Tech Coloproctol (2007)
DOI 10.1007/s10151-007-0345-y

PRACTICE PARAMETERS

C.A. Sartori • A. D'Annibale • G. Cutini • C. Senargiotto • D. D'Antonio • A. Dal Pozzo • M. Fiorino G. Gagliardi • B. Franzato • G. Romano

Laparoscopic surgery for colorectal cancer: clinical practice guidelines of the Italian Society of Colorectal Surgery

Received: 23 September 2006 / Accepted: 6 March 2007 / Published online: 25 May 2007

Introduction

The present guidelines are recommendations of clinical behaviour from a multidisciplinary work group. They are based on the recent scientific literature, and aim to help doctors manage clinical disorders and diseases of colon and rectum. Clinical practice guidelines are not prescriptive, and their purpose is to provide information on which decisions can be made, rather than dictate a specific form of treatment. These guidelines are intended for the use of all practitioners, health care workers, and patients who desire information about the management of the conditions addressed by the topics covered in this paper.

In the development of clinical guidelines for the treatment of colon cancer with a minimally invasive technique, we referred to the EAES Consensus Conference held in Lisbon in 2002 [1]. We searched PubMed and Medline from 1990 to 2006 using the keywords "laparoscopy" and "colorectal neoplasms"; embedded references also were reviewed. Surgical techniques are difficult to evaluate scientifically, so the level of evidence of articles on this topic is, regrettably, low.

C.A. Sartori • C. Senargiotto • A. Dal Pozzo • B. Franzato
San Giacomo Apostolo Hospital
Castelfranco Veneto (TV), Italy

A. D'Annibale
Camposampiero Hospital
Camposampiero (Padua), Italy

G. Cutini
Ospedale civile di Jesi
Jesi (Ancona), Italy

D. D'Antonio
Anna Rizzoli Hospital
Lacco Ameno (NA), Italy

M. Fiorino
Coloproctology Unit
Villa Flaminia Hospital
Rome, Italy

G. Gagliardi (✉)
Villa Igea Hospital
Foggia, Italy
E-mail: gagliarg@yahoo.com

G. Romano
S.G. Moscati Hospital
Avellino, Italy

Preoperative staging and patient selection

Patients who are candidates for laparoscopic resection of colon cancer undergo diagnostic exams to identify the segment of colon involved by the neoplasm and its local spread (TN stage). Although colonoscopy has the best sensitivity and specificity in localizing mucosal neoplasms of colon and rectum, an error rate up to 14% has been reported, especially for right-sided lesions [2]. Computed tomography (CT) is not routinely performed in the preoperative staging of colon cancer [3], but it is mandatory if laparoscopy has to be performed. The surgeon needs to exactly know tumor location, abdominal anatomy, presence of synchronous lesions, and locoregional and metastatic stages. A T4 tumor with infiltration of surrounding structures is a contraindication for laparoscopic resection because bulky masses and neoplastic adhesions are responsable for ~40% of conversions. In patients unable to undergo complete colonoscopy because of endoscopic stenosis or because they can not tolerate it, the neoplasm can be localized with double contrast barium enema or CT colonography. Most experts recommend an 'open' approach for transverse and splenic flexure cancer, especially because of tight adhesions to the omentum [1].

Splenic flexure resections for cancer are only performed in highly specialized centers [4].

Preoperative imaging in patients with colonic cancer is recommended if laparoscopy has to be performed to localize the cancer and evaluate its local spread (TN stage). Conventional laparotomic approach should be performed for cancers of the transverse colon and splenic flexure, because the laparoscopic approach is demanding and not recommended by most experts. Level of evidence, 5; Grade of recommendation, D.

Contraindications

Advanced age

Laparoscopic surgery in elderly patients (>70 years) is not contraindicated, even though operative time, period in intensive care unit, and postoperative stay in hospital are longer than in patients under 70 years [5, 6].

Advanced age is not a contraindication for laparoscopic colonic resection. Level of evidence, 2b.

Risk of anesthesia and pneumoperitoneum

Reduced circulatory and pulmonary functions are not contraindications for laparoscopic colorectal surgery, but accurate blood pressure and arterial gas tension (pO_2 and pCO_2) monitoring are recommended, especially for ASA III and IV patients [7].

