ABCDDV/847

ABCD Arq Bras Cir Dig
2012;25(2):81-87

Original Article

LAPAROSCOPIC AND OPEN COLORECTAL RESECTIONS FOR COLORECTAL CANCER

Ressecções colorretais laparoscópicas e laparotômicas no câncer colorretal

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ABSTRACT - ***Background*** - Surgical resection is the mainstay of treatment for colorectal cancer with curative intent. ***Aim*** - To evaluate the postoperative results of laparoscopic and laparotomic colorectal resections for colorectal cancer. ***Methods*** - A retrospective study of a series of 189 patients. The descriptive variables were age and gender, and for outcome were type of resection, number of lymph nodes resected, free margins, the need for colostomy, complications, operative time and hospital stay. They were analyzed using the chi-square, Student t and Mann-Whitney test, with significance level <0.05. ***Results*** - Of the 189 operated patients, 110 met the inclusion criteria, 75 (68.2%) operated by open surgery and 35 (31.8%) by laparoscopic. The sigmoid colon was the most common site presented by neoplasia and rectosigmoidectomy was performed more by open colorectal resection (p = 0.042). The conversion rate was 7.9% (3/38). The patients were operated by open surgery in 81.5% of time less than 180 minutes (p <0.001). In both pathways, the average number of removed lymph nodes was greater than 12, but laparotomy enabled, more frequently, the resection of 12 or more nodes (p = 0.012). No patient had surgical margins involved, but laparotomy allowed a greater number of patients with a margin greater than 5 cm from the tumor (p = 0.036). Increased number of patients treated by open surgery were hospitalized for more than seven days (p <0.001). There were no statistically significant differences regarding the need for ostomies, complications and mortality. ***Conclusions*** - The laparoscopic approach was as safe and effective as laparotomy in the treatment of colorectal cancer, and was associated with increased operative time, shorter hospital stay and less morbidity.

HEADINGS - Colorectal neoplasms. Laparoscopy. Colorectal surgery.

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Financial source: none
Conflicts of interest: none

Received for publication: 08/01/2011
Accepted for publication: 13/02/2012

RESUMO - ***Racional*** - A ressecção cirúrgica é o principal elemento do tratamento do câncer colorretal com intenção curativa. ***Objetivo*** - Analisar os resultados pós-operatórios de ressecções colorretais laparotômicas e videolaparoscópicas por câncer colorretal. ***Métodos*** - Estudo retrospectivo de uma série de 189 pacientes operados. As variáveis descritivas foram idade e gênero, e as de desfecho foram tipo de ressecção, número de linfonodos ressecados, margens, necessidade de ostomia, complicações, tempo operatório e tempo de internação. Elas foram analisadas por meio dos testes do Qui-quadrado, t de student e Mann-Whitney, com nível de significância <0,05. ***Resultados*** - Dos 189 pacientes operados, 110 preencheram os critérios de inclusão, sendo 75 (68,2%) operados por cirurgia aberta e 35 (31,8%) por via videolaparoscópica. O cólon sigmóide foi o local mais comum de apresentação da neoplasia e a retossigmoidectomia foi a ressecção colorretal mais realizada, e mais por via aberta (p=0,042). A taxa de conversão foi de 7,9% (3/38). Os pacientes operados por via aberta apresentaram em 81,5% tempo operatório inferior a 180 minutos (p<0,001). Em ambas as vias, o número médio de linfonodos ressecados foi maior que 12, porém a técnica laparotômica permitiu, com maior frequência, a ressecção de 12 ou mais linfonodos (p=0,012). Nenhum paciente apresentou margem cirúrgica comprometida, mas a laparotomia permitiu um maior número de pacientes com margem maior que 5 cm em relação ao tumor (p=0,036). Maior número de pacientes tratados por via aberta esteve internado por tempo superior a sete dias (p<0,001). Não foram encontradas diferenças estatisticamente significantes quanto à necessidade de ostomias, complicações e mortalidade hospitalar. ***Conclusões*** - A abordagem videolaparoscópica foi tão segura e eficaz quanto a laparotômica no tratamento do câncer colorretal, e esteve associada a maior tempo operatório, a menor tempo de hospitalização e a relativa menor morbidade.

DESCRITORES - Neoplasias colorretais. Laparoscopia. Cirurgia colorretal.

