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LETTER TO THE EDITOR

Challenges and Opportunities in Thoracic Robotic Surgery

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ABSTRACT

Robotic surgery is a platform for minimally invasive thoracic surgery with similar general advantages as in VATS (Video Assisted Thoracic Surgery) including small incisions, faster recovery, minimal blood loss and shorter hospital stay. The extra advantages of using a robotic platform in thoracic surgery include a three-dimensional surgical view, elimination of physiological tremors, and enabling surgical manipulation in a natural orientation because of the presence of forceps that move in the same manner as human wrist joints. These advantages allow more complex procedures to be performed safely and easier technically, thus leading to better outcomes and improvement in the overall result. As a new advance in thoracic surgery, it has challenges that may become the reason why this technique has difficulty being adopted by a number of surgeons including cost, advancement in VATS technique and instrumentation. Despite the challenges, robotic thoracic surgery offers the platform for the expansion and improvement of thoracic surgery. Development in instrument technologies and designs, in addition to progress and interest in other futuristic technology, are notable opportunities for thoracic robotic surgery.

Keywords: Thoracic Surgery, Robotic Surgery

Introduction

Robotic surgery is a platform for minimally invasive thoracic surgery with similar general advantages as in VATS (Video Assisted Thoracic Surgery) including small incisions, faster recovery, minimal blood loss and shorter hospital stay. In addition to successfully many short-term and long-term benefits in safety and oncologic efficacy¹, minimally invasive thoracic surgery also demonstrates similar long-term survival rates in early-stage cancer and increased tolerance for adjuvant chemotherapy².

The extra advantages of using a robotic platform in thoracic surgery include a three-dimensional surgical view, elimination of physiological tremors, and enabling surgical manipulation in a natural orientation because of the presence of forceps that move in the same manner as human wrist joints³. These advantages allow more complex procedures to be performed safely and easier technically, thus leading to better outcomes and improvement on the overall result eg pulmonary sleeve resection⁴, mediastinal lymph nodes dissection⁵, pulmonary resection in inflammatory and infective disease⁶ as well as large mediastinal tumor⁷. Considering robotic platforms as a new advance in thoracic surgery, it has challenges that may become the reason why this technique has difficulty being adopted by a number of surgeons. However, oversight of this advanced technology as part of the surgical armamentarium would be a disadvantage to encourage the progression and development of thoracic surgery.

Challenges

The main challenge in starting the robotic surgery service in any centre would be the financial burden incurred in acquiring the technology itself. However, the cost of robotic surgery is not just the purchasing value but also includes the consumables items that come with each robotic procedure, in addition to capital and maintenance for robotic equipment eg sterilisation, storage, etc⁸. This issue is more pressing, especially in the country where the surgery performed by the robotic platform is not covered by the insurance system. For instance, prostatectomy in Malaysia is the only robotic surgery procedure listed in the most insurance policy that allowed it to be reimbursed. Thus, the surgical cost of robotic surgery other than being mentioned has to be covered by the patients themselves. The successful centres providing robotic surgery services usually have good funding systems and dedicated teams that are able to do a sufficient number of cases thus reducing the overall cost and improving overall outcome⁹.

Video Assisted Thoracic Surgery (VATS) has been established as a minimally invasive surgical approach in thoracic surgery from a radical start in the 1990's¹⁰. However, thoracic surgery in robotic platforms came later and was only performed in very few dedicated centres¹¹. Over the years, rapid progression in VATS has evolved from multiple ports (2-4 ports) to uniport (Single Port). Uniportal VATS (UniVATS) is a component of the development of VATS¹² which initially started by utilizing a uniportal approach for minor procedures (e.g., pneumothorax and wedge resections)¹³ (21). In the meantime, thoracic surgeons have been able to perform increasingly complex thoracic procedures and have included this method as an extension of the conventional three or two-port VATS technique^{14,15}. Apart from superior in cosmesis, UniVATS results in lower levels of postoperative pain and faster patient recovery because of the single incision which decreases invasiveness compared to multiple ports as in a robotic platform. The safety and feasibility of the UVATS approach have been confirmed by the collected clinical experience reported from multiple centres worldwide^{16,17}. At the time of this writing, a small number of surgeons have performed Uniportal Robotic Assisted Thoracic Surgery (URATS)^{18,19}, however, it is still at the early stage and can only be performed by the super specialist dedicated team in selective centres with the available system and can be valued as a novel idea²⁰.

In the limitation of easy access to a robotic surgical system, new devices have been developed to offer a valid alternative for VATS instruments that mimic robotic arms. Articulated instruments eg ArtiSential²¹, Intuitool²², Flexdex²³ and Radius Surgical System²⁴ offer additional options for surgeons. These wristed instruments differ from conventional laparoscopic instruments owing to a wrist-like mechanism at the tip, which reproduces the movements of the surgeon's hands, regaining more movement degrees. These instruments offer much cheaper versions similar to robotic arms and are able to be used in paediatric patients²⁵.

Opportunities

Using the robotic platform in thoracic surgery is a step further in advanced surgical technique. It is well-proven and had been demonstrated well by literature. Performing surgery with a robotic platform has a number of advantages including excellent 3D visualisation, physiological tremor elimination, and dexterity that more superior in accuracy to perform some surgeries that are not feasible with the manual thoracoscopic technique currently available.

Having the robotic procedure in place, allows the development and progress in respective surgery to be more advanced and accelerated, associated with improvement in intraoperative and postoperative results, thus better overall outcomes for the patients¹¹.

The development of smaller thoroscopes, high-definition charge-coupled device cameras, 3D vision systems and variable wide viewing angle endoscopes have further refined minimally invasive thoracic surgery, making it safer, more easily adoptable and less invasive²⁶. These ongoing developments are the plus points for surgical robotic technology to improve and further advance. In addition to progress and interest in other technologies eg Artificial intelligence²⁷ Virtual

Reality²⁸, nanorobot technology ^{29, 30}, and augmented reality³¹, it is not impossible for those technologies to merge and combine with robotics surgery platforms and perform thoracic surgery in the future.

Conclusion

The evolution of thoracic surgery over the decades has demonstrated that more treatment options and surgical approaches could be offered for the needed patients and related stakeholders. The future of the robotic surgery platform in thoracic surgery predictably will be successful in the region with adequate resources and support, however rather uncertain to progress in the region with limited interest and basic foundation in the respective technology.

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