Original article

Single center experience in laparoscopic colectomy for cancer

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SUMMARY

Objective: **The application of laparoscopic colectomy for colorectal carcinoma has been disputable regarding its efficacy as an oncological procedure. The aim of this study was to assess the early and long-term results of laparoscopic colectomy for malignant disease.** *Method:* **Between 1990 and 1997, 243 patients underwent laparoscopic colectomy for colon carcinoma, in our center. Morbidity and mortality data were analyzed retrospectively along with disease-free and overall patient survival.** *Results:* **Laparoscopic colectomy was successfully completed in 216 of 243 patients (89%). A perioperative morbidity rate of 22% and mortality rate of 1.4% were observed. The overall estimated 1, 2, 3, 5, and 7-year survival rates were 92%, 82%, 74%, 65%, and 45%, respectively. Only one case (<0.5%) with a trocar site recurrence was observed in this series. There were no recurrences at the wound extraction site, when the wound was protected. The overall estimated 5- and 7-year disease-free survival rates were 79% and 76%, respectively.** *Conclusion:* **Laparoscopic colectomy for cancer can be performed safely and effectively with perioperative morbidity, mortality and survival rates comparable to open colon resection.**

Key words: Laparoscopic surgery, colectomy, colorectal carcinoma

INTRODUCTION

Laparoscopic colectomy is currently practiced with increasing frequency by general surgeons for benign and malignant disease. During the first years of its applica-

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tion there were serious concerns regarding the adequacy of tumor resection and the potential risk of port-site recurrences.[1,2] Our early experience[3,4] and that of other centers[5,6] has proven that laparoscopic colectomy is a feasible and well tolerated procedure with an acceptable rate of perioperative morbidity and mortality. Furthermore, survival rates for laparoscopic colectomy for cancer seem to be comparable to these of the open colectomy, at least after moderate-term follow-up.[6,7] This study reviews our experience with the specific perioperative problems associated with this procedure and studies the long-term survival in a large number of consecutive patients who underwent laparoscopic colectomy for colon carcinoma in our center.

PATIENTS AND METHODS

A retrospective study of a database established for all consecutive cases of laparoscopic colectomy for cancer performed by two experienced surgeons (MJ, GP), in Baptist Hospital of Miami was done. Between March 1991 and December 1997, 274 patients underwent this operation. Of these, thirteen patients were excluded because the tumor was not an adenocarcinoma (two lipomas, seven adenomas, two carcinoids, one lymphoma, and one metastatic tumor from primary lung carcinoma). Eighteen patients were also excluded from the study due to incomplete or missing data.

Preoperative evaluation included physical examination, chest roentgenograms, electrocardiogram, carcinoembryonic antigen, colonoscopy with a biopsy, liver function tests, ultrasonography or computerized tomography. Informed consent was obtained in all cases. All patients received a bowel preparation and broad-spectrum antibiotics. The technique of laparoscopic colectomy was standardized and included intracorporeal resection.[8] The colon was first mobilized and then devascularized at the base of the mesentery using a lin-

ear cutting stapler as well as the harmonic scalpel. Bowel was then delivered extracorporeally through a small counter incision. The exteriorized colon was resected and an anastomosis followed. For right, transverse, and left colectomies the anastomosis was done extracorporeally with linear stapling devices; for sigmoid and low anterior resections the anastomosis was accomplished intracorporeally using the circular stapler. For abdominoperineal resections, the specimen was extracted through the perineal incision after laparoscopic dissection and ligation of the lymphovascular pedicle. The general principles of oncological surgery were followed; special care was taken for minimal intraoperative manipulation of the tumor and adequate mucosal margins of resection.[4] Tumor staging was done according to the American Joint Committee on Cancer Tumor-Node-Metastasis (TNM) staging system.[9]

The patients were mobilized soon after surgery. Clear liquids were begun on the first postoperative day and advanced after the return of bowel function. Complications were defined as events occurring within the first 30 postoperative days, which prolonged hospital stay or required reoperation. Tumor recurrence was diagnosed with computerized tomography and colonoscopy with biopsy. Follow-up was accomplished by chart review and telephone survey of treating physicians and/or patients. Length of follow-up was considered as the time interval between operation and date of last patient contact or death.

