

## Safety and Usefulness of Warm Dissection Technique During Liver Graft Retrieval From Deceased Donors

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### ABSTRACT

**Background.** For deceased-donor liver graft retrieval, the warm dissection technique of hilar dissection before perfusion had been the standard procedure in the early period of liver transplantation. Thereafter, the cold dissection technique of in situ flushing and hilar dissection after perfusion has been preferred in many transplantation centers for rapid procurement of multiple organs. This study intended to assess the safety and usefulness of the warm dissection technique used in deceased-donor liver transplantation.

**Methods.** This study analyzed a single surgeon's experience of the warm dissection technique for 165 cases of liver graft retrieval, regarding the prolongation of retrieval operation time, retrieval-associated graft injury, and recipient outcomes.

**Results.** An additional 20 to 40 minutes was required for warm dissection. The incidence of retrieval-associated graft injury was 13 (7.9%), in which hepatic parenchymal injury was detected in 7 (capsular tear in 6 and subcapsular hematoma in 1) and vascular injury in 6 (celiac axis injury in 5 and common hepatic artery injury in 1). There was no other episode of injury at the branch artery, vena cava, portal vein, and bile duct. There was no significant difference of 1-year graft survival rates between liver grafts with and without graft injury (83% vs 83.3%,  $P = .73$ ).

**Conclusions.** When the vital signs of deceased donor are stable, the warm dissection technique may be helpful to decrease the cold ischemic preservation time because the risk of graft injury is acceptably low and it provides more time for recipient preparation, thus giving potential advantages for marginal liver grafts.

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**I**N the early period of organ transplantation, anatomical exposure and complete dissection of each organ from a deceased donor had been preferred while the heart was still beating. Hilar dissection before perfusion (the warm dissection technique) was the standard procedure for liver graft retrieval in deceased donors from the 1960s to early 1980s [1,2]. Thereafter, in situ flushing and sequential hilar dissection after perfusion (the cold dissection technique) was introduced as a means of rapid procurement of all abdominal organs [3]. Because of drawbacks in the warm dissection technique such as operation time prolongation, deterrent to collaboration between abdomen and chest teams, relatively difficult procedure in less-experienced surgeons, possibility of organ damage, and so on, the cold dissection technique has been replaced with the warm dissection technique, especially for multi-organ harvest.

Because of these backgrounds, reliable clinical data are currently lacking regarding the actual incidence and clinical impact of retrieval-associated iatrogenic injuries of donor livers due to organ retrieval techniques. Graft injuries of the donor livers during organ retrieval by the cold dissection technique have occurred not infrequently and might lead to an increase in recipient morbidity.

The aim of this study was to assess the incidence and types of liver graft injuries after liver graft retrieval by warm dissection technique in deceased-donor liver transplantation (DDLTL).

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**Table 1. Clinical Characteristics of the Deceased Donors and Recipients**

Parameters	Number (%)	Mean (Range)
<b>Donor</b>		
Gender male: female	105 (63.6%): 60 (36.4%)	
Age		42.8 ± 13.3
BMI (kg/m <sup>2</sup> )		23.2 ± 3.6
<b>Recipient</b>		
Gender male: female	113 (68.5%): 52 (31.5%)	
Age		49.6 ± 10.9
BMI		23.4 ± 4.2
MELD score		28.7 ± 10.1
GRWR		2.32 ± 0.61

Abbreviations: BMI, body mass index; MELD, model for end-stage liver disease; GRWR, graft-to-recipient body weight ratio.

## MATERIAL AND METHODS

From January 2010 to December 2013, 278 cases of DDLT were performed in our institution. This study included a single surgeon's (DHJ) experience of 165 cases of liver graft harvest using the warm dissection technique in DDLT. Exclusion conditions were liver graft retrieval by cold dissection technique, retrieval from cardiac death donor, liver graft splitting, and pediatric whole-graft DDLT.

Because the same donor surgeon also performs bench operation of liver graft in our institution, all graft injuries were checked by the donor surgeon. Liver graft injuries were categorized into three types: parenchymal, vascular, and bile duct injury. Parenchymal injury was subdivided into capsular injury, parenchymal rupture, and subcapsular hematoma. Vascular injury was subdivided into artery, vena cava, and portal vein injury.

