

Two-surgeon technique using saline-linked electric cautery and ultrasonic surgical aspirator in living donor hepatectomy: its safety and efficacy.

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Abstract

Background: Saline-linked electric cautery (SLC) is introduced as an effective device to reduce blood loss in liver surgery. The aim of this study is to evaluate the safety and efficacy of two-surgeon technique using SLC and Cavitron Ultrasonic Surgical Aspirator (CUSA) in living donor hepatectomy.

Methods: Forty-three living donor right hepatectomies were enrolled in this study. The first 28 cases underwent liver transection with CUSA alone (CUSA group), while additional SLC was applied in the current 15 cases (two-surgeon technique, TS group).

Results: Blood loss was significantly reduced by two-surgeon technique (1115.2 ± 652.9 g in CUSA group vs 732.3 ± 363.6 g in TS group, $p < 0.05$). In the TS group, there was no bile leakage from the cut surface. The early graft function and postoperative recipient survival were not significantly different between the groups.

Conclusions: According to our single center experience, blood loss and donor complications were significantly reduced by two-surgeon technique using CUSA and SLC, with maintaining the graft viability.

Saline-linked electric cautery (SLC) has been introduced as an effective device to reduce blood loss in liver surgery (1). However, possible heat injury of the hepatic cut surface is a great concern when this type of cautery is used in living donor hepatectomy, in which graft viability should, as much as possible, be maintained. On the other hand, Cavitron Ultrasonic Surgical Aspirator (CUSA) is a unique device to dissect the liver parenchyma, but it has no effect of sealing tissues, and requires meticulous ligations even of small vessels and bile ducts. To guard against these possible disadvantages, Aloia et al. (2) introduced a two-surgeon technique utilizing SLC and CUSA in hepatectomy for neoplasm with promising results, but its safety and efficacy in living donor hepatectomy were not yet clarified. We describe herein the safety and efficacy of two-surgeon technique in living donor hepatectomy.

Patients

From August 1997 to August 2007, we performed 73 living donor liver transplantations. To match the surgical factors, 43 living donor right hepatectomies were enrolled in this study. The middle hepatic vein was not included in the graft in any cases. For liver transection in donor surgery, we adapted CUSA with occasional use of ordinary electric cautery in the first 28 cases (CUSA group), and additional SLC was introduced in the last 15 cases (two-surgeon technique, TS group). The characteristics of the donors in each group are listed in Table 1.

Methods

Surgical Procedure of two-surgeon technique:

Following laparotomy, the liver was mobilized in the standard fashion. After the liver was fully mobilized and the short hepatic veins carefully divided, the right hepatic vein was isolated and taped, followed by transection of the liver parenchyma from the antero-caudal liver surface toward the hepatic inferior vena cava, with or without preserving the middle hepatic vein tributaries. The 3-0 polypropylene stay sutures were placed at the antero-caudal edge of the liver along the plane of intended transection. The primary surgeon dissected the hepatic parenchyma from the patient's right side using the Cavitron Ultrasonic Surgical Aspirator System (CUSA, Valleylab, Boulder, CO). The secondary surgeon operated the SLC device (Dissecting Sealer DS 3.5, TissueLink Medical, Inc., Dover, NH) from the patient's left side (Figure 1.). Occlusion of the hepatic arterial and portal inflow was not used in any cases. The liver parenchyma was dissected with CUSA, and the intraparenchymal vascular anatomy was defined so that a decision on hemostatic technique could be made based on vessel size. The SLC device was used to coagulate and divide dissected vessels 3 mm or smaller. Vessels larger than 3 mm in diameter were ligated with 3-0 or 4-0 silk ties and sharply divided. The few larger vessels were ultrasonically dissected and controlled with 4-0 absorbable monofilament transfixing sutures, and sharply divided. The middle hepatic vein tributaries larger

than or equal to 5 mm in diameter were preserved for subsequent reconstruction in the recipient. Traction on the stay sutures was used to separate and expose the deepening transection plane. Also, the liver hanging maneuver technique (3) was applied to lift the deep part of the transection plane at the final step of the parenchymal transection. A closed suction drain was placed at the conclusion of each procedure.

Statistics

Each data are presented as mean \pm standard deviation. Statistical analysis was performed with the unpaired t-test. $P < 0.05$ was considered statistically significant.

Results

Blood loss was significantly less in the TS group than in the CUSA group (732.3 ± 363.6 g in TS group vs 1115.2 ± 652.9 g in CUSA group, $p < 0.05$, Figure 2). The peak alanine aminotransferase (339.7 ± 135.1 IU/L in TS group vs 388.6 ± 242.1 IU/L in CUSA group) and total bilirubin (2.9 ± 1.1 mg/dL in TS group vs 2.6 ± 1.3 mg/dL in CUSA group) after surgery were not significantly different between the groups. Also, the duration of the operation was not significantly different (484.6 ± 79.2 minutes in TS group vs 426.0 ± 92.5 minutes in CUSA group). In regard to the postoperative complications in the donors, there were 9 significant complications (Table 2). All of the bile leakage was observed in the CUSA group, and was considered to originate from the cut surface of the liver,

because the leakages spontaneously stopped without surgical intervention being required. Although the incidence of bile leakage was not statistically different, there was no bile leakage in TS group.