Invasive monitoring of blood pressure and arterial gases is mandatory in ASA III-IV patients. Grade of recommendation, B. Low pressure pneumoperitoneum can be used in high-risk patients (ASA III-IV). Grade of recommendation, B.

Obesity

Obesity is not a contraindication to a minimally invasive approach for colorectal cancer. It does reduce the technical feasibility of laparoscopy, because anatomical planes are less clear, increasing dissection difficulty and operative times. In addiction, Pandya et al. [8] and Pikarsky et al. [9] reported higher conversion rates in patients with body mass index (BMI) greater than 29–30 kg/m^2, due to increased technical problems.

Obesity is not an absolute contraindication for laparoscopic colectomy but complications and conversion rates are higher in patients with a BMI greater than 30 kg/m^2. Level of evidence, 2c.

T-stage

Complete locoregional clearance is the goal of colon cancer surgery. Locally advanced colon cancer is considered an absolute contraindication by most experts, especially because tumour manipulation and en bloc resection of adjacent infiltrated organs or abdominal wall are technically demanding [1].

In patients with T4 colon cancer, laparotomic resection of the tumour with a potentially curative intent should be performed. Level of evidence, 5. Grade of recommendation, D.

Non-neoplastic adhesions

Adhesions account for about 17% of conversions, but a history of abdominal surgery is not related to an increased conversion rate of laparoscopic colorectal procedures [8, 10]. In case of extensive intra-abdominal adhesions, however, surgeon's experience and operative technique are two relevant factors.

Adhesions due to prior abdominal surgery are not a contraindication for colon laparoscopic surgery. Level of evidence, 4.

Laparoscopic operative technique

Mechanical bowel preparation

Data supporting the benefits of bowel preparation on anastomotic leakage, sepsis and mortality rate are lacking. Several randomized prospective studies on small series of patients did not show any difference in terms of postoperative infection, anastomotic leakage and mortality rate [11–15]. Most surgeons, however, find a well prepared bowel easier to handle, especially when laparoscopic instruments have to be used. Bowel preparation can be safely performed on out-patients, but caution should be used in case of coexisting cardiac and pulmonary pathologies.

Mechanical bowel preparation is a widely used procedure and can safely be performed in the out-patient setting or at home. Level of evidence, 2a. Grade of recommendation, B.

Operative technique and instrumentation

A 3-chip camera offers better resolution. The laparoscope can be angled at 30° or 0°, depending on the surgeon's preference. Laparoscopic instruments, trocar position and extraction site vary among authors.

High-quality imaging systems and technologically advanced instruments are recommended for laparoscopic colon resection. Trocar position is based on surgeon's preference and experience. Level of evidence, 5.

Port-site metastases

With the increase of surgical experience, the initial incidence of port site metastases of 21% has dropped to 0.5%–1% [16]. Surgical experience appears to be the main factor for the occurrence of port-site metastases. Abdominal wall covering with specific wound protectors and the use of plastic bags before specimen extraction are recommended. Slow deflation of CO_2-peritoneum before port removal is advocated by some experts. The value of the no-touch technique for colon cancer surgery is still controversial. An improvement in the 5-year survival was reported by Turnbull et al. in a retrospective analysis [17] but subsequently, in the only prospective randomized trial evaluating 236 patients, Wiggers et al. [18] demonstrated that the no-touch technique did not affect survival: the absolute 5-year survival rates were 56.3% and 59.8% in the conventional and no-touch surgical groups, respectively. In the conventional group, more patients had liver metastases and the time to metastasis was shorter, but differences in survival were not statistically significant.

Correct surgical technique and experience reduce the risk of port-site metastases. Level of evidence, 3a.

