



## Subxiphoid Thoracoscopic Thymectomy and Anterior Mediastinal Mass Resection: Alternative Technique Description

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### Abstract

Thymoma is the most frequent tumor of the anterior mediastinum, and the cornerstone of treatment is surgical resection, whenever possible. Most commonly nowadays, it is done by minimally invasive surgery, with VATS (video-assisted thoracoscopic surgery) or RATS (robotic-assisted thoracoscopic surgery). Either technology is applied, the lateral approach is the most frequent, placing all the ports in the intercostal spaces (up to 3 or 4 incisions) and providing a side view of the surgical area. Even though described and analyzed in the literature, the following paper presents and describes a technique for subxiphoid thymectomy with three-port and without sternum retraction and without xiphoid process resection.

### Introduction

A review of electronic data charts and details of the technique of patients who underwent surgery for anterior mediastinal mass with the subxiphoid thoracoscopic approach, from August 2022 to December 2024 at the Hospital de Base, by the Thoracic Surgery Discipline of the Medical Faculty of São José do Rio Preto (FAMERP). The approval for this study review was obtained from the Ethics and Research Committee of the Hospital. Demographic data and postoperative information were collected. For this descriptive paper, we also highlight some aspects of the technique.

### Material and Methods

#### Technique description

The preparation for the surgery is very similar to the lateral thoracoscopic: the patient is under double-lumen lung ventilation. The use of bispectral index monitoring is restricted to Myasthenia Gravis patients.

The patient is kept in standard dorsal decubitus with a cushion in the back, close to the kidneys, in such a way that it would provide a wider angle in the transition from the thorax to the abdomen (Figure 1). Therefore, we try opening the space between the xiphoid process, the costal flanges bilaterally, and the belly.

The neck and head are also positioned with a cushion to avoid excessive flexion. So far, this position has given us a comfortable space for port placement and instrument movement, without significant changes in the orientation of the anterior mass or vessels. Arms are kept alongside the body and legs open so the surgeon can position himself/herself in the midline and comfortably move his/her arms. The tilt in the bed is made as usual in thoracotomies. However, in this situation, bend the lumbar column and improve a wide angle to manipulate the thoracoscopic instruments and avoid collisions with others from the surgical staff or other devices.

We apply a tri-port method: a 10 mm 30° degree scope below the xiphoid and two 5 mm ports on each side for instruments. Usually, each lateral port is in the hemi-clavicular line at the 6th intercostal space, but always check the best port position from inside after inserting the camera. Rarely during the surgery, we have moments when the instrument is crossing in front of the camera to the other side (opposite pleural space), and these few moments usually occur when enlarging the first opening to the contralateral pleura. Our preferred instruments are a grasper and

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a dissector (Maryland forceps or even the energy sealer). We do not use a sternal retractor or elevator, and we do not resect the xiphoid process. Despite the augmentation of working space at the entry of instruments and inside at the anterior mediastinum compartment, these two maneuvers could add, we try to keep it even less invasive. We also use CO<sub>2</sub> inflation, the gas pressure aids with soft tissue dissection and is a valuable tool.

Starting with a 1 cm to 2 cm incision on the right side of the xiphoid process and the blunt dissection, with the help of finger palpation to create the first tunnel space to place the trocater and the camera. Usually at this point and with gas insufflation, we can see little space retrosternal and try to identify the right pleura and open it (patient under single-lung ventilation) with dissection. Then, the right port is placed, and with a hook or energy sealer device, the left pleura is opened under visualization (changing the side of single-lung ventilation). After the two working ports are placed, the fat tissue is dissected. It has already been well described that the advantages of subxiphoid access to the anterior mediastinum for minimally invasive thoracic surgery (RATS or VATS), the main one relies on the visualization and protection of the phrenic nerves limited bilaterally. This is exactly the landmark used to start dissection, and freeing fat tissue and possible adhesions from the phrenic on each side. The angle also provides a comfortable view and manipulation of the upper mediastinum and vessels, with both sides of the innominate vein and artery. The angle from below and the possibility of nearing the camera straight to the middle allow a clear view of the thymic cornua in the neck and bring it down without great difficulties.

The specimen is removed inside a protective bag through the middle incision. Muscle layer closure is done in standard fashion, and care is taken to maintain the diaphragm insertion intact and avoid future hernias in this location. None of our cases had such problems. Meanwhile, we never had an extremely big or solid tumor that would require a large costal margin incision or a small thoracotomy. The chest tube (20- 24F) is positioned in the subxiphoid incision.

