pISSN: 2508-5778 • eISSN: 2508-5859
Ann Hepatobiliary Pancreat Surg 2024;28:155-160
https://doi.org/10.14701/ahbps.23-138

AHBPS
Annals of Hepato-Biliary-Pancreatic Surgery

Original Article

Incidence of incisional hernia following liver surgery for colorectal liver metastases. Does the laparoscopic approach reduce the risk? A comparative study

Ahmed Hassan[1,2], Kalaiyarasi Arujunan[1], Ali Mohamed[1], Vickey Katheria[1], Kevin Ashton[3], Rami Ahmed[1], Daren Subar[1,2]

[1]Department of General & HPB Surgery, East Lancashire Hospitals NHS Trust, Royal Blackburn Hospital, Blackburn, UK,
[2]Blackburn Research Innovation Development Group in General Surgery (BRIDGES), Royal Blackburn Hospital, Blackburn, UK,
[3]University Hospitals of Morecambe Bay NHS Foundation Trust, Royal Lancaster Infirmary, Lancaster, UK

Backgrounds/Aims: No reports to compare incisional hernia (IH) incidence between laparoscopic and open colorectal liver metastases (CRLM) resections have previously been made. This is the first comparative study.
Methods: Single-center retrospective review of patients who underwent CRLM surgery between January 2011 and December 2018. IH relating to liver surgery was confirmed by computed tomography. Patients were divided into laparoscopic liver resection (LLR) and open liver resection (OLR) groups. Data collection included age, sex, presence of diabetes mellitus, steroid intake, history of previous hernia or liver resection, subcutaneous and peri-renal fat thickness, preoperative creatinine and albumin, American Society of Anesthesiologists (ASA) score, major liver resection, surgical site infection, synchronous presentation, and preoperative chemotherapy.
Results: Two hundred and forty-seven patients were included with a mean follow-up period of 41 ± 29 months (mean ± standard deviation). Eighty seven (35%) patients had LLR and 160 patients had OLR. No significant difference in the incidence of IH between LLR and OLR was found at 1 and 3 years, respectively ([10%, 19%] vs. [10%, 19%], $p = 0.95$). On multivariate analysis, previous hernia history (hazard ratio [HR], 2.22; 95% confidence interval [CI], 1.56–4.86) and subcutaneous fat thickness (HR, 2.22; 95% CI, 1.19–4.13) were independent risk factors. Length of hospital stay was shorter in LLR (6 ± 4 days vs. 10 ± 8 days, $p < 0.001$), in comparison to OLR.
Conclusions: In CRLM, no difference in the incidence of IH between LLR and OLR was found. Previous hernia and subcutaneous fat thickness were risk factors. Further studies are needed to assess modifiable risk factors to develop IH in LLR.

Key Words: Incisional hernia; Laparoscopic surgery; Liver neoplasms; Colorectal neoplasms; Minimal access surgical procedures

INTRODUCTION

Incisional hernia (IH) is an established complication following abdominal surgery. Patients with symptomatic IH are at risk of developing life-threatening complications, including incarceration and bowel strangulation [1], in addition to unsatisfactory cosmetic results and impaired quality of life. Moreover, following surgical repair, there is a reported rate of recurrence of about 30% [2]. In a literature review by Le Huu Nho et al. [3], the incidence of IH following open abdominal surgery was 9.9%, while laparoscopic surgery had a significantly lower reported incidence of IH 0.7%.

In open liver resection (OLR), reports suggest an IH incidence of 14.6% at 36 months [2], and 34.9% at 60 months [4]. Reported risk factors included vertical extended incision (Mercedes), high body mass index, male sex, preoperative chemotherapy, peri-renal fat > 14.7 mm, and previous IH history

Received: November 2, 2023, **Revised:** January 15, 2024,
Accepted: January 24, 2024, **Published online:** March 4, 2024

Corresponding author: Ahmed Hassan, MSc, MRCS
Department of General & HPB Surgery, East Lancashire Hospitals NHS Trust, Blackburn Research Innovation Development Group in General Surgery (BRIDGES), Royal Blackburn Hospital, Haslingden Rd, Blackburn BB2 3HH, UK
Tel: +44-7775718328, E-mail: ahmedhassan@doctors.net.uk
ORCID: https://orcid.org/0000-0002-5281-6912

[2,4-6].

