Perspective on Thoracic Surgery

Steps in the development of a VATS lobectomy program

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Abstract: Video-assisted thoracoscopic surgery (VATS) lobectomy has been employed in recent decades for the treatment of non-small cell lung cancer (NSCLC). Although trials have shown this procedure to be safe and feasible a VATS approach for lobectomy has not been widely used yet. Surgeons can go beyond this limit by following a specific operative plan focused on learning the minimally invasive technique in centers of excellence and then including: a pre-operative phase based on the radioclinical assessments and an operating phase designed to develop a methodical approach to VATS technique. At the beginning it's recommended to follow a learning curve with careful selection of patients keeping in mind that intraoperative complications may occur even later, especially in presence of clinical nodal disease or significant calcification on preoperative CT scan, which represents the main reason for conversion from VATS to thoracotomy.

Keywords: Video-assisted thoracoscopic surgery (VATS); lobectomy; lung cancer

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Introduction

For more than two decades the use of video-assisted thoracoscopic surgery (VATS) has been applied for the treatment of lung cancer (1). In the 2014 edition, the National Comprehensive Cancer Network (NCCN) Guidelines claimed that: "VATS is strongly recommended in early non-small cell lung cancer (NSCLC) patients without anatomic or surgical contraindications, in case that such procedure does not violate the tumor treatment criteria and/or chest surgery principles". Many single-institution and multi-institution trials have shown VATS lobectomy to be a feasible procedure (2,3) and controlled studies have pointed out in recent years the benefits of a minimally invasive approach over thoracotomy, such as reduced post-operative pain, reduced hospital stay and lower post-operative complications (4,5).

Basic tips

Before starting a VATS lobectomy program it's recommended to have a consolidated experience on minimally invasive thoracic surgery for minor procedures such as pleural biopsies, pulmonary atypical segmentectomies, etc. This allows the surgeon to develop confidence with correct port placement, use of video screen for guidance without looking through access incision and use of instruments tailored for VATS (6). Both the surgical and nursing staff should attend VATS courses to learn the techniques, visiting centers of excellence with high VATS lobectomies volume. In this way it's possible to develop familiarity with staplers and new appropriate instruments (6). To complete, it would be useful to watch unedited videos to review the techniques, discuss scientific papers and attend animal laboratories (7).

Pre-operative planning

At the beginning we recommend careful pre-operative patient assessment such as body habitus, previous intra-thoracic procedures, with special attention to patients with a history of inflammatory lung disease. It's highly recommended to examine carefully the pre-operative chest CT scan and PET scan to identify adherent calcified lymph nodes or lymph node metastases: the role of imaging

studies is critical in predicting complications or difficulties associated with VATS (8). For the same purpose, it's also important the knowledge of anatomical variants using an optimal operative planning that includes chest CT scan and pre-operative bronchoscopy (9).

Operative planning

Direct and indirect experience suggests anterior approach for VATS lobectomy. In this way, through an extension of the anterior utility incision, it's easier to clamp the major vessels in case of major bleeding (10). During the procedure, in the first step, the surgeon must learn how to achieve an exposure optimization using angled or flexible endoscopic thoracoscopes and how to ensure the correct port placement. There are many advices to obtain a good thoracoscopic view, such as lens cleaning, cleaning inside the trocar port up to the anti-condensation solutions and devices for smoke aspiration (11). The surgical procedure can be facilitated using instruments tailored to VATS surgery and articulating staplers, without forgetting in some cases the use of additional devices such as catheter leaders that allow wall dissection of tubular structures without causing injury by endoscopic staplers (11). During VATS lobectomy the surgeon has today many energy devices available for dissection but it's necessary to know that they should be used with caution to avoid heat injury. Also important is learning the correct application of clips to the pulmonary artery or pulmonary vein branches to avoid bleeding from their avulsion during tissue manipulation or tearing for incorrect application (12). At the beginning we always recommend a careful dissection in order to have a complete overview of the anatomy: among the reasons for conversion to thoracotomy there are the so called VATS-related problems such as vascular or bronchial injuries. During the initial experience of VATS lobectomy, one of the most interesting technical aspects is the fissure dissection. In case of complete fissure we recommend the exposure of the pulmonary artery in the fissure dividing the lung parenchyma overlying the artery by electrocautery, blunt dissection or sharp dissection: the procedure allows a nice view of the bronchovascular structures and a complete intrafissural nodal dissection. In case of incomplete or fused fissure we recommend the so called "tunnel" technique: the dissection starts from the anterior part of the fissure, looking for a cleavage plane between the artery and the parenchyma up to the back of the fissure. This procedure, after complete opening of the fissure with staplers, provides optimal view of the bronchovascular structures with prevention of prolonged air leaks and reduction of post-operative hospital stay (13). We have concerns about the so called "fissureless" technique, especially for patients with lobar lymph nodes disease (14) and the potential risk of pulmonary artery injury during bronchial dissection (12).