Statistical analysis was accomplished using Statistica software (Statsoft, Tulsa, Oklahoma). The survival rates for all stages and the disease-free survival rates were determined using the Kaplan-Meir product limit analysis. Difference between survival curves according to stage was evaluated using the log rank test.

RESULTS

Laparoscopic colectomy was attempted in 243 patients with colonic adenocarcinoma and was achieved in 216 (89%). The other 27 patients (11%) required conversion to open colectomy due to reasons which precluded a proper oncological resection with the laparoscopic method (Table I). The 216 patients (114 male, 102 female) who underwent successful laparoscopic colectomy constitute the population under study. The patients' ages ranged between 34 to 96 years (mean age $\pm$ SD $= 69.43 \pm 11.23$ years).

Thirty patients had a family history of colon carcinoma. Twenty-two patients had previous colonic disease: 3 had colonic polyps, 13 diverticulosis and 6 colon carcinoma diagnosed and treated surgically 3 months to 22 years earlier. Most patients were managed surgically on an elective basis. However, 5 patients underwent urgent surgery for incomplete intestinal obstruction. The average ASA rating was 2.2 ± 0.8.

The tumor distribution was: right colon, 85 cases (40%), transverse colon, 6 cases (3%), left colon, 18

Table 1. Reasons for conversion to open colectomy

Reason	RC	LC	SC	LAR	APR	No. of cases
Severe adhesions	2	1		2	1	6
Bulky tumor	1	1	3	3	1	9
Low rectal tumor				1		1
Large mesorectum				1		1
Colonic obstruction		1				1
Peritoneal metastases				1		1
Scarring rectal stump			1			1
Liver biopsy			1			1
Inability to find tumor	1	1				2
Poor visualization			1	3		4
Total	4	4	6	11	2	27

*Right colectomy

**Left colectomy

***Sigmoid colectomy

****Low anterior resection

*****Abdominoperineal resection

cases (8%), sigmoid colon, 57 cases (26%), and rectum, 46 cases (21%). There were four cases with synchronous tumors (2%): all of them had two tumors: transverse-sigmoid (1), cecum-hepatic flexure (1), cecum-sigmoid (1), cecum-sigmoid polyp (1). These cases with synchronous tumors underwent extended left colectomy, extended right colectomy, right and sigmoid colectomy, and right hemicolectomy with sigmoid polypectomy, respectively. The distribution of laparoscopic colorectal procedures is presented in Table II.

The abdominal wall was protected with an impermeable plastic sleeve during specimen extraction in 121 cases and unprotected in 95 cases. The median operative time was 132 minutes (range, 48 to 360 min). Four patients with anemia required transfusion of 2-4 units of blood postoperatively. The median time to discharge was 5 days (range 2 to 38 days), with most patients being discharged within 4 days.

Histopathological examination of the surgical specimen revealed that proximal and distal margins were free of tumor in all cases. The mean lymph node harvest was 8 (range 2-35) nodes. Tumor classification according to stage revealed: stage 0, n= 26, stage I, n= 50, stage II, n= 63, stage III, n= 55, stage IV, n= 22.

In the early postoperative period 48 patients developed complications (morbidity rate 22%). Six patients developed two complications each (Table III). Complications were managed expectantly except for one case with severe anastomotic bleeding, which required reexploration at the second postoperative day. Seven patients (3%) developed long-term complications, within a median period of 8 months (range 4-10 months) after surgery (2 anastomotic stricture, 2 proctocolitis, one internal volvulus, 3 impotence).

There were two deaths within 30 days after surgery, for a perioperative mortality rate of 1.4%. Two of these patients had advanced disease at the time of operation and died of cancer. One patient developed an anastomotic leak and severe sepsis and died after 28 days in the hospital.

With a median follow-up of 24 (range 2 to 95) months, the overall estimated 1, 2, 3, 4, 5, 6 and 7-year survival rates were 92%, 82%, 74%, 68%, 65%, 63%, and 45%, respectively (Fig. 1). The 2-year survival rates were 100% for stage 0 (in situ), 97% for stage I, 88% for stage II, 84% for stage III, and 0% for stage IV. The 5-year survival rates were 93% for stage 0, 92% for stage I, 62% for stage II, 56% for stage III, and 0% for stage IV (Fig. 2). A statistically significant difference in sur-

Table 2. Distribution of laparoscopic colorectal procedures.

