



Right VATS thymectomy, utilising a subxiphoid incision and the LigaSure retractable L-hook

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Abstract: We describe a technique of right sided video-assisted thoracoscopic surgery (VATS) thymectomy in a lady who had a large 7 cm mass which was adherent to the pericardium, extended into the superior poles of the thymus and had adhesions to the lung bilaterally. We utilized 3 mm × 5 mm ports from the right-hand side and a 12 mm subxiphoid incision which was used to retrieve the tumour at the end of the case. Due to the bulky nature of the tumour we also added a 5 mm port to the left chest to visualize the left phrenic nerve towards the end of the case. The pericardium is widely excised in this case as the tumour is adherent to it. The LigaSure L-hook is demonstrated which was particularly useful in this case. This device can grasp, blunt dissect, cut and seal as usual like any other LigaSure, but there is a switch that can retract the LigaSure back and advance a hook diathermy without removing the instrument from the chest. We hope this video and description demonstrates that endoscopic thymectomy is safe and feasible even in more difficult cases and provides the same completeness of resection as open surgery.

Keywords: Video-assisted thoracoscopic surgery thymectomy (VATS thymectomy); thoracic surgery; LigaSure

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Introduction

There is a wide range of techniques that may be used for a thymectomy. When considering the approach that you intend to use principles laid out by ITMIG in 2011 which should be borne in mind. They require an *en bloc* thymectomy for all thymomas including perithymic fat, cervical poles and, for patients with myasthenia gravis, that extended thymectomy must be performed including mediastinal pleura, pericardiophrenic fatty tissue and dissection of the aorto-pulmonary window (1).

When considering the exact approach and variations that can be employed we have been impressed by subxiphoid approaches to the chest. Early descriptions in thoracic surgery were described by Mineo and colleagues (2,3) for metastasectomy where 2 ports were placed in the intercostal

spaces. Then the xiphisternum was resected and the linea alba incised for 8 cm vertically to allow entry for the surgeons' hand into the hemithorax so that the whole lung could be palpated for metastases, including the contralateral hemithorax.

More recently this has been replicated but with a single subxiphoid approach avoiding all incisions between the intercostal spaces using a Covidien SILS (single incision laparoscopic surgery) port and CO₂ to perform bilateral metastasectomy (4).

Cardiac surgery has also been performed using a subxiphoid only approach by Levinson (5,6) including multi vessel off pump coronary artery bypass graft (CABG) and atrial septal defect repairs, using a 7 cm subxiphoid incision and a sternal elevator.

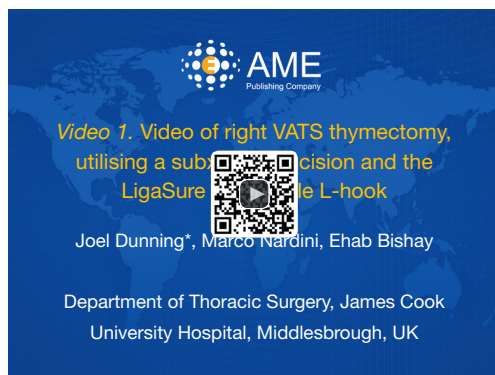


Figure 1 Video of right VATS thymectomy, utilising a subxiphoid incision and the LigaSure retractable L-hook (10). VATS, video-assisted thoracoscopic surgery.

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Subxiphoid surgery has been extended to lobectomy of every lobe by Liu *et al.* from Taiwan using a sternal elevator rather than CO₂ (7). They have successfully performed lobectomy of every lobe with a single subxiphoid port and also have performed segmentectomies in this fashion.

Resection of anterior mediastinal masses have been described with a subxiphoid incision (8) and thymectomy has also been performed using a single subxiphoid approach (9). This has been achieved using the SILS port and CO₂.

Our current approach continues to use ports from the right chest but in order to reduce the size of these incisions we like to use a subxiphoid utility port.

Port insertion for right video-assisted thoracoscopic surgery (VATS) thymectomy

The intercostal spaces range in size from 7–10 mm and therefore large ports and instruments may easily cause damage to intercostal nerves causing post thoracostomy pain in addition there is now a wide range of instruments that are 5 mm or less and reduction in the number of exchanges made increases the speed of the procedure, thus we like to use 3 mm × 5 mm ports and a 5 mm camera. The LigaSure with retractable L-hook means that all that is needed for most of the operation is a grasper in the left hand and the LigaSure L-hook in the right hand. In thymectomies there is usually little in the way of bleeding and the vessels can easily be addressed by the LigaSure device.

The patient is positioned supine, often with a support under the right scapula in a right sided approach. A single lumen tube is sometimes used as we use CO₂ to create space

in anterior mediastinum bilaterally so single lung isolation is not always required, although in the accompanying video (*Figure 1*) a double lumen tube was used. The patient was on one lung ventilation until the left pleura was breached and then double lung ventilation resumed. The CO₂ is set at 8 mmHg at a maximum flow rate of 8 liters per minute and reduced if there is hypotension, high airway pressures or hypercarbia.

As a finger cannot be first inserted into the chest for a 5 mm port we use a disposable plastic 5 mm port, which has a clear central trocar to enter the chest (Applied Medical, Kii-Fios early entry port). The CO₂ is attached to the side arm and a 5 mm straight camera is placed into the trocar. An incision is made over the skin of the 5th space in the anterior axillary line and under screen vision and CO₂ insufflation the trocar is pushed into the chest. The pleura and then the lung is seen on the screen and further advancement is paused as the lung is pushed away by the CO₂. The port is then inserted safely into the chest.

