Single site robotic surgery for thoracic diseases

Kook Nam Han, Hyun Koo Kim, Young Ho Choi

Department of Thoracic and Cardiovascular Surgery, Korea University Guro Hospital, Korea University College of Medicine, Seoul, Korea

Correspondence to: Hyun Koo Kim. Department of Thoracic and Cardiovascular Surgery, Korea University Guro Hospital, Korea University College of Medicine, 97 Guro-donggil, Guro-gu, Seoul 152-703, Korea. Email: kimhyunkoo@korea.ac.kr.

Abstract: Robotic-assisted thoracic surgery has gained widespread acceptance for various thoracic diseases owing to its surgical accuracy. With recent advances in robotic-surgery devices, the single-site approach has become possible in robotic surgery. Herein, we report the case of single-site robotic surgery for mediastinal tumors by the thoracic approach. We performed robotic surgery with single-site instruments in a 50-year-old male with a mediastinal tumor in the anterior mediastinum. The instruments used were an 8.5-mm endoscope, 5-mm curved non-wristed instruments, and an accessory tracer on the 3-cm-diameter single-port device for the single-site robotic system. The potential benefits of this approach to thoracic surgery are better surgical accuracy and the enhanced operative field of robotic surgery, as well as the potential benefits of single-port thoracoscopic surgery.

Keywords: Robotic surgery; single port thoracoscopic surgery; mediastinal tumor; single site robotic surgery

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Introduction

Robotic-assisted surgery, including esophageal (1), mediastinal tumor (2), and lung surgery (3) is a widely accepted surgical approach for thoracic diseases in the current era. Robotic surgery was originally developed to overcome the limitations of current minimally invasive surgical techniques and to enhance the surgeon's capabilities in performing surgery (4). Compared with conventional minimally invasive surgery, robotic surgery can be performed by the surgeons with better control of the surgical instrument and wrist-articulating devices and under an enhanced three-dimensional surgical view. The robotic system filters the natural hand tremor and enables the surgeon to perform the procedure precisely in a narrow surgical field that is not easily accessible by open surgery (5).

Since its introduction in the mid-1990s, the robotic system has been continuously upgraded to include innovative techniques and devices, such as a near-infrared imaging system, single-port access, new staplers, energy instruments, clip applier, etc. The single-site® robotic system is especially designed for single-port surgery with a five-hole port for an 8.5-mm endoscope, a 5- or 10-mm device, and a gas insufflation port (*Figure 1*). The single-site port can be applied through an incision of at least 15 mm, and the main system automatically re-associates the device configuration which crossed cannula through the port. Currently, only 5-mm semirigid devices other than needles can be used in single-site robotic surgery. Articulating functions mimicking those of wrist articulating devices are not available on single-site surgical systems. In the field of thoracic surgery, single-site robotic surgery might be performed for a mediastinal tumor located in a narrow surgical field. The potential advantages of using a single-site robotic system compared with the pre-existing single-port thoracoscopic approach are less conflicts of instruments and the non-requirement of a surgeon in the operative field to handle the instrument through a small incision. In this paper, we report one of our experiences of single site robotic thymectomy in patient with a thymic cyst anterior mediastinum.

Indications for surgical treatment

Currently, a single-site robotic approach can be offered to selected patients with mediastinal tumors such as neurogenic tumor, early-stage thymoma, or thymic cyst.

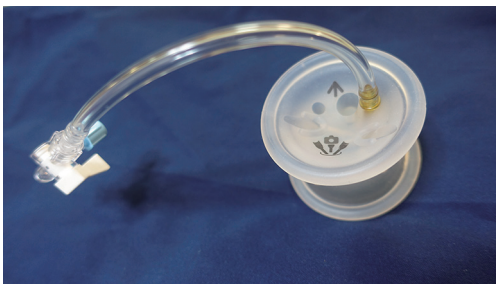

Figure 1 Single site port device for robotic surgery.

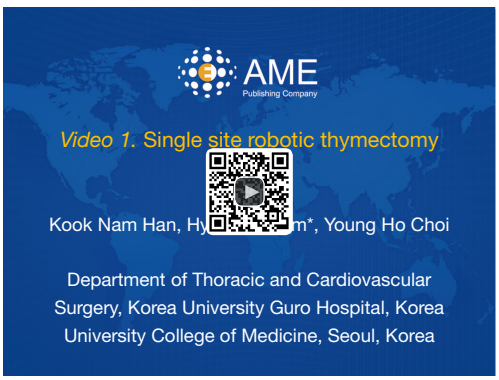

Figure 2 Single site robotic thymectomy (6).
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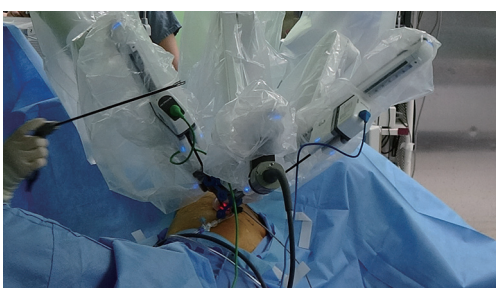

Figure 3 Operative field.

Surgical technique

We present a case in which we used single-site robotic surgery for a mediastinal tumor. A 50-year old male with mediastinal cystic tumor at anterior mediastinum was scheduled for robotic surgery using a single-site robotic system (*Figure 2*). The patient was intubated with a double-lumen endotracheal tube and positioned in a 30° semi-lateral decubitus position. We made a 3-cm incision at the 5th intercostal space, at the midaxillary line. During the operation, we used a single-site port and trocar for insertion of an 8.5-mm endoscope and 5-mm semirigid robotic instruments (*Figure 3*). CO_2 gas was insufflated to deflate the lung, and we inserted small rolled gauzes to control hemorrhage and expose the surgical field. Thymic tissue was dissected and vessels from thymic or innominate vein were secured with vascular clips. After resection, we removed the mass through the incision for the single-site port and inserted a chest drain through the incision. The mass was pathologically characterized as a thymic cyst.

Results

The mean operation time was 69 minutes. Chest drain was removed at postoperative 1 day and the patient discharged at postoperative 2 days without complication.

Discussion

The robotic system for minimally invasive surgery is capable of overcoming the current limitations of thoracoscopic or open surgery (4). Furthermore, the robotic surgical technique is constantly evolving and being upgraded to overcome the limitations of current single-port surgery for various diseases (7). Currently, the use of a single-site robotic surgical system is feasible for cholecystectomy (8,9) and gynecologic surgery (10) and other diseases, however, there is few reports on its use in thoracic surgery. The current single-site robotic system is not appropriate for esophageal or lung surgery because it needs more space for instrument movement; it is more suitable for procedures in narrow spaces. In this study, we evaluate the utility, feasibility, and safety of single-site devices for robotic surgery in selected patients with thoracic diseases. However, articulating device, energy device, and stapler are not available in our single-site robotic system and the conflicts of instruments need to be improved in future systems. Another concern that needs to be resolved is the high cost of the new robotic system.

In conclusion, robotic surgery with single-site devices for a mediastinal tumor is safe and feasible. The development of an improved robotic system for the single-port approach could widen the applicability and improve the success rate of this approach for thoracic diseases and add to the benefits of current single-port thoracoscopic surgery.

Tips and tricks

❖ Single-site robotic surgery is a feasible procedure in

selected patients with mediastinal tumors.

- ❖ Our experience showed that the use of a single-site robotic system for thoracic diseases might be a feasible surgical option for procedures in narrow surgical spaces such as the mediastinum.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this study and any accompanying images.

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