The learning curve

A VATS lobectomy program can't start without a learning curve. For VATS lobectomies the learning curve should consist of 50 cases (15). At the beginning it is essential to know the contraindications to thoracoscopic lobectomy reported in the medical literature, such as: pleural symphysis, chest wall involvement including ribs, severe perivascular fibrosis, large lung cancer that makes difficult the lobe manipulating, abnormal hilar nodes with granulomatous or metastatic disease. In our learning curve the main reasons for the conversion to thoracotomy were: pleural symphysis, absent fissure and poor visualization. An increase in experience was associated with lower conversion rate to thoracotomy and the main reason for the conversion was bleeding during VATS upper lobectomies for peribronchial and perivascular lymph nodes with metastatic disease. It means that with experience improvement in minimally invasive thoracic surgery there is a tendency to treat more advanced pathological stages, but in this case the surgeon should know that lobar or sublobar lymph nodes disease, especially in upper lobectomies, exposes to higher risk of intra-operative bleeding and possibility of conversion to thoracotomy. Getting more experience the surgeon can handle special cases. In our database we also report VATS lobectomies performed in patients with congenital abnormalities such as anomalous connection of pulmonary vein to superior vena cava (*Figure 1*) and in patients who underwent median sternotomy for cardiac surgery such as coronary artery bypass grafting with left internal mammary artery (*Figure 2*).

Recommendations

We believe that, from the beginning to the end of a VATS lobectomy program, two principles should be followed: perform a safe procedure for the patient and respect the principles of oncological radicality. This means that surgeons should not hesitate to convert to thoracotomy, when necessary. In some situations prevention of major intra-operative complications is the main objective of

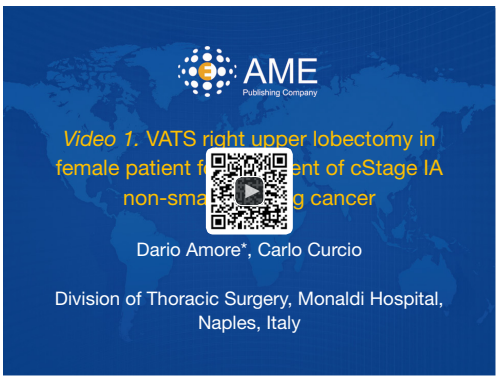

Figure 1 VATS right upper lobectomy in female patient for treatment of cStage IA non-small-cell lung cancer. Preoperative computed tomography scan showed an uncommon congenital anomaly: partial anomalous pulmonary venous connection. The video shows the right upper pulmonary vein draining into the superior vena cava: after hilar dissection this pulmonary vein was transected by stapling device (16). VATS, video-assisted thoracoscopic surgery.
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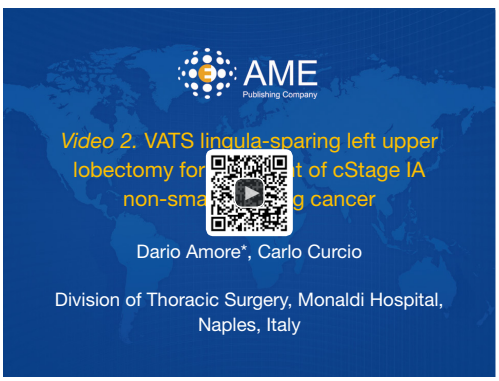

Figure 2 VATS lingula-sparing left upper lobectomy for treatment of cStage IA non-small-cell lung cancer. The elderly patient, four years ago, underwent coronary artery bypass grafting with left internal mammary artery. The video shows: adhesions, from the previous sternotomy, between the lung and mediastinum lysed carefully to avoid damaging the left internal mammary artery. After full mobilization of the lung a safe pulmonary anatomic resection was performed (17). VATS, video-assisted thoracoscopic surgery.
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experienced VATS surgeons and caution attitudes can ensure patient safety with a positive impact on short-term and long-term outcomes. However the surgical staff should not forget that the best strategy to avoid the complications of VATS lobectomy is to prevent them from happening (18). This is possible if all the learning steps are followed in the VATS lobectomy program, keeping in mind the advices exposed above: appropriate planning and intra-operative judgment.

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Footnote

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

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