

Usefulness of a Transumbilical Incision for Organ Removal in Laparoscopic Hepatectomy

KODAI TOMIOKA, TAKESHI AOKI, KAZUHIRO MATSUDA, AKIRA FUJIMORI,
TOMOTAKE KOIZUMI, TOMOKAZU KUSANO, KOJI NOGAKI, YOSHIHIKO TASHIRO,
YUSUKE WADA, TOMOKI HAKOZAKI, HIDEKI SHIBATA, TAKAHITO HIRAI,
TATSUYA YAMAZAKI, KAZUHIKO SAITO, YUTA ENAMI and MASAHICO MURAKAMI

*Division of Gastroenterological and General Surgery, Department of Surgery,
School of Medicine, Showa University, Tokyo, Japan*

Abstract. *Background/Aim:* To evaluate the complication rates and risk factors associated with transumbilical wounds and investigate the usefulness of an incision for organ removal in laparoscopic hepatectomy (Lap-H). *Patients and Methods:* We enrolled 42 patients who underwent Lap-H excluding a small partial resection in our hospital between 2013 and 2018. The occurrences of superficial surgical site infection (SSI) and transumbilical port-site incisional hernia were recorded. *Results:* SSI was not observed, and hernia occurred in 3 patients (7.14%). *Univariate analysis revealed that body mass index (BMI) ($p=0.004$) was significantly associated with the risk of hernia formation. Conclusion:* High BMI is a risk factor for hernia formation in patients undergoing Lap-H with transumbilical incision; hence, wound closure should be performed carefully. The construction of the transumbilical wound for organ removal was feasible with rationality, with no need to create a new wound.

It has been almost thirty years since the first case of laparoscopic hepatectomy (Lap-H) for benign lesion was reported (1). Lap-H is becoming a standard treatment for liver tumors, including malignant lesions. Although the transumbilical incision is often used for anastomosis and organ removal in laparoscopic surgery for all gastroenterological operation nowadays, a new Pfannenstiel incision is purposely created just to remove the resected specimens in some facilities, and there are few investigations

focused on the transumbilical incision in Lap-H. In our department, transumbilical incisions have been used to remove resected organs since the introduction of laparoscopic surgery in the 1990s. A 12-mm port is inserted through the navel at the beginning of the operation, and the umbilical incision is extended craniocaudally to adjust for the size of excised organs approximately 4-8 cm in size.

Adding an incision in the umbilicus has been avoided due to fear of increased rates of surgical site infection (SSI) and postoperative adhesion decades ago; however, it was not associated with complications (2). Furthermore, we have already reported the usefulness of a transumbilical incision as a surgical approach in laparoscopic surgery; infection at the transumbilical wound and incisional hernia occurred at a significantly higher rate following colorectal resection than gastric resection by laparoscopic surgery, and that female sex and diabetes mellitus (DM) were independent risk factors for hernia formation (3, 4).

The present study aimed to evaluate the complication rates and risk factors associated with a transumbilical incision that needed incision extension for the removal of a resected specimen and the usefulness of the incision for organ-removal in Lap-H in a cohort study at a single institution.

Patients and Methods

This study included a cohort of 50 patients who consecutively underwent Lap-H for anatomical resection or large partial resection that needed wound extension for organ removal, at the Division of Gastroenterological and General Surgery, Department of Surgery, Showa University Hospital, Japan, between January 2013 and May 2018. The 8 cases that were converted to laparotomy were excluded, and the cases of small partial resection, which did not require transumbilical incision extension were excluded. The study protocol was approved by the Showa University Ethics Committee (approval number: 3200). All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Correspondence to: Takeshi Aoki, Division of Gastroenterological and General Surgery, Department of Surgery, School of Medicine, Showa University, 1-5-8 Hatanodai, Shinagawa, Tokyo 142-8666, Japan. Tel: +81 337848541, Fax: +81 337845835, e-mail: takejp@med.showa-u.ac.jp

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Patient data were collected from our hospital database, including sex, age, height, weight, body mass index (BMI), history of DM, type of surgery, surgical duration, amount of blood loss, maximum/middle/minimum diameter of resected specimen, intraoperative accident, postoperative complication, superficial or deep/ organ SSI, umbilical wound port-site hernia, and length of postoperative hospital stay.

