Video-assisted mediastinoscopic lymphadenectomy combined with transcervical thoracoscopy

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Abstract: Surgical techniques remain the gold standard to diagnose and staging lung and pleural tumours. Non-invasive techniques have become more accurate but actually they are not enough to plan and evaluating prognosis of lung and pleural tumours. In some cases, we need to explore the pleural cavity and the mediastinal lymph node status to confirm or rule out tumour dissemination. The combination of video-assisted mediastinoscopic lymphadenectomy (VAMLA) and thoracoscopy through a single transcervical incision allows the surgeon to widen the range of the exploration and to improve the staging for lung and pleural cancers. VAMLA allows to perform a complete lymphadenectomy of the subcarinal space, the right and pretracheal areas. We consider sampling more safety on the left side to avoid left recurrent nerve injuries. Once this mediastinal tissue is removed, the right mediastinal pleura can be identified and incised. Once mediastinal pleura is opened, a 5 mm 30º thoracoscope is inserted through the video- mediastinoscope into the pleural cavity. It allows to obtain samples of parietal or visceral pleural, pleural fluid or lung nodules if present. In case of left-sided thoracoscopy the access to the left pleural cavity is anterior to the aortic arch as for extended cervical mediastinoscopy. The combination of VAMLA and thoracoscopy is useful to explore the mediastinum and the pleural space from a single incision and in the same surgical setting through the transcervical approach.

Keywords: Lung cancer; staging; mediastinal lymphadenectomy

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Introduction

The purpose of surgical staging of lung and pleural cancers is planning treatment and assessing prognosis.

Transcervical video-mediastino-thoracoscopy (VMT) (1,2) allows access to the mediastinum and one or both pleural cavities. It facilitates to identify the cell type and stage in lung cancer and other thoracic malignancies, such as mesothelioma (3).

Surgical explorations have the highest certainty (4) before lung or pleural resection.

Video-assisted mediastinoscopic lymphadenectomy (VAMLA) (5-8) is a completely endoscopic procedure performed with the two-valved video-mediastinoscope. It consists of complete lymphadenectomy (including fatty tissue and lymph nodes) of the subcarinal, the right paratracheal and the left paratracheal space- nodal stations 7, 4R and 4L, respectively, according to the International Association for the Study of Lung cancer lymph node map (4,9). In the left paratracheal space we need to be careful not to injury left recurrent nerve. Once right paratracheal lymphadenectomy is completed allows us to identify and incise the right mediastinal pleural. Once it is opened, a 30º-5 mm thoracoscope is introduced through the video-mediastinoscope. With the 30º video-thoracoscope we can explore both pleural cavities and the lung surface. If we identify pleural or lung nodules, biopsies can be taken

Figure 1 Patient's position.

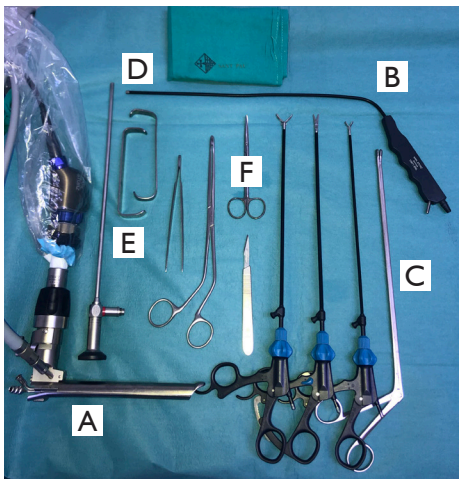

Figure 2 Basic instrument set. (A) Two-bladed spreadable video-mediastinoscope by Linder-Dahan; (B) dissection-coagulation-suction cannula; (C) biopsy forceps with oval jaws, different size; (D) 5 mm 30º video-thoracoscope; (E) two Farabeufs spreaders; (F) needle holder, forceps and scissors.

to confirm or discard tumour dissemination. To access to the left pleural cavity, VAMLA is combined with extended mediastinoscopy, the route of which over the aortic arch is used to access the left mediastinal pleura (10-12).

With this procedure, the mediastinum and the pleural cavities are explored from a single cervical incision and in the same surgical setting, widening the range of the explorations and improving the staging of thoracic malignancies (13,14). It is especially indicated in the next situations:

(I) Patients with lung cancer associated with pleural effusion with negative cytology by thoracocentesis and no lymph node involvement in PET/CT scan but there are other criteria for mediastinal staging (15).
(II) Patients with mesothelioma but the histological subtype (epithelioid, biphasic and sarcomatoid) is unknown or mediastinal staging is required.
(III) Pleurodesis for symptomatic control of malignant pleural effusions.
(IV) Pulmonary nodules detected during the exploration can be resected (13).

Operative techniques

Patient's position and anaesthetic considerations

The patient is in supine position with a sandbag placed between the scapule. It allows to achieve the maximal neck hyperextension. The head is supported on a head ring.

