direct bilirubin. The patient's condition improved immediately after percutaneous transhepatic biliary drainage.

In the second part of this study, we retrospectively compared the outcomes of patients with and without (control group) the preoperative ingestion of an immune-enhanced formula prior to undergoing PD. In patients without hyperbilirubinemia, laboratory data showed that the postoperative GOT and GPT levels were higher in the Impact group than in the control group; in particular, GPT was significantly higher in the Impact group. In a study examining patients with esophageal cancer who ingested Impact immediately before undergoing a transthoracic esophagectomy with lymph node dissection, Takeuchi et al. [24] also reported an immediate postoperative elevation of transaminases. Although the mechanism remains unclear, a preoperative immune-enhanced diet may impose a load on hepatocytes after invasive surgery such as PD. Immune-enhanced formulas have been suggested to possibly cause a high postoperative BUN level as a result of an overload in nitrogen intake [41]. However, in the present series, we did not observe a marked change in the BUN level, and nitrogen overloading did not appear to be excessive.

Regarding the systemic severity of the patients in this study, the APACHE-II score tended to be lower in the Impact group than in the control group. When measured during the immediate postoperative phase, a high APACHE-II score is thought to be linked to mortality, and the APACHE-II score can be regarded as a summary indicator of an individual's response to surgical injury. The patients who received preoperative immunonutrition had a lower systemic severity score, so it appears that Impact consumption might reduce the severity of systemic damage. Several studies have reported that a supplementary diet rich in omega-3 fatty acids is related to a decrease in PGE2, which is a key fever mediator [42–44]. Our results suggest that the preoperative consumption of an immune-enhanced formula may reduce excess postoperative pro-inflammatory cytokine production (such excess production may result in serious complications or lethal multiple organ dysfunctions in patients who have undergone PD). Additional investigations of the detailed changes in some indicators, such as inflammatory cytokines, are needed.

In the present study, incisional wound infection was significantly less frequent in the Impact group than in the control group. SSI including incisional wound infection is a serious complication following surgery, requiring a prolonged hospitalization period, increased medical costs, and decreased patient satisfaction [45, 46]. SSI is primarily caused by surgical procedures, and performing surgery while minimizing the risk of SSI is important. The preoperative oral intake of immune-enhanced formulas, such as Impact, might also be important for preventing incisional wound infection.

The duration of postoperative SIRS and the length of the hospital stay were not significantly different between the two groups in our study. Thus, the effects of the preoperative ingestion of an immune-enhanced formula on the duration of the hospital stay among patients undergoing PD remain unclear. In this study, pancreatic fistula was the most common and important complication, not wound infection. The length of the hospital stay is likely to be affected by the severity of this complication, as it is regarded as a major unfavorable complication after PD. During this study, an end-to-side dunking anastomosis was used for the anastomosis between the pancreatic stump and the jejunum; however, since 2007 (after the completion of the present study), we have adopted a duct-to-mucosa anastomosis with 5-0 absorbable monofilament using a vinyl tube as a lost stent in pancreaticojejunostomy procedures. As a result, the incidence of pancreatic fistula after PD has decreased (data not shown). This concept has also successfully enabled the duration of the hospital stay after PD to be shortened.

To our knowledge, this is the one of few reports to suggest the feasibility and benefit of using an immune-enhanced formula, Impact, as part of the preoperative management of patients scheduled to undergo PD. To date, several groups have reported on immunonutrition in gastrointestinal cancer surgery patients [11, 12, 15, 47]. Most of these reports have demonstrated that patients receiving immunonutrition before and/or after surgery tended to have fewer postoperative complications. Gianotti et al. [22] reported that patients receiving immunonutrition with an enteral formula after PD had a significantly lower incidence of infectious complications than patients in the standard and parenteral groups. Di Carlo et al. [48] also reported similar results for postoperative enteral feeding in patients with pancreatic head cancer. However, no other reports have described patient compliance with preoperative oral intake, or the clinical significance of the preoperative ingestion of immune-enhanced formulas for patients undergoing PD.

In conclusion, a high rate of compliance with the preoperative oral administration of Impact Japanese version (750 mL/day, for 5 days) was observed in Japanese patients without malnutrition who were scheduled to undergo PD. This treatment appeared to be effective for preventing incisional wound infection and reducing systemic severity. To confirm the clinical benefits of preoperative Impact, a randomized control study including the use of a control group receiving a regular diet alone is needed. Of note, the composition of the commercially available Impact in Japan differs slightly from the original Impact used in Western countries, so we approve the

suggestion from Tsujinaka et al. [29] that such a randomized study should be performed exclusively in Japan. In addition, such a study would require a similar quality of operative procedures and perioperative management in both patient groups.

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ORIGINAL ARTICLE

Predictive Factors for Anastomotic Leakage after Simultaneous Resection of Synchronous Colorectal Liver Metastasis

Kentaro Nakajima · Shinichiro Takahashi · Norio Saito · Masahito Kotaka · Masaru Konishi · Naoto Gotohda · Yuichiro Kato · Taira Kinoshita

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Abstract
Background The optimal surgical strategy for resectable, synchronous, colorectal liver metastases remains unclear. The objective of this study was to determine which patients could benefit from staged resections instead of simultaneous resection by identifying predictive factors for postoperative morbidity and anastomotic leakage after simultaneous resection of synchronous, colorectal liver metastases and the primary colorectal tumor.
Methods This study involved 86 patients with synchronous colorectal liver metastases who underwent simultaneous resection of the primary colorectal tumor and the hepatic tumor. Postoperative mortality, morbidity, and other surgical outcomes, including survival and hospitalization, were assessed. Predictive factors for postoperative morbidity and for anastomotic leakage were evaluated.
Results Postoperative morbidity and anastomotic leakage were found in 55 (64%) and 18 (21%) patients. Predictive factors for postoperative morbidity and for anastomotic leakage were intraoperative blood loss and operation time >8 h, respectively. The overall 5-year survival rate was 45%.
Conclusions The frequency of morbidity and that of anastomotic leakage seemed to be high after simultaneous resection for synchronous colorectal liver metastases, especially when intraoperative blood loss or operation time increased greatly. Staged resections should be considered in cases in which excessive surgical stress from simultaneous resection of synchronous colorectal liver metastases would be expected.

Keywords Colorectal cancer · Hepatic metastasis · Liver metastasis · Morbidity · Anastomotic leakage

K. Nakajima · N. Saito
Department of Colorectal Surgery,
National Cancer Center Hospital East,
Kashiwa, Chiba, Japan

S. Takahashi (✉) · M. Konishi · N. Gotohda · Y. Kato · T. Kinoshita
Department of Hepato-biliary Pancreatic Surgery,
National Cancer Center Hospital East,
6-5-1 Kashiwanoha,
Kashiwa 277-8577, Chiba, Japan
e-mail: shtakaha@east.ncc.go.jp

M. Kotaka
Department of Surgery, Sano Hospital,
Kobe, Hyogo, Japan

Introduction

For patients with synchronous colorectal liver metastases (SCLM), hepatic resection is considered the best treatment, with reported 5-year survival rates between 23% and 37%.[1–4] Resections of both the primary colorectal lesion and the hepatic metastases are needed for patients with SCLM when they are resectable. However, the optimal surgical strategy for resectable SCLM still remains controversial.

