Could laparoscopic colon and rectal surgery become the standard of care? A review and experience with 750 procedures

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Introduction: The benefits of the laparoscopic approach to colon and rectal surgery do not seem as great as for other laparoscopic procedures. To study this further we decided to review the current literature and the 10-year experience of a surgical group from university teaching hospitals in Montréal, Québec and Toronto in performing laparoscopic colon and rectal surgery. **Methods:** The prospectively designed case series comprised all patients having laparoscopic colon and rectal surgery. The procedures were carried out by a group of 4 surgeons between April 1991 and November 2001. We noted intraoperative complications, any conversions to open surgery, operating time, postoperative complications and postoperative length of hospital stay. **Results:** The group attempted 750 laparoscopic colon and rectal procedures of which 669 were completed laparoscopically. Malignant disease was the indication for surgery in 49.6% of cases. Right hemicolectomy and sigmoid colectomy accounted for 54.5% of procedures performed. Intraoperative complications occurred in 8.3%, with 29.0% of these resulting in conversion to open surgery. The overall rate of conversion to open surgery was 10.8%, most commonly for oncologic concerns. Median operating time was 175 minutes for all procedures. Postoperative complications occurred in 27.5% of procedures completed laparoscopically but were mostly minor wound complications. Pulmonary complications occurred in only 1.0%. The anastomotic leak rate was 2.5%. The early reoperation rate was 2.4%. Postoperative mortality was 2.2%. No port site metastases have yet been detected. The median postoperative length of stay was 5 days. **Conclusions:** The clinical outcomes of laparoscopic colon and rectal surgery in this 10-year experience are consistent with numerous cohort studies and randomized clinical trials. Laparoscopic colon and rectal surgery in the hands of well-trained surgeons can be performed safely with short hospital stay, low analgesic requirements and acceptable complication rates compared with historical controls and other reports in the literature. Evidence from published randomized clinical trials is emerging that under these conditions laparoscopic resection represents the better treatment option for most benign conditions, but concerns regarding its appropriateness for malignant disease are still to be resolved.

Introduction : La chirurgie du côlon et du rectum par laparoscopie ne semble pas offrir autant d'avantages que d'autres interventions par laparoscopie. Afin d'étudier la question plus à fond, nous avons décidé d'analyser les publications courantes et l'expérience de la chirurgie du côlon et du rectum par laparoscopie acquise en 10 ans par un groupe chirurgical d'hôpitaux d'enseignement universitaires de Montréal, Québec et Toronto. **Méthodes :** L'étude de cas prospective a regroupé tous les patients ayant subi une chirurgie du côlon et du rectum par laparoscopie. Les interventions ont été réalisées par un groupe de quatre chirurgiens entre avril 1991 et novembre 2001. Nous avons pris note des complications intraopératoires, des conversions à la chirurgie ouverte, de la durée de l'intervention, des complications postopératoires et de la durée du séjour à l'hôpital après l'intervention. **Résultats :** Le groupe a tenté de réaliser 750 interventions par laparoscopie au côlon et au rectum. Il en a terminé 669 par laparoscopie. Une atteinte maligne était une indication de chirurgie dans 49,6 % des cas. L'hémicolectomie droite et la colectomie sigmoïde ont représenté 54,5 % des interventions réalisées. Il s'est produit des complications intraopératoires dans 8,3 % des cas, et 29,0 % ont entraîné une conversion à la

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chirurgie ouverte. Le taux global de conversion à la chirurgie ouverte s'est établi à 10,8 %, le plus souvent à cause de problèmes d'ordre oncologique. La durée médiane de l'intervention a atteint 175 minutes. Il y a eu des complications postopératoires dans 27,5 % des laparoscopies, mais il s'agissait surtout de complications mineures au niveau de la plaie. Seulement 1,0 % des patients ont eu des complications pulmonaires. Le taux de fuite à l'anastomose a atteint 2,5 %, le taux de nouvelle intervention précoce, 2,4 %, et le taux de mortalité postopératoire, 2,2 %. On n'a pas détecté jusqu'ici de métastases au site de l'orifice. La durée médiane du séjour après l'intervention s'est établie à cinq jours. **Conclusions :** Les résultats cliniques de la chirurgie du côlon et du rectum par laparoscopie au cours de cette expérience d'une durée de 10 ans sont conformes aux résultats d'un grand nombre d'études de cohorte et d'études cliniques randomisées. Pratiquée par des chirurgiens ayant reçu une solide formation, la chirurgie du côlon et du rectum par laparoscopie est sans danger et entraîne un bref séjour à l'hôpital, de faibles besoins en analgésiques et des taux de complications acceptables comparativement aux témoins historiques et à d'autres comptes rendus dans les écrits scientifiques. On commence à réunir des données probantes tirées d'essais cliniques randomisés publiés qui indiquent que dans ces conditions, la résection par laparoscopie représente le meilleur traitement possible pour la plupart des problèmes bénins, mais il reste à en déterminer la pertinence dans celui des maladies malignes.