One of the differences with standard VAMLA is that a single-lung ventilation with a double- lumen tube is needed to complete the exploration of pleural cavity (*Figure 1*).

Instrumentation

We recommend to use the Linder-Dahan spreadable video-mediastinoscope (Richard Wolf, Knittlingen, Germany) instead of Lerut DCI video mediastinoscope (KARL STORZ SE & Co. KG, Tuttlingen, Germany) because it allows to enlarge the operative field creating an optimal exposure of the mediastinum.

Regarding instrumentation, the same standard mediastinoscopy instruments can be used (*Figure 2*). A 5 mm video-thoracoscope is used to explore the pleural cavity. A 30º viewing provides a panoramic view.

Biopsies of parietal pleural can be performed with the same forceps used during VAMLA. If pleural effusion is identified during thoracoscopy, we should take samples for cytological and biochemical analyses.

Surgical procedure

Incision

A cervical incision is performed over the sternal notch (*Figure 3*). The subcutaneous tissue and the platysma are incised, the paratracheal muscles are separated laterally and the pretracheal fascia is incised. Then, a pretracheal space is created by digital dissections. This space is necessary to insert the video-mediastinoscope into the mediastinum (*Figure 4*).

Figure 3 Cervical incision over the sternal notch.

Figure 4 Insertion of the video-mediastinoscope into the mediastinum.

Figure 5 Subcarinal lymphadenectomy (16).
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VAMLA steps

Subcarinal lymphadenectomy

Subcarinal nodes are completely excised following the landmarks, along the main bronchi, the pulmonary artery and the oesophagus. Like you see in *Figure 5*, when the subcarinal nodes are excised en bloc, the upper part of the para-oesophageal lymph nodes can be excised, too.

Figure 6 Right paratracheal lymphadenectomy (17).
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Figure 7 Left paratracheal lymphadenectomy (18).
Available online: http://www.asvide.com/article/view/32081

Right paratracheal lymphadenectomy

The right inferior paratracheal nodes are totally excised down to the azygos vein and right main bronchus.

Once lymphadenectomy is completed the superior vena cava and the right mediastinal pleura are exposed (*Figure 6*).

Left paratracheal lymphadenectomy

First of all, the left recurrent laryngeal nerve is identified and then the left inferior paratracheal nodes are carefully dissected and removed individually. To explore subaortic and para-aortic nodes in left lung cancers, extended cervical video-mediastinoscopy or parasternal mediastinotomy should be added (10) (*Figure 7*).

Figure 8 The 5 mm 30º video-thoracoscope is introduced through the valves of the video-mediastinoscope.

Figure 9 Using two screens during the exploration.

Figure 10 Right transcervical thoracoscopy (19). Available online: http://www.asvide.com/article/view/32082

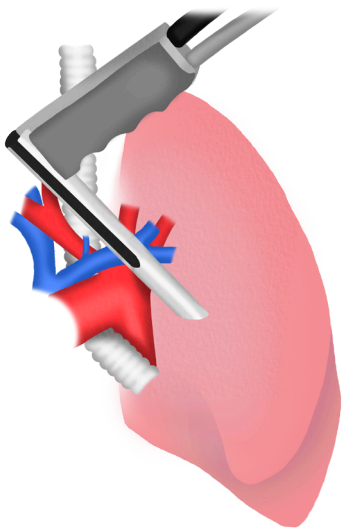

Figure 11 Video mediastinoscope is inserted and advances in front or behind the left innominate vein.

Transcervical thoracoscopy

Right transcervical thoracoscopy

The 5 mm 30º video-thoracoscope is introduced through the valves of the video-mediastinoscope (*Figures 8*,*9*).

After removing the right inferior paratracheal lymph nodes, the mediastinal pleura is grasped and incised. The ipsilateral lung is collapsed and the video-thoracoscope is introduced to the pleural cavity. With a second screen connected to the video-thoracoscope, the entire pleural cavity is explored. The parietal or visceral pleura and lung nodules if present can be biopsied. The opening of the two-valved video-mediastinoscope even allows the insertion of endoscopic staplers to perform wedge resections of the lung (13) (*Figure 10*).

Left transcervical thoracoscopy (*Figure 11*)

To explore the left pleural cavity is necessary to create a tunnel by digital blunt dissection. By the same cervical incision, this tunnel is created between the innominate artery and the left carotid artery moving above the aortic arch and under the left innominate vein.

Once the mediastinal pleura is identified we can perform a pleurotomy under direct endoscopic view to examine the left pleural cavity (20).

Assouad *et al.* described a new approach to the left pleural cavity passing through the retrosternal space. To

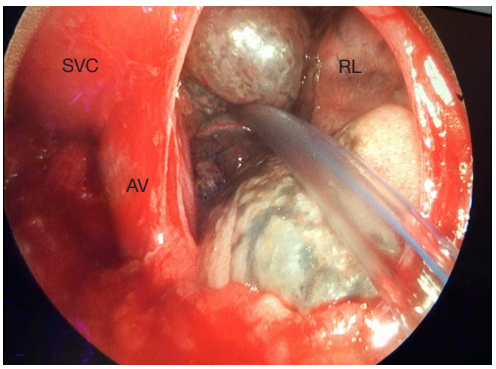

Figure 12 An 8 F chest drain placed through the opening mediastinal pleura. SVC, superior vena cava; AV, azygos vein; RL, right lung.

complete the thoracoscopy they used a flexible endoscope through the valves of the video mediastinoscope (21-23). This new approach was described to reduce the risk of vascular lesions.

