


Transumbilical glove port: A cost-effective method for single-incision laparoscopic hepatectomy

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Abstract

Objectives: Emerging concepts of “reduced port surgery” have gained considerable attention from laparoscopic surgeons, including the field of liver resection. To date, 86 cases of single-incision laparoscopic hepatectomy (SILH) have been reported, with commercially available access devices being used in most of these cases. We report herein a use of homemade transumbilical glove port for SILH.

Methods: A 39-year-old woman represented giant hepatic hemangioma (9-cm in size) located at the left lateral segment (S2/3). Partial hepatectomy was performed by the glove method via single port access with conventional laparoscopic bipolar forceps, grasper and scissors without the need of any single-port specific devices.

Results: The operative time was 77 minutes, and intraoperative blood loss was 50 mL. The postoperative course was uneventful.

Conclusions: Glove method not only has significant advantages in terms of cost, but also is superior in its versatility, allowing wider range of movements compared to conventional access devices. Taking in consideration its cost effectiveness and versatility, glove method may be a good option for SILH.

Keywords

Glove method, single-incision laparoscopic hepatectomy

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Introduction

Laparoscopic or laparoscope-assisted liver resection has been increasingly performed over the last two decades and is now accepted as the gold standard technique for segments 2–6. This technique was first introduced by Gagner et al.¹ in 1992. Since then, numerous reports have shown the feasibility and safety of laparoscopic liver resection. Several potential advantages include less abdominal pain, less hospital stay, and better cosmesis. The Louisville Statement² was the first report from a consensus meeting in 2008 showing clinical evidence to support the hypothesis that laparoscopic approach is equivalent to open surgery in terms of morbidity with better cosmesis and shorter length of hospital stay. In addition, a review of 2804 laparoscopic liver resection cases showed that oncological outcomes were equivalent to open liver resection.³ However, laparoscopic liver surgery has not been tested by controlled trials for efficacy or safety and its true validity is yet to be proved.

Single-port laparoscopic surgery (SPLS) was first reported by Pelosi and Pelosi⁴ in 1992. This report introduced an effort to reduce multiple-port access in laparoscopic appendectomy.

Thereafter, the concept of reduced port surgery or SPLS developed and gained its popularity. The single-incision technique has been applied to a variety of abdominal surgeries, such as cholecystectomy, splenectomy, colectomy, and nephrectomy. Single-incision laparoscopic hepatectomy (SILH) was first reported by Kobayashi et al.⁵ in 2010. They reported a partial sectionectomy for a hepatocellular carcinoma located at segment 3. To date, much work has been undertaken on SILH^{6–22} reflecting that this newly developed technique is gaining increased attention. However, clinical evidence to support the superiority of SILH other than cosmesis is lacking.²³ Recently, the first prospective randomized controlled study to compare multi-port and single-port hepatectomy through a small series was published.²² Indication of SILH is currently decided on an individual basis based on their clinical experience through a

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Figure 1. Preoperative dynamic contrast-enhanced CT.

small series of SILH. In addition, there exists no standard operative technique for SILH.

Less invasiveness is an important feature upon treating benign diseases. Of 113 reported SILH cases, 56 cases (=50%) were benign hepatic tumors, with 17 cases being hepatic hemangiomas. Either single-port access device or fascial puncture was used for port access in these 10 reported hemangioma cases. We report herein a case of SILH for hepatic hemangioma at the lateral segment and describe our operative technique using the glove method and surgical outcome with a focus on feasibility and safety of the evolving technique.

