

Laparoscopic colectomy in colon cancer. A single-center clinical experience

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SUMMARY: Laparoscopic colectomy in colon cancer. A single-center clinical experience.

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Introduction. Aim of our study was to compare the results of the laparoscopic technique to those obtained by traditional open approach in patients with colon cancer.

The advantages, disadvantages, and the contraindications (real and presumptive) of this mini-invasive approach are described, by comparing the data obtained from the international literature with our clinical experience.

Patients and methods. From February 2000 to May 2006, we performed 73 laparoscopic colectomies for cancer in the Operative Unit of General and Laparoscopic Surgery, Department of Surgical Sciences of the University of Chieti, Italy. The data of these patients were compared with the data obtained from 141 other patients who underwent open procedure for the same pathology in the same period and in the same Unit. Factors such as obesity, previous major abdominal surgery, T4 cancers, perforation and obstruction of the colon, tumor located in the transverse colon or in the left flexure of the colon were considered contraindications to laparoscopic approach.

Results. The length of surgical specimens and the number of lymph nodes removed did not show significant differences in the two groups. Two patients in the open procedure group died in the postoperative period. No postoperative death was noted in the group of patients operated by laparoscopic method. Postoperative complications requiring re-operation were observed in 9 patients in the open group and in 3 patients of laparoscopic group. Postoperative complications not requiring re-operation were observed in 16 patients in the open group and in 4 patients in laparoscopic group. Hospital stay was shorter for laparoscopic right or left colectomy compared to corresponding open procedures.

At the follow-up (a mean 30 months), the overall survival was 78% for open colectomies and 82.1% for laparoscopic colectomies. Disease-free survival, excluding patients with stage IV tumor and patients died in the postoperative period, was 77.6% for open colectomies and 82.5% for laparoscopic colectomies. In the group of laparoscopic patients, we observed 1 case of port-site recurrence.

RIASSUNTO: La nostra esperienza di colectomie laparoscopiche per cancro.

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Introduzione. Lo scopo del nostro studio è stato di comparare i risultati ottenuti mediante l'impiego di tecniche laparoscopiche con quelli ottenuti con il tradizionale approccio laparotomico in due gruppi di pazienti con cancro del colon. Vengono descritti i vantaggi, gli svantaggi, le controindicazioni (reali e presunte) di un approccio mini-invasivo, comparando i dati ricavati dalla letteratura internazionale con la nostra esperienza clinica.

Pazienti e metodi. Da febbraio 2000 a maggio 2006 abbiamo effettuato 73 colectomie laparoscopiche per cancro presso l'Unità Operativa di Chirurgia Generale e Laparoscopica del Dipartimento di Scienze Chirurgiche dell'Università di Chieti. I dati di questi pazienti sono stati comparati con quelli ottenuti da altri 141 pazienti sottoposti a colectomia per via laparotomica per la stessa patologia, nello stesso periodo, nella stessa Unità Operativa. Fattori come obesità, storia clinica di pregressa chirurgia addominale maggiore, stadio T4, perforazioni, occlusioni, localizzazione tumorale al colon trasverso o alla flessura splenica sono stati considerati controindicazioni ad un approccio laparoscopico.

Risultati. La lunghezza del tratto di colon resecato ed il numero dei linfonodi asportati non hanno mostrato differenze significative tra i due gruppi. Due pazienti del gruppo sottoposto ad intervento laparotomico sono deceduti nel postoperatorio. Nel gruppo dei pazienti sottoposti ad intervento laparoscopico non si sono registrati decessi. Nel gruppo dei pazienti operati per via 'open' sono state riscontrate complicazioni che hanno richiesto intervento chirurgico in 9 casi, nel gruppo laparoscopico in 3 casi. In 16 pazienti appartenenti al gruppo laparotomico ed in 4 del gruppo laparoscopico sono state riscontrate complicazioni che non hanno richiesto re-intervento. Ad un follow-up medio di 30 mesi la sopravvivenza globale è stata dell'78% per le colectomie laparotomiche e dell'82.1% per le colectomie laparoscopiche. La sopravvivenza libera da malattia, escludendo i pazienti con tumore in stadio IV ed i pazienti deceduti nel postoperatorio, è stata del 77.6% per le colectomie open e dell'82.5% per le colectomie laparoscopiche. Nel gruppo dei pazienti operati per via laparoscopica abbiamo osservato un caso di metastatizzazione in corrispondenza di un port-site.

