is completed by positioning a non-aspirating drain in right parietocolic position, inserting it through the right iliac fossa trocar site.

LEFT COLECTOMY

The regions exposed during this operation are: 1) the inferior mesocolic region for ligature and dissection of the inferior colic vessels; 2) the pelvis; 3) the left parietocolic gutter; 4) the splenic flexure; 5) the pelvis, for execution of the anastomosis. The main drawback to these expositions arises from the small intestine, which must be moved with great calm, grasping it carefully with atraumatic forceps. The indispensable means of exposure is gravity.

The patient is placed in a supine position, with legs apart, right arm folded, and the left arm extended. The patient must be secured to the operating table with shoulder and flank stirrups, so that he can be rotated through different positions during the procedure that will allow for exposure of the operative field. It is useful to have two monitors. However, if only one monitor is available it should be positioned behind the patient's left foot. The monitor is moved behind the patient's left arm during exposure of the splenic flexure. Place the monitor on a mobile truck along with the insufflator, camera, and light source. Cables and tubes

must be of a sufficient length and enter the operative field on the patient's left side. If there are two monitors, the second one is placed behind the patient's left shoulder. The operating surgeon, with a camera person on his left, is positioned on the patient's right side and the assistant is on his left.

Four trocars are used: one 5 mm, two 10 mm, and one 5/12 mm for the mechanical stapler. To make the instruments as interchangeable as possible, however, it is better to use single-gauge trocars, furnished with a universal adapter and valve that allows for instruments to be inserted without using pistons or anything else that requires another hand (Versaport 5/12 mm, U.S. Surgical Corp.). The protracted use of multiple access sites and different instruments requires great care to avoid enlarging the cutaneous incisions and unnecessary spillage of carbon dioxide. It is important to avail oneself of wall stirrups as well.

Pneumoperitoneum is initiated with the insertion of a Veress needle. The first trocar, 10 millimeter in diameter, is placed in the right paraumbilical site and used to pass a 30 degree laparoscope for exploration of the pelvi-abdominal cavity. It is useful to perform an eco-laparoscopy to more completely evaluate intraoperative staging. The three remaining trocars are positioned in the following sites: a 10 mm trocar at the junction of the right anterior axillary line with the transverse umbilical line through which the laparoscope is placed during the whole operation except during preparation of the rectum and creation of the anastomosis, at which time the laparoscope is placed through the paraumbilical trocar; a 5 mm trocar at the left anterior axillary line 3-5 cm cranial to the transverse umbilical line; a 5/12 mm trocar in the right iliac fossa **(Figure 4)**. To avoid intraoperative wall and visceral complications, perform the incision for trocar insertion with wall transillumination, and pass the trocars under direct vision. The operating surgeon performs the ligation and transection of the vascular pedicles, and incision of the mesorectal and mesenteric radix, while positioned on the patient's right side. To feel more comfortable, the operator can move between the patient's legs during mobilization of the splenic flexure.

The first portion of the procedure always involves ligation of the vascular pedicles. After the omentum is placed over the transverse colon, the small bowel loops are moved, in such a way that exposes the peritoneum overlying the aorta. The peritoneum is incised medially to the right ureter in front of the right iliac artery. Then proceeding upwards, the origin of the superior mesenteric artery is identified. This area can be visualized with lateral retraction by the assistant of the sigmoid towards the left anterior wall of the abdomen. The pedicle is ligated and divided between extracorporeal knots (2), clips or by using the stapling cutter.

At the beginning of our experience we performed a double ligation with extracorporeal knots. Now, we divide the vessels between metal clips, leaving proximally two or three clips. In a few cases we used a vascular stapler (Endo-GIA 30) to secure sclerotic vessels or mesenteric fat which bleeds easily. The ligament of Treitz is identified as well as the inferior mesenteric artery. The latter is ligated and dissected in the same way as the former. After the vessels have been divided at their origin, the mesentery is detached from the posterior plane, after identification of the left ureter through a mesenterial "window" over the left iliac artery. After incision of the superior hypogastric lamina, the posterior pre-sacral plane is detached, and we proceed to reflect the anterior sigmoid-rectal peritoneum, following the right ureteral pedicle and the iliac artery.

