

“The long and winding road” of thymic surgery

Vincenzo Pagliarulo, Wanteo Fang

Department of Thoracic Surgery, Shanghai Chest Hospital, Shanghai 200030, China

Correspondence to: Vincenzo Pagliarulo, MD. Department of Thoracic Surgery, Shanghai Chest Hospital, Shanghai 200030, China.

Email: pagliarulo.vincenzo@yahoo.com.

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Surgical approach for thymoma is still a controversial subject sparking continuous debate in the international literature and meetings. Lack of agreement persists about the clinical impact of the different surgical techniques.

This clearly contributes to a rise in interest regarding surgery for thymoma, including the efforts of thoracic surgeons to push forward less invasive approaches. The selection of surgical approach is mainly based on surgeon's experience than on consolidated statistics data and guidelines.

Whatever approach has been chosen, the surgeon has to respect first the oncological principles, that is the complete en bloc removal of the thymic mass (*Table 1*). In addition to the complete resection of the entire thymus, it is important to maintain the capsule surrounding the tumor intact, avoiding any tumor spillage during the procedure. The proximity of the thymus to other vital structures, such as the superior vena cava, brachiocephalic vein, and the phrenic, vagus, and recurrent laryngeal nerves, can make surgical dissection challenging. In addition, thymic tissue may be found at ectopic sites throughout the mediastinum and cervical area. The complexity and variation of the thymic anatomy and the locations of ectopic foci in the perithymic mediastinal fat and other mediastinal locations are important when considering surgical indications and approaches in patients with myasthenia gravis (MG).

Numerous case series have demonstrated that the main factor associated with long-term survival in thymoma is the completeness of resection. These studies show significant survival advantage at 5 and 10 years in those patients undergoing complete R0 resections (1).

Complete resection, especially when performed early in the disease course, has been shown to be associated with satisfactory long-term outcome.

Surgery of the thymus has evolved over the last century, starting since 1911 when Ferdinand Sauerbruch made the first successful thymectomy and opened the “long and winding road” to thymic surgery. Thymectomy for thymoma has traditionally been performed through a trans-sternal approach because of its excellent exposure to the anterior mediastinum. Sternotomy is still regarded by many as the gold standard surgical approach to the thymus. Advantages of the sternotomy include excellent visualization of the thymus and surrounding structures as well as the ability to extend the incision in order to resect and reconstruct all involved structures in cases of advanced thymic pathology. In addition, many surgeons believe that open approach provides the most oncologically sound operation and minimizes the risk of drop metastasis that is potentially associated with minimally invasive approaches. In the treatment of MG, the sternotomy allows for a very thorough exploration of the mediastinum.

Chasing the contemporary way for “scarless” surgery, new trends in thymic resections came to light.

Transcervical thymectomy, multi-port video-assisted thymectomy (intercostal and/or subxifoid), and robotic thymectomy, are also used. Thymectomy via video-assisted thoracoscopic surgery (VATS) is emerging as an increasing feasible and efficacious alternative to open thymectomy. Patients may benefit from minimally invasive approaches and data regarding the oncologic effectiveness of these techniques show benefit regarding overall and disease

Table 1 Thymoma survival according to extend of resection

Extent of resection	Survival according to authors						
	Rea	Zhu	Nakagawa	Regnard	Kim	Okum	Margaritora
Patients	132	175	130	307	108	273	317
Complete resection (%)	81.8	72.0	95.0	84.7	81.5	94.5	93.1
5-y SR (%)	82.5	88.4	96.0	—	81.5	94.5	92.0
10-y SR (%)	71.0	—	94.0	76.0	85.0	95.0	87.4
20-y SR (%)	—	—	—	—	—	—	77.0
Incomplete resection (%)	9.1	13.7	5.0	9.8	18.5	3.3	6.9
5-y SR (%)	16.0	43.2	33.0	—	55.0	—	73.0
10-y SR (%)	9.0	—	33.0	28.0	35.0	60.0	32.0
20-y SR (%)	—	—	—	—	—	—	21.0
Biopsy/gross disease (%)	9.1	14.4	—	5.5	—	1.6	—
5-y SR (%)	33.0	73.5	—	---	—	—	—

free survival, but also reduced blood loss, lower rate of complications such as pneumonia, and shorter hospital stay (2). Given the excellent capability of these techniques to perform a complete and extensive thymectomy, there does appear to be a leading role for minimally invasive thymectomy mainly for the treatment of early stage thymoma. Transcervical thymectomy, as first described at the beginning of the twentieth century, can be considered the first minimally invasive approach to thymus. With the advancement of endoscopic equipment and techniques, multi-port VATS was used to resect the thymus and performed through the left or right chest, according to the location of the tumor and surgeon's preferences. The right side is favored by many because of the increased space in the right chest as well as the improved access and visibility of the venous structures. Others prefer the left side approach for the better view of the thymus upper horns related to the wider angle between the left brachiocephalic vein and internal mammary vein, as described by Dr. Ooi in these two video clips (3,4).