Intraoperative tumour localization

Laparoscopy does not permit tactile sensation, so every effort to exactly mark the segment of involved colon must be performed. This is particularly true for small tumours not involving the serosa, and for hepatic and splenic flexure tumours. Many endoscopic techniques are available to preoperatively mark a tumor: clip placement [19, 20], ink tattooing [21, 22], intraoperative colonoscopy and intraoperative ultrasonography. Colonoscopic tattooing of the lesion with India ink or methylene blue is an effective technique, with high success rate (78.6%–98%) and acceptable morbidity rate (0.22%–8%) [22, 23]. Intraoperative endoscopy is not widely accepted in laparoscopic colonic surgery, because of subsequent small bowel distension [24]. In expert hands, intraoperative laparoscopic ultrasonography localize a mass that is not identifiable at laparoscopy. Recently, some authors have shown that CT colonography can better define the segment of involved colon, especially in case of stenotic tumours [25].

Intraoperative tumour localization is mandatory. Endoscopic preoperative tattooing is the procedure of choice. Alternative techniques are clip placement, intraoperative colonoscopy or laparoscopic colonic ultrasound. Level of evidence, 3a. Grade of recommendation, B.

Laparoscopic surgical technique

Three different approaches are used in laparoscopic colorectal surgery: total laparoscopy, laparoscopy-assisted and hand-assisted. The choice of the technique is up to the surgeon, even if the laparoscopy-assisted one is the most used: a minilaparotomy is needed to remove the specimen and, in most of cases, to perform part of the operation. Dissection of Toldt fascia is performed from the medial to the lateral sides by most, as is early ligation of vascular pedicles [6, 26]. In the hand-assisted technique, mesocolon dissection can be easily performed as in open surgery. The bowel can be resected inside or outside the peritoneal cavity, depending on the surgeon's preference and the type of operation.

Laparoscopic dissection of mesocolon is performed from medial to lateral direction by most. Level of evidence, 3a. Grade of recommendation, B.

Conversion to laparotomy

The mean conversion rate in laparoscopic surgery is ~14%, ranging between 0% and 42% [27, 28]. The most common causes for conversion are: bulky tumours (T3-T4) with infiltration of the abdominal wall or other abdominal structures; tight adhesions; abnormal anatomy; technical problems; intraoperative complications; and surgeon's experience [29]. The conversion rate is strictly related to the learning curve: after 30 laparoscopic colonic procedures, the number of converted procedures significantly decreases [30–32]. The Cleveland Clinic Foundation's colorectal laparoscopic conversion rate can now be used to preoperatively evaluate the risk of conversion. Following this model, patients with BMI>50 kg/m^2, tumours with a diameter >15 cm, and patients with multiple laparotomies for major operations are excluded from the laparoscopic approach. Independent factors related to conversions (ASA grade, BMI, type of operation, pathology, presence of an abscess or fistula, surgeon's experience) have been identified and incorporated into a score that allows predicting the conversion rate, ranging from 0.2% to 88.1% [33].

The mean conversion rate in laparoscopic surgery is ~14% (range, 0%–42%). Laparotomic approach or early conversion are recommended in case of bulky tumours (T3-T4) with infiltration of abdominal wall or other abdominal structures, tight adhesions, abnormal anatomy,

technical problems and intraoperative complications. Level of evidence, 3a. Grade of recommendation, B.

Duration of surgery

Laparoscopic colonic resection of cancer takes longer than open colectomy. Operating times range between 140 and 251 minutes for laparoscopic approach compared to 120–175 minutes for laparotomic procedures [27, 32, 34–37]. In a multicenter randomized controlled trial, colonic resections required a mean operative time of 150 min for laparoscopic procedures and 95 min for open colectomies [16]. Operative times decrease with the surgeon's experience.

Operative time in laparoscopic colonic surgery is longer than in open surgery. Level of evidence, 2a.

Lymphadenectomy and extent of intestinal resection

At least 15 en bloc resected lymphnodes are required to achieve a radical operation. Laparoscopic approach is similar to open resection in terms of length of bowel resected and number of harvested lymphnodes [16, 34, 38].

The extent of colorectal resection and the number of harvested lymphnodes are similar between open and laparoscopic approaches. Level of evidence, 2b.