Mobilization of the sigmoid loop is continued on the left side, preserving the left ureter, down to the anterior junction of a peritoneal incision performed in the pre-vesical plane in male patients. In female patients, the uterus is brought forward and suspended by two endoparietal stitches to permit dissection in the recto-vaginal region. After the surgeon has moved between the patient's legs, division of the parietocolic reflection is completed, moving up to the splenic flexure, and mobilizing the transverse colon where needed. The rectal resection margin is then prepared, skeletonizing the segment, coagulating and trimming fat, until the rectum structures are clearly visible. Curved laparoscopic scissors greatly facilitate this dissection. It is quite easy, then, to identify the superior hemorrhoidal vessel and its branches, which are divided between metal clips or with bipolar coagulation. Resection and closure of the distal margin is performed using a mechanic stapler. If the rectal segment has been accurately prepared for the resection, the use of an endo-GIA doesn't cause any particular problems. We prefer a 30 mm stapling device, although generally two cartridges are needed because in a small region, such as the pelvis, multiple firings make the procedure easier. The dissection is performed with aseptic technique. Mobilization of the colon for anastomosis is tested, checking to see if the descending colon will approximate the rectal stump. After determining the proximal extent of resection, it is useful to mark this position with one or two clips so that its identification is easier when the bowel is exteriorized. A McBurney muscle-splitting laparotomy incision is fashioned in the left iliac fossa sized to accommodate the resected bowel. We introduce, through the incision which is kept open with dilators, 20-25 cm of the transparent plastic bag used to cover the camera. The transected colic stump is exteriorized by grasping it with Duval forceps. When the neoplastic segment is inside the plastic tube, it is exteriorized together with its plastic bag, avoiding in this way any contact with the abdominal wall. After the colon is delivered, resection of the anastomotic artery of Drummond is completed. The proximal colonic section is closed with a purse-string suture after the stump

has been dilated and the anvil of the circular stapler inserted. The anvil is then grasped with a clamp introduced through the right flank trocar site and the bowel replaced in the abdomen. In this way it is possible to avoid loss of time in grasping the stapler head, and, most of all, possible torsion of the bowel. To perform an end-to-end, transanal anastomosis, it is better to use the latest generation of circular staplers (Plus CEEA, U.S Surgical Corp.), furnished with a dumping head, which avoids any tension on the anastomosis at the moment of removing the stapler. After suture of the minilaparotomy, the peritoneal cavity is reinsufflated, and, having introduced the circular stapler transanally, the rectal stump is perforated, and the stapler head coupled, performing a Knight-Griffen, end-to-end anastomosis. Besides checking the colic and rectal doughnuts left in the circular stapler, we always test the anastomosis. After the colon is re-approximated, the pelvis is filled with physiological saline. The rectal lumen is insufflated with air through a large-gauge Foley catheter until the anastomotic segment is distended, to assure that the anastomosis is airtight. The operation is completed with placing of a retroanastomotic drain that exits the right iliac fossa trocar port.

ANTERIOR RESECTION OF RECTUM

The patient, surgical unit and port accesses are positioned essentially in the same way as in left hemicolectomy **(Figures 3-4)**. In female patients, it is important that the uterus be suspended up and away by a transcutaneous stitch. There is no particular difficulty in detaching the rectum from the presacral plane. Anterior and lateral to the rectum, it is useful to identify and define the ureters and, in male patients, the vas deferens and seminal vesicles. To avoid sinking into perirectal fat, one should remain on the plane of the urogenital organs and the aponeurosis of Denonvillier. During this phase of the operation it is beneficial to utilize the bipolar graspers for hemostasis and transection of the middle hemorrhoidal vessels and alar ligaments of the rectum. Some deem it necessary to check the distal margin of resection, performing an intraoperative rectoscopy without traversing the tumor and spilling neoplastic cells. In some cases it is useful to insert an additional trocar in the suprapubic region to perform a perpendicular transection of the rectum, avoiding the necessity of exteriorizing, transanally, the rectal stump. A Knight-Griffen end-to-end anastomosis is performed with a circular stapler. The operation is completed testing the anastomosis and positioning a peri-anastomotic drain to exit the inferior right trocar port. In very low resections it is better to perform the division and purse-string suture of the distal stump by hand, in some cases after the stump has been delivered transanally. Hand-suturing is frequently necessary because linear staplers are difficult to maneuver in the tight confines of the pelvis and there may occur a postoperative anastomotic leak with improper placement of the staple unit.

LAPAROSCOPIC ABDOMINOPERINEAL RESECTION

The patient is placed in a gynecologic and Trendelenburg position, with shoulders, chest and legs firmly secured to the operating table. The operating surgeon and camera person are positioned at the patient's right side, the assistant at the left, and the monitor next to the patient's left foot **(Figure 5)**. Having induced pneumoperitoneum with a Veress needle inserted in the right paraumbilical region, the first trocar is positioned in the same site. Laparoscopic exploration of the abdominal cavity is performed. Placing the remaining trocars is accomplished in a way that allows visualization of the pelvis, sigmoid colon and inferior mesenteric artery. A second trocar is placed in the left pararectal region, at the site at which colostomy is to be performed. During this phase of the operation, great care must be taken to avoid damage to the epigastric vessels that flow in this region. This concern is easily overcome with transillumination of the abdominal wall from inside the body cavity with the laparoscope. Two additional trocars are placed in the right flank and one in the right iliac fossa **(Figure 6)**. These two trocars should be spaced to prevent clashing of the instruments during their use.