While there have been several published reports of the incidence of IH following liver transplant and open liver surgery [4,7,8], much less is published on the incidence following laparoscopic liver surgery. In colorectal liver metastases (CRLM), there are no comparative studies of the incidence of IH in laparoscopic liver resection (LLR) and open surgery (OLR).

The aim of our study was to assess if there was a difference in the incidence of IH in LLR compared to OLR and risk factors for hernia occurrence after resection for CRLM.

MATERIALS AND METHODS

This is a single center retrospective study of adult patients (age ≥ 18 years) who had resection for CRLM between 1st of January 2011 and 31st December 2018 at our institution. The primary end point was development of IH at 3 years following resection. IH developed in relation to another surgery e.g., index colorectal surgery or parastomal hernia, was excluded from analysis.

All instances of IH were radiologically confirmed on review of follow-up surveillance abdominal computed tomography (CT) scans. Hernia defect diameter was reported as the largest fascial defect measured on CT scan. In LLR, we recorded the extraction incision, and whether it was the site of IH.

In OLR, standard subcostal muscle cutting incision with vertical incision is made if required to gain adequate exposure of the operative field. Incisions were closed in 2 layers (posterior rectus/int oblique and transversus abdominis deep layer then anterior rectus/ext oblique) for the horizontal limb, and single midline layer for vertical extension (if present), using 0 polydioxanone (PDS) sutures. In the laparoscopic group, the extraction site was closed using single layer loop 0 PDS, and port sites larger than 5 mm were closed using 2/0 PDS.

The decision to perform laparoscopic or open resection was according to surgeon preference and expertise guided by expected difficulty, considering previous surgery, anatomical location, and size.

Data collected included age, sex, presence of diabetes mellitus, steroid intake, history of previous hernia or liver resection, subcutaneous and peri-renal fat thickness, preoperative creatinine and albumin, American Society of Anesthesiologists (ASA) score, major liver resection (resection of 3 or more hepatic segments [9]), surgical site infection, synchronous presentation, and preoperative chemotherapy. Chemotherapy for 6 cycles or more was considered a long course.

Subcutaneous fat thickness was assessed on preoperative imaging CT (the longest distance between the skin tissue and the outer limit of the muscular layer of the abdominal wall at the level of the umbilicus) and peri-renal fat thickness (maximum distance between the posterior wall of the kidney and the inner limit of the abdominal wall in a slice that contains the renal

Table 1. Univariate and multivariate analysis of risk factors to develop incisional hernia

Risk factor	Univariate analysis		Multivariate analysis	
	HR (95% CI)	*p*-value	HR (95% CI)	*p*-value
Age	1.01 (0.98–1.04)	0.43		
Male	1.92 (0.89–4.11)	0.09	1.96 (0.89–4.32)	0.09
History of DM	1.78 (0.88–3.61)	0.11		
Steroid intake	3.69 (0.89–15.33)	0.07	3.99 (0.93–17.13)	0.06
Previous liver resection	1.16 (0.42–3.22)	0.78		
Future liver resection	1.55 (0.73–3.32)	0.26		
Preoperative creatinine	1.00 (0.99–1.01)	0.49		
Preoperative albumin	0.99 (0.96–1.02)	0.47		
LLR	1.02 (0.56–1.86)	0.95		
Metacronus presentation	1.01 (0.57–1.01)	0.97		
LOS	1.05 (1.02–1.08)	< 0.001	1.06 (1.03–1.09)	< 0.001
Major resection	0.99 (0.56–1.75)	0.99		
Subcut fat thickness	1.03 (1.01–1.05)	0.01	1.02 (1.00–1.05)	0.05
Peri-renal fat thickness	1.02 (0.99–1.04)	0.18		
ASA > 2	1.01 (0.57–1.82)	0.97		
History of previous hernia	2.75 (1.56–4.86)	< 0.001	2.22 (1.19–4.13)	0.01
Surgical site infection	1.23 (0.49–3.11)	0.66		
Preoperative chemotherapy	0.75 (0.41–1.39)	0.36		
Long course chemotherapy	1.06 (0.46–2.45)	0.89		

DM, diabetes mellitus; LLR, laparoscopic liver resection; LOS, length of hospital stay; ASA, American Society of Anesthesiologists; HR, hazard ratio; CI, confidence interval.

vein), and analysed as possible risk factor of IH [2].

