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# Evolution of minimally invasive thoracic surgery

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In the realm of surgery, the pursuit of less trauma is an undying desire shared by both surgeons and patients alike. In the early 1990s, the development of video-assisted thoracoscopic surgery (VATS) had pushed the envelope of thoracic surgery further into a new era of minimally invasive thoracic surgery (MITS). In 2004, Rocco reported the first case of uniportal VATS pulmonary wedge resection (1). In 2011, Dr. Diego Gonzalez-Rivas from Spain further developed the technique and successfully applied it in lobectomy and systemic lymphadenectomy (2,3). As of today, uniportal VATS is ready to take on almost every task as other MITS approaches would do, including bronchial sleeve resection, angioplasty, carinal resection and reconstruction as well as tracheal surgery.

In comparison to conventional multi-port VATS, uniportal VATS has several obvious advantages: (I) postoperative pain is reduced as the incision only involves one intercostal nerve and no trocar is needed, although this has not been confirmed by large randomized trials; (II) the “eyes above” vision is more natural and is close to that provided by an open thoracotomy, which facilitates transition from open thoracotomy; (III) the exposure of the upper mediastinum is better as the camera is placed superiorly, which is advantageous in the downward dissection in fissureless upper lobectomies.

However, the unique setting of uniportal VATS also determines its limitations in the following aspects: (I) the different visualization from multi-port VATS would take some time for the surgeons to adapt to the new camera position; (II) fencing of the instruments and camera is more pronounced because all are placed in the utility incision; (III) use of the stapler is more difficult as it can only access

through the utility incision, especially in the management of upper lobe veins or left upper lobe bronchus in a fissureless lobectomy. In the latter case, using a curved-tip stapler after adequate dissection of hilar structures would be a possible solution. At times, adding an extra port can be the last resort if adherence to uniportal VATS is unsafe or unfeasible.

Compared to VATS, robot-assisted thoracoscopic surgery (RATS) has a number of additional improvements which include: (I) high-resolution, zoomed three-dimensional (3D) vision of the operating zone; (II) steady instrumentation with filtered tremor; (III) excellent intrathoracic dexterity with 360° articulation, particularly suitable for bronchial or vascular reconstruction (4-6). Currently, most RATS features three to four ports. The two-port RATS we routinely use does not simply mean a reduction in the number of incisions. Rather, it combines the advantages of RATS and uniportal VATS and exhibits huge differences in intraoperative visualization and manipulation.

In two-port RATS, the camera is moved upward to the utility port, which provides a similar vision to that of uniportal VATS, ensuring a superior exposure of upper mediastinum. Furthermore, owing to the additional accessory port, part of the difficulties of uniportal VATS can be addressed, including less instrumental fencing and increased flexibility in the stapling angulation for the management of vessels and bronchi.

The two-port RATS is relatively easier for surgeons who are familiar with uniportal VATS to be adapted with. The length of utility incision is usually 4 cm, with a 30° camera placed in the posterior end and the other arms in the anterior end and the accessory port, respectively. The assistant will stand in front of the patient and perform lung

retraction and suctioning through the utility incision. This can sometimes be challenging due to the blockage and movement of the hefty robotic arms. The authors found that the 30° camera facing up would allow more room for the operation of the assistant. The stapler may either choose to enter anteriorly or posteriorly, with temporary removal of the respective arm. Making use of the additional port, there will be a robotic arm dedicated in the delicate retraction and exposure in the target area. Dissection of the vital structures and lymph nodes is thus far more convenient and complete compared to uniportal VATS.

In our experience, compared to RATS with three or four ports, two-port RATS doesn't require a change in the habit of visualization for surgeons who previously perform uniportal VATS. Therefore, with the advantage of smoother learning curve, two-port RATS is recommended as the first step in the transitioning from uniportal VATS to RATS.

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### Footnote

*Conflicts of Interest:* The authors have no conflicts of interest to declare.

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