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Short-term Outcomes and Difficulty of Repeat Laparoscopic Liver Resection

Shozo Mori, MD, PhD, Kohei Mishima, MD, Takahiro Ozaki, MD, Yoshiki Fujiyama, MD, and Go Wakabayashi, MD, PhD, FACS

Objectives: To investigate the feasibility of repeat laparoscopic liver resection (Rep-LLR), including repeat anatomical resection (Rep-AR), as compared to initial-LLR (Ini-LLR).

Background: The indications of LLR have expanded to treatment of recurrent liver tumors. However, the feasibility of Rep-LLR, including Rep-AR, has not yet been adequately assessed.

Methods: Data of 297 patients who had undergone LLR were reviewed. Among the 297 patients, 235 (AR: 168) had undergone Ini-LLR and 62 (AR: 27) had undergone Rep-LLR, and the surgical outcomes were compared between the groups. In addition, multivariate analysis was performed to identify predictors of the difficulty of Rep-LLR based on the operation time and volume of blood loss.

Results: Of the 62 patients who had undergone Rep-LLR, 44, 14, and 4 had undergone second, third, and fourth repeat LRs, respectively. No significant intergroup differences were observed in regard to the operation time, blood loss, conversion rate to open surgery, postoperative morbidity, or postoperative hospital stay. However, the proportion of patients in whom the Pringle maneuver was used was significantly lower in the Rep-LLR group than in the Ini-LLR group. Multivariate analysis identified surgical procedure ≥sectionectomy at the initial/previous LR and an IWATE difficulty score of ≥6 as being independent predictors of the difficulty of Rep-LLR. Use of adhesion barriers at the initial/previous LR was associated with a decreased risk of failure to perform the Pringle maneuver during Rep-LLR.

Conclusions: Rep-LLR can offer outcomes comparable to those of Ini-LLR over the short term.

Keywords: laparoscopic liver resection, repeat liver resection, difficulty score, adhesion barrier, Pringle maneuver

Recently, performance of laparoscopic liver resection (LLR) has spread around the world and become a promising standard approach for liver resection (LR).[1,2] With the development of advanced instruments and advanced techniques, and accumulation of experience, the indications for LLR have expanded to treatment of recurrent liver tumors. Consequently, there has been an increase in the number of reports of repeat-LLR (Rep-LLR) recently.[3–6] Rep-LLR offers the advantages of a lower volume of blood loss, less postoperative morbidity, and a shorter hospital stay in the short term, and comparable outcomes to repeat open liver resection (Rep-OLR) over the long term.[3–6] However, repeat liver resection (Rep-LR) itself is regarded as a challenging procedure because of the formation of scars, adhesions, and anatomical deformities of the remnant liver after the initial/previous LR. Previous reports have suggested that initial/previous LR is associated with an increased difficulty of adopting a laparoscopic approach and a higher risk of conversion to OLR at the Rep-LR.[7,8] However, in experienced hands and specialized centers, and with strict patient selection, laparoscopy is an appropriate option in patients requiring Rep-LR.[9]

There are numerous reports of comparison of the surgical outcomes of Rep-LLR and Rep-OLR and of Rep-LLR and initial-LLR (Ini-LLR).[10–12] However, previous studies have included mostly cases of nonanatomical LLR. Anatomical LLR (Anat-LLR) is highly complex and requires advanced expertise and laparoscopic skills in LLR. Therefore, Anat-LLR, in general, is performed in specialized centers. In addition, to date, there is little evidence in regard to the feasibility and safety of Anat-LLR in patients scheduled for Rep-LR.

Use of the Pringle maneuver is essential to reduce blood loss during liver transection without detrimental effects on the postoperative liver function.[13,14] However, use of the Pringle maneuver in Rep-LR is often difficult because of the formation of adhesions around the hepatoduodenal ligaments after the initial/previous LR. One of the methods to reduce postoperative adhesion formation is to use adhesion barriers.[15–17] Adhesion barriers are useful to decrease the formation as well as severity of adhesions.[15–17] However, whether the frequency of use of the Pringle maneuver during Rep-LLR is affected by the use of an adhesion barrier at the initial/previous LR remains unknown.

