INTRODUCTION

Since laparoscopic liver resection was first reported in 1992,[1] the use of this approach has spread worldwide. Laparoscopic left lateral sectionectomy (LLS) has been reported to be a safe and feasible procedure in several studies.[2,3] LLS is now a standard operation for tumours located in the left lateral region because of its easy anatomic accessibility.[4]

In general, LLS is performed using 4–6 ports.[5] We invented and have been performing a reduced port LLS procedure using 3 ports since 2009. The use of only 3 ports provides the benefits of a more minimally invasive surgery. This report provides an overview of our 3-port LLS approach.

MATERIALS AND METHODS

Patients

All patients who underwent LLS were included, except for patients with a previous history of upper abdominal surgery or those who had undergone the simultaneous resection of another organ. All the patients were treated at Toranomon Hospital (Tokyo, Japan). This study was approved by the

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Institutional Review Board of Toranomon Hospital, Japan. This study conformed to the provisions of the Declaration of Helsinki in 1995 (as revised in Brazil 2013).

**Surgical technique**

The patient was placed in supine position. The position of the operator and scopist was the right side of the patients, and the assistant was the left side. The port sites are shown in Figure 1. A 12-mm port was placed in the umbilical region (sometimes infra- or supra-umbilical) using the open method. Then, a 12-mm port and 5-mm port were placed. Importantly, the right epigastric port must be placed at an extension of the cut line; in preparation for the smooth insertion of a linear stapler. An 8-mmHg pneumoperitoneum was created. The Pringle manoeuvre was only used in cases with uncontrolled bleeding. A SonoSurg® (Olympus, Tokyo, Japan), monopolar electrocauterizer and BiClamp® (Erbe, Tubingen, Germany) were used for tissue dissection, transection of the liver parenchyma and haemostasis. Laparoscopic ultrasonography was routinely used to determine the number and size of the tumours and their relationships to major vascular structures.

After dividing the round ligament, the falciform, left coronary and triangular ligaments were divided to mobilise the left lateral section completely [Figure 1]. The stump of the round ligament was ligated using an ENDOLOOP Ligature PDS II™ (Ethicon, Cincinnati, OH, USA), and extracorporeal traction was applied to the string using an Endo Close™ (Medtronic, Minneapolis, MN, USA). The string was pulled laterally and towards the right to secure the operative field [Figures 1 and 2a]. The lesser omentum was not opened, and the Arantius duct was not divided.

A sufficient tumour margin from the umbilical portion of the portal vein was possible, the parenchymal transection line was set on the line about 1 cm away from the right side of the falciform ligament. Parenchymal transection was performed in a manner similar to the Kelly clamp crushing technique. We used a BiClamp® to clamp and crush the parenchyma and then divided the remaining fine structure using a SonoSurg® [Figure 2b]. In cases with thick hepatic vessels, coagulation using a BiClamp® or endoscopic clips were used to divide the vessels. Parenchymal transection was performed from the ventral to the dorsal side and from the caudal to the cranial side without exposing the main trunk of the left hepatic vein or the portal pedicles for segments II and III. The portal pedicles for segments II and III were divided en bloc using a linear stapler (Echelon FLEX™, Gold cartridge; Ethicon) after crushing for 1 min using the linear stapler [Figure 2c]. The left hepatic vein was divided using a linear stapler (Echelon FLEX™, White cartridge; Ethicon). The resected specimen was promptly placed in a plastic bag. Haemostasis and the absence of bile leakage were confirmed with gauze. The specimen was extracted from the umbilical port with a slight extension of the incision. An abdominal drain was placed only if post-operative bleeding or bile leakage was a concern.

**RESULTS**

A total of 12 patients were included in this report. The 3-port LLS was completed in 11 of the 12 patients. The remaining patient required a conversion to an open procedure because of an insult to the left inferior phrenic vein. Table 1 shows the details of all patients. The median operative time was 82.5 min (interquartile range, 67.25–103 min), and the median blood loss was

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**Figure 1:** Schema for operating procedure. After trocar placement and liver mobilisation, extracorporeal traction is applied to the divided round ligament using a ligature to align the parenchymal transection line with the right epigastric port.

**Figure 2:** Intraoperative visualisation of the operating procedure. (a) Extracorporeal traction is applied to the divided round ligament using a ligature. (b) Transection of the liver parenchyma. (c) Division of the portal pedicle for segments II and III using a linear stapler.
0 mL (interquartile range, 0–0 mL). The pathological surgical margin status was negative in all the cases. The median length of the hospital stay was 8 days (interquartile range, 7–10 days). One patient developed Grade II biliary fistula.

**DISCUSSION**

In this report, the technical details and short-term clinical results of 3-port LLS are presented. The current technique is surgically feasible, and satisfactory short-term outcomes were confirmed with high completion rate (11/12, 92%) and low morbidity rate (1/11, 9%).

To further maximise the benefits of minimally invasive surgery, several operative procedures have recently been developed including reduced port surgery. Reduced port surgery is currently being performed in various fields, and its safety and feasibility have been reported.[4,10–20] In the present study, we introduced a reduced port LLS procedure using 3 ports, which demonstrated good performance as a surgical option. It suggests that 3-port LLS is a feasible surgery for tumours, both benign and malignant, located in the left lateral section.

Based on a literature review of conventional LLS,[4,10–20] the median operative time was 120–320 min, median blood loss was 0–236 mL and the incidence of morbidity was 0–16 (7%). When compared with these results, the present 3-port technique seems not inferior to the conventional LLS with regard to short-term surgical outcomes. The main reason would be accountable for the avoidance of forceful encircling of segment II and III Glissonian pedicles before transection. However, this approach was not associated with increased biliary fistula or unexpected bleeding. Regarding the standpoint of minimising post-operative pain, there are several reports of single incision laparoscopic surgery (SILS) or SILS plus 1 port for LLS.[21,22] However, the reported operative time and amount of blood loss of these techniques were generally longer and larger compared with the current 3-port LLS because skilful surgeons performed the operations in those studies. Therefore, the 3-port approach might be well balanced in terms of surgical safety and invasiveness of the procedure.

The technical difficulty of the 3-port LLS may come down to the use of the left hand when the operator is dextral because the operator must use the left hand to perform parenchymal transection. Therefore, the surgeon should have intermediate-to-high level experience of liver surgery and laparoscopic surgery before undertaking the 3-port LLS. In our institution, only surgeons who experienced adequate open liver resection and laparoscopic surgery can uphold the prerequisites for performing this operation.

Limitations of this study include its retrospective nature and relatively small sample size from a single institution. However, because the number of patients who need to undergo anatomical hepatectomy such as LLS is decreasing – in many cases partial hepatectomy is sufficient – it is difficult to conduct a randomised-control trial or a prospective controlled study in a single institution. In addition, it is difficult to perform a comparison with open surgery because laparoscopic surgery is usually performed for low-risk patients with relatively good hepatic functional reserve and patients with decreased hepatic function or cirrhosis tend to be treated with open hepatectomy. However, the current preliminary outcomes of the 3-port LLS present relatively good short-term outcomes and it may warrant multicentre prospective study to prove the safety and efficacy of 3-port LLS.

**CONCLUSION**

Three-port LLS may be a safe and feasible procedure, and it can be a choice of procedure, especially for patients with good liver function and no history of upper abdominal surgery.

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**Conflicts of interest**

There are no conflicts of interest.
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