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Original Article

Usefulness of the Pinch-Burn-Cut (PBC) technique for recipient hepatectomy in liver transplantation

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Backgrounds/Aims: Surgical bleeding during recipient hepatectomy is a major concern in liver transplantation (LT). Effective intraoperative control of bleeding is necessary. In the Pinch-Burn-Cut (PBC) technique, a small amount of tissue around the dissection plane is pinched with forceps, electocauterized and gently cut. The present study sought to estimate the usefulness of the PBC technique in LT. **Methods:** Between June 2007 and December 2010, 123 adult cases underwent LT in our center. Of these, 72 involved a recipient hepatectomy using the PBC technique (PBC group). and 51 involved the conventional technique (non-PBC group). Clinical parameters were compared between two groups. **Results:** The amount of blood loss and related transfusions were significantly reduced, and the operating time was shorter in the PBC group than in the non-PBC group (p=0.006, $p<0.05$ and p=0.002, respectively). There was also shorter duration of mechanical ventilation after LT in the PBC group (p=0.017). The incidence of postoperative hemorrhage was lower in the PBC group than in the non-PBC group, but had no statistical significance between two group (19.6 % vs. 8.3%, p=0.101). **Conclusions:** Our data suggest that the PBC technique is effective for bleeding control during recipient hepatectomy in LT. **(Korean J Hepatobiliary Pancreat Surg 2012;16:13-16)**

Key Words: Liver transplantation; Hepatectomy; Surgical outcome

INTRODUCTION

Liver transplantation (LT) is associated with the potential for massive operative blood loss, which has been recognized as one of the main causes of morbidity and mortality after LT.[1-4] Massive blood transfusions, following operative hemorrhage in LT, are associated with an increased risk of postoperative complications.[5,6] Therefore, a fine surgical procedure to reduce intraoperative hemorrhage is necessary for favorable outcomes of LT.

During a recipient operation in LT, minimal operative hemorrhage allows for a clear operative field, which eases the complexity of the operation for the surgeon. With the conventional technique, the recipient hepatectomy and tissue dissections are commonly performed by electrocautery using a Bovie dissector, and/or surgical tie and/or suture ligation to minimize operative bleeding. However, the tissue dissection in patients with liver cirrhosis requires a very delicate technique and thus, protracted the operative time due to vigorous development of collateral vessels. To our knowledge, studies addressing a surgical technique to reduce operative hemorrhage during a recipient hepatectomy lacks in literature.

Tanaka et al.[7] introduced the Pinch-Burn-Cut (PBC) technique using a monopolar forceps for tissue dissection during the recipient's operation of LT. In the PBC technique, a small amount of tissue along the dissection plane is pinched with the forceps, electocauterized and then gently cut. Their experience suggested that the PBC technique could decrease the operative bleeding than the methods of the conventional technique for the recipient's operation. In this study, we evaluated the usefulness of PBC technique for recipient's operation by comparing the perioperative data between the recipients undergoing liver transplantation via the PBC technique and the conventional technique.

METHODS

From February 2005 to December 2010, 223 adult liver

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transplantations were performed in our center, which comprised of 161 living donor liver transplantations and 62 deceased donor liver transplantations. The first 100 cases were excluded in this study to account for the learning curve effect. Thus, the remaining 123 cases were enrolled between June 2007 and December 2010. The same team of surgeons performed all transplantation procedures.

Between June 2007 and August 2008, 51 recipients (non-PBC group) received a total hepatectomy using the conventional technique, with a Bovie dissector and/or surgical tie and/or suture ligation. The recipient hepatectomy using a conventional dissection technique has been performed for dissecting the falciform and gastrohepatic ligaments, dissecting the triangular, coronary ligaments, and the hepatic hilum using a Bovie dissector, surgical tie-off and suture ligation. The recipient vena cava was preserved in all cases and the liver was freed from the vena cava by careful ligation and division of short hepatic veins using a surgical tie. Finally, the right diaphragm attached with the bare area of the recipient was collapsed and re-peritonealized using a continuous 2-0 Vicryl suture.