Therefore, we attempted to investigate the short-term outcomes of Rep-LLR as compared to those of Ini-LLR. In addition, we also evaluated the difficulty level of Rep-LLR and the relationships between use of the Pringle maneuver during Rep-LLR and use of adhesion barriers at the initial/previous LR.

METHODS

Patients and Data Collection

This study was conducted with the approval of the ethics committee of Ageo Central General Hospital (approval number: AMG964, 2021). The study subjects were patients who

From the Department of Surgery, Center for Advanced Treatment of HBP Diseases, Ageo Central General Hospital, Saitama, Japan.

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Reprints: Shozo Mori, MD, PhD, Department of Surgery, Center for Advanced Treatment of HBP Diseases, Ageo Central General Hospital, 1-10-10 Kashiwaza, Ageo, Saitama 362-8588, Japan. E-mail: shozomori@hotmail.co.jp.

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had undergone LLR at the Department of Surgery, Center for advanced treatment of HBP diseases, Ageo Central General Hospital, between April 2016 and November 2021. None of the patients required two-stage hepatectomy.

The following data of the patients were collected for the analyses in this study: patient characteristics (age, sex, body mass index, primary diagnosis, and underlying liver disease); preoperative liver function (serum total bilirubin level, serum albumin level, prothrombin time, platelet count, and indocyanine green retention rate at 15 minutes [ICGR15]); preoperative tumor characteristics (maximum tumor size, number of tumors, tumor location, and proximity of the tumor(s) to a major blood vessel); difficulty score (DS); preoperative ascites (yes/no); type of surgical procedure adopted; number of LLR; approach (laparoscopic or open) adopted for the initial/previous LR; use of adhesion barriers at the initial/previous LR; history of upper open laparotomy; and history of chemotherapy.

The short-term outcomes, including the operative outcomes, included the operation time, volume of blood loss, blood transfusion volume, use of the Pringle maneuver, total Pringle time, rate of conversion to open or hand-assist laparoscopic surgery (HALS), postoperative hospital stay, rate of postoperative morbidity (Clavien-Dindo grade ≥IIIa),[18] and 30-day mortality.

The patients were divided into two groups: the Ini-LLR group and the Rep-LLR group. Then, each of these groups was further divided into two subgroups: the initial anatomical LLR (Ini-Anat-LLR) group and the repeat anatomical LLR (Rep-Anat-LLR) group. The clinical characteristics and surgical outcomes were compared among these groups.

Surgical Technique and Indication for Repeat LR

Our standardized LLR procedures were performed as described in our previous reports.[19,20] Similar techniques were used for Rep-LLR. The Pringle maneuver, using the conventional tourniquet technique, was routinely performed extracorporeally to obtain a clear view during the Glissonean approach and prevent unnecessary blood loss during the transection of the liver parenchyma. However, the Pringle maneuver was not adopted in some patients because of the presence of severe adhesions around the hepatoduodenal ligament, location of the tumor near the liver surface, or small estimated liver resection volume. Adhesion barriers were applied routinely in most cases of LLR. A spray-type barrier (AdSpray) or a sheet-type barrier (Seprafilm and Interceed) was applied around the hepatoduodenal ligament, hepatic hilum, remnant liver, diaphragm, stomach, and area under each trocar.

We adopt a laparoscopic approach for Rep-LR in all patients who do not need biliary reconstruction.

Difficulty Scoring System

We calculated the difficulty score (DS) based on the IWATE criteria, which allows prediction of the difficulty level of LLR from preoperative variables and appropriate selection of patients according to the surgeons' skill level (low, intermediate, advanced, expert).[21,22] Briefly, the total score was the sum of the following 6 difficulty indices: (1) tumor location (score, 1–5); (2) extent of hepatic resection (score, 0–4); (3) tumor size (score, 0 or 1); (4) proximity to a major vessel(s) (score, 0 or 1); (5) liver function (score, 0 or 1); and (6) HALS/hybrid (score, 0 or −1). Then, the scores were grouped into four difficulty levels, as follows: low (0–3), intermediate (4–6), advanced (7–9), and expert difficulty (10–12).

