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ORIGINAL SCIENTIFIC REPORT

Incisional Hernia After Laparoscopic-Assisted Right Hemicolectomy

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Abstract

Background Different approaches used for laparoscopic right colectomy have different advantages and disadvantages. This study aims to determine the incidence and clinical relevance of IH after LARHC as the preferred technique in an experienced setting and to assess which factors are correlated with the development of IH.

Methods Between January 2012 and December 2016, all consecutive patients who underwent LARHC were included. Data were obtained in accordance with the Dutch ColoRectal Audit, and IH was scored based on physical examination and imaging at standard follow-up. Logistic regression analysis was used to identify risk factors for IH.

Results A total of 170 patients underwent LARHC. In the same period, 64 patients had an open RHC. IH after LARHC was seen in 24 patients after a median time of 7 months (14%). Only four of these patients underwent operative IH repair (2%). Interestingly, a trend for more IH was seen between two surgeons. Multivariable analysis identified BMI [OR 1.08 (95% CI 1.00–1.15) $P = 0.043$], a history of smoking [OR 2.14 (95% CI 1.03–4.41) $P = 0.040$], and surgical site infection [OR 2.99 (95% CI 1.28–7.00) $P = 0.012$] as risk factors for IH.

Conclusion IH incidence after LARHC was considerable, but few were clinically relevant IHs. The IH incidence should be included in shared decision making. The low clinically relevant IH rate does in our opinion not outweigh possible advantages of LARHC.

Introduction

In many centers, the laparoscopic approach has become the standard for colon cancer surgery. In several studies, laparoscopy was shown to result in less morbidity and a shorter hospital stay than an open approach [1–5], without concessions to tumor recurrence, survival, and quality of life [2, 6–8].

Laparoscopic procedures for right hemicolectomy (RHC) can be classified based on the amount of the procedure performed laparoscopically and on the site of anastomosis creation [9–12]. Laparoscopy-assisted RHC (LARHC) involves laparoscopic mobilization of the right hemicolon after which an extracorporeal anastomosis is performed. When using the laparoscopic RHC (LRHC), the procedure is performed entirely laparoscopic with an intracorporeal anastomosis. In LRHC, the skin incisions can be left even smaller and the extraction site is not bound to location limitations of colon extraction [9–12].

To date, none of the laparoscopic techniques has been identified as definitively superior to others. Some studies suggest a shorter operative time and lower conversions

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rates in LARHC compared to LRHC, and most studies did not find any significant differences [9, 10]. The benefits of extra- over intra-corporeal anastomosis are equally ambiguous, although the most recent meta-analysis did show less short-term morbidity when using intra-corporeal anastomoses; however, a complete laparoscopic approach is technically more demanding.

The differences between techniques in longer-term morbidity, primarily incisional hernia (IH), are also unclear. Reported rates of IH following LARHC vary from 4 to 21% in mostly small series. IH rates vary from 2 to 6% following intra-corporal anastomosis which could be due to alternative extraction sites such as a Pfannenstiel incision [13], but again these series are small with only a handful of events [12]. In addition, these studies usually come from centers that perform both techniques and are not dedicated to a single approach; therefore, the exact IH rates in experienced hands are unclear, which limits the comparison of laparoscopic techniques.

This study aimed to investigate the incisional hernia rate following standardized LARHC with extracorporeal anastomosis in an unselected cohort and identify risk factors for incisional hernia.

Methods

All consecutive patients who underwent LARHC between January 2012 and December 2016 at the Reinier de Graaf Gasthuis, the Netherlands, were included in this study. As a reference for possible selection, data on patients who underwent open RHC were also collected. Data were obtained from a prospective database, which was gathered in accordance with the Dutch ColoRectal Cancer Audit [14]. Additional data were collected from the electronic medical records. The need for ethical approval and individual informed consent was waived by the institutional medical ethics committee.

Patient work up and surgery

All elective patients were preoperatively discussed at a multidisciplinary meeting. Routine work up included an abdominal CT scan, thoracic X-ray, and baseline carcinoembryonic antigen (CEA) level. All patients were considered for laparoscopic surgery, except for emergency cases with bowel obstruction, patients with preoperatively anticipated T4 tumors, or high-risk patients due to previous abdominal surgery. The laparoscopic-assisted approach was the standard laparoscopic approach, and patients with an occasional total laparoscopic procedure were excluded from the analysis. Patients were operated in supine position, and open instruction was performed using an infra-umbilical incision. Three additional trocards were used (two 5 mm and one 10 mm) The lateral to medial approach was used for all cases (Fig. 1). Extracorporeal hand-sewn anastomosis and specimen extraction were performed using a midline umbilical incision with a maximal length of 5 cm starting from the infra-umbilical trocard.

