Editorial

# Is HPB robotic-assisted surgery an evolution or a revolution in laparoscopy?

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## Introduction

Robotic-assisted surgery technology demonstrates a new prospect for surgery. Its advantages are particularly prominent in specific surgery divisions or for specific surgical procedures, which has set off a new wave of surgical technology following laparoscopic surgery. Looking back at the history of surgical development over the past century, there have been many technological waves, some of which have become classics and standards, some of which are constantly evolving, and some of which have been gradually abandoned in practice. In the context of the increasingly mature and accurate laparoscopic surgery, which has become a standard operation of many types of surgery, the government, medical institutions and surgeons should carefully consider the role and future development of robotic-assisted surgery.

## Robotic-assisted surgery is an evolution rather than a revolutionary change of laparoscopic surgery

During 30 years of development, laparoscopic surgery underwent a process of creation, questioning, acceptance, standardization and popularization (1,2). With the gathering of experience and the continuous renewal of surgical equipment, many laparoscopic surgeries, especially laparoscopic hepatobiliary and pancreatic surgeries, approach the goal of precise surgery, that is, quantifiable, visible, controllable, and standardization (3). At experienced laparoscopic surgery centers, 90% of abdominal surgeries can be performed with high quality using laparoscopy. Of course, there are still obstacles in the homogeneity and popularization of some complicated operations such as difficult hepatobiliary and pancreatic laparoscopic surgery. This situation is mainly attributed to the inherent limitations of laparoscopic techniques, including lack of tactile feedback, non-intuitive anatomical operation direction, difficulty in surgical field exposure, difficulty in suturing, limited tools of hemostasis, limited range of movement, and amplification of hand tremors, etc. All of these add additional surgical difficulty in laparoscopic surgery and prolong the learning curve compared with open surgery (4,5). Additionally, the operating space of the chief surgeon in laparoscopic surgery is further limited, so a well-trained and more efficient team of assistants is necessary. The improvement of surgical equipment may help to overcome some problems, but not all of them. Under these circumstances, the robotic-assisted technique was created to address some limitations of the laparoscopic technique. The robotic instruments have a built-in naked-eye 3D vision system and a high magnification field of view which provide a more detailed anatomical structure of the surgical field. The design of a self-controlled camera view by the chief surgeon and human-like robotic arm movement reduces the requirements of assistants to a certain extent. The highly flexible robotic arm design also enlarges operation angles, and the human hand tremor filtering system provides opportunities for operating complicated surgery in a small surgical field, which ultimately improves the quality of surgery and shortens the learning curve.

These advantages are clearly demonstrated in particular hepatobiliary and pancreatic surgery procedures, such as lymphadenectomy, bilioenterostomy, pancreatoenterostomy (6-9). More importantly, the need for robotic surgery directly originates from the shortcoming of laparoscopic technology. Although some instrument layouts such as the Trocar holes and robotic arms, need to be adjusted, the core of robotic-assisted technology, which includes the surgical planning and surgical approach, is inherited from that of laparoscopic surgery. It can be said that robotic surgical technology is essentially the result of the continuous evolution of laparoscopic technology through time. The core concept of robotic surgery is not beyond the scope of current laparoscopic surgery. That is why robotic surgery can successfully inherit the existing laparoscopy surgical planning and continue practicing its evidence-based medicine smoothly (10,11). However, due to this reason, robotic surgery cannot fully overcome the inherent limitations of laparoscopic surgery, especially in the field of complicated hepatobiliary and pancreatic surgery, and no revolutionary improvement has been made. After all, the time when surgical robots with artificial intelligence, tissue perception and feedback, and self-learning capabilities have yet to come. The current robot-assisted surgery system is just a more dexterous laparoscopic operation device. We look forward to revolutionary technological breakthroughs in the future.