We considered the first follow-up CT scan showing IH as the time of diagnosis. Symptomatic IH was defined as hernia causing pain, discomfort, or complications, rather than disfigurement.

This study was approved by the institutional audit department (no. 22847). The requirement to obtain informed consent was waived.

Statistical analysis

Continuous variables were presented as the mean ± standard deviation. For univariate analysis, Mann–Whitney U test was used for continuous variables, and chi^2 for categorical variables. We calculated IH incidence during the follow-up period using Kaplen–Meier curves, and used Log–rank to compare risk factors. Cox regression analysis was used to calculate hazard ratio (HR) and 95% confidence intervals and multivariate analysis. $p \leq 0.05$ was considered statistically significant. All statistical analysis was performed using SPSS version 20.0 (IBM Corp.).

RESULTS

There were 247 liver resections included in the study. In total, 87 (35%) patients had LLR, while 160 patients had OLR. The mean follow-up period was 41 ± 29 months. The mean age was 64 ± 10 years. The male-to-female ratio was 2.6:1. Overall survival following liver resection was 90% at 1 year and 65% at 3 years, respectively. Mean hospital stay was 9 ± 7 days.

Incisional hernia incidence and risk factors

Forty-eight patients developed an IH with an incidence of 10% and 19% at 1 and 3 years, respectively. The mean hernia size was 51 ± 34 mm (10–150 mm). Among patients that developed a hernia, 7 cases reported symptoms (15%), and 7 cases had surgical repair.

Overall risk factors for developing an IH were increased subcutaneous fat (31 ± 9 mm vs. 26 ± 11 mm, $p < 0.001$) and history of previous hernia (17% vs. 7% and 29% vs. 14% at 1 and 3 years, respectively; $p < 0.001$) on univariate analysis. On multivariate analysis, the same factors had a statistically significant HR for IH development (Table 1).

There was a statistically significant association between length of hospital stay and development of IH in our cohort ($p < 0.001$). Preoperative chemotherapy was not a risk factor for developing IH ($p = 0.36$).

Laparoscopic liver resection vs. open liver resection incisional hernia

LLR subgroup had a higher preoperative albumin, a smaller number of major resections, and shorter hospital stay. Table 2 presents the patient characteristics of both groups.

Table 2. Patients' characteristics and differences between OLR and LLR subgroups

Patient characteristic	Whole study group (n = 247)	LLR group (n = 87)	OLR group (n = 160)	*p*-value
Sex				0.07
Male	179 (72)	57 (65)	122 (76)	
Female	68 (28)	30 (35)	38 (24)	
Age (yr)	64 ± 10	64 ± 10	64 ± 10	0.93
Diseased	141 (57)	48 (55)	93 (58)	0.65
History of DM[a)]	38 (16)	10 (12)	28 (18)	0.19
History of previous liver resection	21 (9)	6 (7)	15 (9)	0.50
History of previous Hernia	77 (31)	28 (32)	49 (30)	0.80
ASA > 2	94 (38)	39 (45)	55 (34)	0.10
Steroid intake[b)]	4 (1.6)	2 (2)	2 (1.2)	0.53
Preoperative albumin (g/L)	34 ± 9	36 ± 8	32 ± 9	0.01
Preoperative createnine (μmol/L)	75 ± 25	74 ± 25	76 ± 25	0.31
Synchronous presentation[c)]	102 (41)	33 (38)	69 (43)	0.40
Major resection[c)]	117 (48)	25 (29)	92 (58)	< 0.001
Length of hospital stay (day)	9 ± 7	6 ± 4	10 ± 8	< 0.001
Preoperative chemotherapy	186 (75)	64 (74)	122 (76)	0.64
Long course preoperative chemotherapy (out of 186 who had chemotherapy)	146 (78)	46 (72)	100 (82)	0.11
Surgical site infection	24 (10)	8 (9)	16 (10)	0.84

