

A comparative analysis between laparoscopy and open colectomy: assessment of perioperative and oncological outcomes



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AIM: Aim of the study was to compare two groups of patients affected by colorectal adenocarcinoma that underwent to open colectomy and laparoscopic colectomy respectively, highlighting the advantage and problems.

MATERIAL OF STUDY: This is a retrospective analysis. Between January 2003 and December 2006, 54 patients who underwent colectomy were recruited. Of these, 26 patients underwent open colectomy, and 28 laparoscopy.

RESULTS: For open colectomy the average duration of surgery was 177.9 minutes (surgical time) and 280.4 minutes (time of operating room) with a minimum of 110 and a maximum of 360 minutes, with significant differences according to type of surgery performed and the patient's clinical history. For laparoscopy the average duration was 293 minutes, (range 135 - 520), with significant differences depending on the portion of the intestinal tract removed.

DISCUSSION: The comparison of two different surgical techniques, laparoscopic and open colectomy revealed some differences. The duration of the resection was greater for laparoscopy when compared to the traditional technique.

CONCLUSIONS: Both approaches are technically feasible, safe and oncologically correct. Laparoscopic technique shows a much more favorable outcome in terms of pain, absence of extensive scarring, the incidence of incisional hernias and hospital stay -surgery compared with surgery laparotomy.

KEY WORDS: Colon, Rectum, Laparoscopy, Open colectomy

Introduction

Colorectal cancer (CRC) represents the third most commonly diagnosed cancer in males and the second in females, with over 1.2 million new cases and 608,700

deaths estimated in the world ¹. In Italy its incidence is reported to be around 35000 new cases/year and in Emilia Romagna, North Italy, it's calculate approximately to 3400 new cases/year with a small prevalence in the males ^{2,3}. Although the most important prognostic factor is represented by the tumor stage at diagnosis, in many cases surgery remains an important therapeutic tool, especially when radicalism is expected. Currently the laparoscopy represents the standard operative technique for colorectal cancer together with open colectomy ⁴.

Aim of the study was to compare two groups of patients affected by colorectal adenocarcinoma that underwent to

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open colectomy and laparoscopic colectomy respectively, highlighting the advantage and problems.

Methods

This is a retrospective analysis of data from the authors' prospectively collected colorectal surgery database. Between January 2003 and December 2006, 54 patients who underwent colectomy at the Department of Surgery of our Hospital were recruited. Of these, 26 patients underwent open colectomy, and 28 laparoscopy. All patients received prophylaxis with low molecular weight heparin, antibiotic prophylaxis with a cephalosporin, worn elastic stockings "anti-thrombus" before and after surgery.

Histopathological classification, pTNM status followed the current guidelines^{4,5}. Clinical and surgical data, including the post-operative outcome were collected from surgical databases and the pathological findings were obtained by the histological records of the Pathology Department of Modena.

The statistical significance of differences in clinical and biological data between cases and controls was determined by χ^2 test or Fisher's exact test (for categorical data), and Wilcoxon-Mann-Whitney test (for continuous variables).

Logistic Regression was carried out in order to verify which factors were independently associated with the presence of micrometastasis in the lymph nodes.

Moreover, we used this Cox Regression model to assess the possible independent role of different variables (clinical data, morphologic parameters and micrometastasis) in the prognosis of stage I colorectal cancer patients.

Patients were all followed-up at our Institution and disease free survival was defined as the interval between surgery and the first documented evidence of disease in local-regional area and/or distant sites. Overall survival was defined as the interval between surgery and death due to the disease.

Results

OPEN COLECTOMY

Were subjected to laparotomy surgery 26 patients (14 males and 12 females), with a mean age of 68.3 years (range 53-86 years). The histological diagnosis was in all cases of adenocarcinoma and lesions were located in the cecum (8 cases), in the right colon (5 cases), left colon (2 cases) in the sigmoid colon (9 cases) and rectum (2 cases). Surgical and pathological data are shown in Table I - Panel A.

