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Anatomic Trisegmentectomy: An Alternative Treatment for Huge or Multiple Hepatocellular Carcinoma of Right Liver

Jia Changku[1], Weng Jie[2], Qin Qifan[3], Chen Youke[2] and Fu Yu[2]*

[1]*Department of Hepatobiliary Pancreatic Surgery, Nanjing Medical University, China*

[2]*Department of Hepatobiliary Pancreatic Surgery, The Affiliated Hospital of Hainan Medical University, China*

[3]*Department of General Surgery, Lin'gao County Hospital of Hainan Province, China*

Abstract

Background: The patients with huge (≥10 cm) or multiple Hepatocellular Carcinoma (HCC) in right liver and insufficient volume of remnant left liver cannot be performed right hemihepatectomy in that liver failure will occur post operation. We designed anatomic trisegmentectomy in right liver to increase the percentage of future liver remnant volume (%FLRV), thus increasing the resectability of huge or multiple HCC.

Methods: Thirteen patients were analysed by preoperative CT scan for liver and tumor volumetries. If right hemihepatectomy was performed, %FLRV would be at the range of 29.6% - 37.5%. However, if trisegmentectomy was done, %FLRV would increase by an average of 14.0%. So patients will not undergo postoperative liver failure due to sufficient %FLRV. Therefore, we designed anatomic trisegmentectomy, with retention of segment 5 or segment 8, to increase %FLRV and increase the resectability for huge or multiple HCC.

Results: After trisegmentectomy, the inflow and outflow of remnant liver were maintained well. Severe complications and mortality was not happened post operation. Of the 13 patients, 10 survived up to now. Of the 10 living cases, postoperative lung metastasis was found in 2 and intra hepatic recurrence was found in 1. These 3 patients survive with tumor after comprehensive therapies including oral administration of Sorafenib.

Conclusion: Compared to right hemihepatectomy, anatomic trisegmentectomy in right liver guarantees the maximum preservation of %FLRV to increase the resectability of huge or multiple HCC, thus improving the overall resection rate.

Keywords: Anatomic segmentectomy; Hepatocellular carcinoma; Respectability; Liver volume

Introduction

Huge (≥10 cm) or multiple liver tumors often advance beyond any criteria of liver transplantation, and patients with huge or multiple liver tumors are also unable to benefit from radio frequency ablation. So hepatectomy is the only curative option for such patients [1-4]. However, complete resection of huge or multiple Hepatocellular Carcinoma (HCC) usually results in loss of major liver tissue in many such cases. So the radical resection cannot be performed if the percentage of future liver remnant volume (%FLRV) is too small or insufficient. For example, patients with huge or multifocal tumors in right liver and small volume of left liver cannot be performed right hemi hepatectomy in case of postoperation liver failure. Fortunately, in some cases, not all the 4 segments of right lobe (Couinaud segmentation) were involved by tumors though there are huge or multifocal tumors in right liver. %FLRV will be greatly increased if this uninvolved segment is preserved, thus decreasing the risk of postoperative liver failure and increasing the respectability of huge or multifocal HCC. In this study, we introduced anatomic trisegmentectomy including liver segmentectomy of 6, 7 and 8 and segmentectomy of 5, 6 and 7 to increase the respectability of huge or multiple HCC.

Materials and Methods

Patients

Thirteen patients underwent anatomic trisegmentectomy from Feb 2012 to Jul 2015 in this study. Of these 13 cases, 6 underwent 5, 6 and 7 segmentectomy and 7 underwent 6, 7, 8 segmentectomy. All of them were male and their mean age was 58 years (range: 43-67 years). Laboratory examination

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Correspondence:
Jia Changku, Department of Hepatobiliary Pancreatic Surgery, Hangzhou First People's Hospital, Nanjing Medical University, Hangzhou 310006, China, Tel: +86-571-56006928; Fax: +86-571-56006928; E-mail: jiachk@126.com

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Table 1: Clinical features and postoperative outcomes of patients underwent 5, 6, 7 segmentectomy.
DFS: disease-free survival.

