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Feasibility of Laparoscopic Right Posterior Sectionectomy for Malignant Lesion Compared to Open Right Posterior Sectionectomy: Retrospective, Single Center Study

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Purpose: We aimed to compare the operative outcomes of laparoscopic right posterior sectionectomy (RPS) and open RPS and evaluate the feasibility of laparoscopic RPS.

Methods: From January 2009 to December 2017, laparoscopic liver resections were performed in 235 patients at Chonnam National University Hwasun Hospital, South Korea. We retrospectively analyzed the clinical data of 16 patients who underwent laparoscopic RPS and compared the outcomes with those who underwent open RPS (n=17).

Results: The laparoscopic group had a mean tumor size of 3.82±1.73 cm (open group [OG]; 4.18±2.07 cm, p=0.596), mean tumor-free margin of 10.44±9.69 mm (OG; 10.06±10.62 mm, p=0.657), mean operation time of 412.2±102.2 min (OG; 275.0±60.5, p<0.001), mean estimated blood loss of 339.4±248.3 ml (OG; 236.4±102.7 ml, p=0.631), mean postoperative hospital stay of 11.63±2.58 days (OG; 14.71±4.69 days, p=0.027), and mean postoperative peaks of aspartate aminotransferase, alanine aminotransferase, total bilirubin, and prothrombin time of 545 mg/dl, 538 mg/dl, 1.39 mg/dl, 1.41 international normalized ratio (OG; 237 (p<0.001), 216 (p<0.001), 1.52 (p=0.817), and 1.45 (p=0.468)), respectively. There were no deaths or major complications in ether group. There were no cases of open conversion. Laparoscopic RPS was associated with a shorter hospital stay, prolonged operation time and lower complication rate. With long-term prognosis, no difference was found in overall survival rate and disease-free survival rate between the two groups.

Conclusion: Laparoscopic RPS can be performed, but the problems of long operative time and decrease in liver function should be resolved.

Keywords: Hepatectomy, Laparoscopy, Liver neoplasms

INTRODUCTION

Laparoscopic hepatectomy has evolved significantly in the past decades. Limited laparoscopic hepatectomy for peripheral lesions is considered safe for both benign and malignant lesions of the liver, owing to lesser bleeding, fewer complications, better cosmetic results, and better quality of life compared to open hepatectomy.[1-4] Oncological outcomes in overall and disease-free survivals with laparoscopic hepatectomy and open surgery are comparable for hepatocellular carcinoma and

colorectal cancer liver metastasis.[5-8] Currently, laparoscopic left lateral sectionectomy is the routine method, but recommendations suggest that major hepatectomy should be performed only by experienced surgeons.[1] In particular, because of technical difficulties in full liver mobilization and effective traction to well-visualize the resection plane in laparoscopic resection of tumors located in the right posterior lesion, laparoscopic right posterior sectionectomy (RPS) is rarely performed.[9-12] A few case series of laparoscopic RPS have been reported. The purpose of this study was to compare the operative outcomes of laparoscopic RPS with those of open RPS and evaluate the feasibility of laparoscopic RPS.

MATERIALS AND METHODS

Study population and data source

We retrospectively reviewed medical charts of 235 patients who underwent a laparoscopic liver resection at Chonnam National University Hwasun Hospital, South Korea in the period from January 2009 to December 2017. We analyzed the clinical data of 16 patients who underwent laparoscopic RPS and compared the outcomes with those who underwent open RPS (n=17). All elective liver surgeries were performed by surgeons with over 10 years of experience. The baseline characteristics of patients who were evaluated included age, sex, body mass index (BMI), preoperative American Society of Anesthesiologist (ASA) class, and liver cirrhosis.

Data on the patients' clinicopathological characteristics, operative procedures, and postoperative outcomes were retrospectively collected from the medical records. Postoperative complications were defined as those that developed within 30 postoperative days, and were divided into local and systemic complications based on the development site. The severity was graded based on the Clavien-Dindo classification of surgical complications. This study was approved by the Institutional Review Board of Chonnam National University Hwasun Hospital.

Operation indication and technique

The indications for laparoscopic RPS were similar to those for open RPS. Tumors invading or adjacent to the main portal pedicle or inferior vena cava and central lesions in the suprahepatic junction adjacent to major hepatic vein were considered a contraindication.

