

Technological aids in uniportal video-assisted thoracoscopic surgery

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Abstract: With the evolution of uniportal video-assisted thoracoscopic surgery (VATS), the technological aids have come to help skill surgeons to improve the results in thoracic surgery and feasible to perform a complex surgery. The technological aids are divided into three important groups, which make surgical steps easy to perform, besides reducing surgical time and surgical accidents in the hands of experienced surgeons. The groups are: (I) conventional thoracoscopic instruments; (II) sealing devices using in uniportal VATS; (III) high definition cameras, robotic arms prototype and the future robotic aids for uniportal VATS surgery. Uniportal VATS is an example of the continuing search for methods that aim to provide the patient a surgical cure of the disease with the lowest morbidity. That is the reason companies are creating more and new technologies, but the surgeon have to choose properly and to know how, when and where is the moment to use each new aids to avoid mistakes. The future of the thoracic surgery is based on evolution of surgical procedures and innovations to try to reduce even more the surgical and anesthetic trauma. This article summarizes the technological aids to improve and help a thoracoscopics surgeons perform a uniportal VATS feasible and safe.

Keywords: Uniportal VATS; VATS instruments; technological aids surgery; thoracic surgery; advance uniportal VATS; robotic arm

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Introduction

With the advances in the field of thoracoscopic surgery, all thoracic procedures can now be performed by uniportal video-assisted thoracoscopic surgery (VATS). Recent improvements in surgical devices and the experience gained in VATS enable complex surgeries for advanced tumor stages to be performed safely. VATS is the emerging technique in the modern thoracic surgery practice (1). For a surgeon to be able to perform a uniportal VATS Lobectomy safely and successfully, proper steps must be

ensuring. Multiple key maneuvers and tricks are inherent to the uniportal approach (2). This article summarizes the technological aids to improve and help a thoracoscopic surgeons perform a uniportal VATS Surgery.

Main text

In the hands of skilled surgeons, the technological aids in uniportal VATS are important for thoracic surgeries of any level of complexity. Among these technological



Figure 1 Uniportal thoracoscopic instruments: the video shows how new instruments with curves facilitate the accomplishment of the dissection and vascular stapling, in the realization of segmentectomy right S1 uniportal VATS (4). VATS, video-assisted thoracoscopic surgery.

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aids, there have been created energy devices for vascular sealing and dissection of tissues that help to decrease the time of dissection and provide greater comfort to the surgeon, as well as resulting in lower risk of bleeding and/or complications. These aids are important to help the completion and to improve the surgical technique and obtain better results for the patient. So we have decided to show how these aids influence in an important way the realization of the following procedures that are performed by surgery uniportal VATS.

Thanks to the recent improvements in video-assisted thoracoscopic techniques (VATS) and anesthetic procedures, a great deal of complex lung resections can be performed avoiding open surgery. The experience gained through VATS techniques, enhancement of the surgical instruments, improvement of high definition cameras and avoidance of intubated general anesthesia have been the greatest advances to minimize the trauma to the patient (3).

Uniportal VATS can also be implemented as an approach not only for standard cases but for advance tumors and for vascular and bronchial reconstruction (2), Thanks to the implementation and development of new technological aids, which facilitate the execution and improvement of the thoracic surgeon's expertise in uniportal VATS.

The uniportal VATS surgery has since gained popularity around the world with more and more thoracic surgery centers adopting this technique over the standard multi-port VATS approach.

The reason for adopting this technique throughout the

world has not been because of its more appealing cosmetic result, but rather most probably because of its minimal invasive, surgical safety, reduced post-operative pain and shorter length of stay. These quality measures are indicators of greater efficacy compared with the standard approach.

Among the technological aids that surround the uniportal VATS surgery we can define as any new equipment or instrument that helps or contributes in an easy and efficient way to perform any surgical procedure in surgery.

Further development of new technologies probably will focus on sealing devices for all vessels, fissures, refined staplers and instruments, improvements in 3D systems or wireless cameras, and robotic surgery (3).

The technological aids in VATS surgery will be presented in three different groups.

Conventional thoracoscopic instruments

The evolution of the instruments for performing a uniportal VATS surgery is evident by the creation of new dissection clamps, suckers, scissors and many more instruments. Such these have been modified by adding curves throughout their length, this allows for an easy and ergonomic dissection for the surgeon, thus avoiding inadequate movements, postures and unnecessary surgical steps to complete any procedure (*Figure 1*).

Instruments with distal and proximal articulation: a complete set of instruments such as the one show allows the surgeon to do the surgery without having troubles with the incision, since only the fixed part of the instrument is in contact with it during dissection

Reticulated and curved staplers: the angle of the staplers makes it easy to pass the structure, avoiding tension and unnecessary risks during vascular dissection (*Figure 1*).

Vascular clips (click aV Grena): for vessel when the angle for vascular division is difficult, also for small segmental branches of the pulmonary artery that can be safely divided using this clips (*Figure 1*).

As we show in the video, the vein was distally dissected to expose the apical segment, which was ligated with the endovascular curved stapler, the artery was distally dissected to the upper lobe to expose the segmental branches. So we can use vascular clips on small branches, this saves time and money (5).