The introduction of laparoscopic cholecystecomy in the late 1980s by Muhe and Mouret ushered in the modern era of minimally invasive surgery. The benefit to patients of reduced pain, shortened hospital stay and faster recovery along with superior cosmesis rapidly resulted in laparoscopic cholecystectomy becoming the standard of care.[1,2] Similar benefits were anticipated as the laparoscopic approach was subsequently applied to nearly all aspects of abdominal surgery. In fact, in centres where the technical expertise is available, laparoscopic splenectomy, adrenalectomy and Nissen fundoplication have now become the preferred method of treatment.[3–5]

The first reports of laparoscopic colectomy were published in 1991.[6,7] Although numerous large case series, cohort studies and recent randomized trials have attested to similarly improved outcomes compared to open surgery, acceptance of the laparoscopic approach for colon and rectal surgery has lagged behind other laparoscopic procedures. The reasons for this undoubtedly include the technically demanding nature of this approach, the requirement for increased operating room resources, a lack of available training opportunities and early concerns about the treatment of malignant disease. Additionally, the magnitude of improvement seems attenuated compared with other laparoscopic procedures, leaving some skepticism of the overall benefits.

The purpose of this paper is to review the large experience over the past decade of a single surgical group routinely and consistently offering the laparoscopic approach to patients requiring colon and rectal surgery and to survey the contemporary literature.

Methods

Beginning with the first procedure performed, all patients scheduled to undergo attempted laparoscopic colon and rectal surgery by this group, between April 1991 and November 2001, were entered into a prospectively designed, computerized database. Data collected included patient demographics, information on comorbid conditions, indication for surgery, surgeon, procedure performed, intra- and postoperative complications, operating time (skin-to-skin), length of postoperative hospital stay and postoperative follow-up to the most recent office visit.

Patients were unselected, consecutive referrals to 1 of 4 academic surgeons (E.C.P., J.M., R.G., C.M.S.) practising in university teaching hospitals that provide resident and fellow training in advanced minimally invasive surgery. All 4 surgeons routinely offered all elective patients a laparoscopic approach with the result that there was no case selection by the surgeon. This does not account for possible case selection by referring physicians.

Fellow and resident trainees were involved in all cases and performed some or all of the procedure according to their level of experience. All patients received preoperative prophylaxis for deep venous thrombosis, broad-spectrum parenteral antibiotics and an oral bowel preparation when appropriate. All patients provided informed consent for the planned laparoscopic procedure.

Statistical analyses consisted of the Student t-test, the χ^2 test or rank sum test for nonparametric data where appropriate. A p value of 0.05 was considered statistically significant.

Surgical technique

For right-side colon resections, patients are positioned supine and the bladder is catheterized. A 12-mm blunt-tipped trocar is inserted through the umbilicus using an open technique. After insufflating a carbon dioxide pneumoperitoneum to 15 mm Hg, a 30° viewing 10-mm laparoscope connected to a 1- or 3-chip charge-coupled device (CCD) camera is inserted. Two or 3 video monitors are positioned with at least 1 on each side of the patient. These are moved regularly throughout the procedure to ensure that the surgeon is always operating facing a monitor and the operating assistant has an ergonomic view of the procedure. Operating trocar placement is variable. Two or 3 additional 5-mm trocars are used, with one placed in the left

lower quadrant and another suprapubically or in the epigastrium, or both. With the patient in a steep Trendelenburg position, the small bowel is extracted from the pelvis, and the cecum and ascending colon are mobilized with electrocautery. The patient is then levelled while the omentum is transected or detached from the transverse colon, and the hepatic flexure taken down. Once the colon is mobilized so that the ileocecal junction can be brought above the umbilicus, the hepatic flexure can be brought below the umbilicus and both can be brought across the midline, division of the mesentery, bowel resection and anastomosis are performed extracorporeally through a 4- to 5-cm extension of the umbilical trocar site.