LAPAROSCOPIC TECHNIQUE

Twenty-eight subjects (17 males and 11 females), with

a mean age of 67.7 years (range of 40-84 years) underwent laparoscopy. In 25 cases the histological diagnosis was adenocarcinoma while 3 reported a large polypoid adenomatous lesion with villous architecture and high-grade cellular dysplasia. The tumors were located in the cecum (8 cases; two were large polyps), in the right colon (6 cases; 1 was a polyp) in the hepatic flexure (1 case), in the transverse colon (2 cases), left colon (2 cases), sigma (7 patients) and rectum (2 cases), respectively occurred at 16 and 6 cm from the anus internal sphincter.

Clinical, surgical and pathological data are listed in Table I - panel B.

HISTOLOGY

Histologically, 11 cases were G1 - well differentiated adenocarcinoma, 25 were G2 - moderate differentiated adenocarcinoma and 18 were G3 - poorly differentiated adenocarcinoma; of these 3 showed more than 50% of mucina as component. The number of lymphnodes removed for the adipose tissue varied from 1 to 65, (average = 20.5). The pTNM staging and status of the surgical margins are shown in Table II.

SURGICAL TIME

For open colectomy the average duration of surgery was 177.9 minutes (surgical time) and 280.4 minutes (time of operating room) with a minimum of 110 and a maximum of 360 minutes, with significant differences according to type of surgery performed and the patient's clinical history: 13 hemicolectomy right → average of 175.4 minutes, 8 hemicolectomies left → average of 150 minutes, 1 resection of the sigmoid → 110 minutes, 3 anterior resection of the rectum-sigma → 215 minutes; total colectomy → 360 minutes. For laparoscopy the average duration was 293 minutes, (range 135 - 520), with significant differences depending on the portion of the intestinal tract removed. Details are listed in Table III.

POSTOPERATIVE COMPLICATIONS

No intra-operative complications has been reported in the 28 laparotomy cases. In one patient we observed widespread and extensive visceroparietal adhesions caused by previous abdominal surgery that lengthened the operative time to 360 minutes. Two patients have received 2 to 4 units of packed red blood cells and from 2 to 3 units of plasma during surgery. Five patients received from 1 to 4 units of packed red blood cells in the post-operative time (11 total units in five patients). A patient received 2 units of packed red blood cells during the re-operation (pancreatic abscess in a patient previously operated by right hemicolectomy).

TABLE I - Clinical data of 54 cases of surgical patients by type of intervention.

		Panel A - laparotomy (26 cases)	Panel B - Laparoscopy (28 cases)	
		N (%)	N (%)	
PATIENTS	Male	14	17	
	Female	12	11	
AGE	Range	53-86	40-84	
	Media	68,3	67,7	
TYPE OF CANCER	Blind	8 (31%)	8 (28%)	
	Right colon	5 (19%)	6 (21,4%)	
	Hepatic flexure		1 (3,6%)	
	Transverse Colon		2 (7,1%)	
	Left colon	2 (8%)	2 (7,1%)	
	Sigma	9 (34%)	7 (25%)	
	Rectum	2 (8%)	2 (7,1%)	
TYPE DI INTERVENTION	Right hemicolectomy	13 (47%)	15 (53%)	
	Left hemicolectomy	8 (30%)	6 (21,4%)	
	Segmental resection of the transverse colon			
	Sigmoid resection	1 (4%)	2 (7,1%)	
	Anterior resection of rectosigmoid	4 (15%)	1 (3,6%)	
	Total colectomy	1 (4%)	2 (7,1%)	
Related action	Salpingo	7	Plastic back (Nissen-Rossetti)	1
	Adhesiolysis for adhesions syndrome	3	Adhesiolysis for syndrome adhesions	3
	Appendectomy	1	Cholecystectomy	3
	Cholecystectomies	3	Liver resection for metastases	3
	Herniectomy	1	For synchronous bladder tumor TURB	3
			Duodenal resection	1

Nine patients had postoperative complications:

- 2 suppurations of the surgical wound in the fourth and sixteenth post-operative day;
- 1 case of acute anemia in second post-operative day;
- 1 abscess of the recto-bladder recess in the tenth post-operative day;
- 1 acute pancreatitis with pancreatic abscess in the thirtieth post-operative day;
- 1 bronchitis episode in the third post-operative day;
- 1 hemoperitoneum from the renal capsule the night of the intervention;
- 1 anastomotic leak treated with parenteral nutrition and antibiotic therapy in the seventh post-operative day;
- 1 case of pneumonia with concomitant underliver hematoma in the thirteenth post-operative day.

