International Journal of Surgery 21 (2015) 97–102

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Original Research

Safety and feasibility of laparoscopic sigmoid colon and rectal cancer surgery in patients with previous vertical abdominal laparotomy☆

Mustafa Haksal [a], Yasar Ozdenkaya [a], Ali Emre Atici [b], Nuri Okkabaz [b], Nihat Aksakal [b], Ayhan Erdemir [b], Osman Civil [b], Mustafa Oncel [a, *]

[a] Department of General Surgery, Istanbul Medipol University Medical School, Istanbul, Turkey
[b] Department of General Surgery, Kartal Education and Research Hospital, Istanbul, Turkey

HIGHLIGHTS

- Only vertical incisions and sigmoid colon or rectal cancers are included.
- Previous vertical laparotomy does not worsen outcomes of laparoscopic resection.
- Laparoscopic sigmoid colon&rectal resection in cases with previous laparotomy is safe.

ARTICLE INFO

Article history:
Received 28 February 2015
Received in revised form
13 June 2015
Accepted 18 July 2015
Available online 29 July 2015

Keywords:
Laparoscopy
Rectal cancer
Laparotomy
Incision

ABSTRACT

Introduction: Current study aims to analyze the impact of previous vertical laparotomy on safety and feasibility of laparoscopic sigmoid colon and rectal cancer operations.
Methods: All consecutive patients who underwent a laparoscopic resection for sigmoid colon or rectal cancer were included. These aspects were abstracted and compared within no laparotomy and previous vertical laparotomy groups: demographics, perioperative aspects, pathological features and survival.
Results: There were 252 patients in no laparotomy group, and 25 cases with previous vertical incisions including lower (n = 12, 48%), upper (n = 7, 28%), and lower&upper (n = 2, 8%) midline and paramedian (n = 4, 16%) laparotomies. Veress insufflation and open technique were used in 19 (76%) and 6 (24%) cases, respectively, during the insertion of the first trocar in previous laparotomy group. Patients in previous laparotomy group were significantly older (59.2 ± 13.4 vs. 66.2 ± 10.1, p = 0.01), but gender, ASA scores, tumor and technique related factors were similar within the groups, including operation time (200 [70–600] vs. 200 [130–390] min, p = 0.353), blood loss (250 [100–1500] vs. 250 [0–2200] ml, p = 0.46), additional trocar insertion (10 [4%] vs. 3 [12%], p = 0.101), conversion (20 [7.9%] vs. 4 [16%], p = 0.25), postoperative complication (59 [23.4%] vs. 4 [16%], p = 0.06) and 30-day mortality (7 [2.8%] vs. 1 [4%], p = 0.536) rates. Oncological outcomes regarding pathological features and 5-year survival rates (65% vs. 73.2%, p = 0.678) were not different.
Conclusion: The presence of a previous laparotomy does not worsen the outcomes in patients undergoing laparoscopic removal of sigmoid or rectal cancer, thus laparoscopy may be considered to be safe and feasible in these cases.

1. Introduction

Adhesions have long known to be a consequence of abdominal operations; and besides its effects including small bowel obstruction, chronic abdominal pain and female infertility, they have been also accepted to increase intra-operative risks in case of an abdominal re-operation, particularly when a laparoscopic procedure is planned [1]. Abdominal adhesions have been believed to lengthen the operation time, and increase the incidence of

☆ This paper was partly read as a podium presentation at ECTA 2nd Biennial Meeting New Technologies in Colorectal Surgery at June 15–17 2011 in Turin, Italy.

* Corresponding author. Department of General Surgery, Istanbul Medipol University Medical School, TEM Avrupa Otoyolu Goztepe Cikisi, No:1 Bagcilar, 34214, Istanbul, Turkey.
E-mail address: mustafa.oncel@medipol.com.tr (M. Oncel).

http://dx.doi.org/10.1016/j.ijsu.2015.07.687
1743-9191/

intestinal injury [2,3]. It has been reported in a review that the incidence of access injury during laparoscopy was 0.18% and 60% of those occurred in patients who had previous surgical procedures [2]. Accordingly, previous laparotomy had been initially considered as a contraindication for advanced laparoscopic surgical procedures. This is particularly true for colorectal cancer operations due to the complexity of the surgery in these cases, which requires dissections in different quadrants of the abdominal cavity [4].