INTRODUCTION

Colorectal cancer (CRC) survival rates have substantially improved in the last decades, mostly due to the evolution of screening techniques, development of chemotherapy medication, improved radiotherapy treatments and the sophistication of surgical techniques and postoperative care. The central point of the treatment is the adequate resection of the primary tumor[12].

Since its introduction, the minimally invasive approach has been rapidly becoming the preferred treatment of surgical digestive diseases due to a number of reasons like reduced postoperative pain, hospital stay, daily activities return time, decreased morbidity rates and aesthetics[23].

However, in colorectal surgery, the adoption of laparoscopy was slower, given that, unlike other laparoscopic operations, it is a technique that requires advanced skills and equipment. As an abdominal incision would still be needed for the anastomosis and/or for the extraction of the specimen, the technique was seen to offer few advantages over open procedures25. An American study shows that proportion of laparoscopic cholecystectomy performed in the USA evolved from 2.5% to 73.7% between 1988 and 1992, while laparoscopic sigmoidectomies evolved from 4.3% to only 7.6% between 2000 and 2004[11].

Currently, laparoscopic approach is being expanded to colorectal procedures, especially in the treatment of diverticular disease, colorectal polyps, inflammatory bowel disease, colon endometriosis and rectal prolapse, promoting a reduction in the levels of complications, pain and length of hospital stay, while improving the quality of life of patients[11,15,23,25].

Unlike benign diseases, the use of laparoscopy in the treatment of CRC has been receiving a slower acceptance as the objects of study in these cases do not limit themselves to those mentioned before, but must include oncologic resection such as the longitudinal and circumferential margins, number of resected lymph nodes, recurrence, and overall and disease-free survival rates[13].

Many studies have been published aiming at studying specifically the colorectal laparoscopic surgery in CRC. The multicenters CLASICC[12,14], COST[24,29], COLOR[3,5] and the Barcelona[20] study have been gradually presenting similar oncological results between open and laparoscopic surgeries.

Inicially, these studies reaffirmed the superiority of the laparoscopic technique in terms of postoperative pain, recovery of peristalsis, length of hospital stay, return time to usual activities and the number of complications[1,12,23], even though they presented significantly higher operating times. However, until the beginning of last decade, the observation intervals were not long enough to safely analyze the oncological criteria in medium and long term, and the first publications still feared to recommend the use of a laparoscopic surgery for the treatment of CRC. The preliminary publication of the study COST[29] in 2002, which analyzed initial surgical results and postoperative quality of life, postulated that the laparoscopic procedure should not be offered to patients with CRC. On the other hand, the 2004 meta-analysis already presented better results of the laparoscopic surgery in terms of reduced pain, less morbidity, faster recovery and early hospital discharge, besides the fact of not compromising oncological principles[1].

As soon as other multicenter and randomized studies started to give strength to the scientific evidence, there was an worldwide increased in the use of the laparoscopic approach for the treatment of colorectal neoplasms[18,22].

The first national survey, which involved only teams of surgeons belonging to the Brazilian Society of Coloproctology, estimated a total of 5259 laparoscopic colorectal resections between 1992 and 2007[28]. They observed an evolution of 75% in the number of teams performing laparoscopic colorectal resection and of 185% in the number of patients operated on between 2001 and 2007, half of them due to a malignant disease. In another survey, performed in the state of Minas Gerais, it was estimated that 4.5% of the colorectal resections were performed using laparoscopy, half for CRC[8].

Despite increasing evidences, the indication for laparoscopic colectomy in CRC is still controversial. The feasibility of lymphadenectomy, the risk of local and portal recurrence and the analysis of long-term survival rates still limit the general acceptance of the colorectal laparoscopic resection. In this context, the analysis of open and laparoscopic resections attempts to demonstrate, both specifically and globally, in which aspects these techniques differ from each other.

This study aims at analyzing postoperative outcomes of colorectal resections performed through open and laparoscopic approaches for CRC.

METHOD

This study was approved by the Research Ethics Committee of UNISUL.

Records of patients who were submitted to colorectal resection for CRC, in open or laparoscopic surgery, by a team of surgeons of the Imperial Hospital de Caridade (IHC), between January 2005 and October 2010, were analyzed.

