Editorial

The current status of non-intubated thoracoscopic lobectomy

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Introduction

Surgical innovation has come a full circle with the recent advances in performing thoracic surgery without general anesthesia and mechanical ventilation. What was done out of necessity historically is now presented as a choice. Wang and colleagues present here, a patient that underwent a non-intubated uniportal lobectomy with mediastinal lymph node dissection and discuss the indications and rationale for performing non-intubated video-assisted thoracoscopic (NIVATS) lobectomy (1). There is an abundance of literature describing NIVATS techniques and the benefits of avoiding general anesthesia in thoracic surgery. It is important to note however, that a lobectomy performed with an intention to cure cancer is an entity of its own. In this editorial we will aim to focus on the specific role of NIVATS for lobectomy as an oncological procedure.

History of NIVATS lobectomy

The first successful lung resection by Rolandeus was in the year 1499, prior to the advent of the endotracheal tube in 1928 and single lung ventilation in 1931 (2). When Vischnevski (3) and Ossipov (4) described their results with using local anesthesia for lung resections in the 1950s and 1960s, they referred to general anesthesia as the "new technique" which was still being used sparingly for most thoracic operations in the then U.S.S.R. With the development of minimally invasive thoracic surgery, i.e., VATS, there was a resurgence of interest in minimizing the impact of anesthesia as well and the likelihood that lesser invasive surgery would be better tolerated without general anesthesia.

Al-Abdullatief *et al.* described the first non-intubated lobectomy in 2007 (5) and Chen *et al.* further elaborated on the technique and demonstrated the safety and feasibility of NIVATS lobectomy in 2011 (6). Following this, there has been a splattering in literature regarding NIVATS in general but has been quite limited with regard to lobectomy.

What is NIVATS lobectomy?

While it is commonly understood that NIVATS means "no endotracheal intubation", it is important to note that there are variations within the technique that potentially impact outcomes.

In the referred article (1), Wang and colleagues describe their procedure using local anesthesia at the incision site and intraoperative intercostal block, together with a laryngeal mask airway (LMA) for respiratory control. Several NIVATS studies have reported a similar technique using spontaneous breathing with an LMA. Some others have described the procedure using a facemask or transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) (7,8). There is no high-quality data comparing these details and their outcomes and their relevance to NIVATS anatomical resections versus simpler NIVATS procedures.

Intraoperative pain management strategies mostly include intercostal blocks or epidural anesthesia together with local anesthesia. Hung *et al.* compared intercostal nerve blocks versus epidural anesthesia in patients that underwent NIVATS lobectomy with spontaneous ventilation and found no difference between the two techniques (9).

In addition to the above, most authors recommend and practice cough-suppressive techniques such as vagal blockade or intrathoracic spray of local anesthetic.

Why consider NIVATS lobectomy?

The safety and feasibility of NIVATS in general has been extensively published at this point. Several authors have exhaustively reviewed the physiological and mechanical advantages of avoiding general anesthesia and endotracheal intubation. Reduced risk of airway injury, improved cardiopulmonary dynamics and control, decreased intrapulmonary shunting and hypoxemia, decreased risk of diaphragm dysfunction and atelectasis and an attenuated surgical stress response are commonly discussed (10,11).

A recent meta-analysis by Xue *et al.* reviewed eight published articles comparing intubated VATS versus NIVATS for major lung resections in 970 patients. They found no difference in postoperative complication rate, surgical duration, and the number of dissected lymph nodes (12). Of note, only one of the eight studies was a randomized controlled study and included all thoracoscopic procedures (13). Chuang *et al.* (14) reviewed five studies comparing intubated and NIVATS lobectomy with most studies reporting comparable major perioperative outcomes. Some of these studies reported a quicker post-operative oral intake, shorter chest tube duration, shorter length of stay and fewer complications in their NIVATS groups (6,11).