Laparoscopic colorectal surgery for cancer has been accepted to be technically feasible and oncologically safe [5,6]. The benefits of laparoscopic surgery include better cosmesis, decreased surgical trauma, reduced requirements for analgesics, earlier return to bowel function, and a shorter postoperative stay [7,8]. However, because of potential risks of laparoscopy, surgeons have more commonly preferred to perform conventional surgery in cases with a previous laparotomy [9,10]. In recent years, increasing expertise, and successful results in laparoscopic abdominal surgery have encouraged surgeons to extent the limits of laparoscopy beyond more challenging occasions. Accordingly, it has been recently questioned whether or not previous laparotomy is truly a valid contraindication for laparoscopic colorectal approach. Several studies have evaluated the perioperative outcomes in patients with previous abdominal surgery and generally denied the superiority of conventional colorectal surgery over laparoscopy [4,9,11–15]. But most of these studies may be criticized in two standpoints. First, several analyses have included different kinds of previous abdominal incisions, some of which have limited or no effect on laparoscopic technique, since the location of the procedure is far from the previous incision site [4,9,12,14,15]. This is particularly true for subcostal or McBurney incisions, which are less likely to adversely affect the outcomes in cases undergoing laparoscopic sigmoidal or rectal resections. Secondly, other studies have included different types of laparoscopic procedures such as right or left hemicolectomy or anterior or low anterior resections, which makes the data heterogeneous and the conclusions relatively unreliable [4,11,12]. Accordingly, little data exist evaluating the influence of the precise type of previous procedure or incision on the outcomes of laparoscopic colorectal surgery [9]. Thus, current study aims to analyze the safety and effectiveness of laparoscopy in sigmoid colon or rectal cancer patients, who had previous vertical laparotomy.

2. Materials and methods

Institutional Ethics Board approved the design and content of the study prior to data abstraction (Reference number: B104ISM4340029/1009/58). All consequent patients who underwent laparoscopic resections for lesions located at sigmoid colon or rectum between 2006 and 2013 were retrospectively abstracted from a prospectively designed database. Those who had a recurrent cancer operation or surgery for other tumors rather than adenocarcinoma were excluded in order to homogenize the information. For the same purpose, the study was confined to include only the cases with sigmoid colon and rectal tumors, for which the procedures were quite similar regarding the extent of dissection field, type of anastomosis, and the locations of trocars and incisions. Finally, patients with previous laparotomy via subcostal, pfannenstiel, umblical, flank, McBurney incisions or those underwent a laparoscopic cholecystectomy were excluded, since the effect of these incisions on laparoscopic sigmoid or rectal cancer surgery was believed to be limited. In case of an advanced (T3-4 or N positive) rectal cancer, the patients received preoperative chemoradiation therapy if the tumor was located at the distal two third of the rectum. Patients were assigned into two groups according to whether or not they had had a previous laparotomy. All procedures were performed or supervised by a single surgeon (MO).

Operation Technique

A Veress needle insertion just below or above the umbilicus was performed during the initiation of pneumoperitoneum in no laparotomy group. Veress needle insertion was also usually preferred in cases in previous laparotomy group, but the location was taken far from the previous incision line, where would be later used as a trocar site. Open technique for trocar placement was only chosen in selected cases in previous laparotomy group, generally in obese patients or when Veress needle insertion technique failed. In previous laparotomy group, the first trocar was generally inserted far from the previous incision line, where was planned to be used as a working trocar during the further steps of the operation. Following trocars were inserted under the direct vision obtained via the first trocar. The operation was generally completed with 5 trocars in both groups as reported in our previous papers; except in case of an abdominoperineal resection which was performed via 4 trocars, since extensive splenic flexure mobilization was not necessary for these cases [16,17]. Consequently, the 5th or 6th trocars were considered as additional ports in case of an abdominoperineal or anterior/low anterior resections, respectively. A medial to lateral approach was preferred and high ligation of the inferior mesenteric artery was routinely performed in both groups [18]. In case of a previous lower midline incision, it was used instead of pfannenstiel incision for the removal of the specimen out of abdomen. An intracorporeal anastomosis was often performed; however in case of an anterior resection an extracorporeal anastomosis was sometimes preferred especially in non-obese patients. A longer incision than that required for the extraction of the specimen from the abdominal cavity is defined as conversion. The perioperative management policies were similar in no laparotomy or previous laparotomy groups, including evaluation of the disease, preoperative patient preparation, and intraoperative decisions such for conversion and stoma creation, or postoperative patient care.

