

Implementation of laparoscopic approach in colorectal surgery – a single center’s experience

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Videosurgery Miniinv 2018; 13 (1): 27–32

DOI: <https://doi.org/10.5114/wiitm.2018.72748>

Abstract

Introduction: Implementation of the laparoscopic approach in colorectal surgery has not happened as rapidly as in cholecystectomy, because of concerns about oncological safety. The results of controlled trials in multiple centers showed the method to be safe. Consequently, surgeons decided to try the approach with colorectal surgery. This process, in our clinic, began in earnest about four years ago.

Aim: To analyze and present the clinical outcomes of applying the laparoscopic approach to colorectal surgery in a single center.

Material and methods: We retrospectively identified patients from a hospital database who underwent colorectal surgery – laparoscopic and open – between 2013 and 2016. Our focus was on laparoscopic cases. Study points included operative time, duration of the hospital stay, postoperative mortality and rates of complications, conversion, reoperation and readmission.

Results: Of 534 cases considered, the results showed that the relation between open and laparoscopic procedures had reversed, in favor of the latter method (2013: open: 82% vs. laparoscopic: 18%; 2016: open: 22.4% vs. laparoscopic: 77.6%). The most commonly performed procedure was right hemicolectomy. The total complication rate was 22%. The total rate of conversion to open surgery was 9.3%. The postoperative mortality rate was 3%.

Conclusions: Use of the laparoscopic approach in colorectal surgery has increased in recent years world-wide – including in Poland – but the technique is still underused. Rapid implementation of the miniinvasive method in colorectal surgery, in centers with previous laparoscopic experience, is not only safe and feasible, but also highly recommended.

Key words: laparoscopy, colorectal surgery, implementation, outcomes, miniinvasive surgery.

Introduction

Laparoscopy is not applied as widely to colorectal surgery in Poland as might be expected, because of lingering concern about oncological safety, which are no longer valid.

Implementation and rapid adoption of the laparoscopic approach in cholecystectomy revolutionized this surgical procedure and had an influence on other areas of surgery. Clearly, laparoscopic cholecystecto-

my has been shown to have significant benefits, such as faster recovery, limited operative trauma, and reduced postoperative pain and length of hospital stay. These factors led to general acceptance of the laparoscopic method as an alternative to conventional open surgery in cholecystectomy [1, 2]. There has been nothing to suggest that colorectal surgery would not see the same benefits from the laparoscopic method.

With the implementation of the laparoscopic approach in colorectal surgery there is a chance that

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we will see an increase in the instances of some undesirable outcomes. Those increases would be short term, though. Long term, we would actually see decreases, where operative time and complication rate are concerned [3]. Work that has been done at our clinic substantiates these assumptions.

The first reports of laparoscopic colon resection in the world were published in 1991, with the procedures being performed independently by Jacobs and Fowler [4–8]. The first colorectal resection in our clinic – sigmoidectomy – was successfully performed by Prof. Stanowski in 1993 [6]. Around that time and before, due to a lack of adequate equipment and because the procedure itself was seen as very convoluted and technically difficult, surgeons eschewed colorectal resections. One of the major reasons for slow implementation of laparoscopy in colorectal surgery, especially in Poland, was higher costs compared to those of open approach [9]. Early case reports showing a high number of abdominal port-site recurrences did not help [8, 10].

Due to safety concerns the miniinvasive technique was more voluntarily used in benign colorectal diseases [11]. Over time, the results of randomized controlled trials performed at multiple centers showed the laparoscopic method to be at least comparable to the open one in terms of oncologic safety. Furthermore, laparoscopy might even have some additional advantages over the latter method [12–15].

Surgeons from our clinic, encouraged by these reports and having acquired greater facility with laparoscopy, decided to implement this method in colorectal surgery. This process began in earnest about four years ago.

Aim

In this study we aim to analyze and present the clinical outcomes of applying the laparoscopic approach in colorectal surgery.