Patients with incomplete data or operated for different neoplasia or benign diseases were

eliminated. Descriptive variables were age and gender, whereas outcome variables comprised type of resection, number of resected lymph nodes, margins, need for ostomy, complications, operating time and hospital stay.

Mean, median and standard deviation were calculated for all continuous quantitative variables. Variables for operating time, hospital stay and surgical margin (nearest margin) were dichotomized in the median for statistical analysis. To evaluate age, patients were regrouped in "up to 59" and "60 or over" groups (adults/elderly). In regards to the types of colorectal resections, a descriptive analysis was made, and for the statistical analysis the two most prevalent resection groups, namely rectosigmoidectomy and right colectomy, were taken into consideration. To statistically evaluate the number of resected lymph nodes, patients were redistributed in two groups: up to 11 lymph nodes and 12 or over lymph nodes. Other variables were treated descriptively.

Initially, data was analyzed descriptively. Association tests between dependent and independent variables were carried out using chi-square for nominal variables and t student or Mann Whitney (chosen because of the degree of normality of variables) with significance levels of <0.05.

RESULTS

The study included 110 patients submitted to colorectal resection for CRC, of which 75 (68.2%) underwent open surgery and 35 (31.8%) were submitted to laparoscopic procedures. Three patients had their operations started with laparoscopy but the procedures had to be converted to the open approach and they were thus allocated to the open group. Conversion rate was of 7.9%. Of the total, 64 were men and 46 women. Forty two men (65.6%) were operated by open surgery and 22 (34.4%) by the laparoscopy approach. Among women, 33 (71.7%) underwent open surgery and 13 (28.3%) laparoscopy. Compared to women a higher percentage of men were operated by laparoscopically; the difference however is not statistically significant (p=0.497).

Age varied between 28 and 93 years, with a mean of 64.6 (dp-15.5) and median 65.5. In the open group the mean age was 65.8 years (dp=12.7) and median 68. In the laparoscopic, mean age was 62 (dp=12.5) and median 60. A statistical significant difference (p=0.049) was observed toward a higher prevalence of open surgeries among patients aged 60 or over.

In regards to the topography of the neoplastic lesions, 20 tumors were located in the rectum, 49 in the sigmoid colon, four in the transverse colon, 27 in the ascending colon and 10 in the cecum. As far as the types of colorectal resections are concerned, 42 (56.4%) rectosigmoidectomies, 35 (31.8%) right ileocolectomies and four (3.6%) transversectomies were performed. Nine patients were treated for other types of colectomies. For the statistical analysis, the two most prevalent groups were contemplated (Table 1). There was statistical significance (p=0.042) for a higher prevalence of rectosigmoidectomies operated by open approach.

TABLE 1 – Distribution of types of colorectal resection between open and laparoscopic approaches

Type of operation	Open		Laparoscopic		Total
	N	%	N	%	N
Rectosigmoidectomy	35	46,7	27	77,1	62
Right colectomy	27	36	8	22,8	35
Transversectomy	4	5,3	0	0	4
Segment colectomy	7	9,6	0	0	7
Sobtotal Colectomy	2	2,9	0	0	2
Total	**75**	**68,2**	**35**	**31,8**	**110**

Ostomies were needed in 15 cases (13.6%), of which 12 colostomies (80%) and three (20%) ileostomies. Results demonstrate a higher frequency of ostomies in the open group, though showing no significant difference (p=0.464).

Operating time was evaluated according to the duration of anesthesia. With a range from 69 to 345 minutes, mean operating time was 186.5 minutes (dp=56.9) and the median 180. Open resections had a mean operating time of 172.2 (dp=48.4) while those performed laparoscopically had a mean operating time of 217.3 (dp=62.1). Of a total of 65 patients (59.1%) whose median operating time was under 180 minutes, 53 (81.5%) had open surgery, showing a statistical significance of (p>0.001).

Some kind of postoperative complication occurred to 38 patients (34.5%) (Table 2). Of these, 28 (73.7%) were in the open group and 10 (26.3%) in the laparoscopic. A higher frequency of postoperative complications was observed in patients submitted to open surgery when analyzing postoperative complications and hospital stay. Patients with no complications had shorter hospital stay, with a significant p value (p=0.001). Global mortality rate was of 6.4%, of which 8% for open and 2.8% for laparoscopy. Although a higher rate of mortality was observed in the open approach, p value for this association was not significant (p=0.303).