Patient and method

Patient

A 39-year-old woman was referred to our outpatient clinic by her general practitioner with persistent epigastric discomfort. Her physical examination revealed no abnormal findings and no palpable mass was detected. Figure 1 shows her preoperative abdominal dynamic contrast-enhanced computed tomography (CT) scan. The unenhanced CT scan showed a 9-cm low density area at the edge of the left lateral segment of liver (S2/3). The dynamic contrast-enhanced CT demonstrated peripheral early globular enhancement and centripetal fill-in pattern with the rapid attenuation of enhancing areas. Based on these radiological findings, the patient was diagnosed with hepatic hemangioma and planned for a single-incision laparoscopic partial hepatectomy. Our institution does not require ethics approval for reporting individual case. Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Surgical technique

Patient was put under general anesthesia and placed in the supine position with her legs apart. The first operator stood between the patient's legs and the second operator (the scopist) stood on the left side of the patient. A 3.0 cm supraumbilical incision was made for Alexis wound retractor™ (S size: Applied Medical; Rancho Santa Margarita, CA, USA), which was inserted by an open access method and a surgical glove was attached. Three low-profile laparoscopic ports

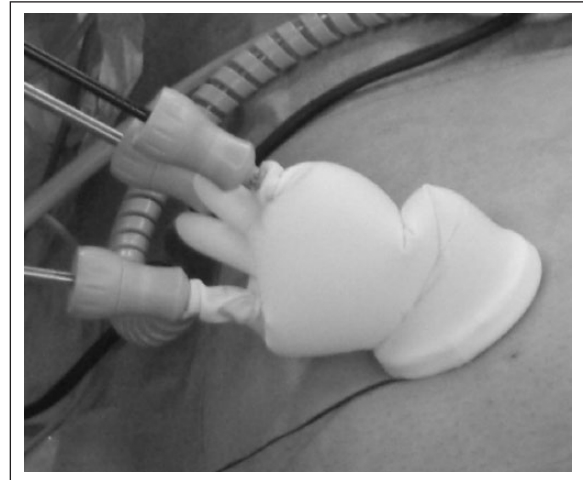


Figure 2. Glove method.

(5-mm trocars) were inserted through the holes of the surgical glove with cut fingertips, and pneumoperitoneum of 10 mmHg was maintained by CO₂ throughout the procedure (Figure 2). A 5-mm flexible laparoscope (Olympus; Tokyo, Japan) was used for visual inspection of the abdominal cavity. There was little adhesion around the liver.

The tumor was identified at the left segment (S2/3) of liver. The tumor mounted over the stomach and reached over the spleen. The liver parenchyma was retracted by conventional laparoscopic grasper, first sealed by bipolar coagulation (BiClamp; ERBE, Tübingen, Germany) keeping an adequate resection margin of 2 cm and dissected by laparoscopic scissors (Figure 3). The same maneuver was repeated multiple times to perform partial resection of the lateral segment and the tumor was resected from the liver. The supraumbilical incision was needed to extend to 5 cm to retrieve the specimen. Hemostasis was assured and no drain was inserted.

Result

Surgical outcome

The operative time was 77 min, and intraoperative blood loss was 50 mL. There was no need for additional port access or conversion to laparotomy. The patient had an uneventful postoperative course without wound-related complications

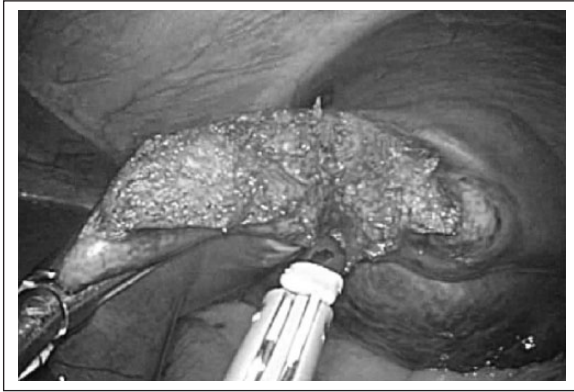


Figure 3. Parenchymal transection by BiClamp™.

and discharged on the fifth postoperative day. She had no complaints during the follow-up period (30 months), and no recurrent tumors have been identified.

Pathological findings

The tumor weighed 100 g and measured 9 cm × 5 cm × 3 cm in size. The pathological specimen was diagnosed as a typical hemangioma.

