Editorial Commentary

Can newly developed device contribute to improve outcome of laparoscopic liver resection?

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In the initiation phase of laparoscopic liver resection (LLR), studies from Western countries reported LLR in benign legions of the liver (1,2). In 1993, we experienced laparoscopic partial liver resection for both of primary and metastatic malignancy, with liver cirrhosis occasionally. Thereafter, we reported the first experience of laparoscopic left lateral sectionectomy and suggested it to be a safe minimally invasive surgery (3,4). However, at that time only few laparoscopic energy devices were available for hemostasis in a well vascularized organ, liver. We formerly used microwave tissue coagulator, ultrasonic surgical aspirator and Argon beam coagulator during LLR (3). Unfortunately, these devices were not designed specifically for hepatectomy and the Argon beam coagulator has been deprecated due to the potential risk of gas embolism (5).

During the last quarter of a century, surgical technique of laparoscopic liver transection has largely evolved based on development of instrument with advances in surgeon and institutional experience. Classic indications for LLR were limited tumor size, type, and location. Especially, macroscopic nodular type tumors smaller than 4 cm or pedunculated tumors from the liver, which are smaller than 6 cm, were considered favorable candidate for LLR. Regarding the location, tumors on the surface of antero-lateral region or left lateral section were appropriately indicated (6).

This has changed in recent years, and expert institutions have performed major hepatectomy including anatomical liver resection in laparoscopic fashion. This is accomplished by using various energy technology, such as electrocautery, ultrasound, microwave, and water jet in liver surgery. Surgical devices including energy derived instruments must be "surgeon's hands". Despite the variety of selection of instruments, there is no specific instrument which has been recommended for liver parenchymal transection in both of laparoscopic and open procedures. A review on parenchymal transection technique for LLR by the 2nd International Consensus Conference on Laparoscopic Liver Resection held in Morioka, Japan (2nd ICCLLR) recommended the use of combination of surgical instruments during parenchymal transection, based on the depth of liver resection and instrument functions such as "division", "isolation" and "coagulation". Surgical energy devices must be incorporated as an essential tool for laparoscopic liver parenchymal transection (5,7).

In general, ultrasonic shears are used to transect the superficial layer of the liver. Then, deeper transection requires meticulous exposure of intraparenchymal structures using an ultrasonic surgical aspirator or clamp-crushing method. Small vessels can be sealed and divided by using the ultrasonic shears or bipolar cautery-based vessel sealing device. Division of large vessels including the Glissonian sheath or large hepatic veins can be performed by stapler. Surgical clips are acceptable option for large vessel division. Hemostasis of the hepatic transection plane can be obtained by monopolar or bipolar electrocautery with or without saline drip.

Parenchymal transection in cirrhosis poses more technical challenge mainly from difficulty obtaining hemostasis. This is due to the loss of elasticity caused by liver fibrosis, fragility of the altered hepatic structure,

difficulty in identifying intraparenchymal vasculatures and coagulopathy caused by portal hypertension and liver dysfunction. In these circumstances, pre-coagulation technique, in which the transection plane is coagulated by diathermy using the electrocautery or the microwave prior to liver parenchymal transection, can assist for the reduction of blood loss during hepatectomy on liver cirrhosis (8). Therefore, liver surgeons should use devices based on their understanding and the applicability in particularly for procedures of LLR (7).

Wakabayashi et al reported their experimental study using a porcine model to assess the safety and efficacy of new instrument applicable for liver resection (9). It is noteworthy that both long term assessment with contrast-enhanced computed tomography and Pathological findings suggested the advantage of newly developed laparoscopic hybrid pencil (LHP). As the authors described, each instrument plays role in LLR with its merit and demerit. Therefore, Electric and ultrasonic combined technology with monopolar output is unique and may overcome their drawbacks.

Their LHP device showed two remarkable advantageous functions; obtaining hemostasis and non-adherence to the tissues by combined technology of ultrasound and monopolar energies. They succeed to shorten the duration of liver transection, to reduce blood loss, cleaning of tip of device and instrument changes by using LHP than laparoscopic monopolar pencil (LMP). The LHP showed less frequency of hemorrhage and coagulator usage than in the laparoscopic ultrasonic shears (LUS). In pathological finding, the thermal tissue damage by the LHP was considered equivalent to those of the LMP and LUS devices. This suggests that there is no disadvantage using the hybrid energy.

Despite its advantages, limitation during liver parenchymal transection has remained, even in this newly developed device. Eventually, monopolar and bipolar electrocautery device with coagulating mode were utilized in acquiring complete hemostasis on the transection plane after the LLR by using these three devices (LHP, LMP, and LUS).

The method of liver parenchymal transection changed depending on which energy device was mainly used. They performed transection vertically to the liver parenchyma without advanced forceps dissection during LLR using the LHP device. We agree with author's comment that the LHP would be an efficient instrument for the resection on the peripheral part of the liver, in where does not have large vessels to isolate. On the other hand, the advanced liver dissection technique using Maryland forceps, such as clamp crushing method" was utilized in LLR by the LMP device. Likewise, clamp crushing technique by LUS itself using wide-opened Jaw was also applied in LLR using LUS. Therefore, this study showed that the best method performed during liver transection should be changed by the type of devices used.

In the future, we expect that the best instruments can accomplish all aspects of hepatic transection, such as "division", "isolation" and "coagulation". Development of devices specifically for LLR can contribute to improve outcome of this surgery.

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