From the perspectives of less operation with less mental stress and simplifying perioperative treatment, simultaneous resection of the primary colorectal and liver tumors is a favorable strategy for patients with SCLM.[5–8] However, several papers reported that the morbidity rate after simultaneous resection of primary and liver tumors was high because of greater surgical stress and a longer

operation time than for single-organ surgery. Staged resection with initial operation for the primary lesion followed by resection of hepatic tumors is regarded as an alternative strategy to avoid excessive surgical stress for patients with SCLM, though the efficacy of this strategy and the patients who could benefit from this strategy are unknown.[4–6,9,10]

Thus, this study was conducted to determine which patients could benefit from staged resections instead of simultaneous resection by identifying predictive factors for postoperative morbidity and anastomotic leakage after simultaneous resection of SCLM.

Patients and Methods

Patient Population

The medical records of all consecutive patients who underwent liver resections for colorectal liver metastases from January 1992 to January 2004 at our institution were analyzed retrospectively, with institutional review board approval. Eighty-six patients had SCLM. During this period, all SCLM patients received simultaneous resection of primary colorectal and hepatic tumors irrespective of the patient's or the tumor's characteristics. Lateral lymph node dissection was routinely performed in patients with advanced lower rectal cancer. All 86 patients underwent contrast enhanced computed tomography (CT) of the chest, abdomen, and pelvis, as well as hepatic MRI, preoperatively.

As a control, the morbidity of 167 patients who underwent hepatectomy for metachronous liver metastasis from colorectal cancer from January 1992 to January 2004 and that of 1,728 patients who underwent only resection for colorectal cancer with colorectal reconstruction during the same period were also reviewed. Of the 1,728 colorectal cancer patients, 1,319 had colon cancer and 409 had rectal cancer.

Postoperative Morbidity

Incidences of the following postoperative complications were analyzed: anastomotic leak, rectovaginal fistula, intraperitoneal or pelvic abscess, wound infection, wound dehiscence, ileus, enteroparesis, postoperative delirium, urinary tract infection, dysuria, empyema thoracis, pleural effusion, atelectasis, cholecystitis, perihepatic or subphrenic abscess, bile leak, liver failure, and others. Anastomotic leakage was defined as follows: peritonitis and a dehiscence in the anastomosis, discharge of pus from the anus, vaginal fistula, or feces from the abdominal drain. Leakage was confirmed by CT scan, contrast enema, re-operation, or digital rectal examination. All complications were graded according to the classification proposed by Clavien et al.[11] Postoperative mortality was defined to include any death during postoperative hospitalization or within 30 days.

Assessment of Predictive Factors for Postoperative Morbidity

Correlations between postoperative morbidity and the following patient, tumor, and surgical factors were analyzed: age, sex, body mass index (BMI), preoperative comorbidity, site of primary tumor, intestinal obstruction by tumor, size of primary tumor, differentiation of tumor, distribution of hepatic tumors, number of hepatic tumors, hepatic tumor size, operative methods, operation time, intraoperative blood loss, and blood transfusion.

Survival

Patients were followed regularly at 3-month intervals with blood testing and CT. Survival and follow-up were calculated from the time of the operation to the date of death or last available follow-up. The survivors' median follow-up time after surgery was 73 months.

Statistical Analysis

Statistical comparisons of baseline data were performed using the chi-square test. Continuous variables were compared with the independent t test. Multivariate analyses to evaluate the independent predictive factors for postoperative complications or anastomotic leakage were done by multiple logistic regression analysis. The survival rate was calculated by the Kaplan–Meier method.[12] A difference was considered significant when p was less than 0.05.

Results

Patients and Operative Details

From 1992 to 2004, 86 patients were treated with simultaneous resection of primary and hepatic tumors for SCLM. There were 37 female and 49 male patients, with a median age of 59 years (range, 40 to 85 years). The site of the primary tumor was colon in 48 and rectum in 38. The primary tumor was staged as T3 in 54 (63%) and T4 in 32 (37%) according to the TNM classification. Metastatic lymph nodes were found in 65 patients (76%). The mean diameter of the primary tumor was 55 mm (range, 26–140 mm).

Liver metastases were solitary in 29 patients and multiple in 57 patients. In 47 patients (55%), the hepatic

tumor showed a unilobar distribution, while a bilobar tumor distribution was observed in 39 (45%). The mean diameter of the hepatic tumor was about 43 mm (range, 5–200 mm). The mean resected liver volume was 380 g (range, 10–1,660 g).

The operation for primary colorectal cancer was right (hemi) colectomy in 17 patients, transverse colectomy in 1, left (hemi) colectomy in 4, sigmoidectomy in 24, high anterior resection in 7, low anterior resection in 20, very low anterior resection in 6, inter-sphincteric resection in 2, Hartmann's operation in 1, and abdomino-perineal resection in 4 (Table 4). A diverting stoma to prevent anastomotic leakage was made in 22 (26%) patients at the surgeon's discretion, and lateral lymph node dissection was performed in 20 (23%). In terms of liver tumor resection, lobectomy was performed in 11 patients, segmentectomy in 22, bisegmentectomy in 1, trisegmentectomy in 2, subsegmentectomy in 3, and partial resection in 47.

Adjuvant therapy was given to only 17 patients (19.8%) because adjuvant chemotherapy for colorectal cancer in stage III or more was performed since January 2003. Neoadjuvant chemoradiation targeting for rectal cancer was given to three patients (3.5%).

Morbidity

No patients died within 30 days of the operation, but 55 (64%) patients developed complications (Table 1). Eighteen patients (21%) experienced leakage, of whom 6 needed urgent re-operation with ileostomy and drainage of an intra-abdominal collection caused by leakage. Postoperative bleeding, wound dehiscence, and ileus were the reasons for the three other re-operation cases. The most frequent complication was wound infection.

The morbidity rate of the 167 patients who underwent hepatectomy for metachronous colorectal liver metastasis during the same period was 19.8%, and that of 1,728 patients who underwent only resection for colorectal cancer was 32.1%. Anastomotic leakage occurred in 123 (7.1%) of the aforementioned 1,728 patients.

Factors Affecting Complications, Especially Anastomotic Leakage

Postoperative complications were significantly correlated with presence of diverting stoma ($p<0.01$), duration of operation greater than 8 h ($p<0.01$), amount of intraoperative blood loss ($p<0.01$), and intraoperative blood transfusion ($p<0.01$). The aforementioned factors were entered into multivariate analysis. Only a greater amount of blood loss had a predictive value for increased occurrence of postoperative complications.

Then, the correlations between anastomotic leakage and clinicopathological factors were examined to identify risk factors for anastomotic leakage after simultaneous resection for SCLM. Patients who underwent abdomino-perineal

Table 1 Postoperative complications after simultaneous resection for SCLM according to Clavien grade

Complications	No. of patients	Gr I	Gr II	Gr IIIa	Gr IIIb	Gr IVa
Colon and rectum						
Anastomotic leakage	18 (21%)		12		6	
Intrapelvic abscess	6 (7%)	1	4		1	
Intraperitoneal abscess	5 (6%)	1	0	3	1	
Rectovaginal fistula	4 (5%)		1		3	
Liver						
Bile leakage	7 (8%)	6	1			
Hepatic abscess	7 (8%)		5	1	1	
Liver failure	3 (3%)	1	1			1
Postoperative bleeding	1 (1%)				1	
Other organs						
Wound infection	25 (29%)	23	2			
Pleural effusion	12 (14%)	1		11		
Wound dehiscence	6 (7%)	3	2		1	
Enteroparesis	5 (6%)	5				
Postoperative delirium	4 (5%)	1	3			
Dysuria	4 (5%)		4			
Urinary tract infection	3 (3%)		3			
Pneumonia	2 (2%)		2			
Others	7 (8%)	1	4		2	

resection (n=4) or Hartmann's operation (n=1) were excluded from the analysis. Anastomotic leakage was significantly correlated with lateral lymph node dissection (p<0.01), primary site of rectum (p=0.01), duration of operation greater than 8 h (p<0.01), and amount of intraoperative blood loss (p=0.02). Neither serum levels of TP and ALB, steroid usage, nor neoadjuvant therapy showed correlation with occurrence of anastomotic leakage (data not shown). Multivariate analyses revealed operation time greater than 8 h (p<0.01) as the only independent predictive factor for anastomotic leakage after simultaneous resection of SCLM (Table 2). Extent of hepatectomy, timing of anastomosis and hepatectomy, and usage of Pringle maneuver did not correlate with occurrence of complication or anastomotic leakage.

