Technique of robotic right donor hepatectomy

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INTRODUCTION

Live donor right hepatectomy (LDRH) is arguably the pinnacle of hepatobiliary surgery. Even though minimally invasive surgery (MIS) for LDRH has been reported since 2011, transition from open to MIS appears to be slow amongst liver surgeons. Prolonged experience with open LDRH coupled with exquisite laparoscopic suturing skills is mandatory for this transition. Recently introduced robotic platform with its improved dexterity has a shorter learning curve compared to conventional laparoscopic surgery.\(^1\) Perhaps the transition from open to MIS may be easier with robotic technique for complex surgeries such as robotic LDRH.\(^2\)

Since 2018, we have performed 144 robotic live donor hepatectomies, of which 139 were right lobe donations, largest reported series till date. We describe our technique of robotic LDRH to attenuate the learning curve of those stepping into this new sophisticated ecosystem.
PATIENTS AND METHODS

Our evaluation process for LDRH has been described before.[3] In addition, prospective donors underwent magnetic resonance cholangiopancreatogram (MRCP) for delineation of bile duct anatomy.

Operative technique

Preparation

Indocyanine green 0.5 mg/kg is administered at induction so as to obtain maximum concentration in the bile duct at the time of division. The patient is placed in reverse Trendelenburg position with 15 degrees right up tilt. Robotic Xi system (Intuitive surgical, Sunnyvale, CA) is docked from head end in alignment with the lie of the donor.

After port placement [Figure 1], surgery starts by the division of falciform till the suprahepatic inferior vena cava (IVC) and hepatic veins are clearly visualised. Mobilisation is initiated by the release of coronal ligament to the right of right hepatic vein (RHV). Subsequent mobilisation in a clockwise manner from below is accomplished by the retraction of gallbladder (GB) with robotic 4th arm and the use of gold finger through the assistant port [Figure 2]. Complete mobilisation of liver from IVC till hepatocaval ligament is performed. At this stage, small veins <3 mm draining from liver to IVC are doubly clipped/sutured and divided. Inferior hepatic veins >5 mm are kept intact for stapling at the end. The absent tactile feedback of the robot often keeps the surgeon unaware of the pressure applied on liver during mobilisation. It is crucial to remain gentle so as to avoid subcapsular haematoma/liver lacerations. We do not perform the hanging manoeuvre.

Hilar dissection and caudate division

After dissecting the GB off the liver bed, the biliary bifurcation is identified, and the fibro-fatty tissue to the right of common hepatic duct is separated to recognise the precise site for right hepatic duct (RHD) division. Right hepatic artery and portal vein are delineated [Figure 3]. Complete caudate transection is performed to define the plane anterior to IVC [Figure 4].

Parenchymal transection

We usually harvest the right lobe with subtotal middle hepatic vein (MHV) sacrificing the drainage of segment 4b. Temporary inflow occlusion is applied to identify the line of demarcation for transection. Rubber band retraction technique[4] is used to aid in parenchymal transection. Bipolar forceps in third arm are used to crush and coagulate the parenchyma in tandem with monopolar hot shears in first arm that cuts the tissue. This technique which we term ‘roboto-clasia’ [Figure 5] can be used for intra-parenchymal vessels up to 3 mm in size. Vessels from 3 to 5 mm are controlled with robotic clips. We prefer the wristed monopolar scissors to the rigid harmonic scalpel.
as a direction of parenchymal dissection can be adjusted to the plane of transection. Other vessels >5 mm can be safely dissected with lap CUSA controlled by assistant surgeon. Once 4b vein is divided, MHV is looped, doubly ligated with Hem-o-Lok clips (Teleflex Inc, Morrisville, NC) and divided. Transection is then continued in the plane deeper to the bile duct.

**Bile duct division**

ICG which was initially given at induction will now clearly delineates the extrahepatic biliary anatomy on firefly mode (Intuitive surgical, Sunnyvale, CA) of cholangiography [Figure 6]. It is crucial to revisit the preoperative MRCP at this stage. RHD is initially snipped with robotic fine endowrist (Potts) scissors. Feeding tube is used to probe and confirm the left and common hepatic duct. After confirmation, RHD is completely divided keeping the feeding tube into left duct as a guide. The remnant biliary stump is then suture closed with 6-0 Maxon (Medtronic, USA) stitches.

**Final parenchymal transection**

The supraportal 12 O’clock position of IVC is identified to enter the optimal plane for completion of transection. The bipolar Maryland forceps is used to hook and lift the liver capsule off the IVC which is then divided.
with monopolar hot shears till the insertion of RHV is reached [Figure 7]. RHV is then looped carefully to obtain adequate cuff on graft side and to avoid narrowing of IVC after stapling.

**Graft retrieval**

The Pfannenstiel incision (10–12 cm) is made and deepened up to the peritoneum. A retrieval bag (Sejong Medical, Paju-si, South Korea) inserted through the assistant port aids in easy retrieval of the graft. Hepatic artery is first divided with two hem-o-lok clips on donor side. Portal vein is then divided with two hem-o-lok clips on the donor side and one on the graft side. RHV [Figure 8] followed by paracaval structures (IHV and hepatocaval ligament) is then transected with staplers (Signia™ Stapling System, Medtronic, USA) and the graft is extracted.

**DISCUSSION**

Robotic platform may be easier to adapt for minimally invasive LDRH due to several reasons. First, precise suturing with fine stitches is feasible in robotic surgery. Hence, bleeding during transection and suturing of donor bile duct stump can be tackled with ease when compared to laparoscopic surgery. Second, bile duct division can be performed real time with ICG cholangiography exactly simulating open bile duct division. Thus, all types of biliary anatomy which are suitable for open surgery can be dealt with robotically as well. Advantages of robotic surgery notwithstanding, donor safety, and the fiscal burden have to be borne in mind.

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**Conflicts of interest**

There are no conflicts of interest.

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