

Case report

**Usefulness and limitation of laparoscopic assisted hepatic resections
at a single Japanese institute: A preliminary report**

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ABSTRACT

Background/Aims: We preliminary examined the characteristics in patients who underwent laparoscopic assisted hepatic resection (LAPH) to clarify its advantages and limitations of this procedure. **Methodology:** We examined the patient demographics, surgical records and outcome in 9 patients undergoing LAPH between 2001 and 2007 by comparing results in 15 patients (control group) who did not undergo laparoscopy before 2000.

Results: Subjects included 5 males and 4 females with a mean age of 66.7 ± 12.2 years (\pm SD, range, 54-78 years). By comparing the control group, patient demographics were not different. Four patients underwent the left lateral sectionectomy and others underwent partial hepatic resection. One patient needed the combined resection of abdominal wall and left lateral sector because of the direct invasion from liver tumor. There were no remarkable morbidity and mortality in all patients. Mean operation time in the LAPH group was significantly longer than that in the control group (356 ± 68 vs. 276 ± 59 minutes) ($p=0.015$), particularly in patients undergoing partial resection. Mean blood loss was not different between groups. Mean days of use of pain releaser and hospital stay in the LAPH group was significantly shorter than that in the control group ($p<0.001$). These tendencies were similar in each operative procedure. **Conclusions:** LAPH can be safely performed even in patients with chronic injured liver and recovery of these patients from operation was faster than that by the conventional hepatectomy under laparotomy.

KEYWORDS: laparoscopy, mini-laparotomy, hepatectomy, liver tumor

ABBREVIATIONS: laparoscopic assisted hepatectomy (LAPH)

INTRODUCTION

Laparoscopic surgery has been widely accepted over the past 20 years (1-3). Since the first report of laparoscopic liver resection in human by Reich et al., the laparoscopic or laparoscopy assisted hepatectomy has been gradually performed in the world wide including Japan (4-6). Despite problems such a fear of parenchymal bleeding during transection or gas embolism during pneumoperitoneum, the development of safe techniques and improvements in instrumentation for hemostasis have widened indications of laparoscopic hepatectomy (7-9). At this stage, partial resection or left lateral sectionectomy of the liver was stably performed at any institutes, which has become a standard operative procedure (10). To avoid gas embolism, mini-laparotomy is often applied during hepatic transection using the abdominal wall lifting method (11). We have preferred to use a Laparo-lift system using an electric lifting device for various laparoscopic surgeries (11, 12). We have also experienced the laparoscopy assisted hepatectomy (LAPH) or the fenestration of hepatic cyst during a decade using above instruments. In the present report, we preliminary examined the patient demographics, surgical data and patient outcome in 9 patients who underwent LAPH to clarify advantages and limitations of this procedure.

PATIENTS AND METHODS

Subjects were 9 patients with liver tumors who underwent LAPH in the Division of Surgical Oncology, Nagasaki University Graduate School of Biomedical Sciences (NUGSBS) between 2001 and August 2007. The control group consisted of 15 patients who underwent left lateral hepatectomy (n=5) or partial hepatectomy (n=10) by laparotomy with the upper median incision or subcostal incision, in whom the latter procedure was performed before 2000. They included 10 males and 5 females with a mean age of 61.5 ± 7.9 years (\pm SD, range, 53-70 years). Liver diseases included hepatocellular carcinoma (n=6) and metastatic liver carcinoma (n=9). The background liver diseases included normal liver function (n=10) and chronic viral liver diseases (n=5; caused by hepatitis B virus [n=3] or HCV [n=2]).

In our hospital, the volume of the liver to be resected is determined pre-operatively by results of indocyanine green retention rate at 15 minutes (ICGR15) using Makuuchi's criteria [13].

The study design was approved by the Ethics Review Board of our institution and a signed consent for PVE was obtained from each subject. The present analysis was a retrospective study. Data were retrieved from both anesthetic and patient charts plus the NUGSBS database, for the duration of the initial hospitalization following hepatectomy.