For left-side colon resections and rectal resections, 3 operating trocars are used in addition to the umbilical trocar. A 12-mm trocar is placed in the right lower quadrant, and 5-mm trocars are placed in the left lower quadrant and left upper quadrant. In steep Trendelenburg position, with the small bowel out of the pelvis, the sigmoid colon and descending colon are mobilized along the white line of Toldt. The left ureter is identified. The sigmoid colon is elevated, and a window is created in the sigmoid mesocolon by identification and high ligation of the inferior mesenteric vessels, leaving 3 secure clips on the patient's side of each vessel. Proximal and distal mesenteric division is performed intracorporeally with electrocautery. For low rectal resections, with excellent visualization, the presacral space is easily entered and dissected while avoiding injury to the pelvic autonomic plexus. The bowel is divided distally with a linear endoscopic stapler and delivered though a muscle-splitting 4- to 5-cm extension of the left lower quadrant trocar site. The proximal bowel resection, sizing and insertion of the anvil of an endoluminal circular stapler are performed extracorporeally. The incision is closed before reinsufflation and stapled reanastomosis under laparoscopic visualization. The splenic flexure is mobilized as necessary for a tension-free anastomosis.

For abdominoperineal resection or proctectomy, the rectum is mobilized laparoscopically to the levator muscles before performing a standard perineal dissection. If 2 teams are used, care is taken not to enter the pelvis and release the pneumoperitoneum before full laparoscopic rectal mobilization is complete. Ileal pelvic pouches were fashioned extracorporeally through a Pfannenstiel incision before stapled anastomosis under laparoscopic visualization.

Results

A total of 750 laparoscopic colon and rectal procedures were performed. They were fairly evenly divided among the 4 surgeons (250, 203, 197 and 100). Of the patients, 52% were female and the mean (and standard deviation [SD]) age was 59.0 (17.9) years (range from 12–94 yr) and mean (and SD) weight was 69.7 (16.4) kg (range from 36.5–150 kg). The indication for surgery was malignant disease in 372 (49.6%) cases (Table 1). Right hemicolectomy and sigmoid colectomy accounted for 409 (54.5%) of all procedures performed (Table 2).

Intraoperative complications (Table 3) occurred in 62 (8.3%) patients. Most intraoperative complications were managed laparoscopically, with 18 (29.0%) patients requiring conversion to open surgery. The complication was not always the cause of conversion.

Conversion to open surgery was required in 81 (10.8%) cases overall (Table 4). The most common reasons for conversion were oncologic concerns in 30 (37%) cases. Compared with benign disease, patients were more likely to require conversion to open surgery if they under-

Table 1

Indication for Surgery in 750 Patients Who Underwent a Colon or Rectal Laparoscopic Procedure

Indication	No. of cases
Malignant disease	372
Adenocarcinoma	367
Carcinoid	3
Lymphoma	1
Squamous cell carcinoma	1
Diverticular disease	154
Chronic diverticulitis	111
Acute diverticulitis	41
Diverticulosis	2
Inflammatory bowel disease	128
Crohn's disease	73
Ulcerative colitis	55
Benign tumours	64
Polyp	58
Lipoma	3
Leiomyoma	2
Polyposis	1
Other	32
Iatrogenic perforation	7
Rectal prolapse	6
Angiodysplasia	5
Volvulus	3
Ischemia	3
Stercoral ulcer	2
Stricture	2
Radiation enteritis	1
Complex anal fistula	1
Parastomal hernia	1
Colocutaneous fistula	1

Table 2

Procedure Performed in 750 Patients Who Underwent a Colon or Rectal Laparoscopic Procedure

Procedure	No. of cases
Right hemicolectomy	218
Sigmoid colectomy	191
Anterior resection	126
Total abdominal colectomy	50
Abdominoperineal resection	49
Left hemicolectomy	34
Total proctocolectomy	20
Reversal of Hartmann's colostomy	14
Transverse colectomy	11
Hartmann's colostomy	11
Ileal J-pouch anal reconstruction	10
Ileostomy closure	9
Loop colostomy	4
Small-bowel resection	2
Ileocolic bypass	1

went a laparoscopic procedure for malignant disease (13.4% v. 8.2%, $p = 0.028$). Patients requiring conversion to open surgery weighed significantly more than those having procedures completed laparoscopically (median 75.0 v. 67.6 kg, $p < 0.001$). There was a nonsignificant trend toward a higher conversion rate when we compared the first 50 procedures performed by each surgeon with subsequent procedures (12% v. 10.4%, $p = 0.613$). The conversion rate for the laparoscopic fellowship-trained surgeon's first 50 cases was 8%. Excluding the fellowship-trained surgeon's experience, the gap in conversion rates between each surgeon's first 50 cases and subsequent cases was wider (13.4% v. 9.4%) but still not significant ($p = 0.216$). Adhesions from previous surgery was the stated cause in 13 (16%) conversions.

