—Report on Experiments and Clinical Cases—

The Usefulness of Laparoscopic Hepatectomy

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Abstract

Background: The aim of this study was to investigate the advantages of laparoscopic hepatectomy over open surgery for liver tumors.

Patients and Method: A retrospective study was performed of 10 patients with liver tumors (9 with hepatocellular carcinoma and 1 with focal nodular hyperplasia) at our hospital. Five patients who had received laparoscopic hepatectomy (Lap-Hx group) were compared with 5 patients who had undergone open hepatectomy (O-Hx group) in the same period. The operative procedure was partial hepatectomy and cholecystectomy in both groups. For liver excision, a microwave coagulation device and an ultrasonically activated scalpel were used.

Results: Mean patient age was 55.6 ± 13.9 years in the Lap-Hx group and 51.8 ± 14.1 years in the O-Hx group. Four patients in the Lap-Hx group had hepatocellular carcinoma with liver cirrhosis and 1 patient had focal nodular hyperplasia. All patients in the O-Hx group had hepatocellular carcinoma and 4 patients had associated liver cirrhosis. The mean tumor size was 2.6 ± 1.5 cm in the Lap-Hx group and 3.0 ± 1.8 cm in the O-Hx group. The two groups did not thus differ significantly in the preoperative background factors. Blood loss and duration of the postoperative hospital stay were significantly less in the Lap-Hx than in the O-Hx groups(213 ± 82 *vs* 247 ± 97 min; 154 ± 128 *vs* 648 ± 468 m*l*, p=0.05: and 10.4 ± 2.3 *vs* 18.0 ± 5.1 days, p=0.017), but operating time did not differ significantly.

Conclusions: Laparoscopic hepatectomy has the advantages of reducing the amount of operative blood loss because of the magnified view afforded by the laparoscope and shortening the hospital stay. The procedure is therefore recommended for patients with appropriate liver tumors, in particular, hepatocellular carcinoma in the cirrhotic liver.

(J Nippon Med Sch 2007; 74: 158–162)

Key words: endoscopic surgery, laparoscopic hepatectomy, laparotomic hepatectomy

Introduction

Most of hepatocellular carcinomas (HCCs) progress from chronic hepatitis or cirrhosis due to infection with hepatitis B virus (HBV) or hepatitis C virus (HCV) and exhibit a variety of developmental patterns. In particular, HCCs are associated with a high frequency of intrahepatic metastasis and multicentric occurrence accompanied by underlying chronic liver disease caused by HBV or HCV. Hepatectomy is the standard therapy with the

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highest cure rate, although postoperative recurrence rates are still high[1,2]. If there is a risk of postoperative liver failure, the choice of treatment for HCC depends on the underlying chronic liver disease. Nonsurgical treatments, such as microwave or radiofrequency ablation[3,4] and transcatheter arterial embolization[5], have been widely used in view of the superior quality of life (QOL) and minimal invasiveness they allow, thus provoking controversy about whether nonsurgical treatment or hepatectomy is more appropriate.

Endoscopic surgery, a rapidly adopted minimally invasive surgery, has been applied to the treatment of HCC. However, few studied have examined the usefulness of laparoscopic hepatectomy for HCC or its associated morbidity and mortality[6]. In this study, we investigated the advantages of laparoscopic hepatectomy for liver tumors in comparison with open surgery.

Patients and Methods

From 1999 through June 2002, laparoscopic hepatectomies were performed in 5 patients, including 4 patients with HCC at the time of informed consent. One patient had focal nodular hyperplasia (FNH). All patients with HCC had Child's B liver function and liver cirrhosis and were HCV-positive. The location of HCC by Couinaud's classification was as follows: segment III, 1 case; segment IV, 1 case; and segment VI, 2 cases. The case of FNH was located in segment V.

During this same time period (1999～2002), 76 open hepatectomies were performed. Five patients who underwent partial hepatectomy were retrospectively selected by the same criteria: the tumor was solid, located in the left lateral segment or lower segment, and was less than 5 cm in diameter. Four patients had HCC and cirrhosis (Child's class A, 1 patient; Child's class B, 3 patients) and 1 patient had HCC but no cirrhosis. All operations were performed by the authors. The patients undergoing laparoscopic hepatectomy (Lap-Hx group) were compared with those who underwent open hepatectomy (O-Hx group) with respect to operation time, blood loss, and length of postoperative hospital stay. For statistical analysis, the Student's *t*-test and the log-rank test were used. Differences with *P* values less than .05 were considered significant.