Short term results after laparoscopic colonic surgery for cancer

Morbidity and mortality rates

Morbidity and mortality rates are similar for laparoscopic and laparotomic colonic surgeries. Morbidity ranges between 8% and 15% [39], while mortality rates are 1%–2% [6, 40, 41]. Some randomized controlled trials reported lower complication rates for patients over 70 years at age. The learning curve needs at least 20 procedures to reduce and stabilize the complication rate [29, 31, 42]. Specific complications of laparoscopic surgery are vascular injuries, incisional hernias, ureteral damage, wound infections, and cardiopulmonary dysfunctions. Mortality rate (within 30 days of surgery) was similar in several randomized controlled trials [5, 38, 43–45]. According to the Clinical Outcomes of Surgical Therapy (COST) study [16], mortality rates for both laparoscopic and laparotomic groups were 1%, $p<0.40$).

Mortality and morbidity rates are similar after laparoscopic and laparotomic surgeries for colon cancer. Level of evidence, 2b.

Hospital stay

Several studies reported a significantly shorter hospital stay after laparoscopic surgery for colon cancer [40, 46–49]. The largest multicenter randomized controlled study (COST trial) reported a mean stay of 5 days after the mini-invasive approach compared to 6 days after laparotomic operation [16]. The applications of fast-track protocols (e.g. locoregional anaesthesia, postoperative pain control, early postoperative mobilization and resumption of food intake) can reduce the hospital stay after laparotomy by up to 3 days [50]. At the moment, similar studies after laparoscopic surgery are lacking.

The length of hospital stay is significantly shorter after laparoscopic surgery for colon cancer than after open aproach. Fast-track protocols reduce the length of stay after open surgery; similar studies for laparoscopy are needed. Level of evidence, 1a.

Postoperative pain

Quality of life, hospital stay and return to work are strictly connected to postoperative pain. Several studies documented a significantly lower postoperative pain and use of analgesics after laparoscopic surgery [16, 46, 48, 51, 52].

Postoperative pain is significantly lower after laparoscopic surgery than after laparotomy for colon cancer. Level of evidence, 2a. The use of analgesics is significantly lower after laparoscopic surgery than after open colectomy for colon cancer. Level of evidence, 1b.

Gastrointestinal function

Bowel movements at auscultation, first passage of air or stool and first oral feeding are usually considered as parameters for resumed gastrointestinal function. Several randomized controlled trials showed a statistically significant advantage in terms of first passage of air and feces, resumption of bowel movements at auscultation, and time to postoperative oral intake of food after laparoscopic surgery compared to laparotomy [32, 53].

During the postoperative period, gastrointestinal function recovers earlier after laparoscopic surgery than after laparotomic procedures for colon cancer. Level of evidence, 2b.

Postoperative pulmonary function

Functional pulmonary parameters (FVC, FEV, PEF, $SatO_2$) in the postoperative period after laparoscopic

cholecystectomy are less impaired than after laparotomic procedures. Similar significant results were found in several randomized clinical trials for colonic laparoscopic resections [48, 54–56].

Postoperative pulmonary function after laparoscopic surgery for colon cancer is less impaired than after open surgery. Level of evidence, 1b.

Postoperative response to stress after laparoscopy for colon cancer

The immune system is less impaired after laparoscopic surgery, probably because of the lower surgical trauma. Cortisol blood levels after laparotomic surgery are as high as after major trauma [52], as are the levels of cytokines and inflammation proteins [57, 58]. Some studies reported reduced blood levels of cortisol, C-reactive protein and pro-inflammatory cytokines after laparoscopic surgery for colon cancer, producing positive effects on the systemic immune response [59–64].

Stress response after laparoscopic colonic resection for cancer is lower than after laparotomic operations. Level of evidence, 1b.

Long term results after laparoscopic colonic surgery for cancer

Overall and disease-free survival rates

From the beginning, data on survival after laparoscopic colonic resections for cancer were not significantly different from those for laparotomic procedures. Retrospective analysis showed similar results as well in terms of both overall and disease-free survival rates [65–67]. In the COST randomized multicenter trial, 872 patients were followed for a mean of 4.4 years after laparoscopic and laparotomic operations for colon cancer. There were no significant differences between groups in terms of cumulative incidence, time to recurrence, overall survival and disease-free survival, at each stage of disease [16]. Preliminary results on 3-year disease-free survival rates from COLOR and CLASSICC trials showed similar patterns [68, 69]. A combined analysis of the three studies has to be performed to obtain an adequate statistical evaluation of the hazard ratio with more than 1000 cases [70].