After the loops of the small bowel are moved upwards to the right, the peritoneum is incised anterior to the right iliac artery and medially to the right ureter. Moving upwards, the origin of the inferior mesenteric artery is identified. Dissection in this region is facilitated by lateral retraction of the sigmoid upwards toward the anterior left abdominal wall by the first assistant utilizing bowel forceps. Dissection is continued to the left, until ureter and left genital vessels are visible. These structures are isolated and detached from the mesosigmoid. The inferior mesenteric artery is ligated at the origin of the left colic artery, with metal clips, a vascular stapler such as Endo-GIA 30, or with extracorporeal knots. If the inferior mesenteric vein flows close to the artery, it can be sectioned together with it. If the mesenteric vein is not in close approximation, it is isolated and ligated separately. After having detached the ureter and left genital vessels, the mesosigmoid is divided with bipolar forceps, metal clips, or staples, care being taken to secure the mesenteric and marginal vessels. After the sigmoid is detached from its mesentery, it is divided using a 30 mm Endo-GIA with vascular cartridge. Dissection is continued towards the pelvis, dividing the peritoneum on both sides of the rectum. During this phase, the left ureter must be identified and protected. The rectum and its mesentery is then subject to a posterior, lateral, and finally anterior mobilization. Using a 10 mm palpation probe shaped like a paddle (Karl Storz GmbH), it is possible, to completely detach the mesorectum from the sacral plane. After the alar ligaments of the rectum are coagulated and divided, the rectum is retracted upwards, and dissection continued down to the floor of the pelvis, perform-

Table 1.
Laparoscopic colorectal procedures (April 1, 1992 - December 31, 1996).
(b = benign; m = malignant)

Operation	Patients	Assisted	Facilitated	Converted	%
Right colectomy	28 (2b/26m)	**20 (2b/18m)**	2 (m)	6 (m)	**71 %**
Left colectomy	60 (16b/44m)	**48 (13b/35m)**	7 (3b/4m)	5 (m)	**81 %**
Miles	12 (m)	**10 (m)**	0	2 (m)	**83.3 %**
Anterior resection	30 (2b/28m)	**19 (1b/18m)**	8 (1b/7m)	3 (m)	**63.3 %**
Transverse resection	4 (2b/2m)	**4 (2b/2m)**	0	0	**100 %**
Left flexure resection	4 (m)	**2 (m)**	2 (m)	0	**50 %**
Hartmann's	13 (m)	**7 (m)**	0	6 (m)	**58.3 %**
Reversal of Hartmann's	3 (2b/1m)	**3 (2b/1m)**	0	0	**100 %**
Rectopexy	1 (b)	**1 (b)**	0	0	**100 %**
Other	3 (m)	**3 (m)**	0	0	**100 %**
Total	158 (24b/134m)	**117 (20b/97m)**	19 (4b/15m)	22 (m)	**74.1 %**

Table 2.
Causes of conversion.

Bulky tumors and/or contaminating adjacent structures	16/158	10.1 %
Adhesions	8/158	5 %
Obesity	5/158	3.1 %
Difficult mobilization of the rectum	3/158	1.8 %
Resectable metastases	2/158	1.2 %
Intraoperative hypercapnia	2/158	1.2 %
Imperfect anastomosis	2/158	1.2 %
Ureteral injury	1/158	0.6 %
Tumor not visualized	1/158	0.6 %
Difficult coloepiplioc detachment	1/158	0.6 %
Total	41/158	25.9 %

Table 3.
Intraoperative and postoperative complications.

Complications	Pts.	Reoperation
Anastomotic leak	4	2
Anastomotic fistula	6	2
Wound infection	7	
Hemorrhage	4 (1 intraoperative)	1
Anastomotic stenosis	4	2
Colic iatrogenic perforation	1	1
Vesicle injury	1 (intraoperative)	
Ureteral injury	1 (intraoperative)	
Rotation of the anastomosis	1	1
Rectovaginal fistula	1	
Obstruction	1	
Total	31/158 (19.6 %)	9/158 (5.6 %)

ing a complete cleansing of the region. The descending colon is then mobilized so that it can reach the site of the colostomy without tension, i.e. the site in which the left trocar had previously been positioned. The proximal section of colon is transected with a mechanic stapler. The segment to be resected is put into the pelvic cavity. The perineal phase of a laparoscopic Miles operation follows the same sequences as in traditional surgery. The perineal wound is closed with separate stitches after the specimen has been delivered transanally. A drain is positioned in this site. It must be noted that the bony structure of the pelvis permits laparoscopic inspection without creating a pneumoperitoneum as well, allowing a check of hemostasis even when the incision is open.