Values are presented as number (%) or mean ± standard deviation.
DM, diabetes mellitus; ASA, American Society of Anesthesiologists; LLR, laparoscopic liver resection; OLR, open liver resection.
[a)]Data is missing in 11 patients, [b)]data is missing in 4 patients, [c)]data is missing in one patient.

Table 3. Clinical presentation of IH

IH factor	Overall (n = 48)	LLR (n = 16)	OLR (n = 32)	*p*-value
Time to develop hernia (day)	256 ± 561	445 ± 336	625 ± 653	0.69
Symptomatic presentation[a)]	6 (13)	1 (6)	5 (16)	0.65
Size of hernia defect (mm)[b)]	51 ± 34	53 ± 37	50 ± 33	0.96
Surgical repair[c)]	6 (13)	3 (20)	3 (10)	0.38

Values are presented as mean ± standard deviation or number (%).
IH, incisional hernia; LLR, laparoscopic liver resection; OLR, open liver resection.
[a)]Data missing in one patient, [b)]data missing in 2 patients, [c)]data missing in 3 patients.

There was no significant difference in incidence of IH between LLR and OLR at 1 and 3 years, respectively ([10%, 19%] vs. [10%, 19%], $p = 0.95$) (Fig. 1). Similarly, there was no difference in time to develop IH, hernia related symptoms, size, or surgery between the groups (Table 3).

Laparoscopic liver resection specimen extraction incision and incisional hernia analysis

In total, 14 IH developed at the Extraction incision, and only 2 at other port sites. No IH developed at Pfannenstiel incision (4 incisions), in comparison to other extraction incision (Table 4). The incidence of Extraction site hernia was higher in vertical incisions in comparison to horizontal incisions, although it was not statistically significant due to small numbers (26% vs. 17%, $p = 0.19$; Fisher's exact test).

DISCUSSION

Laparoscopic liver surgery has demonstrated advantages over open surgery, with shorter hospital stay, and a lower incidence of postoperative complications [10,11]. On long-term follow-up, the focus of published reports was on overall survival and disease-free survival, which are comparable [12-14]. However, IH following liver surgery remains a significant long-term complication with its impact on life quality. While several studies have discussed the incidence of IH in open liver or liver transplant surgery, little is known of the incidence of IH in LLR, and how it compares to the incidence of IH in OLR. To the best of our knowledge, this is the first study to compare the incidence of IH between LLR and OLR in a single pathology (CRLM). Our findings demonstrate no difference in the incidence of IH at one and three years, respectively. In addition, this is the longest follow-up reporting on IH following LLR in the literature and included only a single pathology to reduce variations within each group.

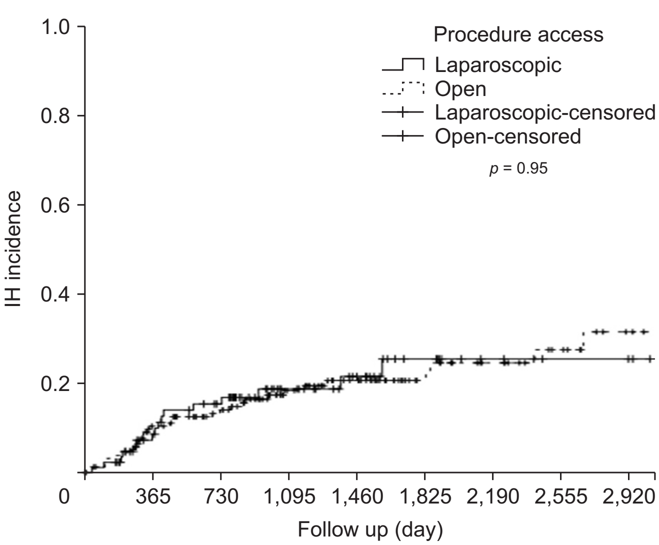

Fig. 1. Incidence of incisional hernia (IH) among open liver resection and laparoscopic liver resection.