SSI was defined according to the criteria of the American College of Surgeons National Surgical Quality Improvement Program (5). Wound hernia was defined according to the definition by Tonouchi *et al.* (6). Occurrence of SSIs was identified by the infection control team, and umbilical port-site hernias were assessed using computed tomography (CT) and clinical findings in routine follow-up period (approximately 3-60 months). Patients with DM underwent diabetes assessments preoperatively and were operated under glycemic control.

In all cases, preoperative mechanical bowel preparation was performed, and a second-generation cephalosporin was administered intravenously 30 min before surgery. The wound closure methods and covering methods were performed following a standardized protocol in our department. We cut the skin in the craniocaudal direction from the center of the navel and inserted the first 12-mm port (Figure 1a). For cosmetic reasons, the umbilical wound was minimally extended in the craniocaudal direction to adjust to the size of the resected organ (approximately 4-8 cm) (Figure 1b), and a wound protector was attached to extract the specimen (Figure 1c).

The anterior and posterior laminae of the rectal sheath on the wound was nodule-sutured with a monofilament absorbable suture material. All wounds were washed with 50 ml saline, buried interrupted dermal sutures were constructed using a 4-0 monofilament absorbable suture material (Figure 1d), and the wound was sealed with hydrocolloid dressing for 48 hours postoperatively (Figure 1e).

Data are presented as mean±standard deviation (SD), unless otherwise specified. Risk factors were investigated using univariate analyses, including the χ^2 test, Fisher's exact test, Wilcoxon rank-sum test, Wilcoxon signed-rank test, and univariate logistic regression. Significant variables were then analyzed using multivariate logistic regression analysis. All analyses were performed using JMP Pro 14 (SAS Institute Inc., Cary, NC, USA). Statistical assessments were two-sided, and a *p*-value <0.05 indicated significance.

Results

Of the total 42 patients, 28 were male (66.7%) and 14 were female (33.3%), with a mean±SD age of 66.30±12.74 years (median, 69.0 years; range=34-89 years).

The diseases targeted for surgery and the procedures are presented in Table I; The diseases included hepatocellular carcinoma (HCC) (n=22), metastatic carcinoma (n=15), cholangiocellular carcinoma (n=2), focal nodular hyperplasia (n=1), hepatocholelithiasis (n=1), and hemangioma (n=1). Patients underwent hepatic left lateral segmentectomy (n=19), left hemihepatectomy (n=4), right hemihepatectomy (n=1), subsegmentectomy (n=12), large partial resection (nearly close to anatomical resection) (n=6). All 42 purely laparoscopic hepatectomies were completed successfully, and no positive surgical margin was encountered.

Table I. Disease and surgical procedure.

	Number
Disease	
Hepatocellular carcinoma	22
Metastatic carcinoma	15
Cholangiocellular carcinoma	2
Focal nodular hyperplasia	1
Hepaticolithiasis	1
Hemangioma	1
Procedure	
Left lateral segmentectomy	19
Left hemihepatectomy	4
Right hemihepatectomy	1
Subsegmentectomy	12
Partial resection	6

Superficial or deep/organ SSI was not observed in any patient (0.00%). A transumbilical wound hernia was observed in 3 patients (7.14%). The median time to hernia development was 3.0 months (range=2-19 months). The comparison of the groups with and without umbilical wound hernias indicated that body mass index (BMI) (32.78±5.50 vs. 22.04±3.07; *p*=0.004) was significantly associated with an increased risk of hernia formation (Table II).