Our standard working instrumentation is a laparoscopic grasper forceps in one hand and an energy sealer device in the other, changing them whenever needed or the surgeon judges so. After adapting and facing some difficulties with ergonomics, there are two points that we usually might foresee as obstacles. The first is placing the lateral ports too far away from the sternum, closer to the axillary line. That would keep the surgeon with his/her arms stretched and wide open, causing fatigue to the shoulders. If it happens anyway at a momentary step of the surgery, the assistant surgeon can temporarily manipulate the grasper to hold any tissue. Even the surgeon can hold the camera and the energy device at this brief moment. The second one is when operating on patients with a high abdominal volume. There are some aspects that we judge as predictors of difficulty at surgery, such as BMI, reduced lumbar mobility, severe infiltration, or invasion of major vessels. Sometimes an elevated BMI cannot be translated into the same difficulty as a central obese patient with high abdominal circumference. In these situations, the surgeon or the assistant might not have enough space with the camera or instruments, and keep pushing them down against the belly. It can be cumbersome and even dangerous when dissecting the vascular structures. This is one of the main points to judge if the subxiphoid approach is suitable for a patient with central abdominal obesity.

**Results**

The subxiphoid thoracoscopic approach was adopted as one

option for positioning at our institution. From August 2022 to December 2024, 15 patients were submitted to thoracoscopic subxiphoid thymectomy at the Hospital de Base by the Thoracic Surgery Discipline.

The patients' information and the post-surgical data from this series are detailed in Table 1 (age, sex, diagnosis, resection status, ICU, LOS, resection, diagnosis, surgery time, and complications).

There were five men and ten women, with a mean age of 43.3 years (15-74). There were four thymomas, of which three had myasthenia gravis. Eleven patients were non-thymomatous myasthenic patients, and three had other diagnoses for anterior mediastinal masses.

All patients had R0 resection. There was no case in the retrosternal space created that was sufficient for instrumental movements or tissue dissection. Two patients needed conversion to sternotomy due to invasion of the tumor into the innominate vein. In this situation, the subxiphoid incision was a facilitator because there was no need to turn the patient, and the operative field was ready for the sternotomy. It was even possible to keep the camera whilst an instrument kept the compression, and the assistant started opening.

One patient with conversion had a type B2 thymoma with myasthenia. He spent a total of 24 days in the hospital, but with no further complications in the follow-up. The other was a female with type AB thymoma, with seven days as an inpatient, but also with no other complications. Both are currently in regular follow-up at the outpatient clinic.

Fourteen patients went to the ICU (eight had myasthenia) and stayed an average of 2.0 days. The total length of stay was 6.0 days. Despite this case of conversion, there were no other significant issues. The mean surgical time was 255 minutes. Removing those two cases of conversion, the meantime drops to 120 minutes. There were no other postoperative complications on the long-term follow-up.

**Discussion**

Several studies compare the results between methods of

**Table 1:** Surgical and post-operative.

Sex	Myasthenia Gravis	Diagnosis	ICU (Days)	LOS (Days)	Complications
F	Yes	Thymoma	1	1	No
F	No	Lymphoid hyperplasia	3	1	No
M	No	Broncogenic cyst	3	1	No
M	Yes	Thymoma A	5	6	No
M	No	Thymic Cyst	4	2	No
M	No	Lymphoid hyperplasia	2	3	No
M	No	Thymoma B2	24	7	Yes
F	Yes	Lymphoid hyperplasia	1	2	No
F	No	Hibernoma	1	1	No
F	No	Lymphoid hyperplasia	1	1	No
F	Yes	Lymphoid hyperplasia	1	1	No
F	Yes	Thymoma AB	3	2	Yes
F	No	Breast cancer metastasis	0	2	No
F	Yes	Lymphoid hyperplasia	3	2	No
F	No	Lymphoid hyperplasia	2	1	No



Figure 1: Patient position.

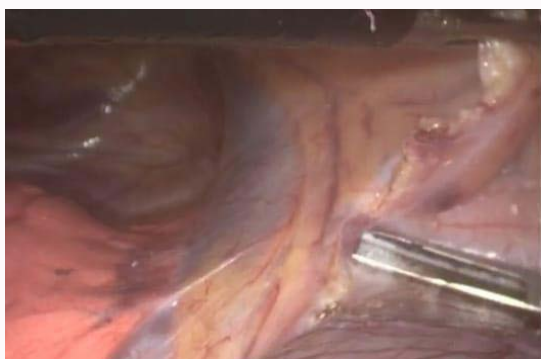


Figure 2: Right phrenic nerve visualization.



Figure 3: Anterior view and three-port manipulation.

thymectomy or anterior mass resection. And when discussing the subxiphoid approach, there is a wide range of different details. The first description of such method was in 2012 by Suda, with a sternum elevator and a port to allow CO<sub>2</sub> flow [1-6].

Abu-Akar and his well-experienced uniportal team published a paper reporting the experience of 38 patients with the single-incision subxiphoid [5]. In their technique, there is no CO<sub>2</sub> insufflation nor sternum retraction, but they resect the xiphoid cartilage and use specific uniportal instruments. The mean surgery duration for pure mediastinal masses was 155 min (55 min up to 210 min), similar to our results, when excluding conversions.

