Original Article on Thoracic Surgery

Subxiphoid uniportal VATS thymectomy

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Contributions: (I) Conception and design: M Zieliński; (II) Administrative support: None; (III) Provision of study materials or patients: None; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: M Zieliński; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Background: To present the technique of minimally invasive extended thymectomy performed through the uniportal subxiphoid approach, with double elevation of the sternum for nonthymomatous myasthenia gravis (MG).

Methods: Operative technique: the whole dissection was performed through the 4–7 cm transverse or longitudinal subxiphoid incision with use of videothoracoscope. The sternum was elevated with two hooks connected to the sternal frame (Rochard bar, Aesculap-Chifa, Nowy Tomysl, Poland). The lower hook was inserted through the subxiphoid incision and the superior hook was inserted percutaneously, after the mediastinal tissue including the major mediastinal vessels were dissected from the inner surface of the sternum. The fatty tissue of the anterior mediastinum and the aorta-pulmonary window was completely removed.

Results: There were four patients in the period 1.1.2017–30.4.2017. There was no mortality and morbidity.

Conclusions: The uniportal subxiphoid approach combined with double elevation of the sternum enabled very extensive thymectomy in case of thymoma.

Keywords: Subxiphoid; thymoma; thymectomy; myasthenia gravis (MG); mediastinum

Received: 13 September 2017; Accepted: 25 September 2017; Published: 17 November 2017.
doi: 10.21037/jovs.2017.09.13
View this article at: http://dx.doi.org/10.21037/jovs.2017.09.13

Introduction

There are two most important principles in the surgical treatment of nonthymomatous myasthenia gravis (MG). One of these is the necessity of removal the whole thymus gland, without leaving any part of the gland in the mediastinum, or in the neck, which is currently might be the problem in VATS thymectomy (1). The other rule, which is generally accepted by the majority of thoracic surgeons is the need of performance of thymectomy in an extended technique, with removal of the adipose tissue surrounding the thymus gland (2,3). In case of myasthenia associated with thymoma the need for extended thymectomy is less clear with no strong data supporting such an aggressive approach. There are very few recommendations regarding the extent of surgery in case of thymomas associated with MG (4). The need for removal the whole thymus gland has been questioned for thymomas without MG (5). The role of thymectomy is totally unclear in case of the other thymic pathologies like the thymic cysts. Thymectomy should not be performed in patients with the thymic hyperplasia without MG.

In the recent years multiple studies have been published confirming that minimally invasive techniques of thymectomy were equally effective for the treatment of thymomas as the standard transternal thymectomy (3,6).

However, the choice of the specific minimally invasive technique of thymectomy is a specific unsolved problem. There are several operative approaches for minimally invasive thymectomy including unilateral video-assisted thoracic surgery (VATS), bilateral VATS, robotic video-assisted techniques (RATS), transcervical thymectomy and subxiphoid thymectomy (7-12). This last approach was introduced by Kido *et al.*, who performed thymectomy within the mediastinum, without opening of the mediastinal pleura (12). During the last decade the uniportal subxiphoid approach was used successfully. However, with exception of Suda *et al.* who described their experience in several publications in the other two studies only case reports were presented (13-15). Our team was the second one using the subxiphoid approach but out policy was quite different from the method of Kido *et al.* We used the technique combining the transcervical and subxiphoid incisions with double elevation of the sternum with use of the Rochard frame and bilateral single VATS ports and performed thymectomy in the maximally extended technique, similar to this described by Jaretzki *et al.* who use the transcervical-transsternal approach (2,16). Subsequently, we modified our technique by introduction of the subxiphoid-right VATS approach, the subxiphoid-bilateral VATS approach and, finally by the uniportal subxiphoid approach, which will be described in this article (17,18).

Patients selection and work-up

All patients with nonthymomatous MG are the candidates for this kind of procedure. In case of the advanced stage III thymomas the transsternal approach is preferred. In case of nonthymomatous MG the operation is proposed primarily to patients in the MGFA class I–IIIb (mild to moderate ocular, bulbar and extremities muscles affected) (19). In case of severe MG the operation is postponed until the patient's clinical improvement after preoperative preparation with steroids, immunosuppressive drugs, plasmapheresis or immunoglobulins.

Pre-operative preparation

Equipment preference card

(I) The modified Rochard frame with two hooks;
(II) Bi-clamp, harmonic knife or LigaSure;
(III) The Yankauer suction tube;
(IV) The Cameleon videothoracoscope (Carl Storz);
(V) Standard VATS instruments.

