Special article

Usefulness of Omental Wrapping to Prevent Biliary Leakage and Delayed Gastric Emptying in Left Hepatectomy

Atsushi Nanashima, Syuuichi Tobinaga, Takafumi Abo, Takashi Nonaka, Masaki Kunizaki, Hiroaki Takeshita, Shigekazu Hidaka, Terumitsu Sawai, Toru Yasutake, Takeshi Nagayasu

Division of Surgical Oncology,

Department of Translational Medical Sciences, Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto, Nagasaki, 8528501, Japan.

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Address for correspondence and reprints requests:

Atsushi Nanashima, MD,

Division of Surgical Oncology, Department of Translational Medical Sciences,

Nagasaki University Graduate School of Biomedical Sciences,

1-7-1 Sakamoto, Nagasaki 852-8501, JAPAN.

Tel: +81-95-819-7304, Fax: +81-95-819-7306

E-mail: a-nanasm@net.nagasaki-u.ac.jp

ABSTRACT

Background/Aims: To identify the clinical significance of the omental wrapping (OW) technique after left hepatectomy to reduce bile leakage and delayed gastric emptying, we examined clinical and surgical parameters after left hepatectomy with or without biliary reconstruction in 79 patients.

Methodology: This was a retrospective study of data from 14 patients undergoing OW compared to 65 patients in the control group.

Results: Bile leakage and delayed emptying after hepatectomy were observed in 15 and 11 patients, respectively. Gender, background liver function, liver diseases, and preoperative liver function tests were not significantly different between both groups. Prevalence of extent of hepatectomy, existence of segment 1 resection, biliary-enteric anastomosis, operating time and blood loss were also not significantly different between groups. Prevalence of bile leakage was similar between the OW and the control group (14 vs. 20%)(p=0.91). Prevalence of delayed gastric emptying was not significantly different between groups, but this complication was not observed in the OW group in comparison with the control group (0% vs. 20%)(p=0.31). Prevalence of other complications and hospital stay after hepatectomy were similar between groups.

Conclusions: Significant differences for preventing left hepatectomy related complications were not found; however, it is possible that OW could reduce delayed gastric emptying.

Key Words: Hepatectomy; Omental wrapping; Bile leakage; Delayed gastric emptying; Prevention

Abbreviations: (OW) omental wrapping,

INTRODUCTION

Hepatic resection has been safely performed; however some complications including bile leakage occur, leading to long hospital stays [1, 2]. Even though hemostatic techniques and devices have recently improved, bile leakage from the liver cut-surface or a large bile duct occurs, and this complication often causes intraabdominal infection [3]. Based on our experience and previous reports, bile leakage and delayed gastric emptying have been frequently observed in cases of left hemi-hepatectomy [4-6]. Delayed gastric emptying may occur after mechanical occlusion or the disruption of gastrointestinal movements [7]. Mechanical occlusion may occur with displacement or torsion of the stomach in the resected space and adhesion at the cut surface of the liver may interrupt gastric movement [4, 5]. It is necessary to prevent these complications in cases of left hepatectomy.

Wrapping procedure using internal tissues has been used to cure or prevent leakage at anastomotic sites or organ injury in the field of surgery [8-11]. Particularly, the greater omentum of the stomach is widely used because of the healing effect from the abundant blood supply of omental tissue [8, 9]. Omental graft pedicle can be extended to the distant part in the abdomen, even the rectal anastomosis, where the tissue volume is rich [12]. Omental wrapping would be a useful option to cover the wide cut surface of the amputed liver, and trials of omental wrapping have been reported in a few papers [8, 11, 13-15]. These reports showed that intra-abdominal complications, including bile leakage after hepatectomy, were reduced by this procedure. Furthermore, the omental graft is tight and placement of this tissue into the empty space after hepatectomy may avoid displacement of the stomach. Yoshida et al. reported the usefulness of omental fixation between the hepatic cut-surface and the stomach to prevent delayed gastric emptying [4, 5]. However, the clinical significance of applying an omental

patch to avoid the above complications has not been fully clarified . We also believe that this technique could be useful in liver surgery.

In the present study, we examined the relationship between use of omental wrapping (OW) on the cut surface of the liver after left hepatectomy and the incidence of bile leakage or associated intra-abdominal abscess, delayed gastric emptying of the stomach and patient outcomes in 79 patients undergoing anatomical left hepatectomy with or without biliary-enteric reconstruction. The purpose of the present study was to clarify whether OW reduced biliary complications or improved patient outcomes after hepatectomy.

METODOLOGY

Patients

The subjects were 79 patients who underwent hepatic resections in the Division of Surgical Oncology, Department of Translational Medical Sciences, Nagasaki University Graduate School of Biomedical Sciences (NUGSBS) between 2000 and October 2009. They included 55 males and 24 females with a mean age of 66.2±9.5 years (±SD, range, 35-82 years). Liver diseases included hepatocellular carcinoma (n=24), intrahepatic cholangiocarcinoma (n=19), metastatic liver carcinoma (n=13), extrahepatic biliary tract carcinoma (n=18) and other benign diseases (n=5). The background liver diseases included normal liver function (n=43), chronic viral liver diseases (n=24 including 6 with cirrhosis), alcoholic liver diseases (n=1) and obstructive jaundice (n=11). Child-Pugh classification included A (n=76) and B (n=3), or Liver Damage Grade *by the Liver Cancer Study Group of Japan* [16] included A (n=72) and B (n=7). The type of hepatectomy included extended left hemi-hepatectomy (n=42) and hemi-hepatectomy (n=47), which included combined resection of segment 1 in 3. Resection of the extrahepatic bile duct and its enteric reconstruction were performed in 29 patients who had biliary tube drainage after hepatectomy.

