



## Liver Transplantation in Korea: Past, Present, and Future

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### ABSTRACT

**Purpose.** This study reviewed the past and present status of liver transplantation (LT) and outlooks for the future of LT in Korea.

**Method.** The first LT in Korea was successfully performed using a deceased donor graft in 1988. Pediatric and adult living donor liver transplantations (LDLTs) were initiated in 1994 and 1997, respectively. From 1988 to 2013, 10,581 LTs were performed at 40 centers, whereas LDLT accounted for 76.5% of all LTs.

**Results.** In the early 1990s, the deceased organ donation rate was less than 1.5 per million population (PMP) per year, but it increased to 5 PMP beginning in 2008. Despite the increasing number of deceased donor liver transplantations (DDLTs), high prevalence of hepatitis B virus (HBV)-induced cirrhosis and hepatocellular carcinoma (HCC) has provoked persistent performance of adult LDLT with technical advancement including middle hepatic vein (MHV) reconstruction of right lobe graft and dual graft LDLT with 1 nationwide donor mortality.

**Conclusion.** The number of LTs in Korea in 2010 was 23.2 PMP (1042 LTs/45 million population), lower than 23.5 PMP of Spain, but higher than 20 PMP of the United States. However, future LT numbers may decrease because of lowering the HBV carrier rate (neonatal HBV universal vaccination began in 1992), new potent anti-HBV agents, and lowest birth rate (1.22 children per family) with a decrease of potential live donors.

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**L**IVER TRANSPLANTATION (LT), the ultimate treatment for end-stage liver disease (ESLD), developed quickly in the 1980s. The first deceased donor liver transplantation (DDLT) in Korea was successfully performed in 1988 by Kim from a full-size liver donation from a 15-year-old boy with a brain tumor to a 13-year-old girl with Wilson's disease; she is now alive. Then, with a 4-year gap after the first DDLT, 7 DDLTs were performed in 1992 at 3 institutes (Seoul National University, 2; InJe University, 2; and Asan Medical Center, 3). Notably, a reduced DDLT was performed first in Asia in 1992 by Kim from a deceased adult's donated liver to an 11-year-old biliary atresia (BA) patient. After DDLT had been known to be an optional standard treatment for ESLD with the limited supply of deceased donor liver grafts, the first successful pediatric and adult living donor liver transplantations (LDLTs) were performed by Lee et al in 1994 [1], from a father to a 9-month-old BA patient and, in early 1997, to a 37-year-old hepatitis B virus (HBV)-LC and hepatocellular carcinoma

(HCC) patient; both patients are alive now. In 1997, right lobe (RL) LDLT was performed by the Asan group from wife donor to 42-year-old HBV-cirrhotic husband recipient; he is alive. To overcome the rarity of deceased liver grafts, pediatric split-liver transplantation (SLT with lateral sector and right trisector) were successfully performed: in 1998 by Seoul National University, and SLT for 2 adult recipients (left lobe [LL] and modified RL) in 2000 by the Asan group. Furthermore, marginal donors, such as donors after cardiac death (DCD), donors who are HBV(+) carriers, deceased donors older than age 70, and steatotic live donor grafts (>30% macrosteatosis), have been cautiously applied with

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This study was supported by research grants from Asan Medical Center and University of Ulsan College of Medicine.

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success in major institutes. However, the widening gap between the growing number of patients on the LT waiting list and the supply of cadaveric liver grafts becomes a strong motivation for development of various adult LDLTs with technical innovations such as modified RL graft in 1998, dual LDLT in 2000, donor exchange program in 2003, and ABO-incompatible (ABO-i) LDLT without local infusion therapy in 2009. Growth of adult LDLT has been achieved in Asian countries, where deceased organ donation has been uncommon and prevalence of HBV-cirrhosis and HCC is high. LDLT for the seriously ill patients with a high model for end-stage liver disease (MELD) score (>30) has resulted in comparable results with DDLT (1-year graft survival rate, 85%). Meanwhile, in LDLT, donor safety is of paramount importance and cannot be compromised regardless of the implication for the intended recipient. There is 1 reported donor mortality among 8000 donor hepatectomies in Korea. At present, efforts have been made to promote the hidden unnoticed deceased organ donation program by nationwide campaign and transplantation-related societies. Nevertheless, LDLT continues its role of the most effective alternative to DDLT in the present, also in the future because DDLT numbers still stay in a plateau of around 350 cases annually in Korea.

