Original Article

Laparoscopic-assisted Colon and Rectal Surgery – Lessons Learnt from Early Experience

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Abstract

Introduction: Current evidence shows that laparoscopic bowel surgery is associated with a lower incidence of postoperative ileus, lower postoperative pulmonary and wound complication rates, shorter hospital stays and a quicker return to activity than open surgery. This paper aims to report our early experience with laparoscopic-assisted colorectal procedures in our Centre for Advanced Laparoscopic Surgery and the important lessons we have learnt from this. Materials and Methods: All laparoscopic-assisted colon and rectal surgical (LAC) procedures performed between January 2000 and December 2003 were reviewed. Clinical and operative records of these patients were reviewed. Data retrieved included patient demographics, selected intra-operative parameters, and postoperative outcomes. In order to provide a comparable reference, an equal number of matched open procedures over the same period were accrued and similarly analysed. All patients were managed on a standard carepath. All data were entered into a database and analysed using a statistical software package. Results: Forty-two laparoscopic-assisted colorectal procedures were performed from June 2000 to December 2003. A similar number of diagnosis-matched patients with open colorectal procedures were used as comparison. The diagnoses included cancer (68.5% versus 73.8%), diverticulosis (5.7% versus 9.5%) and polyps (14.3% versus 9.5%). Seven were converted to open surgery because of bleeding, adhesions and locally advanced disease. Laparoscopic-assisted procedures performed included 1 right hemicolectomy, 5 left hemicolectomies, 9 anterior resections, 1 abdominal-perineal resection, 3 sigmoid colectomies, 11 colostomies and 1 Hartmann's procedure. Mean perioperative time (146 min versus 125 min, $P = 0.173$) was comparatively longer. Mean duration for analgesic requirement (2.25 days versus 2.64 days, $P = 0.05$), mean length of stay (5.31 days versus 9.07 days, $P < 0.05$), mean time to commencement of diet (2.91 days versus 4.05 days, $P < 0.001$) and mean time to first bowel movement (2.57 days versus 4.10 days, $P < 0.001$) were all comparatively shorter. General morbidity rates (17.1% versus 21.4%, $P = 0.35$) were lower. No local wound complications were found in our laparoscopic-assisted group. Patients who had undergone open surgery instead of the planned laparoscopic-assisted procedures fared more poorly. Conclusions: Laparoscopic-assisted colorectal procedures performed in well-selected patients are associated with shorter hospital stays, quicker return of bowel function and lower morbidity when compared to the matched open procedures. Early experience should be acquired from performing technically simple procedures in patients with benign conditions before progressing to definitive resections in those with cancer.

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Key words: Colorectal cancer, Diverticulosis, Laparoscopic colorectal surgery, Laparoscopy, Perioperative outcomes, Polyps

Introduction

Great strides in laparoscopic surgical techniques have been progressively made throughout the various surgical subspecialties. More procedures can be performed laparoscopically today than when the first laparoscopic cholecystectomy came to light in 1982.

The impact of these techniques on colon and rectal surgery has been significant. Emerging evidence in the

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literature has shown that laparoscopic bowel surgery is associated with less ileus, lower rates of pulmonary and wound complications, shorter hospital stays and quicker return to activities of daily living.[1-5] Initial concerns over port site recurrences in oncologic resections, adequacy of surgical resections, oncologic clearance and immunomodulation have been addressed by several studies.[6-8]

Our unit began performing colon and rectal surgical procedures laparoscopically in 2000. The aim of this study was to review our early experience and results by comparing them with a group of matched procedures performed using the conventional open method. These results would enable us to identify key lessons learnt from this early experience, which may be beneficial to a unit embarking on laparoscopic colon and rectal surgery.

Materials and Methods

All laparoscopic-assisted colon and rectal surgical (LAC) procedures performed between January 2000 and December 2003 were included in this study. The clinical and operative records of these patients were reviewed with the intention of obtaining the relevant clinical data, recording selected intraoperative parameters, and postoperative outcomes of these patients.

All procedures were performed by at least 1 of the 3 trained consultant colorectal surgeons in the department (DMOC, RS, KSW), assisted by the colorectal residents. These 3 surgeons had completed exit certification in general surgery and spent some time training in laparoscopic colorectal surgery at overseas centres of excellence. The selection of patients was based on individual surgeon preference. Initial patient selection was confined to patients who had benign conditions. However, with improved experience over time, the technique was also offered to patients with malignancies.

All patients had their procedures performed under general anaesthesia. They were placed in Lloyd Davies stirrups together with pneumatic calf compression stockings. Beanbags were used as shoulder blocks to prevent the patient from slipping off the operating table if a steep Trendelenberg position was indicated. The patient's arms were tucked in by the side with soft sponge cushions and the thighs were placed almost parallel to the floor. Standard thromboembolic prophylaxis in the form of subcutaneous low molecular weight heparin was administered before and after surgery until the patients were ambulant.