No.	Sex	Age (yr)	Diagnosis	ICG-R15 (%)	Child–Pugh liver function grade	%FLRV for right hemihepatectomy	%FLRV for 5–7 segmentectomy	Survival period (d)
1	Male	55	Multifocal tumors	7.5	A	35.7	51.4	310, dead
2	Male	64	Huge tumor, 11.5 cm × 9.6 cm	5.8	A	34.5	49.2	734, DFS
3	Male	67	Huge tumor, 12.0 cm × 10.7 cm	9.8	A	30.8	46.2	567, DFS
4	Male	58	Huge tumor, 13.0 cm × 11.5cm	10.5	A	34.6	48.8	382, lung metastasis, alive
5	Male	54	Multifocal tumors	8.6	A	30.4	45.5	338, DFS
6	Male	59	Multifocal tumors	6.5	A	29.6	41.3	186, DFS

Table 2: Clinical features and postoperative outcomes of patients underwent 6, 7, 8 segmentectomy.
DFS: disease-free survival.

No.	Sex	Age (yr)	Diagnosis	ICG-R15 (%)	Child–Pugh liver function grade	%FLRV for right hemihepatectomy	%FLRV for 6–8 segmentectomy	Survival period (d)
1	Male	61	Multifocal tumors	6.8	A	29.8	44.7	1440, DFS
2	Male	43	Huge tumor, 12.2 cm × 9.3 cm	5.5	A	34.5	46.2	383, dead
3	Male	59	Huge tumor, 11.5 cm × 10.7 cm	13.8	B	32.6	46.9	1060, intrahepatic recurrence, alive
4	Male	54	Huge tumor, 12.2 cm × 11.5 cm	8.3	A	31.8	48.6	1021, lung metastasis, alive
5	Male	53	Multifocal tumors	2.6	A	37.5	50.3	930, DFS
6	Male	60	Huge tumor, 13.5 cm × 11.6 cm	7.9	A	33.4	46.5	802, dead
7	Male	67	Huge tumor, 11.5 cm × 9.7 cm	5.8	A	37.4	48.7	520, DFS

showed that all the patients were positive of HBsAg. Ultrasound B and CT scan showed that cirrhosis existed to varying degrees in all of the livers. All patients had tumors in right liver with multiple lesions in 5 patients and huge lesion in 8 (Table 1 and 2). Maximal diameter of the tumor ≥10 cm was huge HCC. Preoperative imaging showed that maximal diameter of the tumor was 13.5cm. Two or three lesions of tumor were referred to as multifocal tumors. Laboratory examination showed that all patients had elevated serum α-fetoprotein (AFP). Extra hepatic metastasis was ruled out by abdominal Ultrasound B, chest CT and whole body bone scan prior surgery. Ethics approval: The study was reviewed and approved by the Medical Ethics Board of Hangzhou First People's Hospital, Nangjing Medical University. Informed consent: All study participants, or their legal guardian, provided informed written consent prior to study enrollment.

Preoperative assessment

Preoperative assessments including hepatic function, hepatic functional reserve and hepatic imaging were examined. The test of indocyanine green retention at 15 min (ICG-R15) was used to evaluate hepatic functional reserve (Table 1 and 2). Manual 3D reconstructions of the liver by contrast-enhanced CT were made preoperatively. Total liver, left liver and segments of right liver, as well as the tumors were manually outlined and their volumes were calculated as reported [5,6]. %FLRV was calculated using the formula: %FLRV = (remnant liver volume) × 100/(total liver volume - tumor volume) [7]. Liver volumetry showed that if right hemihepatectomy was performed, %FLRV would be at the range of 29.6%-37.5% in this study (Table 1 and 2). The risk of postoperative liver failure would be high due to insufficient %FLRV. However, if 5,6,7 segmentectomies were performed in 6 patients, %FLRV would increase by an average of 14.5%. If 6,7,8 segmentectomies were performed in 7 patients, %FLRV would increase by an average of 13.6%. Compared to right hemihepatectomy, %FLRV would increase by an average of 14.0% if trisegmentectomies including 5,6,7 segmentectomies and 6,7,8 segmentectomies were performed (Table 1 and 2). Trisegmentectomies decrease the risk of liver failure post operation due to increased %FLRV. So we designed anatomic trisegmentectomy, with retention of segment 5 or 8 respectively, to increase the resectability of huge or multiple HCC.

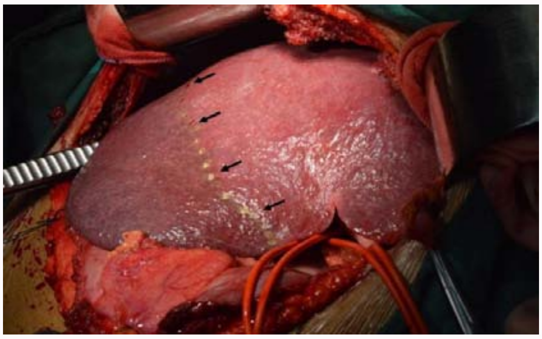

Figure 1: Right hemihepatic Glissonean pedicle and segment 6,7 Glissonean pedicle of case 5 in 5,6,7 segmentectomy group were sequentially divided. Demarcation between segments 6,7 and segment 5,8 was determined by ligation of the segment 6, 7 Glissonean pedicle. Arrow: interface between segments 6,7 and segment 5,8.

