Editorial

Global standardization of laparoscopic liver resection and challenges for the future

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Hepatobiliary Surgery and Nutrition recently published a review by X Cai that describes the current status and future of laparoscopic liver resection (LLR) in China. The advent of LLR has led to significant changes in the field of liver surgery, with numerous reports outlining how this procedure offers a better, less invasive approach for the treatment of liver disease. Two international consensus conferences regarding LLR—held in 2008 (Louisville, USA) and 2014 (Morioka, Japan)—highlighted the efficacy and safety of LLR, and discussed the surgical indications, technique, standardizations, and precautions that should be considered when performing LLR (1,2). Delegates deliberated whether open liver resection (OLR) should remain the current standard procedure for liver disease, and the importance of LLR within this arena. There was agreement that minor LLR offers sufficient safety and benefit to be considered standard practice, but major resection requires further investigation. The most recent guidelines from the European meeting on LLR, held in 2017 in Southampton, UK (3), integrate the available evidence and expert knowledge on LLR, taking into consideration relevant stakeholders' opinions and complying with international methodology standards across five domains (indications, patients and complex diseases, procedures, techniques, and implementation). The guidelines emphasize the importance of a team-oriented approach and the need to recruit experts in OLR and laparoscopic surgery within a specialist center.

In his review, Cai describes the indications and procedures for LLR. Most procedures, such as partial LLR and left lateral sectionectomy, can be routinely performed. An international survey suggests that, in the past, LLR was less frequently indicated for the treatment of "difficult" segments, such as posterosuperior segments (segments 7 and 8) and the caudate lobe (segment 1), as compared with the more accessible segments (segments 2 to 6) (4). Now, however, LLR is indicated for the treatment of all segments of the liver, including these difficult segments. Some centers with experience in LLR have reported the feasibility and reproducibility of using LLR for the treatment of difficult segments, with several case series (5,6). However, LLR for these difficult segments is sometimes challenging for anatomical reasons. For posterosuperior segments, a lateral approach, using intercostal ports and thoracoscopy has been reported. There are several reports that a lateral approach using intercostal ports and modifying the patient's position may be useful alternatives to the classical approach for posterosuperior segment (6).

It appears that some procedures involving laparoscopic major resection, such as hemi-hepatectomy, still require further evaluation and verification. A report from the largest meta-analysis of laparoscopic resection has shown that, compared with OLR, major resections in LLR have less blood loss and morbidity, shorter length of stay, and similar operating times, transfusion rates, and completeness of resection (7). However, major resections are still in an investigational stage. Indeed, expert surgeons have suggested that laparoscopic major left and right hepatectomies are sufficiently different that their feasibility, reproducibility, and implementation should be

considered separately (3). For inflow control in laparoscopic major hepatectomy, many experienced centers prefer the hilar approach, regularly demonstrating its safety and reproducibility. However, several centers have reported good outcomes with a Glissonian approach. The choice of an anterior approach in major LLR should be selected in accordance with the surgeon's preference and experience, tumor size, and liver fragility.

The instruments and systems for laparoscopic surgery have rapidly developed, and this has facilitated the use of more advanced procedures and tools in LLR, including liver transection devices, intraoperative ultrasonography, and robotic systems. Improved laparoscopic vision, achievable with a flexible 3D camera, allows for meticulous liver parenchymal dissection, even in a narrow surgical field (e.g., posterosuperior segments) and in areas surrounding the major hepatic vessels. A previous report showed reduced operating time in laparoscopic major hepatectomy using a 3D camera, even when used by an expert surgeon (8). This suggests improved surgical outcomes and shortened learning curves for inexperienced surgeons, especially when the procedure is difficult. Despite this, few studies report the use of 3D cameras for LLR. Indocyanine green fluorescence imaging has also been developed for the intraoperative detection of liver tumors and is particularly useful for identifying segmental boundaries during liver resection. This image-navigation technique could be a reliable tool for anatomic resection (e.g., mono-segmentectomy) as it would allow for clear boundaries between segments of the liver, even inside the liver parenchyma, during resection (9). These and other innovations will improve the feasibility and reproducibility of LLR.

The review also sheds light on the benefits of laparoscopy in other complex procedures, such as donor hepatectomy and staged hepatectomy (e.g., associating liver partition and portal vein ligation for staged hepatectomy or ALPPS). For living donor hepatectomy, a laparoscopic approach improves patient quality of life, with better outcomes in terms of length of hospital stay and return to work (10). However, laparoscopic donor major hepatectomy is still not a standard procedure and therefore should be limited to centers with expertise in this type of surgery. A Japanese nationwide study that reviewed the surgical incisions of 3,121 cases found that the safety of the donor and the graft's quality were maintained among donors who received surgery through small incisions (11). In that study, pure laparoscopic donor hepatectomy (PLDH)—performed by only one center in Japan—was associated with a high complication rate (21.4%). The study concluded that the number of patients in the PLDH group was too small to perform a valid statistical evaluation. Therefore, PLDH should only be performed in highly experienced centers.

Since ALPPS was first reported in 2012, several centers have performed this procedure to achieve liver hypertrophy within the short term and successful radical resection by staged hepatectomy. In previous work, Cai introduced the novel technique of round-the-liver ligation and achieved results that were equally effective as liver partitioning and that avoided bile leakage after the first stage of the procedure. Although a laparoscopic approach to ALPPS has been reported, this procedure is still not standard to achieve adequate future liver volume for its safety and patients' overall survival even in OLR (12). It should generally not be considered as first-line treatment as an alternative to portal vein embolization or the conventional approach of two-stage hepatectomy.

Cai anticipates that the next challenge in LLR will be the standardization of procedures and the systematic training of young surgeons. Population-based evidence of LLR implementation has indicated low rates of adoption outside of high-volume centers (13). From the National Impatient Sample (NIS) and National Surgical Quality Improvement Project (NSQIP) databases, the rates of LLR and OLR accounted for only 3.5% and 4.8% of liver resections, respectively (14). LLR is a complex procedure and requires advanced laparoscopic skills, comprehensive experience with open liver surgery, and the support of experienced surgeons or teams. Therefore, we agree that the future prospect and challenge in this field will be how to disseminate reliable techniques and management from high-volume centers. In that sense, a national or global registry will be important to control the safe dissemination of LLR. In Japan, a prospective registry for LLR was launched in October 2015 (15). Registered institutions must submit data pertaining to prospective LLR patients at four intervals: preoperatively, postoperatively, after discharge, and after readmission. The latest results, from October 2015 to December 2017, show a 90-day mortality of 0.22% (n=9/4,095, the result including all procedures), which has been deemed as acceptable. The Southampton guidelines recommend fellowships, courses, and proctored programs to facilitate the training and development of laparoscopic liver surgeons (3). These fellowships should be conducted in highly experienced centers that routinely perform all procedures of LLR, including major and complex procedures. Even though minor resection of LLR is fairly commonplace among

liver surgery units, major resection should also be included in hepatobiliary fellowships for the safe dissemination of all aspects of LLR. The Southampton guidelines also recommend that each specialist center should offer a laparoscopic approach as part of its multidisciplinary management of liver disease. Such specialist centers should have at least two experienced surgeons to support each other for the development and maintenance of established techniques. It will be necessary to develop novel teaching approaches and instrumental innovation that help surgeons to improve their learning curve, and these developments will allow more patients to gain the benefits of LLR for liver diseases in the future.

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Footnote

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