The open technique of the initial 10-mm trocar insertion was adopted for all cases. Carbon dioxide insufflation was used to create the pneumoperitoneum and an intra-abdominal pressure of 12 mm Hg to 15 mm Hg was maintained. Subsequent placement of 5-mm, 10-mm or 12-mm trocars were performed under direct laparoscopic vision. A straight-viewing 0° laparoscope was used. Dissection was faciliated by the use of the harmonic shears (Harmonic Scalpel, Ethicon Endo-Surgery, Inc, Cincinnati, OH, USA) or the Ligasure (Valleylab, Tyco Healthcare, Boulder, CO, USA). Delivery of resected specimens took place via a small minilaparotomy in the midline, a Pfannenstiel incision or a skin-crease lower abdominal incision, depending on the preference of the surgeon.

Postoperative analgesics were administered either with patient-controlled analgesia (PCA) pumps or intramuscular opioids. These were converted to oral analgesics once the patient was able to tolerate oral feeding. All patients, regardless of the surgical approach, were managed with a standard colorectal carepath that had been in place since 1999 in this department.

To provide a comparable reference, an equal number of diagnosis-matched open procedures over the same period were accrued and similarly analysed.

All data were obtained from the patients' case notes, operative notes, outpatient clinic notes and clinical charts. These were entered into an Excel database and analysed using SPSS software. The Student's *t*-test and the Mann-Whitney U test were used to determine the significance of the differences in mean values for continuous variables. A P value of <0.05 was deemed significant.

Results

A total of 42 laparoscopic-assisted colon and rectum (LAC) procedures were performed over the 4-year period. There was an equal gender distribution, with 20 male and 22 female patients. Their mean age was 60 years (range, 23 to 83). Thirty-nine were Chinese whilst the other 3 patients comprised 1 Malay, 1 Indian and 1 Eurasian (Table 1).

The diagnoses of these 42 patients are shown in Table 2. Thirty patients had procedures performed for cancer. The other 12 had benign conditions, including 3 with diverticular disease, 5 with colorectal polyps and 1 with full thickness rectal prolapse. The comparison group comprised a matching group of patients, with the diagnoses shown in the same table.

Of these 42 procedures attempted laparoscopically, 7 (16.7%) required conversion to an open technique for the following reasons: 5 were converted due to the extensive adhesions encountered, 1 for excessive bleeding encountered during dissection and 1 for locally advanced disease which made dissection technically difficult. The remaining 35 LAC procedures completed successfully are shown in Table 3. Eleven patients had a diverting loop colostomy created laparoscopically.

Of the 30 cancer patients who had LAC procedures

Table 1. Demographic Data

	Laparoscopic-assisted		Open	
Number	42		42	
Gender	Male	Female	Male	Female
	20	22	18	24
Mean age (years)	60		64	
Range	23-83		27-93	
Race	Chinese	39	Chinese	36
	Indian	1	Indian	2
	Malay	1	Malay	2
	Others	1	Others	2

Table 2. Indications for Surgery

	LAC		Converted		Open	
Cancer	24	68.5%	6	85.7%	31	73.8%
Diverticular disease	2	5.7%	1	14.3%	4	9.5%
Polyps	5	14.3%	-	-	4	9.5%
Rectal prolapse	1	2.9%	-	-	-	-
Other benign conditions	3	8.6%	-	-	3	7.1%
• Sigmoid volvulus						
• SRUS						
• Rectovaginal fistula						

LAC: laparoscopic-assisted colorectal procedures; SRUS: solitary rectal ulcer syndrome

Table 3. Types of Operation

	LAC	Converted	Open
Right hemicolectomy	1	3	11
Left hemicolectomy	5	1	2
Anterior resection	9	-	13
Suture rectopexy	2	-	-
Abdominoperineal resection	1	-	3
Others	17	3	13
Colostomy	11	1	2
Sigmoid colectomy	3	1	5
Hartmann's	1	-	4
Total colectomy	2	1	2
Total	35	7	42

LAC: laparoscopic-assisted colorectal procedure

Table 4. Operations for Cancer

	LAC	Open
Right hemicolectomy	2	7
Left hemicolectomy	5	1
Anterior resection	6	11
APR	1	3
Loop colostomies/ileostomies	12	2
Hartmann's procedure	2	4
Sigmoid colectomy	2	3
Total	30	31

APR: abdominoperineal resection; LAC: laparoscopic-assisted colorectal procedures

performed, 12 were diverting loop stomas (Table 4). The rest included 2 right hemicolectomies, 5 left hemicolectomies, 6 anterior resections, 1 abdominoperineal resection, 2 sigmoid colectomies and 2 Hartmann's procedure. The mean tumour size for the 18 who had definitive resection performed was 4.7 cm (range, 2 to 10). Following adequate mobilisation of the indicated segment of colon, intracorporeal bowel transection was performed in all but 1 patient. Fifteen patients had restoration of bowel continuity performed. In 10 of them, the anastomosis was created intracorporeally after re-establishment of pneumoperito-neum following complete bowel resection and delivery. For the remaining 5, the transected ends were brought out through the delivery incision and a hand-sewn anastomosis fashioned using absorbable sutures.