Discussion

More recently, considerable clinical attention has been devoted to less invasiveness in the field of abdominal surgery. As a result, almost all the abdominal surgery can be performed laparoscopically. We have seen in recent years an enormous improvement in laparoscopic techniques, which include the concept of “reduced port surgery,” the ultimate form of which being SPLS. When contrasted with colectomy or gastrectomy, laparoscopic liver resection has developed much more slowly possibly due to its complicated anatomy and the risk of hemorrhage. The Louisville Statement² was the first report which showed that laparoscopic liver surgery was an effective and safe approach for selected cases. Of special interest is the single-incision technique for hepatectomy that was first reported in 2010 by Kobayashi et al.,⁵ followed by an extensive body of additional reports. Until now, 113 cases of SILH have been reported from 18 institutes.^{5–22} However, all the reports are retrospective studies of a small series of case reports. Therefore, the feasibility of SILH should be verified by means of controlled trials between single-incision surgery versus classical multi-port liver surgery so that we can decide the indication of SILH.

Over 80% of hepatic hemangiomas maintain as benign tumors and most of hepatic hemangioma can be observed without surgical intervention. The operative indication is (1) a risk of rupture because the tumor is larger than 10 cm or locates at the edge of liver, (2) rapid tumor growth, (3) symptoms such as abdominal pain and appetite loss, (4) consumption coagulopathy, and/or (5) undetermined diagnosis. In our

case, the patient required hepatectomy due to the risk of rupture and abdominal symptom. Less invasiveness has been a major issue in abdominal surgery, especially for benign tumors such as hepatic hemangioma, for which SPLS is often a good option. Of 113 reported SILH cases, 17 cases were hepatic hemangiomas (Table 1).^{9,14–16,22} For malignant tumors, a small transumbilical incision of SILH often needs to be extended to more than 5 cm to keep an intact specimen, which makes SILH entirely without its merit. By contrast, for benign tumors such as hemangiomas, one can be allowed to crush or morcellate tumors for retrieval of the specimens that enables even giant hemangiomas to be collected through a 2-cm transumbilical incision and maximizes the merit of SILH. Of 10 reported cases of SILH for hepatic hemangioma, all the tumors were located at the left lateral segment with size ranging from 0.8 to 11 cm, operative time ranging from 40 to 135 min, and blood loss ranging from 5 to 800 mL. This suggests that hemangiomas at the left lateral segment (segment 2 and/or 3) is a good indication for SILH. Because the line of parenchymal transection is in line with the axis of laparoscopy, which enables the surgeon to handle in a coaxial fashion. The size of hemangioma does not seem to be a limiting factor for SILH as most resected tumors were “giant hemangiomas” with their size being more than 4 cm. In addition, all the 11 cases were performed through a 2- to 3-cm transumbilical incision without a need for additional port access or conversion to open surgery. Transumbilical incision is often undistinguishable postoperatively and can be classified as a type of natural orifice transluminal endoscopic surgery (NOTES). In a clinical setting, the severity of symptoms is carefully weighed against potential morbidity and invasiveness of liver surgery by a surgeon to decide the indication of surgical intervention for hepatic hemangioma on a patient-by-patient basis. However, the minimal invasiveness of SILH may change the benefit–risk balance of hepatic hemangioma surgery.

Either commercially available single-port access device (e.g. single-incision laparoscopic surgery (SILS) port™, GelPOINT™) or fascial puncture was used for transumbilical port in 10 reported SILH cases for hepatic hemangiomas. We used the glove technique, which was introduced by Ichihara et al.²⁴ in 2004 and mainly developed in Korea.^{25,26} The use of glove technique has gained popularity in SPLS and has been described in many organs including colon,²⁷ appendix,²⁸ spleen,²⁹ and surgery in gynecology³⁰ and urology.³¹ The glove technique provides a wider axis of movements. Using the glove method, the instruments can be crossed, rotated, or used apart. In addition, surgeons can add an instrument up to five at most through each finger while access devices have fixed port sites of three or four. Furthermore, the glove method eliminates the need for single-port access devices (SILS port™=\$570, GelPOINT™=\$390), which results in cost reduction (Alexis wound retractor™=\$90). Most laparoscopic surgeons may perform lateral sectionectomy by multi-port approach. However, single-port approach is a good

Table 1. Literature review of single-incision laparoscopic hepatectomy for hepatic hemangioma.