Primary outcome

Data on IH were collected and recorded as present when observed during follow-up by the surgeon or nurse practitioner, or at any other hospital visit. Furthermore, all radiological abdominal diagnostics (CT scan or ultrasound) were reviewed for evidence of a possible asymptomatic IH. Incisional hernias were scored according to the symptoms and treatment and classified according to the European Hernia Society classification for incisional hernias [15].

Variables

Comorbidity was defined as the presence of any of the following: cardiovascular disease, pulmonary disease, neurologic disease, endocrinology disease (diabetes mellitus and any thyroid problem), renal disease, ulcer disease, Crohn's disease, or colitis.

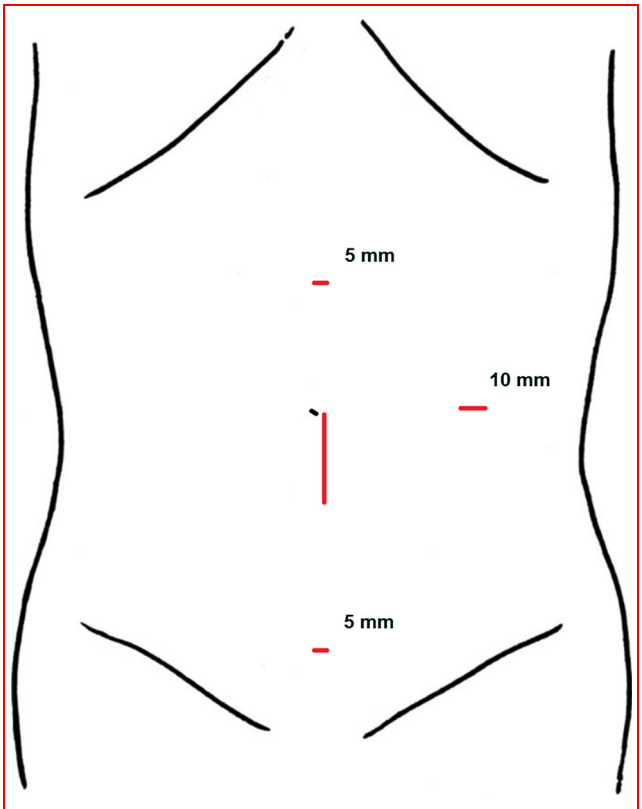

Fig. 1 Trocar placement and extraction site during laparoscopic-assisted right hemicolectomy

All complications within 30 days after surgery were scored and graded according to Dindo et al. [16] with complications of grade IIIa or higher considered as a major complication. In addition, the comprehensive complications index (CCI) was calculated for each patient [17]. Conversion was defined as an unplanned incision over 5 cm and was always performed using a midline infra-umbilical incision.

Statistical analysis

Continuous data were presented as median with interquartile range (IQR). Categorical variables were analyzed using the Chi-square or Fishers' exact tests, and continues variables were analyzed using Mann–Whitney *U* test. Uni- and multivariable analyses were performed using logistic regression analysis. Variables with p values equal to or below 0.100 in the univariable analysis were included in multivariable analysis. A *P* value below 0.05 was considered to indicate statistical significance.

Data analyses were performed using SPSS (version 24, IBM, Chicago, IL).

Results

In the study period, a total of 254 patients underwent RHC. Of these patients, LARHC was performed in 170 patients and 64 patients underwent open RHC. The remaining 20 patients underwent LRHC and were excluded from the analysis.

Baseline patients and disease characteristics as well as outcomes are displayed in Table 1.

The laparoscopic approach was the standard treatment, and the open approach was reserved for emergency cases, patients with anticipated T4 tumors, and those with severe comorbidity and prior open surgery, which resulted in the differences presented in Table 1. The higher morbidity rates, readmission and reoperation rates, as well as the prolonged hospital stay in the open group are likely a result of the former.

Incisional hernia

During follow-up, 24/170 (24%) patients were diagnosed with IH after LARHC. The conversion rate was 16% (27/170). Five of the IHs occurred in the 27 converted patients (19%), which was not different from the 19 IHs in the 134 patients without conversion (13%, $P = 0.546$). Only four of these IH required surgical correction, and all others were asymptomatic or managed solely with supportive measures such as a hernia belt. In the open group, IH rate was 15/64 (24%) in the open group ($P = 0.114$) and only one patient required surgical correction. The symptoms, treatment, and classification of incisional hernias were similar between the laparoscopic and open cohort (Table 2).

A notable difference in IH rates was observed between surgeons in both the LARHC and open group (Fig. 2). IH rates differed between the two most experiences surgeons (12/84 for surgeon C and 6/69 for surgeon D, $P = 0.02$). The median duration until diagnosis of IH was 7 (4–12) versus 14 (1–42) months in the LARHC and open group, respectively ($P = 0.700$). Uni- and multivariable analysis to identify risk factors for IH is displayed in Table 3. A history of smoking, higher BMI, and surgical site infection were identified as risk factors for IH, and interestingly, the laparoscopic approach was not protective.