These aspects were abstracted and compared within the groups: demographics, patients' characteristics, tumor localization, application/omission of neoadjuvant radiation therapy, intraoperative information (operation technique, extension of the resection, operation time, requirement of additional organ resection, amount of intraoperative bleeding, necessity of additional trocar and conversion to open surgery), postoperative data (requirement for transfusion, complications, reoperation and 30-day mortality rates; and length of hospital stay), pathological characteristics (T stage [T0-2 or T3-4], length of the specimen, number of harvested lymph nodes, N status [node negative and positive], presence of vascular and perineural invasions, differentiation [well-moderate, poor and undetermined], length of distal margin and radial margin positivity); and survival. The causes of conversion, reoperations and 30-day mortality were stated. The impact of adhesions on conversion was separately evaluated.

Statistical Analysis: Data were analyzed by using SPSS 15.0 for Windows. Results were given as percentages, mean and standard deviations or median and ranges. Quantitative and qualitative variables were compared with student's t-test and chi-square (Pearson's or Fischer's Exact) test, respectively. Survival analysis was performed with Kaplan–Meier analysis. A p value less than 0.05 was considered to be statistically significant.

3. Results

A total of 347 patients underwent a laparoscopic sigmoid colon or rectal cancer surgery at our institutions between 2006 and 2013

were evaluated. These were excluded from further analyses: cases who had previous laparotomies via pfannenstiel (n = 27, 7.8%), McBurney (n = 19, 5.8%), subcostal (n = 14, 4%), flank (n = 1, 0.2%) or umblical (n = 1, 0.2%) incisions or previous laparoscopic cholecystectomy (n = 1, 0.2%); or those who did not have adenocarcinoma, but other pre-malign or malign colorectal tumors (n = 9, 2.6%). Thus a total of 277 cases (185 [66.8%] males and median [SD] age was 59.8 ± 13.2 years) were the subjects of the current study. Patients in the previous laparotomy group were significantly older (p = 0.014), however gender was similar within the groups (Table 1). There were 252 patients in no laparotomy group and 25 cases with previous vertical incisions including lower (n = 12, 48%), upper (n = 7, 28%), and lower&upper (n = 2, 8%) midline and paramedian (n = 4, 16%) laparotomies in previous laparotomy group. Among the 25 patients in previous laparotomy group, 7 (28%) had one, and 1 (4%) had two additional incisions.

These were the indication and/or procedures during the previous laparotomy: bowel injury due to penetrating or blunt abdominal trauma (n = 7, 28%), cholecystectomy (n = 4, 16%), prostatectomy (n = 4, 16%), diverting colostomy as a bridge to elective surgery (n = 3, 12%), hysterectomy (n = 3, 12%), primary repair of duodenal ulcer perforation (n = 2, 8%), gastrectomy for intractable peptic ulcer disease (n = 2, 8%), intraabdominal mass excision (n = 1, 4%), abdominal wall hernia repair with bowel resection (n = 1, 4%) and unknown (n = 1, 4%). Of those 4 cases had had additional hysterectomy (n = 3, 12%) or appendectomy (n = 1, 4%) via pfannenstiel or McBurney incisions, respectively; and finally of those a single case (4%) had had both appendectomy and hysterectomy via two separated incisions.

Veress insufflation was achieved in 19 (76%) patients in previous laparotomy group, while an open technique was preferred in 6 (24%) during the insertion of the first trocar. The locations of the insufflation were always far from the previous incision line and were superior umbilical region in 9 (36%), right lower and upper quadrants in 6 (24%) and 2 (8%), respectively, epigastrium in 5 (20%), suprapubic area in 2 (8%). These sites were used as camera or working trocar sites during further steps of the operation. Finally left lower quadrant was used in a single patient (4%), who had previously had multiple incisions for the insertion of the initial trocar, where would be used as an additional trocar site.

Tumor characteristics and perioperative treatment parameters were similar within the groups (Table 1). Inadvertent organ injury happened and was missed in a single patient (0.4%) during the separation of the adhesions in no laparotomy groups (p = 0.173). It was diagnosed on postoperative day 3 and treated with a diverting ileostomy from the injury site at the time of re-laparotomy. Although conversion rates were statistically similar within the groups, severe adhesions were the leading reason in previous laparotomy group, making the difference statistically significant (2 out of 4 conversions in 25 cases vs nil out of 20 conversions in 252 patients previous laparotomy and no laparotomy groups, respectively, p = 0.022). Perioperative early outcomes including complication, reoperation and 30-day mortality rates and hospitalization period were also similar within the groups (Table 2). The analyses of pathological characteristics showed no significant difference without the groups, as well as positive radial margin rates in patients with rectal cancer (Table 3). Finally, the 5-year survival rates were 65% and 73.2% in no laparotomy and previous laparotomy groups, respectively, showing no statistical difference (Fig. 1).

