# Pure three-dimensional laparoscopic full left hepatectomy of a living donor for an adolescent in China

**Jiu-Lin Song, Hong Wu, Jia-Yin Yang**

Liver Transplantation Center, Department of Liver Surgery, West China Hospital of Sichuan University, Chengdu, Sichuan 610041, China.

*To the Editor:* Living donor liver transplantation (LDLT) has expanded the donor pool in countries with low cadaveric organ donation rates. Generally, a left-side liver allograft is sufficient and safe for child and adolescent recipients.[1] For the sake of the donor's cosmetic demands and for early functional rehabilitation, laparoscopic technology has been used in live hepatectomy since 2002.[2] Three-dimensional visualization provides better depth perception and tactile feedback than does conventional two-dimensional laparoscopy.[3] In this report, we presented a case of pure three-dimensional laparoscopic full left live hepatectomy.

A 39-year-old mother, weighing 56 kg, height 158 cm and body mass index (BMI) of 22.4 kg/m$^2$, volunteered to donate the left side of her liver to her 13-year-old son (weight 34 kg, height 148 cm and BMI of 15.5 kg/m$^2$). The recipient was diagnosed with cryptogenic decompensated cirrhosis with severe portal hypertension, refractory ascites, splenomegaly, hypersplenism and a history of recurrent episodes of esophageal gastric variceal bleeding. His Child-Pugh class was B-10. His model for end-stage liver disease score was 11.

The donor was comprehensively evaluated before surgery. Liver volume and vascular anatomy were evaluated by computed tomography (CT) angiography on a three-dimensional reconstruction system (IQQA-liver software, EDDA Technology, Princeton, NJ, USA). Biliary anatomy was assessed by magnetic resonance cholangiopancreatography (MRCP). The donor's left liver volume, excluding the middle hepatic vein (MHV) and caudate lobe, was 414 cm$^3$ with a graft-to-recipient weight (GRWR) of 1.22% and a remnant liver volume of 65.7% [Figure 1A]. The left liver had 1 portal vein and 2 branches of arteries. The MRCP showed normal biliary confluence with 1 bile duct from the left liver [Figure 1B].

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The donor was informed of the risks of laparoscopic liver procurement and three-dimensional visual surgery. Written informed consent was obtained from both the donor and recipient prior to their surgeries. All procedures performed in this study were in accordance with the ethical standards of the Ethics Committee of the West China Hospital of Sichuan University.

Under general anesthesia, the donor was placed in 30° reverse Trendelenburg position with arms abducted and the surgeons standing at the 2 sides of the donor. The placement of 5 optic trocars is shown in Figure 1C. An Endoeye Flex 3D video laparoscope (© Olympus, Tokyo, Japan) was used [Figure 1D].

After inspecting the peritoneal cavity, the left lobe was mobilized, and cholecystectomy was performed. Then, the 2 branches of left hepatic arteries (LHA) and the left portal vein (LPV) were dissected and taped with vessel loops [Figure 1E]. The common trunk of the left hepatic vein (LHV) and MHV was encircled by dissecting the tunnel between the trunk of the hepatic vein and the retrohepatic inferior vena cava [Figure 1F].

By transiently clamping the left inflow vessels, the ischemic demarcation line on the liver surface was marked as the transection line. Intraoperative ultrasound was used to identify MHV, which was kept with the donor [Figure 1G]. A laparoscopic Harmonic™ scalpel (© Ethicon, Somerville, NJ, USA) and ultrasonic aspirator (CUSA Excel+, Integra, New Jersey, USA) were used for parenchymal transection. The intrahepatic vessels were divided between Hem-o-Lok clips (Weck®, Telefex Medical, North Carolina, USA). When transecting to the hilar plate, the left hepatic bile duct was clamped and divided at the branch point of left and common hepatic duct with rereading of the MRCP image. Then, the previous 10 cm subumbilical median incision was prepared without opening the peritoneum. After heparin was given to the donor, the LHAs and LPV were clamped and divided using Hem-o-Loks. The LHV was divided using

**Correspondence to:** Dr. Jia-Yin Yang, Liver Transplantation Center, Department of Liver Surgery, West China Hospital of Sichuan University, Chengdu, Sichuan 610041, China
E-Mail: yang_jy123@sina.com