Definition of Anatomical Resection and Major LR

The type of surgical procedure used for LLR was defined according to the Tokyo 2020 Terminology of Liver Anatomy and Resections.[23] Anatomical resection (AR) is defined as complete removal of the liver parenchyma within the draining portal territory. AR includes subsegmentectomy, segmentectomy, sectionectomy, bisectionectomy, or trisectionectomy. Non-AR includes partial resection (PR) or enucleation. The liver parenchyma within the draining portal territory is identified and visualized based on negative ICG staining during the Glissonean approach at our department.[19,20] Major LR was defined as resection of more than three segments according to Couinaud's classification.

Classification of the Difficulty Level of Rep-LLR

The difficulty level of Rep-LLR was classified into 3 categories according to the IMM classification, based on the operation time, blood loss, and conversion rate to open surgery, as described previously[24,25]; grade 1: low difficulty level (wedge resection and left lateral sectionectomy); grade 2: intermediate level (anterolateral segmentectomy [segments 2, 3, 4b, 5, or 6]; grade 3: high difficulty level (posterosuperior segmentectomy [segments 1, 4a, 7, or 8]).

Distribution of the Grade Based on the 75th Percentiles of the Operation Time and Blood Loss in Rep-LLR

The grade based on the operation time and blood loss in the 75th percentile was used to classify the difficulty level of Rep-LLR into 3 categories: score of 2: ≥75th percentile of both the operation time and blood loss; score of 1: ≥75th percentile of either the operation time or blood loss; a score of 0: <75th percentile of both the operation time and blood loss.

Statistically Analysis

SPSS version 17.0 (SPSS, Inc, Chicago, IL) was used for all the statistical analyses. Continuous data were expressed as the median values (ranges) and compared using the Mann-Whitney *U* test or Kruskal-Wallis test, while the categorical data were expressed as *n* (%) and compared using the Chi-squared test or the Fisher exact test. Univariate and multivariate analyses were performed using the Chi-squared test or the Fisher exact test, and a multiple logistic regression analysis with forward stepwise selection was used to identify predictors of an intermediate/high difficulty level of Rep-LLR and of nonuse of the Pringle maneuver at the Rep-LLR due to the presence of adhesions around the hepatoduodenal ligament. $P \leq 0.1$ was set as the cutoff value for the elimination. Differences at $P < 0.05$ were considered as being statistically significant.

RESULTS

Data of a total of 297 patients who underwent LLR during the specified study period were included in the analyses. Among these 297 patients, 235 (79.1%) patients underwent Ini-LLR and 62 (20.9%) patients underwent Rep-LLR. AR had been performed in 168 (71.5%) of the 235 patients who underwent Ini-LLR and 27 (43.5%) of the 62 patients who underwent Rep-LLR (Figure 1).

Clinical Characteristics

Comparisons of the clinical characteristics between the Ini-LLR and Rep-LLR groups and between the Ini-Anat-LLR and Rep-Anat-LLR groups are shown in Supplemental Table 1 (http://links.lww.com/AOSO/A139). The proportions of males and patients with the primary diagnosis of HCC and CRLM were greater in the Rep-LLR group ($P = 0.010$ and $P = 0.008$, respectively). The preoperative ICGR15% was significantly worse in