Table 3 showed the rates of complication ≥ IIIa and anastomotic leakage according to operative procedures of the primary and hepatic resections which were performed in the same patient. Complication ≥ IIIa and anastomotic leakage were more frequently observed in patients with rectal resection; however, extent of hepatectomy did not seem to affect occurrence of complication ≥ IIIa or anastomotic leakage.

Hospitalization was significantly longer in the 55 patients with postoperative morbidity (32.2 days) than in the 31 patients without postoperative morbidity (17.6 days) (p<0.01). In addition, hospitalization was significantly longer in the 18 patients with anastomotic leakage (43.5 days) than in the 63 patients without anastomotic leakage (22.2 days) (p<0.01).

Survival

The overall survival rate after simultaneous resection for SCLM of the 86 patients was 61% at 3 years and 45% at 5 years, with MST of 47 months.

Discussion

For patients with resectable SCLM, both primary tumor resection and hepatectomy for liver metastasis could lead to long-term survival, with a 5-year survival rate of 23–37%. However, the optimal strategy, including surgical resection and perioperative treatment, remains controversial for resectable SCLM. In terms of surgical resection for SCLM, it has not been resolved whether simultaneous resection or staged resections would be preferable.

There are several rationales for simultaneous resection of SCLM. In simultaneous resection, the treatment strategy would become simpler. In the staged resections, a series of neoadjuvant chemotherapy or chemoradiotherapy, resection of primary tumor, chemotherapy between two operations, hepatectomy, and adjuvant chemotherapy could be the maximal total treatment for SCLM, while simultaneous resection could simplify and shorten the treatment schedule by eliminating one operation. Completion of the two resections and initiation of adjuvant chemotherapy occur earlier with simultaneous resection than with staged resections. Considering survival, comparable survival for simultaneous resection was shown in comparison with that for staged resections.[13] Furthermore, simultaneous resection could relieve patients from a considerable degree of mental and physical stress and decrease total treatment cost by preventing a second resection for hepatic metastases. Recent advances in colorectal and hepatic surgery have enabled simultaneous resection to be performed more safely. Martin et al. reported the safety and efficacy of simultaneous resection. By avoiding a second laparotomy, the overall complication rate was reduced, and length of hospital stay was shortened, with no change in operative mortality.[7,8]

However, at present, staged resections with initial resection of the primary tumor followed by hepatic resection have been frequently performed in patients with SCLM for several reasons.[4,5,9,10] First, the perioperative risk of staged resections has been thought to be less than that of simultaneous resection.[4,13,14] Sheele et al. reported 13 anastomotic leakages of 90 simultaneous procedures in their series, and two of them led to death.[4] Thelen et al. proposed the criteria for simultaneous liver resection according to the age and extent of liver resection, because death after simultaneous liver resection (n=4) occurred after major hepatectomies, and three of these four patients were 70 years of age or older.[15] Second, staged resections might offer a chance to evaluate liver or extrahepatic metastases between the two operations. Lambert et al. reported that staged resections of synchronous hepatic metastases with an interval of 3 to 6 months might allow occult disease to become clinically detectable and could potentially identify patients for whom a hepatic resection would offer no survival benefit.[10] Fujita recommended an interval resection to assess the metastatic status of the regional lymph nodes, because the presence of six or more lymph node metastases was an independent poor prognostic factor in patients with resected SCLM and a relative contraindication for hepatic resection.[9] Some authors proposed chemotherapy between primary tumor resection and liver resection to select patients that could benefit from hepatectomy.[13,16] Alternatively, a liver-first approach of doing liver resection first and primary resection second was newly proposed as a strategy for SCLM.[17,18] The liver-first approach might avoid needless radical colorectal surgery by confirming curability of hepatic metastases first and also might increase resectability compared with the ordinary staged resections especially in patients with progressive hepatic metastases.

Table 2 Correlation between anastomotic leakage and clinicopathological factors in patients who underwent simultaneous resection for SCLM

		Leakage (−) (n=63)	Leakage (+) (n=18)	Univariate analysis p value	Multivariate analysis p value, RR (95%CI)
Patient characteristics					
Median age (range) (years)		59 (40–85)	59 (41–73)	0.81	
Male/female		33/30	12/6	0.42	
BMI (mean±SD)		21.9±2.9	22.5±2.2	0.44	
Preoperative comorbidity					
Absent		44	12	0.78	
Present		19	6		
Primary colorectal tumor					
Site	Colon	42	6	0.01	N.S.
	Rectum	21	12		
Stenosis	Absent	56	0	0.34	
	Present	7	18		
Tumor size, mm		52.0	58.0	0.25	
pT stage	pT3	41	9	0.25	
	pT4	22	9		
pN stage	pN0	17	2	0.22	
	pN+	46	16		
Histology	Well, mod	60	15	0.12	
	Poor	3	3		
Liver metastasis					
Distribution	Unilobar	38	9	0.43	
	Bilobar	25	9		
Number of tumors (range)		2.3 (1–8)	2.6 (1–8)	0.57	
Tumor size, mm		47	33	0.06	
Operative factors					
Lateral lymph node dissection					
Absent		55	10	<0.01	N.S.
Present		8	8		
Diverting stoma					
Absent		48	11	0.24	
Present		15	7		
Liver resection					
Partial Hx, segmentectomy		51	16	0.72	
≥Lobectomy		12	2		
Timing of anastomosis					
Colectomy→anastomosis→Hx		20	4	0.20	
Colectomy→Hx→anastomosis		7	5		
Hx→colectomy→anastomosis		36	9		
Pringle maneuver					
Absent		10	1	0.44	
Present		53	17		
Operation time					
<8 h		53	8	<0.01	<0.01, 6.63 (2.09–20.9)
≥8 h		10	10		
Blood loss, g (range)		1,345 (162–6,000)	2,487 (430–6,560)	0.02	N.S.
Transfusion					
Absent		39	9	0.37	
Present		24	9		
Blood transfusion, ml		343	1,212	0.05	

RR relative risk, *CI* confidence interval, *Hx* hepatectomy, *N.S.* non-significant (p>0.05)

Table 3 Rates of complication ≥ Gr IIIa and anastomotic leakage according to the site of primary colorectal resection and extent of hepatectomy

Primary colorectal resection	Hepatectomy	Complication ≥ Gr IIIa	Anastomotic leakage
Colectomy	<Lobectomy	4/40 (10%)	5/39[a] (13%)
	≥Lobectomy	0/7 (0%)	1/7 (14%)
Rectal resection	<Lobectomy	11/32 (34%)	11/28[b] (39%)
	≥Lobectomy	2/7 (29%)	1/7 (14%)

