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Central Bisegmentectomy for Malignant Liver Tumors: Experience in 8 Patients

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Central bisegmentectomy (CBS) of the liver is an *en bloc* hepatic resection of Couiaud segments 4, 5, and 8. The indications for CBS include benign and malignant tumors occupying both the left medial and right anterior segments. However, CBS has rarely been reported. Here, we investigate CBS in patients with suboptimal liver function for whom an extended lobectomy is not an optimal solution. Each case was 1 of 8 patients who underwent CBS for hepatocellular carcinoma (HCC) or colorectal cancer liver metastasis (CRLM) at the Department of Surgery, Jikei University Hospital. Indications for CBS consisted of CRLM in 3 patients and HCC in 5 patients. The median duration of operation was 552 minutes, and median blood loss was 2263 g. No postoperative nor in-hospital mortalities occurred. In this study, 1-, 2-, and 3-year disease-free survival rates were 62.5%, 12.5%, and 12.5%, respectively, and 1-, 2-, and 3-year overall survival rates were 100%, 100%, and 85.7%, respectively. CBS is advocated for central liver tumors in patients with suboptimal liver function for whom extended lobectomy could result in less than optimal remnant liver volume and function.

Key words: Central bisegmentectomy – Colorectal cancer liver metastasis – Hepatocellular carcinoma

Central bisegmentectomy (CBS) of the liver is an *en bloc* hepatic resection of Couiaud segments 4, 5, and 8.[1] McBride and Wallace[2] first reported this procedure in 1972. The indications for CBS include benign and malignant tumors occupying both the left medial and right anterior segments. The traditional procedure for such tumors is extended right or left lobectomy or trisegmentectomy. Because of the possibility of conservation of remnant liver parenchymal volume, CBS may be superior to extended lobectomy or trisegmentectomy, especially for patients with low residual liver function due to viral hepatitis or adjuvant chemotherapy. However, CBS has rarely been reported. We herein report our

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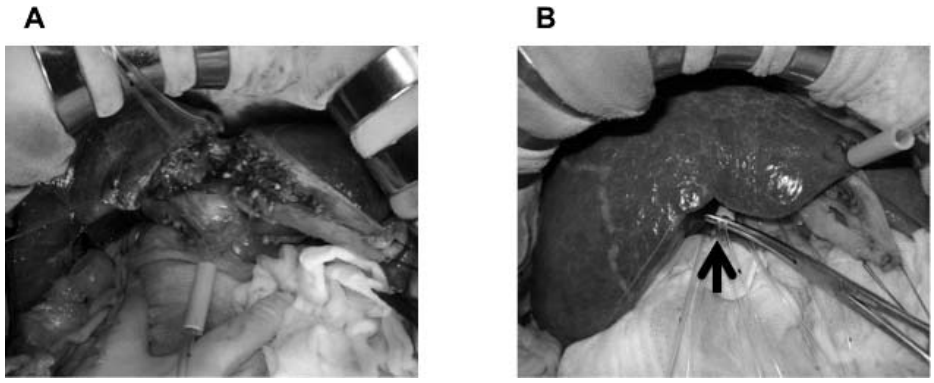

Fig. 1 Hepatic parenchymal dissection between the left medial and lateral section is performed by dividing the Glisson branches arising from the right side of the umbilical portion (A), and dissection between the right anterior and posterior sections is performed along the demarcation line by obliterating the Glisson pedicle of the right anterior section (B, arrow).

experience with 8 patients who underwent CBS for colorectal cancer liver metastasis (CRLM) or hepatocellular carcinoma (HCC).

Patients and Methods

Between January 2003 and December 2011, 10 patients underwent CBS for HCC or CRLM at the Department of Surgery, Jikei University Hospital, Tokyo, Japan. Of these, 2 patients were excluded: 1 patient who underwent an *en bloc* CBS and total caudate lobectomy for HCC in the paracaval portion of Couiaud segment 1 with a largest diameter of 34 mm, and 1 patient who underwent CBS and 2 partial hepatic resections with concomitant low anterior resection of the rectum for carcinoid tumor and liver metastases; the remaining 8 patients were included in this retrospective study. Generally, the extent of hepatic resection was determined based on the retention rate of indocyanine green at 15 minutes ($ICGR_{15}$) before surgery and in reference to the hepatic reserve as described by Miyagawa *et al*.[3]

The details of the techniques for CBS were as previously described.[4] Our essential points for CBS are as follows: Hepatic parenchymal dissection between the left medial and lateral section is performed by dividing the Glisson branches arising from the right side of the umbilical portion (Fig. 1A), and dissection between the right anterior and posterior sections is performed along the demarcation line by obliterating the Glisson pedicle of the right anterior section (Fig. 1B). For avoiding congestion of the right anterior section, division of the middle hepatic vein is performed after interruption of the inflow vessels to the right anterior section.

