



Is it now possible to transition from laparoscopic liver resection to robotic liver resection?

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Minimally invasive surgery (MIS) has significantly progressed and emerged as the preferred approach for various gastrointestinal procedures, including gastrectomy, cholecystectomy, and various colorectal surgeries (1). However, the widespread acceptance of robotic surgery in liver resection has encountered obstacles, attributed to factors such as the lack of appropriate surgical instruments, the intricate learning curve, and safety apprehensions. Nonetheless, the utilization of MIS in liver resection is linked to decreased blood loss, reduced post-operative pain, shorter hospital stays, and lower morbidity rates compared to both open and laparoscopic liver resection procedures (2).

Recently, a review article discussing the current and future role of robotic surgery in liver surgery and transplantation was published in *Hepatobiliary Surgery and Nutrition* (3). This review provides valuable insights into the advantages of robotic liver resection over open and laparoscopic techniques, highlighting features such as three-dimensional imaging, a rapid learning curve, and precise movement control. Additionally, it explores the potential benefits of robotic donor hepatectomy, including reduced postoperative pain and improved surgical outcomes. However, this study concluded that while robotic surgery shows promise, more research is necessary to fully

comprehend the role of robotic surgery in living donor hepatectomy.

Robotic surgery seems safe and feasible for trained professionals. However, further data are needed to determine its superiority over laparoscopic or open methods in living donor hepatectomy. This article underscores several considerations regarding robotic surgery. Firstly, liver surgery can be more challenging compared to surgeries involving other organs due to its complex anatomy, including complex vascular and biliary structures. Hepatectomy is a surgical procedure involving the resection of liver parenchyma, unlike surgeries involving gastrointestinal organs (4). During this procedure, surgeons encounter numerous blood vessels and bile ducts, requiring a precise understanding of the liver's anatomical structure. Dissecting the vessels and bile ducts within the liver parenchyma without causing damage is challenging, whether performed through MIS or open surgery. This becomes even more difficult, particularly in the absence of suitable robotic instruments. Secondly, patient selection is crucial in robotic surgery. Given the technical complexity of robotic liver resection, careful consideration of the patient's liver anatomy and surgical suitability is essential to ensure optimal outcomes. Although the indication of patient

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selection is expanding, open or laparoscopic methods are still preferred for donor safety in complex liver anatomy (5). Thirdly, ensuring the safety of robotic surgery requires the involvement of highly skilled surgeons. Only experienced surgical experts can guarantee safe and effective robotic procedures, minimizing the risk of complications and ensuring favorable surgical outcomes (6).

As we transitioned from open liver resection to laparoscopic liver resection and then to robotic liver resection, the number of hands available to us decreased. In open liver resection, including the second assistant, there were a total of six hands involved. In laparoscopic liver resection, there were four hands, and in robotic liver resection, there were three. With fewer hands available, surgeries became somewhat cumbersome and time-consuming. Instruments had to move back and forth through trocar ports, and the freedom of finger movement was lost, replaced by instruments that simply opened and closed. Moreover, there is a need for constant instrument exchange during surgery. Additionally, to compensate for the reduced role of hands, we devised the rubber band retraction technique and had to use laparoscopic instruments such as Cavitron Ultrasonic Surgical Aspirator (CUSA) (7,8). However, despite the longer operative time, the enhanced visualization and utilization of more advanced energy devices enabled us to perform more meticulous surgeries. This trend appears to align with the results of several current studies, indicating that robotic surgery reduces blood loss rates and ensures safer procedures, but is associated with the disadvantage of longer surgical times.

In this article, robotic surgery for the recipient in living donor liver transplantation (LDLT) was not mentioned. Suh *et al.* recently reported successful MIS of the recipient in LDLT (9). In their study, the recipient's cirrhotic liver was extracted laparoscopically, and the hepatic and portal veins were anastomosed using the laparoscopic approach. Subsequently, they utilized the robotic system for the anastomosis of the hepatic artery and bile duct. However, both the operative and ischemic times more than doubled, potentially affecting graft survival and the postoperative recovery of the recipient. Given these initial results, it seems that there is still a long way to go before performing recipient surgery using MIS.

In conclusion, the current advantages of robotic surgery are evident, as mentioned. However, whether it is superior to laparoscopy remains a challenge to be substantiated in the future. Currently, the instruments used in robotic hepatectomy are not specifically tailored for liver resection.

As a result, we are employing a hybrid approach, integrating laparoscopic instruments, or devising methods for easier liver resection. By adding arms capable of retracting the liver and with the potential development of equipment such as robotic CUSA, we anticipate that future advancements will lead to safer procedures with reduced operative times compared to current robotic hepatectomy.

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