[a] One patient who underwent Hartmann's operation was excluded from the analysis

[b] Four patients who underwent abdomino-perineal resection were excluded from the analysis

This study evaluated morbidity, especially anastomotic leakage, after simultaneous resection for SCLM in order to assess the safety of simultaneous resection. Anastomotic leakage is sometimes fatal and can cause a difficult situation with physical and mental discomfort or pain. The morbidity rate of patients who underwent simultaneous resection for SCLM seemed to be higher than that of patients with resected metachronous colorectal hepatic metastasis or that of patients who underwent only resection for colorectal primary cancer. Predictive factors for postoperative morbidity and for anastomotic leakage were intraoperative blood loss and operation time greater than 8 h, respectively. The overall morbidity rate and the rate of anastomotic leakage were 91% and 50%, respectively, in patients with operation time greater than 8 h, and 54% and 13%, respectively, in patients with operation time less than or equal to 8 h. Blood loss and operation time usually represent the amount of surgical stress. Excessive surgical stress was possibly correlated with postoperative morbidity. Hospitalization of patients with complications was significantly longer than that of patients without complications. In particular, the average hospitalization of the 18 patients with anastomotic leakage was more than 43 days. Retrospective studies have also indicated that the occurrence of anastomotic leakage is associated with increased morbidity, mortality, and prolonged hospital stay. Additionally, anastomotic leakage may be associated with an increased risk of local recurrence.[19]

Various risk factors for anastomotic leakage have been analyzed by several investigators. Age, sex, obesity, level of anastomosis, smoking, blood transfusion, tumor diameter, preoperative (chemo) radiotherapy, physical status, obstruction, and coronary heart disease have been shown to be significant risk factors for leakage.[20–24] In simultaneous resection for SCLM, not only the factors related to the tumor, the patient, or the colorectal operation, but factors related to the hepatectomy could affect the occurrence of anastomotic leakage. However, the extent of hepatic resection, sequence of colectomy, hepatectomy, anastomosis, use of the Pringle maneuver, and total time of the Pringle maneuver were not predictive factors for anastomotic leakage or postoperative complications in patients with resected SCLM.

Recently, a diverting stoma has been often used to prevent anastomotic leakage in patients who undergo low anterior resection by diverting the fecal stream and keeping the anastomosis free of material.[19,25,26] In this study, the presence of a diverting stoma was not a predictive factor for absence of postoperative anastomotic leakage. However, the analysis estimating efficacy of a diverting stoma in this study was not accurate, because a diverting stoma was basically used in patients whose risk for anastomotic leakage was considered to be high by the surgeons. The site of primary tumor that has been reported as a strong predictive factor in previous studies was not a predictive factor for anastomotic leakage in this series. Use of diverting stoma might affect the result of analyses of predictive factors for anastomotic leakage. A randomized, controlled trial is needed to elucidate the efficacy of a temporary diverting stoma.

Although several rationales for the simultaneous resection for SCLM are clear, staged resections should be selected to prevent anastomotic leakage or serious complications when the scheduled operation would result in considerable surgical stress, i.e., predicted operation time greater than 8 h according to the results of the present study. Predicted operation time should be calculated by considering various factors, such as characteristics of the patient, primary and metastatic tumor, extent of operation, difficulty of the procedure, and so on. Based on the results of this study, we now select staged resections when operation time is expected to be greater than 8 h; otherwise, we select simultaneous resection. A prospective study of SCLM to evaluate the efficacy and safety of the operation time-based decision model is in progress.

Currently, adjuvant chemotherapy is one of the key factors which could affect prognosis. Then, comparison of ratio of patients who could receive adjuvant chemotherapy will be essential when comparing the efficacy of simultaneous resection and that of staged resections in a future study of SCLM. Furthermore, in staged resections, there is a risk that some patients could not undergo a second resection after the first resection due to tumor progression or complication of first surgery. Resection rate of patients who could undergo both primary and hepatic resections

should be assessed when comparing simultaneous resection and staged resections in SCLM.

The limitations of our study are its retrospective design and the relatively small number of patients studied.

Conclusion

The morbidity rate and the frequency of anastomotic leakage were high with simultaneous resection for SCLM, especially in patients with greater intraoperative blood loss or operation time greater than 8 h. For patients with SCLM, staged resections should be considered when simultaneous resection would involve excessive surgical stress.

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CASE REPORT

Intraductal oncocytic papillary neoplasm of the extrahepatic bile duct: report of a case

Yuichiro Kato · Masaru Konishi · Takahiro Kinoshita · Shinichiro Takahashi · Naoto Gotohda · Taira Kinoshita

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Abstract We report a rare case of an intraductal oncocytic papillary neoplasm (IOPN) of the extrahepatic bile duct. A 66-year-old man was admitted to our hospital for investigation of right-sided back pain. Ultrasonography, computed tomography and magnetic resonance imaging showed a papillary lesion, 3 cm in diameter, in the middle bile duct, invaginating into the cystic duct. We made a provisional diagnosis of middle bile duct cancer and performed substomach-preserving pancreatoduodenectomy. Macroscopically, the middle bile duct contained a two-humped papillary tumor, one tip of which invaginated into the cystic duct. Microscopically, the tumor consisted of cuboidal cells with abundant eosinophilic cytoplasm resembling that of oncocytes and a fine fibrovascular core. The tumor cells were stained strongly with antimitochondria antibody. Based on these findings, the tumor was diagnosed histologically as IOPN of the extrahepatic bile duct. The patient died of prostate cancer 51 months after surgery, but without evidence of recurrence of the IOPN.

Keywords IOPN · Oncocytic · Bile duct · Cholangiocarcinoma · Intraductal papillary neoplasm

Introduction

Pancreatic IOPN, with its distinctive pathological characteristics of oncocytic tumor cells with abundant mitochondria in the cytoplasm and a complex arborized papillary structure, was first described by Adsay et al. [1]. This neoplasm usually expresses MUC1 and MUC5AC, but MUC2 expression is weak or focal. The tumor cells are stained strongly with antimitochondria antibody. The entity of pancreatic IOPN is becoming more obvious and it is now considered as a subtype of intraductal papillary mucinous neoplasm (IPMN) of the pancreas [2–6].

The term "intraductal papillary mucinous neoplasm of the intrahepatic and extrahepatic bile ducts" (IPNB) was introduced only recently [7–9]. Zen et al. [9] reported that IPNBs are characterized by prominent papillary proliferation within a dilated bile duct, gastrointestinal differentiation, mucin hypersecretion, association with invasive mucinous carcinoma, and a more favorable prognosis than conventional cholangiocarcinoma. These tumors share many, but not all, clinical, histopathological, and genetic features with pancreatic IPMNs [8–12]. There are four main types of differentiation of IPNB: the same as those of pancreatic IPMN [8, 9, 13].

Since its initial description by Wolf et al.[14], there have been several reports about onococytic tumors of bile duct [9–11, 13–23]. However, biliary IOPN is an extremely rare bile duct tumor, the clinicopathological features and biological behavior of which remain unclear. We report a case of IOPN of the extrahepatic bile duct.

