An Exceptional Series: 5000 Living Donor Liver Transplantations at Asan Medical Center, Seoul, Korea

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GENESIS OF LIVER TRANSPLANTATION AT ASAN MEDICAL CENTER

Asan Medical Center (AMC), established in 1989, is the largest hospital in Korea with a capacity of 2700 beds. AMC has a clinical focus on liver transplantation (LT), an area of increasing demand in Korea. Subsequent to an extensive training in large animals, the first LT (a deceased donor liver transplant [DDLT]) was performed in August 1992, recorded as the third of its kind in Korea. In 1994, AMC performed the first successful pediatric living donor LT (LDLT) in Korea. AMC has completed >300 LDLTs annually since 2010 and has become the by far largest volume transplant center in Korea (performing 41.6% of all LDLT in the country) and in the world.[1,2]

AMC'S ROLE AS A PIONEER IN LDLT

The AMC team has pioneered LDLT in Korea and has also helped centers around the world to establish the procedure (Figure 1). Global attention has been achieved with the first LDLT using a modified right lobe graft in 1999.[3] This landmark operation played a major role in improving recipient outcomes while ensuring donor safety. This modified procedure has by now become the standard for LDLT using the right lobe.[4] AMC also introduced the world's first dual-graft LDLT utilizing "two left-lobes" in 2000. This innovative technique is recognized as a strategy to avoid small-for-size (SFS) graft syndrome in "large-size" recipients while ensuring donor safety. Our experience with dual-graft LDLT combing various grafts and recipients have documented both feasibility and success of the procedure.[5] Additional innovations by the Asan team include an intraoperative portogram addressing the portal flow steal phenomenon during LT and a paired donor exchange program for adult LDLT, introduced in 1998 and 2003, respectively.[4]

We want to emphasize that AMC has always focused on sharing data with the centers around the world to optimize outcomes. International transplant professionals from prestigious centers have visited our institution and we have shared details of donor/recipient evaluation, advanced surgical techniques, and perioperative management.[1]

OUTCOMES OF LIVER TRANSPLANTATION AT AMC

AMC's LT team accomplished 6000 LTs by July 2018 and 5000 LDLTs including 500 dual-graft LDLTs by August 2018. Notably, 17% of LDLTs have been performed in patients with high urgency criteria. In 2017, our team achieved a remarkable 0% in-hospital mortality in 361 LDLTs recipients (Figure 2).[1] Since the start of our LDLT program in 1994, we have performed approximately 5500 living donor hepatectomies without serious complications or mortalities. Various types of grafts including right and left lobe, right posterior segment graft, left trisegment with caudate lobe have been procured from living donors, considering donor anatomy and recipient requirements. Since 2009, live donor hepatectomies have also been accomplished in a minimal invasive approach for selected donors. The length of the incision is approximately 10 to 12 cm depending on weight/size of the graft and body feature of the donor. A "pure" laparoscopic living donor left lateral sectionectomy has been performed for the first time in the Asia-Pacific region in May 2008. As of January 2019, approximately 100 "pure" laparoscopic living donor hepatectomies have been done without significant surgical complications. Outcomes of live donor liver transplants subsequent to laparoscopic and open living donor right hepatectomies have been comparable.[6]

The ABO incompatible (ABO-I) adult LDLT program has been launched in November 2008. This approach has been carefully adapted based on the accumulated clinical experience and research. Currently, AMC's standardized treatment protocol includes the application of rituximab and plasmapheresis and a maintenance immunosuppressive regimen composed of tacrolimus, mycophenolate mofetil (500 mg