Median operating time was 175 (range from 50–450) minutes overall. For segmental resections only, the operating time was longer for procedures converted to open surgery than those completed laparoscopically (median 212 v. 165 min, $p < 0.001$).

Of 669 procedures completed laparoscopically, postoperative complications occurred in 184 (27.5%). Most common were minor wound complications (Table 5). Twenty percent of wound infections occurred in a perineal wound and not at abdominal sites. There were only 7 pulmonary complications (1.0%). Postoperative ileus and small-bowel obstruction occurred with equal frequency (3.9%). The anastomotic leak rate was 2.5% (14 of the 555 laparoscopic procedures in which an anastomosis was performed). Sixteen patients (2.4%) required early reoperation for complications. Postoperative mortality was 2.2%. No recurrence of malignant disease at port sites has yet been detected.

The median postoperative hospital stay for all procedures was 5 (range from 1–72) days with a mode of 4 days. Postoperative length of stay was longer if conversion to open surgery was required than if the laparoscopic approach was successful (median 7 v. 5 d, $p < 0.001$). Of the 669 patients having successful laparoscopic procedures, 114 (17%) were discharged home within 3 days of surgery, 241 (39%) within 4 days, and 381 (57%) within 5 days. One hundred and fifty-three (23%) patients stayed longer than 7 days, 104 (68%) of whom had postoperative complications. Patients having a postoperative complication had a significantly longer hospital stay than those without complications (median 9 v. 5 d, $p < 0.001$). Median time to resumption of full diet was 3 (range from 1–25) days. Twenty-seven (4.0%) of the 669 patients were discharged home on oral fluids. Median length of postoperative hospital stay declined from 6 days in the first half of the series to 5 days in the second half ($p < 0.001$).

Table 3

Intraoperative Complications in 750 Patients Who Underwent a Colon or Rectal Laparoscopic Procedure*

Complication	Complications, no.	Cases converted to open surgery, no.
Hemorrhage	24	8
Mesentery	17	5
Pelvis	3	2
Spleen	2	1
Epigastric vessel	2	0
Bowel injury	16	4
Small-bowel perforation	6	2
Colon perforation	5	0
Rectal perforation	2	0
Duodenal perforation	1	0
Serosal tear	2	1
Serosal burn	1	1
Stapler misfire	8	2
Failed anastomosis	4	1
Leak detected	2	0
Revised for ischemia	1	0
Revised for twist	1	1
Ureteric injury	3	2
Inadequate tumour localization	3	1
Other	5	2
Tension pneumothorax	1	1
Aspiration	1	1
Bradycardia and desaturation	1	0
Massive subcutaneous emphysema	1	0
Gallbladder serosal burn	1	0

*When totalled, the columns do not agree with the text since multiple complications occurred in some cases.

Table 4

Factors Leading to Conversion to Open Surgery

Factor	No. of cases
Oncologic concerns	30
Tumour fixation	21
Tumour bulk	9
Intraoperative complications	17
Bleeding	7
Bowel injury	3
Instrument failure	3
Missed pathologic condition	2
Twisted anastomosis	1
Ureteral injury	1
Adhesions	13
Inflammation	10
Surgeon inexperience	5
Ventilatory failure	2
Exposure	4
Obesity	3
Colonic distension	1
Total	81

Discussion

Whether laparoscopic colon and rectal surgery should become a standard or even a routine option for patients depends on a number of key factors. The approach must be technically feasible. The benefits must outweigh any potential disadvantages. Concerns regarding appropriateness for cure of malignant disease must be assuaged. It must be practically feasible, particularly with respect to resources and training.

From this review and others it is clear that with varying degrees of difficulty, colon and rectal procedures ranging from simple segmental resec-tions to restorative proctocolectomy can be accomplished laparoscopically. The technical feasibility has been demonstrated. It remains the responsibility of the operating surgeon to ensure that established surgical principles are applied and that no "shortcuts" are taken simply to complete a procedure laparoscopically. A properly performed open procedure is always preferable to a poor laparoscopic attempt.