Case report

A 66-year-old man was admitted to our hospital with right-sided back pain. The patient's history was remarkable for hypertension and prostate cancer, but he had no history of cholelithiasis or hepatitis. Physical examination revealed no jaundice. Total bilirubin was within normal limits

Y. Kato (✉) · M. Konishi · T. Kinoshita · S. Takahashi · N. Gotohda · T. Kinoshita
Department of Digestive Surgery, National Cancer Center Hospital East, 6-5-1 Kashiwanoha, Kashiwa, Chiba 277-8577, Japan
e-mail: yuikato@east.ncc.go.jp

Fig. 1 Preoperative images. **a**, **b** Contrast-enhanced computed tomography showed a papillary lesion, 3 cm in diameter, in the common bile duct, invaginating into the cystic duct (*black arrow head*). **c** Magnetic resonance cholangiopancreatography revealed a defect in the common bile duct (*white arrow head*), but no abnormality of the bile duct

(0.5 mg/dl) as were other laboratory data, including the tumor markers, CEA and CA19-9. We performed endoscopic nasal biliary drainage (ENBD) for decompression of the biliary tract. Ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI) showed a papillary lesion, 3 cm in diameter in the middle bile duct, invaginating into the cystic duct (Fig. 1a, b, c). Cholangiography showed dilatation of the common bile duct to 10 mm in diameter, but there was no evidence of the excretion of mucin or dilatation of the major duodenal papilla. Based on these findings, we diagnosed middle bile duct cancer.

At laparotomy, an elastic-hard nodule was palpated in the hepatoduodenal ligament. Intraoperative ultrasonography demonstrated a papillary lesion, 3 cm in diameter, in the middle bile duct, without invasion of the adjacent structures or lymph node involvement. We performed substomach- preserving pancreatoduodenectomy.

Macroscopically, the resected specimen contained a two-humped papillary lesion, 3.9 × 2.3 cm, in the middle bile duct (Fig. 2a). One tip of the lesion invaginated into the cystic duct. The tumor was yellow-white on cross section. Microscopically, the tumor consisted of cuboidal cells with abundant eosinophilic cytoplasm, resembling that of an oncocyte, and a fine fibrovascular core. The tumor cells formed a papillary-tubular growth pattern (Fig. 2b, c). An increase in N/C ratio, atypical cells with irregular-sized nuclei, and clear nucleoli were observed. The mitotic rate and degree of cytoarchitectural atypia were moderate, and the tumor invaded the subserosal layer. These findings were suggestive of invasive carcinoma. Immunohistochemically, the tumor cells were stained strongly with antimitochondria antibody (Fig. 2d), AE 1/3, CAM 5.2, and CEA. Based on these findings, we diagnosed an IOPN of the extrahepatic bile duct. There was no regional nodal involvement.

The patient's postoperative course was complicated by pancreatic leakage and hepatic infarction, but he was finally discharged from hospital on postoperative day 68. He died of the prostate cancer 51 months after surgery; however, there was no evidence of recurrence of the IOPN.

Discussion

The first case of IOPN of the bile duct was reported by Wolf et al. [14], and to our knowledge, only 27 cases in

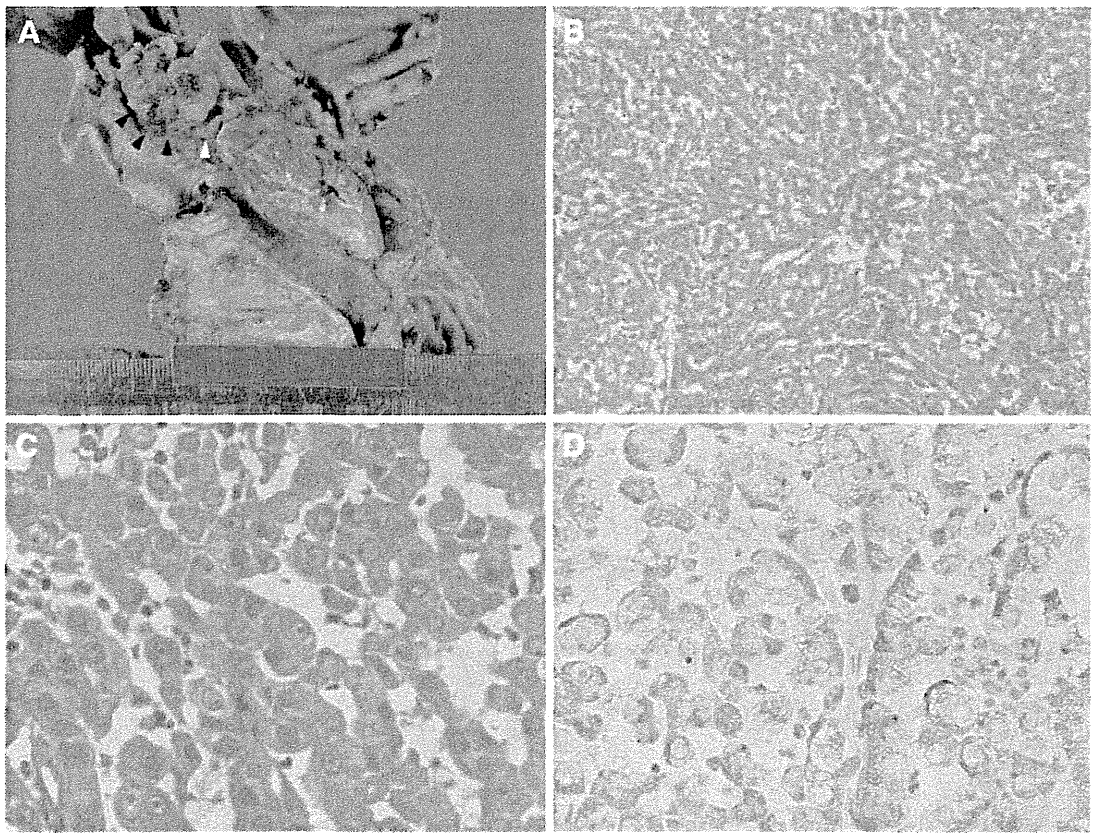

Fig. 2 **a** Macroscopically, the tumor was a two-humped papillary lesion in the middle bile duct (*black arrow head*). One tip of the two-humped lesion invaginated into the cystic duct (*white arrow head*). **b** Low power view of the intraductal neoplasm in the bile duct shows arborized papillary epithelia with fibrovascular cores (H&E; ×40). **c** High power views shows cuboidal cells with abundant eosinophilic cytoplasm resembling that of oncocytes (H&E; ×200). **d** Most of the tumor cells showed diffuse cytoplasmic reactivity for the antimitochondria antibody

total, including the present one, have been documented [9–11, 13–23]. The mean age of these patients was 56.9 years (range 8–83 years) and there was a male preponderance (17 males, 10 females). The tumor sites were the intrahepatic bile duct in 18 cases (66.7 %), being the left lobe in 12, the right lobe in 4, and both lobes in 2; and the extrahepatic bile duct in 9 cases (33.3 %), being the hilar bile duct in 3, the common hepatic duct or common bile duct in 5, and the gall bladder in 1. The most common site of biliary IOPN was the intrahepatic bile duct of left lobe, accounting for 44.4 % of cases. The tumor in the present case was located in the common bile duct, which is considerably rare. The clinical symptoms were abdominal pain in 12 (44.4 %) patients, jaundice in 7 (25.9 %), abdominal fullness in 4 (14.8 %), a palpable mass in 4 (14.8 %), and no symptoms in 6 (22.2 %). The tumor markers, CEA and CA19-9, were almost within normal limits in all except two cases. The mean size of the tumor was 7.1 cm (range 0.3–21). Pathological examination revealed high grade dysplasia or invasive carcinoma in 21 cases (77.8 %) and low grade to moderate dysplasia in 6 cases (22.2 %). In the majority of biliary IOPN cases, malignant tumor cells were observed; therefore, biliary IOPN should be resected completely whenever possible.