Analysis of the histological reports showed that the mean number of lymph nodes harvested for the LAC group was 11.8 (range, 4 to 21). This was comparable to the corresponding harvest in the open group, which was 12.2 (range, 3 to 28).

In the converted group, 3 underwent right hemicolectomies, 1 a left hemicolectomy, 1 a loop colostomy, 1 a Hartmann's procedure and 1 a total colectomy.

The mean operative time for the LAC group was 146 minutes (range, 15 to 315) (Table 5). This compared with 125 minutes (range, 40 to 245) in the open group. This difference was not significant ($P = 0.173$). Analgesia was required for an average of 2.25 days for those in the LAC group. This compared with 3.43 days in the converted group and 2.64 days in the open group ($P = 0.05$). When the groups were compared for time to commencement of oral feeding, the LAC group took a significantly shorter time at 2.91 days as compared to 4.29 days ($P = 0.07$) for the converted group and 4.05 days for the open group ($P < 0.001$). The time taken to the first bowel movement was similarly shorter in the LAC group, when compared to those who had the procedure converted (mean of 2.57 days; range, 1 to 6 versus mean of 3.71 days; range, 2 to 11; $P = 0.45$). When compared to the open group, which had a mean of 4.1 days (range, 1 to 10), the difference was statistically significant ($P < 0.001$).

There were 6 (17.1%) patients who had general complications (Table 6). This compared with 4 (57.1%) in the converted group and 9 (21.4%) in the open group. These differences were, however, not statistically significant.

It was notable that there were no respiratory complications

Table 5. Perioperative Outcomes

	LAC (n = 35)	Open (n = 42)	Sig	Converted (n = 7)
Mean operative time (minutes)	146	125	*P* = 0.17	154
Range	15-315	40-245		105-200
Mean duration of analgesic requirements (days)	2.25	2.64	*P* = 0.05	3.43
Range	1-7	1-4		2-7
Mean time to commencement on oral diet (days)	2.91	4.05	*P* <0.001	4.29
Range	1-9	1-11		2-6
Mean length of stay (days)	5.31	9.07	*P* <0.05	12.71
Range	2-15	2-62		4-27
Mean time to first bowel movement (days)	2.57	4.10	*P* <0.001	3.71
Range	1-6	1-10		2-11

LAC: laparoscopic-assisted colorectal procedures; Sig: statistical significance

Table 6. Morbidity

	LAC	Open	Sig	Converted
General complications	6	9	*P* = 0.35	4
Respiratory	-	3		1
Cardiac	1	1		-
Ileus	3	2		2
Pulmonary embolism	-	-		1
Deep vein thrombosis	-	2		-
Others	2	1		-
Local complications	-	4	*P* <0.001	2
Wound infection	-	4		1
Wound dehiscence	-	-		1
Total	6	8		6

LAC: laparoscopic-assisted colorectal procedures; Sig: statistical significance

in the LAC group. Similarly, there were no complications related to the wound in this group of patients. This was not the case for the converted group (2 out of 7) and the open group (4 out of 42).

Discussion

Laparoscopic or minimally invasive surgery has become an integral component of the modern day surgeon's armamentarium. Today's patient demands that the option of this form of surgery be made available when confronted with a condition that is acceptably treated using this modality.

There is sufficient evidence at present to demonstrate the benefits of laparoscopic bowel surgery in benign colon and rectal conditions. These include lower frequencies of ileus, lower rates of postoperative complications including less pulmonary complications and wound infections, shorter hospital stays, earlier return of gastrointestinal function and earlier return to work.[1-4,9-11] Initial technical difficulties with advanced laparoscopic skills required for bowel mobilisation and manipulation have been overcome as an increasing number of surgeons spend more time perfecting their techniques. Early experience with inflammatory bowel disease and diverticulosis has led to the tentative use of laparoscopic techniques in managing colon and rectal cancers. This issue remains contentious and until long-term results of several trials conducted in the United States and Europe are published, concerns of port site recurrences, adequacy of oncologic resection and long-term survival will remain.

Our institution's Centre for Advanced Laparoscopic Surgery (CALS) conducts laparoscopic courses accredited by the Society of American Gastrointestinal Endoscopic Surgeons (SAGES) Framework for Post-Residency Surgical Education and Training. In line with this effort, we commenced performing laparoscopic bowel surgery in 2000. The results of this analysis of our early experience serve as an audit as well as a reference for our practice.