Recurrence of HCC or CRLM was defined as newly detected hepatic or extrahepatic tumors by ultrasonography, computed tomography, magnetic resonance image, or angiography with or without an increase in serum α-fetoprotein (protein induced by vitamin K absence or antagonist-II) in HCC patients and in serum carcinoembryonic antigen (carbohydrate antigen 19-9) in CRLM patients. For recurrent HCC in the liver, repeated hepatic resection, local ablation therapy, or transarterial chemoembolization was given based on hepatic functional reserve judged mainly by $ICGR_{15}$. Extrahepatic recurrence was mainly treated conservatively. For recurrent CRLM, repeated hepatic resection, local ablation therapy, or systemic chemotherapy was performed based on hepatic functional reserve judged mainly by number, size, and location of the recurrent liver tumors, $ICGR_{15}$, and remnant liver volume. For lung metastasis, limited partial lung resection or systemic chemotherapy was carried out. For local recurrence, tumor resection, radiotherapy, or systemic chemotherapy was selected.

This retrospective study was approved by the Ethics Committee of the Jikei University School of Medicine.

Results

Patient characteristics and clinicopathologic variables

Patient characteristics and clinicopathologic variables are outlined in Table 1 and Table 2. Within the study population, the median age was 68 years (range, 57–80 years), and 2 of them were women. Three patients underwent CBS for CRLM, 5 patients for HCC. Median resected tumor number was 1.5 (range, 1–4), and median largest tumor diameter

Table 1—Patient characteristics

Case	Gender	Age, y	Diagnosis	Number of tumors	Largest tumor diameter, mm	Procedures	Concomitant procedure
1	F	57	CRLM	1	50	CBS + PR (S1)	—
2	M	57	CRLM	4	45	CBS + PR (S3, S6)	PALN resection
3	F	80	CRLM	2	43	CBS	—
4	M	62	HCC	1	15	CBS + PR (S1)	—
5	M	65	HCC	1	43	CBS	—
6	M	73	HCC	2	80	CBS	—
7	M	71	HCC	4	105	Extended CBS	—
8	M	76	HCC	1	32	CBS	—

CBS, central bisegmentectomy; CRLM, colorectal cancer liver metastasis; HCC, hepatocellular carcinoma; S, Couiaud segment; PR, partial resection; PALN, para-aortic lymph node.

was 44 mm (range, 15–105 mm). Median duration of operation was 552 min (range, 370–1030 min), and median blood loss was 2263 g (range, 490–6620 g). Five patients received allogeneic blood transfusion. Postoperative complications developed in 4 patients, consisting of bile leakage in 3 patients and surgical site infection in 1 patient. Median postoperative hospital stay was 15 days (range, 11–43 days), and no postoperative or in-hospital mortalities occurred.

Postoperative treatment for tumor recurrence and survival

Tumor recurrence developed in all 3 CRLM patients, consisting of lung metastasis in 2 and liver, lung, and lymph node metastases in 1 patient. One patient underwent partial lung resection and is alive and disease free. The other 2 patients received chemotherapy; however, they died due to progression of metastatic tumors, one on postoperative day 931 and the other on postoperative day 1667.

Tumor recurrence developed in 4 HCC patients, consisting of recurrent HCC in the liver in 3 patients and lung metastasis in 1 patient. Partial hepatic resection was performed in 1 patient, partial hepatic resection with concomitant radiofrequency ablation therapy was performed in another patient, and lung resection was performed in a third patient. One patient received transarterial chemotherapy via the hepatic artery. All 5 patients are alive, including 4 disease-free patients. In this study, 1-, 2-, and 3-year disease-free survival rates after CBS for HCC and CRLM were 62.5%, 12.5%, and 12.5% (Fig. 2A), respectively, and 1-, 2-, and 3-year overall survival rates were 100%, 100%, and 85.7% (Fig. 2B), respectively.