Material and methods

Study design

We retrospectively identified patients from a hospital database, who underwent colorectal surgery – laparoscopic and open – between 1st January 2013 and 31st December 2016, in our department. Institutional review board approvals were obtained.

Our focus was on laparoscopic cases. Three senior surgeons performed 267 (94%) of these procedures. The remaining cases were seen as outliers, and therefore we excluded them from our study. Eight cases, due to unresectable malignancy, ended with ostomy being employed. Consequently, we also did not take these cases into consideration. There were no selection criteria for the laparoscopic approach. Application of the miniinvasive approach was based on the surgeon's experience, as well as access to an operating theater and essential instruments.

A perioperative study was conducted in patients with tumor pathology, which included colonoscopies with biopsy, computed tomography (CT) scan of the abdomen and pelvis, X-ray of the chest and a blood test for tumor markers.

The operations were performed under general anesthesia with endotracheal intubation following preoperative antibiotic and antithrombotic prophylaxis and bladder catheterization. All the patients underwent mechanical bowel preparation.

Study variables

Study variables were analyzed in each case together with patients' demographic variables. The following baseline variables were collected: gender, age, body mass index (BMI), American Society of Anesthesiologist score, diagnostic group and previous abdominal surgery.

Surgical variables include the following: type of resection (right hemicolectomy, left hemicolectomy, sigmoidectomy, rectal resection, colectomy and other), operative time, rate of conversion, type of pathology (malignant, benign, i.e. polyps, diverticulitis, inflammatory bowel disease and other), length of hospital stay, postoperative mortality and rates of complications (bleeding, anastomotic leak, abdominal access and others), conversion, reoperation and readmission within 30 days. The anatomopathological variables include TNM staging, G-staging.

Highly skilled surgical oncologists – each with at least 12 years of experience in surgery, post-residency, and 10 years of experience in laparoscopy – performed all of the analyzed procedures.

Results

Five hundred and thirty-four patients were included in the study (284 via laparoscopic approach; 250 via open approach). Figure 1 illustrates the

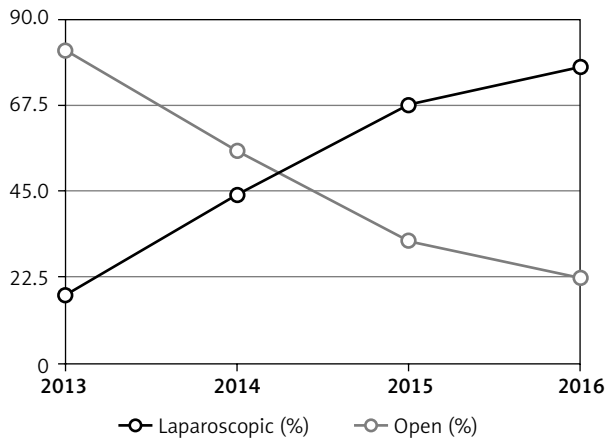


Figure 1. Laparoscopic versus open colorectal resections 2013–2016

change in trend that occurred between laparoscopic and open colorectal resections between 2013 and 2016. When the first laparoscopic procedures were performed in 2013, open procedures were the majority (open: 82% vs. laparoscopic: 18%), but by 2016 those percentages had reversed (open: 22.4% vs. laparoscopic: 77.6%).

Two hundred fifty-nine patients receiving laparoscopic approach were analyzed. The base variables are shown in Table I. The vast majority of patients had comorbidities (85.9%), and the majority were over 65 years old. One hundred (38.6%) patients had previously undergone abdominal procedures, of which 16% were colorectal resections. The procedures were performed due to malignancy in 218 (84.2%) cases (1 case of sarcoma), benign lesion, i.e. diverticulitis and polyps in 35 (13.5%) cases, inflammatory bowel disease in 2 cases (0.8%) and other pathologies in 4 (1.5%) cases. Surgical variables are shown in Table II.

