



# Laparoscopic liver resections at the gates of 2020: a stand-alone field of hepatobiliary surgery

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We read with interest the review entitled “Laparoscopic liver resection: the current status and the future” written by Dr. Xiujun Cai and published in *Hepatobiliary Surgery and Nutrition* (1). The author has to be commended for the excellent and updated excursus on the actual role and future perspectives of laparoscopic liver resections (LLR). The manuscript summarizes well the most acknowledged indications, procedures, techniques and concepts related to the learning process, and highlights the still ongoing issues and open debates on the topic. In this article, we aim to add few considerations and highlight some latest evidences to facilitate an even more comprehensive knowledge of the readers.

The author has started by pointing out the relevance of the first and second consensus on LLR, respectively held in Louisville (USA) in 2008 and in Morioka (Japan) in 2014. These have been essential in opening the road to the feasibility of LLR for selected indications and procedures, and stressing the importance of reaching adequate level of evidence on important elements as their efficacy, long-term outcomes, cost-effectiveness and learning curves. It is worth mentioning a further milestone that took place in Southampton (UK) in 2017, when the first international guidelines on LLR were released by a pool of eminent experts after a Delphi reiterative process to ensure a collective agreement (2). The accumulated evidence on indications, complex patients, procedures, techniques and implementation allowed to draw recommendations to prompt a safe and efficient uptake of LLR worldwide. Moreover, in 2018 two additional international consensus (on robotic liver surgery and laparoscopic living donor hepatectomy) produced specific statements on these procedures (3,4). These successful and

dedicated events are the demonstration that LLR have become a stand-alone growing field that deserves both a specific insight as well as full integration in the traditional world of hepatobiliary surgery from the clinical and scientific standpoint. Until most updated or higher levels of evidence are disclosed, we feel appropriate to recommend that surgeons and institutions willing to develop or expand a LLR program should follow the guidance of such fruitful expert consensus with careful consideration of their local resources and personal experiences.

After the first reports in the early '90s, LLR on anterolateral segments have been rapidly up taken. The reasonable compromise between technical complexity and clinical efficacy has acted as an engine for pioneer surgeons to gain experience and become expert centers, with the subsequent diffusion of these procedures even in non-tertiary referral units. However, as remarked by Cai, the actual scenery of laparoscopic resections includes procedures of great difficulty as hemihepatectomies, caudate lobe resections, anatomical segmentectomies, resections on the posterosuperior segments up to conventional two stage hepatectomies and ALPPS. Various technical adjustments have been described to accomplish these challenging resections. The well-known caudal approach for major resections, first described by Gayet, represents the most acknowledged conceptual change for this technique. Few years ago, we have also described a systematic choice of approach to laparoscopic right hemihepatectomy based on the liver texture, size and position of the lesion and closeness to the hepatocaval confluence (5). For deeply and centrally located liver lesions, the “diamond technique” has also

been described to decrease the difficulty of parenchyma-sparing resections associated with laparoscopy (6). The abovementioned technical expedients exemplify that the laparoscopic approach to liver resections imposes the surgeon to a set of theoretical knowledge and practical skills different from open surgery, which needs to be systematized and standardized as much as possible to facilitate an orderly learning curve towards increasingly difficult procedures.

Hepatocellular carcinoma and colorectal liver metastases remain the predominant indications. Especially for cirrhotic patients, the advantages of minimally invasiveness in terms of reduced ascites and liver decompensation may also apply to patients with baseline advanced liver impairment. In this setting, it has been demonstrated that the postoperative course of selected Child B patients receiving a LLR may be not different to Child A, and that portal hypertension is not a risk factor for postoperative major complications when a liver resection in cirrhosis is performed by laparoscopy (7). Also, the benefits for other oncological indications are increasingly being reported (8). Recently evidence on the advantages of LLR for patients with metastases from breast cancer has been published, highlighting a faster return to adjuvant treatments (9). The advantages have to be interpreted also in the setting of different procedures. Despite a traditional definition of major hepatectomies, a recent large multicenter study has pointed out the different benefits and outcomes for laparoscopic right and left hemihepatectomies when separately compared with their respective open (10). With an even more focused analysis, we have recently published evidence on a significant differential benefit between laparoscopic anterolateral and posterosuperior resections compared with their open counterparts: while both resulting beneficial when compared to open, the advantages of laparoscopy appear greater for posterosuperior than anterolateral resections despite their technical complexity (11). The degree of advantage provided by laparoscopy has to be studied more in detail for different type of resections, keeping in mind that the most difficult seems to be associated with the greatest clinical benefits.

As far as concerns the operative strategies, the use of methods for inflow control remains a crucial point to ensure the feasibility and efficacy of liver resections, especially when performed by laparoscopy. The limitation of blood loss keeps the surgical field clean and dry, thus helping to conduct safe and oncologically efficient resections even in those locations most hostile to laparoscopic instruments. Several studies have reported the safety of an intermittent

Pringle maneuver even in diseased parenchyma. In addition, a wide use of an intermittent clamping (either systematic or on demand) has been described by a large number of centers with extensive experience and regular activity with LLR without any alert on perceived detrimental effects of associating the Pringle maneuver to the pneumoperitoneal pressure. We are in full agreement with the latest recommendations which regard the Pringle maneuver as the most effective method for the inflow control, and stress the possibility to take advantage of a selective hemihepatic control when convenient.

Regarding technical aspects, we totally agree on the central and non-replaceable role of intraoperative ultrasound, which is well defined in LLR as well as in open especially for cancer patients (2,12). We also recall that advanced vision technologies, real-time indocyanine green fluorescence imaging and augmented reality navigation systems are additional elements applicable to LLR. Their role should be considered helpful to accomplish especially the most difficult resections, as they may compensate several technical challenges as the lack of palpation, favor the recognition of structures, facilitate correct transection planes and detect sources of biliary spillage. Instead, the area of ideal application of robotics in liver surgery remains still to be determined. Since their perioperative efficacy appears similar to that of pure laparoscopy and the robotic approach retains increased costs, further studies are advocated to optimize their adoption and allocation (3).

The issue of cost-effectiveness of LLR deserves a specific focus, since their impact on financials may be significant. It should be considered that several studies have already demonstrated the economic advantages associated with laparoscopic minor resections, mainly related to the beneficial postoperative course. The evidence of cost-neutrality for major or complex liver resections needs to be fine-tuned. Notwithstanding a recent study has provided an estimate of not negligible costs associated with conversion, the adoption of a pure laparoscopic approach for major laparoscopic liver resection still appears without cost disadvantage compared to open (13). In addition, more evidence is needed to determine the financial impact of LLR in low income countries.

We conclude congratulating with Dr. Cai for the nice update on the status of LLR in China. The efforts put by Chinese surgeons and centers into laparoscopic liver surgery are well known to the worldwide community of hepatobiliary surgery: commendable examples of procedures have been presented at international meetings, and relevant publications

are part of the core literature on the topic. We take this opportunity to mirror the development in the far East with the continuous progress and spreading of LLR in Italy (14). As for China, our commitment is witnessed by various publications from tertiary referral centers and, more recently, by studies on many topics arising from the Italian prospective registry on laparoscopic liver resections (I GO MILS) (15).

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