Surgical Procedure

The technique of laparoscopic hepatectomy was as follows. Patients were placed under anesthesia according to the same protocol. Each patient's position and trocar placement were decided on the basis of tumor location. Laparoscopic hepatectomies were performed with the 4- or 5-trocar technique.

The extent of the tumor and its relationship with the vascular anatomy and with other tumors in the liver was determined with intraoperative ultrasonography (Aloka Co., Ltd., Tokyo, Japan). Because of the possibility of CO_2 embolism via the pneumoperitoneum during transection of the liver parenchyma and vessels[7], the pressure of the pneumoperitoneum was maintained at a low pressure (4 to 6 mmHg), particularly during liver parenchymal transection.

The line of the intended liver parenchymal transection was marked on the liver surface with diathermy. After the liver was punctured with a microwave scalpel (Azwel Co., Ltd., Osaka, Japan) along the line of the transection, it was irradiated with microwaves (average power, 75 W) for 45 seconds. The liver was dissected with an ultrasonically activated scalpel. The resected liver was placed into a plastic bag. Extraction of the undivided specimen was performed in all patients through the slightly enlarged trocar incision, thus enabling histologic review.

Results

Demographic data of the clinicopathologic features in the Lap-Hx and O-Hx groups are shown in **Table 1**. We found no differences between the groups in any of the preoperative background variables, including tumor size.

Laparoscopic hepatectomy was successful without conversion to open laparotomy. Postoperative complications did not occur in either group.

The operation time was slightly shorter for the

Table 1 Clinicopathologic features

	Lap-Hx	O-Hx	P value
Number	5	5	NS
Male/Female	2/3	4/1	NS
Age	55.6 ± 13.9	51.8 ± 14.1	NS
Tumor	HCC 4 cases (LC 4 cases: Child A/B; 0/4) FNH 1 case	HCC 5 cases (LC 4 cases: Child A/B; 1/3)	
Size(cm)	2.6 ± 1.5	3.0 ± 1.8	NS

Lap-Hx: laparoscopic hepatectomy, O-Hx: open hepatectomy (mean ± SD)
HCC: hepatocellular carcinoma, LC: liver cirrhosis
FNH: focal nodular hyperplasia, NS: not significant

Table 2 Clinical features

	Lap-Hx(n = 5)	O-Hx(n = 5)	P value
Operation time(min)	213 ± 82	247 ± 97	NS
Blood loss(m*l*)	154 ± 128	648 ± 468	p = 0.05
Postoperative Hospital stay(days)	10.4 ± 2.3	18.0 ± 5.1	p<0.017

Lap-Hx: laparoscopic hepatectomy, O-Hx: open hepatectomy (mean ± SD)

Lap-Hx group than the O-Hx group, but the difference was not statistically significant. The blood loss was significantly lower and the postoperative hospital stay was significantly shorter in the Lap-Hx group than in the O-Hx group **(Table 2)**.

Discussion

Laparoscopic surgery for liver resection is a highly specialized procedure, because the liver, given its unique anatomical features, presents technical difficulties for surgery such as the control of bleeding and bile leakage from the intrahepatic vessels. However, important technologic developments and improved endoscopic procedures are being established. Equipment modifications, such as intraoperative ultrasonography, ultrasonic dissection, microwave coagulators, and argon laser beam coagulators, have all been recognized for their efficacy in liver surgery, as has the introduction of endoscopic linear staplers and laparoscopic coagulation shears. Thus, laparoscopic partial hepatectomy has recently been more performed more often. There have been reports of laparoscopic right and left lobectomy[8,9], and laparoscopic surgery has also been applied to left lateral segmentectomy for living donor liver for transplant[10].

The most important issue regarding laparoscopic hepatectomy for liver tumors, especially HCC in the cirrhotic liver, is appropriate knowledge of, and adherence to, the procedure's indications. It is dangerous to broaden the indications without evidence because such expansion could jeopardize the twin goals of laparoscopic surgery: minimal invasiveness and safety. The indications for laparoscopic hepatectomy are essentially identical to those for open hepatectomy in terms of preoperative assessment of liver function. However, patients with cirrhosis and poor liver function can tolerate laparoscopic hepatectomy if the tumor is in a location affording easy access. Therefore, in determining whether laparoscopic hepatectomy is indicated, the size, type, and location of the tumor must be evaluated. Nodular tumors smaller than 4 cm or pedunculated tumors smaller than 6 cm are proper indications[11]. Concerning location, tumors in the lower segment or the left lateral segment are good candidates. Thoracoscopic hepatectomy may also be feasible for tumors in the upper segment, but it would be difficult to obtain a free surgical margin

for the inferior portion of the tumor. Moreover, if accidental bleeding occurs, meticulous hemostasis is required. Thus, thoracoscopic hepatectomy is not indicated except in cases involving pedunculated tumors.