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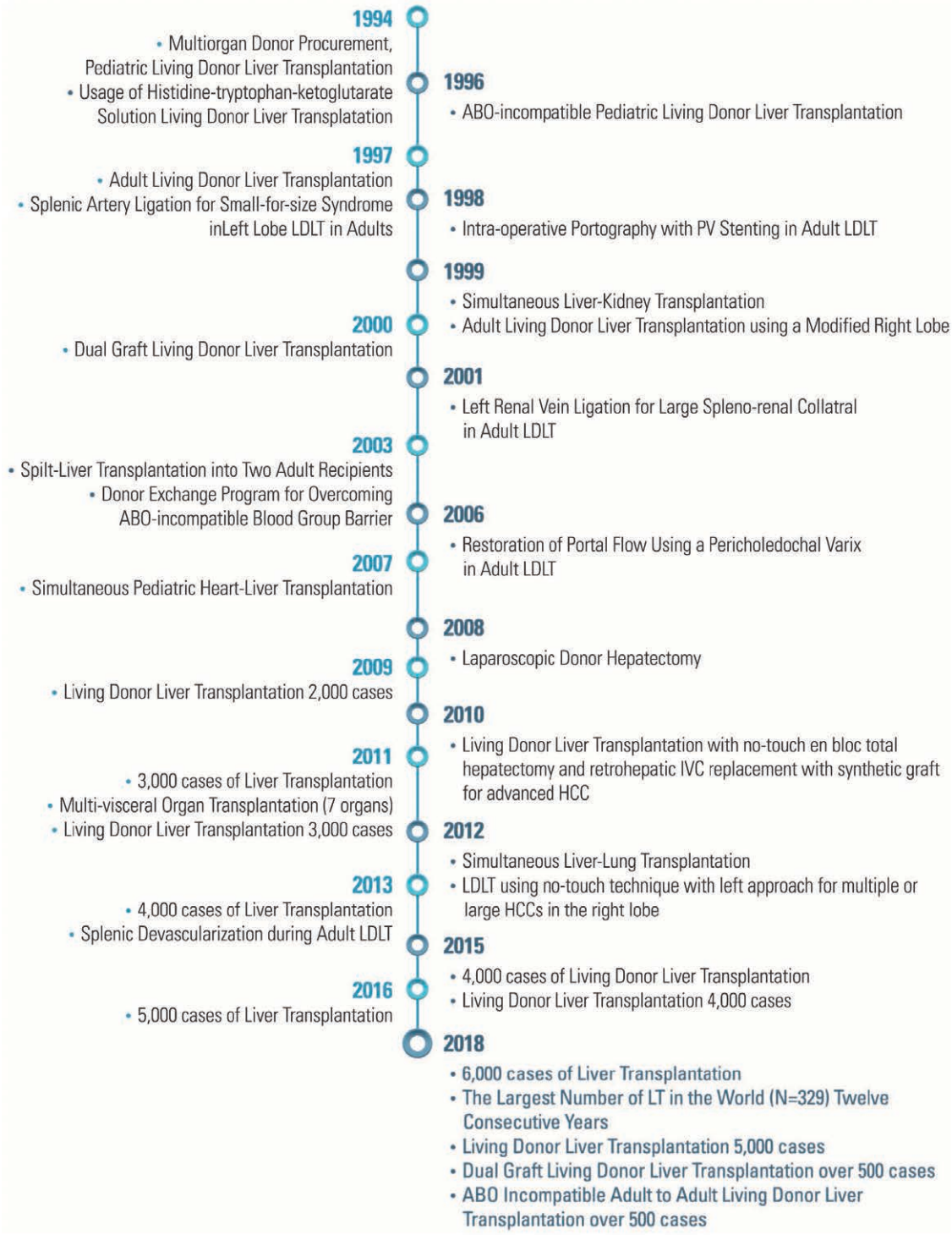

FIGURE 1. AMC's role as a pioneer in LDLT. AMC, Asan Medical Center; HCC, hepatocellular carcinoma; IVC, inferior vena cava; LDLT, living donor liver transplantation; PV, portal vein.

twice daily), and steroids.[7] The proportion of ABO-I LDLT continues to rise, accounting for >20% of the annual number of adult LDLTs performed at AMC since 2012. By January 2018, we have accomplished 500 ABO-I adult LDLT.[1]