Surgical procedures

Liver resection line was determined by selective hepatic inflow occlusion. After cholecystectomy, the right hemihepatic Glissonean pedicle and the segment 6,7 Glissonean pedicle were sequentially divided. Demarcation between segment 6,7 and segment 5,8 could be determined by ligation of the segment 6,7 Glissonean pedicle (Figure 1). Then the right hemihepatic Glissonean pedicle was occluded. So

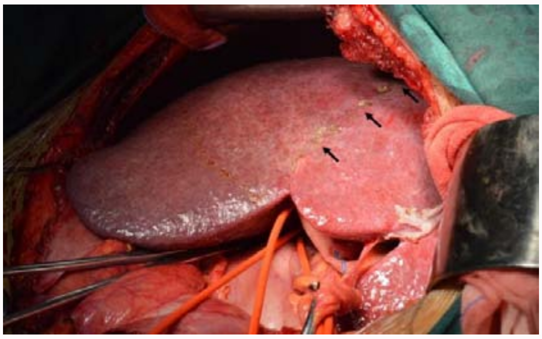

Figure 2: Right hemihepatic Glissonean pedicle of case 5 in 5,6,7 segmentectomy group was occluded. So the interface between right and left liver was demarcated (arrow).

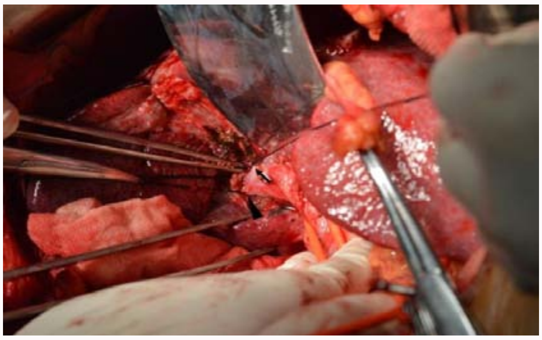

Figure 3: A branch pedicle of segment 5 of case 5 in 5,6,7 segmentectomy group was dissected and occluded. Arrow: A branch pedicle of segment 5. Triangle arrow: Glissonean pedicle of segment 6,7.

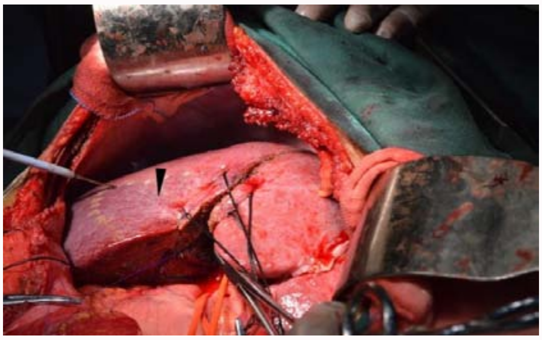

Figure 4: After occlusion of one branch pedicle of segment 5, a ischemic area of segment 5 (triangle arrow) was marked upon the diaphragmatic surface of the liver.

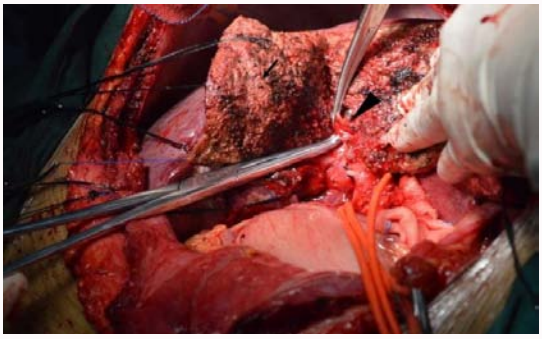

Figure 5: Another branch pedicle of segment 5 (triangle arrow) of case 5 in 5,6,7 segmentectomy group was dissected.