From September 2008 to December 2010, the PBC technique was applied in 72 recipient hepatectomies (PBC group). The dissection of perihepatic ligaments, including the hepatic hilum, was done with the application of the PBC technique. In the PBC technique, a small amount of soft tissue at the dissection plane was pinched with a monopolar forcep, and then the tissue was coagulated by supplying an electric current via monopolar forceps until spontaneously cut (Fig. 1). The monopolar forcep was connected to the electrosurgical generator (Valleylab Force FX^{TM}, Covidien, Inc, Boulder, CO, USA) of 30 watts power, with the "spray" mode. Surgical tie or suture ligation were limitedly used only for a large vascular structure dissection. The reperitonealization of the diaphragm was not performed. The remaining procedure was the same.

The perioperative data of recipients using the PBC technique (PBC group) and using the conventional technique (non-PBC group) were retrospectively analyzed and compared between the above two groups. Statistical analysis was performed with SPSS version 16.0 (SPSS, Chicago, IL), using the Chi-square test or Fisher's exact test to compare the categorical variables. The Student's *t* test was utilized to compare continuous variables. $p<0.05$ was considered to be statistically significant.

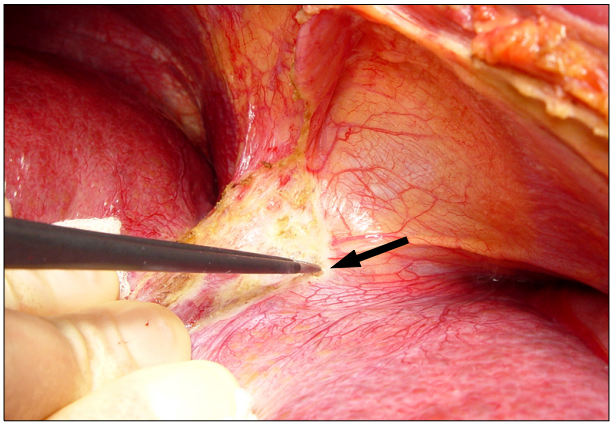

Fig. 1. Dissection of the falciform ligament using Pinch-Burn-Cut (PBC) technique. Fine collateral vessels around the tip of the monopolar forcep were obliterated by PBC technique (arrow).

RESULTS

Preoperative characteristics of the recipients showed no significant difference between non-PBC group and the PBC group (Table 1). The intra-operative data showed that the cold ischemic time of the graft and total operation time of the recipients were both significantly shorter in the PBC group than in the non-PBC group ($p<0.001$ and $p=0.002$, respectively). The amount of operative bleeding was significantly lower in the PBC group than in the non-PBC group ($p=0.006$). Also, the amounts of intra-operative transfusion of red blood cell, fresh frozen plasma and platelet were also lower in the PBC group than in the non-PBC group ($p<0.05$, Table 2).

The postoperative data of the recipients showed that the duration of mechanical ventilation after LT in the PBC group was shorter than in the non-PBC group ($p=0.017$). There was a lower incidence of postoperative hemorrhagic complications in the PBC group (n=6 [8.3%]) than in the non-PBC group (n=10 [19.6%]). However, the difference was not statistically significant ($p=0.101$). The 1-year survival rate was not significantly different between the two groups (Table 2).

DISCUSSION

The present study was undertaken to determine the efficacy of the PBC technique during the recipient hepatectomy in LT. To the best of our knowledge, this study is the first analytic report of the PBC technique in LT.

Table 1. Preoperative characteristics of the recipients in the non-PBC group and PBC group