Right-sided resections constituted the majority, with sigmoidectomy being the second most common procedure and rectal resection the third. In the four analyzed types of procedure, the mean operative time was 151 min (range: 30–350 min). Mean operative times, more specifically, were as follows: right hemicolectomy, 133 min (range: 30–350 min); left hemicolectomy, 170 min (range: 60–290 min); sigmoidectomy, 137 min (range: 50–295 min); rectal resection, 168 min (range: 70–335 min).

The total complication rate was 22%. Complications that occurred most frequently, $n = 33$ (12.7%) were what we described as 'others', which for the most part were instances of post-operative wound

Table I. Patients' demographic characteristics

Parameter	N (%)
Gender:	
Female	101 (39)
Male	158 (61)
Age group [years]:	
< 35	6 (2.3)
35–50	29 (11.2)
51–65	86 (33.2)
≥ 65	138 (53.3)
BMI [kg/m ²]:	
< 18.5	6 (2.3)
18.5–25	92 (35.9)
26–30	101 (39.5)
≥ 30	57 (22.3)
ASA:	
I	36 (14.1)
II	157 (61.3)
III	61 (23.8)
IV	2 (0.8)
Diagnostic group:	
Benign	35 (13.5)
Malignant	218 (84.2)
IBD	2 (0.8)
Other	4 (1.5)
Previous surgery:	
Abdominal	100 (38.6)
Colorectal	16 (16)
Comorbidities	220 (85.9)

infection, ileus and bowel obstruction, dehiscence, and strangulation of inguinal hernia. Anastomotic leak was the second most common complication, $n = 16$ (6.2%), followed by bleeding, $n = 6$ (2.3%), and abdominal abscess, $n = 2$ (0.8%). Not all of the complications required reoperation, although reoperation was needed in 34 (13.1%) cases. The total rate of conversion to open surgery was 9.3%. Reasons for conversion included poor views, tumor

Table II. Surgical variables

Parameter	Value
Number of patients	259
Indication for surgery	
Malignant/benign pathology, <i>n</i> (%)	218 (84.2)/ 41 (15.8)
Type of resection, <i>n</i> (%):	
Right hemicolectomy	93 (35.9)
Left hemicolectomy	25 (9.7)
Sigmoidectomy	68 (26.3)
Rectal resection	63 (24.3)
Colectomy	6 (2.3)
Others	4 (1.5)
Operative time, mean (range) [min]	151 (30–150)
Rate of conversion, <i>n</i> (%)	24 (9.3)
Rate of complication, <i>n</i> (%)	57 (22)
Rate of reoperations, <i>n</i> (%)	34 (13.1)
Morbidity, <i>n</i> (%)	8 (3)

infiltration into the surrounding tissue and adhesions. The number of readmissions within 30 days was 8 (3.1%), due to wound infection or ileus and small bowel obstruction. The mean duration of the hospital stay was 8 days (range: 2–103 days). The postoperative mortality rate was 3% (*n* = 8). Two patients died due to complications of freeing massive adhesions of the small bowel resulting in enterocutaneous fistula, 2 due to dehiscence of anastomosis, and the rest were associated with patients' comorbidities following intraoperative bleeding (1 case) or bleeding from anastomosis (2 cases).

The anatomopathological variables in malignant disease according to the AJCC 7th edition TNM staging system are shown in Table III.

Discussion

The impact of laparoscopy on long-term oncological treatment results was a subject of controversy for many years due to port-site metastases and concerns regarding the lower number of lymph nodes retrieved [16]. The high number of metastases in the abdominal wall, especially in trocar wounds – described in some of the first publications concerning

Table III. Anatomopathological variables in malignant disease according to AJCC 7th edition TNM staging system (number of patients = 217)

