Editorial

Laparoscopic liver resection: what are we doing? Where are we going?

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Laparoscopic liver resection (LLR) continues to evolve to improve short- and long-term outcomes of patients needing hepatectomy. Two international consensus meetings held in 2008 (Louisville, KY, USA) and 2014 (Morioka, Japan) have significantly contributed to advance the technical aspects of LLR and its global dissemination (1,2). LLR has now reached stage 3, the "Assessment" stage of innovation, in the IDEAL framework that defines the stepwise progression of novel surgical practice (3-5). Recently, Cho *et al.* have published practical guidelines for performing LLR (6). This editorial aims to summarize the guidelines and address unsolved questions related to LLR.

Indications

An international questionnaire called International Survey on Technical Aspects of Laparoscopic Liver Resection (INSTALL) was conducted prior to the second international consensus meeting. Approximately half of the respondent surgeons from East Asia agreed with the expansion of surgical candidacy in cirrhotic patients with hepatocellular carcinoma (HCC) if the resection was performed laparoscopically (7). A recent study conducted in Hong Kong demonstrated that LLR may provide not only short-term advantages (e.g., less blood loss during parenchymal transection; limited mobilization of the liver; and minimum defect of the abdominal wall, leading to shorter hospital stay compared with an open approach) but also long-term oncological benefits (8). The current HCC treatment guidelines need to be updated in an international framework, because there are significant discrepancies between the Eastern and Western countries (9). For biliary tract cancers involving the liver (i.e., intrahepatic or perihilar cholangiocarcinoma and gall bladder carcinoma), because a majority of cases need bile duct reconstruction and/or lymph node dissection for curative resection and accurate staging, the roles and benefits of LLR remain unclear. Only a few studies have reported the safety and feasibility of LLR for biliary tract cancers, and a well-designed comparative study with open and robotic approaches is warranted (10,11). Laparoscopic living donor hepatectomy requires the most careful expansion of indications of LLR. At present, laparoscopic donor left lateral sectionectomy is considered as the standard procedure in pediatric living donor liver transplantation only in highly specialized centers (12-14). For full right or full left hepatectomies in adult living donor liver transplantation, laparoscopy-assisted donor hepatectomy is a viable option as a transitional procedure (13,14) because of scarcity of clinical evidence regarding pure laparoscopic donor right or left hepatectomy (15-17).

Tumor size and location

Although several studies have reported the feasibility of LLR for large (5–10 cm) and giant (>10 cm) tumors (18,19), a validation study of the Iwate criteria demonstrated that the surgical difficulty in performing LLR is increased in patients with a tumor size ≥3 cm (20). LLR should be performed judiciously, taking into account functional hepatic reserve in patients, proximity to major vasculature, the risk of tumor rupture, and the experience of the surgical

team. Additionally, LLR has also been shown to be a safe and feasible technique for tumors located in the "difficult" portions of the liver (segments 1, 7, and 8 and the superior part of segment 4); however, it remains to be a highly complex procedure and demands advanced expertise (14).

Major and anatomical LLR

The second international consensus conference concluded that major LLR remains to be an innovative procedure in the exploration phase (IDEAL 2b) (2). In the European Guidelines Meeting on Laparoscopic Liver Surgery that was held at Southampton (UK) on February 2017, the expert panel suggested that LLR for the left and right hepatectomies should be separately taken into consideration (14). Anatomical LLR for HCC has been recommended at both aforementioned conferences (2,14) based on previous reports, mainly from Japan, describing the superior oncological outcomes of anatomical resection for HCC compared with a nonanatomical approach (21,22). However, a true anatomical hepatectomy is technically demanding and requires a thorough knowledge of liver anatomy. Regarding the use of LLR for large/giant tumors and for tumors in difficult segments, major and anatomical LLR should be performed by only experienced surgeons, and its roles and benefits need to be further assessed.

Education

Recently, a risk-adjusted cumulative sum analysis (5) revealed that "early adopters" of LLR who received specific training in stage 3 of the IDEAL classification were able to overcome the learning curve both for minor and major hepatectomies faster than the "pioneers" who were self-taught in stage 2. This study shed light on "the importance of training and mentoring in the acquisition of complex skills" such as LLR. The Southampton meeting (2017) also emphasized that LLR should be performed within "the confines of an institution with an established support network and experience in liver surgery". Furthermore, conducting registry-based, high-quality studies are highly recommended to periodically update the position of LLR along with its exponential diffusion and evolution.

The Second World Congress of the International Laparoscopic Liver Society will be held in Tokyo from May 9 to May 11, 2019 (http://ills2019.com). This meeting will focus on "better outcomes with quality improvement" in LLR to hopefully update this surgical innovation to stage 4, the final phase of the IDEAL paradigm. At present, several pre-congress research projects are under way to elucidate the clinical questions raised in this editorial, including the Second International Survey on Technical Aspects of Laparoscopic Liver Resection (INSTALL-2), that will investigate the current position of "difficult LLR" from a global perspective and illuminate its future.

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