Robotic ultrasound and ultrasonic robot

Jintao Guo, Hongyi Li[1], Yunliang Chen[2], Peng Chen[3], Xiang Li[4], Siyu Sun
Endoscopy Center, Shengjing Hospital of China Medical University, [1]CEO, Shangxian Micro Invasive Medical Equipment Co. Ltd, Shenyang, Liaoning Province, [3]General Robot Technology Co. Ltd, CTO, Shenyang, Liaoning Province, [2]Sonoscape Medical Corp., R&D Center, Technical Director, Shenzhen, Guangdong Province, [4]Chief Scientist, Acoustic Life Science R&D Center, Co. Ltd., Shanghai, China

The application of robots in the diagnosis and treatment of diseases is gradually increasing every year. Among them, the number of surgeries performed using the da Vinci Robotic Surgical System is growing at 15% per year, which is not due to the increase in the total number of surgeries performed worldwide, but due to the fact that some conventional surgical procedures have turned to robotic surgery, indicating that the da Vinci robot has its own attractiveness.

The da Vinci Robotic Surgical System is an advanced robotic platform designed to perform complex surgical procedures through a minimally invasive approach. Simply put, It is an advanced laparoscopic system. It increases the angle of view, reduces hand tremor and allows surgical procedures to be performed on target organs at different angles due to its "EndoWrist" instrument that is more flexible than the laparoscope. It is smaller than the human hand and can perform surgeries in narrow spaces. The da Vinci surgical robot enables surgeons to perform surgeries in a relaxed work environment, thus reducing fatigue and allowing surgeons to focus better. Moreover, it also reduces the number of participating surgeons.[1-5]

Meanwhile, the application of robots in the diagnosis of diseases has also been reported in previous studies. The da Vinci surgical robot improves the surgical accuracy by increasing the surgical resolution. Similarly, the diagnostic robot also improves the objectivity and accuracy of diagnosis by avoiding interference due to subjective factors.

Ultrasonography offers many advantages for medical imaging; however, a lack of trained sonographers in remote communities limits access to sonography for many patients. As a result, many patients have to travel, or be transported, to secondary and tertiary care centers, which often delay diagnosis and subsequent treatment, burden patients and their families, and increase costs. The study conducted by Adams *et al.*[6] who used a telerobotic ultrasound system (BK Ultrasound) for adult abdominal sonography showed that 92% of organs visualized on conventional examinations were sufficiently visualized on telerobotic examinations. Five pathological findings were identified on both telerobotic and conventional examinations: three findings were identified using only conventional sonography and two findings were identified using only telerobotic sonography. There is no significant difference between the two modalities in measurements of the liver, spleen, and diameter of the proximal aorta; however, telerobotic assessments overestimated the distal

Access this article online

Quick Response Code:

Website: www.eusjournal.com

DOI: 10.4103/eus.eus_69_18

How to cite this article: Guo J, Li H, Chen Y, Chen P, Li X, Sun S. Robotic ultrasound and ultrasonic robot. Endosc Ultrasound 2019;8:1-2.

Address for correspondence
Dr. Siyu Sun, Endoscopy Center, Shengjing Hospital of China Medical University, No. 36, Sanhao Street, Shenyang 110004, Liaoning Province, China. E-mail: sunsy@sj-hospital.org
Received: 2018-10-06; **Accepted:** 2018-12-26; **Published online:** 2019-02-14

aorta, common bile duct diameters and underestimated kidney lengths ($P < 0.05$). Robotic enucleations can also be performed through a 12-5 MHz robotic probe (BK Drop-In 8826). In the study of Gunelli *et al.*,[7] 22 robotic enucleations on <3 cm renal tumor were performed through a robotic probe. Once the kidney had been isolated from the adipose capsule at the site of the neoplasia, the exact position of the lesion could be easily identified. No complications due to the use of the ultrasound probe were observed.

EUS is a combination of endoscopy and ultrasonography. It was initially used in the diagnosis of gastrointestinal submucosal tumor, gastrointestinal tumor, and pancreaticobiliary disease. In recent years, EUS is increasingly used in the preoperative precision diagnosis and treatment alongside the continuous upgrading of endoscopic instruments. Its importance is self-evident as preoperative precision diagnosis and pathological evaluation often provide clinical guidance to physicians in developing a reasonable treatment regimen. Fine-needle aspiration (FNA) for mediastinal, abdominal, and pancreatic lesions allows minimally invasive preoperative pathological diagnoses, but it poses certain difficulties as the material quality and incidence rates of complications, such as hemorrhage and infections, are affected by the experience and proficiency of endoscopists. Different tissues have different hardness, and therefore, the puncture strength is also different. To select the puncture strength is hard for beginners. EUS-guided treatments, including pancreatic pseudocysts drainage, chemoradiotherapy for advanced pancreatic cancer, biliary drainage for malignant biliary obstruction, as well as more advanced treatments, such as EUS-guided transduodenal gallbladder drainage and gallbladder-preserving cholecystolithotomy and gastrointestinal anastomosis, require experienced and highly skilled endoscopists, as well as precise operation, which greatly limit the development of these minimally invasive therapeutic approaches. Therefore, it is necessary to develop an artificial intelligence-assisted EUS surgical robot.

The EUS surgical robot enables intelligent, accurate, and efficient diagnoses and treatment of gastrointestinal diseases. Besides, it has also overcome technical issues faced with virtual reality-assisted interventional endoscopic navigation and high-precision ejection device. This technology will further reduce the incidence rate of complications as it will greatly improve the technical success rate and safety of FNA through precise observation of the anatomical structure of organs surrounding the gastrointestinal tract and precise positioning. Therefore, it will contribute to the establishment of next-generation industrial standards for EUS instruments. Ultrasonic robot will be the future of EUS.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Crippa S, Zerbi A, Boninsegna L, *et al.* Surgical management of insulinomas: Short- and long-term outcomes after enucleations and pancreatic resections. *Arch Surg* 2012;147:261-6.
2. Dedieu A, Rault A, Collet D, *et al.* Laparoscopic enucleation of pancreatic neoplasm. *Surg Endosc* 2011;25:572-6.
3. Song KB, Kim SC, Hwang DW, *et al.* Enucleation for benign or low-grade malignant lesions of the pancreas: Single-center experience with 65 consecutive patients. *Surgery* 2015;158:1203-10.
4. Fernández-Cruz L, Molina V, Vallejos R, *et al.* Outcome after laparoscopic enucleation for non-functional neuroendocrine pancreatic tumours. *HPB (Oxford)* 2012;14:171-6.
5. Zureikat AH, Moser AJ, Boone BA, *et al.* 250 robotic pancreatic resections: Safety and feasibility. *Ann Surg* 2013;258:554-9.
6. Adams SJ, Burbridge BE, Badea A, *et al.* Initial experience using a telerobotic ultrasound system for adult abdominal sonography. *Can Assoc Radiol J* 2017;68:308-14.
7. Gunelli R, Fiori M, Salaris C, *et al.* The role of intraoperative ultrasound in small renal mass robotic enucleation. *Arch Ital Urol Androl* 2016;88:311-3.