Conversion to open surgery is not a complication. It is a wise decision when the technical limitations of an attempted laparoscopic procedure exceed a surgeon's ability to ensure that sound surgical principles are applied.

However, the effectiveness of the laparoscopic approach will depend on compliance. The anticipated benefits of the laparoscopic surgery will decline as conversion rates increase. Surgeons acquiring new experience with laparoscopic colon and rectal surgery may wish to select their patients and procedures based on anticipated difficulty and risk of conversion. From our own experience, we have developed a simple model for predicting conversion to open surgery. Our findings logically suggest that the risk of conversion rises with obesity, the presence of malignant disease and surgeon inexperience.[8]

The overall rates of intraoperative and postoperative complications in this series are well within the range reported in other large case series of laparoscopic colon resections (Table 6[9–13]), even given that the data were collected prospectively with the attendant heightened sensitivity to outcomes. The recent 3-year audit of 15 427 open segmental colon resections in Illinois reported a rate of postoperative complications of 24.2% and 4.4% mortality,[14] with which the present series compares favourably.

The short-term benefits of the laparoscopic approach have been suggested repeatedly but inconsistently in retrospective cohort studies (Table 7[15–38]). The evidence is demonstrated more clearly in prospective randomized trials (Table 8[39–44]). Excluding the voluntary registry of the American Society of Colon and Rectal Surgeons,[9] the present study is the largest prospective case series yet published. Our own outcomes are in accordance with most published reports (Table 6). Although the improvement in recovery does not seem as dramatic as with end organ surgery, there should be little doubt that laparoscopic colon and rectal surgery results in less pain, less ileus and shorter hospital stay. The recent preliminary report of the multicentre, prospective, randomized trial by Weeks and associates,[39] despite suspect quality-of-life assessments,[45]

Table 5

Postoperative Complications

Complication type*	Complications, no.	Early reoperation, no.	Death
Wound	49		
Infection	40		
Seroma	5		
Hematoma	2		
Dehiscence	1	1	
Richter's hernia	1	1	
Ileus	26		
Small-bowel obstruction	26	6	1
Urinary retention	25		
Cardiac	23		
Myocardial infarction	9		6
Angina	6		
Congestive heart failure	5		1
Arrhythmia	3		
Anastomotic leak	14	5	1
Hemorrhage	9	1	
Pulmonary	7		
Pneumonia	5		1
Atelectasis	2		
Thromboembolic	4		
Pulmonary embolism	3		1
Deep vein thrombosis	2		
Stroke	3		2
Stoma complication	3	2	
Pseudomembranous colitis	3		
Anastomotic stricture	2		
Fistula	2		
Delirium tremens	1		
Brachial plexus injury	1		
Diabetes insipidus	1		
Upper gastrointestinal hemorrhage	1		1
Liver failure	1		1
Total no. of patients*	184	16	15

*There were multiple complications in some cases.

clearly demonstrated a reduction in analgesic requirements and postoperative length of stay with laparoscopic surgery that is consistent with the findings of other reports. The improvement in outcomes was statistically significant even when analyzed on the basis of intent-to-treat. This is particularly impressive given the re-

Table 6

Laparoscopic Colon and Rectal Surgery Large Case Series (> 300 Procedures)

Study	No. cases	Country	Conversion, %	Complications, %	OR time, min	Length of stay, d
Bennett et al, 1997[9]	1194	United States	25	5 IOC, 15 POC	NR	6
Current series, 2002	750	Canada	10.8	8.3 IOC, 27.5 POC	175	5
Kockerling et al, 1998[10]	500	Germany	7.0	21.4	176	NR
Shiedeck et al, 2000[11]	399	Germany	6.3	36	146–235	14–15.4
Fleshman et al, 1996[12]	372	United States	15.6	NR	NR	NR
Fielding et al, 1997[13]	359	Australia	7.3	18.6	130–240	5.7

IOC = intraoperative complication, POC = postoperative complication, OR = operating room.