Excluding the seven hospital deaths, postoperative hospital stay of the 103 remaining patients range from three to 36 days, with a mean of 8.8 (dp=5.8) and median of seven days. Regrouping the sample under the median (up to seven days and over seven days), it was observed that most of the patients who stayed for more than seven days in hospital had undergone open surgery: 34 (87.2%) out of 39 patients (p<0.001).

TABLE 2 – Distribution of postoperative complications for open and laparoscopic techniques

Postoperative complications	Open	Laparoscopic	Total
Sepsis	3	1	4
Stercoral fistula	4	2	6
Wound infection	10	1	11
Fever	3	2	5
Ileus	3	2	5
Wall dehiscence	3	0	3
Intestinal obstruction	2	2	4
Respiratory insufficiency	3	0	3
Bleeding	2	0	2
Death	6	1	7
Total	**39**	**11**	**50**

The number of resected lymph nodes ranged from 0 to 72, with a mean of 15 (dp=10.3) and median of 13. Patients with 12 or more lymph nodes accounted for 68% of the open cases and 42.8% of laparoscopic cases (p=0.012).

In regards to surgical margins, all reports pointed to free margins. Besides, the nearest margin to the tumor was analyzed to range from 1 to 19cm. Distributing patients under two margins groups, up to 5cm and above 5cm, a higher number of patients with margins above 5cm were observed within the open group: 39 out of 50 (78% - p=0.036).

Table 3 groups outcome variables and their respective statistical analysis with p values for each association.

TABLE 3 – Statistical analysis between open and laparoscopic techniques according to outcome variables

	Open		Laparoscopic		P
	N	%	N	%	Value
Gender					0,497
Male	42	65,6	22	34,4	
Female	33	71,7	13	28,3	
Age					0,049
Mean / Median (dp)	65,8 / 68 (12,7)		62 / 60 (12,6)		
< 59 years	22	56,4	17	43,6	
· 60 Years	53	74,6	18	25,4	
Type of resection					0,042
Rectosigmoidectomy	35	56,5	27	43,5	
Right colectomy	27	77,1	8	22,9	
Ostomy					0,464
No	66	69,5	29	30,5	
Ileostomy/Colostomy	9	60	6	40	
Operating time					0,000
Mean (dp)	172,2 (48,4)		217,3 (62,1)		
< 180 minutes	53	81,5	12	18,5	
· 180 minutes	22	48,9	23	51,1	
Postoperative Complications					0,368
Absent	47	65,3	25	34,7	
Present	28	73,3	10	26,3	
In-hospital death					0,303
No	69	67	34	33	
Yes	6	85,7	1	14,3	
Lenght of stay *					0,001
Mean (dp)	10 (6,4)		6,3 (3,3)		
< 7 days	35	54,7	29	45,3	
· 7 days	34	87,2	5	12,8	
Lymph nodes resected					0,012
Mean (dp)	15,9 (9,2)		13,2 (12,4)		
< 12	24	54,5	20	45,5	
· 12	51	77,3	15	22,7	
Surgical margins **					0,036
Compromized	0		0		
< 5 cm	33	58,9	23	41,1	
· 5 cm	39	78	11	22	

* Excluding hospital deaths
** Nearest distance to tumor

DISCUSSION

The present study selected patients in a way to reflect that, when in presence of advanced neoplasia, major comorbidities or complications such as obstruction and perforation, patients were preferably submitted to open surgery. Considering the sampling period, the indication of laparoscopic surgery for CRC is consistent with the literature trend towards the laparoscopic approach. Although no specific analysis was made concerning this issue, the majority of laparoscopic surgeries occurred in the last sampling years.

As expected, considering that neoplastic disease is significantly more common among the elderly, this study found an advanced median age in its sample. Köckerling et al.[16] presented a study of 500 patients submitted to laparoscopic colorectal surgery in which those with neoplastic disease were significantly older. A 2003 cohort study showed that laparoscopic colorectal surgery is safe and effective among the elderly[26].

Of the 38 patients that were initially submitted to laparoscopic surgery, three were converted to open surgery, corresponding to a conversion rate of 7.9%. Conversions were motivated by adhesions, need for total colectomy and large tumors.