Conclusions. *Our clinical experience, even if limited by the number of patients and by the duration of follow-up period, contributes in confirming the reliability of laparoscopic procedures in the treatment of tumours of the colon and the safety of oncological results.*

Conclusioni. *La nostra esperienza clinica, anche se limitata per numero di pazienti e durata del follow-up, contribuisce a confermare la fattibilità delle procedure laparoscopiche nel trattamento dei tumori del colon e la sicurezza dei risultati oncologici.*

KEY WORDS: Laparoscopic colectomy - Colon cancer.
Colectomia laparoscopica - Cancro del colon.

Introduction

Laparoscopic colectomy was for the first time described by Jacobs (1) in 1991. Contrary to other laparoscopic procedures which become rapidly therapeutic 'gold standard' for the treatment of some pathologies, laparoscopic colectomy had difficulties to expand.

According to the data from the literature regarding this topic (2-5) and the results obtained from the most recent randomised clinical trials (6), which compared laparoscopic and laparotomic colectomies, we decided to present our surgical experience of the treatment of colon cancer by laparoscopic procedure. We compared our data with those of the patients who underwent laparotomic colectomy for cancer in our Operative Unit in the same period.

The aim of our study was to compare the results obtained in our clinical practice with the most recent data obtained in literature, in order to identify the advantages, disadvantages, and real and presumptive contraindications in the laparoscopic approach of colon cancers.

Patients and methods

From February 2000 to May 2006 we performed 73 laparoscopic colectomies for cancer in the Operative Unit of General and Laparoscopic Surgery of the Department of Surgical Sciences of the University of Chieti, Italy. The data of these patients were compared with the data obtained from other 141 patients operated by open procedure for colon cancer in the same period. We performed 27 laparoscopic colectomies and 46 open colectomies for right colon cancers; 32 left laparoscopic colectomies and 45 left open colectomies; 14 laparoscopic anterior resections and 50 laparotomic anterior resections.

We considered the following criteria of exclusion for the laparoscopic procedure: obesity (Body Mass Index, BMI>30), tumor extension to the surrounding organs and structures (T4), tumors more than 10 cm of diameter; previous major abdominal operations, perforation and obstruction, tumors located in the transverse colon or in the left flexure of the colon.

In the group of those operated by laparoscopic procedure 19 patients were affected by tumors in stage I, 27 in stage II, 17 in stage III, 10 in stage IV. Of patients operated by laparotomic procedure, 33 were affected by tumors in stage I, 39 in stage II, 42 in stage III, 27 in stage IV.

In the group of patients who underwent open colectomies: the mean age was 75 years \pm 4.8; 69 (49%) were male; 12 (8.5%) were obese; 37 (26.2%) had a clinical history of previous major abdominal surgery; 45 (32%) had a narrow colon stenosis; and 9 (6.3%) presented a cancer localized in left flexure of the colon.

In the group of patients who underwent laparoscopic procedure: the mean age was 74.4 years \pm 4 and 35 (48%) were male. Characteristics of tumors and patients who underwent laparoscopic and open colectomies for cancers are summarized in Table 1.

We used a standard surgical technique (7-9). The first step of laparoscopic left hemi-colectomy and anterior resection consists of the identification and ligation of the inferior mesenteric artery at the origin and of the vein beneath the pancreas. The mobilization begins from the medial side of descending colon and sigma along Told's fascia, prior to identification of the ureter. Once this phase is completed, we free the proximal portion of descending colon by dissecting along the left avascular plane until we reach the left flexure of the colon, in such a way to create a tension free anastomosis. After completion of this phase the rectum is then dissected using a linear laparoscopic stapler.

In order to extract the segment of the colon to be dissected, a minilaparotomy is created in correspondence of the pre-existing port-site in left iliac fossa. The mini-laparotomy is protected from eventual 'cancer seeding' by using an impermeable plastic bag. After exteriorization of the segment, its dissection is performed in the traditional way. In this way the tumor and the lymph nodes contained in the mesocolon are removed in block. A 'purse string' is

TABLE 1 - CHARACTERISTICS OF TUMORS AND PATIENTS WHO UNDERWENT LAPAROSCOPIC AND OPEN COLECTOMIES FOR CANCERS.