To date, there is only a single retrospective comparative study by Darnis et al. [15] that compares the incidence of IH between laparoscopic and OLR. However, that study included only left lateral sectionectomies for malignant and benign indications. They reported no difference in clinically relevant IH with a median follow-up of 27 months. This is consistent with a study published by Mishra et al. [16], in primary colorectal neoplasm excision. In their retrospective analysis of 1,057 resections with a median follow up of 44 months, 14.4% of the 768 open cases developed an IH, compared to 15.9% of the 289 laparoscopic cases, with no statistical difference.

The incidence of IH following LLR in our study was 16% and 19% at 2 and 3 years, respectively. A similar incidence of 16.4% was reported at a median of 25 months follow-up by Guilbaud et al. [17] in a cohort of 163 patients undergoing liver resections, mainly for malignant pathology. However, this study included mixed malignant pathology, possibly suggesting that the underlying pathology does not influence the incidence of

Table 4. IH in relation to extraction incision

Extraction incision	Transverse supraumbilical	Pfannenstiel	Midline vertical
Total number[a)]	19	4	39
IH	4	0	10

IH, incisional hernia.
[a)]25 cases missing information on extraction incision (29%).

IH. To the best of our knowledge, Wabitsch et al. [18] was the only other available study in the literature reporting the incidence of IH after LLR. Like our study, this was a retrospective observational study, and included 49 laparoscopic procedures for different indications, and both multiple and single incision laparoscopic (SIL) procedures. They reported a lower IH rate of 12%, with a median follow-up of 26 months. However, the study cohort were younger, with a lower male-to-female ratio, in comparison to our study. Male sex and age were reported as risk factors for the development of IH following open liver surgery [2,4-6]. This may provide an explanation for their lower IH reported incidence.

The IH rate for OLR was 10% and 19% at 1 and 3 years, respectively. The reported incidence of IH after OLR for CRLM in the literature is 8%–41% at 1 year [6,19], and 34.9%–59.2% IH at 5 years [4,19]. The latter study reported by Nilsson et al. [4] had an older cohort, which could explain their higher incidence.

In laparoscopic cholecystectomy, studies have shown that SIL cholecystectomy had a 4 times higher incidence of IH [20,21]. Similarly, when comparing SIL colorectal surgery to multiple incision laparoscopic surgery, a higher IH in the SIL group was observed, and was related to the extraction (single incision) site [22]. In the previously mentioned report by Mishra et al. [16], most IH after laparoscopic primary colorectal surgery was at the extraction site. These observations might suggest that a longer single incision in SIL or at the extraction site in laparoscopic resection surgery raises the incidence of IH to match the open group. However, to our knowledge there is no specific published data on the relationship between incision length and the risk of IH development, and on whether there is a critical length that increases this risk. Unfortunately, due to the retrospective nature of this report, not enough data related to the length of the extraction site was available to produce significant results.

In addition, the published literature suggests that the extraction site influences IH rates. Guilbaud et al. [17] reported IH to be higher in midline incisions, compared to subcostal and suprapubic extraction incisions, in their series of 163 LLR. Similarly, in a large retrospective review of 2,148 patients who had undergone laparoscopic colorectal surgery, extraction-site IH rates were highest after periumbilical or midline incisions, and lowest with a Pfannenstiel incision [23]. They suggested that the reason could be that midline incisions usually involve the umbilical region, which is considered an innate area of abdominal wall weakness, and in comparison, to the rest of the abdominal wall, has a natural lower vascularity. Our study suggests similar advantage of Pfannenstiel extraction over other incisions, although due to lower numbers, it was not significant. This could provide scope for future studies and potential preventive measures to lower the risk of IH related to extraction incision.

