Advances in Uniportal Video-Assisted Thoracoscopic Surgery
Pushing the Envelope

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KEYWORDS

• Uniportal • New technology • Nonintubated lung resection • NOTES • Uniportal sleeve • 3D camera

KEY POINTS

- The potential benefits of a direct view, anatomic instrumentation, better cosmesis, and potential less postoperative pain have led uniportal video-assisted thoracic surgery to become of increasing interest worldwide.
- The geometric characteristics of the uniportal approach enable expert surgeons to perform complex cases and reconstructive techniques, such as broncho-vascular procedures or carinal resections.
- We can expect more developments of subcostal or embryonic natural orifice translumenal endoscopic surgery access, evolution in anesthesia strategies, and cross-discipline imaging-assisted lesion localization for uniportal procedures.
- The further development of modern 3-dimensional image systems, single-port robotic technology, and wireless cameras in awake or nonintubated patients will probably play an important role in the near future.

Video content accompanies this article at http://www.thoracic.theclinics.com/

INTRODUCTION

Uniportal video-assisted thoracic surgery (VATS) has a history of more than 15 years[1] and, more recently, has become an increasingly popular approach to major pulmonary resections.[2,3] The potential advantages of reduced access trauma, less pain, and better cosmesis, together with patient demand, have seen uniportal VATS spread across the world.[4,5] The early period of uniportal VATS development was focused on procedures such as sympathectomies, pleural deloculations, mediastinal biopsies, bullectomies, and wedge resections for pulmonary nodules.[6–8] The new era of uniportal VATS started in 2010 with the development of the technique for major pulmonary resections.[2] Since then, we have expanded the

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application of this technique to a variety of minimally invasive thoracic surgeries.[9–12] The experience we acquired with the uniportal technique during the past years as well as technological improvements have contributed to the increased adoption of indications for uniportal VATS resections. In only a period of 5 years, experts have been able to apply uniportal VATS technique to encompass more complex procedures such as segmentectomies,[13,14] advanced cases after induction therapies[11] or pneumonectomies,[15,16] and even to challenging procedures including bronchial sleeve,[17–19] vascular reconstructions,[12,20] carinal resections,[12] or double sleeves.[12,21,22] The large number of surgical videos posted on the Internet, live surgery events, and experimental courses have also contributed to the rapid expansion of uniportal VATS during the past years. Training and adoption of the technique in more thoracic departments and outcome reports for long-term survival and oncological benefits are necessary to reinforce the worldwide adoption of this approach. The 5-year overall survival and disease-free survival in our series of patients with stage IA of non–small-cell lung cancer (NSCLC) was 90% and 75%, respectively.[23]

As with any recent approach for lung cancer treatment, safety and efficacy are paramount. Studies so far have shown the uniportal VATS approach to be at least as safe and effective as conventional VATS.[24] Postoperative pain has been shown to be less following uniportal VATS lung resection when compared with multiportal VATS,[9] and current data show at least equivalent disease-free survival at intermediate follow-up for patients with early-stage NSCLC who received uniportal VATS surgery.[25] We believe it is important to minimize the surgical aggressiveness, especially in patients with advanced-stage lung cancer in whom the immune system is weakened by the disease or by induction treatments. The minimally invasive surgery represents the least aggressive form to operate lung cancer and the uniportal technique is the final evolution in these minimally invasive surgical techniques.[26]

The main advances of uniportal VATS during the past years are related to improvements in surgical technique and implementation of new technology (better staplers and energy devices, 3-dimensional [3D] and ultra–high-definition view). The experience gained during the past years has allowed refinement of the technique to develop tricks to easily manage the upper lobe vein and bronchus (both being the most difficult structures to divide), to use energy devices for hilar dissection, and to control most of the intraoperative bleeding. The uniportal approach also facilitates the performance of radical lymphadenectomies and reconstructive complex tracheo-bronchial and vascular procedures. Furthermore, the use of a single incision can be combined with nonintubated techniques as well used for major pulmonary resections through a subxiphoid incision.

IMPROVEMENTS IN SURGICAL TECHNIQUE: DEVELOPMENT OF USEFUL TRICKS

Upper Lobe Vein Division

The most difficult structure to divide through a single-incision approach is the upper lobe vein. It is also the most frequent reason for conversion to a multiport approach during the learning curve. The uniportal view facilitates the dissection and division of the upper arterial trunk, usually hidden by the superior vein when we use a conventional thoracoscopic approach. Once the arterial branch is divided, it is important to dissect the vein as distal as possible to optimize passage of the stapler. We recommend encircling of the vein by using a vessel loop for upper lobectomies. Pulling the vein enlarges the space and clears the vision for stapler insertion.

A useful trick to facilitate the passage of the stapler is to insert the curved tip suction device behind the vein. By doing this maneuver, the suction device serves as a guide and the artery is protected when the stapler is inserted (**Fig. 1**, Video 1).

Yang and colleagues[27] used a Foley catheter to guide the endostapler to the right position and Guo and colleagues[28] described a method of intrathoracic vertical overhanging approach to make the placement of the endostapler easier during single-port VATS lobectomy.

The use of the curved-tip stapler technology (Covidien, Mansfield, MA) clearly facilitates the passage around the artery and superior pulmonary vein through a single incision. The new vascular powered staplers, more narrow (7 mm) and with a curved tip (Ethicon Endo-Surgery Inc, Cincinnati, OH) or the 80° angulated 5-mm curved-tip staplers (microCutter Xchange 30; Cardica, Inc., Redwood City, CA, USA) are an excellent option for the uniportal approach and especially useful for the management of the upper vein.

If, despite using these tricks, there are still difficulties in dividing the vein, then the use of a conventional TA stapler (2 cartridges) is an easy alternative and a valid option, especially useful during the learning curve.[29] Another option is to approach the vein with the angulation of the tip of the stapler oriented to the fissure (**Fig. 2**). If the fissure is complete, the passage is easier with this orientation. In case of incomplete fissure,