4. Discussion

Reoperations in patients with previous laparotomy are challenging procedures, since adhesions are observed in 93% of patients after abdominal operations and may increase operation time, blood loss and risks of inadvertent intestinal perforation, conversion and postoperative complications [1,3,19]. Accordingly, laparoscopic colorectal surgery had been accepted as a contraindication in patients with a previous laparotomy. However, in recent years, increasing expertise and recent advances have encouraged surgeons to use laparoscopy in these patients particularly after obtaining successful results in minimally invasive colorectal surgery. Besides, data analyzing the safety and efficacy of this particular topic have been limited and uncertain in some perspectives. First some studies include heterogeneous information since they have right and left colon, and rectal cancer patients and those with

Table 1
Demographics, and tumor and treatment related parameters.

	No Laparotomy (n = 252)	Previous Laparotomy (n = 25)	P
Demographics			
Age	59.2 ± 13.4	66.2 ± 10.1	0.014
Gender (males) (%)	172 (68.3)	13 (52)	0.71
ASA (%)			0.133
I, II, III, IV	20 (7.9)/137(54.4)/92(36.5)/3 (1.2)	0/11(44)/13(52)/1(4)	
Tumor Localization (%)			0.451
Sigmoid colon/Rectum	46 (18.3)/206 (81.7)	7 (28)/18 (72)	
Neoadjuvant chemoradiation therapy (%)[a]	95 (71.4)	18 (60.6)	0.212
Type of Resection (%)			0.896
Anterior	58 (23)	7 (28)	
Subtotal/Extended left	9 (3.6)	1 (4)	
Low anterior	150 (59.5)	14 (56)	
Abdominoperineal	35 (13.9)	3 (12)	
Sphincter Preservation[a]			0.999
Yes/No (%)	152 (81.3)/35 (18.7)	14 (82.4)/3 (17.6)	
Operation period (min)[b]	200, 70–600 (n = 247)	200, 130–390 (n = 24)	0.353
Additional organ resection (%)	36 (14.7)	6 (24)	0.228
Intraoperative bleeding (ml)[b]	250 (100–1500) (n = 247)	250 (0–2200) (n = 24)	0.460
Postoperative transfusion (%)	49 (20.2)	9 (36)	0.069
Additional trocar insertion (%)	10 (4)	3 (12)	0.101
Conversion (%)[c]	20 (7.9)	4 (16)	0.25

[a] Only rectal cancer patients were considered during the analysis.
[b] Due to missed data, the analyses included the available number of patients stated in the parenthesis.
[c] These were the causes for conversion: T4 tumors (n = 11; 4.4%), technical or anatomical problems (n = 3, 1.2%), hemorrhage (n = 2; 0.8%), close surgical margin (n = 1; 0.4%), medical problem (n = 1; 0.4%), tumor perforation (n = 1; 0.4%) and intra-operative diagnosis of hepatic metastasis (n = 1; 0.4%) in no laparotomy group; and adhesions (n = 2; 8%), T4 tumor (n = 1; 4%) and hemorrhage (n = 1; 4%) in previous laparotomy group.

Table 2
Postoperative aspects regarding complications, reoperation and early mortality rates and hospital stay.

	No Laparotomy (n = 252)	Previous Laparotomy (n = 25)	P
Complications (%)			
Anastomotic leak/fistula[a]	24 (11.1)	1 (4.5)	0.484
Surgical site infection	19 (7.5)	0	0.999
Prolonged ileus	11 (4.4)	1 (4)	0.999
Medical problems	9 (3.6)	2 (8)	0.260
Prolonged hemorrhagic drainage	8 (3.2)	0	0.999
Prolonged urinary retention	6 (2.4)	1 (4)	0.780
Missed bowel injury	1 (0.6)	0	0.999
Overall	59 (23.4)	4 (16)	0.060
Reoperation (%)[b]	11 (4.4)	0	0.609
30-day mortality (%)[c]	7 (2.8)	1 (4)	0.536
Hospitalization stay (in days)	6 (2–66)	6 (4–36)	0.539

[a] The exclusion of patients underwent an abdominoperineal resection left 217 and 22 cases in no laparotomy and previous laparotomy groups, respectively.
[b] Reasons for reoperation: anastomotic leak (n = 7, 3.2%), hemorrhage (n = 2, 0.8%), missed bowel injury (n = 1, 0.4%) and bowel obstruction (n = 1, 0.4%).
[c] Reasons for 30-day mortality: Sepsis after anastomotic leak and/or surgical site infection (n = 3, 1.2%), pulmonary embolism (n = 1, 0.4%), cardiac failure (n = 1, 0.4%), pulmonary infection (n = 1, 0.4%), renal failure (n = 1, 0.4%) in no laparotomy group; and sepsis after anastomotic leak (n = 1, 4%) in previous laparotomy group.