Discussion

Although it had been recommended to avoid the navel due to its unsterile area, Jesus *et al.* have reported that midline abdominal incisions through the navel were related to low occurrence rate (4.5%) of wound infections and that a transumbilical wound was a safe surgical technique (7). In recent years, midline abdominal incision through the navel has become a basic laparotomy method in gastrointestinal and hepatobiliary-pancreatic surgery. Furthermore, a transumbilical incision is commonly used in laparoscopic surgery. In our department, it is routinely used in all abdominal laparoscopic procedures because it has the following advantages; A) better cosmetic outcome and avoidance of crafting another wound for organ removal, B) ease extension in craniocaudal direction, C) ability to minimize skin incision, D) ability to reach the abdominal cavity safely and directly *via* the shortest anatomical distance. With regard to the extension of the wound, it is possible to remove a large organ from the body using the extensibility of the skin. Therefore, a transumbilical incision appears reasonable and provides excellent aesthetic results.

In the present study, we investigated the occurrence of transumbilical wound complications in Lap-H. We evaluated SSI as a short-term complication and umbilical port site hernia as a long-term complication. Umbilical port-site SSI

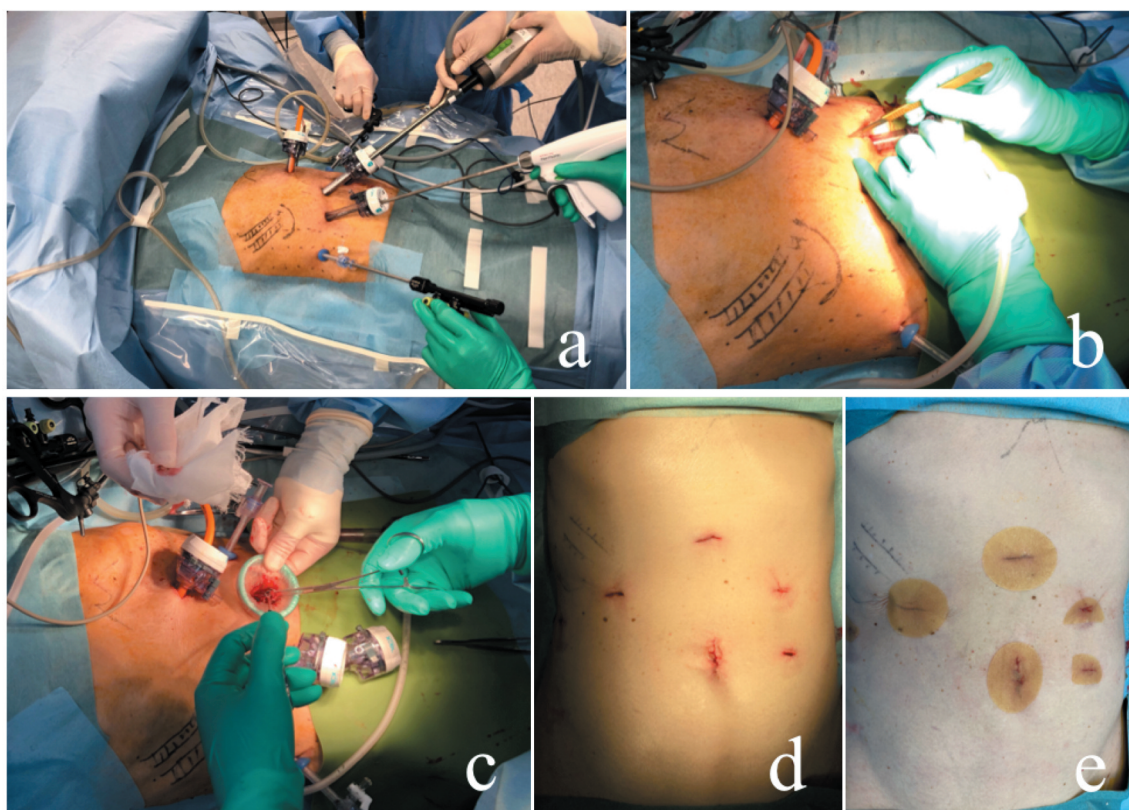


Figure 1. Transumbilical wound a) Intraoperative insertion of a 12-mm port through the transumbilical wound. b) The incision is created and extended to enable removal of the organ. c) The wound protector is attached, and the resected specimen is removed. d) The wound after closure. e) The wound is covered with hydrocolloid dressing.