Procedure

The patient

A uniportal subxiphoid extended thymectomy presented on the videos was performed in a patient with a thymoma with MG and completely obliterated right pleural cavity. In our patient the dimensions of the thymoma were 40×30×20 mm^3.

Surgical technique of the uniportal subxiphoid approach with double elevation of the sternum.

The patient was positioned supine on the operating table with a roll placed beneath the thoracic spine to elevate the chest and to hyperextend the patient's neck. Under general anaesthesia an endobronchial tube was inserted to conduct possible selective lung ventilation during the latter part of the procedure.

A longitudinal 7 cm subxiphoid incision was made above the xiphoid process. The xiphoid process was left without removal. In this case we used a selective ventilation of the left lung.

The anterior mediastinum was opened from below the sternum. A sternal retractor connected to the traction frame (Rochard bar, Aesculap-Chifa, Nowy Tomysl, Poland) was placed under the sternum, which was elevated to facilitate access to the anterior mediastinum from below (*Figure 1*). The whole dissection was performed through the subxiphoid incision under control of a 10 mm EndoCameleon-type videothoracoscope (Karl Storz, Germany) inserted alternatively to the right and left pleural cavities.

The right and left mediastinal pleura were cut near the sternal surface up to the level of the right and left internal thoracic veins, which were left intact with electrocautery hook or bipolar cautery (Bi-clamp, ERBE). Alternatively, such devices as a harmonic knife, LigaSure or vascular clips can be used to secure the vessels throughout the procedure. In this patient the right pleural cavity was completely obliterated. A limited dissection of the right lung was performed enabling an extended thymectomy. After dissection of the mediastinal tissue from the inner surface of the sternum a 2–3 mm puncture was performed over the sternal notch and a single-tooth hook was inserted percutaneously under the sternal manubrium. The second hook improved exposure of the superior mediastinal and the lower neck regions facilitating considerably performance of the procedure and enabling visualization of the whole upper poles of the thymus and the lower part of the thyroid. The prepericardial fat was dissected from the pericardium and diaphragm both for the right and for the left side. Dissection of the prepericardial fat containing the thymus gland proceeded upwards in en bloc fashion under control of thoracoscope, without any attempt

Figure 1 Subxiphoid incision, elevation of the sternum, opening of the right mediastinal pleura, dissection of the mediastinal tissue from the sternum, introduction of the percutaneous hook elevating the sternal manubrium (20).
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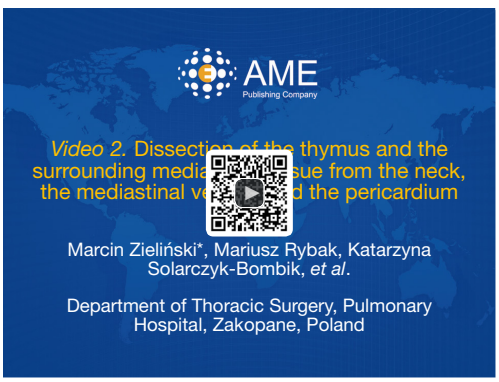

Figure 2 Dissection of the thymus and the surrounding mediastinal tissue from the neck, the mediastinal vessels and the pericardium (21).
Available online: http://www.asvide.com/articles/1823

to dissect the thymus gland with the tumor separately. The right and left phrenic nerves were the margins of dissection. The dissection of the thymus proceeded along the left innominate vein with closure with vascular clips and division of the thymic veins (*Figure 2*). The left mediastinal pleura was opened at the very beginning of dissection, enabling the maneuver of transferring of the dissected specimen obscuring plane of dissection from the right to the left pleural cavity. This maneuver facilitated dissection substantially due to improved exposure of the rest of the thymus. Dissection proceeded cranially with closure and division of the lower thyroid veins, performed in the same way as in the case of the thymic veins. The liberated upper poles of the thymus

Figure 3 Completion of dissection and extraction of the specimen from the chest, the view of the specimen and chest wall after closure of the incision (22).
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were grabbed and pulled caudally enabling dissection of the thymus from the pericardium. Dissection of the specimen along the left phrenic nerve was performed, the same as was done on the right side (*Figure 3*). The specimen containing the thymus and the adipose tissue was placed in a plastic bag and removed. Haemostasis was checked and single chest tube was inserted into the left pleural cavities through the subxiphoid incision without any drainage of the right pleural cavity due to the limited dissection of the right lung. The anaesthesiologist hyperexpanded both lungs. The subxiphoid incision was closed in the standard manner, a puncture incision was closed with a single 5/0 suture, which was replaced with a peristrip on the next day. The patient was extubated immediately after the operation. Final pathology was thymoma B2, according to the WHO classification, stage pT1a according to the Masaoka-Koga classification.