We followed the procedure described in previous study on laparoscpic RPS.[9,13,14] A pneumoperitoneum was established through a 10-mm umbilical port and maintained below 12 mmHg. A flexible laparoscope was used. Initially, a cholecys-

tectomy was performed in the usual manner. The liver was fully mobilized from the inferior vena cava, and multiple small hepatic veins were clipped and divided. Thereafter, the major Glissonian pedicle of the right posterior section was dissected and transected using an Endo-GIA stapler, which demarcated the right posterior section and this guided the plane of resection. The superficial hepatic parenchyma was transected using the Harmonic Scalpel (Ethicon, Cincinnati, OH, USA) along the demarcated line that was created by the ischemia and the deeper portion of the parenchyma was dissected using a laparoscopic cavitron ultrasonic surgical aspirator. Laparoscopic ultrasonography was used to localize the tumor and find its relationship with the major hepatic veins, for demonstration of any satellite nodule of HCC, and for helping achieve an adequate margin. The small branches of the hepatic veins were controlled with endoclips and the large branches of the right hepatic vein were transected with the Endo GIA. Once the specimen was completely detached, it was inserted into a protective bag. We usually extract the specimen through the incision created by extending the epigastric port site for large specimens.

Statistical analysis

Open RPS and laparoscopic RPS were compared using the appropriate statistical analyses. Numerical variables were expressed as mean±standard deviation or median and range and compared using the Student's t-test or Mann-Whitney U test, respectively. The patient survival was calculated by the product limit method of Kaplan and Meier, and the differences in the survival between the groups were compared using the log-rank test. Two-sided p values<0.05 indicated statistical significance. Statistical analyses were performed with SPSS 20.0 (SPSS Inc., Chicago, IL).

RESULTS

Table 1 summarizes the patient demographics for the open (OG) and laparoscopic groups (LG). A total of 33 patients (25 men and 8 women) underwent RPS during the study period. Sixteen patients (49.5%) underwent laparoscopic RPS, while 17 (50.5%) patients underwent open RPS. There were no significant differences in age (59.7±8.3 years in OG vs. 58.8± 9.8 years in LG, p=0.794), sex (p=0.606), ASA class (p=0.533), or BMI (22.8±2.1 kg/m^2 in OG vs. 24.8±3.51 kg/m^2 in LG, p=0.53). LG had a lower proportion of liver cirrhosis cases (n=5, 31%) compared to OG (n=13, 76%, p=0.025). There were no significant differences in the pathologic diagnosis or result. Pathologic diagnoses were hepatocellular carcinoma and cholangiocarcinoma in 16 (94%) and 1 (6%) patients, respectively, in

Table 1. Demographic data and pathologic results of patients

	Open (n = 17)	Laparoscopic (n = 16)	p value
Age, year			0.794
Mean ± SD	59.7 ± 8.3	58.8 ± 9.8	
Median (IQR)	58 (42 ~ 75)	59 (44 ~ 75)	
Sex, n (%)			0.606
Male	12 (70.6)	13 (81.3)	
Female	5 (29.4	3 (28.7)	
ASA, n (%)			0.533
I	1 (6)	3 (19)	
II	16 (94)	13 (81)	
III	0 (0)	0 (0)	
BMI (kg/m^2), mean ± SD	22.8 ± 2.1	24.8 ± 3.5	0.53
Liver cirrhosis, n (%)	13 (76)	5 (31)	0.025
Pthologic diagnosis, n (%)			0.533
Heatocellular carcinoma	16 (94)	13 (81)	
Cholangiocarcinoma	1 (6)	0	
Colorectal cancer liver metasatis	0	3 (19)	
Pathologic result			
Tumor size (cm), mean ± SD	4.18 ± 2.07	3.82 ± 1.73	0.596
Resection margin (mm), mean ± SD	10.06 ± 10.62	10.44 ± 9.69	0.657

ASA = American Society of Anesthesiology; SD = standard deviation; IQR = interquartile range; BMI = body mass index.

Table 2. Surgical outcome

	Open (n = 17)	Laparoscopic (n = 16)	p value
Op time, mean ± SD	275.0 ± 60.5	412.2 ± 102.2	<0.001
Blood loss, mean ± SD	236.4 ± 102.7	339.4 ± 248.3	0.631
Hospital stay (POD), mean ± SD	14.71 ± 4.69	11.63 ± 2.58	0.027
AST, peak (mg/dl)	237 ± 115	545 ± 178	<0.001
ALT, peak (mg/dl)	216 ± 145	538 ± 263	<0.001
T-bil, peak (mg/dl)	1.52 ± 0.56	1.39 ± 0.39	0.817
PT, peak (INR)	1.45 ± 0.17	1.41 ± 0.15	0.468

SD = standard deviation; POD = postoperative day; AST = aspartate aminotransferase; ALT = alanine aminotransferase; INR = international normalized ratio.