has been previously reported to occur at rates of 1.06%-25.9% (3). Laparoscopic procedures were found to reduce the incidence of port-site infections and other wound-related complications (7). The risk factors for SSI that is limited to laparoscopic colon resection have been reported to include increased BMI and a history of DM (8-10). We have already reported that SSI occurs at a significantly higher rate following colorectal resection than gastric resection, and female sex and DM were considered as risk factors of incisional hernia (3). Additionally, in colorectal resection, anastomosis methods and the anastomotic site (intra/extra-abdominal) do not contribute to the occurrence of complications (4).

The incidence of transumbilical wound infections in Lap-H was 0% (0/42). Similarly, several studies have reported incidence rates of 0-11.8% (11-17). Thus, our results are comparable to previous reports. According to our previous report, the incidence of SSI in laparoscopic gastric and colorectal resection is 2.64%, and especially in laparoscopic colorectal resection is 3.85% (3). The reason for the low incidence of SSI in Lap-H was highly likely to be due to the

fact that they were completed as a sterile, low-contamination procedure. However, consideration should be given to the impact of selection of cases for safe laparoscopic surgery and the exclusion of high-risk surgical procedures for postoperative bile leaks that may contribute to the development of SSI.

Concerning incisional hernia, the incidence rates of a port-site hernia have been reported to be 0%-25.9% (3). Furthermore, female sex, DM, SSI, wound size, and high BMI have been identified as risk factors for hernia formation (3, 18). The surgical procedure was limited to Lap-H, and the incidence of hernia has been reported to be 1.85-5.9% (17, 19, 20).

In the present study, an umbilical port-site hernia was noted in 3 of 42 patients (7.14%). Although the length of the transumbilical incision was not measured, the length of the three sides and the median value of the resected specimen were analyzed, because the incision was extended depending on the size of the resected organ. The wound length was evaluated by approximating the size of the excised specimen. Then, the length of the transumbilical incision was not found to contribute to developing hernia. In the present study, high

Table II. Demographic data of patients with and without transumbilical wound hernia. Continuous data are expressed as mean±SD.

Variable	No wound hernia (n=39)	Wound hernia (n=3)	p-Value
Age (Years)	65.95±12.70	71.00±15.13	0.406
Gender (male:female)	27:12	1:2	0.254
Height (cm)	163.45±8.90	152.00±11.53	0.070
Weight (kg)	59.09±10.65	77.33±25.32	0.149
BMI (kg/m ²)	22.04±3.07	32.78±5.50	0.004
Diabetes mellitus	6 (15.38%)	1 (33.33%)	0.430
Heart disease	2 (5.26%)	1 (33.33%)	0.209
Pulmonary disease	3 (7.50%)	0 (0.00%)	1.000
ICG 15	10.55±5.94	13.67±2.08	0.190
Major resection	5 (12.82%)	0 (0.00%)	1.000
Operation time (min)	217.36±74.96	214.00±50.48	0.732
Blood loss (g)	89.82±141.52	124.33±171.07	0.805
Intraprocedure events	0 (0.00%)	0 (0.00%)	1.000
Tumor major axis (cm)	3.95±1.86	4.5±1.50	0.436
Resected specimen major diameter (cm)	10.18±3.86	8.17±4.19	0.339
Resected specimen median diameter (cm)	6.86±2.05	6.00±2.65	0.448
Postoperative complication	0 (0.00%)	0 (0.00%)	1.000
Postoperative hospital stay	10.62±4.09	9.33±1.53	0.863

BMI was believed to be a risk factor of transumbilical incisional hernia. The BMIs in patients with and without hernias were 32.78±5.50 kg/m² and 22.04±3.07 kg/m², respectively ($p=0.004$). Owing to the high amounts of subcutaneous fat in patients with high BMI, a reliable muscle sheath and transumbilical wound suturing can be difficult and involves several technical factors. However, the direct relationship between subcutaneous fat and BMI remains unknown, and we plan a further study to evaluate this relationship.