Technique of laparoscopy assisted hepatectomy

LAPH was performed with a patient in a supine position with 30 degree of head-up. Operator stood on the right hand side of the patient and other operators including a scope assistant were on the other side. Under general anesthesia, a 12mm size of mini-laparotomy near the naval was performed at first and pneumoperitoneum with 8mmHg of carbon dioxide insufflations. After confirming an intraabdominal free space, 12mm-in-size of trocar was placed at paraumbilical portion, upper median portion, at the level of naval on the right and left mid-clavicle lines as **Fig. 1**. Inspection of hepatic tumor and tumor location were carefully examined by a flexible laparoscope (LTF TypeV3, Olympus Co., Tokyo) and ultrasonography, and surrounding ligaments of the liver was sufficiently dissected to mobilize the resected liver using an electrocautery and harmonic shears (Sonosurg long-straight scissors, 5mm, Olympus Co.). When the mobilization was accomplished, a 4-5cm-in-length of mini-laparotomy was performed near the target liver. Wound was covered by a plastic protector and was lifted by a retractor. Abdominal wall was mainly lifted by the Laparolift system (Origin Medsystems, Menlo Park, CA, USA) (12). A laparofan retractor (OMS-LF 10, Origin) with a 10-cm blade was inserted into the paraumbilical port site and the abdominal wall was lifted using a force of 13.5-18.2 kg (**Fig.2**). Preparation for In some cases, Pringle's maneuver (=intermittent hepatic in-flow occlusion) (14) was performed by arranging a tourniquet around the hepatoduodenal ligament, which was squeezed by the

forceps during hepatic transection. Through the small incision, hepatic transection was performed. Cut lines of the intended transection were marked by Sonosurg and parenchyma was dissected by Cavitron's ultrasonic surgical aspirator (Olympus) or by a forceps fracture method (15). Thick Glisson's branches and left hepatic vein were divided using an autosuture (Endopath Endocutter TES45-Flex ; Johnson & Johnson Co., Tokyo) in case of left lateral sectionectomy (**Fig.3**). Transected plane was burned using Tissue Link Dissecting Sealer 3.0TM (Century Medical, Inc., Dover, NH, USA) to secure hemostasis. Fibrin glue or other sealant was not used for hemostasis. Intraabdominal drainage tube was placed until feeding.

Statistical analysis

All continuous data were expressed as mean \pm SD. Data for different groups were compared using one-way analysis of variance (ANOVA). Chi-square test was used for comparison of categorical variables. Differences between groups were analyzed by Fisher's exact test. A two-tailed P value of less than 0.05 was considered significant. StatView Software for Windows, version 5.0 (SAS Institute, Inc., Cary, NC) was used in all statistical analyses.

RESULTS

They included 5 males and 4 females with a mean age of 66.7 ± 12.2 years (\pm SD, range, 54-78 years) (**Table 1**). Liver diseases included hepatocellular carcinoma (n=7) and metastatic liver carcinoma (n=2). The background liver diseases included normal liver function (n=3) and chronic viral liver diseases (n=6; caused by hepatitis B virus [n=2] or HCV [n=4], including one with cirrhosis). By comparing the control group, these demographics were not different between groups. Case 3 showed the direct invasion from liver tumor in the left lateral sector to the abdominal muscle.

Four patients underwent the left lateral sectionectomy and others underwent partial hepatic resection (**Table 2**). Case 3 needed the combined resection of the abdominal wall and, therefore, operating time was longer and blood loss was remarkable. Tumors located in the surface of the liver within 2cm in patients undergoing partial resections. Severe complications were not observed in all cases and no patient died during hospital stay. Case 3 was excluded from the comparison analysis between the LAPH and control group as below because a longer operation was added. Mean operation time in the LAPH group (356 ± 68 minutes) was significantly longer than that in the control group (276 ± 59 minutes) ($p=0.015$). In patients undergoing left lateral sectionectomy, mean operating time was not significantly different between LAPH group and the control group (359 ± 48 v.s. 302 ± 49 minutes, $p=0.35$). In patients undergoing partial resection, mean operation time in the LAPH group (354 ± 84 minutes) was significantly longer

than that in the control group (261 \pm 59 minutes) ($p=0.043$). Mean blood loss was not significantly different between LAPH group and the control group (358 \pm 232 vs. 330 \pm 105 minutes, $p=0.78$), which were not different between groups in each operation (left lateral sectionectomy and partial resection) either. Mean days of use of pain releaser in the LAPH group (2.9 \pm 1.6 days) was significantly shorter than that in the control group (4.9 \pm 1.1 minutes) ($p<0.001$). In patients undergoing left lateral sectionectomy, mean duration of use of drugs in the LAPH group (3.5 \pm 2.4 minutes) tended to be shorter than that in the control group (5.2 \pm 1.6 days) ($p=0.11$). In patients undergoing partial resection, mean duration of use of drugs in the LAPH group (2.4 \pm 0.6 days) was significantly longer than that in the control group (4.7 \pm 0.7 days) ($p<0.001$). Mean hospital stay in the LAPH group (17.2 \pm 6.7 days) was significantly shorter than that in the control group (23.3 \pm 2.9 days) ($p=0.003$). In patients undergoing left lateral sectionectomy, mean stay in the LAPH group (15.8 \pm 4.6 days) tended to be shorter than that in the control group (22.2 \pm 2.2 days) ($p=0.032$). In patients undergoing partial resection, mean stay in the LAPH group (18.4 \pm 8.4 minutes) tended to be shorter than that in the control group (23.8 \pm 3.1 minutes) ($p=0.09$).

