

Robotic Hepatectomy: A New Paradigm in the Management of Hepatocellular Carcinoma?

Suguru Yamashita, MD, PhD and Claudius Conrad, MD, PhD

Department of Surgical Oncology, The University of Texas MD Anderson Cancer Center, Houston, TX

We congratulate Chen et al. for reporting possible benefits of robotic hepatectomy for hepatocellular carcinoma (HCC).¹ In the present report, these experienced surgeons demonstrate that, compared with open hepatectomy, robotic hepatectomy can provide superior short-term outcomes (shorter hospital stay and decreased need for patient-controlled analgesia) and similar long-term outcomes (recurrence-free survival [RFS] and overall survival) despite longer operative times. Per the authors, the prolonged operative times were associated with the time required to dock the robot, exchange instruments, and perform delicate dissection without haptic feedback. While it has already emerged that laparoscopic surgery performed by experienced liver surgeons results in better postoperative outcomes than open surgery for minor liver resections, the additive benefits for robotic hepatectomy due to the potential advantages of instrument flexibility, stability, and three-dimensional vision are less defined.^{2,3} A concern regarding the increased cost of the robotic approach over the laparoscopic approach emerges again in this study (robotic was almost twice as expensive) and warrants a more in-depth analysis as to the main contributors.

This study included a substantial proportion of patients with liver cirrhosis (Ishak's score ≥ 5 ; 37/81, 46 %)⁴ and major hepatectomy (34/81, 42 %) in the cohort treated with robotic hepatectomy. Previous investigators have already reported that minimally invasive surgery is applicable to patients with cirrhosis, which might be attributable to lower fluid requirement, avoidance of large incisions resulting in preserved collateral blood flow through the abdominal

wall, less manipulation, and less respiratory impairment.⁵ While the feasibility and safety of laparoscopic surgery for major hepatectomy and complex anatomical resections are still considered at an evaluation stage, the role of robotic surgery for these cases is even less well-defined.⁶ Since half of the patients in this study underwent robotic major hepatectomy, this study provides further evidence that robotic major hepatectomy can be performed safely, with optimal outcome, by experienced surgeons.

Of note, the authors showed a borderline significant improvement in RFS in patients undergoing robotic hepatectomy (RFS rate at 3 years: 72 %) compared with matched patients undergoing open hepatectomy (RFS rate at 3 years: 58 %; $p = 0.062$). Although Chen et al. did not mention the median follow-up period, it is conceivable that statistically significant superiority of RFS in patients with robotic hepatectomy might emerge if the authors were to extend the observation period. There are several possible explanations for the better prognosis of patients treated with robotic hepatectomy. First, lower postoperative systemic inflammatory response and/or preserved immunological response could play a role. This explanation is based on an extrapolation of the correlation between poor prognosis after resection for HCC and high neutrophil-to-lymphocyte ratio and studies on the impact of complications on oncologic outcomes in colorectal liver metastasis surgery.^{7,8} Second, there may be an interaction between improved prognosis after tumor resection and optimal control of postoperative pain, as has been recently suggested.⁹ Third, the authors reported that the patients treated with robotic hepatectomy had significantly wider surgical margins than the matched patients treated with open hepatectomy. This finding stands in contrast to other studies on minimally invasive hepatectomy, which, on average, have demonstrated similar or closer margins for minimally invasive hepatectomy compared with open hepatectomy.^{10,11} While the optimal margin for resection

of HCC continues to be an area of active research, the finding of a wider margin with robotic hepatectomy is novel and warrants sharing technical details of how this can be achieved with the community of minimally invasive liver surgeons.

Robust evidence from randomized controlled trials of open versus minimally invasive liver surgery is still lacking. Such trials are challenging because of the lower rates of minimally invasive surgery than open liver surgery; the lower incidence of primary and secondary liver cancer than of cancer at other anatomic sites, e.g. colorectal cancer; and the presence of surgeon and patient biases.¹² In the present study, the same surgical team performed the open and robotic cases. Elucidating potential biases and detailing how the decision was made to perform robotic, laparoscopic, or open hepatectomy would have further supported the conclusion of the manuscript. Nevertheless, while the potential biases of a retrospective analysis must be recognized, the design of the present study, which included propensity score matching in terms of demographics, functional liver reserve, and tumor size, is the best available design at the moment, short of a clinical trial.

In summary, we commend Chen et al. for this detailed analysis of their robotic surgery experience, which offers further support for the premise that robotic hepatectomy for HCC performed by experienced surgeons can provide superior short-term outcomes with encouraging long-term oncologic outcomes.

CONFLICTS OF INTEREST Suguru Yamashita and Claudius Conrad have no conflicts of interest associated with this study.

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