Patients	Laparoscopic group	Open group
Number	73	141
Age, years	74.4 \pm 4	75 \pm 4.8
Male	35 (48%)	69 (49%)
Female	38 (52%)	72 (51%)
Obesity	0	12 (8.5%)
Previous major abdominal surgery	0	37 (26.2%)
Severe stenosis	0	45 (32%)
Left flexure of colon	0	9 (6.3%)
Stage I	19 (26%)	33 (23.4%)
Stage II	27 (37%)	39 (27.6%)
Stage III	17 (23.2%)	42 (29.7%)
Stage IV	10 (13.7%)	27 (19.1%)

applied by hand and the anvil of the circular stapler is then introduced into the colic stump. The 'purse string' is then tied. The portion of the colon prepared in this way is re-introduced into the abdominal cavity. The mini-laparotomy is then closed and pneumoperitoneum is created once more.

The stalk of the circular stapler is introduced through the anus and the spike will pass through the suture in the proximal extremity of the rectum under laparoscopic vision. After uniting the anvil and the stalk of the stapler, the closure of the instrument will permit the creation of colo-rectal end-to-end anastomosis according to Knight-Griffen technique. We usually control the integrity of the anastomosis using methyl blue dye introduced through the anus.

In the right hemi-colectomy, the first step consists in the identification of the last portion of the ileum, the appendix and the cecum. The dissection begins along the avascular plane of the right colon. A wider mobilization of the ascending colon will progressively allow the visualization of the right ureter, Gerota's fascia and duodenum. Lastly transverse colon will be freed through the dissection of the great epiploon until we reach the middle colic artery. We performed vascular ligation and resection of the colon by extra-corporeal method in 17 patients. In the others (10 patients) we performed the vascular dissection during laparoscopic phase, using linear laparoscopic stapler. At the end of the mobilization process a mini-laparotomy is created in correspondence of the umbilical port-site protected by an impermeable plastic bag. The mobilized intestine is then extracted through this incision. After completing the vascular phase of the operation, the intestinal portions are dissected and a side-to-side anastomosis between the ileum and transverse colon is performed and the intestine re-inserted into the abdominal cavity. Pneumoperitoneum is created once again and the anastomosis is checked on.

Results

In the right hemi-colectomies (Tab. 2) we achieved the following mean operative time: 140 min \pm 23.6 SD for laparoscopic colectomies and 133 min \pm 21.7 SD for open colectomies. Mean time required for the onset of intestinal habits in patients operated by laparoscopic colectomies was 2.5 days \pm 0.6 SD and 3.1 days \pm 0.5 SD in patients who underwent open procedures. Postoperative hospital stay was 6 days \pm 1 SD and 8.1 days \pm 0.7 SD in laparoscopic colectomies and open colectomies respectively. The length of the dissected portion of colon was 20.7 cm \pm 0.9 SD in laparoscopic colectomies compared to 23.4 cm \pm 0.9 SD in open colectomies. Average number of lymph nodes removed in laparoscopic colectomies was 11.2 \pm 1 SD and 12.1 \pm 0.8 SD in open colectomies. There were no conversions to laparotomic procedures

For left hemi-colectomies (Tab. 2) the mean operative time was 208 min \pm 17.9 SD for laparoscopic colectomies and 185 min \pm 11.2 SD for open colectomies. The mean time for the onset of intestinal habits in laparoscopic colectomies (excluded 2 patients converted to open procedure and 1 patient who required re-operation) was 2.8 days \pm 0.6 SD and 3.4 days \pm 0.6 SD for open colectomies (excluded 3 patients who re-

quired re-operation and 1 patient deceased in postoperative period). The hospital stay after laparoscopic colectomy was 6.9 days \pm 1.3 SD compared to 9.2 days \pm 1 SD in open colectomy (excluded 1 patient deceased in postoperative period). The average length of colon segment removed was 20 cm \pm 1 SD in laparoscopic colectomies and 22.3 cm \pm 1.2 SD in open colectomies. The average number of lymph nodes removed in laparoscopic colectomies was 18.8 \pm 1.3 SD and in open colectomies was 12.9 \pm 1.4 SD. We had 2 conversions of laparoscopic left colectomies to open colectomies due to adhesions surrounding the tumor and bleeding and 1 patient who required re-operation for intestinal obstruction. In the group of open colectomies we observed 3 patients who required re-operation: 1 patient for intestinal obstruction and 2 patients for anastomotic fistulas.