By comparing our laparoscopic cases with a similar series of open hepatectomies performed by the same surgeon, we were able to confirm the feasibility and safety of laparoscopic hepatectomy, with a mortality rate of 0% for the entire study cohort. Blood loss was significantly greater in the O-Hx group (mean ± SD; 648 ± 468 m*l*) than in the Lap-Hx group (mean ± SD; 154 ± 128 m*l*: p=0.05). No patient in the Lap-Hx group required blood transfusions during the hospital stay. This improvement in hemostasis could be attributed to the slower and more meticulous hepatic transection using microwaves, and the tamponading of the cut surface by the pneumoperitoneum. One interesting result of our study was that operating time (laparoscopic *vs* open) was similar in both groups (mean: 213 *vs* 247 min; p=NS). We believe that these results can be explained by the extensive experience of our team with laparoscopic procedures and by careful patient selection.

The main clinical advantage of using a minimally invasive technique to gain access to the liver resection was a significantly shorter postoperative hospital stay. The difference in mean postoperative stay between the two groups was 8 days (10.4 *vs* 18.0 days; p<0.017). Shorter hospital stays after laparoscopic hepatectomy should be possible with additional experience.

With respect to the operative method, laparoscopic partial hepatectomy is an effective and less invasive operation, in our experience. If larger volume of liver must be resected, laparoscopic-assisted hepatectomy should be considered[12], because it is easy to mobilize the liver, obtain good exposure, and determine tumor location by palpation, and achieve hemostasis by immediate compression. However, patients who require anatomical resection, such as a right lobectomy, would most likely be poor candidates for laparoscopic liver surgery[13], although we have had no direct experience. Because the required operative time would be longer without significant operative exposure, a skin incision of at least 15 cm would be required to remove the large volume of liver tissue, and the conversion rate to standard open hepatectomy would be high. The overarching principle of laparoscopic surgery is to achieve minimal invasiveness with optimal safety; thus, laparoscopic right lobectomy is too invasive to provide the expected benefits of laparoscopic surgery.

The indications for surgical resection and ablation therapy for HCCs remain controversial. The treatment of HCC and, more specifically, the indications for hepatectomy are extremely limited, and nonsurgical ablation therapy has been advocated by some for its advantages in providing better QOL, although curability is contraversal[14]. However, the Liver Cancer Study Group of Japan has reported that patients who underwent hepatic resection had a higher survival rate than did a nonsurgical treatment group, even for patients with small HCCs[2]. Under such circumstances, laparoscopic hepatectomy represents an intermediate option between ablation therapy and conventional hepatectomy; ablation therapy is less invasive than surgical resection, but laparoscopic hepatectomy allows more-complete resection and optimal pathologic evaluation of the resected specimen. Whereas laparoscopic surgery is less invasive than standard hepatectomy, laparoscopic hepatectomy is inferior to open hepatectomy in terms of anatomical resection. Laparoscopic systematic resection is considered a contraindication because of its technical difficulties. A recent case-control study has demonstrated the safety, associated with less blood loss, of laparoscopic left lateral segmentectomy[15].

Due to the specific characteristics of HCCs, including their high recurrence rate and their association with chronic hepatitis and cirrhosis caused by HBV or HCV, the most important goals in treatment are curability and minimal invasiveness. However, achieving both of these goals may not always be possible. Laparoscopic hepatectomy can avoid the disadvantages of standard hepatectomy and ablation and is beneficial for patient QOL because of its minimal invasiveness. This procedure

is expected to develop further in the future as a new surgical method for HCC, a method that improves QOL as long as the indications are strictly followed based on preoperative liver function and the location and size of tumors.

In conclusion, our findings suggest that laparoscopic surgery is a good alternative to open surgery for minor liver resections in selected patients. Further study with a greater number of cases, a longer follow-up period, and prospective randomization is needed to better define the role of laparoscopic hepatectomy, in particular, with regard to HCC in patients with cirrhosis.

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(Received, November 28, 2006)
(Accepted, February 1, 2007)