Procedures by type	No. of cases
Right hemicolectomy	82
Extended right colectomy	4
Transverse colectomy	6
Left hemicolectmy	18
Extended left colectomy	1
Sigmoid colectomy	57
Low anterior resection	34
Abdominoperineal resection	9
Hartmann's procedure	2
Colostomy	1
Combination of procedures	2
Total	216

Table 3. Postoperative complications.

Complications	No. of cases
Wound infection	5
Anemia	3
Postoperative fever	5
Cardiac arrhythmia	2
Atelectasis	3
Pneumonia	5
Respiratory failure	2
Intraabdominal bleeding	1
Anastomotic bleeding	4
Anastomotic leak	3
Small bowel obstruction	9
Ileus	12

vival among the five stage groups was noted (p<0.001). Of the 50 deaths which occurred during the follow-up period, 33 (15%) were due to regional recurrence or metastatic disease and the remaining to unrelated causes.

There was only one case with recurrence at a trocar site that was diagnosed at 401 days postoperatively. There were 3 cases with recurrence at the wound extraction site of 95 unprotected wounds (3%). These occurred at 230, 272 and 435 days postoperatively. All four of these patients developed metastatic disease in other organs. However, no recurrences were observed at the wound extraction site in the 121 cases where the wound was protected with a plastic sleeve.
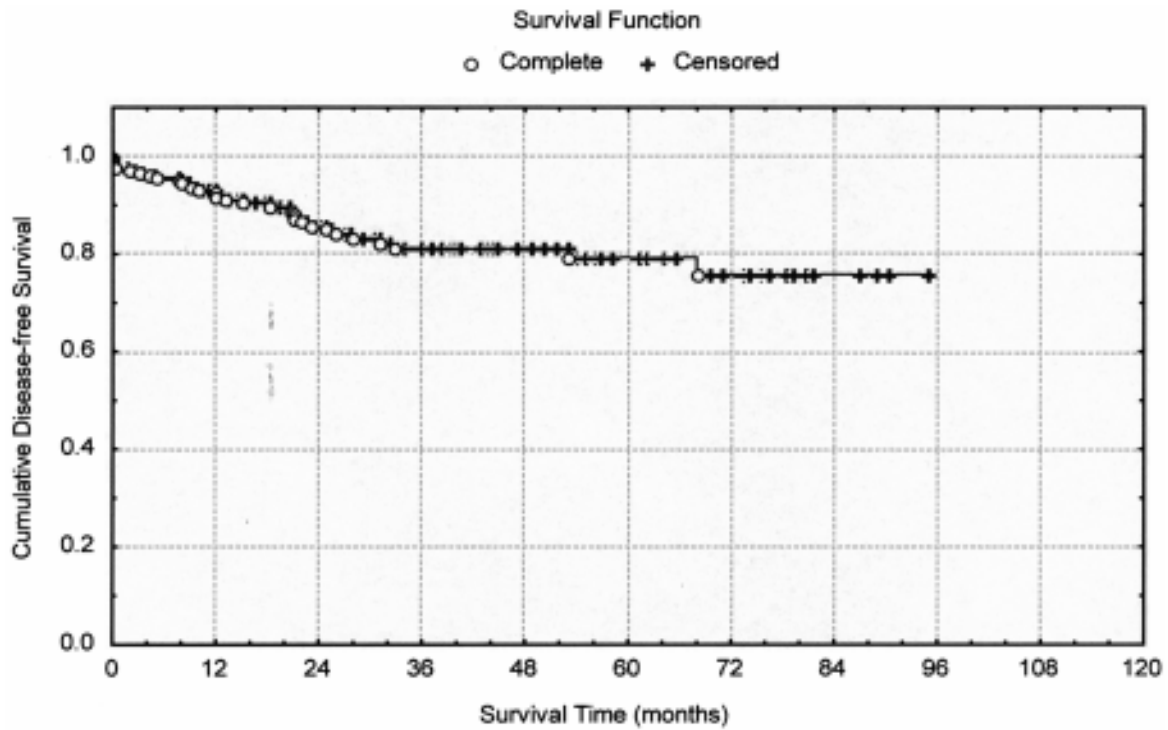
Figure 1. Overall survival for patients undergoing laparoscopic resection for colon carcinoma.
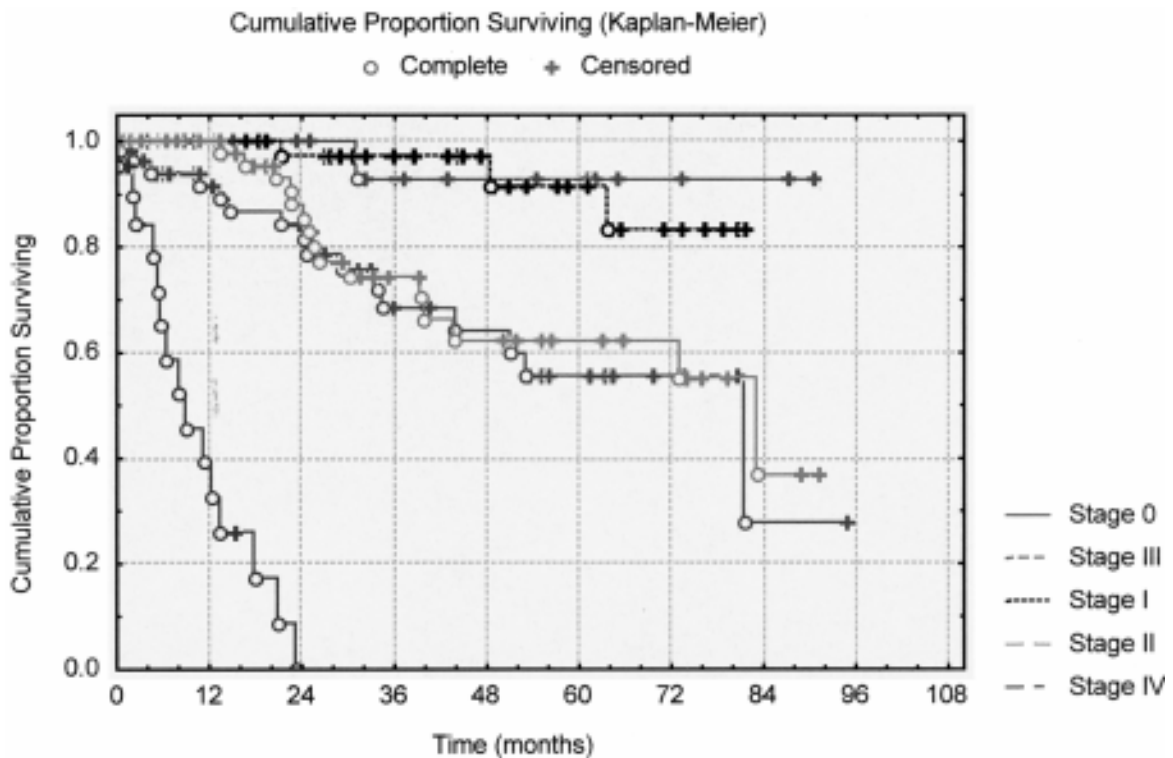

