Surgical Techniques for Liver Resection

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Major goals during liver resection are the reduction of intraoperative blood loss and avoidance of parenchymal trauma. Despite refinements in many techniques of liver resection over the past 20 years, intraoperative hemorrhage has remained an important issue. For many years, liver transections have been done using finger-fracture or other crushing techniques using a Kelly (or similar) clamp.[1] Over the past two decades, several novel devices have been developed aiming at more bloodless and accurate parenchymal transection, including the bipolar forceps, ultrasonically activated scissors, argon beam coagulator, monopolar floating ball, and dissecting sealer (TissueLink Medical, Inc.; Dover, NH). However, these techniques may cause deep tissue damage and do not have the ability to discriminate vascular or biliary structures from the surrounding parenchyma. Other devices, which do not generate heat and thereby do not cause thermal damage to the surrounding healthy liver tissue, have been proposed, including the cavitron ultrasonic surgical aspirator (CUSA; Tyco Healthcare, Mansfield, MA) and the Hydrojet (Hydro-Jet; Erbe, Tubingen, Germany).

Inflow occlusion (Pringle maneuver) has been used for many years to prevent bleeding during parenchyma transection. The concomitant use of low central venous pressure (CVP) anesthesia further minimizes blood loss by preventing retrograde bleeding from the hepatic veins. Assuming that inflow occlusion and low CVP anesthesia cause significant damage through ischemia and reperfusion, there has been a growing interest in using new devices that facilitate bloodless transection, obviating the need for inflow occlusion.

However, none of these devices or techniques have gained unanimous acceptance among liver surgeons. It is also unknown how to adapt these techniques for specific diseases or underlying liver diseases. For example, we recently reported some advantages to the use of the Hydrojet for the radical treatment of hydatid disease in patients with bilobar diseases.[2] However, no consensus exists regarding the best surgical techniques or devices to be used in patients with cystic or solid lesions or in patients with malignant or benignant disease.

So far, liver resection devices have been tested in only two randomized controlled trials comparing clamp-crushing technique versus CUSA[3] and CUSA versus Hydrojet,[4] using inflow occlusion in all cases. Both randomized trials had critical limitations, as Takayama et al.[3] included normal and cirrhotic livers, and the study of Rau et al.[4] was not based on a sample size and power calculation. There are no randomized controlled trails that compare the most commonly used devices to each other such as the clamp-crushing technique, CUSA, Hydrojet, and dissecting sealer. Further experience with transection devices has been reported by only lower evidence retrospective studies.

Therefore, in view of the lack of available convincing data, we designed a prospective randomized trial in 100 noncirrhotic and noncholestatic patients undergoing liver resection, comparing four different techniques of parenchyma transection: clamp-crushing technique under inflow occlusion, CUSA, Hydrojet, and dissecting sealer. The results have been recently reported in the *Annals of Surgery*.[5] Inflow occlusion was used in the three latter groups only when needed. End points such as intraoperative blood loss, transection time, degree of reperfusion injury, and postoperative complications were determined to identify the most efficient device for liver parenchyma transection in terms of safety and costs. In our study, the clamp-crushing technique had the highest transection velocity and the lowest blood loss and proved to be most cost-efficient device compared with CUSA, Hydrojet, and dissecting sealer.[5] However, the degree of postoperative reperfusion injury and complications did not differ significantly among the groups.

In conclusion, there is evidence that the clamp-crushing technique associated with inflow occlusion is the most effective and cost-effective surgical technique for liver transection in patients with normal liver parenchyma. However, which technique should be preferred in patients with an injured liver (e.g., cholestasis, cirrhosis, fibrosis, fatty liver) or in some

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patients with specific diseases remains unknown. Further properly designed trials are necessary to address these issues.

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