A 2005 randomized study involving 794 individuals aiming at comparing laparoscopic and open surgery for CRC found a conversion rate of 29%, which were associated with adhesions, obesity and uncertainty of tumor clearance[12]. A similar rate (25.7%) had been published earlier for laparoscopic colectomies. Another recent study lowered this rate to 17%, still higher than the one found in this study.

However, in most of these studies, patients were randomized to open or laparoscopic surgery regardless of tumor stage. This non-selective approach led to an increase of conversion rates given that advanced tumors initially selected for laparoscopic surgery had to be converted to open handling. In the present study, tumors identified as advanced were primarily submitted to open surgery, in anticipation of technical difficulties. Another randomized study, which excluded locally advanced tumors from the laparoscopic group, presented a conversion rate of only 4,2%[4].

Even in randomized studies, conversion rates tend to lower along de years. The CLASICC[6] study reports a reduction in conversion rates from 38% to

16% following learning curves.

Open median operative times were shorter than laparoscopic. Taking the 180 minutes global midline of operative time as the cutting point, it was identified that 59,1% of the short lasting surgeries were open ones. In this study shorter operative time was significantly associated with open surgery (p<0,001).

A 2007 American prospective study of 200 patients submitted to laparoscopic colorectal surgery[27] demonstrated a shorter operative median time of 120 minutes. The study, however, involved the treatment of other conditions besides CRC, a fact that can probably explain this difference. Nonetheless, in a randomized study of only colon cancer patients, it was observed that longer operative times (142X118 minutes) were significantly associated with laparoscopic surgery (p<0,001)[20]. In regards to rectal cancer, a case-control study from three centers also found significantly longer operative times (180X150 minutes) among patients treated laparoscopically (p<0,001)[9]. A 2008 meta-analysis of 25 randomized studies[30] reinforced the findings of longer operative times in laparoscopic colorectal surgery for CRC. Following the learning curve, however, a trend towards shortening operative times has been established[16].

The most frequent presentation site of CRC in this study was the sigmoid colon, flowed by the rectum and ascending colon. Less common were cecum and transverse colon cancers. These findings explain the high prevalence of rectosigmoid and right colon resections in this sample, in accordance to the 2008 national survey[28].

A greater prevalence of open rectosigmoid resections in comparison to other colorectal procedures was noted. A 2008 North-American cohort reported that patients with sigmoid CRC were more frequently treated laparoscopically [IC95%: 1,36 (1,28-1,43)][2].

Among laparoscopic operations, the most prevalent was rectosigmoid resection (77,1%). Consistent with the present findings, a 2009 national study of 120 laparoscopic colectomies identified 72,5% of rectosigmoid resections[6].

Ostomies were more frequent among patients submitted to open surgery when compared to laparoscopy, but there was no statistical difference (p=0,464). In a 2009 randomized study comparing open and laparoscopic treatment of rectal cancer, 60,8% of sphincter sparing procedures required ileostomy. No statistical difference was noted between open and laparoscopic surgery, although a higher percentage was identified among laparoscopic patients[22]. Likewise, in a 2009 retrospective study of 471 rectal cancer patients treated open or laparoscopically showed no significant difference in terms of ostomy requirement[21].

The number of dissected lymph nodes (mean=15,9) in the open group was greater than in the laparoscopic group (mean=13,2). However, in both groups the minimum of 12 was achieved, as recommended by the literature 10. Moreover, it was noticed that in the open group the dissection of more than 12 lymph nodes occurred more frequently, with statistical difference (p=0,012).

A retrospective 2010 national study evaluating a series of 50 patients with CRC submitted to laparoscopic or open surgery demonstrated a mean of 10.3 and 10.1 lymph nodes for the first and second group, respectively[17].

A 2008 retrospective cohort failed to identify differences in terms of number of lymph nodes between the two techniques. However, patients operated in hospitals with lower volumes of laparoscopic assisted colectomy were twice as likely to have less than 12 lymph nodes when compared to referral centers[2].

An anatomopathologic investigation of lymph nodes must be detailed and its results are likely to present a broad variation. Due to the retrospective nature of this study, there was no standardization of lymph node analysis and reports from different labs were used. It was noticed that there was a difference between labs in regards to the total number of dissected lymph nodes, regardless of the surgical approach.