In the anterior resections (Tab. 2) the average time for operation observed was 220 min \pm 20.8 SD for laparoscopic colectomies and 195 min \pm 10.9 SD for open colectomies. The start of intestinal movements, in laparoscopic colectomies (excluded 1 patient converted to open procedure and 2 patients who required re-operation), occurred after 4 days \pm 0.7 SD compared to the 4 days \pm 0.8 SD in open colectomies (excluded 6 patients who required re-operation and 1 patient deceased in postoperative period). The average hospital stay was 10 days \pm 2.4 SD in laparoscopic colectomies and 9.3 days \pm 1.5 SD in open colectomies (excluded 1 patient deceased in postoperative period). Length of colon segment removed was 23.5 cm \pm 1.3 SD for laparoscopic colectomies and 27.2 cm \pm 1.1 SD for open colectomies. Average number of lymph nodes removed was 11.7 \pm 1 SD in laparoscopic colectomies and 12.9 \pm 1.4 SD in open colectomies. We had 1 conversion of a laparoscopic anterior resection to open colectomy due to difficulties we met in the identification of anatomical structures (the patient had dolichosigma) and 2 patients who required re-operation for anastomotic fistulas. In the group of open colectomies we observed 6 patients who required re-operation: 1 patient for intestinal obstruction, 1 patient for hemoperitoneum and 4 patients for anastomotic fistulas.

Considering all cases of open colectomy we observed 9 (6.3%) major postoperative complications which required re-operation. There were 6 (4.2%) cases with anastomotic fistulas (treated by Hartmann's procedure), 2 (1.4%) cases of intestinal obstruction caused by adhesions (these were treated by lysis of the adhesions) and 1 (0.7%) case of haemoperitoneum treated by surgical haemostasis. Minor postoperative complications which did not require re-operation were 16 (11.3%) in the group of open colectomies: there were 6 (4.2%) cases with postoperative pneumonia and 10 (7%) cases with infection of the wound.

TABLE 2 - RESULTS OF LAPAROSCOPIC COLECTOMIES COMPARED WITH OPEN COLECTOMIES.

	Patients	Laparoscopic 27	Open 46
Right colectomies	Operative time	140 min ±23.6 SD	133 min ±21.7 SD
	Intestinal habits	2.5 days ±0.6 SD	3.1 days ±0.5 SD
	Hospital stay	6 days ±1.0 SD	8.1 days ±0.7 SD
	Length of dissected colon	20.7 cm ±0.9 SD	23.4 cm ±0.9 SD
	Lymphnodes (n)	11.2 ±1 SD	12.1±0.8 SD
Left colectomies	Operative time	208 min ±17.9 SD	185 min ±11.2 SD
	Intestinal habits	2.8 days ±0.6 SD*	3.4 days ±0.6 SD**
	Hospital stay	6.9 days ±1.3 SD	9.2 days ±1 SD***
	Length of dissected colon	20 cm ±1 SD	22.3 cm ±1.2 SD
	Lymphnodes (n)	18.8 ±1.3 SD	12.9±1.4 SD
*2 patients excluded for conversion, 1 patient excluded for re-operation **3 patients excluded for re-operation, 1 patient deceased in postoperative period ***1 patient deceased in postoperative period			
Anterior resections	Operative time	220 min ±20.8 SD	195 min ±10.9 SD
	Intestinal habits	4 days ±0.7 SD*	4 days ±0.8 SD**
	Hospital stay	10 days ±2.4 SD	9.3 days ±1.5 SD***
	Length of dissected colon	23.5 cm ±1.3 SD	27.2 cm ±1.1 SD
	Lymphnodes (n)	11.7 ±1 SD	12.3±1.1 SD
*1 patient excluded for conversion, 2 patients excluded for re-operation **6 patients excluded for re-operation, 1 patient deceased in postoperative period ***1 patient deceased in postoperative period			
Overall survival		60 (82.1%)	110 (78%)
Disease-free survival		52 (82.5%)°	87 (77.6%)°°
°Excluded patients with IV stage tumor °°Excluded patients with IV stage tumor and patients deceased in the postoperative period			

Considering all cases of laparoscopic colectomy we had in total 3 (4.1%) conversions. There were also 3 (4.1%) major postoperative complications which required re-operation. There were 2 (2.7%) cases of anastomotic fistulas after anterior resections (treated using Hartmann's procedure) and 1 (1.3%) case of intestinal obstruction after left colectomy due to adhesions which was then treated by lysis of the adhesions and an ileal resection. All re-interventions were performed using a laparotomic approach. There were 4 (5.4%) minor postoperative complications which did not require re-operation in patients treated by laparoscopic procedure: we had 1 (1.3%) case of postoperative pneumonia and 3 (4.1%) cases of wound infection.