In our hospital, the volume of liver to be resected is determined pre-operatively by results of indocyanine green retention rate at 15 minutes (ICGR15) using Takasaki's formula [17]. The estimated resected liver volume, excluding tumor volume (cm^3), is measured by CT volumetry [18]. Essentially, the planned hepatectomy is performed when the permitted resected volume of the liver is greater than the estimated resected volume of the liver.

The study design was approved by the Ethics Review Board of our institution and a signed consent for clinical study using patient records was obtained from each subject. The present analysis was a retrospective and historical study but not randomized. Data were retrieved from

both anesthetic and patient charts plus the NUGSBS database, for the duration of the initial hospitalization following hepatectomy.

Technique of hepatectomy and greater omental wrapping

All patients underwent hepatectomy under open laparotomy. The procedure included routine clamping of the hepatoduodenal ligament to occlude total inflow to the liver during transection. It also included the use of the forceps crush clamping method [7] and an ultrasonic dissector (USU MH-207, Olympus, Tokyo, Japan) at some points around the major vessels for the transection of liver parenchyma. By using the Kelly clamp, the hepatic parenchyma was widely and gently crushed and confirmed the remnant vessels, which were tied with an absorbable braid (Ethicon Inc., Somerville, NJ) and divided. Any bleeding and macroscopically detected bile leakage points at the cut plane were sutured by absorbable 4-0 monofilament polydioxanone (PDS)-II suture (Ethicon,). We used fibrin glue on the cut surface of the liver to ensure hemostasis. One drainage tube was placed on the cut surface, which was removed after confirmation of postoperative bile leakage. A uniform perioperative care was employed in all patients.

After hepatectomy, the greater omentum was cut and removed from the transverse colon and a predetermined volume of omental patch graft was isolated. This graft was spread out and used to cover the cut surface of the liver to avoid biliary fistula and the body of this graft was placed between the stomach and the diaphragm to avoid displacement of the stomach (Figure 1).

The subjects were divided into two groups; omental wrapping (OW) group (n=14) (18%) and non-OW group (n=65). Selection of OW was started in 2007. Analyzed parameters were age, gender, background liver, liver diseases, liver functional parameters, extent of

hepatectomy, existence of anastomosis, operating time, blood loss, various postoperative complications including biliary leakage and delayed gastric emptying or period of hospital stay. Biliary leakage was macroscopically defined via intraabdominal drainage tube. Delayed gastric emptying was defined when normal food intake could not be tolerated for more than 1week and naso-gastric tube drainage was necessary for more than 5 days due to stasis of gastric juice.

Statistical analysis

All continuous data were expressed as mean ± SD. Data for different groups were compared using one-way analysis of variance (ANOVA). Chi-square test was used for comparison of categorical variables. Differences between groups were analyzed by Fisher's exact test or Scheffé's multiple comparison test. A two-tailed P value of less than 0.05 was considered significant. StatView Software for Windows, version 5.0 (SAS Institute, Inc., Cary, NC) was used in all statistical analyses.

RESULTS

Table 1 shows the comparison of patient demographics, surgical record and postoperative outcomes between the OW and the control group. Gender, background liver and liver diseases were not significantly different between groups. Preoperative liver function tests were not significantly different between groups but ICGR15 tended to be lower in the control group. Prevalence of extent of hepatectomy, existence of segment 1 resection and biliary-enteric anastomosis were not significantly different between groups. Operating time and blood loss were not significantly different between groups either. Prevalence of bile leakage was similar between the OW and the control group (14 vs. 20%). Prevalence of delayed gastric emptying was not significantly different between groups but this complication was not observed in the OW group in comparison with the control group (0% vs. 20%). Prevalence of other complications and hospital stay after hepatectomy were similar between groups.

