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EDITORIAL

Robotic surgery: a time of change

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The first robotic laparoscopic surgery procedures date back to the late 1990s, including a series of cholecystectomies performed in Strasbourg using the ZEUS robotic system (Computer Motion, USA) [1]. At the time, this innovative approach was greeted with skepticism in the surgical community: "Why would anyone want to replace a surgeon's hand with a robot?". However, the subsequent history of surgery shows an immense development of robotic surgery, marked by the company Intuitive Surgical, which merged with Computer Motion in 2003, representing one of the biggest success stories in the medical device industry.

Currently, the timing is ideal for new developments after patents held for over 20 years have expired. Accordingly, there are now more than 100 companies worldwide offering robotic systems for all surgical disciplines.

Bianchi et al. [6] present their first case series of robot-assisted left and right hemicolectomies and Raffaelli et al. [2] report their first case series of robot-assisted lateral transabdominal adrenalectomies performed using the Hugo RAS™ system (Medtronic, USA).

These studies have the important worth of highlighting the procedure-specific setup of the operating room for left and right hemicolectomy and transabdominal adrenalectomy, respectively. Specific to the modular Hugo RAS™ system with separate instrument and camera arm carts, detailed instructions on trocar placement, docking angles and tilts of the individual robotic arms are reported, and patient and team positioning are illustrated.

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Both institutions are already high-volume robotic centers, and the involved surgeons have been specially trained on the new platform to ensure safe implementation. During the right and left colectomies for colon cancer, Bianchi et al. report a mean docking time of 8 min, and console times ranged from 255 to 264 min [6]. No critical alarm was encountered with the system, and no intraoperative complication or conversion occurred. With a minimum trocar distance of 8 cm, few low-priority alarms due to external clashing were encountered during the procedures, allowing the surgical steps to continue quickly, without affecting the total operative time. Similarly, after establishment of a robotic adrenalectomy program using the daVinci system (Intuitive Surgical, USA) in their department, 23 years after the first report of laparoscopic adrenalectomy assisted by the ZEUS AESOP system, Raffaelli et al. introduced a new device into the toolbox of robotic adrenal surgery [2]. A median docking time of 5 min (range: 5–8) and median console time of 55 min (range: 29–108) show the expert level of uneventful procedures and outcomes, without device-related adverse events.

As each robotic system has its specific characteristics, one template for the "introduction of robotic surgery" is no longer sufficient. Robotic surgery experts collaborate with surgical robotic system manufacturers to provide procedure-specific guidance, driving the surgeons starting their practice with a new robotic system to the optimized set up of each system for safe implementation. Device-specific technical and procedural training and preparation are the basic keys to safe and successful introduction of any new device into the operating room. The IRCAD France training center, therefore, offers dedicated courses for robotic surgery, covering a wide range of currently available robotic systems for laparoscopic and thoracoscopic surgery. As example, we have demonstrated the feasibility of robotic posterior retroperitoneoscopic adrenalectomy using the Versius® Surgical Robotic System (CMR Surgical Ltd, United Kingdom) [3] with positioning of the three subcostal ports adopted from the approach introduced and standardized by Professor M.K. Walz [4]. Challenged by the proximity between the trocars in this setup, some instrument arm collisions occurred, which were solved by repositioning the robotic arm joints [3].

The two papers concerning the application of the Hugo system in colorectal surgery and in transabdominal adrenalectomy are exemplary for the safe introduction of a new system. They are witness for the evolution and competition that will take place in the field of surgical robotics. This kind of competition is of course ideal for the patient, as it inevitably stimulates research and development in order to have the smartest robot that not only integrates the image, but also may enable, in the next future, semi-automatic or even fully automatic operations. The power of artificial intelligence integrated into robotics as a guidance system will also provide warnings in case of deviation from procedure-specific international recommendations and standards.

This type of robotic system for minimally invasive surgery is essentially for laparoscopic surgery. The parallel progress of endoluminal surgery will be accelerated through the use of flexible robots, especially as artificial intelligence diagnostic systems allow increasingly early diagnosis of tumors that are often invisible to the eye of the gastroenterologist or surgeon. It is inevitable that tomorrow's interventions on all tumors of the alimentary tract, due to their very early detection, will be carried out by use of flexible endoluminal robots [5]. At the same time, new robotic systems are being developed for percutaneous surgery, which is certainly the future for small tumors in the liver and lungs.

Parallel advances in communication systems, notably 5G today and 6G tomorrow, will make it possible to democratize and spread the application of telemedicine to surgery, in which IRCAD was a pioneer with the Lindbergh operation carried out in 2001 between New York and Strasbourg. Such connectivity between experts will shorten the learning curve in the interest of any patient. With the growing availability of a variety of robotic systems and adapted funding strategies, robotic surgery is becoming more and more important. In this way, the surgical community can shape the future of minimally invasive surgery worldwide with the support of the jointly developed and provided advanced instrumentation in collaboration with industrial partners.

Data availability Not applicable.

Declarations

Conflict of interest JM has a consultant agreement with KARL STORZ, and BS has a consultant agreement with CMR Surgical and Intuitive Surgical. IRCAD partners are Intuitive Surgical, Medtronic, KARL STORZ, CMR Surgical, and ENDOQUEST Robotics.

Research involving human participants and/or animals, and Informed consent Not applicable.

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