various benign diseases, which obviously require different types of interventions [4,13–15,20,21]. In addition, some other analyses have included the patients who had previous incisions far from the operation region, which probably do not limit the feasibility of the procedure. For example, we believe that the presence of a pfannenstiel incision does not affect the feasibility of a laparoscopic transverse colectomy, as right subcostal incision does not adversely influence the practicability of a laparoscopic anterior resection. In contrast to the previous information, the type of the procedure is not varied in the current study, since it includes only patients with sigmoid colon or rectal tumors. For the same purpose, current data analyze only the patients with vertical incisions. These incisions are more likely to have an impact on the outcomes of the surgery, since they are reported to generate more severe adhesions than other types of incisions and adhesions directly invading the surgical field in case of an anterior or low anterior resection [21]. In our opinion, the exceptional and precise formation of the current study may make our conclusions more reliable.

Table 3
Pathological feature and surgical margins.

	No Laparotomy (n = 252)	Previous Laparotomy (n = 25)	P
T Stage (%)			0.415
T0-2	72 (28.6)	8 (32)	
T3-4	180 (71.4)	17 (68)	
Length of specimen (in cm)	24 (9–50)	26 (21–38)	0.483
Harvested lymph nodes	12 (0–62)	12 (3–26)	0.347
N Status (%)			0.636
Node negative	143 (56.7)	16 (64)	
Node positive	109 (43.3)	9 (36)	
Presence of vascular invasion (%)[a,b]	49 (33.0) (n = 159)	14 (37.6) (n = 34)	0.242
Presence of perineural invasion (%)[a,b]	68 (44.0) (n = 159)	16 (42.9) (n = 34)	0.647
Differentiation (%)[a]			0.777
Well-moderate	228 (90.5)	23 (92)	
Poor	24 (9.5)	2 (8)	
Distal margin (in cm)	4.8 ± 3.3	5.3 ± 4.2	0.446
Positive radial margin (%)[c]	3 (1.5)	0	0.999

[a] Pathological examinations revealed complete tumor response to neoadjuvant chemoradiation therapy in 17 [6.7%] and 2 [8%] in no laparotomy and previous laparotomy groups, respectively.
[b] Due to missed data, the analyses included the available number of patients stated in the parenthesis.
[c] Only rectal cancer patients were considered during the analysis, and a radial margin less than 2 mm was considered as positive.

Since the information in the groups are similar regarding patients' gender, ASA classification, tumor location, neoadjuvant treatment in case of a rectal cancer, operative technique, extension of the resection, T and N status, and other pathological features, we believe that data in both groups were comparable. In contrast, current study has revealed that patients in previous laparotomy group are significantly older than those in no laparotomy group. This may be an incidental finding, but may also be related to the fact that previous operations such as prostatectomy or hysterectomy, are more likely to be performed in elderly and has been performed in several cases in previous laparotomy group in the current study.

Since the presence of a previous operation may increase the risk of bowel injury, safety during the establishment of pneumoperitoneum is critical in these cases. Different techniques have been described for this purpose including open method for trocar insertion, optical trocars with visualization or ultrasound guided veress needle insertion [22–24]. We have decided to use Veress needle insertion or placement of the first trocar with an open technique. Both methods are used on a virgin location far from the previous incision. Previous data have demonstrated that Veress needle injury is less than 1% when it is inserted far from the initial incision and similar to those that are applied through the umbilicus in patients without previous surgery [25]. In contrast, trocar insertion with an open technique has also been shown to be safe in cases with previous laparotomy [22]. Although superiority of a technique over the other one has not been demonstrated, there are some basic principles that may be followed in order to initiate a secure pneumoperitoneum including avoidance of access attempts through previous scars, willingness and ability to change the type of access if initial attempts fail, and close inspection of the area when pneumoperitoneum is established [20]. Following these well-defined rules, we have not observed any inadvertent injury during the creation of pneumoperitoneum or insertion of the first trocar in our study. Adhesiolysis may increase the risk of bowel injury, but more tragically the damage may not be diagnosed during the operation. A meta-analysis has stated that almost half of the bowel injuries cannot be recognized at the time of surgery, and delay in diagnosis increases the risks for morbidity and mortality [26]. In the current study, we have observed a single patient with bowel injury, which was not recognized during the initial operation, and a relaparotomy and diverting ileostomy from the injury site were necessitated in no laparotomy group. In our opinion, current study has revealed that the rate of bowel injury at the time of laparoscopic sigmoid colon and rectal tumor surgery in patients who had a previous laparotomy is rare and similar or close to those in cases with a virgin abdomen, if the surgeon follows some certain rules mentioned above.

