Standardization of Laparoscopic Central Bisectionectomy by Extrahepatic Glissonean Pedicle Isolation and HV Root - At First One-way Resection Based on Laennec's Capsule

Yutaro Kato, Atsushi Sugioka, Yoshinao Tanahashi, Gozo Kiguchi, Masayuki Kojima, Sanae Nakajima, Akira Yasuda, Jun-ichi Yoshikawa, Ichiro Uyama

Corresponding author:

Yutaro Kato, MD
Department of Surgery
Fujita Health University
1-98, Dengakugakubo
Kutsukake-cho, Toyoake
Aichi, 470-1192, Japan
Tel: +85-562-93-9254
Fax: +85-562-93-7060
E-mail: y-kato@fujita-hu.ac.jp

Department of Surgery, Fujita Health University, Toyoake, Aichi, Japan

ABSTRACT

Laparoscopic central bisectionectomy (LCBS) is a highly advanced procedure for centrally located liver tumors. According to our approaches for anatomic liver resection composed of the Laennec's capsule-based extrahepatic Glissonean pedicle approach (GPA) and hepatic vein (HV) root-at first one-way parenchymal resection, we have standardized techniques for LCBS. The extrahepatic GPA starts with cystic cholecystectomy facilitating extrahepatic isolation of the anterior section pedicle (G-ant), which is ligated. The segment IV pedicle (G-IV) is isolated extrahepatically. Under occlusion of G-ant and G-IV, parenchymal dissection starts from exposing the root of middle hepatic vein (MHV) and continues in the cranio-caudal direction along the umbilical fissure vein, according to the left demarcation line. During parenchymal dissection, G-IV and MHV are divided. Then, the right hepatic vein (RHV) is exposed at its root and tracked downward, and during the rightward liver dissection along the hilar plate, G-ant is divided. The one-way resection continues along RHV and between the anterior and posterior sections toward the right liver edge, where LCBS is completed. In conclusion, LCBS can be standardized by the Laennec's capsule-based extrahepatic GPA and HV-root at first one-way parenchymal resection. Moreover, laparoscopic caudal vision provides a good surgical view for one-way parenchymal resection.

Key words: central bisectionectomy, laparoscopic liver resection, Glissonean pedicle, Laennec's capsule, plate system, hepatic vein

Abbreviations:

CBS: central bisectionectomy of the liver
LCBS: laparoscopic central bisectionectomy of the liver
GPA: Glissonean pedicle approach
HV: hepatic vein
G-ant: the Glissonean pedicle of the anterior section of the liver
MHV: the middle hepatic vein
RHV: the right hepatic vein
LHV: the left hepatic vein
HP: the hilar plate
G-IV: the Glissonean pedicle of the segment IV
G-IVa: the right cranial branch of the Glissonean pedicle of the segment IV
G-IVb: the caudal branch of the Glissonean pedicle of the segment IV
G-IVc: the left cranial branch of the Glissonean pedicle of the segment IV
UFV: the umbilical fissure vein

INTRODUCTION

Central bisectionectomy (CBS) is a highly advanced hepatectomy procedure for centrally located liver tumors that needs control of multiple portal pedicles and exposure of the major hepatic veins, with an eventual large resection plane. Because complex procedures are included in CBS, its technical standardization has not been established either in open or laparoscopic approach. Particularly in regard to anatomic laparoscopic CBS (LCBS), only a few case series have been reported (1-5).

Received: 18.02.2020

Accepted: 23.03.2020

Our basic approaches to anatomic liver resection are composed of two techniques: the extrahepatic Glissonean pedicle approach (GPA) and hepatic vein (HV)-root at first one-way parenchymal resection, regardless of the types of hepatectomies. Both techniques are based on the anatomical background of Laennec's capsule (6).

In this report with a video presentation, we describe our surgical techniques for LCBS according to our basic concepts of anatomic liver resection, and discuss the features of the procedures, the difference from other techniques, potential merits and possibility of standardization.