No postoperative mortality was observed in the group of laparoscopic colectomies, while 2 (1.4%) pa-

tients belonging to the group of open colectomies died of myocardial infarction (one was 83 years and the other 78). After 3 months from the operation we observed the recurrence of disease around the port-sites (an expression of disseminated peritoneum seeding) in 1 patient who had laparoscopic right hemi-colectomy (tumor stage: T3, N2, M0).

Patients underwent postoperative follow up of 30 months. The overall survival in the group of open colectomies was 78% (110 patients), while in the group of laparoscopic colectomies it was 82.1% (60 patients). Disease-free survival (excluded IV stage tumors and 2 patients deceased in postoperative period) was 77.6% (87 patients) in the group of open colectomies and 82.5% (52 patients) in the group of laparoscopic colectomies.

Discussion and conclusions

Our experience, although limited by the number of patients and by the short follow up period, showed good results in the laparoscopic approach to colon tumors, even if it is necessary to consider the clinical conditions which were, in some cases, different from patients operated using laparotomic approach. That's due to the fact that patients with different tumor stages (patients with T4) and clinical pictures (obese patients, previous surgical abdominal operations, complete and sub-complete intestinal obstructions) were excluded from laparoscopic procedure. We noted a reduction of post-operative morbidity in the group of patients who underwent laparoscopic procedure. The comparison of the incidence of respiratory complications and of wound infections between the two groups of patients are 1.3% vs 4.2% and 4.1% vs 7%, respectively. There were 9 patients (6.3%) belonging to the open group who underwent re-operation and 3 patients (4.1%) in the laparoscopic group were re-operated. Bowel movements were earlier and postoperative hospital stay was shorter in patients who underwent laparoscopic procedure for left and right colectomy. This data has not been confirmed in case of laparoscopic anterior resection, but it must be noted that in this study, in the group of 14 patients, the results were heavily affected by two re-operations and one conversion and these happened in the early phase of our clinical experience.

From oncological point of view, if it is true that surgical specimens of the laparoscopic group are slightly shorter than those of the open group, this does not affect the number of lymph nodes removed or not even surgical margins of resection, which were negative in all cases.

We noted only one case of port-site seeding in a patient with advanced stage of disease, in an early phase of our clinical experience.

As far as overall and disease-free survivals are concerned, a mean period of 30 month follow up will determine the possibility to observe only the preliminary data. These, however, are satisfactory and in conformity with those obtained by open surgery. Therefore the results obtained, even if they are not final and not validated by a long period of follow up, seem to be promising and able to confirm the safety and reliability of laparoscopic procedures in resection of colon cancers.

A recent review of literature regarding this topic has instead shown that the spread of this method is limited. In fact, the percentage of laparoscopic colectomies performed in the United States was below 10% (10) and, in 2002, less than 5% of colectomies performed in Germany was done by laparoscopic procedure (11).

The results emerging from the international literature analysis have posed interesting questions. What are the advantages of laparoscopic approach to colon pathologies? Are there disadvantages and/or relative or absolute contraindications? What are the reasons which limit today the wide use of laparoscopic colectomy? The results obtained from the evaluation of scientific publications and randomized clinical trials, comparing laparoscopic colectomy to the traditional approaches, have tried to answer these questions by evidencing the most controversial aspects (Tab. 3).

So what are the advantages of laparoscopic resection of the colon? One of the most important advantages of laparoscopic approach to tumors of the colon is the reduced necessity of postoperative analgesics. Lack of wide laparotomy and substantial respect of the integrity of the abdominal wall are responsible factors in the reduction of postoperative pain and therefore less necessity to use pain killers (12-14). Even in our experience we have noted a less necessity to the use of postoperative analgesics. Such aspect has been evidenced mainly in right and left colectomies, but less in anterior resections.

