

# Recent advances in uniportal video-assisted thoracoscopic surgery

Diego Gonzalez-Rivas

Coruña University Hospital (CHUAC) and Minimally Invasive Thoracic Surgery Unit (UCTMI), Coruña, Spain

Correspondence to: Diego Gonzalez-Rivas, MD, FECTS. Coruña University Hospital (CHUAC) and Minimally Invasive Thoracic Surgery Unit (UCTMI), Coruña, Spain. Email: [Diego.Gonzalez.Rivas@sergas.es](mailto:Diego.Gonzalez.Rivas@sergas.es).

**Abstract:** 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. Uniportal VATS for major resections has become a revolution in the treatment of lung pathologies since initially described 4 years ago. The huge number of surgical videos posted on specialized websites, live surgery events and experimental courses has contributed to the rapid learning of uniportal major thoracoscopic surgery during the last years. The future of the thoracic surgery is based on evolution of surgical procedures and anesthetic techniques to try to reduce the trauma to the patient. Further development of new technologies probably will focus on sealing devices for all vessels and fissure, refined staplers and instruments, improvements in 3D systems or wireless cameras, and robotic surgery. As thoracoscopic techniques continue to evolve exponentially, we can see the emergence of new approaches in the anesthetic and the perioperative management of these patients. Advances in anesthesia include lobectomies performed without the employment of general anesthesia, through maintaining spontaneous ventilation, and with minimally sedated patients. Uniportal VATS resections under spontaneous ventilation probably represent the least invasive approach to operate lung cancer.

**Keywords:** Uniportal surgery; awake lobectomy; single-port robotic; non-intubated; lung cancer

Submitted Jan 22, 2015. Accepted for publication Jan 27, 2015.

doi: [10.3978/j.issn.1000-9604.2015.02.03](https://doi.org/10.3978/j.issn.1000-9604.2015.02.03)

View this article at: <http://dx.doi.org/10.3978/j.issn.1000-9604.2015.02.03>

Thanks to the recent improvements in thoracoscopy, a great deal of complex lung resections can be performed without performing thoracotomies (1,2). During the last years, experience gained through video-assisted thoracoscopic techniques, enhancement of the surgical instruments and improvement of high definition cameras have been the greatest advances. The huge number of surgical videos posted on specialized websites, live surgery events and experimental courses have contributed to the rapid learning of minimally invasive surgery during the last years. Nowadays, complex resections are being performed by thoracoscopic approach in experienced centers (3). Additionally, surgery has evolved regarding the thoracoscopic surgical approach, allowing us to perform difficult procedures by means of a small single incision, with excellent postoperative results (4,5).

Uniportal video-assisted thoracic surgery (VATS) has a history spanning over more than 10 years and, more recently, has become an increasingly popular approach to manage most of the thoracic surgical diseases (6). The potential advantages of reduced access trauma, less pain and better cosmesis, together with patient demand, have seen uniportal VATS spread across the world (7). Since we developed the uniportal technique for VATS major pulmonary resections in 2010, we have increased the application of this technique to more than 95% of cases in our routine surgical practice (8,9). The experience we acquired with the uniportal technique during the last years, as well as technological improvements in high definition cameras, development of new instruments, curved tip applicators for vascular clips and more angulated staplers have made this approach safer, incrementing the indications

for single-port thoroscopic resections. We believe it is important to minimize the surgical aggressiveness especially in advanced stage lung cancer patients where 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 single-port or uniportal technique is the final evolution in these minimally invasive surgical techniques (10).

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 (11). Despite offering excellent visual feedback and robotic arm dexterity and precision, several ports are still required for the lobectomy (12). 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.