It is critical to consider that lobectomy is a procedure primarily performed for the treatment of lung cancer. An anatomic R0 resection and proper mediastinal staging are the basic principles of lung cancer surgery. It is difficult to compare data coming from different regions of the world with varying NIVATS experience and varying techniques and protocols. Wang *et al.* found that non-intubated thoracoscopic lobectomy was not an independent predictor of recurrence or overall survival (OS) in their 5-year follow up period (15) and Zheng *et al.* actually reported better 5-year OS in NIVATS lobectomy patients (16). Zheng and colleagues explain their results based on the preserved immune surveillance in NIVATS patients needing fewer opioids and having an attenuated stress response. Wang and colleagues describe a very thorough lymph node dissection in the patient presented in this paper (1). This is in line with the limited literature reporting no difference in number of lymph nodes harvested, although one study reported fewer lymph nodes dissected in the NIVATS group compared to the intubated group (12.6 *vs.* 18; P=0.003) (17). The studies specifically addressing the question of longer-term outcomes are certainly encouraging but are not randomized controlled trials and are coming from centers with extensive experience with NIVATS.

In the referred study, Wang and colleagues use the uniportal technique combined with NIVATS. The uniportal technique has also been quite extensively studied and although good quality randomized data is lacking, most suggest comparable perioperative and oncological outcomes (18,19) to the multiportal VATS technique. It seems only natural to combine the two approaches if the intention is to create as physiological an environment as possible with minimal stress to the patient. The majority of the NIVATS lobectomy studies report a uniportal approach but a good few describe a multiportal approach as well. It is unlikely that one VATS technique is superior to the other as long there is adherence to the basic principles of lung cancer surgery. What is important is that a surgeon must first be comfortable with a VATS lobectomy technique before attempting NIVATS lobectomy.

Adoption of NIVATS approach to lobectomy and other considerations

It is interesting to note, that although NIVATS has potential benefits, is being safe and is reproducible, the approach has not been widely adopted and has met criticism (20). The data we have is mostly from specific parts of Asia and Europe and from a limited few surgeons in these parts of the world. Pompeo et al, in their survey of ESTS members in 2015 found that 67% of the responders performed NIVATS procedures (21). Only 17% of them were high volume NIVATS surgeons, and lobectomies accounted for less than 2% of the procedures.

While interesting, it is not surprising. Thoracoscopic lobectomy is a complex procedure and NIVATS, although not in its infancy, is certainly not mature enough yet. Protocols for ideal pain control and anesthetic management are yet to be defined. Major issues such as pulmonary artery bleeding, need for conversion to thoracotomy and need for emergent intubation have to be factored in during planning. Careful patient selection and focused multidisciplinary planning can minimize complications. The conversion rate from NIVATS to intubation for lobectomy is 2.8–10% (14), and there is no difference in the conversion rate from VATS lobectomy to thoracotomy when comparing NIVATS to VATS under general anesthesia.

Patients for a NIVATS lobectomy need to be very rigorously selected. In addition to the routine physiologic and oncologic assessment of a patient for VATS lobectomy, a surgeon must evaluate the psychological readiness of a patient for NIVATS. It is important for the patient to understand that they will not be under general anesthesia and what that means. As regards to patient factors, we also need to critically evaluate the benefit to the patient with this approach. NIVATS has been advocated for thoracoscopic procedures in old and frail patients that might be at a higher risk for complications from general anesthesia (22,23).

An important consideration is that this is an approach which requires the "buy in" of not just the surgeon and patient but also the anesthesiologist. NIVATS is an advancement in thoracic surgery made possible by advances in field of anesthesia. Building and maintaining a successful NIVATS program that includes complex lung resections involves having a group of anesthesiologists with an interest and capability in evaluating and managing these patients. Consistent performance of simpler NIVATS procedures could encourage the group to take on more complex resections.

Conclusions

The NIVATS approach with its demonstrated safety and feasibility has definitely found a place for itself in modern day thoracic surgery. Its wider adoption and its role in more complex procedures are yet to be determined. We do believe that embracing challenges is the only way to grow. We can always find comfort in justifying our current choices. The enhanced recovery protocols with minimally invasive thoracic surgery have brought about a paradigm shift in post-operative expectations for patients and surgeons. Rather than using this as our hammock, we need to use it as our launch pad to innovate, evolve and progress to further improve outcomes for patients. While a NIVATS uniportal lobectomy is one of the many available approaches, it certainly has the potential to become the preferred approach in a good majority of patients in the right environment.

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