DISCUSSION

Intra-peritoneal bile leak is a major complication after hepatectomy, and leads to longer hospital stay or serious complications such as sepsis [1-3, 19]. Prevalence of biliary leak or fistula after hepatectomy ranges between 12-18% and our present result was not different from these previous reports [20-22]. When biliary leak occurs, patients undergo treatment management for a long period. If adequate prevention of intra-abdominal bile collection could be accomplished, surgical results would improve. Hotta et al. reported that bile leak was the most common intra-abdominal abscess formation, and bile leak was caused by long operating time or left side hepatectomy [20]. We have previously reported the tendency of bile leak in left side hepatectomy in a preliminary report [6]. Previous trials have demonstrated the use of various methods and materials, including omentoplasty, Gerota's fascia, and synthetic absorbable mesh or sutures, to decrease deep abdominal complications, including biliary leakage in cases of hepatectomy, liver trauma and hydatid cyst [8, 9, 11]. Absorbable sutures or autograft materials should be avoided to prevent surgical site infections [23, 24]. In these materials, a sufficient volume of the omental graft can be easily obtained in the same operative field. OW has often been used for covering the liver surface, colorectal anastomosis, and pancreatic anastomosis [12, 25]. Omentum has the absorbable ability of intraabdominal fluid, anti-bacterial effects, and positive outcomes on wound healing [26-28]. Therefore, OW is thought to be an effective procedure in the surgical site. However, our present result showed that OW was not significantly effective for preventing biliary leakage after left hepatectomy. Results from previous reports with respect to preventing biliary leakage using OW have been controversial [13-15]. Kourakilis et al. reported better results with myoplasty than with omentoplasty [14]. Dziri et al. showed significant effectiveness of OW for decreasing deep abdominal complications [15]. In this study, the total number of OW patients was less

compared to the control group. Biliary leakage was observed in two patients in the OW group while 13 patients had a bile leak including massive fistula. Based on improvements in the OW group, it is possible that effectiveness of OW will be clarified in future studies. In the present series, left hepatectomy with or without enteric anastomosis was examined. Usually, bile leakage after hepatico-jejunostomy is not frequently observed [29] and, furthermore, biliary drainage tubes were placed in the present series. Therefore, we could examine these patients together in the present study. In our series, anastomotic biliary leakage was not observed. In the last decade, fibrin glue has also been a useful treatment to prevent post-hepatectomy bleeding or biliary leak [30]; however, a recent randomized study showed negative results of fibrin glue for preventing biliary fistula[31]. At this stage, as the adverse effects of OW have not been reported, this material would be the best covering material for the hepatic cut-surface.

Delayed gastric emptying is a frequent complication after pylorus preserving pancreaticoduodenectomy [32]. Hormonal alteration, gastric adhesion or various systemic conditions might cause this complication [5, 7]. Mechanical occlusion is also a cause. Umeshita et al. reported this complication after living donor liver transplantation [32] and, furthermore, Yoshida et al. reported a significant association between hepatectomy with lymphadenectomy and delayed gastric emptying [4, 5]. In such cases, OW solved the displacement of the stomach causing delayed gastric emptying. Based on our previous report, this complication occurred in some cases with left hepatectomy [6]. To prevent this complication, in the present study, we placed the OW beyond the stomach. As a result, delayed gastric emptying was not observed, although the difference of prevalence of this complication was not statistically significant. A future study with more subjects needs to be done to clarify the effectiveness of fixation of the omentum.

In conclusion, we have examined the usefulness of omental wrapping and placement after left hepatectomy to control biliary leakage and delayed gastric emptying in 79 patients. Although statistical significance was not observed, it seemed that delayed gastric emptying could be reduced by omental placement between the stomach and the diaphragm. Further study with a larger number of patients will be necessary to clarify the usefulness of OW after left hepatectomy.

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Figure legend

FIGURE 1 The greater omental graft from the colon was covered at the cut-surface of the liver after left hepatectomy and, furthermore, the body of the graft was placed between the stomach and the diaphragm.

TABLE 1. Comparison between Post-hepatectomy Bile Leak and Clinical Status, Surgical Record and Outcomes.

	OW group [n=14]	Control group [n=65]	p value
Gender			
Male/Female	12/2	43/22	0.20
Background liver			
Normal/chronic hepatitis/cirrhosis/jaundice/alcoholic	7/3/3/1/0	36/15/3/10/1	0.30
Liver disease			
HCC/CCC/liver metastasis/ BC/others	5/3/1/4/1	19/16/12/14/4	0.20
Child-Pugh classification			
A/B	13/1	63/2	0.47
Liver damage grade			
A/B	11/3	61/4	0.12
Preoperative liver functions			
ICGR15 (%)*	14.5±7.3	11.4±6.6	0.10
Total bilirubin level (mg/dl)	1.1±0.3	1.6±2.5	0.37
Prothrombin activity (%)	93±14	88±13	0.36
Extent of hepatectomy			
Extended left hepatectomy/left hepatectomy	6/8	36/29	0.58
Resection of segment 1			
Yes/ No	1/13	2/63	0.45
Bile duct anastomosis			
Yes /No	7/7	22/43	0.41
Operating time (minutes)	524±212	541±147	0.65
Blood loss (ml)	1842±1387	1534±1398	0.42
Postoperative complications (Yes/No)			
Bile leakage	2/12	13/52	0.91
Delayed gastric emptying	0/14	11/54	0.13
Long-term ascites or pleural effusion[§]	1/13	7/58	1.0
Intra-abdominal infection	1/13	6/59	1.0
Hepatic failure	0/14	3/62	0.96
Hospital stay (day)	33±12	35±19	0.49

HCC; hepatocellular carcinoma, CCC; cholangiocarcinoma, GBC; gall bladder carcinomas

ICGR15; indocyanine green retention rate at 15 minutes. OW; omental wrapping

*Data are mean±SD,

FIGURE 1