Table 7

Laparoscopic Versus Open Colon and Rectal Surgery Cohort Studies

Study	Indication	Lap:Open	Matched	Intent to treat	Conversions, %	Outcome of laparoscopic v. open surgery OR time	Ileus	LOS	Other
Franklin et al, 1996[15]	Cancer	191:224	No	Yes	4.2	NR	NR	=	
Lezoche et al, 2000[16]	Colon surgery	150:160	No	Yes	8.6	↑	↓ PF	↓	↓ analgesic
Hong et al, 2001[17]	Cancer	98:219	No	Yes	12.5	=	↓ OI, BM, PF	↓	↓ analgesic
Bergamaschi and Arnaud, 1997[18]	Colon surgery	95:90	No	NR	1.1	↑	= PF	↓	= cost
Chen et al, 2000[19]	Colon surgery	83:83	Yes	NA	NR	↑	↓ OI, BM	↓	
Khalili et al, 1998[20]	Cancer	80:90	No	No	8	=	↓ OI	↓	↓ EBL
Hoffman et al, 1994[21]	Colon surgery	80:53	No	No	22.5	↓ LOS, otherwise insufficient statistical data			
Falk et al, 1993[22]	Colon surgery	66:NR	No	No	41	NR	NR	↓	= cost
Begos et al, 1996[23]	Colon surgery	50:34	No	No	34	=	↓ OI	↓	= analgesic
Wu et al, 1997[24]	Crohn's disease	46:70	No	No	11	↓	NR	↓	↓ EBL
Senagore et al, 1993[25]	Colon surgery	38:102	No	No	32	↑	↓ BM	=	↓ EBL, ↓ cost
Young-Fadok et al, 2000[26]	Polyps	38:38	Yes	Yes	18.4	↑	↓ OI, BM, PF	↓	↓ analgesic
Young-Fadok et al, 2001[27]	Crohn's disease	33:33	Yes	Yes	5.9	↑	↓OI	↓	↓ analgesic, ↓ cost
Tabet et al, 2001[28]	Crohn's disease	32:29	No	NR	12.5	=	↓ OI, BM	↓	↓ analgesic
Bemelman et al, 2000[29]	Crohn's disease	30:48	No	Yes	6.7	=	= OI	↓	
Kohler et al, 1998[30]	Diverticulitis	29:34	No	No	7.5	↑	↓ OI, BM	↓	↓ EBL
Leung et al, 1999[31]	Cancer of right colon	28:56	Yes	Yes	14	↑	↓ OI	↓	= analgesic
Peters and Bartels, 1993[32]	Colon surgery	28:33	No	No	14	↑	↓ OI, BM, PF	↓	
Alabaz et al, 2000[33]	Crohn's disease	26:48	No	Yes	11	↑	NR	↓	= cost
Saba et al, 1995[34]	Colon surgery	25:25	No	No	25	=	↓ OI, BM	↓	
Marcello et al, 2001[35]	Acute colitis	24:24	Yes	NA	0	↑	↓ BM, PF	↓	= EBL
Musser et al, 1994[36]	Colon surgery	24:24	No	Yes	25	=	=	=	= cost
Van Ye et al, 1994[37]	Cancer	14:20	No	No	6.7	=	↓ OI	=	↓ analgesic
Liberman et al, 1996[38]	Diverticulitis	14:14	Yes	NA	0	=	↓ OI	↓	= cost

Lap = laparoscopic, OR = operating room, LOS = length of stay, NR = not reported, ↑ = significantly longer or greater for laparoscopic than open surgery, ↓ = significantly shorter or less for laparoscopic than open surgery, PF = passage of flatus, OI = oral intake, BM = bowel movement, NA = not applicable, EBL = estimated blood loss.
= is no significant difference between laparoscopic and open surgery.

ported 25% rate of conversion to open surgery.

No discussion on the presumed advantages of laparoscopic surgery would be complete without acknowledging the work of Holte and Kehlet on "fast track surgery,"[46] who clearly demonstrated that whereas laparoscopic surgery may be an important way of reducing postoperative pain and ileus, it is not the only means of doing so. A multimodal approach of opioid-sparing analgesia, early enteral feeding and laparoscopy may have synergistic benefits that are greater than laparoscopy alone.