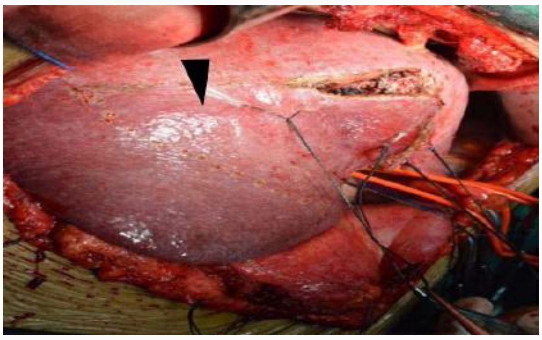

Figure 6: After occlusion of the branch pedicle of segment 5, total ischemic area of segment 5 (triangle arrow) was marked upon the diaphragmatic surface of the liver. Finally, a “ └┐ ” shape- like broken resection line was marked upon the diaphragmatic surface of the liver.

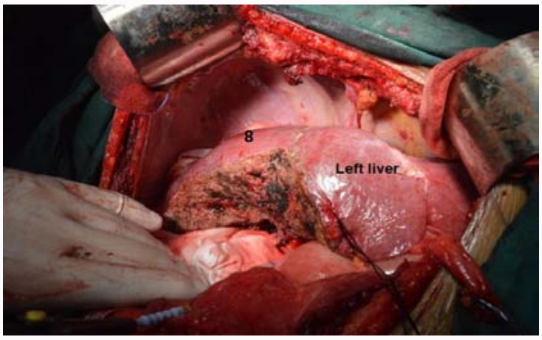

Figure 7: After hepatectomy, the inflow and outflow of segment 5 of case 5 in 5,6,7 segmentectomy group were maintained. Segment 8 and left liver was indicated.

the interface between segment 5,8 and segment 4 can be demarcated (Figure 2). After demarcation, the right hemihepatic Glissonean pedicle was unoccluded. Then, for 5,6,7 segmentectomy, the area of segment 5 could be demarcated by dissection and occlusion of the branch pedicles of segment 5 during parenchymal transection (Figure 3-6). Finally, a “ └┐ ” shape- like broken resection line could be demarcated upon the diaphragmatic surface of the liver. For 6,7,8 segmentectomy, the area of segment 8 was determined by the technique of intraoperative ultrasound as reported [5]. Finally, a “ ┌┘ ” shape- like broken resection line could be demarcated upon the diaphragmatic surface of the liver. Liver resection was completed along the broken resection line. Then the tumor free segment 5 or 8 would be reserved during trisegmentectomy in right liver. If needed, only right hemihepatic inflow occlusion was used to reduce blood loss during liver resection. Parenchymal transection was performed using ultrasonic scalpel and cavitron ultrasonic surgical aspirator (CUSA).

Postoperative management

Postoperative follow-up and postoperative check-up were performed on time. Tests of liver function, assay of serum AFP and imaging studies were examed at regular intervals. Because huge or multifocal tumors are risk factors for recurrence, so all of the patients in this study were given 3 times therapy of transcatheter arterial chemoembolization (TACE) post operation in order to prevent recurrence in the remnant liver. TACE was given at intervals of 30 d in the first 3 months post operation. Sorafenib, the molecular targeted anti-tumor drug for HCC was given for those metastatic or recurrent patients.

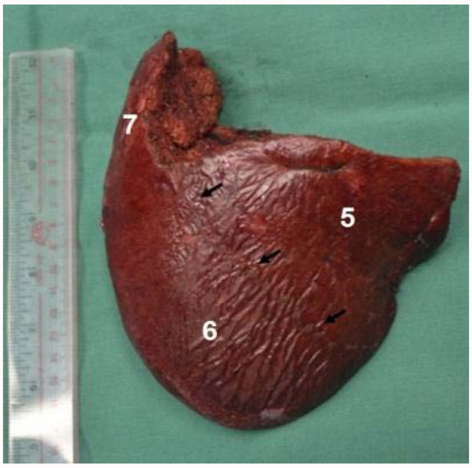

Figure 8: Gross specimen showed that tumors were completely resected. Segments 5,6 and 7 were indicated. Arrow: interface between segment 6 and segment 5, which was demarcated in operation.

Results

Anatomic trisegmentectomy in right liver was completed uneventfully for all of the patients, with a mean operative time of 285min (210-470 min) and a mean blood loss of 720ml (400–1800 ml). After trisegmentectomy, the inflow and outflow of remnant liver were maintained well (Figure 7). Gross specimens showed that tumors were totally removed (Figure 8) and hepatocellular carcinomas were verified by postoperative pathology. There were no perioperative mortality and server postoperative complications. AFP level of all patients reduced to the normal range within two months post operation.

