

Transcervical uniportal pulmonary lobectomy

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Background: The aim of the study is a description of surgical technique of uniportal transcervical video-assisted thoracoscopic surgery (VATS) for pulmonary lobectomy.

Methods: We used a collar neck incision (transcervical) of an average length 5–8 centimeters. The manubrium of the sternum is elevated with a hook connected to the Zakopane II frame (Aesculap-Chifa, B. Braun, Nowy Tomyśl, Poland). The first step is a transcervical extended mediastinal lymphadenectomy (TEMLA), for improved staging and possible improved survival. The nodes removed during TEMLA undergo intraoperative imprint cytology examination. In case of no metastasis a uniportal VATS lobectomy through the neck follows. Ventilation of the operated lung is disconnected and the pleural cavity is entered by opening of the mediastinal pleura. Pleural adhesions, if present are managed with electrocautery. The branches of the pulmonary artery and vein are sequentially dissected and managed with endostaplers or vascular clips. The lobar bronchus and the fissures are divided with endostaplers and the resected lobe is removed in an endobag.

Results: There were 16 patients operated on in the period 1.2.2016–30.7.2016. There were two conversions—in one patient with left lower lobe tumor we had to convert to uniportal VATS left lower lobectomy due to extensive adhesions. In the other patient undergoing right lower lobectomy there was a conversion to right thoracotomy because of the bleeding from the pulmonary artery. There was no mortality and complications occurred in three patients. The mean operative time was 245.6 min (range, 145–385 min) for the whole TEMLA procedure with imprint cytology and lobectomy and 175.6 min (range, 75–295 min) for a lobectomy solely.

Conclusions: A uniportal transcervical VATS approach for pulmonary lobectomy combined with transcervical extended mediastinal lobectomy (TEMLA) provides an opportunity for radical pulmonary resection and superradical extensive mediastinal lymphadenectomy.

Keywords: Thoracoscopy; lymphadenectomy; lobectomy

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Introduction

Video-assisted thoracoscopic surgery (VATS) technique has been used with an increased acceptance for pulmonary resection for various diseases including pulmonary lobectomy for non-small-cell cancer (NSCLC). Typically, VATS lobectomies have been performed through intercostal

incisions, with four-two incisions. During the last decade VATS operations through a single incision (uniportal approach) gained much popularity (1). A common disadvantage of all intercostal incisions is a considerable pain suffered by patients even though no mechanical retraction of the ribs is used in VATS operations. Besides



Figure 1 Collar incision in the neck and elevation of the sternal manubrium (10).

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Figure 2 Performance of transcervical extended mediastinal lymphadenectomy (TEMLA)—part 1 (11).

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Figure 3 Performance of transcervical extended mediastinal lymphadenectomy (TEMLA)—part 2 (12).

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the intercostal approach there are at least two other minimally invasive VATS approaches including subxiphoid and transcervical techniques (2-9). The main justification for use of these approaches is to minimize an amount of postoperative pain. The aim of this article is to present the initial experience with use of transcervical uniportal pulmonary lobectomy which is combined with Transcervical Extended Mediastinal Lymphadenectomy (TEMLA).

Patient selection and workup and pre-operative preparation

At the present time patients selection should be very careful with limitation to easy cases. A special indication is a suspicion of the metastatic mediastinal nodes involvement on chest computer tomography (CT) or positron emission tomography combined with CT (PET CT) without pathological/cytological confirmation of metastasis on invasive staging with endobronchial ultrasound/transbronchial needle aspiration (EBUS/TBNA) or endoscopic ultrasound/fine needle aspiration (EUS/FNA). Due to TEMLA as an initial step of a procedure the removed mediastinal nodes are intraoperatively studied with use of the imprint cytology technique and in case of discovery of the metastatic nodes an operation is cancelled at this point and the patients is referred to a neoadjuvant therapy.