In 7 patients it was necessary to perform a re-operation:

- 2 post-incisional surgical respectively 8 and 36 months from the previous surgery;
- 2 placement of drainage under CT guidance both in the thirteenth post-operative day;

- 1 placement of central venous catheter in the twelfth post-operative day;
- 1 laparotomy with hemostasis made the same night of the intervention;
- 1 gastroenteroanastomosis intervention with jejunostomy and peritoneal toilettes for pancreatic abscess in the thirtieth day after the operation.

Two cases of laparoscopy were converted to laparotomy: the first, because of the patient's intolerance to pneumoperitoneum; the other one for the detection of a locally advanced cancer of the ascending colon, extensively infiltrating the meso and duodenum. No patient received blood transfusions during surgery, while in six cases were transfused one or two units (11 total units in six patients) of concentrated erythrocytes in the postoperative period (four patients on Day 1, one in 7th and one in the 9th). A patient received five units during the re-operation (according to Hartmann colostomy for anastomotic dehiscence). Eight patients of the group that underwent to laparoscopy developed post-operative complications:

TABLE II - Pathological Anatomy. Injuries made and divided according to the intervention

HISTOLOGY	Well-differentiated adenocarcinoma - G1		5 (20%)
	Moderately differentiated adenocarcinoma - G2	19 (73%)	16 (64%)
	Poorly differentiated adenocarcinoma - G3	7 (27%)	4 (16%)
MARG STATIN US	Right hemicolectomy	105 (5-370)	86 (40-150)
	Left hemicolectomy	105 (30-250)	82 (50-130)
	Segmental resection of the transverse colon		13 (7-20)
	Sigmoid resection	30	30
	Anterior resection of rectosigmoid	28 (17-43)	35 (30-40)
	Total colectomy	200	370 (180-560)
NODES	Media	20.5	20.1
	Range	1 and 65	9 and 39
STAGE I	TNM		
	T1 N0 M0	1	3
IIA	T2 N0 M0	6	2
	T3 N0 M0	7	8
IIB	T4 N0 M0		1
	T3 N1b M0	7	3
IIIB	T4b N1b M0		2
	T3 N2a M0	4	2
IIIC	T2 N1a M1a		1
	T3 N1b M1b		3

specifically we reported a case of jejunal perforation sterocorous peritonitis treated with peritoneal toilettes and laparoscopic suture of perforation on day 1, two cases of anastomotic dehiscence treated with colectomy according to Hartmann in 6th and 7th day, a case of sub bowel obstruction for functional stenosis of the anastomosis treated with Foley colostomy on 4th day of infection and four cases of minilaparotomy treated with antibiotic therapy in 6 th and 7 th day.

CANALIZATION

The recovery of the post-surgical canalization occurred between 2-9 days with an average of 4.5 days for cases of laparotomy and from a minimum of 2 to a maximum of 7 days with an average of 2, 9 for those treated with laparoscopy.

DISCHARGE

The discharge was carried out by the 7th to the 31st post-operative day, with an average stay of 11 days for patients treated with laparotomy technique and was performed by the 5 th to the 15 th post-operative day with

a mean hospital stay of 8.4 days for patients treated with laparoscopic technique.

ADJUVANT CHEMOTHERAPY

At the time of discharge all patients were sent to oncology for medical cancer therapies. The data related to therapy are reported in Tab III.

TABLE III - Comparison of two series studied.

	Panel A Laparotomy (26 cases)	Panel B Laparoscopy (28 cases)
Resection margin	97 mm	95 mm
Lymphnodes removed	20,5	20.1
Trip times	177.9 min	293 min
Morbidity	34.6%	28,5%
Wound infection	7,1%	14.2%
Failure Anastomosis	3.8%	7.1%
Average length of stay	11 days	8.4 days
Sewer average	4.5 days	2.9 days

FOLLOW UP

Four patients that underwent to laparotomy showed a relapse with lung, liver, and sigmoid metastasis, radiologically detected at 1, 11, 3 and 15 months. A patient died 21 months after surgery, while the remaining 3 patients are still alive. In the group of laparoscopy we observed 3 deaths: one patient died 21 months after surgery, for respiratory failure due to pulmonary metastases; a second patient died after 3 months for chronic ischemic heart disease (heart disease and hypertensive patients), a patient died in 34th post-operative day, due to a global heart-lung failure.