RESULTS

There were 117 laparoscopic procedures completed out of 158 patients (74.1%): 103 resections, 95 of which were for malignant disease and 18 for benign disease, 7 Hartmann's procedures for malignant neoplasias, 3 reversal of Hartmann's procedures (two for a benign lesion and one for a malignant one), 1 rectopexy and 3 ileotransversostomies **(Table 1)**. There were 41 conversions out of 158 cases (25.9%); 19 cases (12%), however, were converted to a laparoscopic-facilitated procedure. The mortality rate was 1.9% (3/158), because of one anastomotic leak and one respiratory insufficiency in two laparoscopic facilitated procedures, and because of one cerebral ischemia in a converted case. The most frequent causes of conversion were bulky tumors, tumors contaminating adjacent structures (16/158), adhesions due to previous surgical operations (8/158), or patient obesity (5/158) **(Table 2)**. As one can see, the percentage of feasibility decreases significantly in resections of the rectum, dropping to 63.3% **(Table 1)**. In our series, this was due to anatomic or pathological reasons, such as large neoplasias, contamination of surrounding structures, or the patient's obesity, occurrences that made vision and laparoscopic moves in the pelvic cavity difficult. There were 31 complications (15%), only three during the operation; one because of a vesicle injury, solved intraoperatively, another because of an ureteral injury at the beginning of our experience which required conversion, and another because of damage to the epigastric vessels caused by a trocar and managed with a transcutaneous suture **(Table 3)**. There was only one (0.9%) wall recurrence, 15 months after the operation, at both trocar and drainage sites, with peritoneal carcinomatosis, in a patient with rectal neoplasia, who suffered a perforation of the rectum during dissection, with bowel spillage. The average number of lymph nodes harvested in resected specimens was 12.8 (range 1-41); the mean distance of the tumor from the proximal margin of resection was 11.5 cm, from the distal margin, 7.5 cm (range 1-25). The postoperative stage was: Dukes' A 15 pts; Dukes' B1 8 pts; Dukes' B2 45 pts; Dukes' C1 2 pts; Dukes' C2 33 pts; Dukes' D 9 pts. The mean operative time was 165 minutes (range 40-360). The average hospital stay was 9.2 days (range 6-40). The administration of narcotics was remarkably reduced compared to open surgery, and was limited to non-morphinic analgesics for no longer than two days after the operation. On postoperative day two, after the passage of flatus, liquids via phleboclysis came to an end, and patients were placed on a liquid diet. On postoperative days three and four they resumed a regular diet. Patients could be discharged on postoperative day four, but we usually preferred to protract their hospital stay until the eighth day, to monitor any anastomotic leak. The patients were allowed to perform physical activity 10 or 15 days after surgery including heavy labor. Heavy physical activity occurred at least 50 days earlier than in open surgery.

CONCLUSIONS

We can affirm that the activity of Italian surgeons in this field began with only a few followers in 1992. This approach has rapidly interested other centers, stirred by the issue of feasibility. However, each has followed his own path, and scant attention has been paid to the issue of establishing a standard technique. This issue is of primary importance in order to generate reproducible data and be able to compare results. Nevertheless, case reports have grown richer and richer, and patient selection has become more accurate. Most of all, a thorough laparoscopic exploration can be performed and accurate staging of neoplastic disease made at the beginning of each operation, leading to better identification of those patients that will benefit from this technique.

The technique of laparoscopic colectomy as described by us lends itself to standardization and respects the highest oncologic principles. It is difficult to develop a barrier for endoluminal contamination, but failure to do so can be ascribed, in our opinion, to improper or imperfect surgical technique.

There is in minimally invasive surgery, and most of all in advanced cases, an extended learning curve for the surgeon who has to practice for a long period of time before reaching that level of manual dexterity and expertise necessary to complete the same kind of operation performed in an open fashion. This must not, however, dissuade the surgeon from performing an oncologic operation. It is important at this juncture for laparoscopic colon surgery to remain in the hands of selected and highly specialized centers, because of the necessity for controlled clinical studies. It will be the primary duty of institutions responsible for surgical training to ensure that this approach becomes widespread, and maintain that rigor and adherence to the oncologic principles of exeresis that must be observed.

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