Role of team members

To manage effectively patients undergoing thymectomy for MG there must be a well-organized team consisting of several specialists experienced in diagnosis, operative treatment and postoperative care of patients with MG:

(I) Neurologists—diagnosis of MG, preoperative preparation of the MG patient with anticholinesterase, steroid/immunosuppressive drugs or/and plasmapheresis/intravenous immunoglobulins, selection of patients for thymectomy (together with a thoracic surgeon), follow-up, further care of MG patients.

(II) Thoracic surgeons—selection of patients for thymectomy (together with a neurologist), performance of an operation in minimally invasive technique.
(III) Anaesthesiologists—proper conducting of anaesthesia and postoperative treatment of myasthenic patient.
(IV) Nurses—care of MG patients before and after an operation.
(V) Physiotherapists—care of MG patients before and after an operation.

Post-operative management

Generally, a patient is extubated immediately after the operation. Steroids and/or immunosuppressive drugs are started soon after the operation. The anticholinesterase drugs given in the preoperative doses are resumed when the clinical symptoms of MG recur, which may happen after a variable period of time. Generally, the chest tubes are removed on the first or second postoperative day and the patients are discharged on the 4–7th postoperative day.

Tips, tricks and pitfalls

(I) The subxiphoid incision can be made longitudinally or transversely, just below the junction of the lower angle of the sternum. The length of the incision depends on the patients' body habitus—in case of slim patients 3 cm could provide an adequate approach instead of the length of 5–7 cm, which is usually performed in the medium body habitus patients.
(II) The xiphoid process can be preserved in case it soft, cartilaginous. When the xiphoid is ossified it is better to remove it.
(III) To avoid occurrence of postoperative hernia after transverse subxiphoid incision we recommend making it a little below the insertion of the xiphoid process to the lower sternal angle, due to the presence of the rectus muscles at this level, which allows for reconstruction of the fascia covering the muscle and protects the wound from dehiscence. If the incision is made to high (cephalad) there is no fascia at this level place and closure of the wound is not safe.
(IV) Generally, we start dissection by cutting the mediastinal pleura beneath the sternum and opening of both pleural cavities to proceed with dissection on the right and left, alternately; the other option is to start dissection from the right pleural cavity with completion of dissection in the left one.
(V) For the use of the presented technique we advise to keep hypoventilation of both lungs, if possible; the other option is to ventilate the left and right lung, alternately.
(VI) After dissection of the mediastinum from the posterior surface of the sternum the mediastinal structures are pressed posteriorly towards the spine, with the Yankauer suction tube to protect these structures from injury during percutaneous insertion of the second sternal hook elevating the sternal manubrium.
(VII) The next step is dissection of the right and left epiphrenic fat pads from the domes of the diaphragm and the pericardium. Dissection of the specimen containing the whole thymus gland is proceeded in the cephalad direction. In case of obese patients and especially in thymomas it is useful to transfer the specimen to the contralateral pleural cavity. This maneuver gives the clear view of the plane of dissection facilitates dissection of the specimen from the pericardium.
(VIII) During dissection on the right it is useful to rotate an operating table to the right and to rotate it in the opposite direction during dissection on the left side.
(IX) Dissection of the area cranial to the left innominate vein is the most difficult part of the procedure. The aim is to reach and visualize of lower poles of the thyroid gland to remove completely the upper poles of the thymus and the surrounding fatty tissue. The innominate artery, right and left carotid arteries and the trachea should be clearly dissected. This can be achieved with the simultaneous use of the bipolar cautery (or harmonic knife or LigaSure) and the Yankauer suction tube, which is used to dissect and retract tissue. Avoidance of injury of the left recurrent nerve might occur during dissection in the area located on the left side of the trachea.

Acknowledgements

None.

Footnote

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

Ethical Statement: The study was approved by the institutional ethical committee and obtained the informed consent from the patient operated on.

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doi: 10.21037/jovs.2017.09.13

Cite this article as: Zieliński M, Rybak M, Solarczyk-Bombik K, Wilkojc M, Czajkowski W, Kosinski S, Fryzlewicz E, Nabialek T, Szolkowska M, Pankowski J. Subxiphoid uniportal VATS thymectomy. J Vis Surg 2017;3:171.