## Comments about robotics technology at this stage

Laparoscopic surgery was always compared with traditional open surgery during its development, the former presented better results in minimally invasive procedures and accelerated patient recovery for benign diseases, but it remained controversial in malignant tumor surgery. Especially in laparoscopic surgery for biliary tract tumors, an improper operation can easily lead to tumor widespread. Currently, robotic-assisted surgery is also gradually expanding its surgical indications, covering almost all laparoscopic procedures that have been carried out so far. Therefore, researchers conducted large-scale multi-center randomized controlled studies to compare robotic surgery to laparoscopic surgery. Because robotic-assisted surgery is a relatively new technology with low prevalence, most of the pre-existing studies concluded non-inferior or even negative results of certain surgeries, such as cervical cancer surgery. The latest International Expert Consensus on Minimally Invasive Anatomic Hepatectomy (Expert Consensus Guidelines: How to safely perform minimally invasive anatomic liver resection) believed that robot-assisted surgery has not yet obtained sufficient evidence of its advantages in hepatectomy (12,13). Although some laparoscopic surgeries such as laparoscopic pancreaticoduodenectomy can be almost perfectly performed by specialized hepatobiliary and pancreatic centers, robotic-assisted surgery has pronounced advantages in small space operations when performing pancreaticojejunostomy, bile duct reconstruction and blood vessel reconstruction, etc. (14-16). Meanwhile, it is undeniable that robotic surgery has a relatively higher cost, which should be taken into reasonable consideration because the paid price also covers the cost of the development of medical science and technological equipment. As science and technology continue to develop, and with the implementation of the national policy of centralized procurement policy for the localization of robotic-assisted devices, robotic-assisted surgery will become more prevalent so the cost of use will be significantly reduced. Over time, robotic surgery may be compensated in terms of time and cost during the overall treatment process. The cost can be offset by its obvious benefits in certain procedures (such as radical prostatectomy). For most regular surgical procedures, the additional medical cost of robotic surgery does not substantially improve the efficacy and benefit of patients compared with those of laparoscopic surgery. The cost-benefit ratio is the core indicator for evaluating the effect of different surgical treatment efficacy. As the result, although robot-assisted surgery has advantages in certain surgical procedures, it should be used in conjunction with laparoscopic surgery, rather than one replacing the other.

## Avoid deviation in the usage of robotic surgery

All kinds of surgical new technology must follow the general law of development, that is standardization, simplification, and accessibility, otherwise, problems of selection bias and unequal distribution of medical resources will rise. Robotic-assisted surgery is a major advancement in surgical technology, but traditional open surgery and laparoscopic surgery are still the mainstream. It is undeniable that many medical institutions and surgeons expect to join the high-end club of robotic surgery. Some surgeons see this as a sign of improvement in their medical level and are proud of the number of robotic surgeries they have completed. A problem is that when not all surgeons in a department master both laparoscopic and robotic surgery, doctors

must consider how to objectively advise the most beneficial surgical methods to patients, avoiding suggestions based on surgeons' own expertise. Influence from business companies should not be ignored either. Business operation in the field of science and technology is not derogatory, and the development of science and technology itself cannot be separated from business promotions. However, if limitations and indications of the medical technology are ignored during the promotion process, it may ultimately harm the interests of patients and enter the trap of putting the cart before the horse. Different technological methods should be chosen on the need of the patient's condition and surgical planning to avoid extensive use.

To sum up, robotic technology is the one of the development directions in future for minimally invasive surgery. Under the general surgical principles and requirements, the development of robotic surgery and laparoscopic surgery is not contradictory. In fact, they come from the same origin. Laparoscopic technology is easy to promote and readily accessible, and its accumulated experiences from surgical planning approaches and evidence-based medical evidence will continue to provide a strong boost to the development of robotic surgery. At this moment, as a combination of minimally invasive technologies, robotic surgery and laparoscopic surgery have different choices for different cases of surgical requirements. Selection based on the patient's need, adhering to general surgical principles, gathering experiences through practice, and regulating practitioners with guidelines are the priorities in the field of robotic surgery.

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