Currently, it is possible to perform all types of lobectomies with use of transcervical technique. There are several contraindications to transcervical uniportal lobectomy including an advanced stage disease, severe atherosclerosis and calcified and anthracotic intrathoracic nodes and some other technical difficulties—in such patients conversion to intercostal or subxiphoid VATS or open thoracotomy is indicated.

Besides, patient workup and pre-operative preparation is the same as for standard VATS lobectomy.

Preoperative preparation

Procedure

Transcervical extended approach utilizes a typical a 5–8 centimeters collar incision in the neck. The critical technical point enabling a wide access to the chest is elevation of the sternal manubrium with a special retractor (Zakopane II frame, Aesculap-Chifa, B. Braun, Nowy Tomyśl, Poland) (*Figure 1*). The first step is TEMLA, which theoretically might affect survival (*Figures 2 and 3*).



Figure 4 Transcervical entrance to the right pleural cavity and insertion of the Alexis ring retractor (13).

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Figure 5 Dissection and division of the upper right lobe structures, division of the fissure, removal of the resected upper lobe is removed in an endobag, inflation of the right lung (14).

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Figure 6 Two chest tubes are inserted to the chest through the transcervical incision (15).

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VATS lobectomy is the next step after obtaining results of intraoperative examination of the nodes, confirming no metastasis. The patients position is modified with a roll placed under the operated side of the chest, which creates a semi-lateral position which is made even more lateral with rotation of the operating table. Obtaining a lateral position considerably facilitates performance of transcervical lobectomy.

Ventilation of the operated lung is disconnected and the mediastinal pleura is opened. Entrance to the right and left pleural cavities are made in different ways. On the right, the entrance is made in front of the innominate artery, which is pressed towards the back by a peanut. Due to the elevation of the sternum and retraction of the innominate artery the right mediastinal pleura can be visualized and opened. The Alexis ring retractor is inserted to the right pleural cavity, which creates an opening similar to the utility thoracotomy enabling performance of the uniportal lobectomy (Figure 4).

After inspection of the right pleural cavity and division of any pleural adhesions with electrocautery hook the upper trunk of the right pulmonary artery and the pulmonary vein of the upper lobe are dissected and divided with endostaplers with much care to avoid division of the middle lobe vein (Figure 5). The next step is dissection of the segment 2 artery which is dissected, closed with two vascular clips and divided. The right lung is retracted anteriorly to show the right main bronchus and the right upper lobe bronchus, which are dissected and the upper lobe bronchus is divided with use of an endostapler. The step of a division of the fissure is an application of the stapler on the posterior part of the oblique fissure, between segments 2 and 6. The next application of a stapler is between the most anterior parts of the segment 3 and the middle lobe. The last step is a division of the middle part of the fissure, which was left after the previous divisions of the anterior and posterior parts of the fissure. The resected lobe is removed in an endobag, hemostasis is checked and the lung is inflated to check any air leaks (Figure 6). It is possible to put sealing sutures or sealants, if necessary. Two size 28 or 24 chest tubes are inserted through the operative wound—one is placed posteriorly, with a tip placed just above the diaphragm, the other one is placed in front of the lung with the opening in the tube located just below the opening in the mediastinal pleura. The wound is closed with approximation of the edges of the platysma and the skin with single interrupted sutures (Figure 7). In Table 1 the list of transcervical lobectomies performed by our team is shown.

Equipment preference card

- (I) The Zakopane II frame (Aesculap-Chifa, B. Braun, Nowy Tomyśl, Poland)
- (II) Bi-clamp, Harmonic knife or Ligasure
- (III) The Yankauer suction tube
- (IV) The Cameleon videothoracoscope (Karl Storz)
- (V) Standard VATS instruments
- (VI) Curved shaped electrocautery hook
- (VII) Alexis® O™ Retractor. Company: Applied Medical Resources Corporation Retail

Postoperative management

Generally, postoperative management is no different than in standard VATS lobectomy. Usually, we remove chest tubes when a volume of daily drainage is below 300 ml, without an air leak. The tube placed posteriorly is removed first. Usually, the time of drainage is 4–6 days and the time of postoperative stay about 10 days.