Once the transcervical thoracoscopy is completed a small chest drain could be placed through the opening mediastinal pleura (*Figure 12*). The tube is connected to a suction system and if the air leak persists the tube could be externalized through the cervical incision, and fixed to the skin.

Comments

Transcervical VMT (1,2) was described by Deslauriers *et al.* in 1976. The absence of flexible endoscopes made that the procedure had not been fully applied. Many years later, the emergence of new endoscopes has allowed the revitalization of this technique (14,24).

Although this technique can offer different utilities we want to emphasize its role in staging in lung cancer and mesothelioma.

In lung cancer, a precise staging is crucial. In most patients with lung cancer, mediastinal staging is key to decide on the best therapeutic option. However, in those with an accompanying pleural effusion and negative thoracocentesis, its malignant nature must be confirmed or rule out, because if malignant nature is confirmed, tumour resection is not indicated.

We have different surgical techniques for staging lung cancers. At present, the improvement of endoscopic surgical techniques and their combination allow a more accurate staging with little surgical aggression to the patient (3).

VAMLA (5-8) gives us the possibility to perform a proper transcervical lymphadenectomy of the subcarinal and the right inferior paratracheal nodal stations and, thus, improving the accuracy of mediastinal staging compared to standard mediastinoscopy.

With mesothelioma the combination of VAMLA and transcervical thoracoscopy may increase the evidence on prognostic information. On the one hand, VAMLA informs us of nodal involvement (25) and, on the other hand, transcervical thoracoscopy allows the biopsy of material from the pleural surface helping to determine the subtype (epithelioid, biphasic and sarcomatoid). All this information is crucial in the decision-making of patients suitable for multimodality therapy (3).

From a single transcervical incision, VAMLA and video-thoracoscopy can be combined. With the 30º video-thoracoscope, the parietal and visceral pleura are visualized, as well as the inferior and lateral lung and pleural surface. In some cases, a flexible video-thoracoscope can be useful in order to visualise more of the chest cavity and improve the yield of the procedure in terms of obtaining tissue samples distant from the pleurotomy site (24). Through the valves of the video-mediastinoscope, it also is possible to take samples of pleural effusion introducing any suction system in the pleural cavity connected to a fluid container.

If malignancy is confirmed by frozen-section, a pleurodesis can be performed to avoid recurrence. Although many agents can be used, magnesium sulphate (talc) is effective, easy to be applied and cheap (26).

The access to the left pleural cavity is not so direct as on the right side because the supra-aortic vessels and the aortic arch have to be negotiated to reach the left mediastinal pleura. The route of the extended cervical mediastinoscopy, facilitates reaching the left mediastinal pleura to complete the diagnostic and/or therapeutic procedures (3).

Several relative or definitive contraindications of the technique are described. Mediastinal adhesions secondary to previous radiotherapy or surgery is the more common but it exists other contraindications like: pleural infection, mediastinal pleural invasion, posterior location of lung nodules, sever neck rigidity, large goitres, ascending aortic aneurism or atheromatosis of the aorta (3,10,14,27).

The most important difference with traditional thoracoscopy, is that you avoid a transthoracic approach. Avoidance of transthoracic ports probably decreases the risk of post-operative pain with no increase in surgical risk (28). Using a transcervical approach, we reduce the risk of wound recurrence due to its contamination with tumour cells in patients with malignant pleural mesothelioma (2,14).

Table 1 Complications

Injury of left recurrent nerve
Mediastinitis
Wound infection
Haemorrhage
Prolonged air leak
Residual pneumothorax
Wound tumour recurrence

Potential complications are described in *Table 1* (2,7). Like in traditional mediastinoscopy, we have to be careful with the dissection of left paratracheal nodes to avoid the transient or permanent left recurrent laryngeal nerve palsy. Some series describe this complication after VAMLA in 3.2% of the patients (7).

To reduce the risk of injury we recommend to visualize the nerve and avoidance of the electrocautery in close proximity to the nerve. Small bleedings near to the nerve should be controlled by temporary compression or clipping.

In conclusion, the developed in VATS has allowed the widespread application of video-assisted thoracoscopic surgical techniques. Regarding lung cancer and mesothelioma staging, it has allowed the combination of VAMLA and transcervical-thoracoscopy, improving the accuracy in staging of lung cancer and mesothelioma. By one incision we can answer many questions about diagnosis, staging and prognosis. For all these reasons, the combination of VAMLA and mediastino-thoracoscopy should be kept in mind for the described indications.

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