In our cohort, risk factors for IH development were a history of previous hernia, and subcutaneous fat thickness. Previous hernia history was identified as a risk factor for the development of IH in open liver surgery [4]. Subcutaneous fat can be an indication of obesity, and was reported in a large retrospective review of 3,927 abdominal surgeries as a risk factor for developing IH [1]. They reported increased risk of IH (HR, 1.18; confidence interval, 1.03 to 1.35) with each 1 cm increase in subcutaneous fat thickness. It was suggested that the thicker the subcutaneous fat, the higher the incidence of incision-related surgical site infection (SSI). However, in our study, there was no statistically significant difference in SSI rate and subcutaneous fat thickness.

Preoperative chemotherapy was reported as a risk factor for IH following abdominal surgery [1]. Similarly, in open liver surgery, preoperative chemotherapy (bevacizumab) or more than six cycles treatment has been reported to be associated with an increased risk of developing IH [4]. In our study, prolonged preoperative chemotherapy was not a risk factor for IH development. Of 247 patients, 146 had long-course chemotherapy, of which 26 patients developed an IH. The fewer patients in this group might have been reflected in the non-statistically significant effect of long-course chemotherapy.

There are a few limitations to our study. It is a retrospective single center study. The number of patients who developed IH may be too small to demonstrate statistically significant results, especially in relation to the natural history of IH. Only two laparoscopic major liver resections were performed prior to 2014, which then increased after the appointment of a trained laparoscopic liver surgeon. This observation is likely attributed to the available expertise to perform major LLR in the earlier years of the study, which led to a greater number of major liver resections in the OLR arm. While there was no difference in IH at 3 years, a longer follow-up is possibly needed. A larger scale, multicenter study with a longer follow-up is probably needed to confirm and identify risk factors and the natural history of IH.

Conclusion

There was no difference in IH incidence between LLR and OLR following surgery for CRLM. Most IHs in laparoscopic liver surgery are related to extraction incision. Further larger scale study is required to confirm and explore different preventive techniques.

FUNDING

None.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ORCID

Ahmed Hassan, https://orcid.org/0000-0002-5281-6912
Kalaiyarasi Arujunan, https://orcid.org/0009-0005-3850-9181
Ali Mohamed, https://orcid.org/0009-0003-4790-9350
Vickey Katheri, https://orcid.org/0009-0003-1103-5911
Rami Ahmed, https://orcid.org/0009-0006-0707-1639
Daren Subar, https://orcid.org/0000-0003-4512-9388

AUTHOR CONTRIBUTIONS

Conceptualization: DS. Data curation: K Arujunan, AM, VK, K Ashton, RA. Methodology: AH. Writing - original draft: AH. Writing - review & editing: AH, DS.