Many publications (3, 15) have documented an earlier onset of intestinal movements, flatus and evacuation. In our experience, we noted a rapid onset of bowel movements in right and left colon resections by laparoscopic procedure but not in anterior resections. The above listed advantages contribute to a reduced hospital stay after operation (3, 12, 13). However, some recent reports have in part reconsidered this aspect, stressing the fact that more often the length of hospital stay after colectomy is connected to the tradition of the Surgical School and is not influenced in a substantial way by the type of surgical approach (16).

Data from literature have shown a reduced percentage of postoperative complications, above all respiratory complications (4-5). As regards major complications such as: anastomotic fistulas and intestinal obstruction, these have a similar incidence compared to 'open' surgery (12, 13). Moreover some authors have evidenced a reduced necessity of blood transfusions (4, 17).

Besides to the above mentioned advantages, it is necessary to keep in account also the contraindications of laparoscopic resection of the colon. Contraindications to general surgery, such as serious coagulopathy, remain valid even for laparoscopic surgery. Are there specific contraindications for laparoscopic colectomies? Except an acute heart and pulmonary failure incompatible with pneumoperitoneum, cardio-respiratory pathologies are not contraindications to laparoscopic approach. In fact, laparoscopic approach, for its mini-invasive characteristics, is in most cases indicated for the rapid recovery of the respiratory function (18,

TABLE 3 - ADVANTAGES AND DISADVANTAGES (REAL AND PRESUMPTIVE) OF LAPAROSCOPIC COLECTOMY.

<p><i>Advantages</i></p> <ul style="list-style-type: none"> • Decreased hospital stay • Less analgesia is needed after laparoscopic colectomy than after open colectomy • Morbidity and mortality were better or at least similar to that of open colectomy • Resumption of gastrointestinal function is earlier after laparoscopic colectomy • Postoperative pulmonary function is less impaired after laparoscopic resection of colon cancer • Intraoperative blood losses are lower with laparoscopic colectomy than with open colectomy
<p><i>Disadvantages</i></p> <ul style="list-style-type: none"> • Contraindications • Technique and learning curve • Duration of surgical procedures • Costs • Conversions • Oncologic issues

19). In our clinical experience the incidence of postoperative respiratory complications in laparoscopic patients was lower compared to patients treated by open surgery. If it's true that obese patients are the ones in which laparoscopic approach is mostly indicated, it's also true that technical difficulties of laparoscopic surgery in obese patients are remarkably high. This can cause an increase in the percentage of conversions (2, 20-23). Large randomized clinical trials (COST, COLOR) (13, 16) have considered a BMI >30 as a criterion of exclusion. Previous major surgical operations in the abdomen can present remarkable difficulties. Adhesions are not absolute contraindications but form about 17% of all the causes of conversions (17). We did not consider contraindicated to laparoscopic procedure patients who previously underwent appendectomy, hysterectomy or cholecystectomy, but only contraindicated those who underwent major abdominal surgery.

These are probably the only absolute contraindications to perform resection of the colon by laparoscopic procedure. A tumor that extends to the surrounding structures and/or organs (T4 tumor) makes it extremely difficult to perform an 'en bloc' resection by laparoscopic procedure. Even bulky tumors having dimensions greater than 8-10 cm would need a larger incision in order to remove the tumor. This is not obviously in conformity of the advantages of laparoscopic procedure (2, 12). Even if they are not to be considered as true contraindications, tumors of the colon located in the transverse colon or in the left flexure of the colon make it technically difficult to perform the laparoscopic procedure (12). Large randomized clinical

trials, such as COLOR and COST trials (13, 16), have excluded patients affected by tumors of the transverse colon. After a careful selection, only surgeons with great experience and only in selected centres can afford to operate patients in the phase of obstruction or perforation of the colon (24). We considered an absolute contraindication to laparoscopic approach tumors obstructing the bowel. This can cause difficulties of proper vision due to dilatation and fragility of intestinal wall.

Finally we evaluate the disadvantages of laparoscopic resection of the colon. Surgical techniques are now standardized and well established for left and right hemi-colectomies and for anterior resections (7-9). However, the technical aspect is one of the major reasons which has limited the diffusion of this surgical procedure. In fact, the operation is not easy to perform. The dissection involves different quadrants of the abdominal cavity, forcing the operator to intervene and/or save structures using procedures and instruments which require a great skill and experience. Experience represents one of the major factors to obtain good results. Much has been written about learning curve. Large multi-center randomized clinical trials (13, 16) have included surgeons who have performed at least 20 laparoscopic resections of the colon. Some authors support that at least 30 procedures are necessary (25, 26), others support that the 'steady state' is reached after 70-80 operations (27). Well, what is certain is that this procedure is more difficult to learn than other laparoscopic procedures and that experience plays an important role in order to obtain good results. It is now widely known that laparoscopic colectomies last longer than laparotomic colectomies (4, 12, 26, 28). Even in this case, a greater experience seems to play an important role in reducing the operative time. Even in our clinical experience operative time was longer for right and left laparoscopic colectomies and for laparoscopic anterior resections, although we noted a progressive time reduction as surgical experience grew.