The use of single-port VATS thymectomy derives mainly from single-port VATS lung resection experiences as anesthetic and surgical techniques for the former are not significantly different from those of the latter. Over the past few years, surgical techniques and experience in minimal invasive surgery have evolved resulting in single-incision thoracoscopic surgery for lung resections. The aim of this approach is to diminish the surgical trauma by reducing the number of port sites, resulting in a wide acceptance

of single-port VATS lobectomy due to the reduction in postoperative pain and to a shorter recovery time compared to multi-port VATS. Different sites of incision have been used: infrasternal, subxifoid and intercostal (5,6).

Several papers discussed the benefits and disadvantages of single-port surgery for lung resection. Short-term postoperative results, functional outcome, and costs available in the literature lack of general agreement. Authors supporting single-port surgery for lung resections advocate that the latter has several benefits when compared to multi-port VATS. By using fewer incisions, a potential reduction of postoperative pain with less painkillers use may be accomplished. In addition, accelerated postoperative recovery may result in a shorter hospital stay. Furthermore, a superior cosmesis can be reached with placement of a single port, although single-port VATS usually requires a larger initial thoracic incision than conventional multiport thoracoscopic approach. Literature on single-port VATS consists mainly of case series, with conflicting results. Some studies demonstrated that single-port surgery seems to be a safe and feasible approach for the surgical treatment of lung diseases. Other papers showed an increased amount of blood loss in the single-port VATS arm for lung resections. There is literature on cost-effectiveness of single-port VATS for lung resection established that single-port procedures have secondary benefits including a decreased hospital stay, a faster return to work and improved cosmesis, with a possible positive effect on total costs. These preliminary results required further research as other papers show no

cost advantages between single-port and multi-port VATS for lung resection.

So far, the literature on single-incision VATS thymectomy is more limited. Randomized controlled trials comparing single-port with multi-port VATS thymectomy are lacking and so far, mainly case reports were published. To obtain a further overview of the literature, PubMed was searched using the following search terms: 'thymectomy', 'thymoma', 'VATS', 'single-port', and 'single incision'. Case reports, comparative studies and case series (7) on mediastinal tumor resection were found. All these papers discussed the benefits of single-port VATS in patients with thymic disease attempting to determine whether single-port VATS thymectomy can play an alternative role in current minimal invasive thoracic surgery. But all of them show a low statistical significance for the outcomes. Nevertheless, short-term postoperative results, functional outcome, and costs have been considered and appear to be at least none-inferior to the multi-port VATS thymectomy ones. In addition to potentially better postoperative outcomes (including postoperative pain, morbidity and hospital stay) associated with single-port VATS thymectomy, it is also evident that longer operating time in the early period is needed when comparing single-port to multi-port VATS. Operation time decreases as surgeons gain more experience or come from single port VATS lung resection approach. Many thoracic surgeons believe that this approach has its limitation in oncologic clearance and outcome leading to some controversy regarding adopting the single-port VATS approach in the thoracic surgical field. There remains little information on the long term surgical outcomes of single-port VATS thymectomy compared with multi-port VATS. Future prospective cohort studies are needed to address the issue. Further advancement of surgical technology has led to the development of robotic surgical system for the thymoma surgery. With the advent of robotic surgery, reference centers have transitioned to this modality. The superiority of robotic thymectomy has been shown in some papers, but still considered controversial and under investigation. The multiple surgical options put the surgeons to choose the most case-specific approach mainly based on personal experience with a moderate inter-observer agreement (6,7).

In these surgical videos, Dr. Ooi offered a step-by-step description of the single intercostal (left and right) VATS en bloc thymus and perithymic fat removal technique. As a simple, reproducible, and minimally invasive approach to tissue extraction, it may help reducing the intercostal trauma associated with multiport VATS approaches. One advantage

of this single-port approach is the direct endoscopic view similar to that of open thoracotomy. Moreover the dissection has been performed via blunt technique and vessels have been ligated with endoscopic clips, thus saving the cost of using expensive devices. The authors showed that it is not mandatory to use specialized instruments during single-port VATS thymectomy. Nevertheless the handling of conventional endoscopic instruments through such limited port requires considerable surgical skills and operating time at an early learning period. And with this single port approach, it is impossible to use artificial pneumothorax with CO₂ insufflation, which is believed by many to help enlarge the operation field and improve the surgical view of the anterior mediastinum. Technically, the steps performed in single-port VATS thymectomy are no different from those of the multi-port VATS (3,4).

Debate regarding the gold standard surgical approach will continue. And definitive answers will not be available until further results from investigation on long-term outcome. Until now, the literature is still weak to support single port VATS. Despite all these considerations, preliminary data, as well contradictory, encourage single-port surgery (6), maybe pushed by the enthusiasm of a new fascinating and challenging procedure, but can this be consider the right direction in "the long and winding road" of thymic surgery?

This question would remain open. Despite of being an attractive surgical technique, single-port VATS requires further validation, before it could be considered as the preferable procedure for thymic disease.

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Footnote

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