Variable	<i>N</i> (%)
pT:	
pTx	1 (0.5)
pTis	0
pT0	0
pT1	10 (4.6)
pT2	33 (15.2)
pT3	154 (71)
pT4a	12 (5.5)
pT4b	7 (3.2)
pN:	
pNx	3 (1.4)
pN0	120 (55.3)
pN1a	23 (10.6)
pN1b	20 (9.2)
pN1c	14 (6.5)
pN2a	20 (9.2)
pN2b	17 (7.8)
pM:	
pMx	
pM0	177 (81.6)
pM1a	30 (13.8)
pM1b	10 (4.6)
G:	
Gx	0
G1	12 (5.5)
G2	193 (88.9)
G3	11 (5.1)
G4	1 (0.5)

laparoscopic colorectal surgery – caused widespread concerns regarding the safety of this approach. Some reports suggested a 10–20% risk of port-site metastases and peritoneal dissemination [17–19]. To further investigate the cause of these complications, factors related to laparoscopy, the patient and the tumor were analyzed in experimental studies [20, 21]. The so-called ‘chimney effect’, the leakage of CO₂ alongside trocars through the trocar wound and aerosolization of tumor cells – these were among the main factors that contributed to the occurrence of unfavorable postoperative complications [22].

Based on these data, some changes in the laparoscopic technique were proposed to avoid, or at least reduce, the risk of port-site metastases [23, 24]. These recommendations included: emptying the CO₂ through trocars, use of the 'no touch technique', i.e. avoiding touching or manipulating the tumor, protecting the wall incision with a special device, and closing the main vessels running to the tumor.

However, despite these initial concerns about oncological safety, well-designed, prospective, randomized, multi-centered trials, that compared mini-invasive and open approaches, have demonstrated no differences in the incidence of metastases in the surgical wound or in the oncological outcomes between these two types of procedures [10, 25–27].

Use of laparoscopy, in management of colorectal malignancies, is currently accepted worldwide [28]. Although use of the mini-invasive approach in colorectal surgery has been increasing in recent years, the percentage of patients who undergo laparoscopic surgery is still limited and there are also significant differences among centers [29, 30].

In our study we analyzed colorectal resections performed in our center between January 2013 and December 2016. Out of 534 patients who underwent major colorectal resection, 18% and 77.6% underwent mini-invasive surgery in 2013 and 2016, respectively, with a conversion rate of 9.3%.

In recent years, there have been several reports on implementation of laparoscopy in colorectal surgery. The Norwegian Colorectal Cancer Registry evaluated the use of laparoscopy for all colon cancer resections performed in 2007–2010. Out of 8707 patients with colon cancer who underwent major resections, 16% and 36% received laparoscopic treatment in 2007 and 2010, respectively. The conversion rate of laparoscopic procedures was 14.5% [31].

The Surgical Care and Outcomes Assessment Program analyzed the use of laparoscopy for elective colorectal resection at 48 hospitals in the United States from 2005 to 2010. The use of laparoscopic procedures increased from 23.3% in 2005 to 41.6% in 2010 [32].

In another recent study, using the University Health System Consortium administrative database – which included more than 300 academic hospitals and consisted of 85,712 patients who underwent colon resections between October 2008 and December 2011 – the mini-invasive approach was attempted in 36,228 (42.2%) patients, with 5751 (15.8%) patients requiring conversion to an open procedure.

There was a trend toward increasing utilization of the mini-invasive approach from 37.5% in 2008 to 44.1% in 2011 [33].

The low rate of conversion in our data could be biased by the high percentage of right-sided lesions and proportionally lower percentage of rectal resection, which are the most demanding cases. Where achievement of nearly 80% employment of the laparoscopic approach in colorectal surgery is concerned, the determining factor may have been the 3 surgeons who performed the operations. Their work greatly shortened the learning curve and improved results.

Conclusions

Although use of the laparoscopic approach in colorectal surgery has increased in recent years worldwide – including in Poland – several studies have shown that mini-invasive techniques are still underused and there are also great differences among centers. In our opinion, fast implementation of laparoscopy in colorectal surgery, in centers with previous laparoscopic experience, is safe and feasible. A high volume of cases per surgeon is an important factor for shortening the learning curve and improving the outcomes.

Conflict of interest

The authors declare no conflict of interest.

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Received: 16.05.2017, **accepted:** 2.09.2017.