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REVIEW ARTICLE

Effectiveness and safety of robotic-assisted versus laparoscopic hepatectomy for liver neoplasms: A meta-analysis of retrospective studies

Lidong Hu [a,b,f], Liang Yao [d,f], Xiaofei Li [b,c], Penghui Jin [a,b], Kehu Yang [e,**], Tiankang Guo [b,*]

[a] *Department of Clinical Medicine, Gansu University of Traditional Chinese Medicine, Lanzhou 730000, People's Republic of China*
[b] *Department of General Surgery, Gansu Province People's Hospital, Lanzhou 730000, People's Republic of China*
[c] *Department of Clinical Medicine, Ningxia Medical University, Yinchuan 750004, People's Republic of China*
[d] *Institution of Clinical Research and Evidence Based Medicine, Gansu Province People's Hospital, Lanzhou 730000, People's Republic of China*
[e] *Evidence-Based Medicine Center, School of Basic Medical Sciences, Lanzhou University, Lanzhou 730000, People's Republic of China*

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Summary This meta-analysis aimed to investigate the effectiveness and safety of RAH and LLR for liver neoplasms. A systematic search was performed in PubMed, EMbase, the Cochrane Library, Web of science, and China Biology Medicine disc up to July 2016 for studies that provided comparisons between the surgical outcomes of RAH and LLR for liver neoplasms. WMD, OR and 95% CI were calculated and data combined using the random-effect model. The quality of the evidence was assessed using GRADE methods. A total of 17 studies were included in the meta-analysis, in which 487 patients were in the RAH group and 902 patients were in the LLR group. The meta-analysis results indicated: compared to LLR, RAH was associated with more estimated blood loss, longer operative time, and longer time to first nutritional intake ($p < 0.05$). There was no significant difference in length of hospital stay, conversion rate during

* Corresponding author. Department of General Surgery, Gansu Province People's Hospital, No. 204, Donggang West Road, Chengguan District, Lanzhou, Gansu 730000, People's Republic of China.
** Corresponding author. Evidence-Based Medicine Center, School of Basic Medical Sciences, Lanzhou University, No. 199, Donggang West Road, Chengguan District, Lanzhou, Gansu 730000, People's Republic of China.
E-mail addresses: huabner@163.com (K. Yang), tiankangguo2017@126.com (T. Guo).
[f] These authors contributed equally to this work.

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operation, R0 resection rate, complications and mortality ($p > 0.05$). Three studies reported the total cost, and the result showed a higher cost in the RAH group when compared with the LLR group ($p < 0.05$). This meta-analysis indicated that RAH and LLR display similar effectiveness and safety in hepatectomy. Considering the lack of high quality original studies, prospective clinical trials should be conducted to provide strong evidence for clinical guidelines formation, and the insurance coverage policies should be established to promote the application of robotic surgery in the future.

1. Introduction

According to Torre's report in the Cancer Journal for Clinicians, there were an estimated 782,500 new liver neoplasms cases and 745,500 liver neoplasm deaths worldwide during 2012, of which about 50% of the total new cases and deaths were in China.[1] So far, surgical resection is regarded as the golden standard for the treatment of liver neoplasms. Since the rise of minimally invasive surgeries in the 1990s, laparoscopic liver resection (LLR) has been extensively applied to benign and malignant lesions of the liver, from minor or major liver resection to living donor liver donation. Many non-randomized studies have indicated that LLR is effective and safe for the treatment of liver neoplasms. TLH was associated with less estimated blood loss and faster recovery when compared to open hepatectomy. But in oncologic outcomes the two techniques were comparable.[2–8] However, due to the complicacy of the hepatic vascular and bile duct structures, difficulties of exposure, bleeding tendencies during operation, and limited operating space, the advantages of LLR are downplayed.[9–11]

Theoretically, the robotic surgery system, as an emerging technique, provides seven degrees of freedom for the human hand to make flexible and accurate movements.[12] The robotic surgery system can also provide a three-dimensional view; as well as magnify the field of operation, which assists in delicate tissue dissection and precise intracorporeal sutures.[13,14] The technique is particularly applicable to non-linear resections; such as a curved parenchyma resection, hilar dissection, and liver posterior segment resection. In addition, reports on advanced robotic surgery continue to increase with time.[15–19]

However, most of the current studies on robotic-assisted hepatactomy (RAH) are case–control studies and case series.[10,20–22] RAH versus LLR and open hepatectomy are comparable in terms of estimated blood loss, operative time, conversion rate, R0 resection rate, length of hospital stay, and complications.[23–26] There were systematic reviews and meta-analyses (SR/MAs) published on RAH versus LLR for liver neoplasms, but they only included small sample studies; hence, the influence of these tests was minimal.[27,28] The results from these SR/Mas greatly varied, and the interpretation of the results was not comprehensive. Besides, the authors from those reviews only included studies published before 2015, whereas we found several new related studies published in 2016 upon further investigation.[17–19,26,29,30] Moreover, we reviewed clinical practice guidelines for liver neoplasms from China, the United States, Europe, Singapore, and South Korea, and found that they did not recommend the application of robotic surgery in liver neoplasms resection because of the lack of strong evidence supporting the application of robotic surgery in hepatectomy[31–35] except in the South Korea guideline. South Korea's clinical guideline mentioned that RAH was implemented in very select cases, and comparative studies between robotic-assisted hepatectomy and open or laparoscopic hepatectomy were investigated.[35,36] Therefore, the robotic surgery system has bright prospect for development and application in liver neoplasms resection. Hence, we conduct a meta-analysis based on current studies to demonstrate whether RAH is effective and safe for liver neoplasms. In addition, we adopted the GRADE (Grading of Recommendations Assessment, Development and Evaluation) system to evaluate the quality of the evidence from various important outcomes in this meta-analysis.

2. Materials and methods

2.1. Literature search

A systematic search was performed in PubMed, EMbase, the Cochrane Library, China Biology Medicine disc (CBMdisc) up to July 2016 for the studies that provided comparisons between the surgical results of RAH and LLR for liver neoplasms. The following search terms were used: "robotic liver resection", "robotic hepatic resection", "robotic hepatectomy", "liver cancer or liver neoplasm or liver tumor or liver carcinoma or hepatic tumor or hepatic carcinoma or hepatic cancer or hepatic neoplasm or hepatocellular carcinoma". In order to search more potential relevant studies, we used a vague term "liver neoplasm" in the search strategy to include articles about hepatocellular carcinoma, liver metastases, adenoma, FNH, etc. All searches were carried out using a combination of medical subject heading terms (MeSH) and free words. According to the references in the literature, we performed a second search with expanded literature guidelines to ensure there was no relevant information or data missing from our research. We included all patients regardless of age and gender who had received robotic or laparoscopic liver

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