After CO₂ insufflation has pushed the diaphragm inferiorly, a second port is placed in the mid clavicular line, usually in the 3rd space.

Then a 3rd port is placed under vision in the mid clavicular line just above the diaphragm.

Once the diaphragmatic fat has been removed, a 2 cm vertical incision is made below the xiphisternum and down to the linea alba. The linea alba is divided by electrocautery for 2 cm and then a finger is inserted and pushed up vertically under the xiphisternum then under the sternum. The finger is then moved towards the camera in the chest and is easily seen. Once the finger has entered the chest cavity, this is removed and replaced by a 12 mm CO₂ port. The subxiphisternal port can be useful to place the camera in order to see the contralateral phrenic nerve.

Conduct of the thymectomy

The thymus and thymic fat is removed from the diaphragmatic surface and retracted cranially, then the right phrenic nerve is visualized and using the LigaSure the thymus is taken off the phrenic nerve leaving a small margin only.

This dissection plane is continued up on the surface of the Superior Pulmonary vein up and beyond the right internal mammary vein.

Then the pleura is dissected medial to this vein and then the dissection plane is continued medial to the right internal mammary artery (RIMA). This dissection can now be continued across the thymus under the sternum all the

way across to the left pleural cavity and this pleural cavity opened.

Next the thymus is lifted anteriorly and released from the pericardium, or a very low threshold is taken to take a disc of pericardium with the sample especially in older patients or larger thymomas where the tumour may be more invasive in nature. In this video a particularly large area of pericardium had to be removed. This is very straightforward as there are rarely any adhesions to the heart. Care should be taken at the pericardial reflection with the aorta and pulmonary artery.

Attention is then turned to removing the right superior horn from behind the right internal mammary vein. Usually this is fairly straightforward and if vision is impaired by the RIMA vein then the camera should be placed in the subxiphoid port. It is tempting to short-cut removing this horn and going across it mid-way, but if it is followed until the thyro-thymic ligament then you should not be cutting across fatty tissue as you get above it. You should see the innominate artery and the trachea below it and they should be void of fatty tissue.

The thymus is then retracted caudally and dissected off the innominate vein. There is always a thymic vein which can always be sealed with the LigaSure. Often if the opposite pleura has been widely opened, it is possible to push the thymoma away right over into the opposite pleura using its own weight to act as retraction as the left superior pole is also removed and the thymus is taken off the innominate vein up to the left internal mammary vein.

Often the most technically challenging part is visualization of the opposite phrenic nerve. The subxiphoid port, often facilitates an excellent view of the opposite phrenic nerve if the thymus is not too bulky. However, in the video presented, the view was impaired by the size of the thymus and thus another 5 mm port was added to the left chest, significantly improving the vision. We had to staple off a section of lung and the stapler was advanced through the subxiphoid port.

Blood supply of the thymus

Vessels invariably arise from both left and right internal mammary arteries and veins, vessels pass down the thyrothymic ligament and inferiorly smaller vessels can come from pericardiophrenic vessels.

These should always be specifically sought and sealed. The thymic vein is constant and also should always be sought.

Removal of the thymus

After release of the thymus, it is placed in the right hemithorax, and the area is checked for bleeding. Intercostal nerve blocks are placed using a long needle under vision from the subxiphoid port.

The sample is only removed as the final intraoperative step as CO₂ insufflation will be lost once the subxiphoid port is extended to remove the thymus in a retrieval bag.

Once removed in a bag, a single size 20 Fr drain is inserted into the mediastinum. This may either remain for a few hours, or if the case has been particularly dry and the lungs were not adherent to the thymus then consideration should be taken to removing it in the operating room. Our protocol is to place the patient on a positive end expiratory pressure (PEEP) of 10 cmH₂O for 10 minutes while all the other ports are sutured closed and then to place the end of the drain into a bowl containing water. If there are no bubbles then the drain is removed.

Safety considerations

Throughout the operation there is a 5 mm suction irrigator available for use. We also have 5 mm dissecting peanuts and 5 and 10 mm endoclip applicators available. If a larger vessel bleeds then pressure can be applied and the suction irrigator can be used to identify the source of bleeding. This can then be grasped prior to application of a clip. If the innominate vein is damaged, then it must be remembered that this is a low-pressure vessel and the patient can be placed in reverse Trendelenburg to reduce further the pressure in the vein. Additional CO₂ insufflation can also collapse small low-pressure veins to give more time to identify the location of bleeding.

Summary

The most important consideration in VATS thymectomy is that the same quality of resection is achieved as by an open operation. Challenges include good vision of both phrenic nerves and good vision of the superior horns above the innominate vein.

The described thymectomy approach achieves many of these aims. The subxiphoid port allows an excellent view of both phrenic nerves and the superior horns of the thymus. It also allows painless removal of the sample at the end of the operation. The 5 mm ports allow the surgeon to use a multiport approach that they may be more used to than a

uniportal subxiphoid approach. The LigaSure retractable L-hook is an outstanding novel instrument that reduced instrument exchange and speeds up surgery. We encourage surgeons to try this approach as one method of performing VATS thymectomy.

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Footnote

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