Discussion

This study reports on the IH rates after LARHC in a single hospital where LARHC is the technique of choice and laparoscopic colorectal surgery is considered in every patient without clear contraindications. In this relatively unselected cohort, IH incidence was 24/170 (14%), while only 4 (2%) patients required operative correction of the IH.

Data on IH after LARHC or LRHC are inconsistent in the literature; they primarily come from small series with few events and series from centers using several laparoscopic techniques. A comparative study of LRHC with LARHC found only one case of IH in the LARHC group out of a total 72 patients [18], while a similar study diagnosed six IHs in 23 LARHC cases compared to none in 21 LRHC cases [18]. A larger study found IHs in 2 out of 91 LRHC patients and 17 out of 100 LARHC patients [19]. Several factors might contribute to the large variation in IH incidence in these LARHC cohorts ranging from 4 to 21%. Firstly, the definitions of IH vary, as does the reported duration of follow-up, and as mentioned above, the series include only 29–100 LARHC cases. In addition, these three centers performed LRHC and LARHC in similar proportions in the study period, which might result in differences compared to a center dedicated to either LARHC or RHC.

The present study was performed in a center in which laparoscopy is considered the standard for all colectomy procedures in all patients, unless there is a valid reason to consider otherwise, such as emergency procedures or T4 tumors. LARHC has been the standard RHC approach for all surgeons, and therefore, considerable experience has been accumulated, which is reflected in the mean duration of 109 min of LARHC procedures, compared to 142–186 min in other reports [18–20] and the low incidence of anastomotic leaks (2%).

Table 1 Clinical characteristics

	All patients (n = 234)	Laparoscopy-assisted (n = 170)	Open (n = 64)	P value
Age [median (IQR)]	73 (66–79)	72 (67–79)	74 (66–81)	0.511
Male gender [n (%)]	113 (48)	80 (47)	33 (52)	0.560
BMI [median (IQR)]	25 (23–29)	26 (23–29)	24 (22–27)	0.017
ASA score [n (%)]				0.050
I	34 (15)	29 (17)	5 (8)	
II	138 (59)	102 (60)	26 (56)	
III	61 (28)	39 (23)	22 (34)	
IV	1 (0)	–	1 (2)	
Previous abdominal surgery [n (%)]	69 (30)	47 (28)	22 (34)	0.337
Emergency surgery [n (%)]	25 (11)	1 (1)	24 (38)	<0.001
T stage [n (%)]				<0.001
0 or in situ	6 (3)	6 (4)	–	
I	11 (5)	11 (7)	–	
II	34 (15)	30 (18)	4 (6)	
III	150 (64)	108 (64)	42 (66)	
IV	33 (14)	15 (9)	18 (28)	
N stage [n (%)]				0.262
I	58 (25)	38 (22)	20 (31)	
II	36 (15)	25 (15)	11 (17)	
M1 stage [n (%)]	27 (12)	13 (20)	14 (8)	0.020
Operating time [min, median (IQR)]	107 (85 (133)	109 (88–135)	99 (79–129)	0.091
Conversion [n (%)]	–	27 (16)	–	–
Major morbidity [≥ Dindo IIIA, n (%)]	27 (12)	10 (6)	17 (27)	<0.001
CCI [median (IQR)]	0 (0–21)	0 (0–21)	21 (0–35)	<0.001
Incisional hernia [n (%)]	39 (17)	24 (14)	15 (24)	0.114
Asymptomatic	22 (9)	11 (6)	11 (17)	
Symptomatic; non-operative management	12 (5)	9 (5)	3 (5)	
Symptomatic; operative correction	5 (2)	4 (2)	1 (2)	
Surgical site infection [n (%)]	26 (15)	22 (13)	14 (22)	0.105
Anastomotic leak [n (%)]	7 (3)	3 (2)	4 (6)	0.091
Readmissions [n (%)]	21 (9)	11 (7)	10 (16)	0.039
Reoperation [n (%)]	15 (6)	5 (3)	10 (16)	0.001
Hospital stay [days, n (%)]	9 (7–13)	8 (7–9)	14 (9–19)	<0.001
90-day mortality [n (%)]	4 (2)	1 (1)	3 (5)	0.063

Interestingly, there was a notable difference in IH rates after LARHC between surgeons, especially between the most experiences surgeons C and D (25 versus 9%). While many factors could be debit to the difference, surgeon D placed two absorbable standing fascia sutures in the caudal corner of the extraction site in addition to the running suture, while surgeon C used the running suture only. With the latter technique, the fascia may not be clearly visible during the final sutures, which might have led to suboptimal closure. Several studies concluded a continuous suture with longer suture to wound length ratios and small bites are effective to limit IH incidence, which could also have caused the differences observes in this report [21–23].