## Operative Procedure

As soon as the cruciate incision was made from the xiphoid process to the pubis, the liver was inspected to discern its color and texture and then a liver wedge biopsy was performed. After ligation of the cystic duct, the distal common bile duct was transected and bile was irrigated with saline. Quantity and quality of bile was checked. Anatomical variation of the hepatic artery (eg, left hepatic artery from the left gastric artery, right hepatic artery from the superior mesenteric artery) was checked by palpation. The Cattell-Braesch maneuver was performed to expose the inferior vena cava and aorta. The terminal abdominal aorta was dissected to insert an aortic perfusion catheter. The superior mesenteric vein or inferior mesenteric vein was dissected to insert a portal perfusion catheter. After making an incision to the diaphragmatic crura, the sub-diaphragmatic aorta was encircled with a nylon tape. Hepatic hilum was dissected before cross-clamping of the aorta. The gastroduodenal artery was isolated or ligated and divided. The common hepatic artery, left gastric artery, and splenic artery were identified. Aortic and portal cannulas were placed after systemic heparinization, and then infusion of histidine tryptophan ketoglutarate perfusion solution started. This warm dissection technique required additional procedure time of 20 to 40 minutes. This procurement procedure has been the preferred method of liver graft retrieval during last 20 years in our institution. After finishing in situ perfusion, the liver graft was then excised along the usual standard technique.

## Statistical Analysis

Continuous variables were expressed as mean ± standard deviation. Survival rates were estimated with Kaplan-Meier method and compared with the log-rank test. A probability value of  $P < .05$  was

considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics 21.

## RESULTS

Clinical characteristics of the deceased donors and recipients are shown in Table 1. The mean donor age was  $42.8 \pm 13.3$  years; donor body mass index (BMI) was  $23.2 \pm 3.6$ ; recipient age was  $49.6 \pm 10.9$  years; the graft-to-recipient weight ratio (GRWR) was  $2.32 \pm 0.61$ ; and the model for end-stage liver disease (MELD) score was  $28.7 \pm 10.1$ .

Common graft injuries occurring during organ retrieval were parenchymal and arterial injuries (Table 2). Most parenchymal injuries were minor capsular tears without parenchymal rupture that was easily managed by simple monopolar coagulation. Only one recipient was re-admitted after hospital discharge due to expansion of the subcapsular hematoma. Arterial injury occurred more frequently at the celiac axis level. There was no hepatic artery thrombosis after engraftment in the recipients of this study. There were no episodes of the right hepatic artery or left hepatic artery injury, vena cava and portal vein injury, and bile duct injury.

There were no significant differences in the 1-year and 3-year graft survival rates between the liver grafts with and without graft injury (83% and 78.7% vs 83.3% and 83.3%, respectively;  $P = .73$ ; Fig 1).

## DISCUSSION

Graft injury during organ retrieval is a relatively frequent complication and has a potential to influence morbidity and mortality of the recipients [4–8]. However, clinical data are still lacking regarding the actual incidence of retrieval-associated injury to the donor liver grafts. Nijkamp et al [5] reported that procurement injuries of donor livers were observed in approximately one-third of all cases although the overall graft survival rates were not significantly different for grafts with or without anatomical injury.

In this study, the incidence of liver graft injury was not so high when compared with the results of other studies (Table 3) [4–8]. Parenchymal and arterial injuries were the common problems found during organ retrieval. The most common site of arterial injury was the celiac axis. However,

**Table 2. Graft Injury of the Deceased Donor Livers Occurred During Organ Retrieval**

Type of Injury	Number (n = 165)	Percentage (%)
Parenchymal injury	7	4.2
Capsular tear	6	3.6
Parenchymal rupture	0	0
Subcapsular hematoma	1	0.6
Artery injury	6	3.6
Celiac axis	5	3
Common hepatic artery	1	0.6
Other hepatic artery	0	0
Portal vein injury	0	0
Vena cava injury	0	0
Bile duct injury	0	0

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