According to a previous report, radiological examination may reveal cystic or solid, intra- or extrahepatic biliary IOPN lesions. Cysts may be uni- or multilocular. Communication with bile ducts or a filling defect may be seen on cholangiography [10, 17]. There are no distinctive radiological findings of biliary IOPN; however, 18F-fluorodeoxyglucose positron emission tomography (FDG-PET) may be useful in the preoperative diagnosis of biliary IOPN. In our previous report of pancreatic IOPN, we mentioned that it had high sustained uptake values (SUVs) on FDG-PET. The tumor cells of IOPN have abundant mitochondria in the cytoplasm, so metabolic activity is very high, resulting in high SUVs [4]. The tumor cells of biliary IOPN contain many densely packed mitochondria such as pancreas IOPN [11, 14], so biliary IOPN may also show high SUVs on FDG-PET.

Recurrence of biliary IOPN was reported in only 3 (11.1 %) of the 27 cases. Two of these patients died of recurrence, in the peritoneum and lymph nodes, respectively [14, 22], and one was alive with recurrence in the anastomosis site [18]. The recurrence was found 6 months after the operation in one of these three patients, and 20 and 30 months after the operation, respectively, in the other two. There was no evidence of recurrence of the disease in any of the other patients. Although the recurrence rate was low and tumor progression seemed to be slow, there are insufficient data in the literature to determine the clinical course of biliary IOPN; yet, its biological behavior seems to be less aggressive than that of conventional cholangiocarcinoma.

In conclusion, the carcinogenesis of this tumor remains unclear, largely because of the limited number of patients reported. Its carcinogenesis is expected to be clarified as additional clinicopathological evidence accumulates through further reported cases.

Conflict of interest There is no financial support or relationship that may pose a conflict of interest.

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Surgical Outcome of Liver Transection by the Crush-Clamping Technique Combined with Harmonic FOCUS™

Naoto Gotohda · Masaru Konishi · Shinichiro Takahashi · Takahiro Kinoshita · Yuichiro Kato · Taira Kinoshita

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Abstract
Background New energy devices are constantly being introduced for all types of surgery, including liver surgery. These devices help surgeons perform operations. Meanwhile, intraoperative blood loss is a concern of liver surgeons. Various methods to reduce intraoperative bleeding during liver resection have been reported. There are some reports that the use of energy devices was effective for liver transection. Recently, the Harmonic FOCUS™ (HF), an ultrasonically activated device, was developed. The shape of the HF is similar to that of Kelly forceps. Hepatectomy can be performed by the clamp-crushing method using the HF instead of Kelly forceps. We obtained good results of liver resection with the HF, and report these outcomes in this study.
Methods From November 2009 to March 2011, a total of 51 patients underwent hepatectomy with the use of the HF. The control group consisted of 59 patients who underwent hepatectomy without the HF from February 2009 to September 2009. The surgical outcomes were evaluated and compared retrospectively.
Results Mean blood loss was 640 mL in the HF group compared to 1,176 mL in the control group. The number of patients needing a blood transfusion was smaller in the HF group ($p = 0.02$). Mean operative time was shorter in the HF group (171 vs. 235 min, $p < 0.001$). All these surgical outcomes were significantly better in the HF group. Postoperative morbidity was not increased in the HF group, and we could perform liver transection safely.
Conclusion The crush-clamping method combined with the HF is effective for liver transection. Liver resection can be performed quickly using this method.

N. Gotohda (✉) · M. Konishi · S. Takahashi · T. Kinoshita · Y. Kato · T. Kinoshita
Department of Surgical Oncology, National Cancer Center Hospital East, 6-5-1 Kashiwanoha, Kashiwa, Chiba 277-8577, Japan
e-mail: ngotohda@east.ncc.go.jp

Introduction

Several techniques have been reported for liver surgery [1–8]. Various energy devices are used for parenchymal transection of the liver and reduce intraoperative blood loss during liver resection. However, the best method of liver resection using energy devices is still not established. Although some reports have described the superiority of liver resection with energy devices in randomized control trials and clinical reports [6, 8], there does not seem to be a consensus on the use of energy devices to minimize blood loss during liver resection. It has been demonstrated that the clamp-crushing method without an energy device is still more rapid and is associated with lower rates of blood loss in meta-analysis [9]. Therefore, the choice of device is often based on the individual surgeon's preference.

We have performed liver resection using a Harmonic ACE® Curved Shears (HA) (Ethicon Endo-Surgery, Cincinnati, OH, USA) since it became available in Japan. We used the HA only in the superficial liver parenchymal layer less than 20 mm deep when we performed hepatectomy and used the clamp-crushing method with Kelly forceps in the deeper liver parenchymal layer. HA is an ultrasonically activated device, and the Harmonic FOCUS™ Curved Shears (HF) (Ethicon Endo-Surgery) is the latest model, introduced in 2009. The HF differs in the shape and handling from the HA though both devices are attached to the same Harmonic generator. The shape and handling of the HF

resembles those of the Kelly forceps. When using the HF, Kelly forceps are not needed and liver transection can be performed safely and quickly in the deep layer of the liver. We started to use the HF in our hospital in October 2009 and evaluated the outcomes of hepatectomy using HF in this study.

Patients and methods

From November 2009 to March 2011, a total of 51 patients underwent hepatectomy with the use of the HF at the Department of Surgical Oncology, National Cancer Center Hospital East. During this period, our surgical procedure for parenchymal transection of the liver was the clamp-crushing method using the HF. Patients for whom we could measure the liver transection time, transection area, and the number of ligations were analyzed as the HF group in this study. Another surgeon counted the number of ligations using a counter during hepatectomy.

As the control group, we used the 59 patients who underwent hepatectomy with the HA from February 2009 to September 2009. In the control group (HA group), we used HA only in the superficial liver parenchyma layer, less than 20 mm deep, though we used the harmonic device. Then we crushed the deep liver parenchyma using Kelly forceps and ligated the residual tissue.

The ultrasonically activated device is able to seal small vessels safely without bleeding in the superficial liver parenchyma. However, there are many major vessels in the deeper liver parenchyma layer and we cannot expose these vessels and seal or ligate them precisely using an ultrasonically activated device like the HA.

On the other hand, the shape and handling of the HF are like the Kelly forceps (Fig. 1). We are able to use the HF as we do Kelly forceps. We crushed the tissue of the deep liver parenchyma with the nonactivated HF and sealed the exposed vessels with the activated HF. In the HF group, all the advantages of ultrasonically activated devices and the clamp-crushing method were realized by the HF. Glisson's sheath and hepatic veins approximately >3 mm in diameter were ligated in the HF group.

All patients underwent hepatectomy through open laparotomy. Liver transection was performed using the clamp-crushing technique and intermittent Pringle maneuver, i.e., 15 min with the clamp on and 5 min with the clamp off in both groups. Patients who needed bilio-enteric reconstruction were excluded from this analysis.

We evaluated the clinical data retrospectively. All continuous data are expressed as mean ± SD. Statistical analysis was performed using the χ^2 test for categorical data and the Mann-Whitney U test for continuous data. Statistical significance was defined as $P < 0.05$. All statistical calculations were performed using a statistical analysis package (SPSS ver. 18′ SPSS, Inc., Chicago, IL, USA).