Figure 2. Survival for patients undergoing laparoscopic resection for carcer according to stage. A statistically significant difference in survival among the 5 groups overall was noted (p<0.001).

Overall estimated 1, 2, 3, 5, and 7-year disease-free survival rates were 92%, 84%, 80%, 79%, and 76%, respectively (Fig. 3). Quality of life was poor in 33 patients (15%) with metastatic disease or locoregional recurrence. However, postoperative recovery and quality of life in the long-term were excellent in the majority of patients.

DISCUSSION

After the proven success of laparoscopic cholecystectomy, surgeons quickly applied the laparoscopic technique in other general surgical procedures[3]. Laparoscopically assisted colectomy is a more challenging procedure than laparoscopic cholecystectomy. There is concern, however, regarding the proper role of laparoscopic colectomy in the treatment of malignant disease. The short-term advantages of decreased hospital stay, minimal pain and discomfort, fewer pulmonary complications, better cosmesis and less postoperative ileus have been well documented.[2, 8, 10, 11, 12, 13] However, many surgeons are not convinced that laparoscopic surgery is appropriate for the treatment of potentially curable malignancies since the long-term effects are yet unknown.[14] Based on these concerns we created a database of patients who had undergone laparoscopic colectomy and performed a retrospective review of our data to calculate long-term survival statistics.