In the group of patients operated on laparoscopy, three developed liver metastasis in 9, 12 and 14 months after surgery. Two of them died 22 and 28 weeks after surgery, while the third is still alive. Within the four patients with advanced disease at diagnosis, only one died for disease progression 12 months after surgery. One patient died of causes unrelated to the neoplastic disease and two are still alive.

Discussion

The comparison of two different surgical techniques, laparoscopic and open colectomy revealed some differences. We observed that the duration of the resection was greater for laparoscopy when compared to the traditional technique. This finding is consistent with results from other scientific papers which also report that surgical time are significantly reduced, mainly depending from the greater experience of the surgeon⁷⁻¹¹. In the present study the mean duration of surgery in patients treated with open surgery approach (177.9 minutes) was similar to that reported in literature, while it is slightly higher for the group of patients treated by laparoscopy (293 minutes). The mean operative time reported in the literature vary from 140 to 251 minutes for laparoscopy, compared to that reported for open surgery (120-175 minutes) and longer procedures time are reported for surgery on the rectum¹². The duration of a laparoscopic time was slightly higher since the first cases of colonic resection video-laparoscopic performed by us, there is still in the "learning curve"¹³. Schlachta and Lezoche^{14,15} reported that the surgical times, intra-operative complications and the percentage of conversions decrease after the execution of at least 30 colectomies.

The criteria for the extent of resection, integrity of margins and extent of lymphadenectomy should be similar whether you choose laparoscopic technique or laparotomy¹⁶⁻²⁰. In our study, these criteria were broadly respected and surgical margins results being far enough away from the neoplastic lesion and absolutely free. Analyzing the average distance of the tumor from surgical margins and the average number of lymph

nodes removed per piece we reported that they are similar irrespective of the approach to treatment (9.5 cm - 20.1 lymph nodes for laparoscopy; 9.7 cm - 20.5 for laparotomy). The majority of the Authors believe that a lymphadenectomy oncologically adequate should include at least 12 nodes and that a number greater than 18 is related to an increase of survival, progressively greater are the most lymph nodes removed^{21,22}. This linear correlation between the number of lymph nodes and survival confirms the therapeutic effect of lymphadenectomy.

Laparoscopy show significant benefits in terms of morbidity compared to open surgery²³ and also the data related to our study confirm this trend. In fact, the overall incidence of post-operative complications and the rate of re-operations for the group treated laparoscopically (respectively 28.5% and 14.2%) appears to be lower than that recorded for the group of patients who underwent resection laparotomy (34.6% and 26.9%). Comparing the data in the literature complications of surgery observed in both procedures, however, are of the same type: anastomotic leakage, occlusion, infection, but in much lower percentages in laparoscopy, in particularly in patients aged <70 years^{16, 19}.

Specific complications of laparoscopy are damaged vascular and visceral introduction to "blind" the first trocar or Veress needle^{7,8,24,25}, lesions of the ureters²⁴ and the occurrence of incisional hernias at the headquarters of trocars or of minilaparotomy²⁶⁻²⁷. None of these specific complications was found in our series. On surgical wound infections are the main complications in the short term and in our series 14.2% after laparoscopy compared with 7.1% after laparotomy, these data perfectly in line with the literature represented by 14% after laparoscopy against 11% of open surgery²⁸.

Regarding the postoperative hospital stay, the majority of randomized clinical trials show that it is significantly reduced after a laparoscopic procedure, compared to a traditional one²⁹. Most trials also observe an inpatient post-laparoscopy varies from 5.7 to 18.7 days, compared with open surgery after a hospital stay of 8 to 35.8 days, with an average reduction between the two procedures of 1-7 days^{8,10,17,30-32}. In our Center, the hospital stay after laparoscopic colonic resection varies from 5 to 15 days (mean 8.4 days) and hospital stay after laparotomy resection varies from 7 to 31 days (average of 11 days), on line with the data of other Authors. The postoperative pain control is a key element that influences the length of hospital stay, resumption of normal activities and mobilization and thus the quality of life. Laparoscopic approach reduces the post-operative pain compared to open surgery, and this has been amply demonstrated by recording the consumption of analgesics after surgery^{17,29}. As for the hospital even the resumption of gas-

tro-intestinal resume more quickly after intervention with minimally invasive technique compared to the traditional laparotomy, as well as post-operative data related to our study confirm these results.