SURGICAL TECHNIQUES

The patient is placed at the left semi-flank position with the legs closed and with the right arm stretched toward the left side. The operating surgeon and the scope operator stand at the left side of the patient. The operating table is set in a 10-degree reversed Trendelenburg position. The 12-mm optical port is placed at approximately 5 cm to the right side and above the umbilicus and the pneumoperitoneal pressure is set at 10 mmHg. Additional four 12-mm ports are placed at the epigastrium, the right subcostal para-sternal region, the right subcostal region on the mid-clavicular line, the right lateral subcostal region and the left mid-abdomen on the left parasternal line. Laparoscopy is performed with a flexible scope. The round ligament is divided and its liver-side stump is lifted up to the epigastrium and fixed there to obtain a wide surgical field at the hepatic hilum. The falciform ligament is divided and the anterior surface of the common trunk of MHV and LHV is dissected ventrally.

The first step is the cystic plate cholecystectomy, in which the cystic plate is detached from the Laennec's capsule of the gall bladder bed, along with cholecystectomy (6). This procedure allows a good access to the root of the Glissonean pedicle of the anterior section (G-ant). After cutting the reflecting serosa covering the hepatoduodenal ligament and the quadrate lobe of the liver, several pieces of fibrotic tissue that connect the hilar plate (HP) and liver parenchyma, 'the anchors' as we call, are divided. Only after such preparation, you can find a space between the parenchyma and the hilar plate or the Glissonean pedicle sheaths. Then, the space between the HP and the Laennec's capsule of the confronting parenchyma is accurately dissected. Such Laennec's capsule-preserved layer dissection at the Gates IV and V according to the Gate theory proposed by Sugioka et al. (6), facilitates extrahepatic isolation of

G-ant without parenchymal dissection at the hilum. At this point, G-ant is ligated and the discolored anterior section is confirmed.

The next step is isolation of the Glissonean pedicle of the segment IV (G-IV). In most cases, there are three pedicles included in G-IV: G-IVa (right cranial), G-IVb (caudal) and G-IVc (left cranial). By dissecting the ventral surface of the umbilical plate at Gates II, you can find G-IVc, which is the firstly exposed pedicle, and divide it. Then, after dissecting Gate III and passing a tape from Gate II to Gate III, you can isolate G-IV including G-IVa and G-IVb en bloc extrahepatically. Division of G-IVc and clamping of the G-IV reveals discoloration of the segment IV (SIV). Occlusion of G-ant and G-IV collectively produce complete ischemia of the central bisections (right anterior and left medial sections) before parenchymal dissection, and the right and left demarcation lines are clearly demonstrated.

The third step is parenchymal dissection. Under occlusion of G-ant and G-IV, parenchymal dissection starts from exposing the common trunk of the middle (MHV) and left (LHV) hepatic veins. Liver transection continues from the cranial to the caudal side according to the demarcation line between the segments IV and III. In most cases, the umbilical fissure vein (UFV) joins the root of LHV or the MHV/LHV bifurcation, and cranio-caudal resection is carried out along UFV. On the way of parenchymal dissection toward the hilum, G-IV is divided alone or G-IVa and G-IVb individually, and the following dissection approaches to the hilum till the HP is exposed.

The fourth step is isolation and division of MHV at its root, which is exposed by the cranial parenchymal dissection. After dividing MHV, you can expose the root of the right hepatic vein (RHV) by the rightward further dissection around the hepatic vein confluence. Thereafter, RHV is tracked toward the peripheral side. It is notable that when MHV and RHV are exposed from their root side, the Laennec's capsule of the attaching parenchyma is naturally preserved on the vein wall.

The final step is division of G-ant and the following one-way parenchymal dissection. The surgical field turns to the hilum. The preceding parenchymal dissection has already exposed the HP, along which dissection continues from the left side. The ligated G-ant is encountered on the way of dissection and is divided. The rightward cranio-caudal, one-way parenchymal resection continues along RHV and the demarcation line between the anterior and posterior sections. LCBS is completed at the right edge of the liver. We normally do not use Pringle maneuver during LCBS. The specimen is extracted from the extended incision at the optical port.

DISCUSSION

The technical difficulties of CBS may derive from several factors including meticulous control of multiple Glissonean pedicles, extensive exposure of the major hepatic veins, long-time parenchymal dissection of a large liver area, potential massive bleeding and difficulty in handling of a large volume of the liver portion. Previous reports on LCBS are only case series describing varied operative techniques on a small number of patients and thus the safety and feasibility of this procedure have not been established (1-5). Therefore, standardization of the surgical techniques of LCBS is helpful and crucial.