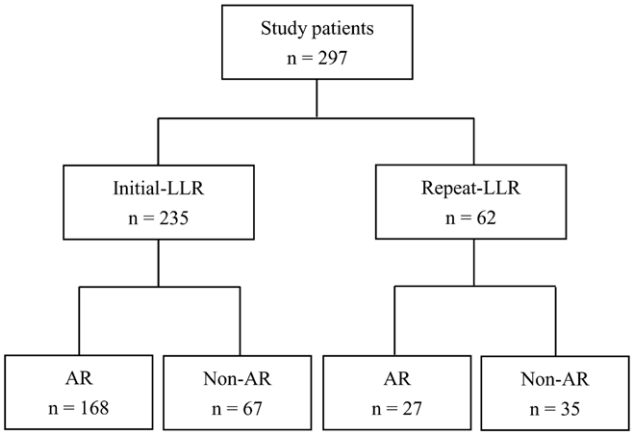

FIGURE 1. Flow-chart showing all the study patients who underwent laparoscopic liver resection. AR, anatomical resection; LLR, laparoscopic liver resection.

the Rep-LLR and Rep-Anat-LLR groups than in the Ini-LLR and Ini-Anat-LLR groups ($P < 0.001$ and $P = 0.012$, respectively). There were no significant differences among the groups in any of the other variables examined.

Surgical Outcomes

The surgical outcomes in the Ini-LLR versus Rep-LLR group and in the Ini-Anat-LLR versus Rep-Anat-LLR group are shown in Supplemental Table 2 (http://links.lww.com/AOSO/A140). Overall, adhesion barriers were applied in 271 of the 297 patients (91.2%); of the 271 patients, in 211 patients, adhesion barriers were used around the hepatoduodenal ligament. The proportion of cases of AR (subsegmentectomy or segmentectomy/sectionectomy/bisectionectomy/trisectionectomy) as the surgical procedure adopted, the proportion of cases of major LR, and the median DS were significantly higher in the Ini-LLR group than in the Rep-LLR group ($P < 0.001$, $P = 0.009$ and $P = 0.002$, respectively). The proportion of patients in whom the Pringle maneuver was performed was higher and the median total Pringle time was longer in the Ini-LLR and Ini-Anat-LLR groups as compared with the Rep-LLR and Rep-Anat-LLR groups ($P < 0.001$, $P = 0.002$, $P = 0.018$, and $P = 0.029$, respectively). However, no significant differences in the other variables were observed among the groups. The reasons for conversion to the open surgical approach or HALS included the need for portal vein reconstruction and restricted operative field and maneuverability in the Ini-LLR group (open: n = 1; HALS: n = 2), and presence of severe adhesions, restricted operative field and maneuverability, or massive bleeding, in the Rep-LLR group (open: n = 1; HALS: n = 2). A total of 25 patients developed severe postoperative morbidity (Clavien-Dindo grade ≥IIIa), including biliary leakage in 10 patients, liver failure in 3 patients, biliary stenosis in 2 patients, and renal failure, pneumonia, and duodenal ulcer in 1 patient each of the Ini-LLR group, and biliary leakage in 3 patients and postoperative bleeding, congestive heart failure, adhesive intestinal obstruction, and nonocclusive mesenteric ischemia in 1 patient each of the Rep-LLR group.

Details of the Repeat Laparoscopic Liver Resection

Supplemental Table 3 (http://links.lww.com/AOSO/A141) shows the details of the Rep-LLR and Rep-Anat-LLR. Recurrences near the previous resected segment or the adjacent segment/a different segment were observed in 43 patients (69.4%) and 19 patients (30.6%), respectively. The number (proportions) of patients undergoing a second, third, and fourth Repeat-LLR were 44 (71%), 14 (22.6%), and 4 (6.4%) of the 62 patients, respectively. Among the patients who underwent a second Rep-LLR, 37 and 7 patients had undergone LLR and OLR at the initial surgery. On the other hand, all the patients who underwent a third and fourth Rep-LLR had undergone LLR at the previous surgery. The median operation time and blood loss in patients who had undergone LLR and OLR at the initial/previous LR were 356 minutes (101–585 min) and 150 cc (3–1569 cc), and 317 minutes (145–424 min) and 291 cc (150–1722 cc), respectively ($P = 0.663$ and $P = 0.089$). In terms of type of LR (initial/previous → repeat), 54 (87.1%), 6 (9.7%), and 2 (3.2%) patients needed minor LR → minor LR, major LR → minor LR, and minor LR → major LR, respectively. The Pringle maneuver was not used in 27 patients (43.5%) because of the presence of adhesions around the hepatoduodenal ligament (n = 15) or because it was not planned at all owing to location of the tumor near the liver surface or small volume of liver resection (n = 12). Adhesion barriers around the hepatoduodenal ligament had been used at the previous LR in 35 patients (56.5%).