OG, and hepatocellular carcinoma and colorectal cancer liver metastasis in 13 (81%) and 3 (19%) patients, respectively, in LG (p=0.533). The mean tumor size in OG and LG were 4.18±2.07 cm and 3.82±1.73 cm (p=0.596), and the mean resection margin in OG and LG were 10.06±10.62 mm and 10.44±9.69 mm, respectively (p=0.657) (Table 1). There was one R1 resection (tumor free resection margin<1 mm) in OG and no in LG.

Table 2 summarizes surgical outcome for the open (OG) and laparoscopic groups (LG). The operation time was significantly longer in LG (412.2±102.2 min) compared to OG (275.0±60.5 min, p<0.001). There were no significant differences in the estimated blood loss (236.4±102.7 ml in OG vs. 339.4±248.3 ml in LG, p=0.631), peak total bilirubin (1.52±0.56 mg/dl in OG vs. 1.39±0.39 mg/dl in LG, p=0.817) or peak prothrombin time (international normalized ratio, 1.45±0.17 in OG vs. 1.41±0.15 in LG, p=0.468). Peak aspartate aminotransferase (AST 545± 178 U/L vs. 237±115 U/L, p<0.001) and alanine aminotransferase (ALT; 538±263 vs. 216±145 U/L, p<0.001) levels were

higher in LG compared to OG. The mean duration of hospital stay after the surgery was shorter in LG (11.63±2.58 days) compared to OG (14.71±4.69 days, p=0.027), which was statistically significant (Table 2, 3).

Based on the Clavien-Dindo classification, there were two (5.8%) complications (grade 2; urinary tract infection and wound infection) in OG and none (0%) in LG. There was no mortality within 90 postoperative days in either group. Additionally, there were no cases of open conversion (Table 4).

Out of 33 patients, 29 were diagnosed with hepatocellular carcinoma (OG=16, LG=13). None of them receive Transcatheter arterial chemoembolization (TACE) before surgery. The mean follow-up period was 43.6 month for OG and 42.7 month for LG. The number of deaths in the follow-up period were 3 in OG and 1 in LG. Local recurrence rate were 6.3% (1/16) in OG and 7.7% (1/13) in LG. A patient with local recurrence in OG underwent TACE and one in LG underwent 2nd operation. In terms of the long-term outcome, we found no differences in the patient survival rate and disease-free survival rate between the two groups (Fig. 1, 2).

DISCUSSION

While preserving the hepatic reserve function, to secure the tumor-free margin is extremely important. In order to make sure the tumor-free margin, we routinely use the laparoscopic ultrasound examination repeatedly during the operation. This also helps to identify unexpected satellite lesions and localize major vessels.

Despite the retrospective nature, this study shows that laparoscopic RPS is a feasible therapeutic option as an alternative to open RPS. Laparoscopic RPS was associated with shorter

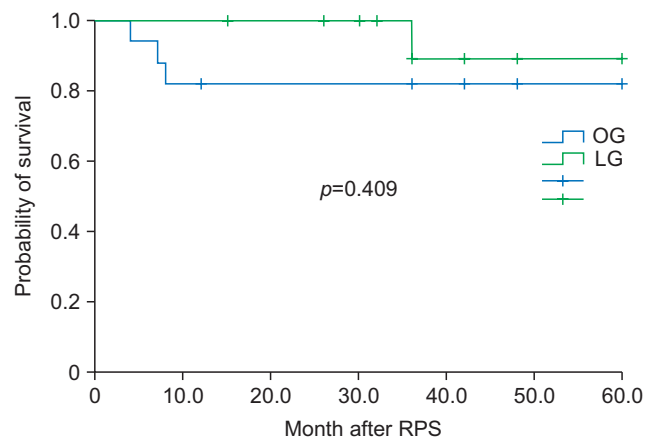**Table 3.** Details of laparoscopic right posterior resection