Of the 13 patients, 10 survived up to now, with the longest surviving time of 4 years. One patient in the group of 6,7,8 segmentectomy died 383 d postoperatively due to obstructive supportive cholangitis of unknown causes. Another one in this group died from intrahepatic multiple recurrence and liver failure at 802 d post operation. One patient underwent segmentectomy 5,6,7 died at 310 days due to the multiple intrahepatic metastasis and liver failure. Of the 10 living cases, postoperative lung metastasis was found in 2 and intrahepatic recurrence was found in 1. These 3 patients survive with tumor after comprehensive therapies including oral administration of Sorafenib. Qualities of life of these patients are well. Postoperative outcome are summarized in Table 1 and 2.

Discussion

It has been a major topic for hepatobiliary surgery to increase the safety and resection rate for HCC by increasing liver remnant volume [8-12]. The patients with huge or multiple HCC in right liver and insufficient volume of remnant left liver cannot be performed right hemihepatectomy in that liver failure will occur post operation. For all the patients in this study, liver volumetry showed that if right hemihepatectomy was performed, %FLRV would be at the range of 29.6% - 37.5%. These patients cannot be performed right hemihepatectomy due to liver cirrhosis and insufficient %FLRV. However, compared to right hemihepatectomy, %FLRV would increase by an average of 14.0% if trisegmentectomies including 5,6,7 segmentectomies and 6,7,8 segmentectomies were performed. So these patients can be performed right hemihepatectomy due to sufficient %FLRV. Therefore these patients obtained the opportunity to perform the curative operation because of sufficient remnant functional liver. And because of anatomic resection, it makes the maximum preservation of functional liver tissue and complete tumor excision as well as tumor-free margins [13,14].

In this study, hepatectomies were uneventfully completed with a mean operative time of 285min (210-470 min) and a mean blood loss of 720ml (400 – 1800ml). There were no perioperative mortality and server postoperative complications like postoperative abdominal bleeding and bile leakage. The blood loss in our study (mean: 720 mL) equals to that reported in many literatures [15,16]. For treatment effects, serum AFP reduced to the normal range within 2 months post operation in all patient, which indicate that anatomic trisegmentectomy in right lobe can achieve the goal of complete tumor excision.

All of the 13 patients have survived more than 6 months postoperation. Ten of them survived up to now, with the longest surviving time of 4 years. Although postoperative lung metastasis was found in 2 and intrahepatic recurrence was found in 1 among the 10 living cases, these 3 patients survive with tumor after comprehensive therapies including oral administration of Sorafenib. Overall, patients in this study achieved satisfied short-term survival and good life quality postoperation, which indicated that trisegmentectomy had a good therapeutic efficacy for huge and multifocal tumors.

Techonlogically, the approach of Glissonean pedicle dissection benefits anatomic trisegmentectomy of right liver. There is a safe plane between Glissonean pedicle and the liver parenchyma along which dissection of Glissonean pedicle is simple, convenient, practical and time-saving with reduced damage of vasculars [17]. Then two steps of Glissonean pedicle occlusion were used to determine the resection line. For 5,6,7 segmentectomy, after demarcation between the segment 6,7 and segment 5, 8 as well as right liver and left liver, the area of segment 5 could be demarcated by dissection and occlusion of the branch pedicles of segment 5 during parenchymal transection (Figure 3-6). As for 6,7,8 segmentectomy, parenchyma transection between segment 5 and segment 4 will be performed if the branch pedicles of segment 8 be dissected and isolated because of deep-seated of the pedicle of segment 8. And the risk of damage to the branch pedicles of segment 5 will be high during dissection and parenchyma transection. So it was unnecessary to compulsorily isolate the branch pedicles of segment 8. For 6,7,8 segmentectomy, the area of segment 8 was determined by the technique of intraoperative ultrasound B with a transverse marked line upon the diaphragmatic surface of the liver between segments 8 and 5. Finally, a “ ┌┘ ” shape- like broken resection line was demarcated.

In addition, two steps of Glissonean pedicle isolation guarantees selective occlusion of right hemihepatic inflow afterward. If needed, only right hemihepatic inflow occlusion was used to reduce blood loss during trisegmentectomy in this study. This technique enables blood inflow to left liver and avoids splanchnic stasis during the whole resection process [17-19]. Thus, there was no total hepatic ischemia-reperfusion injury and hemodynamic instability. It particularly benefits patients with liver cirrhosis [17,18].

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