At moment, there is no difference in terms of survival between laparotomic and laparoscopic procedures. The final results of the first multicenter randomized controlled trial (COST) supported these observation with high statistical power. Meta-analyses including other randomized controlled trials need to be performed. Level of evidence, 1b.

Laparoscopic colorectal surgery for rectal cancer

Laparoscopic extraperitoneal rectal resection with total mesorectal excision (TME) is technically feasible, although it is a demanding procedure. Few studies have evaluated the oncological results after laparoscopic TME. A single-center randomized trial compared open surgery with mini-invasive approach and reported similar 5-year survival rates (72.9% vs. 76.1%) and probabilities of 5-year disease-free survival (78.3% vs. 75.3%); histopathological data, morbidity and mortality rates were equal as well [71]. The bias of this study was the inclusion of rectosigmoid and high rectal cancers. The first prospective study on 100 patients with middle and low rectal tumors was published recently [72], showing again the feasibility of laparoscopic TME with a 12% of conversion rate. The mean follow-up of this series was 45.7 months (range, 12–72); pelvic recurrence rate was 4.2%. In another series of 102 patients who underwent laparoscopic rectal resection with TME, the conversion rate was 3% and the local

Table 1 Criteria for evidence-based medicine (From [75])

Grade of recommendation	Level of evidence	Possible study designs for the evaluation of therapeutic interventions
A	1a	Systematic review (with homogeneity) of RCTs
	1b	Individual RCT (with narrow confidence interval)
	1c	All or none case series
B	2a	Systematic review (with homogeneity) of cohort studies
	2b	Individual cohort studies (including low-quality RCTs)
	2c	"Outcomes" research
	3a	Systematic review (with homogeneity) of case-control studies
	3b	Individual case-control study
C	4	Case series (and poor-quality cohort and case-control studies)
D	5	Expert opinion without explicit critical appraisal, or based on physiology, bench research or "first principles", animal studies

recurrence rate was 6%, at a mean follow-up of 36 months (range, 6–96) [75]. The adequacy of laparoscopic approach has also been shown in a series of 95 patients with advanced rectal cancer, where the conversion rate was 7.2% and the local recurrence rate was 5.3%, at a mean follow-up of 48.2 months (range, 4–84) [76].

Rectal laparoscopic resection is technically feasible but requires particular surgical experience. At the moment, no definitive studies have reported oncological results at least equal to those of open surgery. Level of evidence, 2. Grade of recommendation, B.