It has been also debated that the presence of a previous laparotomy may worsen the outcomes of laparoscopy, since intra-abdominal adhesions may limit the practicability of the operation. Although the conversion rate has been stated up to 26.5%, and an increase in patients with previous laparotomy has been reported in several series; most data in the literature have denied a statistically significant elevation in this particular problem [4,13,15,21]. Similarly, current data have not presented a significant difference between the groups regarding this issue. Besides, the conversion rates may be criticized to be higher than expected. This seems to be related to the fact that there are several cases with T4 tumors requiring multiple visceral

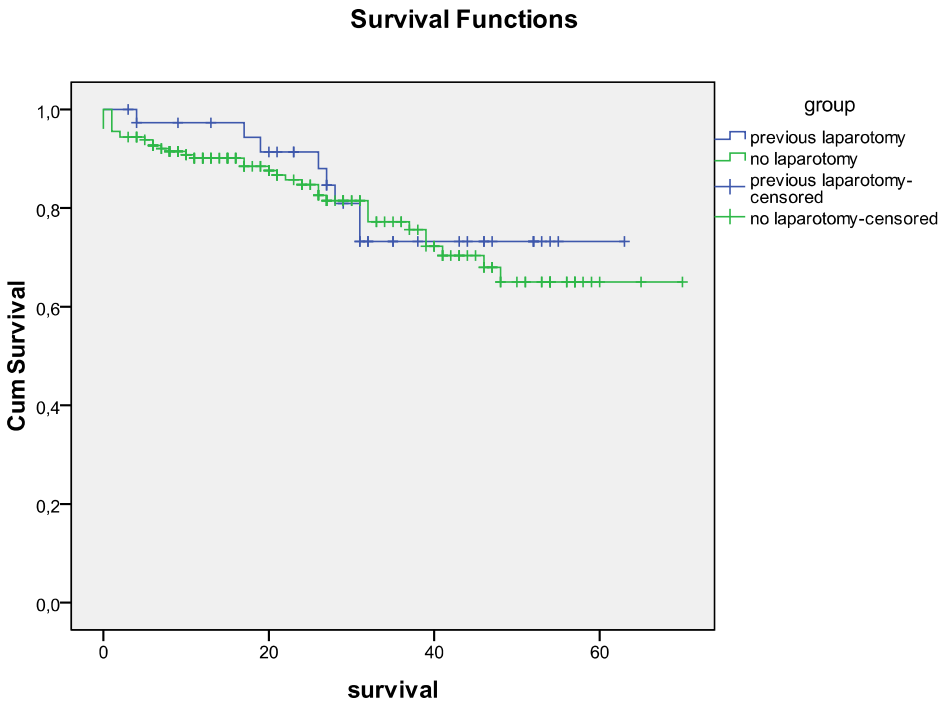

Fig. 1. The overall 5-year survival rates were 65% and 73.2% in no laparotomy and previous laparotomy groups, respectively; and Kaplan–Meier analysis revealed no statistical difference between the groups.

resections in our series, and some of these patients have necessitated conversion to open surgery. In addition, current study has shown that conversion secondary to severe adhesions is significantly more common in previous laparotomy group (2 out of 25 vs. nil out of 252 cases, $p = 0.022$). However, we are not sure about the reliability of this information because of the limited number of the cases. Current study has also evaluated the rate of additional trocar insertion due to technical difficulties, and revealed that the rates of additional trocar application are similar within the groups, although there is a tendency against previous laparotomy group. In addition, some studies have also shown that other perioperative findings including intraoperative bleeding were not worsened in cases with previous laparotomy [4,15,21]. Current study denies such a finding, and shows that both intraoperative bleeding and postoperative necessity of transfusion are similar within the groups. Finally, the pathological features regarding the number of harvested lymph nodes, the length of distal margin, the rate of positive radial margin (for only rectal cancers), and most critically survival which may reflect the quality of the operation in oncological perspective have been exceptionally studied in previous studies [18]. In our opinion, it may be more notable in the current information that all parameters showing the oncological safety of the procedure, including survival, were identical in no laparotomy and previous laparotomy groups, revealing the oncological safety of laparoscopy in patients with previous laparotomy.