REFERENCES

1. Itatsu K, Yokoyama Y, Sugawara G, Kubota H, Tojima Y, Kurumiya Y, et al. Incidence of and risk factors for incisional hernia after abdominal surgery. Br J Surg 2014;101:1439-1447.
2. Chen-Xu J, Bessa-Melo R, Graça L, Costa-Maia J. Incisional hernia in hepatobiliary and pancreatic surgery: incidence and risk factors. Hernia 2018;23:67-79.
3. Le Huu Nho R, Mege D, Ouaïssi M, Sielezneff I, Sastre B. Incidence and prevention of ventral incisional hernia. J Visc Surg 2012;149:e3-14.
4. Nilsson JH, Strandberg Holka P, Sturesson C. Incisional hernia after open resections for colorectal liver metastases – incidence and risk factors. HPB 2016;18:436-441.
5. Togo S, Nagano Y, Masumoto C, Takakura H, Matsuo K, Takeda K, et al. Outcome of and risk factors for incisional hernia after partial hepatectomy. J Gastrointest Surg 2008;12:1115-1120.
6. D'Angelica M, Maddineni S, Fong Y, Martin RCG, Cohen MS, Ben-Porat L, et al. Optimal abdominal incision for partial hepatectomy: increased late complications with Mercedes-type incisions compared to extended right subcostal incisions. World J Surg 2006;30: 410-418.
7. Cos H, Ahmed O, Garcia-Aroz S, Vachharajani N, Shenoy S, Wellen JR, et al. Incisional hernia after liver transplantation: risk factors, management strategies and long-term outcomes of a cohort study. Int J Surg 2020;78:149-153.
8. Arslan MK, Aydin C, Topaloglu S, Calik A, Tomas K, Karabulut E. Incidence of and risk factors for incisional hernia after liver surgery performed with a J-Shaped right subcostal incision. Am Surg 2017;83: e49-53.
9. Bismuth H, Chiche L. Surgery of hepatic tumors. Prog Liver Dis 1993; 11:269-285.
10. Fretland ÅA, Dagenborg VJ, Bjørnelv GMW, Kazaryan AM, Kristiansen R, Fagerland MW, et al. Laparoscopic versus open resection for colorectal liver metastases: the OSLO-COMET randomized controlled trial. Ann Surg 2018;267:199-207.
11. Kuemmerli C, Fichtinger RS, Moekotte A, Aldrighetti LA, Aroori S, Besselink MGH, et al. Laparoscopic versus open resections in the posterosuperior liver segments within an enhanced recovery programme (ORANGE Segments): study protocol for a multicentre randomised controlled trial. Trials 2022;23:206.
12. Maurette RJ, Ejarque MG, Mihura M, Bregante M, Bogetti D, Pirchi D. Laparoscopic liver resection in metastatic colorectal cancer treatment: comparison with long-term results using the conventional approach. Ecancermedicalscience 2017;11:775.
13. Chiang MH, Tsai KY, Chen HA, Wang WY, Huang MT. Comparison of surgical outcomes for laparoscopic liver resection of large hepatocellular carcinomas: a retrospective observation from single-center experience. Asian J Surg 2021;44:1376-1382.
14. Tian F, Leng S, Chen J, Cao Y, Cao L, Wang X, et al. Long-term outcomes of laparoscopic liver resection versus open liver resection for hepatocellular carcinoma: a single-center 10-year experience. Front Oncol 2023;13:1112380.
15. Darnis B, Mohkam K, Golse N, Vibert E, Cherqui D, Cauchy F, et al. Long-term abdominal wall benefits of the laparoscopic approach in liver left lateral sectionectomy: a multicenter comparative study. Surg Endosc 2021;35:5034-5042.
16. Mishra A, Keeler BD, Maxwell-Armstrong C, Simpson JA, Acheson AG. The influence of laparoscopy on incisional hernia rates: a retrospective analysis of 1057 colorectal cancer resections. Colorectal Dis 2014;16:815-821.
17. Guilbaud T, Feretti C, Holowko W, Garbarino GM, Marchese U, Sarran A, et al. Laparoscopic major hepatectomy: do not underestimate the impact of specimen extraction site. World J Surg 2020;44:1223-1230.
18. Wabitsch S, Schulz P, Fröschle F, Kästner A, Fehrenbach U, Benzing C, et al. Incidence of incisional hernia after laparoscopic liver resection. Surg Endosc 2021;35:1108-1115.
19. Maki H, Kim BJ, Kawaguchi Y, Fernandez-Placencia R, Haddad A, Panettieri E, et al. Incidence of and risk factors for incisional hernia after hepatectomy for colorectal liver metastases. J Gastrointest Surg 2023;27:2388-2395.
20. Haueter R, Schütz T, Raptis DA, Clavien PA, Zuber M. Meta-analysis of single-port versus conventional laparoscopic cholecystectomy comparing body image and cosmesis. Br J Surg 2017;104:1141-1159.
21. Milas M, Deveđija S, Trkulja V. Single incision versus standard multiport laparoscopic cholecystectomy: up-dated systematic review and meta-analysis of randomized trials. Surgeon 2014;12:271-289.
22. Sangster W, Kulaylat AN, Stewart DB, Schubart JR, Koltun WA, Messaris E. Hernia incidence following single-site vs standard laparoscopic colorectal surgery. Colorectal Dis 2015;17:250-256.
23. Benlice C, Stocchi L, Costedio MM, Gorgun E, Kessler H. Impact of the specific extraction-site location on the risk of incisional hernia after laparoscopic colorectal resection. Dis Colon Rectum 2016;59:743-750.