

# Non intubated VATS: where do we stand?

Filippo Longo<sup>1</sup>, Raffaele Rocco, Pierfilippo Crucitti<sup>1</sup>, Diego Gonzales-Rivas<sup>2,3</sup>, Gaetano Rocco<sup>4</sup>

<sup>1</sup>Section of Thoracic Surgery, Department of Vascular Surgery, Campus Bio-Medico University of Rome, Via Alvaro Del Portillo, 200 - Rome, Italy; <sup>2</sup>Department of Thoracic Surgery, Coruña University Hospital and Minimally Invasive Thoracic Surgery Unit (UCTMI), Coruña, Spain; <sup>3</sup>Department of Thoracic Surgery, Shanghai Pulmonary Hospital, Tongji University School of Medicine, Shanghai 200433, China; <sup>4</sup>Department of Thoracic Surgery and Oncology, Division of Thoracic Surgery, National Cancer Institute, IRCCS, Fondazione Pascale-Napoli, Italy

**Contributions:** (I) Conception and design: G Rocco, F Longo, P Crucitti (II) Administrative support: G Rocco, P Crucitti; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: F Longo, R Rocco, G Rocco, D Gonzales-Rivas; (V) Data analysis and interpretation: All authors (VI) Manuscript writing: F Longo, G Rocco, P Crucitti; (VII) Final approval of manuscript: All authors.

**Correspondence to:** Filippo Longo, MD. Section of Thoracic Surgery, Department of Vascular Surgery, Campus Bio-Medico University of Rome, Via Alvaro Del Portillo, 200 - Rome, Italy. Email: [filippo.longo@unicampus.it](mailto:filippo.longo@unicampus.it).

**Abstract:** Video-assisted thoracic surgery (VATS) is currently being used to diagnose and treat several intrathoracic conditions with minimal morbidity, reduced hospital stay and possibly costs reduction compared with standard open surgery. Moreover, uniportal VATS (uniVATS) is emerging as a new, feasible and safe procedure capable to offer the same advantages compared with multiportal approaches; the addition of non intubated techniques may indeed pave the way to an innovative fast tracking concept. In recent years many authors focused on the possibility to avoid side-effects of intubated general anesthesia as well, in order to maintain more physiologic muscular, neurological and cardiopulmonary status in order to reduce the procedure-related traumas leading to faster recovery and optimized outcomes. This is a review of the pertinent literature regarding this technique.

**Keywords:** Video-assisted thoracic surgery (VATS); non-intubated/tubeless anesthesia

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## Introduction

Video-assisted thoracic surgery (VATS) is currently being used to diagnose and treat several intrathoracic conditions with minimal morbidity, reduced hospital stay and possibly costs reduction compared with standard open surgery (1).

Many efforts have been made to reduce chest wall trauma driven by the awareness that the fewer number of ports the better patient's post-operative course. In this setting, uniportal video-assisted thoracic surgery (uniVATS) is emerging as a new, feasible and safe procedure capable to offer the same advantages compared with multiportal approaches in terms of operative technique with a better post-operative outcome both for minor and major operations (2,3).

Once the efficacy and safety of a single incision approach was demonstrated, many authors have focused in recent

years on the possibility to avoid side-effects of intubated general anesthesia as well, in order to maintain a more physiologic muscular, neurological and cardiopulmonary status. This, in turn, would reduce the procedure-related traumas leading to optimized recovery and overall outcomes.

Despite several indisputable advantages, the use of a general anesthesia with single-lung ventilation can be associated with several potential adverse effects including an increased risk of pneumonia, an impaired cardiac performance, neuromuscular problems, a risk of major airways injury, a composite ventilator-related injuries (i.e., barotraumas) and the development of atelectasis in both the dependent and the nondependent lung (4).

In particular, immediately after a surgical procedure, the ability to cough, which mainly depends on the efficacy of diaphragmatic contraction and pain relief, seems to be one

of the most important factors affecting lung function.

To avoid intubated anesthesia-related adverse effects, non-intubated strategies have been proposed in recent years (5).

Despite there is still a lack of strong evidence, preliminary reports including several randomized studies have suggested optimal feasibility of several surgical procedures using a tubeless technique including management of pleural effusion, spontaneous pneumothorax, wedge resections of undetermined pulmonary nodules, lung volume reduction surgery (LVRS) for severe emphysema and anatomical lung resection for lung cancer treatment (6).

### Evolution of non-intubated VATS

One of the main difficulties of a non-intubated VATS procedure consists in reducing patient's movements caused as example by lung parenchyma manipulation or mediastinal nodes removal by the surgeon, thus generating cough and sudden diaphragm excursions. Pain control and a perfect sedation are mandatory as well to perform a safe non-intubated procedure. In this setting, non-intubated VATS can be performed on patients using an effective thoracic epidural anesthesia in various levels of consciousness, from being awake to being sedated with intravenous general anesthesia (7). Moreover, sedation or hypnosis is favored not only because it is preferred by patients but also because it blunts the cough reflex and movement from artificial pneumothorax and one-lung ventilation (OLV) (8). Furthermore, cough reflex suppression is achieved by injecting the vagus nerve with local anaesthetics or by administering aerosolized lidocaine. For major procedures, the epidural catheter can be positioned at T3–T4 level and remifentanyl can be used to maintain deep sedation (9).