Discussion

Surgical resection is the only therapeutic strategy that offers a potential cure for patients with either primary or secondary liver tumors, especially those with good performance status and adequate liver function.[5,6] Improvements in the understanding of liver anatomy and advancements in image technology have contributed to the development of segmental liver resection.[7] The $ICGR_{15}$ is useful for predicting the safe limit of liver resection in each patient, and liver volumetry using computed tomography is helpful for evaluating whether the

Table 2—Patient clinicopathologic variables

Case	Duration, min	Blood loss, g	Transfusion	Complication	Postoperative hospital stay, days	Status	DFS, y	OS, y	Recurrence sites
1	540	5485	+	Bile leakage	43	Death	1.61	2.55	Lung
2	725	510	−	—	13	Death	0.67	4.60	Liver, lung, LN
3	370	640	−	—	12	Alive	0.30	3.23	Lung
4	563	4300	+	—	11	Alive	3.93	3.93	—
5	410	490	−	—	14	Alive	1.57	2.89	Liver
6	1030	3500	+	Bile leakage	21	Alive	1.62	2.86	Liver
7	689	6620	+	SSI	16	Alive	1.32	2.85	Liver
8	429	1025	+	Bile leakage	22	Alive	0.23	1.45	Lung

DFS, disease-free survival; LN, lymph node; OS, overall survival; SSI, surgical site infection.

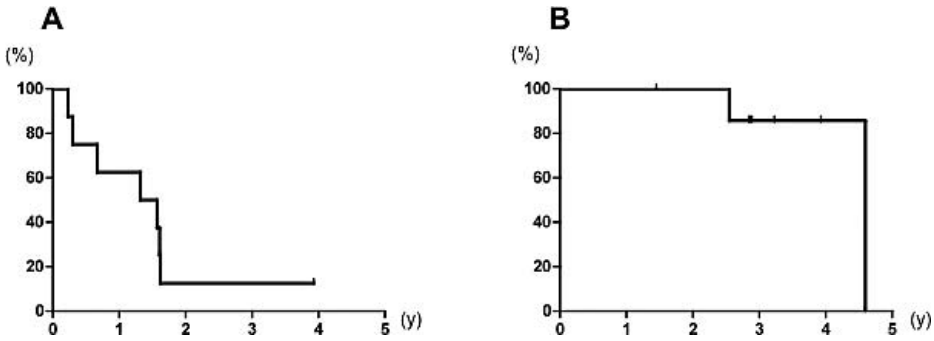

Fig. 2 One, two, and three-year disease-free survival rates after CBS were 62.5%, 12.5%, and 12.5%, respectively (A), and overall survival rates were 100%, 100%, and 85.7%, respectively (B).

remnant liver volume is adequate. For centrally located liver tumors, the conventional operative procedure is extended left or right lobectomy. Because of inadequate remnant liver volume, extended lobectomy bears a considerable risk of postoperative liver failure, particularly in patients with impaired preoperative liver function due to cirrhosis or preoperative chemotherapy. CBS may be superior to extended lobectomy, because more liver parenchyma is conserved.[8–10] Preserving more liver parenchyma decreases morbidity and mortality rates[11] and increases the possibility of the second hepatic resection in the case of a recurrent intrahepatic tumor.[12] However, more extensive dissection of vascular pedicles and larger resection surfaces of liver parenchyma in CBS may result in excessive blood loss, longer duration of operation, or greater incidence of postoperative bile leakage,[8,13,14] and CBS has not been frequently used for treatment of centrally located liver tumors. Because of the ability to prevent excessive intraoperative blood loss and postoperative complications using recent surgical techniques, image technologies, and preoperative assessment of liver function and measuring of remnant liver volume, CBS leads to a better therapeutic outcome for centrally located liver tumors, especially in patients with preoperative impaired liver function.

Conclusion

CBS is advocated for central liver tumors in patients with suboptimal liver function, such as when HCC complicates viral hepatitis or cirrhosis, and patients with metastatic liver tumors with associated steatosis due to chemotherapy, for whom extended lobectomy could result in less than optimal remnant liver volume and function.

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