The subxiphoid thoracoscopic approach is even safe and feasible for complex thymic resections, as demonstrated by Jiang. In his series of 48 patients, there were 39 with pericardium and/or lung resections. And nine had left innominate vein infiltration. Three patients received neoadjuvant therapy (chemo or radiotherapy). The median tumor size was 5 cm. All 48 patients had R0 resection. His three-port

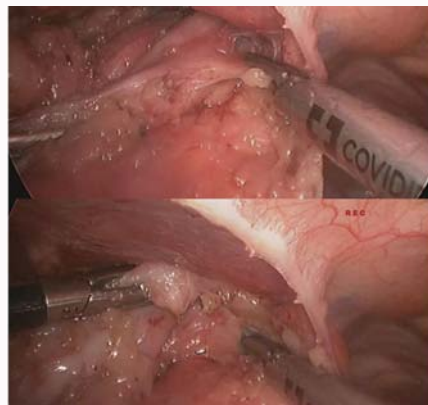


Figure 4: Pulling down the left superior thymic horn after identification of the left phrenic nerve and the left portion of the brachiocephalic artery.

technique included the aid of a sternum elevator [4].

Hashimoto describes in his paper his technique for subxiphoid RATS with four robotic arms (two on the right side, the camera in the middle line, and the fourth arm at the left side) in eight patients [7-9]. He also did not resect the xiphoid nor use a sternum elevator, although he describes using the robotic arm with the camera to push the sternum upwards. Another valuable experience is reported by Kang, with a total of 110 patients who underwent robotic subxiphoid thymectomy [10]. His three-arm technique includes a 3 cm Linea alba incision with the cartilage process resection. Some details and tips described in the paper are the possibility of changing the camera to the lateral ports or adding a fourth arm to combine complex procedures (phrenic nerve salvage, lung or pericardium resection, stapler the innominate vein). In his analysis, the previous experience of the group with lateral thymectomy was useful, but in a cumulative sum of the learning curve, 50 cases were a cut-off point for comfortable confidence and experience for such complex resections. Safeness and the anterior view of the total anterior mediastinal were advantages weighed in favor of the subxiphoid, besides the short length of stay in Kang's series ( $2.2 \pm 1.4$  days), with no mortality and very low morbidity.

Another study showing the efficacy and safety of the minimally invasive subxiphoid approach for invasive Thymic tumors describes RATS multiport incisions. Park relates in his paper the use of both lateral and subxiphoid RATS for anterior mediastinal masses, with no difference in indication when other organs invasion was present between the two groups neither difference in complications. But the innominate vein resection was more frequent with the subxiphoid RATS, as he describes that the choice of this approach was influenced by the invasiveness of the tumor in this area. He even conducted a propensity score matching. The subxiphoid group also had a shorter length of hospital stay, a lower pain score, and less operation time. Although Park himself explains the fact that obesity is less common in the Asian population in comparison with western patients. The body mass index (BMI) was also pointed out by Kakuturu and Toker as an adversity for the choice of incisions, but not necessarily as a contraindication [7]. A commentary paper questions whether this incision might facilitate abdominal hernias in obese patients [8]. However, the same paper points out advantages of the middle-line approach, such as that bagging the specimen might be easier even for larger tumors, which could be removed by subcostal incision. And that the area under the innominate vein at the left is better dissected

with safety through this angle [8].

A meta-analysis and systematic review comparing the subxiphoid and intercostal approaches for thymectomy included 13 studies with good data and outcomes assessment [1]. This meta-analysis showed no difference in operation time or in total complications (intraoperative or postoperative), but a difference in blood loss, drainage days, and length of stay, with significantly less in the subxiphoid group. The evaluation of pain through a Visual Analogue Score (VAS) on specific days (first, third, and seventh days after surgery) was also statistically different, with lower complaints in the subxiphoid group. This study, altogether with others, also suggests that subcostal/subxiphoid incisions might cause less damage to the intercostal nerves, therefore less pain [1-3]. Another aspect that is pointed out is that as subxiphoid had fewer drainage days and length of stay, lower complications and pain, it translates into reduced costs for the hospital.

## Conclusion

The subxiphoid approach for thymomas, mediastinal masses, or fat thymic tissue removal (as in non-thymomatous Myasthenia Gravis) is a safe and efficient resection method. The visualization provided gives the confidence to dissect all the tissue between both phrenic nerves with direct visualization of each one and a straight look from above to the mediastinum and vessels similar to a sternotomy. Our technique dismisses the use of sternum elevator or xiphoid resection, although other papers point to advantages and good outcomes with such additions or even other differences (uniportal, no CO<sub>2</sub> inflation, blunt dissection). Future studies should focus on multicentric analysis and randomized comparison on the outcomes with the traditional lateral intercostal approach. The ergonomics of the surgeons is not a problem, and the patient's length of stay results do not differ from the usual related in the literature.

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