Case	Diagnosis	Tumor size (cm)	Cirrhosis on pathology	Operative time (minutes)	Blood loss (ml)	Blood transfusion (ml)	Margin (mm)	Hospital stay (days)	Complication	Concersion
1	HCC	2.5	No	285	250	0	3	12	No	No
2	HCC	2.8	Yes	570	650	320	25	9	No	No
3	HCC	4.3	No	395	170	0	1	16	No	No
4	CLM	4.2	No	255	150	0	15	7	No	No
5	HCC	2	Yes	585	400	0	25	14	No	No
6	HCC	3	No	365	100	0	5	10	No	No
7	HCC	3.1	No	415	130	0	1	13	No	No
8	HCC	2.8	Yes	470	180	0	1	10	No	No
9	CLM	7	No	325	750	0	10	12	No	No
10	CLM	0.5	No	360	150	0	20	10	No	No
11	HCC	7	No	380	400	0	10	13	No	No
12	HCC	4.1	Yes	425	150	0	1	13	No	No
13	HCC	3	Yes	465	750	0	20	12	No	No
14	HCC	5	No	380	130	0	25	16	No	No
15	HCC	4.3	No	600	750	0	3	8	No	No
16	HCC	5.5	Yes	400	320	0	2	11	No	No

HCC = hepatocellular carcinoma; CLM = colorectal cancer liver metastasis.

Table 4. Mortality and morbidity of patients

	Open	Laparoscopic
Mortality in 90 days, n (%)	0 (0.0)	0 (0.0)
Morbidity	2 (11.8)	0 (0.0)
Clavien-Dindo grade II, n (%)	UTI : 1 (5.8)	
	Wound infection 1 (5.8)	

Fig. 1. Comparison of patient's survival rate between OG and LG. No significant difference in survival rate was found between the two groups. OG = open group; LG = laparoscopic group.

hospital stays and lower complication rates compared to the open method, and there were no significant differences in tumor-free resection margin, blood loss, postoperative peak total bilirubin level, or peak prothrombin time between the groups. There was a tendency for longer operative time and elevated AST and ALT (decreased liver function) in LG. These results are generally consistent with previous studies on laparoscopic RPS.[15,16] Cho et al. reported that a mean operation time of 567 min (412 min in this study), mean duration of postoperative hospital stay of 10.6±4.8 days (11.63±2.58 days in this study), and mean tumor-free margin of 3.0±5.8 cm (10.44±9.69 mm in this study).[16] Although the follow-up period was not long and there was loss to follow-up, no difference

was found in overall survival rate and disease-free survival rate between the two groups.

The present study has several potential limitations. First, it was a retrospective analysis conducted at a single center, so selection bias may exist in the results. Second, the sample size
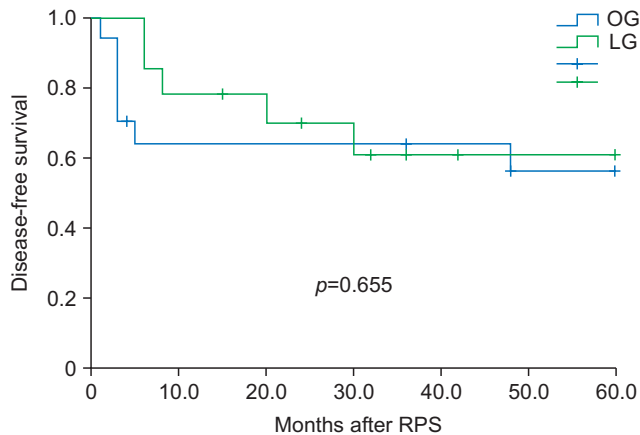
Fig. 2. Comparison of disease-free survival rate between OG and LG. No significant difference in disease-free survival rate was found between the two groups. OG = open group; LG = laparoscopic group.

was relatively small (n, LG=16, OG=17). Therefore, there were deficiencies in gaining statistical power. Third, there was no accurate evaluation of oncological outcomes, such as disease-free survival or overall survival, as more laparoscopic RPS has been performed relatively recently due to the operator's learning curve and there was no strict patient selection criteria.

Despite these limitations, this study has important implications. This is one of the few studies comparing laparoscopic RPS to open RPS at a single medical center. Thus, it provides an opportunity for a multicenter prospective cohort study to overcome these limitations in the future.

CONCLUSION

In conclusion, laparoscopic RPS is a possible surgical procedure in patients with a lesion in the right posterior region of the liver. We need to resolve the problems of long operative time and consequent decrease in liver function. Further studies with a larger number of patients and a longer follow-up period are required to evaluate the oncological outcomes.

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Conceptualization: CKC. Formal analysis: HJK. Methodol-

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CONFLICT OF INTEREST

None.

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