Classification of the Difficulty Level of Rep-LLR Based on the IMM Classification

The surgical difficulty level in patients who underwent Rep-LLR was classified into grade 1 (n = 36, 58.1%), grade 2 (n = 9, 14.5%), or grade 3 (n = 17, 27.4%) according to the IMM classification (Supplemental Table 4, http://links.lww.com/AOSO/A142). The median DS (IWATE criteria) increased significantly, with a linear increase from group I to group III ($P < 0.001$). Although there were significant differences in the median operation time or blood loss among the 3 groups ($P = 0.001$ and $P = 0.001$), no linear increase from group I to group III was observed. No significant differences were observed in any of the other variables among the groups.

Distribution of the Grade Based on the 75th Percentiles of the Operation Time and Blood Loss in Rep-LLR

The 75th percentiles of the operation time and blood loss were 401.25 minutes and 500 cc, respectively. Based on these data, 38 (61.3%), 17 (27.4%), and 7 (11.3%) patients were assigned scores 0, 1, and 2, respectively, for Rep-LLR.

Predictors of Score 1 or 2 Based on the Operation Time and Blood Loss in Rep-LLR

The results of univariate and multivariate analyses performed to identify predictors of score 1 or 2 based on the operation time and blood loss of Rep-LLR are shown in Supplemental Table 5 (http://links.lww.com/AOSO/A143). Multivariate analysis with adjustments identified only surgical procedure ≥sectionectomy at the previous LR ($P = 0.015$, odds ratio = 4.947, 95% confidence interval [CI] = 1.366–17.913) and DS ≥6 ($P = 0.036$, odds ratio= 3.396, 95% CI = 1.083–10.653) as being independent predictors of score 1 or 2 of Rep-LLR.

Predictors of nonuse of the Pringle Maneuver at the Rep-LLR due to the Presence of Adhesions Around the Hepatoduodenal Ligament

The results of univariate and multivariate analyses performed to identify predictors of nonuse of the Pringle maneuver at the Rep-LLR due to the presence of adhesions around the hepatoduodenal ligament are shown in Supplemental Table 6 (http://links.lww.com/AOSO/A144). Multivariate analysis with adjustments identified only use of adhesion barriers around the hepatoduodenal ligament at the previous LR ($P = 0.020$, odds ratio = 0.203, 95% CI = 0.053–0.775) as being

independent predictors of nonuse of the Pringle maneuver at the Rep-LLR due to presence of adhesions around the hepatoduodenal ligament.

DISCUSSION

LLR is rapidly becoming a promising option for liver resection around the world, replacing OLR on account of its feasibility and safety.[26–28] The number of cases of major LLR is also gradually increasing, year by year, with accumulating experience and development of more advanced surgical instruments/techniques.[29–31] In addition, the indications of LLR has also expanded to Rep-LR for the treatment of recurrent liver tumors in recent years.[3–5] In a study of 1582 HCC patients at 42 high-volume liver surgery centers around the world, Morise et al[4] reported, based on propensity score matching analysis, that Rep-LLR was associated with a lower volume of intraoperative blood loss, and longer operation time, but a similar blood transfusion rate, postoperative hospital stay, and morbidity and mortality at 90 days as compared to Rep-OLR. They concluded that Rep-LLR is feasible in selected patients with recurrent HCC.