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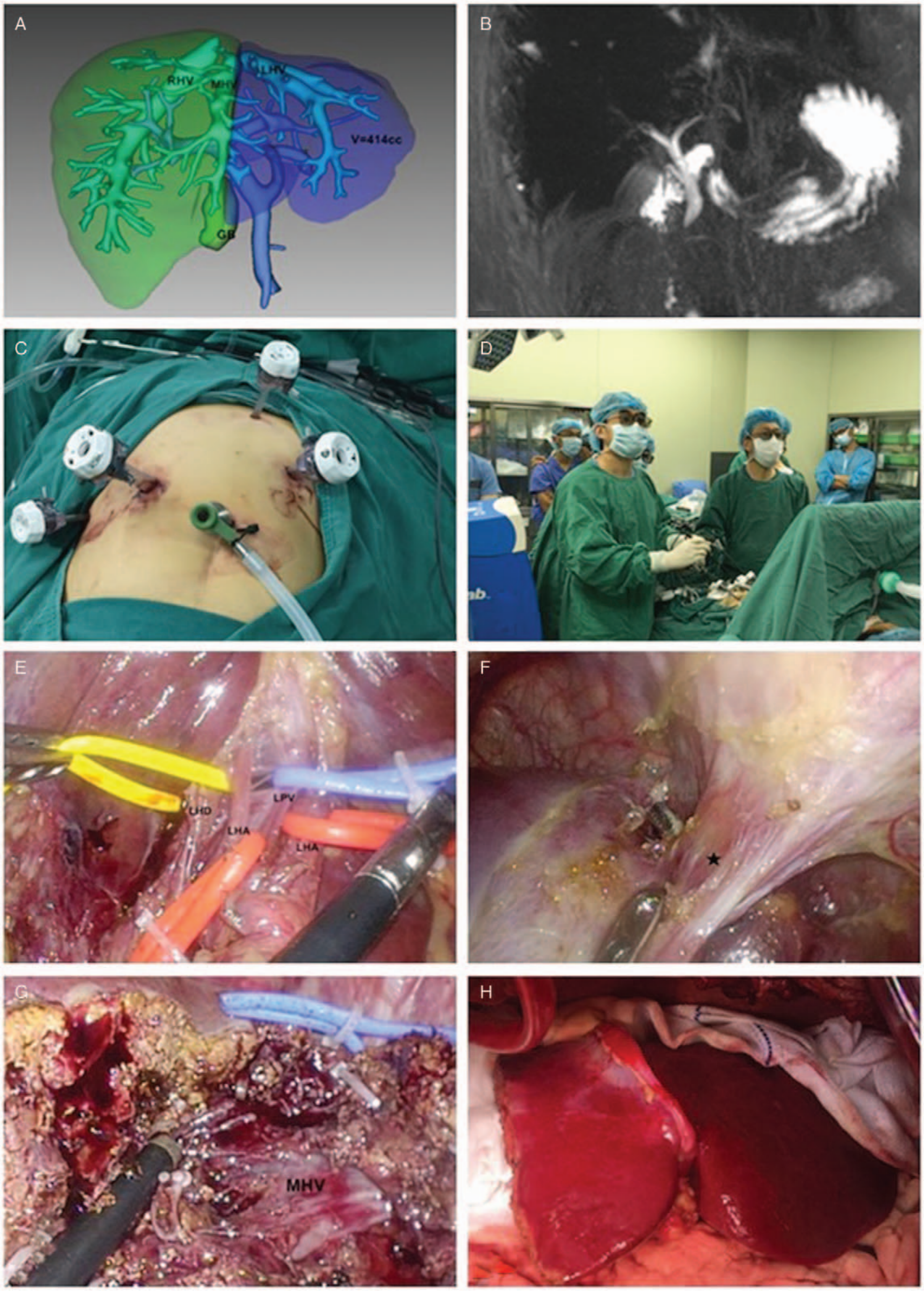


Figure 1: (A) Liver volumetry of the donor by three-dimensional CT scan. (B) Anatomy of the donor biliary duct by MRCP. (C) Trocar positions. (D) Operators with three-dimensional glasses on both sides of the patient. (E) Encircled vessels of left donor liver. LHA: left hepatic artery; LPV: left portal vein; LHD: left hepatic duct. (F) Encircled outflow vessels of left liver. ★: Common trunk of the left and middle hepatic veins. (G) The transection plane is kept at the left side of MHV. (H) Implanted liver graft. MHV: middle hepatic vein; MRCP: magnetic resonance cholangiopancreatography.

a vascular stapler. After the graft was extracted through the incision, hemostasis was obtained and 1 drainage tube was left. The recipient underwent splenectomy and piggy-back transplantation [Figure 1H].

The donor's operation time was 495 min. Blood loss was less than 100 mL with no transfusion. The graft weighted 400 g with a GRWR of 1.18%, and the remnant liver was 66.8% of the donor's liver volume. The donor was discharged on the sixth postoperative day with normal liver function. The recipient's operation time was 460 min. The recipient was discharged at the 38th postoperative day with normal graft function.

The primary concern in LDLT is the healthy living donor's safety. Left lobe donation was reported to have lower morbidity than that of right lobe donation.[1] Though there is a potential risk of insufficient allograft volume, left lobe allografts can still be safely transplanted to selected adult and adolescent recipients.[4] In this case, the remnant liver volume was 66.8% for the adult donor, and GRWR was 1.18% for the adolescent recipient. Therefore, the utilization of left lobe balanced the donor's safety and the recipient's need.

In experienced centers, laparoscopic liver donation has been technically feasible and fairly safe for all pediatric and some adult LDLTs, resulting in greater cosmetic satisfaction and fewer wound complaints.[5] From October 2015 to August 2018, we have completed 18 laparoscopic living donor hepatectomies, including 6 left lateral lobes, 5 left lobes (including this case) and 7 right lobes.

Nevertheless, the most challenging issue for laparoscopy is technical difficulty and prolonged surgical procedure learning curves. Furthermore, one of the major limitations of conventional two-dimensional laparoscopy is the absence of depth perception and tactile feedback. However, the three-dimensional laparoscopy can produce a stereoscopic view of the operative field, demonstrating the superiority of improved speed and the precision of laparoscopic procedures compared with traditional two-dimensional laparoscopy.[3] The three-dimensional high definitive imaging system, using videoscopes with flectional tips, enables surgeons to view anatomy from the ideal angles without restriction. The addition of depth perception and hand-eye coordination by three-dimensional laparoscopy contributes to accurate hilum dissection, as well as better identification of intro-corporeal vessels and achievement of hemostasis.[3]

In conclusion, we presented our initial experience with pure three-dimensional laparoscopic left hepatectomy for LDLT. Nevertheless, laparoscopic donor hepatectomy should only be performed in select cases with normal anatomy for the sake of donor safety by an experienced surgical team with expertise in both laparoscopic liver surgery and living donor hepatectomy.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s)/ patient's guardians has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the article. The patients/patient's guardians understand that their names and initials will not be published and due efforts will be made to conceal the identity of the patient, although anonymity cannot be guaranteed.

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## Conflicts of interest

None.

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