PILLARS OF SUCCESS

Excellent outcomes are based on standardized surgical techniques, protocols for donor/recipient evaluation, and perioperative management. Our surgical success is based on a careful assessment of the following: (1) adequate graft volume to avoid small-for-size graft syndrome; (2) sufficient portal vein inflow supporting liver graft regeneration; (3) an optimal hepatic vein outflow, preventing graft congestion; and (4) a solid surgical technique for the anastomosis of the bile duct. Surgical techniques have been demonstrated during live surgical demonstrations at international meetings and

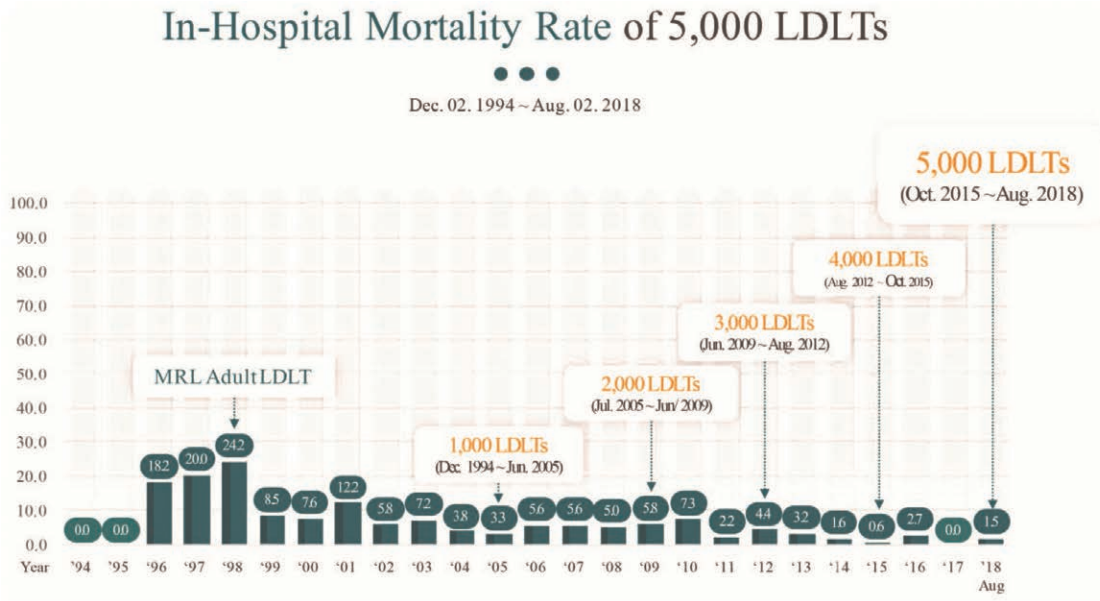

FIGURE 2. Recipient in-hospital mortality rate of 5000 LDLTs: In 2017, AMC's LT team achieved 0% in-hospital mortality after LDLT. LDLT, living donor liver transplantation; LT, liver transplantation.

our outcomes have been published in peer-reviewed, highly visible scientific journals.[1,4,8] Details of the "Asan-criteria" for donor selection and protocols for donor/recipient evaluation have also been published.[9,10]

With increasing experience and the development of novel surgical techniques, we have been able to offer LDLT to high-risk patients who have not been accepted at other centers. A "no-touch en-bloc total hepatectomy" technique has been implemented in 2010 for patients with advanced hepatocellular carcinoma minimizing tumor spread through surgical manipulation.[11]

AMC' success would have not been possible without the support of a multidisciplinary team of experts in addition to a strong institutional support.

SUPPORT OF INTERNATIONAL TRANSPLANT PROGRAMS

In addition to participating in numerous international multicenter studies, we have broadly shared our clinical and investigational experience. AMC has also contributed through large-scale international medical projects, helping to establish liver transplant programs in developing countries. "Asan in Asia" is currently supporting liver transplant programs in Mongolia and Vietnam. Since 2016, LDLT are accomplished independently by local surgeons at the National Central Hospital of Mongolia after the completion of 45 LDLTs in cooperation.

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