There has been significant skepticism about the efficacy of laparoscopic surgery as an oncological procedure.[15] However, recent studies comparing laparoscopic to open colectomy did not reveal any significant difference in lymph node yield between the two approaches.[11,12] Actually, experienced pathologists may not be able to tell whether a specimen was removed laparoscopically or through traditional open techniques[2]. Our mean lymph node yield of 8 nodes (range 2-35) was similar to previously published series comparing laparoscopic to open colectomy.[13,14] We always perform a ligation of the mesenteric vessels at their point of origin to obtain an adequate lymphatic resection. With experience, the length of bowel resection and degree of lymph node resection can be identical to open colectomy.[8]

Port-site recurrence has emerged as a technical concern of laparoscopic technique.[15,16] There have been isolated case reports of wound and trocar site recurrence, and there has been much speculation regarding their cause.[8,17] The current data supports that the incidence of port-site recurrences may not be much different from open wound recurrences.[14,18] Our incidence of port-site recurrences was <0.5%, which is similar to previous
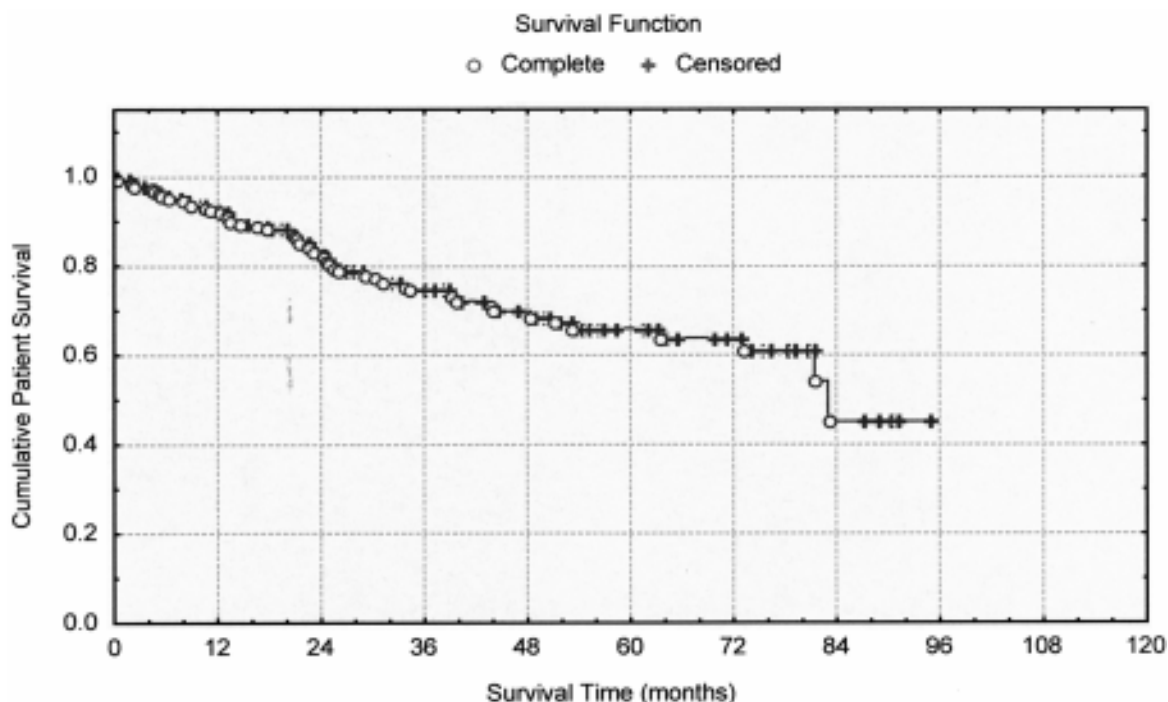

Figure 3. Overall disease-free survival for patients undergoing laparoscopic colon resection for colon carcinoma.

published reports ranging 0 to 1.2%.[2,19] Interestingly, this rate is also similar to the incidence of abdominal wound tumor recurrence, which ranges from 0.6 to 1%.[2,20] It is also noteworthy that most of the recurrences reported have been in patients with advanced disease. Given these findings it is likely that port-site recurrences are more a reflection of the malignant pathology, rather than a direct consequence from the effects of laparoscopy. For the time being, however, meticulous protection of the wound extraction site is deemed necessary.[2,17,20] It is obvious from our results comparing the protected wounds versus the non-protected wounds (0 recurrences versus 3%), that this is critical. Great care must also be taken to avoid tumor contact with laparoscopic instruments and ports.