In the present study, we obtained comparable surgical outcomes between Rep-LLR/Rep-Anat-LLR as also between Ini-LLR/Ini-Anat-LLR, including in terms of the operation time, volume of blood loss, blood transfusion rate, conversion rate to open surgery or HALS, incidence of postoperative morbidity (Clavien-Dindo grade ≥IIIa), postoperative hospital stay, and mortality at 30 days (Supplemental Table 2, http://links.lww.com/AOSO/A140). Biliary leakage was the main liver-specific postoperative morbidity in both the Ini-LLR group and the Rep-LLR group, and the incidence of this complication was similar in both groups. Thus, Rep-LLR was not associated with an increased risk of biliary leakage. These results suggest that a laparoscopic approach for Rep-LR is feasible and safe, with no adverse influence on the surgical outcomes.

However, there are also several possible disadvantages of adopting the laparoscopic approach for Rep-LLR. The proportion of cases in which the Pringle maneuver was successfully used was significantly lower in Rep-LLR/Rep-Anat-LLR groups as compared with Ini-LLR/Ini-Anat-LLR (Supplemental Table 2, http://links.lww.com/AOSO/A140). The main reason for this was the severe adhesion formation around the hepatoduodenal ligament after the Ini-LR (Supplemental Table 3, http://links.lww.com/AOSO/A141). Formation of severe adhesions around the liver, hepatoduodenal ligament, or peritoneum frequently occurs after LR. Belli et al[32] investigated for patients with recurrent HCC and demonstrated a greater degree of intraabdominal adhesion formation in patients who had previously undergone OLR as compared to LLR. Moreover, a larger number of thick and hypervascularized adhesions, typical of cirrhotic patients, which are associated with a major risk of bleeding and bowel injuries at the time of reintervention, were observed in the group that had previously undergone OLR. These findings indicate that precise and meticulous adhesiolysis should be ensured during Rep-LLR to obtain improved surgical outcomes, especially in patients with a previous history of OLR or liver cirrhosis. Consequently, this will lead to improved surgical outcomes.

Of the 62 patients who underwent Rep-LLR, the initial/previous LR has also been performed by the laparoscopic approach (LLR) in 55 patients. Surprisingly, in all cases of repeat third or fourth LR, a laparoscopic approach had been used for the previous LRs (LLR) (Supplemental Table 3, http://links.lww.com/AOSO/A141). These data could serve as reference for centers attempting to develop LLR. At our center, in principle, we adopt a laparoscopic approach for Rep-LR in all patients who do not require biliary reconstruction, irrespective of whether it is major or minor LR. Despite this policy, our conversion rate is low. Shafaee et al[33] reported the results of their analyses of Rep-LLR from the experience of 3 institutions. Patients with previous OLR experienced more intraoperative blood loss and a higher transfusion rate than those with previous LLR. They concluded that Rep-LLR can be performed safely and with good results, particularly in patients with previous LLR. Mise et al[34] investigated the feasibility of OLR for third or fourth Rep-LR in cases of recurrent HCC and reported that third or more Rep-OLR was associated with a prolonged operation time and increased postoperative morbidity as compared to second Rep-OLR. However, similar results were not obtained between the third or fourth Rep-LLR and second Rep-LLR in this study (data were not shown). These findings appear to underscore the benefit of a laparoscopic approach. In the Southampton Consensus Guidelines for laparoscopic liver surgery, the experts suggest that adoption of the laparoscopic approach for the Ini-LR may facilitate repeated resections by limiting the formation of adhesions, which represents an important advantage.[9] Therefore, a laparoscopic approach for LR is the most desirable for Rep-LR in patients with recurrent liver tumors.