The demographic distribution of our patients was consistent with the spectrum of patients in the capture zone of our institution. The 2 groups were comparable in this aspect. The indications for surgery for both groups were similar, although not identical in number. The larger proportion of patients with cancer was again reflective of the distribution of the workload of the colorectal unit. Our early cases were mainly confined to patients with benign conditions, namely diverticulosis, large polyps, and rectal prolapse, all of which have been proven to benefit from treatments using laparoscopic techniques.[12]

The procedures performed in patients with cancer were initially confined to those who required a loop diversion colostomy either prior to initiation of neoadjuvant chemoradiation or those who had advanced, irresectable disease. Laparoscopic stoma creation is an ideal prelude to the more complex laparoscopic colorectal resections. It is not as technically demanding, associated with much less morbidity, familiarises the surgical team with the operating room set-up and various technical manoeuvres such as bowel handling and mobilisation, and affords some form of staging of the malignancy. With familiarisation with, and improvements in, the techniques acquired over the course of time, laparoscopic-assisted resections were used for selected cancer patients. The decision for using this approach was made by the individual surgeon. Nevertheless, large, bulky and locally advanced tumours were excluded. The number of lymph nodes harvested for both the LAC and the

open group with cancers were essentially identical, suggesting that the adequacy of oncological clearance in these patients is comparable, a point that has been proven in several well-conducted studies.[6-8]

The LAC group did not have a significantly longer mean operative time compared to the open group. However, this could have been due to the larger number of diverting colostomies in the former group. Nevertheless, as is the case for all laparoscopic surgeons, operative time was progressively reduced with increased experience. Our conversion rate of 16.7% fell within the ranges that have been reported in the literature.[13-15] It is our hope that this will improve as the CALS develops, with more LAC procedures being routinely performed.

Despite the smaller length of incisions, the mean duration of analgesic requirements for both groups of patients did not differ significantly (2.25 days versus 2.64 days, $P = 0.40$).

The significant benefits seen in our LAC group of patients were in their ability to tolerate diet quicker (2.91 versus 4.05 days, $P < 0.001$) and the earlier return of bowel movements as manifested by the time taken to move their bowels (2.57 versus 4.10 days, $P < 0.001$). In terms of the length of stay in hospital, our LAC group required much shorter stays (mean of 5.31 days versus 9.07 days, $P < 0.02$). The perioperative management of the patients in both groups was identical, adhering to the standard carepath the unit employs for all colorectal resections. These results essentially corroborate those of the large randomised series published in the literature.[2,3,16]

When we looked at the results for the small group of patients who had their procedures converted from laparoscopic to the open method, it is worth noting that these compared unfavourably with even those of the open group, a finding that has been described in the literature.[12,17,18] We attribute this to the added duration of the operation, given that the time taken before the decision to make the conversion might have adversely affected the operative outcome. We therefore believe that in cases where laparoscopic surgery is judged to be difficult, the decision to convert should be made early.

Although there was an absolute difference in the general complication rates between the LAC and the open group, this was not significant. Not unexpectedly, there were no pulmonary complications in the LAC group. There were also no local wound complications in the LAC group despite the fact that wound protectors were not routinely used during specimen extraction.

Whilst we are aware that this was a small retrospective series, the short-term results indicate greater clinical benefits in LAC in well-selected patients. Although the matched groups were not completely identical, we felt that obtaining a cross-section of cases performed by the same group of surgeons over the same period of time would be the ideal means of comparison.

In a unit that is embarking on laparoscopic bowel surgery, we believe that surgeons should hone their experience with benign procedures such as diversion colostomies and rectopexies before proceeding to resections for benign conditions such as huge sessile polyps not amenable to colonoscopic removal and diverticular disease. These operations are associated with lower morbidity than the corresponding open procedures. However, the decision to convert to open surgery should be made early in the surgery. A rule of thumb would be failure of progress of the operation after an hour of laparoscopic dissection or when there is excessive blood loss obscuring the visual field. Resections for malignant conditions should only be embarked on when the surgeon has acquired sufficient experience and expertise in laparoscopic bowel surgery. Bulky tumours requiring an incision length greater than 10 cm for delivery are perhaps best resected by laparotomy or a skin-crease mini-laparotomy, depending on the surgeon's preference.

Conclusion

Laparoscopic-assisted colon and rectal procedures in selected patients can be performed safely and effectively. There are significant advantages of shorter periods of bowel ileus, earlier toleration of oral diet and shorter hospital stays. Minimal local wound complications and pulmonary complications are additional benefits. Experience should be acquired by performing procedures in benign conditions (where there are no issues of long-term survival, oncological clearance and port-site recurrences) before progressing to definite resections in malignant conditions. The decision to convert to an open procedure should be made early in order to improve outcomes.

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