Current study has revealed higher anastomotic leak rates than expected particularly in no laparotomy group (11.1%), after the exclusion of patients received abdominoperineal resections. We do not know the exact cause(s) of this finding; however it may be because we have considered any kind of suspicious finding in routine CT scan examination on postoperative day 5 or 6 as anastomotic leak. Consequently most of these patients did not have any adverse clinical finding, thus a relaparotomy for an anastomotic leak was necessitated in only 3.2% of cases in no laparotomy group, which might be probably accepted as clinically evident and actual anastomotic leak rate.

Current study has some limitations mostly due to its retrospective design and the limitation in number of cases. Although it is a retrospective analysis, the data has been abstracted from a prospective database. In addition, in order to rule out selection bias, all consequent patients were included to the study. However, there are still some missed information regarding the amount of intraoperative bleeding and some pathological features. This is a significant limitation in the current study. In addition, the number of patients particularly in previous laparotomy group is limited. The main reason for this limitation occurs from the design of the study, which let us to include only the cases with vertical incisions; since, in our opinion, other incisions have a limited effect on the safety and feasibility of laparoscopy. Another aspect in study design restricting the number of the patients is that the analyses have focused on only sigmoid colon and rectal tumors in order to homogenize the information and tumors located other sites of colon have excluded. Because of the fact that the study has included only 25 cases in one arm, our results are questionable, especially when the p value is close to statistical significance. Therefore although some comparisons are deemed not statistically significant, in some perspectives consequent conclusions may not be valid. In our opinion, it is necessary to consider and interpret the information in the current study accordingly.

As conclusion, the presence of a previous laparotomy does not worsen the outcomes in patients undergoing laparoscopic removal of sigmoid or rectal cancer. This is particularly true for the risk of inadvertent bowel injuries, which is the most frightening risk in patients with a previous laparotomy, who are actually candidates for laparoscopy. In addition, current study has also revealed that laparoscopy may not increase risks of conversion to open surgery, complications, reoperation or 30-day mortality, or lengthen the operation time in these patients. Most importantly, the oncological results regarding number of harvested lymph

nodes, length of distal margin, radial margin positivity, and survival are not adversely affected by laparoscopy. Thus, laparoscopic resection of sigmoid or rectal cancers may be considered to be safe and feasible in patients with a previous vertical laparotomy.

Ethical approval

Dr Lutfi Kirdar Kartal Education and Research Hospital, Institutional Ethics Board approved this study.

Reference number is B104ISM4340029/1009/58.

Funding

None.

Author contribution

Mustafa Haksal: Conception and design, acquisition of data, participated in drafting the article, have given final approval.

Yasar Ozdenkaya: Conception and design, interpretation of data, participated in drafting the article, have given final approval.

Ali Emre Atici: Conception and design, critical revisions during the creation of the manuscript, have given final approval.

Nuri Okkabaz: Acquisition of data, interpretation of data, have given final approval.

Nihat Aksakal: Interpretation of data, critical revisions during the creation of the manuscript, have given final approval.

Ayhan Erdemir: Acquisition of data, critical revisions during the creation of the manuscript, have given final approval.

Osman Civil: Acquisition of data, participated in drafting the article, have given final approval.

Mustafa Oncel: Conception and design, critical revisions during the creation of the manuscript, have given final approval.

Conflict of interest statement

The authors declare that they have no conflict of interest.

Guarantors

Mustafa Haksal, MD Mustafa Oncel, MD.
Nuri Okkabaz, MD.

Disclosures

The authors do not have any disclosures.