Another point of controversy is that the identification of the tumor may be unpredictable with the laparoscopic method.[15] If the mass is known to be small, the surgeon may opt to have preoperative colonoscopic marking of the tumor with methylene blue or India ink.[7] Another option that has been helpful is intraoperative colonoscopy. Both of these methods can significantly reduce the difficulty in tumor identification at surgery.

The advent of new technologies has made possible the completion of even difficult oncological cases. Tumors of the mid- and lower rectum can be successfully excised with relative ease using the laparoscopic method, even in patients who are obese or have a narrow pelvis. The laparoscopic abdominoperineal resection (LAPR) has been successfully performed in our and other centers for the treatment of very low rectal tumors.[21] For patients with unresectable disease a laparoscopic colostomy can be performed with minimal postoperative pain and a faster recovery.

The conversion rate in our series was 11%. This is comparable to other recent studies, which reported conversion rates from 6 to 42%.[6,7,14,19,22,23] Large bulky tumor fixed to adjacent tissues, which precluded a proper oncologic resection, was the most common cause for conversion to open resection. There is a trend similar to the initial experience with laparoscopic cholecystectomies. As we gained expertise with laparoscopic colectomies, there has been a notable decrease in the conversion rate over the last few years.

Laparoscopic colectomy seems to represent an improvement in surgical technique. It accomplishes the same objective as the open approach without the need for an abdominal incision. Consequently as a minimally invasive procedure, it reduces the acute phase response after surgery,[24] thereby decreasing the risk of postoperative complications.

Morbidity rates of open and laparoscopic colectomy have been compared.[11,13] Our rate of 22% is not significantly different from 15-37% for laparoscopic colectomy[13,14,19,23,25,26] and 15-30% for the open approach.[5,11,13] Matched-controlled studies comparing clinical outcomes between the laparoscopic and open approach did not find significant differences in the overall morbidity rates.[13,22,26] Only one patient in our series required reoperation. Our perioperative mortality rate was only 1.4%, which is similar to the one reported in other laparoscopic series[7,11,19,23] and much better than the one reported by Fielding (7%) in a large study concerning the open colectomy.[27]

Long-term survival also appears favorable in our series. To the best of our knowledge this is the first report of 7-year survival after laparoscopic colectomy for cancer. Our 2, 3 and 5-year survival rates are equivalent to other reports on the laparoscopic approach.[7,13,14] Survival according to stage and the overall 7-year survival in our series appear equivalent or even better than the ones-reported by Chapuis, et al, in a large cohort on the open colectomy.[28]

Our results demonstrate that morbidity and mortality rates and long-term survival after laparoscopic colectomy for colon cancer are comparable to those of the open colectomy. Appropriate clinical judgement regarding when to convert to open surgery and strict oncologic principles should be adhered to when using the laparoscopic approach. We believe that laparoscopic colectomy holds much promise for the future. As experience in laparoscopic colorectal surgery is continuously improving, we believe that it may gradually replace open surgery, at least in elective cases.

REFERENCES

1. Wexner SD, Cohen SM. Port site metastases after laparoscopic colorectal surgery for cure of malignancy. Br J Surg 1995; 82:295-298.
2. Ramos JM, Gupta S, Anthone GJ, Ortega AE, Simons AJ, Beart RW. Laparoscopy and colon cancer, is the port site at risk? A preliminary report. *Arch Surg* 1994; 129:897-899.
3. Jacobs M, Verdeja JC, Goldstein HS. Minimally invasive colon resection (laparoscopic colectomy) Surg Laparosc Endosc 1991; 1:144-150.
4. Jacobs M, Plasencia G. Laparoscopic colon surgery: some helpful hints. Int Surg 1994: 79:233-234.
5. Franklin ME Jr, Rosenthal D, Abrego-Medina D, et al.

Prospective comparison of open vs. laparoscopic colon surgery for carcinoma: five-year results. Dis Colon Rectum 1996; 39 (Suppl): S 35-S 46.

6. Leung KL, Yiu RYC, Lai PBS, Lee JFY, Thung KH, Lau WY. Laparoscopic-assisted resection of colorectal carcinoma. Dis Colon Rectum 1999; 42: 327-333.