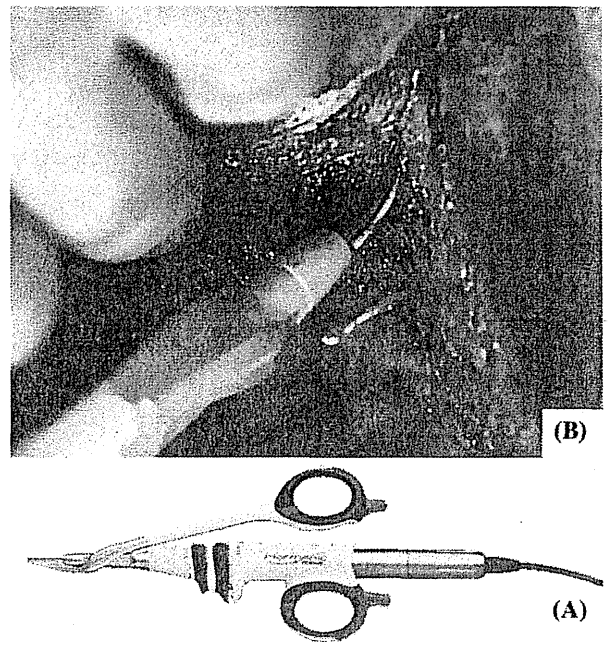

Fig. 1 **a** The Harmonic FOCUS. **b** Intraoperative photograph of the area of liver transection using the Harmonic FOCUS

This study was approved by the institutional review board of the National Cancer Center.

Results

Patients' characteristics are given in Table 1. Gender ratio and disease characteristics of the patients were similar in the two groups. There were no significant differences in the preoperative liver function test or scores (indocyanine green retention rate at 15 min, Child-Pugh score, and MELD score [10]) between the two groups. The Child-Pugh score was A in all patients of the two groups. The mean MELD score was 7.9 points for both groups, so there was no significant difference.

Surgical outcomes are given in Table 2. The surgical procedures (type of hepatectomy) and the rate of repeat hepatectomy were not significantly different between the two groups. However, mean operative time was significantly shorter in the HF group than in the HA group (171 vs. 235 min; $p < 0.001$). Mean blood loss was also significantly less in the HF group than in the HA group (640 vs. 1176 mL; $p = 0.02$). The number of patients needing an intraoperative blood transfusion was significantly smaller in the HF group ($p = 0.003$).

Postoperative complications occurred in seven patients (11.9 %) in the HA group and in four patients (7.8 %) in

Table 1 Patient characteristics in two groups with use of Harmonic ACE (HA) and Harmonic FOCUS (HF)

	HA group	HF group	*P* value
Patients (No.)	59	51	
Age (years)	65.4 ± 12.0	64.4 ± 11.2	0.479[a]
Gender (male/female)	42:17	36:15	0.945[a]
Disease			0.975[b]
Hepatocellular carcinoma	28	25	
Intrahepatic cholangiocarcinoma	4	3	
Metastatic liver carcinoma	27	23	
Hepatitis			0.990[b]
None	39	34	
HBsAg positive	9	8	
HCV Ab positive	11	9	
Indocyanine green retention rate at 15 min (%)	11.1 ± 5.9	10.2 ± 5.4	0.505[a]
Child-Pugh score (A:B/C)	59:0	51:0	
MELD score	7.9 ± 1.5	7.9 ± 1.2	0.669[*]

Values are mean ± SD or number of patients

[a] Mann-Whitney *U* test

[b] χ^2 test

Table 2 Surgical outcomes in two groups with use of Harmonic ACE (HA) and Harmonic FOCUS (HF)

	HA group	HF group	*P* value
Patients (No.)	59	51	
Repeat hepatic resection			0.392[a]
Yes	9 (15.2 %)	5 (9.8 %)	
No	50 (84.8 %)	46 (90.2 %)	
Type of hepatectomy			0.282[a]
< 1 segmentectomy	37	28	
1 segmentectomy	14	10	
> 1 segmentectomy	8	13	
Operative time (min)	235 ± 100	171 ± 68	<0.001[b]
Blood loss (mL)	1,176 ± 2,092	640 ± 540	0.020[b]
Blood transfusion (Y/N)			0.003[a]
Yes	12 (20.3 %)	1(2.0 %)	
No	47 (79.7 %)	50 (98.0 %)	
Morbidity (Y/N)			0.483[a]
Yes	7 (11.9 %)	4 (7.8 %)	
Bile leakage	2	0	
Abdominal abscess	2	0	
Wound infection	1	3	
Pneumonia (atelectasis)	1	1	
Delayed gastric empty	1	0	
No	52 (88.1 %)	47 (92.2 %)	
Status of surgeon			0.602[a]
Consultant	14 (23.7 %)	10 (19.6 %)	
Trainee	45 (76.3 %)	41 (80.4 %)	
Postoperative hospital stay (days)	10.3 ± 4.7	9.0 ± 3.3	0.125[b]

Values are mean ± SD or number of patients

[a] χ^2 test

[b] Mann-Whitney *U* test

the HF group. There was no significant difference in the incidence of postoperative complications between the two groups and no postoperative mortality in either group. As for the complications associated with liver transection, two patients in the HA group and none in the HF group experienced bile leakage. Two patients experienced postoperative minor bile leakage in the HA group. One patient underwent five partial resections of the liver for colorectal metastatic carcinoma. This patient had the drain removed on postoperative day 9 (POD9) because bile leakage stopped and was discharged on POD12. The other patient underwent left lateral segmentectomy and partial resection for colorectal metastatic carcinoma. This patient had the drain removed on POD7 and was discharged on POD9. Another two patients in HA group experienced postoperative abdominal abscess after the removal of their drains. Percutaneous transhepatic abscess drainage was performed for one patient with a S8 segmentectomy on POD12, and the other patient who had had a right hemihepatectomy was medicated by the antibiotics. The patients were discharged on POD28 and POD15, respectively.

The status of surgeons (consultant vs. trainee) was similar in the two groups. There was no significant difference between two groups.

Mean liver transection speed was 1.5 cm^2/min and the mean total number of ties required during liver transection was 9.7 ties in the HF group, in those patients in whom measurement or counting was performed. Regrettably, were not able to compare these data because we did not measure the liver transection speed or count the number of ties in the period when the HA was used.

Discussion

It is very important to minimize blood loss during liver resection, and liver surgeons have made efforts to achieve this. Several reports have shown the usefulness of energy devices in hepatectomy [1, 6, 11, 12]. However, there does not seem to be a consensus on the use of energy devices to minimize blood loss during liver resection, as a randomized controlled trial showed similar surgical outcomes for the

conventional clamp-crushing method and a vessel-sealing system [4].

Liver transection seemed to be performed easily with energy devices nowadays. However, we experienced postoperative complications such as bile leakage when we used the HA in hepatectomy. We thought that this postoperative bile leakage occurred because Glisson's sheath was not completely sealed when we used the HA blindly in the deep liver parenchymal layer. It was difficult to seal the sheath precisely in the deep liver parenchymal layer. On the other hand, there are many small vessels in the superficial liver parenchymal layer which can be sealed completely with energy devices. Therefore, we used the HA only in the superficial liver parenchymal layer that is less than 20 mm deep because it contained no major vessels. We have also performed hepatectomy with the clamp-crushing technique before. Therefore, we performed liver parenchymal transection with the clamp-crushing method using Kelly forceps (no use of HA) in the deep liver parenchymal layer until the introduction of the HF.

