Commentary

Laparoscopic liver surgery: yesterday, today and tomorrow

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Laparoscopic liver surgery (LLS) is currently considered as a standard of care approach for selected patients in an increasing number of centers worldwide (1). In his review article entitled "Laparoscopic liver resection: the current status and the future", Professor Cai aimed to present how LLS has evolved over time, current concepts and what is expected for the future (2). Indeed having overcome several obstacles of the past, which slowed its wider adoption and after over 2 decades of implementation LLS is acknowledged as a safe and efficient approach for the treatment of a plethora of hepatic lesions in the hands of certified hepatobiliary surgeons with additional experience in minimally invasive surgical procedures (3). Laparoscopic liver resections (LLRs) minor and major are expertly performed for primary, metastatic and recurrent malignant hepatic lesions, or in conjunction with other procedures (1,4-6). A significant number of studies and meta-analyses have documented the beneficial influence of LLS in short-term outcomes for selected patients and shown long-term outcomes comparable with those of the traditional open approach (OLR) (1). Moreover, with accrual of vast experience in these procedures, LLS in specialized centers is increasingly performed for more challenging minor and major liver resections as well as live donor liver transplant harvesting without compromising patients' short- or long-term outcomes (7).

LLS is the marriage of surgical technique and technology; hepatobiliary surgeons now possess a significant number of instruments which have allowed for safe implementation of different techniques of hepatic parenchyma transection. Moreover, as also highlighted by the author, the use of intraoperative laparoscopic ultrasound has allowed surgeons for direct and easy-to-repeat vision within the hepatic parenchyma in order to achieve safe and oncologically adequate LLRs. Two more technological innovations, 3-dimentional (3D) laparoscopy and stable carbon dioxide insufflators have received significant focus during the past years and are expected to influence the future of LLS practice (8). In their recently published study, Kawai *et al*. compared short-term outcomes of patients undergoing anatomic right laparoscopic hepatectomy (RLH) with the use of the conventional 2D vision and insufflation system versus 3D vision and optimized insufflation system and demonstrated that the combination of stable pneumoperitoneum and 3D vision led to reduced duration of right hepatic vessels dissection as well as total operation time during RLH, whilst morbidity and mortality were not different among the 2 compared groups (8).

One additional critical issue addressed by the author, which will undoubtedly influence future practice, is the need for establishment of formal training LLS programs for younger hepatobiliary surgeons. Unfortunately, there is currently no international consensus on how to structure a formal LLS education system whereas further research is needed on this field and there are limited reports from highly specialized HPB centers with early experience in starting specialized laparoscopic HPB fellowships. Of interest, a recently published multicenter study aimed to evaluate if younger surgeons working under guidance had different learning curves for safe and efficient LLS compared to the learning curves of pioneer, self-taught surgeons (9). The study showed that under guided and well-structured training programs, younger surgeons learn faster and perform both minor and major LLS equally safe

and efficiently with senior experienced surgeons who had to gain experience in LLS with no former guidance (9). More specifically it was shown that when younger trained surgeons had completed 46 LLR under the guidance of their proctors, they achieved comparable short- and medium-term outcomes with those of the pioneer surgeons who at the time had already performed 150 LLR.

In order to achieve formal inclusion of LLS as an efficient approach within international guidelines for the treatment of malignant lesions, level I evidence is mandatory. To that end, results from randomized controlled trials (RCTs) are of cardinal importance. The results of the OSLO-COMET were presented in 2018 and were in favor of the continued implementation of LLS as it was documented to be a safe and efficient in the treatment of colorectal liver metastases (10). Awaiting for the long-term outcomes of the OSLO-COMET RCT in order to draw more solid conclusions, 2 more prospective international multicenter RCTs are under way; the ORANGE II PLUS trial (NCT01441856) and the ORANGE SEGMENTS trial (NCT03270917) (https://clinicaltrials.gov/). The objective of the 1st is to provide evidence on the outcomes of laparoscopic versus open hemihepatectomies in terms of time to functional recovery, length of stay, intraoperative blood loss, operation time, resection margin, time to adjuvant chemotherapy initiation, readmission percentage, (liver-specific) morbidity, quality of life, body image, reasons for delay of discharge after functional recovery, long-term incidence of incisional hernias, hospital and societal costs during 1- and 5-year overall survival (OS). Moreover, the ORANGE SEGMENTS trial aims to evaluate the impact of parenchymal preserving LLR *versus* the OLR approach specifically for posterosuperior liver segments (involving 1 or 2 of segments IVa, VII, VIII) on the same parameters as the ORANGE II PLUS trial. One more ongoing RCT from China (NCT01768741) aims to investigate the clinical value of LLR in the treatment of hepatocellular carcinoma by assessing its surgical and oncologic outcomes comparing with OLR.

We would like to commend Professor Cai for his review article presenting the current aspects as well as the future of LLS (2). Notwithstanding the fact that today we have well documented benefits of LLS, the road is still long. The nature and outcomes of every study on this relatively "young" approach must still be interpreted with caution and limitations must be acknowledged. Patient and tumor selection are critical determinants for the beneficial outcomes in LLS, whereas it must be highlighted that long-term outcomes are for the time being not shown to be superior to the traditional open approach. Despite the encouraging outcomes of LLS, it remains a challenging approach and is not to be adopted by non-certified hepatobiliary surgeons with additional experience in minimally invasive procedures otherwise patient morbidity, mortality and moreover oncologic adequacy of the procedure may be compromised. LLS is expected to be more widely implemented and expertise to grow significantly. Still, more high-quality and methodologically better-structured studies are needed in order to promote its adoption.

Acknowledgments

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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