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EDITORIAL

Robotic endoscopy in gastroenterology: Has it come of age?

In this issue of JGH Open, Kaan and Ho have written an interesting article on the utilization of robotics in gastrointestinal (GI) endoscopy.[1] Headed by Professor KY Ho, this research group from Singapore has been at the forefront of innovations in robotic endoscopy for many years.[2] The authors briefly discussed the historical development of robotic endoscopy; reviewed the current robotic endoscopic platforms; and proposed three highly plausible ways to overcome the low adoption, namely, (i) demonstration of clinical safety and cost-effectiveness of these devices, (ii) widespread availability of training opportunities in using these devices, and (iii) continued identification of new clinical applications for these devices.

A conventional endoscopic instrument excels as a diagnostic tool. Its design allows it to navigate through the winding GI lumen. However, it struggles when performing complex therapeutic procedures. The main reasons are (i) limited degrees of freedom of movement it allows to the instruments that pass through its working channel; (ii) inability to perform one of the most important aspects of surgical resection, that is, tissue retraction and triangulation, in order to achieve optimal exposure of the operating field; and (iii) lack of a stable operating view—the constantly changing endoscopic view of the operating field poses a challenge when performing a complex therapeutic procedure. The robotic endoscopic system was created to address all these issues.

Robotic endoscopy has been in the market for the last couple of decades now. Various robotic endoscopy systems are available for therapeutic endoscopies such as MASTER (EndoMASTER Pte, Singapore), STRAS system (Kark Storz/IRCAD, Europe), Endomina (Endoscopy Tools Therapeutics, Belgium), Scorpion-shaped endoscopic robot (Kyushu University, Japan), ENDOSAMURAI (Olympus, Japan), Direct Drive Endoscopic System (Boston Scientific, Marlborough, MA, USA), ViaCath system (Hansen Medical, Mountain View, CA, USA), etc. Each of these systems comes with its own version of the two mechanical or robotic arms, which are equipped with high degrees of freedom of movement. The movement of these arms is either fully controlled by a robotic mechanism or mechanically maneuvered by traction wires. The availability of accessory channel in some of these systems further enhances its usability.

Despite the initial hype, robotic endoscopy remains largely underutilized in the field of GI endoscopy. There could be many reasons behind this. First, the high setup and maintenance cost would discourage most endoscopy centers from acquiring the device. Second, these robotic endoscopic systems are intended for advanced procedures such as natural orifices transluminal endoscopic surgery (NOTES) and endoscopic submucosal dissection (ESD). Despite its introduction in 2000,[3] NOTES has not gained significant popularity over its minimally invasive surgery counterpart, that is, laparoscopy. Evidence suggested that the NOTES approach may have higher morbidity and complexity over its minimally invasive surgical approach.[4] ESD, despite being highly effective in the oncologic resection of early cancer, is also not popular outside certain Far Eastern countries such as Japan, Korea, and China. One obvious reason is the low incidence of upper GI cancers outside these countries, let alone the diagnosis of early upper GI cancer that allows endoscopic resection such as ESD.[5] Traditionally, the learning of the ESD procedure, which is well known for its slow learning curve, starts with suitable upper GI lesions and moves on to more difficult lower GI lesions. The lack of upper GI cancers outside this region indirectly prevents others from mastering the ESD procedure and renders the ESD procedure unpopular. Of course, looking at this issue from an opposite angle, the availability of a highly advanced robotic endoscopic system could be a potential game changer, capable of reviving the NOTES procedure and popularizing ESD worldwide. Third, data are still lacking with regard to the usability of these systems to treat lesions in anatomically difficult locations. It is widely perceived that the setup and manipulation of a robotic endoscope can be more labor-intensive than routine endoscope, and hence, despite its advantage in dissection, the skills set and requirement in training for endoscopists to master this new robotic approach requires further exploration.

To the gastroenterologist, robotic endoscopy system is too much of an "overkill" to resect day-to-day small lesions. To the GI surgeon, open or laparoscopic resection is the preferred alternative to salvage incomplete resection after endoscopic resection. Perhaps robotic endoscopy system will find its true match with minimally invasive surgeons or "highly invasive" gastroenterologists who perform complex luminal or transluminal procedures.

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