Laparoscopic instruments for HBP surgery: hemostatic devices

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Laparoscopic surgery differs from open surgery in the method of access because the incisions used are small holes, and a special telescope is used to illuminate and see the operative field, and for exposure the usual method is to insufflate the area with a gas to create space for operative manipulation. Based on these two requirements laparoscopic surgical equipment can be classified into two broad categories. One is the equipment for access and exposure and the other is hand-instruments for the actual operative procedure. Multiple technological advances have allowed surgeons to treat extensive disease and complicated pathology by laparoscopy. As surgeons sought to treat more and more complex cases by laparoscopy, the need for versatile and reliable hemostasis became of utmost importance. In this time, let's see the hand-instruments especially for the hemostatic devices which are absolutely needed in 'HBP surgery'.

Fundamentally, most devices used for hemostasis in the laparoscopic environment are adapted from open surgery. The first electric modality introduced as vessel sealing devices was monopolar electrocurrent which passed through tissue via the use of two electrodes at distant sites. Common monopolar instruments used in laparoscopy include the shears, scissors, hook and spatula. Concentration of current at the smaller electrode allows for hemostatic cutting and coagulation. Bipolar electrosurgery overcomes some of the limitations of monopolar electrosurgery. Bipolar technology employs an active electrode and a return electrode into a single electrosurgical instrument with two small poles, which minimize the risk of damage to adjacent tissue by containing electrical current between the jaws of the forceps. Advanced bipolar devices (eg, LigaSure, EnSeal) combine bipolar current together with tissue apposition and compression to create a tissue seal. These advanced bipolar sealing devices provide excellent hemostasis for vessels up to 7mm. Especially, tissue sensing technology in the LigaSure makes use of a computer algorithm to adjust the current and voltage based on real-time measures of tissue impedance. This results in a constant delivery of wattage over a broad range of tissue types. The Enseal Tissue Sealing System uses a bipolar electrode to concentrate energy on tissue within the plastic jaws of the instrument. Enseal claims to offer improved efficacy by utilizing a temperature sensitive matrix embedded within the jaws of the device that controls the energy delivered to the electrode-tissue interface. Ultrasonic devices (eg, Harmonic scalpel, Sonicision, CUSA, LOTUS) convert electrical energy into mechanical energy, which causes a breakdown of protein in tissues which creates a coagulum. In response to electric current, a piezoelectric crystal located at the tip of the instrument vibrates at about 55,000Hz, generating mechanical forces that rupture cells and form a coagulum. The range of peak tissue temperatures are much lower (60℃ to 100℃) compared with those produced by electrocautery (200℃ to 300℃). In general, the Harmonic Scalpel can be used in just about any abdominal

laparoscopic procedure when hemostatic dissection with relatively little lateral thermal spread to neighboring tissue is desired. However, the main disadvantage of ultrasonic dissection is poor hemostasis with the division of larger vessels (≥4mm). The Sonicision, a cordless ultrasonic dissection device is a hand-held, battery-powered surgical instrument which also delivers high frequency ultrasonic vibrations. The unique cordless design seem to be a major advantage over other ultrasonic devices, which allow for more freedom of movement and better efficiency in the operating room. The Cavitron Ultrasound Surgical Aspirator (CUSA) is another ultrasonic device. Tissue is fragmented, rapidly irrigated, and aspirated away from the dissection field. The liver parenchyma is destroyed, leaving larger vessels intact to be managed by other means such as clipping, LigaSure, Hem-o-lok clips, or vascular staplers. Not all devices used successfully in open surgery are suitable for laparoscopic surgery. One example is the argon beam coagulator. This device uses monopolar electrocautery to produce a coagulated surface with very little smoke by passing electric current through a stream of ionized argon gas to blow away blood and debris from the surgical field. High-flow infusion of argon gas can increase abdominal pressure, limiting its usefulness in laparoscopic surgery. In addition, the argon beam coagulator does not provide dissection or control of larger vessels, and argon gas embolization has been reported in association with liver resection.

The choice of technique is generally according to the surgeon's preference and experience. Every surgeon performs every procedure with their own habits or instrument preferences, there is no winner for the best vessel sealing device. In some instances, a 5mm port is preferred over a 10mm port as smaller instruments are less bulky and can be used dissectors. On the other hand, small tissue bites may prolong operative time or fail to seal larger vessels. Fatty structures, such as the omentum and mesentery, are best addressed with an ultrasonic energy source such as the Harmonic scalpel. This device produces rapid, hemostatic dissection of these structures. When vessels within the mesentery exceed 5mm in diameter, advanced bipolar sealing devices, such as the LigaSure, may be more useful. To conclude, as a surgeon gains more experience with each device, he or she will be better able to predict which instrument is best suited to any particular case.

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