All 43 donors are currently doing well with preoperative activity and normal liver function. In regard to recipient survival, the early postoperative survival by three months after surgery was not significantly different between the groups (93.3% (14/15) in TS group vs 82.1% (23/28) in CUSA group).

Discussion

Reducing blood loss is one of the goals in liver surgery, and several technical inventions have been introduced to achieve it, including the Pringle maneuver (4), selective vascular occlusion (5), and so on. Regarding surgical devices, CUSA has contributed to safe hepatectomy by making it easy to identify the vessels during parenchymal transection (6). However, because CUSA has no function of sealing tissues, meticulous ligation is required to avoid bleeding or bile leakage from the cut surface of the liver. Another novel device of SLC contributes to reducing the ligation during liver parenchymal transection with its effect of sealing tissues (1), but possible heat injury is a great concern when the device is used in living liver donor surgery (7). To guard against these possible disadvantages, Aloia et al. (2) introduced a two-surgeon technique in hepatectomy for neoplasm with promising results, but its safety and efficacy in living donor hepatectomy were not yet clarified. In

our study, we were able to prove that SLC could be safely adapted to living liver donor surgery without injuring either the graft or remnant liver. The graft function was excellent, and no significant complications were observed in the donors.

Despite the meticulous ligations, all of the bile leakage which was observed in the donors was seen in the CUSA group. SLC, with its sealing effect, also seemed to be effective in preventing bile leakage from the cut surface of the liver. The actual reason of this advantage of SLC over ligation is not clear, but small bile ducts might be missed and left open without closure, even by meticulous ligations, and accuracy of ligation might depend on surgeon's skill. SLC is easy to handle, and possibly can seal tissues broadly, including relatively big vessels and bile ducts. According to our study, up to 3mm in size, SLC seemed to prevent bile leakage without ligations.

This study was not randomized, so the good results might have been related to the learning curve, but the two-surgeon technique utilizing SLC is a simple technique and one of the most reliable for reducing blood loss and bile leakage while maintaining the viability of the liver. It should therefore be considered for application in living donor hepatectomy.

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Figure legends



Figure 1

Two-surgeon technique utilizing Cavitron Ultrasonic Surgical Aspirator and saline-linked cautery.

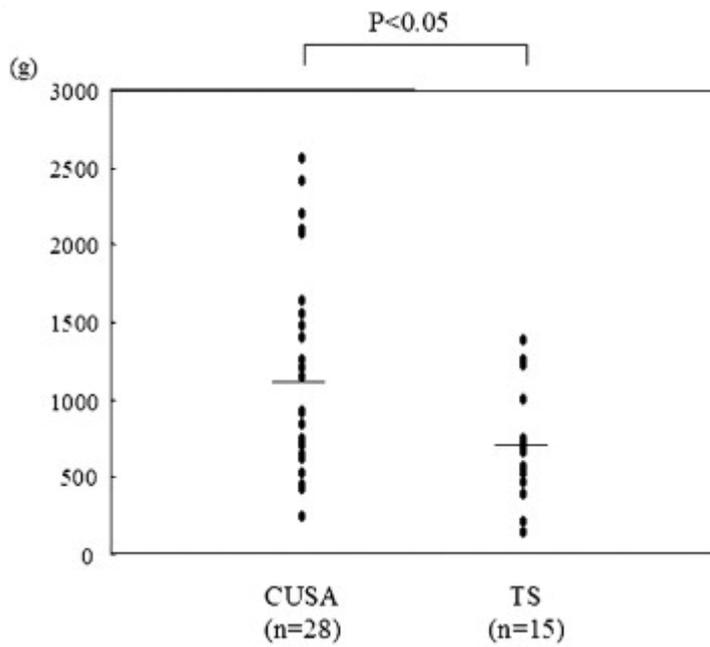


Figure 2

Intraoperative blood loss in CUSA group and TS group.

Table 1 Donor characteristics

	CUSA (n = 28)	TS (n = 15)	
Gender	16 males, 12 females	7 males, 8 females	NS
Age (y)	42 ± 13	37 ± 11	NS
Graft volume (g)	637.2 ± 139.8	640.0 ± 108.9	NS
Residual liver volume (%)	43.6 ± 8.5	44.0 ± 3.9	NS
Graft weight/recipient SLV (%)	56.8 ± 11.2	54.8 ± 7.7	NS

SLV = standard liver volume; NS = no significant difference.

Table 2 Complications

	CUSA (n = 28)	TS (n = 15)
Bile leakage	5	0
Pleural effusion	2	0
Portal vein thrombosis	0	1
Wound infection	1	0