DISCUSSION

Nicholas et al. and others reported that malignant liver neoplasms were involved in approximately 40% of total laparoscopic liver resections (16, 17). However, in the present study and other Japanese reports (11, 18), most of subjects for LAPH were liver malignancy. Even hepatocellular carcinoma patients with chronic injured liver could undergo this procedure. We believe that LAPH is very suitable for patients with impaired liver functions because limited wound of laparotomy may reduce the occurrence of massive ascites or intra-operative bleeding (19). By the conventional laparotomy, the longer operative wound is necessary even for small size of liver tumor locating subphrenic lesion. When the laparoscopy was applied, tumor in the liver surface of such a lesion can be easily observed and a use of laparoscopic devices can be used as well. Visualization of the surgical field under laparoscopic surgery must be better than that under laparotomy (11), and transection or immediate hemostasis can be achieved by various brand new instruments by LAPH (7-9,17). In case 3 of the present series, observation around the invaded tumor lesion to the abdominal wall was quite easily performed and the operative decision could be considered by the laparoscopic examination. Mobilization of the liver could be similarly performed as the same as the usual LAPH without influence of presence of infiltrated tumor. Extent of combined resection of the abdominal wall could be decided using laparoscopy as well, which lead the limitation of resected area of the abdominal wall.

Type of hepatectomy was limited only left lateral sectionectomy or partial resection on the liver surface in the present series. Recently, right hepatectomy or any other hepatectomy were attempted to perform under laparoscopic procedures (7, 20, 21). According to the improvement of operative instruments or surgeons' skill, more extensive hepatectomy will become the standard operation in the near future. It would be necessary to apply the useful technique to easily perform hepatic transection for the wide cut planes. Belghiti's liver hanging maneuver may give full play to enable anatomical hepatic resections under laparoscopy assisted surgery (22). Furthermore, concordant of ablation therapy with LAPH is possible because radio-frequency ablation therapy is effective for small size liver tumor even in the deeper part of liver as the same as liver resection (23).

Risk of LAPH such as limitation of hemostasis for sudden massive bleeding in the cut plane, or gas embolism during pneumoperitoneum was pointed out (17). However, we had no experiences of such a severe trouble during transection in this series. Considered gas embolism seemed to be actually rare (17). Previous reports indicated the reduction of intra-operative bleeding can be achieved by LAPH in comparison with the conventional procedure (24). However, we feel doubtful because the remarkable reasons are not considered except difference of the size of laparotomy wound. The present series showed that blood loss was not significantly different between LAPH and the conventional hepatectomy.

In fact, operating time in LAPH was longer because of limitation of forceps manipulation and, however, our series has been under the learning period. This

difference would become shorter in a larger size of experiences. Significant advantages of LAPH in the present series were reduction of a use of pain releaser after operation and hospital stay in the present series. Recovery of postoperative pain or reduction of hospital stay can be obtained by the laparoscopic hepatectomy in comparison with the surgery under the conventional laparotomy due to the smaller wounds (24, 25). Therefore, our present data were inevitable. We also analyzed this issue in partial resection and left lateral sectionectomy, respectively, and the tendency of better recovery after operation was similar. In cases without laparoscopic procedure, long-term ascites often occurs, which lead the longer hospital stay. However, such a complication was not observed in the present series. LAPH might reduce the production of massive ascites due to limitation of wound size and organ damage by handling. This point seems to be a LAPH's advantage. Even in LAPH, post operative bleeding or bile leakage specific to liver surgery is thought to be similarly occurred.

LAPH will be more available because of cost-effectiveness by the short hospital stay eventually although the cost of procedures or instruments during operation may be higher than that in the conventional operation (26). As described above, LAPH will be more applied in the field of liver surgery in the near future and, however, subject must be still selected in well preserved conditions and surgeons need a wide experience of open liver surgery before LAPH (11). At the point of oncology, the port-site tumor recurrence must be considered by previous reports in intraabdominal tumors (27), and, however,

such a tumor implantation in case of LAPH was rarely reported at this stage (17, 28). In this field, more clarification concerning influences of cancer cells by laparoscopic procedure will be expected.