7. Poulin EC, Mamazza J, Schlachta CM, Gregoire R, Roy N. Laparoscopic resection does not adversely affect early survival curves in patients undergoing surgery for colorectal carcinoma. Ann Surg 1999; 229: 487-492.

8. Jacobs M, Plasencia G, Caushaj P. Atlas of Laparoscopic Colon Surgery. Baltimore: Williams & Wilkins; 1996.

9. Beahrs OM, Henson DE, Hutter RVP, Kennedy BJ. American Joint Committee on Cancer Staging Manual. 5th ed. Philadelphia: JB Lippincott; 1997.

10. Chen HH, Wexner SD, Iroatulam AJN, et al. Laparoscopic colectomy compares favorably with colectomy by laparotomy for reduction of postoperative ileus. Dis Colon Rectum 2000; 43: 61-65.

11. Milsom JW, Bohm B, Hammerhofer KA, Fazio V, Steiger E, Elson P. A prospective, randomized trial comparing laparoscopic versus conventional techniques in colorectal cancer surgery: a preliminary report. J Am Coll Surg 1998; 187:46-57.

12. Melotti G, Tamborrino E, Lazzaretti MG, et al. Laparoscopic surgery for colorectal cancer. Semin Surg Oncol 1999; 16:332-336.

13. Khalili TM, Fleshner PR, Hiatt JR, et al. Colorectal cancer. Comparison of laparoscopic with open approaches. Dis Colon Rectum 1998; 41:832-838.

14. Bouvet M, Mansfield PF, Skibber JM, et al. Clinical, pathologic, and economic parameters of laparoscopic colon resection for cancer. Am J Surg 1998; 176:554- 558.

15. Berman IR. Laparoscopic resection for colon cancer: cause for pause. Import Adv Oncol 1996; 231-243.

16. Bertagnolli MM, DeCosse JJ. Laparoscopic colon resection for cancer-an unfavorable view. Adv Surg 1996; 29:155-164.

17. Tomita H, Marcello PW, Milsom JW. Laparoscopic surgery of the colon and rectum. World J Surg 1999; 23:397-405.

18. Pearlstone DB, Feig BW, Mansfield PF. Port site recurrences after laparoscopy for malignant disease. Semin Surg Oncol 1999; 16:307-312.

19. Schiedeck THK, Schwandner O, Baca I, et al. Laparoscopic surgery for the cure of colorectal cancer. Dis Colon Rectum 2000; 43:1-8.

20. Whelan RL, Allendorf JD, Gutt CN, et al. General oncologic effects of the laparoscopic surgical approach. Surg Endosc 1998; 12:1092-1103.

21. Fleshman JW, Wexner SD, Anvari M, et al. Laparoscopic vs. open abdominoperineal resection for cancer. Dis Colon Rectum 1999; 42:930-939.

22. Gibson M, Byrd C, Pierce C, et al. Laparoscopic colon resections: A five-year retrospective review. Am Surg 2000; 66:245-249.

23. Schlachta CM, Mamazza J, Seshadri PA, Cadeddu M, Poulin EC. Determinants of outcomes in laparoscopic colorectal surgery. Surg Endosc 2000; 14:258-263.

24. Jakeways MS, Mitchell V, Hashim IA, et al. Metabolic and inflammatory responses after open or laparoscopic cholecystectomy. Br J Surg 1994; 81:127-131.

25. Fleshman JW, Fry RD, Birnbaum EH, Kodner IJ. Laparoscopic-assisted and minilaparotomy approaches to colorectal diseases are similar in early outcome. Dis Colon Rectum 1996: 39:15-22.

26. Stocchi L, Nelson H, Young-Fadok TM, Larson DR, Ilstrup DM. Safety and advantages of laparoscopic vs. open colectomy in the elderly: matched-control study. Dis Colon Rectum 2000; 43:326-332.

27. Fielding P, Philips RKS, Hittinger R. Factors influencing mortality after curative resection for large bowel cancer in elderly patients. Lancet 1989; 1:595-597.

28. Chapuis PH, Fisher R, Dent OF, Newland RC, Pheils MT. The relationship between different staging methods and survival in colorectal carcinoma. Dis Colon Rectum 1985; 28:158-161.