It is essential to perform a proper nodule suture to avoid an incisional hernia regardless of the abundant subcutaneous fat. In addition, in a study comparing the incidence of wound complications in Lap-H and open hepatectomy, the incidence of hernia following open hepatectomy was seen to increase 4-fold (11.86%), 10-times the relative risk (20). A higher incidence was observed for open hepatectomy for several reasons. A transumbilical incision has a predefined size of approximately 6 cm (in this study), whereas upper-midline laparotomies extend from the xyphoid to just cephalad of the umbilicus. Furthermore, localized ischemia and decreased tissue-oxygen perfusion likely occurs during open incisions secondary to prolonged soft tissue pressure applied by retractor devices as compared to the minimal, uniform pressure applied by a gel hand port used in Lap-H (20).

The use of a transumbilical incision as an organ removal technique in Lap-H is not as risky compared with open hepatectomy and is more logical than performing an incision for organ excision in other places such as the lower abdomen. Although the incidence of transumbilical incisional hernia in

the present study was higher than that in the previous reports, this was considered to be due to a highly rigorous evaluation involving, not only a clinical evaluation and physical examination, but also a follow-up by outpatient CT every three to six months. The hernia patients with poor clinical symptoms can be identified by performing a careful evaluation of the CT images, and a more reliable hernia incidence can be calculated. Unfortunately, they could not be indicated for hernia repair surgery due to a poor budging sign.

The main features of this research are as follows. First, the focus of this study was the evaluation of the usage of a transumbilical incision as an organ removal site rather than just a port wound. All specimens were removed through the transumbilical incision, and we extended the wound craniocaudally as necessary. Thus, a new organ removal wound was not required. Further, these research findings suggest the utility of this incision in any laparoscopic surgery for all organs. Second, we examined and limited Lap-H for certain diseases, in which most were malignant while the rest were near-malignant. Owing to the strict postoperative follow-up, there was minimal loss of data. Third, all procedures from the transumbilical incision to wound coating and perioperative management have been standardized in our department through an operation manual, thereby minimizing variation and bias.

The present study has several limitations. First, this was a retrospective study. The wound length was unknown, and there was bias in the variable settings. Second, the low incidence and the small number of adverse events indicate that we cannot exclude the possibility of a type 2 error. Third,

selection bias exists because cases where it was safe to perform laparoscopic procedure were selected. For this reason, factors that involve a risk of bile leakage were excluded.

There are several reports comparing the results of Lap-H and open hepatectomy; however, few articles have focused on transumbilical wound complications. Furthermore, this study is valuable because the surgical procedures were limited to large excision specimens, such as hemihepatectomy and anatomical resection, excluding partial resection cases that did not require wound extension for organ removal. In Lap-H, the use of a transumbilical incision as a method for organ removal may be allowed as, in the case of surgery for other organs, there was no need to make a new incision specific for organ removal. The incidence rate for transumbilical wound-related hernia formation was high in patients with high BMI, and a high BMI was considered to be a risk factor for hernia formation. Wound closure needs to be performed more carefully in such patients. Our transumbilical incision approach for organ removal, including wound closure and covering methods, can be considered as a feasible approach with good tolerability and rationality in modern laparoscopic surgery.

Conflicts of Interest

None of the Authors have any conflict of interest to declare regarding this study.

Authors' Contributions

KT, TA and MM designed the study concept and wrote the paper. All Authors examined and performed the operation. All Authors read and approved the final manuscript.

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