Intravenous anesthesia is adequate for simple and short thoroscopic procedures, such as wedge resection or biopsy on peripheral lung parenchyma (6-8,10). For nonintubated VATS major procedures such as lobectomy or segmentectomy, pulmonary manipulations are difficult without an effective regional anesthesia. Although intraoperative regional anesthesia, such as multilevel thoroscopic intercostal nerve blocks (TINBs) or paravertebral blocks, has been applied for VATS, few reports have monitored the effects of or confirmed the anesthetic component provided by regional anesthesia administered intraoperatively.

In 2016 Wang *et al.* reported an effective anesthetic

combination for nonintubated three-port VATS using intraoperative multilevel thoroscopic intra-costal nerve blocks (TINBs) + vagus nerve blocks and bispectral index (BIS)-targeted general anesthesia (a measure of the level of consciousness by algorithmic analysis of a patient's electroencephalogram during general anesthesia) (11). Physiologic parameters such as respiratory frequency, blood pressure, heart rate and bispectral index (BIS) are usually monitored to demonstrate the comparable anesthetic depth and the anesthetic-sparing effect of regional anesthesia. When TINBs are used instead of sedation and thoracic epidural blocks, the effects of TINBs should be confirmed before starting pulmonary manipulations. Moreover, during prolonged procedures, anesthesiologists must monitor TINB fading and the opportunity to repeat nerve blocks. The authors concluded that TINBs are associated with fewer complications than thoracic epidural anesthesia techniques such as pleural puncture and epidural hematoma.

Diego Gonzalez-Rivas recently stressed the advantages of a non-intubated approach for patients who are too risky for intubated general anesthesia for major lung surgery (12). Through intercostal and vagal nerve blocks he found no differences in terms of lung collapse obtained by iatrogenic pneumothorax via VATS under spontaneous breathing. According to this author, tubeless procedure resulted in less lung stress and inflammation with the possibility of a faster and enhanced postoperative recovery and outcome since the respiratory efficiency is increased by the preservation of diaphragmatic function.

Guo *et al.* reported similar results in a retrospective analysis of a group of patients undergoing tubeless VATS segmentectomy. The authors introduced a technique based on spraying lidocaine onto the lung surface as well as on intrathoracic vagal blockade in order to abolish the cough reflex during the operation (13).

Liu *et al.* compared two groups of patients with NSCLC undergoing VATS anatomical resection according to the modality of general anesthesia (intubated Vs non-intubated procedure). The authors observed no intergroup differences in terms of operative time, intraoperative blood loss and number of dissected lymph nodes. Conversely, they noticed significantly better results in the non-intubated group as to postoperative fasting time, overall postoperative chest drainage volume and hospital stay (5).

### Discussion

In the last decades thoracic surgery evolved from a classic

open approach to a minimally invasive one. The advent and spread of conventional video-assisted techniques encouraged many surgeons to search new ways to approach thoracic surgery. Nowadays the literature is pointing at the shorter hospital stay, less postoperative pain and paresthesia both short and long term, as well as less hospitalization costs associated to uniportal video-assisted thoracoscopic surgery (uniVATS) compared with three-port VATS. In this setting, Rocco *et al.* reported on a series of procedures that can be done in non-intubated or awake patients (10,14). Along the same line, pioneers of uniVATS have championed the concept of awake or non-intubated uniVATS for major pulmonary resections (2,3,5,9,12). Another factor potentially in favor of developing non intubated VATS surgery is lung cancer screening yielding to an increasing number of patients found to have an early stage NSCLC (15,16).

In spite of the multiplication of possible applications of non intubated VATS, it becomes of paramount importance to carefully define its indications and especially the contraindications in order to guide surgeons in patients selection.

To this purpose, Gonzalez-Rivas *et al.* recently proposed a roster of exclusion criteria for patient eligibility to VATS awake tubeless procedure that can be divided into patient-related (i.e., obesity, neurological conditions, uncontrolled gastroesophageal regurgitation, central hypoventilation syndrome, persistent cough or mucus retention, hemodynamically instable or severely hypoxia/hypercapnia), anesthesiologist-related (i.e., difficult intubation, technical contraindications to general anesthesia, need to protect the contralateral lung from spillage of endobronchial contents and inexperienced or non-cooperative team), and, finally surgeon-related (i.e., uni-VATS experience, previous operations with adhesions) (17).

A general consensus exists on the importance of a well-trained and dedicated surgical-anesthesiological team. Indeed, conversion to an endotracheal intubation because of intraoperative surgical difficulties or because of patient intolerance requires a rapid resolution based on an agreement from both the surgeon and the anesthetist. Rates of conversion to intubated general anesthesia were reported to be between 2.3% and 10.0%, depending on the type of procedure and the experience matured by the surgical teams (18).

The indications for non-intubated VATS are far from being definitively outlined. Nonetheless, some of them are generally accepted whereas others are still widely

debated. Examples of the former indications are simple and easy-to-perform procedures and surgical management of patients with significant risks for intubated general anesthesia. Conversely, debated indications include use of tubeless VATS for major procedures such as anatomic lung resections, lung-volume reduction surgery and thymectomy (6).

## Conclusions

We are living the advent of uniportal VATS, experiencing its fascinating and impressive feasibility. Nevertheless progress requires caution and the awareness of the necessity to face new approaches in a multidisciplinary manner. Uniportal VATS and non intubated VATS represent an intriguing match which must be seen as the result of a specific surgical and anesthesiological training process from minor to major surgical procedures.

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