Figure 7 The final view of the sutured operative wound (16).

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Intraoperative and postoperative complications are listed in *Table 2*. There were no long-term that developed after cervical lobectomy.

Tips, tricks and pitfalls

- (I) The length of the incision is about 5–8 centimeters and cannot be much shorter because an elevation of the sternum increases the wound. In case of shorter incision the edges of the skin would be excessively stretched.
- (II) After completion of TEMLA an operated side is elevated with bags inserted under the chest. This maneuver, together with rotation of an operative result in semilateral position of patient, which facilitates performance of procedures.
- (III) Entrance to the right and left pleural cavities are made in different ways. On the right, the entrance is made in front of the innominate artery, which pressed towards the back by a peanut. Due to the elevation of the sternum and retraction of the innominate artery the right mediastinal pleura can visualized and opened. The Alexis ring retractor is inserted to the right pleural cavity, which creates an opening similar to the utility thoracotomy enabling performance of the uniportal lobectomy.
- (IV) On the left side, preliminary steps include dissection of the left innominate vein and the left mammary vein, which is closed with two clips on each side and divided. Due to the division of the left mammary vein and the hemiazygos accessory vein (in some cases) the left innominate vein can be retracted in the cephalad and posterior direction and the left mediastinal pleura can be visualized and cut under the sternum creating an entrance to the left pleural cavity. For the left-

Table 1 Types of transcervical uniportal VATS lobectomies

Type of lobectomy	Number of patients	Characteristic of the procedure
Right upper	4	–
Left upper	6	In 1 patient pleural cavity completely obliterated
Right lower	5	In 1 patient pleural cavity completely obliterated
		Conversion to right thoracotomy for bleeding from the pulmonary artery—1 patient
Left lower	1	Conversion to uniportal VATS (dense adhesions)—1 patient
Overall	16	–

VATS, video-assisted thoracoscopic surgery.

Table 2 Postoperative complications

Type of lobectomy	Type of complication	Comment
Right upper plus a wedge of the left upper lobe	Respiratory insufficiency necessitating non-invasive ventilation for 10 days	Bilateral resection
Left upper	Left recurrent nerve palsy, pulmonary aspiration of the gastric content, ARDS, ventilator and tracheostomy for 20 days	Technical problems due to severe pleural adhesions, prolonged operation (6 hours 15 minutes)
Left lower	Conversion to VATS uniport due to severe pleural adhesions	–
Right upper	Delayed introduction of postoperative intercostal chest tube for recurrent pleural effusion	–
Right lower	Conversion to right thoracotomy for intraoperative haemorrhage from the pulmonary artery Postoperative brain stroke	Technical problems due to calcified hilar nodes. Prolonged operation in the 77 years old man

ARDS, adult respiratory distress syndrome; VATS, video-assisted thoracoscopic surgery.

sided transcervical operations the Alexis retractor or any other such device is not used due to the risk of pressure injury of the left phrenic, vagus or left laryngeal recurrent nerves.

- (V) The oblique fissure on the right and the fissure of the left are approached from the back, starting between segment 2 and 6 with creation of the tunnel along the front wall of the pulmonary artery. The fissure is divided with a stapler.
- (VI) The fissure between the upper and middle lobe is divided with application of a stapler between the most anterior parts of the segment 3 and the middle lobe.
- (VII) Two size 28 or 24 chest tubes are inserted through the operative wound—one is placed posteriorly, with a tip placed just above the diaphragm, the other one is placed in front of the lung with the opening in the tube located just below the opening in the mediastinal pleura.

Conclusions

A uniportal transcervical VATS approach for pulmonary lobectomy combined with transcervical extended mediastinal lobectomy (TEMLA) provides an opportunity for radical pulmonary resection and suprardical extensive mediastinal lymphadenectomy.

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None.

Footnote

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

Ethical Statement: The study is approved by the institutional ethical committee and obtained the informed consent from every patient.

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