Authors	No.	Tumor		Resection	Access port	Incisional length (cm)	Blood loss (mL)	Operative time (min)	Hospital stay (days)
		Location	Size (cm)						
Pan et al. ⁹	1	S4	3.5	Partial	Fascial puncture	2.5	55	67	3
Zhao et al. ¹⁴	2	S3	11	Left lateral segment	Triport	1.5	100	90	4
	3	S2/S3	9.8	Left lateral segment	Triport	1.5	800	135	8
	4	S2/S3	8	Left lateral segment	Triport	1.5	100	110	5
	5	S3	6	Partial	Triport	1.5	50	110	3
	6	S3	5	Partial	Triport	1.5	30	60	4
	7	S3	3	Partial	Fascial puncture	1.5	20	40	3
	Cipriani et al. ¹⁵	8	S2/S3	NA	Left lateral segment	Quadriport	NA	NA	NA
9		S2/S3	NA	Left lateral segment	Quadriport	NA	NA	NA	NA
Aikawa et al. ¹⁶	10	S2	0.8	Partial	SILS port	2	5	88	8
Hu et al. ²²	11–17	S2/S3	NA	Left lateral segment	Fascial puncture	NA	NA	NA	NA
Our case	18	S2	9	Partial	Glove method	3	50	77	5

NA: not available; SILS: single-incision laparoscopic surgery.

option for young female patients such as this case where cosmesis is the major concern.

Laparoscopic hepatectomy requires an ultrasonic dissector (e.g. Cavitron Ultrasonic Surgical Aspirator (CUSA) Excel™, Harmonic Scalpel™), an electrothermal monopolar/bipolar coagulator (e.g. Ligasure V™, TissueLink Endo SH2.0™), and articulating forceps (e.g. Roticulator ENDO GRASP™), the majority of which are not usually equipped except for high-volume centers. These devices tend to be expensive, being a major drawback when performing SILH and even precluding the indication of SILH due to economic reasons in many institutes. We used BiClamp™, conventional laparoscopic scissors, a straight nonarticulating grasper, a wound retractor, and a surgical glove. No SPLS-specific device was needed; instead, it was feasible to perform SILH by using conventional laparoscopic devices, which resulted in substantially reduced costs. It is difficult to keep the instrument triangulation and “Roticulator” is often used as the grasper in SILH. Roticulator was not needed in our case, because the glove method facilitates a wider axis of movements and dissection line is in line with the access route, and tumor was heavy enough to make a good countertraction by its own weight. Furthermore, suturing is often difficult in SPLS due to the crowding of instruments, which makes it difficult to control surgical bleeding especially for the right lobe of the liver where the instrument triangulation in a direction parallel with transaction plane is usually difficult. Taken together with these technical aspects of SILH, it is suggested that our method is only applicable for tumors located at segment 2 and/or 3.

In conclusion, SILH using the glove method was performed for hepatic hemangioma located at the left lateral segment (S2/3) without the need for SILH-specific instruments. The accumulation of experience is awaited for deciding the indication and standardization of surgical technique for SILH. We should never broaden the surgical indication

for hepatic hemangiomas with the technical advance of laparoscopic hepatectomy, especially SILH. However, it may be a good option for those who have been hesitating to undergo hepatectomy because of postoperative abdominal pain or incision scar.

Declaration of conflicting interests

The authors declare no conflicts of interests with respect to the authorship and/or publication of this article.

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