References

1. Veldkamp R, Gholghesaei M, Bonjer DW et al (2004) Laparoscopic resection of colon cancer: consensus of the European Association of Endoscopic Surgery (EAES). Surg Endosc 18:1163–1185
2. Vignati P, Welch JP, Cohen JL (1994) Endoscopic localization of colon cancers. Surg Endosc 8:1085–1087
3. Otchy D, Hyman NH, Simmang C et al (2004) Practice parameters for colon cancer. Dis Colon Rectum 47:1269–1284
4. Sartori CA, Dal Pozzo A, Balduino M, Franzato B (2004) Laparoscopic colectomy involving the hepatic flexure. J Chir 141:94–97 (in French)
5. Delgado S, Lacy AM, Garcia Valdecasas JC et al (2000) Could age be an indication for laparoscopic colectomy in colorectal cancer? Surg Endosc 14:22–26
6. Schwandner O, Schiedeck TH, Bruch HP (1999) Advanced age-indication or contraindication for laparoscopic colorectal surgery? Dis Colon Rectum 42:356–362
7. Neudecker J, Sauerland S, Neugebauer E et al (2002) The European Association for Endoscopic Surgery clinical practice guideline on the pneumoperitoneo for laparoscopic surgery. Surg Endosc 16:1121–1143
8. Pandya S, Murray JJ, Coller JA, Rusin LC (1999) Laparoscopic colectomy: indications for conversion to laparotomy. Arch Surg 134:471–475
9. Pikarsky AJ, Saida Y, Yamaguchi T et al (2002) Is obesity a high risk factor for laparoscopic colorectal surgery? Surg Endosc 16:855–858
10. Hamel CT, Pikarsky AJ, Weiss EG et al (2000) Do prior abdominal operations alter the outcome of laparoscopically assisted right hemicolectomy? Surg Endosc 14:853–857
11. Brownson P, Jenkins S, Nott D et al (1992) Mechanical bowel preparation before colorectal surgery: results of a prospective, randomized trial. Br J Surg 79:461–462
12. Burke P, Mealy K, Gillen P, Joyce W et al (1994) Requirement for bowel preparation in colorectal surgery. Br J Surg 81:907–910
13. Santos JC Jr, Batista J, Sirirmarco MT et al (1994) Prospective randomized trial of mechanical bowel preparation in patients undergoing elective colorectal surgery. Br J Surg 81:1673–1676
14. Miettinen RP Laitinen ST, Makela JT, Paakkonen ME (2000) Bowel preparation with oral polyethylene glycol electrolyte solution vs. no preparation in elective open colorectal surgery: prospective, randomized study. Dis Colon Rectum 43:669–677
15. Zmora O, Mahajna A, Bar-Zakai B et al (2003) Colon and rectal surgery without mechanical bowel preparation: randomized prospective trial. Ann Surg 237:363–367
16. Clinical Outcomes of Surgical Therapy Study Group (2004) A comparison of laparoscopically assisted and open colectomy for colon cancer. N Engl J Med 350:2050–2059
17. Turnbull RB Jr., Kyle K, Watson FR, Spratt J (1967) Cancer of the colon: the influence of the no-touch isolation technic on survival rates. Ann Surg 166:420–427
18. Wiggers T, Jeekel J, Arends JW et al (1988) No-touch isolation technique in colon cancer: a controlled prospective trial. Br J Surg 75:409–415
19. Tabibian N, Michaletz PA, Schwartz JT et al (1988) Use of an endoscopically placed clip can avoid diagnostic errors in colonoscopy. Gastrointest Endosc 34:262–264
20. Ohdaira T, Konishi F, Nagai H et al (1999) Intraoperative localization of colorectal tumors in the early stages using a marking clip detector system. Dis Colon Rectum 42:1353–1355
21. Hammond DC, Lane FR, Welk RA et al (1989) Endoscopic tattooing of the colon. An experimental study. Am Surg 55:457–461
22. Botoman VA, Pietro M, Thirlby RC (1994) Localization of colonic lesions with endoscopic tattoo. Dis Colon Rectum 37:775–776
23. Fu KI, Fujii T, Kato S et al (2001) A new endoscopic tattooing technique for identifying the location of colonic lesions during laparoscopic surgery: a comparison with the conventional technique. Endoscopy 33:687–691
24. Cohen JL, Forde KA (1988) Intraoperative colonoscopy. Ann Surg 207:231–233
25. Mainenti PP, Romano M, Imbriaco M et al (2005) Added value of CT colonography after a positive conventional colonoscopy: impact on treatment strategy. Abdom Imaging 30:42–47
26. Sartori CA, Franzato B (1999) The standardization of a technique for laparoscopic left hemicolectomy with radical lymphadenectomy. Chir Ital 51:329–334 (in Italian)
27. Gervaz P, Pikarsky A, Utech M et al (2001) Converted laparoscopic colorectal surgery. Surg Endosc 15:827–832
28. Marusch F, Gastinger I, Schneider C et al (2001) Importance of conversion for results obtained with laparoscopic colorectal surgery. Dis Colon Rectum 44:207–216
29. Marusch F, Gastinger I, Schneider C et al (2001) Experience as a factor influencing the indications for laparoscopic colorectal surgery and the results. Surg Endosc 15:116–120
30. Schlachta CM, Mamazza J, Seshadri PA et al (2001) Defining a learning curve for laparoscopic colorectal resections. Dis Colon Rectum 44:217–222
31. Bennett CL, Stryker SJ, Ferreira MR et al (1997) The learning curve for laparoscopic colorectal surgery. Preliminary results from a prospective analysis of 1194 laparoscopic-assisted colectomies. Arch Surg 132:41–45
32. Lezoche E, Feliciotti F, Paganini AM et al (2000) Laparoscopic colonic resections versus open surgery: a prospective non-randomized study on 310 unselected cases. Hepatogastroenterology 47:697–708
33. Tekkis PP, Senagore AJ, Delaney CP (2005) Conversion rates in laparoscopic colorectal surgery. A predictive model with 1253 patients. Surg Endosc 19:47–54