Our review does not specifically address the appropriateness of laparoscopic surgery for malignant disease except to demonstrate that we have not yet identified a single port-site recurrence. This is in keeping with the findings of other large series, suggesting the port-site recurrence rate in experienced hands should be around 1%,[11,12,47,48] a rate that is similar to the experience with open surgery.[49,50] Our own patients are followed closely, and favourable Kaplan–Meier survival curves from our experience have been published previously.[51] The National Cancer Institute trial has completed accrual, and these findings along with other international prospective trials are anxiously anticipated. The one such study so far concluded is from Spain.[40] This potentially landmark study has not only confirmed significant advantages with regard to improved recovery after laparoscopic

surgery, but in a subgroup analysis has demonstrated that the laparoscopic approach is associated with a survival advantage for stage III colon cancers. It remains to be seen whether other studies confirm this finding. This could have significant implications for the value of the laparoscopic approach.

One of the largest stumbling blocks that remains for laparoscopic colon and rectal surgery is the issue of practical feasibility. There currently exist many barriers to the widespread introduction of this approach. Although most studies have suggested equivalent or reduced overall cost with laparoscopic surgery,[18,22,25,27,33,36,38] there is clearly an increased cost when focusing on equipment and operating room resources. In the current health care environment, it is difficult to advocate for more operating room expenditure even if there may be a clear saving in inpatients beds.

Possibly a larger obstacle is the lack of available training opportunities. It is still debated whether a weekend course was ever sufficient instruction for laparoscopic cholecystectomy. Fortunately, the majority of surgeons now learning laparoscopic cholecystectomy are residents acquiring this skill through repeated exposure as a routine part of their general surgery residency program. This has only become possible because most university surgeons have acquired the necessary skills to teach this procedure. With laparoscopic colon and

rectal surgery this is not yet the case. There are still only a few university instructors who can themselves perform these procedures, severely limiting exposure for trainees.

This issue is further complicated by surgical subspecialization. Any who have previously chosen to avoid laparoscopy by voluntarily leaving cholecystectomies to their general surgery colleagues have by now incurred a 10-year debt of experience with advanced laparoscopy. This adds another barrier to the acceptance and expansion of laparoscopic colon and rectal surgery within teaching centres.

Finally, under the current fee-for-service system, what is good for the patient is not necessarily good for the surgeon. Remuneration for laparoscopic procedures in Canada has traditionally been no different from that for open surgery. This holds for colon and rectal surgery, despite advanced training requirements, greater technical demands and necessarily longer operating times. This effectively creates a financial disincentive to perform this surgery, which will have to be addressed if surgeons are to voluntarily retrain for these procedures. In Ontario, a new fee code has recently been introduced for laparoscopic prostatectomy[52] that may herald progress against this inequity.

Conclusions

We have demonstrated the safety, feasibility and good outcomes that can be achieved with laparoscopic

Table 8

Laparoscopic Versus Open Colon and Rectal Surgery Randomized Clinical Trials

Study	Indication	Lap:Open	Intent to treat	Conversions, %	Outcome of laparoscopic v. open surgery			
					OR time	Ileus	LOS	Other
Weeks et al, 2002[39]	Cancer	228:221	Yes	25	NR	NR	↓	↓ analgesic
Lacy et al, 2002[40]	Cancer	111:108	Yes	11	↑	↓OI	↓	↓ EBL
Milsom et al, 1998[41]	Cancer / polyp	55:54	Yes	6.8	↑	↓PF, = BM	=	↓ analgesic, = EBL
Schwenk et al, 1998[42]	Tumours	30:30	Yes	3	↑	↓OI, BM, PF	NR	
Curet et al, 2000[43]	Cancer	18:18	No	28	↑	↓OI	↓	↓ EBL
Stage et al, 1997[44]	Cancer	15:14	No	17	↑	NR	↓	↓ pain

Lap = laparoscopic, OR = operating room, LOS = length of stay, NR = not reported, ↓ = significantly shorter or less for laparoscopic than open surgery, ↑ = significantly longer or greater for laparoscopic than open surgery, OI = oral intake, EBL = estimated blood loss, PF = passage of flatus, BM = bowel movement. = is no significant difference between laparoscopic and open surgery.

colon and rectal surgery when performed by a small group of surgeons with sufficient technical expertise. We are currently at a cusp in the direction this approach will take. With adequate training and good judgement it is clear that recovery after laparoscopic surgery is improved. There should be no question of the appropriateness and value of this technique for benign disease. The evidence of superior short-term outcomes is available. The issue of suitability for cure of malignant disease will soon be resolved and may produce striking findings. Although laparoscopic colon and rectal surgery is still currently not the standard procedure, if outcomes with respect to malignant disease are equivalent or possibly superior to open surgery, then the last barriers to acceptance will fall. The demand for this approach may well overwhelm available resources and training opportunities.

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