Long term results of the COLOR[5] study have shown a similar mean number of resected lymph nodes, both for the open technique and the laparoscopic approach. In spite of presenting a smaller number of total lymph nodes (averaging 10 in each group) compared to the National Comprehensive Cancer Network[10] recommendation, in the long term there was no significant differences in terms of relapse, overall and disease-free survival.

Analyzing the nearest tumor margin, a larger number of margins with at least 5 cm from the tumor was observed in the group treated by open surgery with p=0.036. A meta-analysis published in 2003 showed that the average margin extension was of 5.3 cm for open and 4.6 cm for laparoscopy, thus significant smaller margins for laparoscopic surgery[18].

No case presented compromised margins, both longitudinal and circumferential. A clinical trial, published in 2009, that evaluated the short term results of colon cancer treatment and compared open and videolaparoscopy surgeries, found no difference in terms of compromised surgical margins[5].

Two randomized clinical trials involving rectum cancer patients found compromised circumferential margins in 2.9% and 6% of patients treated with open surgery and 4% and 7% by laparoscopy, respectively, with no statistical significance[21,22]. Another multicenter clinical trial published in 2005

demonstrated that circumferential margin in rectum resections were positive in 5% of patients treated by open surgery and 7% for laparoscopy. This difference, however, is not statistically significant[12].

Two meta-analyses involving clinical trials comparing short term results of open and laparoscopic surgery for the treatment of CRC, published in 2004 and 2007, have not demonstrated significant differences related to oncologic control of the disease and, more specifically, in relation to the number of resected lymph nodes and the presence of compromised margins[1,13].

A randomized clinical trial with a three-year follow-up, published in 2007, determined equal recurrence rates (0.8%) and similar survival rates for patients treated with open and laparoscopic surgery (98,2% and 98.6% respectively), demonstrating no significant difference in the long term[14].

A meta-analysis and a systematic review of 2008 involving randomized clinical trials of long term follow-up of the surgical treatment of CRC, compared conventional with laparoscopic operations and demonstrated that, statistically, there is no significant difference in relation to local and systemic recurrence and mortality associated to cancer[19].

Hospital stay ranged from three to 36 days, with a mean of 8.8 days (dp=5.8). In this study, it was observed that most of the patients that stayed longer than seven days in hospital had been submitted to laparotomy (87.2%), showing a statistical significant difference ($p<0.001$). A meta-analysis published in 2004, evaluating a total of 12 randomized clinical trials, selected nine studies which reported time of postoperative hospital stay of 1,237 patients. All patients treated laparoscopically had shorter stays[1]. A review of 25 randomized clinical trials of 2008 also concluded that patients treated laparoscopically had shorter postoperative hospital stay periods[30].

Postoperative complications were more frequently found among patients treated by open surgery, the difference, however, is not statistically significant ($p=0.368$). Three randomized clinical trials comparing CRC patients treated by open surgery with patients treated laparoscopically, published in 2004[24], 2005[12] and 2009[5], showed similar rates of postoperative complications, demonstrating that neither technique is significantly associated with higher occurrences of complications. However, a 2002 clinical trial indicated a higher morbidity associated with the open procedure ($p < 0.001$)[20].

It is again stressed in this study the selection of laparotomy for patients with more comorbidities, in later stages of the disease or with a more complicated presentation, thus, resulting in higher rates of complications and longer stays given the higher number of adverse variables.

Evaluating overall mortality, a higher number of deaths was associated with the open approach, though the difference is not statistically significant ($p=0.303$). An American univaried cohort analysis of 2008 indicated a significantly reduced rate of perioperative death in patients treated laparoscopically (2.4% X 3.0%; $p=0.001$). However, when corrected for patient and tumor characteristics as well as for hospital aspects, this difference was no longer significant[2]. Three randomized clinical trials demonstrated a relative higher incidence of perioperative mortality in patients treated by laparotomy, but none found the association to be statistically significant[5,12,24].

Although this study used as a base for its analysis operations which were performed within the learning curve, and considering that this group of surgeons have performed an equal number of colorectal resections of benign diseases within the same period, the findings are consistent with other results in the world literature. Still, these are preliminary results which need to be reassessed with the addition of more recent cases evaluating oncological aspects, such as relapse and survival, for mid and long term outcomes.

CONCLUSIONS

The laparoscopic approach was as safe and effective as laparotomy in the treatment of colorectal cancer, and was associated with increased operative time, shorter hospital stay and less morbidity.

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