Satisfying the criteria of oncological radicality of as traditional surgery, laparoscopy should lead to results in terms of survival lower than those of open surgery. Lacy¹⁶ reported an improvement in survival at three years in the group treated with laparoscopic resection, particularly significant in patients with stage III disease (91% survival compared with 79% of open). Other randomized trials did not show, however, significant differences in survival in patients treated with the two techniques³³. The data for our patients show that there have been three recurrences of the disease (9, 12, and 14 months) for the group treated with laparoscopic technique with an incidence of 10.7%, while in the laparotomy group to date have occurred 4 cases of recovery of the disease (1, 3, 11 and 15 months) with an incidence of 15.3%. The follow-up of the part laparoscopic stops to 2006 (2002-2006); as regards the cases of the comparison period is analogous (2003-2007). In our study, there were a total of 7 deaths, 4 in group approached with laparoscopy in the treatment group and 3 in the group treated with laparotomy. Of these seven deaths, however, only 5 (3 in the laparoscopic group and 2 in the open surgery) are attributable to the disease examined in our study.

The evaluation of the quality of life after surgery was performed by many authors²⁹ with the use of specific questionnaires, and in all cases it was recorded that the anaesthesia improves considerably in the first two weeks after the intervention for patients treated laparoscopically, while after the anaesthesia becomes comparable to that seen after traditional surgery. The laparoscopic surgery induces a minor trauma compared to traditional surgery and this produces a less depression of the immune system. Preservation of the peritoneal membrane, less traumatized by the minimally invasive technique, is important for the prevention of infections and tumor recurrence, mainly in stage III disease, in which a minor immune compromise may be essential to prevent a systemic spread and micrometastatic. These elements are supported by the fact that after laparoscopy is detected smaller values of CRP and IL-6, mediators of stress response, compared to open surgery³⁴⁻³⁷.

In conclusion, in the light of considerations of operating time, margins of resection, postoperative complications, hospital stay, channeling long-term survival, quality of life and post-operative stress, we can say that both approaches are technically feasible, safe and oncologically correct. It's also true that the laparoscopic technique, even if it requires a long period of learning by the surgical team, shows a much more favorable outcome in terms of pain, absence of extensive scarring, the incidence of incisional hernias and hospital stay -surgery compared with surgery laparotomy.

Riassunto

Il presente studio raffronta due gruppi di pazienti affetti da adenocarcinoma dolo-rettale, sottoposti rispettivamente a colectomia con tecnica open e a videolaparoscopia, mettendone in luce benefici e svantaggi. Si tratta di un'analisi retrospettiva: dal gennaio 2003 e il dicembre 2006 sono stati reclutati 54 pazienti; di questi 26 operati in laparotomia e 28 in laparoscopia.

Per la chirurgia laparotomica la durata media dell'intervento è stata di 177.9 minuti (tempo chirurgico) e di 280.4 minuti (tempo di sala operatoria con un minimo di 110 ed un massimo di 360 minuti, con significative differenze in rapporto al tipo di chirurgia effettuata e la storia clinica del paziente. Per la chirurgia laparoscopica la durata media è stata di 293 minuti (range 135-520), con significative differenze dipendenti dalla porzione di intestino asportata.

Il raffronto delle due tecniche chirurgiche, laparotomica versus laparoscopica, ha rivelato alcune differenze. La durata della resezione è stata maggiore per la laparoscopia se confrontata con la tecnica tradizionale.

Entrambi gli approcci rappresentano tecniche convenienti, sicure ed oncologicamente corrette. La laparoscopia mostra maggiori vantaggi in termini di controllo del dolore, assenza di estese cicatrici, riscontro di laparoceli e di degenza post operatoria comparata con la tecnica laparotomica.

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