In conclusion, we examined 9 patients with liver carcinomas who underwent laparoscopy assisted hepatic resection (LAPH). This procedure can be applied even in patients with cirrhosis. Blood loss was not different between LAPH and the conventional hepatectomy. Advantages of LAPH were the shorten operating time; shorten duration of use of pain releaser or hospital stay. LAPH is a safe and useful operative option to induce the postoperative recovery of patients.

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FIGURE LEGENDS

Fig.1 Scheme of port sites for laparoscopic assisted hepatectomy. X; naval. (1) paraumbilical port site for laparoscope, (2) Upper median port, (3) and (4); port sites on the mid-clavicle line.

Fig.2 Figure of abdominal wall lift using Laparolift system in case of left lateral sectionectomy. Upper median port site was opened. White arrow shows Laparolift, black arrow shows Laparofan, and a dotted black arrow shows mini-laparotomy.

Fig.3 Figure of parenchymal transection including left hepatic vein using autosuturing endocutter.

Table 1 Patient demographics in 9 patients undergoing laparoscopy assisted hepatic resection

	Age	Gender	Diseases	Background liver	Associated disease
1	74	Male	HCC	CVH	None
2	64	Female	HCC	CVH	Hypertension
3	69	Female	HCC	CVH*	None
4	54	Male	metastasis	Normal	Gallstone
5	78	Female	HCC	Normal	None
6	74	Female	HCC	LC	Diabetes
7	77	Male	HCC	CVH	None
8	56	Male	HCC	CVH	Hypertension
9	54	Male	Metastasis	Normal	None
10					
11	82	Male	metastasis	2008/1/29	

HCC; hepatocellular carcinoma, CVH; chronic viral hepatitis

*; direct invasion to abdominal wall

Table 2 Surgical records and outcomes

	Hepatectomy	Operation time (minutes)	Blood loss (ml)	Duration of pain Releaser (days)	Hospital stay (days)	Complications
1	LLS	320	230	2	15	None
2	Partial (S4)	470	450	2	20	None
3	LLS [#]	841	960	7	21	Wound infection
4	LLS	413	180	3	17	None
5	Partial (S4)	315	130	2	16	None
6	Partial (S4)	245	870	3	32	None
7	Partial (S6)	387	340	3	14	None
8	LLS	345	380	2	10	None
9	Partial (S6)	354	280	2	10	None

LLS; left lateral sectionectomy, S; segment of the liver,

*; combined resection of the abdominal wall and a fix of resected wall by a plastic surgery

Fig.1

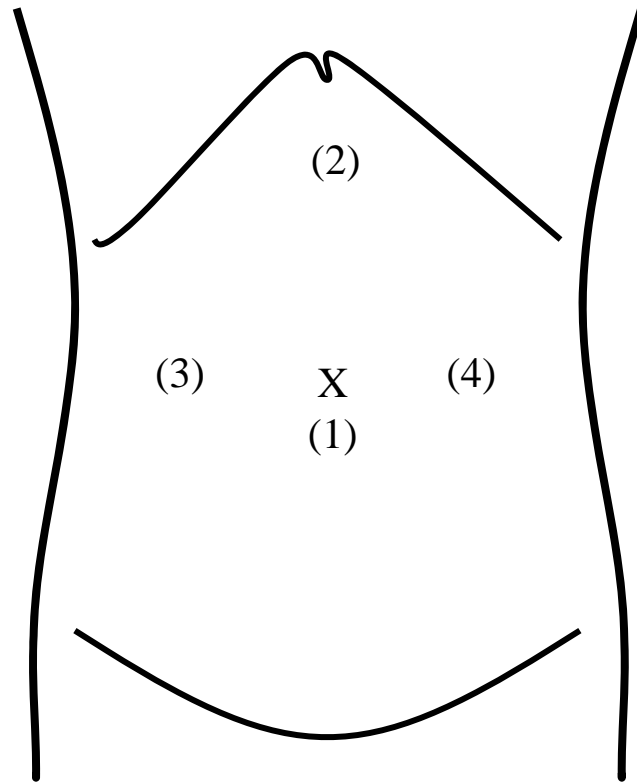


Fig.2



Fig.3