Our techniques for LCBS described here are largely composed of two phases: the extrahepatic control of G-ant and G-IV and the one-way parenchymal resection from the left-cranial to the right-caudal side, starting from the root of the MHV/LHV common trunk. Our method of G-ant and G-IV control needs meticulous preparations including incision of the reflecting serosa covering the liver and the hepatoduodenal ligament, division of several 'anchors' and precise layer dissection preserving Laennec's capsule on the liver parenchyma. However, this approach facilitates bloodless extrahepatic pedicle isolation and occlusion, which serve to produce complete ischemia of the to-be-resected central bisections before parenchymal dissection. Constant inflow block only for the corresponding liver area may be more helpful than the Pringle maneuver in terms of avoiding liver congestion during parenchymal dissection and preserving hepatic functional reserve in the remnant liver portion.

We think that CBS is one of the hepatectomy procedures in which the HV-root at first one-way resection method can be applied the most effectively. Many liver surgeons may set two resection planes during CBS: the left plane between the medial and lateral sections and the right plane between the anterior and posterior sections (1). In contrast, in our approach, we set one flat resection plane created by the one-way parenchymal dissection from the left to the right side. This fashion of resection may be greatly suitable for CBS, because the division of G-IV and MHV, exposure of RHV and division of G-ant can be conducted one by one during a constant flow of one-direction parenchymal dissection. Moreover, particularly in LCBS, all procedures can be seen always from one direction by the laparoscopic caudal view, without a need to change the vision field.

Another merit of one-way resection for CBS is that the specimen-side parenchyma is always lifted up

ventrally and laterally during dissection. Owing to an elevation of the liver tissue, in addition to the effect of the left semi-flank patient position, hepatic venous bleeding from the specimen side is suppressed because of the reduced hydrostatic pressure in the parenchyma.

As in other types of anatomic liver resection using our approach, exposure of the major HVs has an anatomical relevance of Laennec's capsule in CBS. By exposing the wall of MHV or RHV from its root during parenchymal dissection, Laennec's capsule is naturally attached to the side of the vein wall. Preserving Laennec's capsule on the vein wall strengthens the wall itself and protects it from tearing or splitting. Cranio-caudal exposure of the HV also helps reduce the split injury of the joining venous tributaries. Our approach to the outflow and parenchymal dissection, together with a constant block of inflow to the to-be-resected bisections and pneumoperitoneal pressure, may serve to reduce blood loss in LCBS. In fact, in our 2 hepatocellular carcinoma patients undergoing LCBS, blood loss was relatively small (184 g and 56 g).

CONCLUSION

It may be possible to standardize the surgical techniques for LCBS by our method composed of extrahepatic GPA and the HV-root at first cranio-caudal one-way parenchymal resection, which are both based on Laennec's capsule.

Disclosures

The authors have no conflicts of interest to disclose relevant to the content of this article.

Author's Contributions

KY and SA equally contributed to this study

REFERENCES

1. Yoon YS, Han HS, Cho JY, Ahn KS. Totally laparoscopic central bisectionectomy for hepatocellular carcinoma. *J Laparoendosc Adv Surg Tech A*. 2009; 19(5):653-656.
2. Machado MA, Kalil AN. Glissonian approach for laparoscopic mesohepatectomy. *Surg Endosc*. 2011; 25(6): 2020-2022.
3. Kim WJ, Kim KH, Shin MH, Yoon YI, Lee SG. Totally laparoscopic anatomical liver resection for centrally located tumors: a single center experience. *Medicine (Baltimore)*. 2017; 96(4):e5560.
4. Cho CW, Rhu J, Kwon CHD, Choi GS, Kim JM, Joh JW, et al. Short-term outcomes of totally laparoscopic central hepatectomy and right anterior sectionectomy for centrally located tumors: a case-matched study with propensity score matching. *World J Surg*. 2017; 41(11): 2838-2846.
5. Jeung IH, Choi SH, Kim S, Kwon SW. Laparoscopic central bisectionectomy and right anterior sectionectomy using two retraction methods: technical aspects with video. *World J Surg*. 2019; 43(12): 3120-3127.
6. Sugioka A, Kato Y, Tanahashi Y. Systematic extrahepatic Glissonean pedicle isolation for anatomical liver resection based on Laennec's capsule: proposal of a novel comprehensive surgical anatomy of the liver. *J Hepatobiliary Pancreat Sci*. 2017; 24 (1):17-23.