The problem of the costs is one of the most debated point in which there are some questions of disagreement even among centres with more experience. On one hand, there are people who support that laparoscopic technique has an advantage in terms of saving economic resources. This could be explained by the following reasons: short hospital stay after operation, less consumption of drugs, less necessity of assistance, more rapid resumption of duties (28, 29). On the other hand there are people who support that laparoscopic colectomies are more expensive due to long duration of the operation, which results into a longer use of the operating room. Furthermore, an extensive use of expensive disposable instruments would bring

about a further worsening of the expenses, which can be contra-balanced only partially by the short stay in hospital (12, 16, 30, 31).

The percentage of conversions of laparoscopic procedures to the traditional laparotomic procedures varies remarkably in literature, from 0 to 42% (12). Major causes described are represented by bulky tumors, adhesions, phlegmon, abscess, difficulties of identifying anatomical structures, bleeding and technical problems (20, 22, 32). From the data obtained from literature, we can evidence how surgical experience and above all an accurate selection of the patients can play a basic role in avoiding a conversion which could otherwise increase the costs and probably worsen the prognosis (33). Our conversion percentage (4.1%) seems to be low but we think this is mainly due to the use of above named exclusion criteria.

The oncologic issues represent probably the biggest question which regards laparoscopic resection of the colon. Are these oncological procedures correct? The present results of publications in literature and the major randomized trials, which are in their phase of conclusion in these years, have contributed and will contribute in clarifying this topic. Analysing the technical aspects, it has been observed that no significant variations were observed in the length of intestinal segments removed during laparoscopic or laparotomic colectomies (8, 12, 16, 34). Considering the number of lymph nodes removed and free margins even in this case no significant variations were found in both approaches for the two parameters considered (8, 12, 16, 34).

If at the beginning of the experience of laparoscopic surgery of the colon the aspect of port-site metastasis was frightening with percentages reaching to 21%, currently this percentage has reduced to below 1% (4, 12). What are then the improvements which have permitted to reach such results? Many technical aspects have been evidenced (12, 35, 36). In the first place the so called 'no touch technique' in which it has been demonstrated that avoiding the manipulation can limit the diffusion of the cancer cells, as well as the use of

impermeable plastic bags to protect the site of extraction of the tumor. The 'chimney effect' in which it is assumed that the contact between the gas used for the pneumoperitoneum, containing cancer cells, and the port-sites can facilitate cancer cell seeding. For this reason it's advisable to deflate the abdomen only through the trocars, that shouldn't be removed before the end of the evacuation of the gas. The irrigation of the port-sites using povidon-iodine or heparin solution or other types of solutions has been advised in many reports. In conclusion, the use of many methods has been advised, even if most of them are only based on the results obtained by laboratory experiments. Obviously what can be evidenced even in this case is that a good specific surgical experience can contribute to reduce sensibly the incidence of this serious complication.

The survival after laparoscopic colectomy for cancer is one of the crucial points which have been debated for a long time. The data from big multi-centre studies have documented how survival does not vary in a significant way in patients operated by laparoscopic procedures and those operated by open techniques (4, 13). So free survival from disease obtained using mini-invasive approach, are at least similar to those obtained using the traditional technique. Some authors have even supported that there is an advantage in terms of survival in patients operated by laparoscopic technique (4, 13, 37), probably due to less impact in the immune system (4).

The data obtained from international literature and our experience, although limited, have provided us with encouraging results and these are reasons for us to consider laparoscopic resection of the colon sure and safe and capable of providing similar oncological results compared to laparotomic procedures.

We therefore think that we are definitely coming out from the 'experimental phase' described in 1994 by the American Society of Colon and Rectal Surgeons, in which they opposed the resection of colon by laparoscopic technique if not consented by controlled and randomized clinical trials (38).

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