References

[1] Y.E. Altuntas, M. Kement, M. Oncel, et al., The effectiveness of hyaluronan-carboxymethylcellulose membrane in different severity of adhesions observed at the time of relaparotomies: an experimental study on mice, Dis. Colon Rectum 51 (2008) 1562–1565.
[2] M. Schafer, M. Lauper, L. Krahenbuhl, Trocar and Veress needle injuries during laparoscopy, Surg. Endosc. 15 (2001) 275–280.
[3] A.A. Van der Krabben, F.R. Dijkstra, M. Nieuwenhuijzen, et al., Morbidity and mortality of inadvertent enterotomy during adhesiotomy, Br. J. Surg. 87 (2000) 467–471.
[4] A. Vignali, S. Di Palo, P. DeNardi, Impact of previous abdominal surgery on the outcome of laparoscopic colectomy: a case-matched control study, Tech. Coloproctol. 11 (2007) 241–246.
[5] H. Nelson, D. Sargent, H.S. Wieand, et al., Clinical Outcomes of Surgical Therapy Study Group, A comparison of laparoscopically assisted and open colectomy for colon cancer, N. Engl. J. Med. 350 (2004) 2050–2059.
[6] R. Veldkamp, E. Kuhry, W.C. Hop, et al., Laparoscopic surgery versus open surgery for colon cancer: short-term outcomes of a randomised trial, Lancet Oncol. 6 (2005) 477–484.
[7] W. Schwenk, O. Haase, J. Neudecker, et al., Short term benefits for laparoscopic colorectal resection, Cochrane Database Syst. Rev. 20 (3) (2005;Jul) CD003145.
[8] K. Nishiguchi, J. Okuda, M. Toyoda, et al., Comparative evaluation of surgical stress of laparoscopic and open surgeries for colorectal carcinoma, Dis. Colon Rectum 44 (2001) 223–230.
[9] M. Yamamoto, J. Okuda, K. Tanaka, et al., Effect of previous abdominal surgery on outcomes following laparoscopic colorectal surgery, Dis. Colon Rectum 56 (2013) 336–342.
[10] M.A. Weibel, G. Majno, Peritoneal adhesions and their relation to abdominal surgery. A postmortem study, Am. J. Surg. 126 (1973) 345–353.
[11] C.T. Hamel, A.J. Pikarsky, E. Weiss, et al., Do prior abdominal operations alter the outcome of laparoscopically assisted right hemicolectomy? Surg. Endosc. 14 (2000) 853–857.
[12] W.L. Law, Y.M. Lee, K.W. Chu, Previous abdominal operations do not affect the outcomes of laparoscopic colorectal surgery, Surg. Endosc. 19 (2005) 326–330.
[13] I.A. Gonzales, A.M. Malagon, F. Lopez-Tomassetti, et al., Impact of previous abdominal surgery on colorectal laparoscopy results: a comparative clinical study, Surg. Laparosc. Endosc. Percutan. Tech. 16 (2006) 8–11.
[14] I. Nozaki, Y. Kubo, A. Kurita, et al., Laparoscopic colectomy for colorectal cancer patients with previous abdominal surgery, Hepatogastroenterology 55 (2008) 943–946.
[15] Q.H. Wu, T. Zhang, L. Zang, et al., Impact of previous abdominal operations on the outcome of laparoscopic colorectal cancer surgery: a non-randomized cohort study, ZhonghuaWaiKeZaZhi 48 (2010) 675–680.
[16] C. Gezen, Y.E. Altuntas, M. Kement, et al., Laparoscopic abdominoperineal resections for mid or low rectal adenocarcinomas: a retrospective, comparative study, Surg. Laparosc. Endosc. Percutan. Tech. 21 (2011) 396–402.
[17] C. Gezen, Y.E. Altuntas, M. Kement, et al., Complete vs partial mobilization of the splenic flexure during laparoscopic low anterior resection for rectal tumors: a comparative study, J. Laparoendosc. Adv. Surg. Tech. 22 (2012) 392–396.
[18] A. Alici, M. Kement, C. Gezen, et al., Apical lymph nodes at the root of the inferior mesenteric artery in distal colorectal cancer: an analysis of the risk of tumor involvement and the impact of high ligation on anastomotic integrity, Tech. Coloproctol. 14 (2010) 1–8.
[19] D. Menzies, H. Ellis, Intestinal obstruction from adhesions–how big is the problem? Ann. R. Coll. Surg. Engl. 72 (1990) 60–63.
[20] Tracey D. Arnell, Minimally invasive reoperation following laparotomy, Clin. Colon Rectal Surg. 19 (2006) 223–227.
[21] W. Law, K. Lee, W. Chu, Previous abdominal operations do not affect the outcomes of laparoscopic colorectal surgery, Surg. Endosc. 19 (2005) 326–330.
[22] K.S. Gersin, B.T. Heniford, M.J. Arca, et al., Alternative site entry for laparoscopy in patients with previous abdominal surgery, J. Laparoendosc. Adv. Surg. Tech. 8 (1998) 125–130.
[23] J. Fuller, B.S. Ashar, J. Carey-Corrado, Trocar-associated injuries and fatalities: an analysis of 1399 reports to the FDA, J. Minim. Invasive Gynecol. 12 (2005) 302–307.
[24] B. Sigel, R.M. Colub, L.A. Loiacono, et al., Technique of ultrasonic detection and mapping of abdominal wall adhesions, Surg. Endosc. 5 (1991) 161–165.
[25] N. Agarwala, C.Y. Liu, Safe entry techniques during laparoscopy: left upper quadrant entry using the ninth intercostals space—a review of 918 procedures, J. Minim. Invasive Gynecol. 12 (2005) 55–61.
[26] M. Van der Voort, E.A.M. Heijnsdijk, D.J. Gouma, Bowel injury as a complication of laparoscopy, Br. J. Surg. 91 (2004) 1253–1258.