Recent innovations in single-incision approach are the use of subxyphoid technique for major resections and the thoroscopic lobectomy in non-intubated patients. Liu *et al.* from Taiwan successfully performed the first cases of uniportal VATS lobectomies via a subxyphoid approach, which might reduce the risk of intercostal nerve injury and avoids the limitations imposed by narrow rib spaces (13). One of the limitations of this approach are the transmitted pulsation from the heart to the VATS instruments and the difficulties to control a bleeding from upper lobe tumors. Interestingly, an additional advantage of the subxyphoid approach is the ability to gain access to bilateral thoracic cavities to perform bilateral lung resections through a single incision (14). Avoiding the incision through the

intercostal space could be another potential advantage to reduce postoperative pain but further studies will be required to demonstrate that this approach is less painful. Currently, the evolution of the thoroscopic surgery to less invasive techniques, such as the uniportal VATS allows us to consider the possibility of avoiding intubation and general anesthesia. The choice of a single incision technique in an awake or non intubated patient could minimize even more the invasiveness of the procedure. We consider it very important in high risk patients for general intubated anesthesia such as elderly patients or those with poor pulmonary function (15,16). We recently introduced in our department the uniportal VATS lobectomy technique in non-intubated patients. To date we have performed 30 non-intubated uniportal VATS major pulmonary resections with excellent postoperative results (no mortality, 6.6% conversion rate to intubation). The combination of nonintubated or awake thoroscopic surgery and single-port VATS technique is promising because it represents the least invasive procedure for pulmonary resections (17,18). Thanks to avoidance of intubation, mechanical ventilation and muscle relaxants the anesthetic side effects are minimal allowing to most of the patients to be included in a fast protocol avoiding the stay in a intensive care unit. Moreover, the perioperative surgical stress response could be attenuated in non-intubated patients undergoing uniportal VATS as a result of the reduced postoperative stress hormones and proinflammatory mediators related to mechanical ventilation (19,20). Given that only one intercostal space is opened, the use of local anesthesia and blockade of a single intercostal space is enough for pain control at the beginning and during the surgery (no epidural and no vagus blockade is necessary in the single port approach). We use no trocar and during instrumentation we try to avoid pressure on the intercostal nerve so we reduce the risk of intercostal bundle injury. Oxygen (6-9 L/min) is supplied via facial mask. Standard monitoring must include electrocardiogram, non-invasive blood pressure, pulse oximetry, and respiratory rate, along with an approximation of the end-tidal carbon dioxide with a catheter placed in one nostril. The pharmacological management is based on a target-controlled infusion of remifentanyl and propofol, with a premedication of midazolam (0.15-0.25 mg/kg) and atropine (0.01 mg/kg) 15 min before anesthesia, adjusting real-time rate of infusion with the aggressiveness of each period during the surgery. The use of a nebulization of 5 mL of lidocaine 2% 30 min before helps to avoid coughing that could troublesome when performing lung traction and

hilar manipulation during dissection. These non-intubated major pulmonary resections must only be performed by experienced anesthesiologists and uniportal thoracoscopic surgeons (preferably skilled and experienced with complex or advanced cases and bleeding control through VATS). However, intraoperative conversion to general anesthesia is sometimes necessary and the surgical team must have a plan to minimize the risk of the patient. The anesthesiologist must be skilled in bronchoscopic intubation, placing a double-lumen tube or an endobronchial blocker in a lateral decubitus position

One of the criticisms of uniportal VATS approach is the difficulty in palpating small lesions through a single incision. The recent development of advanced multimodality image-guided operating room (AMIGO) in combination with the uniportal approach has opened up new possibilities. The hookwire insertion and uniportal VATS surgery can now be performed in the same room and for those lesions for which it might not be feasible to insert a hookwire, a real-time on-table scan can be performed to localize the tumor for resection and potentially provide additional information on surgical margins (21).

In conclusion, 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 (22). 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.

## Acknowledgements

*Disclosure:* The author declares no conflict of interest.