	Non-PBC group (n=51)	PBC group (n=72)	*p*-value
Age	46 (26-68)	51 (31-65)	0.327
Male	34 (66.7%)	52 (72.2%)	0.838
Type of graft			0.353
Cadaveric donor graft	23 (45.1%)	26 (36.1%)	
Living donor graft	28 (54.9%)	46 (63.9%)	
Etiology of liver disease			0.204
Hepatitis B	30 (58.8%)	52 (72.2%)	
Hepatitis C	2 (3.9%)	3 (4.2%)	
Alcoholism	8 (15.7%)	11 (15.3%)	
Miscellaneous	11 (21.6%)	6 (8.3%)	
Hepatocellular carcinoma	21 (41.2%)	42 (58.3%)	0.069
MELD score	19 (6-49)	16 (6-40)	0.127
Child-Pugh score	9 (7-11.5)	8 (6-11)	0.151
Platelet count (10^9/L)	92.63±84.56	70.06±47.89	0.062
PT-INR	1.88±0.65	1.66±0.84	0.128
Previous abdominal surgery	11 (21.6%)	15 (20.8%)	1.000
Salvage LT	5	14	
Re-LT	4	1	

Data are number (%) or mean±SD or median (range). NOTE: Significance was defined as $p<0.05$. MELD, model for end-stage liver disease; PT-INR, prothrombin time-international normalized ratio; LT, liver transplantation

Table 2. Operative outcomes of graft and recipients after liver transplantation in the two groups

	Non-PBC group (n=51)	PBC group (n=72)	*p*-value
Intraoperative outcome			
Cold ischemic time (minutes)	268.59±139.39	152.92±95.73	0.000
Warm ischemic time (minutes)	43.65±14.32	43.53±14.59	0.964
Operation time (minutes)	725.26±173.34	635.14±128.61	0.002
Intraoperative blood loss (ml)	5,829.79±3,411.86	3,411.86±3,976.14	0.006
pRBC transfused (units)	12.77±12.16	6.47±9.74	0.002
FFP transfused (units)	7.83±7.08	3.89±5.14	0.001
Platelet transfused (units)	10.77±9.09	6.61±6.63	0.005
Postoperative outcome			
Mechanical ventilation (days)	2 (1-54)	1 (0-23)	0.017
ICU length of stay (days)	5 (2-60)	5 (2-118)	0.41
Postoperative hemorrhage	10 (19.6%)	6 (8.3%)	0.101
Survival rate at 1 year	82.4%	87.5%	0.228

FFP, fresh frozen plasma; pRBC, packed red blood cell; ICU, intensive care unit

Based on our data, we suggest that the PBC technique was a useful surgical practice for the recipient hepatectomy. Limitations of our study included retrospective analysis and the time difference between the two groups. However, we tried to limit the learning curve effect by excluding first 100-case experience in our center. During the period of this study, there was no other modification in the method of the recipient's hepatectomy and graft implantation between the two groups, except the adoption of the PBC technique. So, we believe that the comparison between the two groups is reasonable.

Factors that affect intra-operative hemorrhage, during LT, includes surgical technique, coagulation profiles and hemodynamics of the recipients.[8] However, from the surgical point of view, the surgical techniques may play a key role in the intra-operative bleeding. Because the recipient for LT has abundant fine collateral vessels in the ligaments around the liver and poor coagulation profiles by commonly associated liver cirrhosis, the surgical procedure for a recipient is more difficult than in other abdominal procedures. Therefore, fastidious attention and additional time are necessary to achieve meticulous bleeding

control on the recipient hepatectomy field. Dissection of tissues containing small collateral vessels, during recipient hepatectomy, is conventionally performed with electrocautery in many centers. However, electrocautery is not enough to securely control collateral vessels on the cutting edges. Therefore additional suture ligature is usually needed for hemostasis.

In the PBC technique of our experience, a 3-4 mm of width around the tip of the monopolar forceps was coagulated before cutting, thus, a small collateral vessels in dissection plane were easily controlled without additional suture ligature (Fig. 1). After adoption of the PBC technique, we have been able to obtain a clearer operation field due to less bleeding events or oozing from cutting edges of the dissection plane. Results of this study showed that the PBC technique could reduce the amount of intraoperative hemorrhage, followed by less blood product transfusion, and thus, results in a shortened duration of operation time. Shorter cold ischemic time of the graft might be an additional benefit of PBC technique due to the shortening of the recipient procedure.

In conclusion, the PBC technique could provide greater advantageous benefits such as bloodless and faster recipient's operation than the conventional dissection technique. Also the postoperative outcomes of the recipient could be improved by using PBC technique for recipient's operation.

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