DEVELOPMENT OF ADULT LDLT IN KOREA

Over the last decade, the number of LTs in Asia has increased rapidly, by 10-fold, largely as a result of development of LDLT (Fig 1). The successful adult LDLT using a LL graft was first reported from Japan in 1994. However, a LL graft that comprises about one third of the total liver volume is usually small for adult recipients. LL LDLT cannot be properly applied to high MELD patients due to low

graft-recipient weight ratio (GRWR; >0.8%). Recent advances in adult LDLT using RL grafts have overcome the barrier of size-mismatching between the donor and the recipient, and may produce a drastic change in the role of LDLT in transplantation. In Korea, RL grafts constitute 85% of all liver grafts in adult LDLT. Even after the first successful RL LDLT in 1997, Lee et al faced the obstacle of anterior sector congestion of the RL graft [2], and they initiated middle hepatic vein (MHV) reconstruction (modified RL LDLT) with remarkable improvement of the 1-year graft survival rate of 93% [3]. Approximately 85% of their RL grafts are modified RL grafts. A congestion-free RL graft is mandatory to rescue high-urgency patients, such as those with fulminant hepatic failure and acute-on-chronic liver failure. Insufficient graft size has hindered expansion of adult LDLT, when the remaining LL of potential donors is too small to ensure donor safety. This circumstance is encountered in the work-up of 20% of potential donors. Lee et al initiated dual 2 LL grafts LDLT to solve graft-size insufficiency and to ensure donor safety in 2000 [4], and initiated dual RL and LL grafts LDLT for large body size recipient having small size donors in 2001. They performed more than 400 dual LDLTs; indications and results are similar to a RL LDLT, minimizing the donor's risk. By using dual LDLT, a 20% increase in the number of adult LDLTs can be anticipated. In 2004, indications for adult LDLTs were broadened to include complete obstruction of portal vein (PVT) with application of intraoperative cine-portography (IOP) to prevent accompanying "portal flow steal phenomenon" through the large portosystemic collateral shunts, and portal vein (PV) stenting to secure more than 1-cm diameter PV through the whole length after thrombectomy and PV plasty if needed. Renoportals anastomosis, a useful technique for reconstruction of portal inflow when recipients have sclerotic

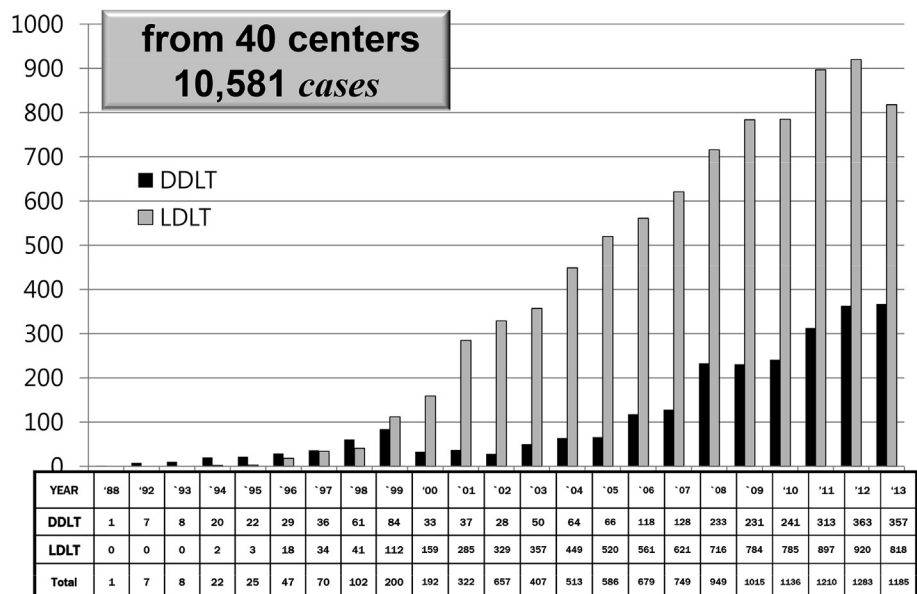


Fig 1. Annual LT in Korea.

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