34. Bouvet M, Mansfield PF, Skibber JM et al (1998) Clinical, pathologic, and economic parameters of laparoscopic colon resection for cancer. Am J Surg 176:554–558
35. Hong D, Tabet J, Anvari M (2001) Laparoscopic vs. open resection for colorectal adenocarcinoma. Dis Colon Rectum 44:10–19
36. Psaila J, Bulley SH, Ewing P et al (1998) Outcome following laparoscopic resection for colorectal cancer Br J Surg 85:662–664
37. Khalili TM, Fleshner PR, Hiatt JR et al (1998) Colorectal cancer: comparison of laparoscopic with open approaches. Dis Colon Rectum 41:832–838
38. Bokey EL, Moore JW, Chapuis PH et al (1996) Morbidity and mortality following laparoscopic-assisted right hemicolectomy for cancer. Dis Colon Rectum 39[10 Suppl]:S24–S28
39. Chapman AE, Levitt MD, Hewett P et al (2001) Laparoscopic-assisted resection of colorectal malignancies: a systematic review. Ann Surg 234:590–606
40. Hewitt PM, Ip SM, Kwok SP et al (1998) Laparoscopic-assisted vs. open surgery for colorectal cancer: comparative study of immune effects. Dis Colon Rectum 41:901–909
41. Lacy AM, Delgado S, Garcia-Valdecas JC et al (1998) Port site metastases and recurrence after laparoscopic colectomy. A randomized trial. Surg Endosc 12:1039–1042
42. Larach SW, Patankar SK, Ferrara A et al (1997) Complications of laparoscopic colorectal surgery. Analysis and comparison of early vs. latter experience. Dis Colon Rectum 40:592–596
43. Franklin ME Jr, Rosenthal D, Abrego-Medina D et al (1996) Prospective comparison of open vs. laparoscopic colon surgery for carcinoma. Five-year results. Dis Colon Rectum 39[10 Suppl]:S35–S46
44. Santoro E, Carlini M, Carboni F, Feroce A (1999) Colorectal carcinoma: laparoscopic versus traditional open surgery. A clinical trial. Hepatogastroenterology 46:900–904
45. Schiedeck TH, Schwandner O, Baca I et al (2000) Laparoscopic surgery for the cure of colorectal cancer: results of a German five-center study. Dis Colon Rectum 43:1–8
46. Milsom JW, Bohm B, Hammerhofer KA et al (1998) A prospective, randomized trial comparing laparoscopic versus conventional techniques in colorectal cancer surgery: a preliminary report. J Am Coll Surg 187:46–55
47. Curet MJ, Putrakul K, Pitcher DE et al (2000) Laparoscopically assisted colon resection for colon carcinoma: perioperative results and long-term outcome. Surg Endosc 14:1062–1066
48. Stage JG, Schulze S, Moller P et al (1997) Prospective randomized study of laparoscopic versus open colonic resection for adenocarcinoma. Br J Surg 84:391–396
49. Lacy AM, Garcia-Valdecasas JC, Pique JM et al (1995) Short-term outcome analysis of a randomized study comparing laparoscopic vs open colectomy for colon cancer. Surg Endosc 9:1101–1105
50. Wilmore DW, Kehlet H (2001) Management of patients in fast track surgery. BMJ 322:473–476
51. Kohler L, Holthausen U, Troidl H (1997) Laparoscopic colorectal surgery-attempt at evaluating a new technology. Chirurg 68:794–800 (in German)
52. Braga M, Vignali A, Zuliani W et al (2002) Metabolic and functional results after laparoscopic colorectal surgery: a randomized, controlled trial. Dis Colon Rectum 45:1070–1077
53. Bokey EL, Moore JW, Keating JP et al (1997) Laparoscopic resection of the colon and rectum for cancer. Br J Surg 84:822–825
54. Schwenk W, Bohm B, Witt C et al (1999) Pulmonary function following laparoscopic or conventional colorectal resection: a randomized controlled evaluation. Arch Surg 134:6–13