SSI was the most important risk factor for the development of IH. Proliferation of bacteria affects the wound healing process and leads to a decrease in the synthesis of collagen which reduces the strength of the abdominal wall and a higher risk of dehiscence [24, 25]. Therefore, all efforts to reduce SSI could result in a lower incidence of IH. The other risk factors in this study BMI and history of smoking, or age as reported in the literature are less easily or impossible to influence.

Table 2 Comparison of hernia symptoms, management, and classification in the laparoscopy-assisted and open group

	Laparoscopy-assisted (*n* = *24*)	Open (*n* = *15*)	*P* value
Hernia symptoms and treatment			0.237
Asymptomatic	11 (46)	11 (73)	
Symptomatic; non-operative management	9 (38)	3 (20)	
Symptomatic; operative correction	4 (17)	1 (7)	
Hernia classification			0.435
M2–W1	–	1 (7)	
M3–W1	4 (17)	1 (7)	
M3–W2	15 (63)	10 (67)	
M3–W3	1 (8)	2 (13)	
M5–W1	1 (8)	–	
L2–W1	3 (13)	1 (7)	

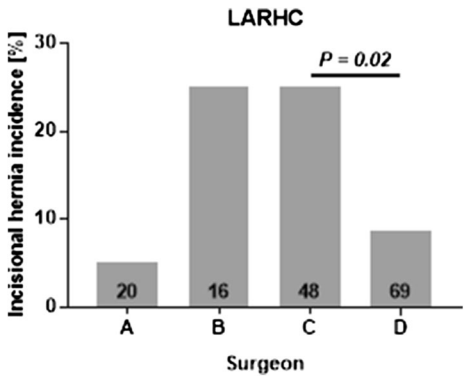

Fig. 2 Incisional hernia rates between surgeons with at least 15 LARHC. Depicted below in the bars is the number of cases per surgeon. Differences between groups were tested using Chi-square tests

Different approaches for laparoscopic RHC have distinct advantages and disadvantages; these differences limit their comparison. LARHC requires a less operative time compared to LRHC and is a less demanding laparoscopic technique, which potentially reduces conversion rates and anastomotic leaks [26, 27]. The benefit of LRHC is the freedom of extraction site, which can be any incision such as a Pfannenstiel incision [21, 28]. This could reduce the IH rate [19, 20]. Although numerous studies have compared different techniques, most are small and retrospective and focus on a specific outcome, which results in heterogeneous results often without large differences between techniques. Also the surgeon experience with the technique is underreported, and often several techniques are performed within a single center. This report demonstrates the results of a dedicated laparoscopic colorectal surgery center, with LARHC as primary technique for RHC.

Table 3 Uni- and multivariable analysis of factors contributing to the development of incisional hernia after LARHC

	Univariable analysis		Mulitvariable analysis	
	Odds ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Age	0.99 (0.96–1.02)	0.548		
Male gender	1.68 (0.84–3.37)	0.146		
BMI	1.07 (1.00–1.15)	0.048	1.08 (1.00–1.16)	0.043
History of smoking	1.99 (0.98–4.02)	0.056	2.14 (1.03–4.41)	0.040
Steroid use	0.71 (0.23–2.16)	0.548		
Metastatic disease	1.51 (0.57–4.02)	0.413		
Previous abdominal surgery	1.08 (0.51–2.27)	0.847		
Laparoscopic approach	0.54 (0.26–1.11)	0.091		
ASA III–IV	1.49 (0.83–3.12)	0.291		
Surgical site infection	2.67 (1.18–6.03)	0.018	2.99 (1.28–7.00)	0.012

This study has several limitations consequential to its retrospective design. IH may not always be symptomatic, and the incidence could be missed during physical examination. However, all patients have a follow-up according to colorectal protocol with abdominal diagnostics, which were all reviewed, and it is unlikely that symptomatic IH would be missed during follow-up. Also the open group was shown to demonstrate patient selection and underscore the unselected LARHC group. Furthermore, the cohort is still relatively small and single center. However, compared with other studies, the present study has one of the largest LARHC patient populations reported. Also to our knowledge, this is the first study on IH in a cohort where laparoscopic-assisted RHC was the standard procedure for right-sided colorectal cancer.

In conclusion, the incidence of clinically relevant IH was low. The main risk factor associated with IH was SSI, although closing technique may also play an important role.

Different laparoscopic strategies for right hemicolectomy have different trade-offs. For a laparoscopic-assisted approach, the risk of IH should be taken into account in shared decision making. But it does not seem to outweigh possible advantages.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards The need for ethical approval and individual informed consent was waived by the institutional medical ethics committee.

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