## References

- Hennon M, Sahai RK, Yendamuri S, et al. Safety of thoracoscopic lobectomy in locally advanced lung cancer. *Ann Surg Oncol* 2011;18:3732-6.
- Gonzalez-Rivas D, Fieira E, Delgado M, et al. Is uniportal thoracoscopic surgery a feasible approach for advanced stages of non-small cell lung cancer? *J Thorac Dis* 2014;6:641-8.
- Kara HV, Balderson SS, D'Amico TA. Challenging cases: thoracoscopic lobectomy with chest wall resection and sleeve lobectomy-Duke experience. *J Thorac Dis* 2014;6:S637-40.
- Gonzalez-Rivas D, Fieira E, de la Torre M, et al. Bronchovascular right upper lobe reconstruction by uniportal video-assisted thoracoscopic surgery. *J Thorac Dis* 2014;6:861-3.
- Gonzalez-Rivas D, Delgado M, Fieira E, et al. Double sleeve uniportal video-assisted thoracoscopic lobectomy for non-small cell lung cancer. *Ann Cardiothorac Surg* 2014;3:E2.
- Rocco G, Martin-Ucar A, Passera E. Uniportal VATS wedge pulmonary resections. *Ann Thorac Surg* 2004;77:726-8.
- Jutley RS, Khalil MW, Rocco G. Uniportal vs standard three-port VATS technique for spontaneous pneumothorax: comparison of post-operative pain and residual paraesthesia. *Eur J Cardiothorac Surg* 2005;28:43-6.
- Gonzalez D, Paradela M, Garcia J, et al. Single-port video-assisted thoracoscopic lobectomy. *Interact Cardiovasc Thorac Surg* 2011;12:514-5.
- Gonzalez-Rivas D, Paradela M, Fernandez R, et al. Uniportal video-assisted thoracoscopic lobectomy: two years of experience. *Ann Thorac Surg* 2013;95:426-32.
- Ng CS, Lau KK, Gonzalez-Rivas D, et al. Evolution in surgical approach and techniques for lung cancer. *Thorax* 2013;68:681.
- Park BJ, Flores RM, Rusch VW. Robotic assistance for video-assisted thoracic surgical lobectomy: technique and initial results. *J Thorac Cardiovasc Surg* 2006;131:54-9.
- Veronesi G, Galetta D, Maisonneuve P, et al. Four-arm robotic lobectomy for the treatment of early-stage lung cancer. *J Thorac Cardiovasc Surg* 2010;140:19-25.
- Liu CC. First report—20131209 Subxiphoid single port VAT. Available online: [http://www.youtube.com/watch?v=Hi\\_gn8s0VzU](http://www.youtube.com/watch?v=Hi_gn8s0VzU). 21 January 2015, date last accessed
- Liu CC. First report—20131211 Subxiphoid single port VATS for bilateral NPC lung mets. Available online: <http://www.youtube.com/watch?v=xNBTuFJV3bQ>. [Accessed on Jan 21, 2015].
- Gonzalez-Rivas D, Fernandez R. Single Port Video-Assisted Thoracoscopic Lobectomy Under Spontaneous Ventilation in a High Risk Patient. *CTSNet*. November 18, 2014.
- Cattaneo SM, Park BJ, Wilton AS, et al. Use of video-assisted thoracic surgery for lobectomy in the elderly

- results in fewer complications. *Ann Thorac Surg* 2008;85:231-5; discussion 235-6.
17. Gonzalez-Rivas D, Fernandez R, de la Torre M, et al. Single-port thoroscopic lobectomy in a nonintubated patient: the least invasive procedure for major lung resection? *Interact Cardiovasc Thorac Surg* 2014;19:552-5.
  18. Gonzalez-Rivas D, Fernandez R, de la Torre M, et al. Uniportal video-assisted thoroscopic lobectomy under spontaneous ventilation. *J Thorac Dis* 2015. [Epub ahead of print].
  19. Tacconi F, Pompeo E, Sellitri F, et al. Surgical stress hormones response is reduced after awake videothoracoscopy. *Interact Cardiovasc Thorac Surg* 2010;10:666-71.
  20. Vanni G, Tacconi F, Sellitri F, et al. Impact of awake videothoroscopic surgery on postoperative lymphocyte responses. *Ann Thorac Surg* 2010;90:973-8.
  21. Ng CS, Hui JW, Wong RH. Minimizing single-port access in video-assisted wedge resection, with a hookwire. *Asian Cardiovasc Thorac Ann* 2013;21:114-5.
  22. Ng CS, Rocco G, Wong RH, et al. Uniportal and single-incision video-assisted thoracic surgery: the state of the art. *Interact Cardiovasc Thorac Surg* 2014;19:661-6.

**Cite this article as:** Gonzalez-Rivas D. Recent advances in uniportal video-assisted thoroscopic surgery. *Chin J Cancer Res* 2015;27(1):90-93. doi: 10.3978/j.issn.1000-9604.2015.02.03