A system for scoring the difficulty level of LLR (IWATE Criteria) has been proposed, to classify the difficulty index and the difficulty level.[21,22] In Rep-LLR, however, some factors such as the type of surgical procedure used at the previous LR and the degree of adhesions may influence the DS in clinical settings. Therefore, we classified the grade (score 1, 2, and 3) in Rep-LLR based on the 75th percentile of the operation time and volume of blood loss; in general, the duration of an operation time and the amount of blood loss are known to be correlated with the difficulty level of an operation in clinical practice. Multivariate analysis identified LR ≥sectionectomy at the initial/previous LR and DS ≥6 as independent predictors of a score 1 or 2 in Rep-LLR (Supplemental Table 5, http://links.lww.com/AOSO/A143). The surgical technique of LR ≥sectionectomy often involves manipulation around the hepatic hilar to identify the second order branches of the Glissonean pedicle;[19,35,36] in addition, LR ≥sectionectomy is associated with a relatively extensive area of resected liver surface. It is speculated that these aforementioned factors may lead to the formation of severe adhesions, deformity, and poor maneuverability of the remnant liver, resulting in a prolonged operation time and higher blood loss volume at the Rep-LLR. DS ≥6 was set as a predictor of a score of 1 or 2 of Repeat-LLR, because the median DS in the Rep-LLR group was 5. The difficulty scoring system (IWATE Criteria) was useful to predict the difficulty level of Rep-LLR in the present study. Accordingly, preoperative assessment of the DS for identifying difficult cases is mandatory in patients being considered for Rep-LLR. It might be desirable to defer/avoid the laparoscopic approach for Rep-LR in patients with high DS, depending on the center's experience or individual surgeons' learning curve for LLR.

In regard to other systems used for evaluating the difficulty of Rep-LLR, Hobeika et al[25] proposed an algorithm based on the IMM classification and factors (previous major LR and presence of sinusoidal obstruction syndrome) associated with unexpected difficulty, to refine the level of expertise required to perform Rep-LLR for CRLM.

Multivariate analysis revealed that use of adhesion barriers around the hepatoduodenal ligament at the initial/previous LR was associated with a decreased risk of failure to perform the Pringle maneuver, due to the formation of adhesions of the hepatoduodenal ligament, during Rep-LLR (Supplemental Table 6, http://links.lww.com/AOSO/A144). Okubo et al[16] reported that use of adhesion barriers at the initial/previous surgery was an independent predictor of few adhesions at both the hepatic hilum and around the liver in patients undergoing Rep-LR. From the clinical viewpoint of laparoscopic surgery, a sprayable

adhesion barrier may be advantageous, as it can be applied easily during surgery.

Use of the Pringle maneuver is known to reduce blood loss during LR, without any detrimental effects.[13,14] In the present study, there was no significant difference in the operation time, blood loss, conversion rate to open surgery/HALS, or the incidence of Clavien-Dindo grade ≥IIIa postoperative morbidity between patients of the Rep-LLR group in whom Pringle maneuver was (n = 35) and was not (n = 27) used (P = 0.080, P = 0.972, P = 0.598, and P = 0.646, respectively). However, these results could have been influenced by various factors such as the type of LR, type of initial/previous LR, primary diagnosis, background liver status, and severity of adhesions. Further investigation is needed to clarify the clinical implications/usefulness of using Pringle maneuver during Rep-LLR.

Our study had some limitations. First, this was a single-center retrospective study in which the data of 297 Japanese patients were analyzed over a 5.5-year period. Second, there may have been a selection bias in this series. Various factors, including the primary diagnosis, preoperative liver function, and the patients' general condition could have influenced the selection of a laparoscopic approach for Rep-LR. Third, the proportion of subjects in the Rep-LLR in whom an open approach had been used for the Ini-LR was small. Hence, the influence of use of an open approach for the Ini-LR on the formation of adhesions around hepatoduodenal ligament could not be evaluated. Therefore, further multicenter studies with larger numbers of patients undergoing Rep-LLR, including Anat-LLR, are required to reach definitive conclusions.

CONCLUSION

Rep-LLR can provide outcomes comparable to those of Ini-LLR over the short term, so that the indications of a laparoscopic approach for Rep-LR seem to be the same as those for Ini-LR. However, careful patient selection for Rep-LLR would be required in cases with a surgical procedure ≥sectionectomy at the initial/previous LR or a DS of ≥6, which were associated with a prolonged operation time or greater blood loss, especially at low-volume centers or in the hands of teams unaccustomed to LLR.

S.M. did study concept and design, and drafting of the article. S.M., K.M., T.O., and Y.F. did data collection. G.W. did critical revision of the article. G.W. did study supervision.

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