Sealing devices using in uniportal VATS

The progress of uniportal VATS surgery is related to the



Figure 2 Sealing devices: the video shows how to perform an advanced instrumentation lymphadenectomy using just electronic device as harmonic and suction (6).

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evolution of energy devices, such as sealing equipment, that these are used not only as tissue dissection also as vascular sealing, which makes avoiding to perform two activities with the same instrument, without the necessity to extract instruments; in this case the ultrasonic devices or Bipolar devices offer precision and stronger large vessel sealing, improved thermal management and large vessel sealing up to and including 7 mm in diameter (*Figure 2*).

The use of the sealing devices help to the surgeon to decrease the use a lot of instruments and make easier to perform an uniportal VATS surgery. These are changing to improve the surgery field. Using curve sealing devices, more safety and precision use.

The ultrasound device HARMONIC® is important for dissection and sealing, for example a lymphadenectomy for lung cancer using only a Suction SCANLAN® and sealing device is an easy and feasible procedure. Improve the operating time and obtain a good clinical result. They permit to keep the operative field clean and avoid unnecessary bleeding from small vessels in fatty tissues or around lymph nodes. During lymph node dissection can avoid lymph leaking after the surgery (*Figure 2*).

High definition cameras, robotic arms prototype and the future robotic aids for uniportal VATS surgery

The field of video-assisted thoracic surgery continues to advance. The advent of the uniportal technique has added a versatile tool for the thoracic surgeon. The arena of minimally invasive surgery is a relatively young field, with

many technological advances still to make an impact in the operating room.

Advances in optics, including 3D cameras, ultra-high definition monitors and ‘retina’ displays, and robotic technologies will all have a dramatic impact on our ability to continue to offer patients safer surgery with less trauma. Optimal equipment can facilitate and made more comfortable the procedure for the surgeon. The ideal equipment necessary to perform a major lung resection includes: 30-degree lens high definition camera thoracoscope: provides a very detailed image and permits the assistant to move the angle of the camera to obtain the appropriate visualization around structures during visualization (7).

The future of the thoracic surgery is based on evolution of surgical procedures and innovations to try to reduce even more the surgical and anesthetic trauma. We truly believe on the use of the uniportal technique combined with future 3D image systems or robotic technology for major pulmonary resections. We understand that the future goes in the direction of digital technology which will facilitate the adoption of single port technique worldwide in the next coming years. The current daVinci robotic technology has been around for over a decade (8).

Despite offering excellent visual feedback and robotic arm dexterity and precision, several ports are still required for the lobectomy (9). Although performing robotic surgery through specialized single-incision laparoscopic surgery (SILS) ports is possible with computer-compensated movements to overcome the difficulties associated with instrument crossover, robotic SILS is probably the limit for the current system design in terms of minimizing surgical access trauma. The main reason for this limitation is simple; essentially the robot is ‘outside’ of the patient. To move forwards into a higher realm, the whole robotic approach needs to be revised. To perform complex robotic thoracic surgery through a single small incision, the robot’s ‘shoulders’, ‘arms’ and ‘head and eyes’ must move inside the thoracic cavity with parallel instrumentations, making the procedure more anatomic and easy (*Figure 3*).

Conclusions

We are confident that technology will support uniportal VATS in the future, so as to facilitate this procedure (i.e., flexible thoroscopes, smaller instrumentation, new devices for sealing vessels or for targeting nodules and single-armed robotic devices). We should, however, avoid the risk of pursuing uniportal VATS too quickly by

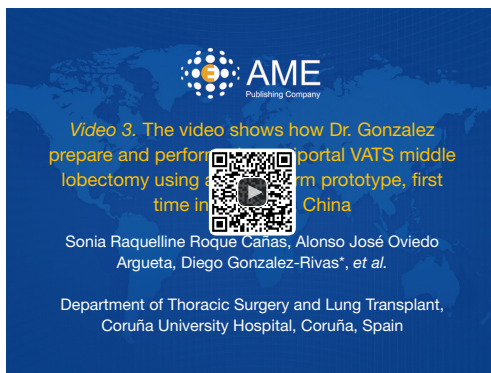


Figure 3 The video shows how Dr. Gonzalez prepare and performed an uniportal VATS middle lobectomy using a robotic arm prototype, first time in Shanghai, China (10). VATS, video-assisted thoracoscopic surgery.

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emphasizing surgical talent at the expense of patient safety and oncological completeness.

The Uniportal approach has created new opportunities for collaboration with the industry to develop new technology and to push the boundaries on the minimal thoracic invasive surgery (11). We expect further development of new technologies like narrower endostaplers, sealing devices for all vessels and fissure, refined thoracoscopic instruments, improvements in 3D systems or wireless cameras, and robotic surgery, which will probably allow the uniportal approach to become the standard surgical procedure for major pulmonary resections in most thoracic departments.

Although technically more demanding, minimally invasive thoracoscopic surgery allows rapid recovery and generates less morbidity compared with open surgery (12). Technical advancements in surgical instruments designed for thoracoscopic surgery, allow surgeons to innovate and to make adaptations to techniques for the treatment of oncological diseases.

Uniportal VATS is an example of the continuing search for methods that aim to provide the patient a surgical cure of the disease with the lowest morbidity. The minimization of surgical invasive and preservation of the lung parenchyma is of great importance, as it offers better postoperative results and less rate of complications (13).

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Footnote

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

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