55. Hardacre JM, Talamini MA (2000) Pulmonary and hemodynamic changes during laparoscopy-are they important? Surgery 127:241–244
56. Milsom JW, Lavery IC, Church JM et al (1994) Use of laparoscopic techniques in colorectal surgery. Preliminary study. Dis Colon Rectum 37:215–218
57. Kloosterman T, von Blomberg BM, Borgstein P et al (1994) Unimpaired immune functions after laparoscopic cholecystectomy. Surgery 115:424–428
58. Schietroma M, Carlei F, Lezoche E et al (2001) Evaluation of immune response in patients after open or laparoscopic cholecystectomy. Hepatogastroenterology 48:642–646
59. Ordemann J, Jacobi CA, Schwenk W et al (2001) Cellular and humoral inflammatory response after laparoscopic and conventional colorectal resections. Surg Endosc 15:600–608
60. Schwenk W, Jacobi C, Mansmann U et al (2000) Inflammatory response after laparoscopic and conventional colorectal resections - results of a prospective randomized trial. Langenbecks Arch Surg 385:2–9
61. Wu FP, Sietses C, von Blomberg BM et al (2003) The systemic and peritoneal inflammatory response after laparoscopic or conventional colon resection in cancer patients: a prospective randomized trial. Dis Colon Rectum 46:147–155
62. Sietses C, Havenith CE, Eijsbouts QA et al (2000) Laparoscopic surgery preserves monocyte-mediated tumor cell killing in contrast to the conventional approach. Surg Endosc 14:456–60
63. Delgado S, Lacy AM, Filella X et al (2001) Acute phase response in laparoscopic and open colectomy in colon cancer: randomized study. Dis Colon Rectum 44:638–646
64. Nishiguchi K, Okuda J, Toyoda M et al (2001) Comparative evaluation of surgical stress of laparoscopic and open surgeries for colorectal carcinoma. Dis Colon Rectum 44:223–220
65. Hoffman GC, Baker JW, Doxey JB et al (1996) Minimally invasive surgery for colorectal cancer. Initial follow-up. Ann Surg 223:790–798
66. Molenaar CB, Bijnen AB, de Ruiter P (1998) Indications for laparoscopic colorectal surgery. Results from the Medical Centre Alkmaar, The Netherlands. Surg Endosc 12:42–45
67. Quattlebaum JK Jr, Flanders HD, Usher CH (1993) Laparoscopically assisted colectomy. Surg Laparosc Endosc 3:81–87
68. Veldkamp R, Kuhry E, Hop WC et al (2005) Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial Lancet Oncol 6:477–484
69. Stead ML, Brown JM, Bosanquet N et al (2000) Assessing the relative costs of standard open surgery and laparoscopic surgery in colorectal cancer in a randomised controlled trial in the United Kingdom. Crit Rev Oncol Hematol 33:99–103
70. Tinmouth J., Tomlinson G., Dalibon N et al (2004) Laparoscopically assisted versus open colectomy for colon cancer. N Engl J Med 351:933–934 (letter)

71. Leung KL, Kwok SP, Lam SC et al (2004) Laparoscopic resection of rectosigmoid carcinoma: prospective randomised trial. Lancet 363:1187–1192
72. Morino M, Parini U, Giraudo G et al (2003) Laparoscopic total mesorectal excision. A consecutive series of 100 patients. Ann Surg 247:335–342
73. Leroy J, Jamali F, Forbes L et al (2004) Laparoscopic total mesorectal excision (TME) for rectal cancer surgery. Long term outcomes. Surg Endosc 18:281–289
74. Sartori CA, Franzato B, Dal Pozzo A et al (2003) The role of laparoscopic surgery in the treatment of advanced rectal cancer. In: Proceedings of the Italian Society of Surgery, vol 1, pp 361–372 (in Italian)
75. Sackett DL, Straus SE, Richardson WS et al (eds) (2000) Evidence based medicine: how to practice and teach EBM, 2nd edn. Churchill Livingstone, London