The Harmonic FOCUS, which is a new device similar in appearance to Kelly forceps, was introduced in 2009 at which time we started to use it for hepatectomy. It seemed easier to perform liver resection using an energy device combined with the clamp-crushing technique: the liver parenchyma is crushed by the nonactivated HF and the tiny areas of residual tissue are checked and completely sealed with the activated HF without changing to forceps. We can perform a liver transection quickly because we can use the HF as a substitute for Kelly forceps and reduce the need for changing to forceps.

This use of the HF for hepatectomy has already been reported [5]. We evaluated its surgical outcomes in accumulated cases and showed that we could perform hepatectomy safely using the HF. The operative time, intraoperative blood loss, and rate of blood transfusion were greatly improved. If we need to ligate tiny areas of remnant tissue by the crush-clamping method during hepatectomy, we sometimes injure them accidentally. We sometimes fail to ligate the small vessels during liver transection and thus postoperative bile leakage occurs. We speculate that the improvement in surgical outcome is due to the exposure and accurate sealing of residual tiny vasculatures and biliary structures from using the HF with the crush-clamping technique. We will be able to avoid complications associated with liver transection with the use of the HF because sealing is easier than ligation for treating those tiny structures properly.

Our evaluation was regretfully not a prospective study so the interpretation of our results is limited. However, for reference, our liver transection speed was about 1.4–1.5 times that with the conventional clamp-crushing method in other reports [4, 13]. On the other hand, in another report, the liver transection speed was 2.3 cm^2/min in patients who underwent hepatectomy with an energy device [6]. This clinical outcome was the result of a single senior surgeon, and we speculate that the faster speed of that surgeon was due to his expert status. Experts in surgery know when to slow down at critical points in the operation. As a result, they can perform the operation faster by the minimizing intraoperative blood loss. Therefore, it is well known that for all surgical techniques, including liver transection, the speed is dependent mainly on the surgeon's skill. Conversely, our results might be able to be interpreted as meaning that hepatectomy using the HF was performed safely, even if the surgeon was a trainee.

In conclusion, the clamp-crushing method combined with the use of the HF is effective for liver resection. We can seal Glisson's sheath and hepatic veins with a diameter <3 mm safely, without postoperative bleeding or bile leakage, with the use of the HF. The crush-clamping technique used with the HF enables liver surgeons to quickly and safely perform hepatectomy. We hope that this method will be widely adopted by liver surgeons for liver transection.

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Laparoscopic Transhiatal Resection for Siewert Type II Adenocarcinoma of the Esophagogastric Junction: Operative Technique and Initial Results

Takahiro Kinoshita, MD, PhD, Naoto Gotohda, MD, PhD,* Yuichiro Kato, MD,* Shinichiro Takahashi, MD, PhD,* Masaru Konishi, MD,* Shinichi Okazumi, MD, PhD,† Ryoji Katoh, MD, PhD,† and Taira Kinoshita, MD, PhD**

Abstract: Laparoscopic distal gastrectomy has gained wide acceptance, and laparoscopic total gastrectomy (LTG) and laparoscopic proximal gastrectomy (LPG) are now also performed for gastric cancer. We extended these techniques to treat Siewert type II adenocarcinoma of the esophagogastric junction (AEG). Ten patients with clinical T1 AEG type II underwent laparoscopic transhiatal (LTH) resection combined with LTG reconstructed by Roux-en-Y (LTH + LTG: n = 2) or LPG reconstructed by jejunal interposition (LTH + LPG: n = 8). Intracorporeal esophagojejunostomy was performed using a circular stapler, of which the anvil head was introduced transabdominally or transorally. The median operation time was 243 minutes, and blood loss was 25.5 g. There were no intraoperative complications or conversion to open surgery. No anastomotic leak was observed, but 1 diaphragmatic herniation to the left thoracic cavity occurred postoperatively. The median length of the proximal margin was 14.5 mm. This operation is technically feasible and can be safely performed after adequate experience of LTG or LPG, though esophagojejunostomy in the mediastinum is technically demanding.

Key Words: adenocarcinoma of the esophagogastric junction, laparoscopic surgery, transhiatal approach

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The incidence of adenocarcinoma of the esophagogastric junction (AEG) is increasing worldwide. Siewert proposed an AEG classification system in 1996,[1] which is now widely used and accepted. This classification defines AEG according to the position of the center of the main tumor as type I, II, and III,[1,2] which is a useful distinction for aiding selection of the appropriate surgical approach. Complete tumor resection (R0) and adequate lymph node dissection are thought to be associated with good long-term prognosis for all types of AEG. The distributions of the 3 types of AEG are reported to differ between western and eastern countries,[3–7] and most AEGs in Asian countries are type II or III,[4–7] with oncological characteristics similar to those of gastric cancer. Most AEG type III tumors in Japan tend to be managed as proximal gastric cancer. The transthoracic approach is generally recommended for type I, whereas the abdomino-transhiatal route is considered to be the optimal surgical approach for type II and III tumors.[3,8] The laparoscopic transhiatal (LTH) approach may thus represent an alternative to open surgery for the treatment of such AEGs.

Laparoscopic gastrectomy with systemic lymphadenectomy is being performed with increasing frequency, especially in Japan and Korea, which have high incidences of gastric cancer. Acceptable oncological outcomes and faster patient recovery times have been reported after laparoscopic surgery for early gastric cancer.[9] Laparoscopic distal gastrectomy is the most frequently performed procedure for lesions of the distal stomach, whereas laparoscopic total gastrectomy (LTG) and laparoscopic proximal gastrectomy (LPG) are also now being performed to treat cancer of the proximal stomach[10]; however, esophagojejunal anastomosis under laparoscopy remains a challenging procedure, preventing the widespread use of these procedures. We have the experience of many cases of LTG and LPG, and have extended the use of these techniques to treat AEG type II, which arises at the anatomic cardia. To date, few studies have reported the safety and feasibility of such procedures. In this study, we report the technical details and our preliminary experiences of LTH procedures for localized AEG type II.

PATIENTS AND METHODS

This preliminary technical report represents a single surgeon's experience (T.K.) at 2 institutions.

Patients

Ten patients (5 males, 5 females) with AEG type II underwent laparoscopic radical surgery between May 2009 and August 2011. The operative procedures in these patients included LTH distal esophagectomy combined with reconstruction by Roux-en-Y (LTH + LTG), or combined with LPG reconstructed by jejunal interposition (LTH + LPG). Preoperative staging was based on gastrointestinal endoscopy, endoscopic ultrasonography, barium swallowing, and computed tomography. The diagnosis in all patients was AEG type II, clinical stage T1N0, beyond the indication range for endoscopic mucosal resection or endoscopic submucosal dissection. The length of esophageal invasion from the esophagogastric junction was estimated to be <3 cm in all cases. Surgery was performed after the informed consent was obtained from the patients.

Surgical Procedures

The patient was placed in the supine position with legs spread. A camera port was placed at the umbilicus, through which a flexible endoscope with a 10-mm tip (Olympus Optical Ltd, Tokyo, Japan) was introduced. Four other

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From the *Department of Surgical Oncology, National Cancer Center Hospital East, Kashiwa; and †Department of Surgery, Toho University Medical Center Sakura Hospital, Sakura, Japan.
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Reprints: Takahiro Kinoshita, MD, PhD, 6-5-1 Kashiwanoha, Kashiwa, Chiba 277-8577, Japan (e-mail: takkinos@east.ncc.go.jp).