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Thoracoscopic versus Open Approach in Thymectomy: Center Experience Study

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ABSTRACT

Background: Minimally invasive thymectomy using VATS has emerged as an effective option in the management of thymic disorders, particularly in cases of benign thymic epithelial tumors.

Aim of the Study: This study aimed to evaluate and contrast two surgical approaches for thymectomy, video-assisted thoracoscopic surgery (VATS) and open sternotomy while analyzing their associated outcomes and complication rates.

Patients and Methods: A prospective randomized cross-sectional analysis was performed at Menoufia University Hospitals involving 30 patients scheduled for thymectomy. Participants were randomly assigned into two equal groups: Group A (15 patients) underwent VATS thymectomy, while Group B (15 patients) received open thymectomy through sternotomy**.**

Results: There were statistically significant differences between open thymectomy group and VATS thymectomy group as regard anesthesia, surgical approach, epidural analgesia, ICU stay and intra-operative blood loss, narcotic requirement, pain score, wound and chest infection, postoperative bleeding and hospital stay ($p<0.05$). There was no statistically significant difference as regard analgesia required 14 days postoperative and conversion to open and incomplete excision ($p>0.05$). Complications in open Thymectomy Group showed that 10 (66.7%) had wound infection and 5(33.3%) had chest infection while in VATS Thymectomy Group 5(33.3%) had Phrenic nerve injury.

Conclusions: Compared to the open approach, VATS thymectomy demonstrated greater safety in thymoma cases, with advantages including shorter hospitalization, decreased intra-operative blood loss, lower risk of postoperative infection, and faster recovery.

Keywords: Myasthenia gravis, Open Thymectomy, Thymic Carcinoma, Thymoma, Video Assisted thoracoscopic thymectomy

INTRODUCTION

Tumors arising from thymic epithelial cells are known as thymomas. They are generally regarded as cytologically non-malignant, whereas thymic carcinomas display overtly malignant cellular characteristics and are associated with a significantly poorer clinical outcome [1, 2]. Thymectomy is most frequently performed for thymomas and myasthenia gravis, while neuroendocrine tumors, benign tumors like thymic cysts, and malignant tumors like thymic carcinoma are less frequently performed.

According to major guidelines, the conventional treatment method for an early-stage thymoma (Masaoka stage I and stage II) is surgical excision via transsternotomy (TS). The two key components of the procedure's therapeutic success are the extensive anterior mediastinum exposure and the prolonged thymectomy with full mediastinal fat exenteration that this method permits. Sadly, TS results in severe tissue damage, surgical difficulties, and morbidity, which prolong hospital stays. The patient population, which is primarily made up of young women, has a relatively low acceptance rate because it also leaves an ugly scar [3]**.**

In the last decade, significant progress has been made in applying video-assisted thoracic surgery (VATS) for thymectomy, encompassing both bilateral and unilateral approaches from either the left or right side. VATS offers enhanced visualization with improved lighting and magnification, made possible by advanced cameras capable of variable angles, which provide excellent exposure of the operative field. In this study, we opted for the uniportal VATS technique [4]**.** Nevertheless, because long-term outcome data remain limited, VATS is still not routinely recommended [5]

A growing body of research has shown that VATS is a safe, efficient treatment for thymomas in their early stages with a good prognosis [6]

So, this study compared two thymectomy procedures (VATS vs. sternotomy) and examined the results and side effects of each operation.

PATIENTS AND METHODS

This randomized prospective cross-sectional analytical study was carried out on 30 patients scheduled for thymectomy at Menoufia University Hospitals from August 2022 till completion of the whole number of cases .Participants were randomly assigned into two equal groups: Group A (15 patients) underwent VATS thymectomy and served as the study group, while Group B (15 patients) underwent conventional open thymectomy via sternotomy and served as the control group.

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Eligibility criteria

- **Inclusion:** Both male and female patients indicated for elective thymectomy due to myasthenia gravis, thymoma, or thymic carcinoma.
- **Exclusion:** Patients with a history of previous thoracic or cardiac surgery.
  All patients underwent a complete preoperative assessment including history taking, physical examination, laboratory investigations, radiological imaging, electrocardiography, and pulmonary function tests.

- **Group A (VATS approach):** The procedure was mainly performed through a uniportal thoracoscopic approach, although a multiport technique could be used if required. Patients were positioned in a 30° right lateral decubitus position with selective lung ventilation to optimize surgical exposure. Access to the mediastinum was gained through the right hemithorax with ports aligned along the submammary fold. Triangulation of the ports improved ergonomics; however, in most cases, a single incision was sufficient. Dissection began at the pleura anterior to the phrenic nerve, proceeding from the diaphragm inferiorly toward the thyroid gland superiorly, and extending laterally between the two phrenic nerves. If visualization was inadequate, contralateral ports were added for completion. The thymus was extracted in an Endo Catch retrieval bag, and chest tubes were inserted before lung re-expansion was confirmed.

- **Group B (Open sternotomy approach):** A vertical midline sternotomy, either partial or full, was performed. Resection boundaries extended from the thoracic inlet and innominate vein superiorly to the diaphragm inferiorly, and laterally to both phrenic nerves. Complete thymectomy with surrounding mediastinal fat was carried out, with additional resection of adjacent structures if infiltrated. Chest drains were inserted, and the sternum was closed using sternal wires.

Postoperative care and follow-up

Following surgery, all patients were clinically monitored for symptomatic improvement, requirement of assisted ventilation, frequency of plasmapheresis, duration of hospitalizaion, and incidence of wound infection. After discharge, follow-up was conducted weekly for the first month and monthly for six months in the cardiothoracic surgery outpatient clinic. Evaluations included clinical assessment, wound inspection, symptomatic status, need for plasmapheresis, and measurement of serum acetylcholine receptor (AchR) antibodies.

Ethical Consideration: The study protocol received approval from the Ethical Committee of the Faculty of Medicine, Menoufia University (IRB: 6/2022-SURG31) following Helsinki Declaration. A written informed consent was obtained from all patients prior to enrollment.

Statistical analysis

Data were processed using SPSS software version 20.0 (IBM Corp., Armonk, NY). Qualitative variables were presented as numbers and percentages. Normality of quantitative data distribution was tested using the Kolmogorov–Smirnov test. Quantitative variables were expressed as mean ± standard deviation and range. Statistical comparisons employed Chi-square, Student's t-test, and Mann–Whitney U test, with a significance threshold set at $p < 0.05$.

RESULTS

Patients in the open thymectomy group were older on average (49.7 vs. 40.2 years), but the difference was not statistically significant (p=0.083). Gender distribution was similar between groups, with no significant difference (p=0.710) **[Table 1].**

Table 1: Comparison between two groups as regard to patient's age (years) and gender.

		Open Thymectomy Group (n = 15)	VATS Thymectomy Group (n = 15)	T	P-Value
Age	**Range**	37-65	18-65		
	Mean ± SD	49.67±11.99	40.20±16.46	1.80	0.08
	No.	**%**	**No.**	**%**	
Male	10	66.7	8	53.3	
Female	5	33.3	7	46.7	0.710

Table 2: showed that there were statistically significant differences between open thymectomy group and VATS thymectomy group as regard anathesia, surgical approach, epidural analgesia, ICU stay and intra operative blood loss where (P<0.001) and there was no statistically significant difference as regard conversion to open and incomplete excision (p-value= 0.483).

Table 2: Comparison between the two groups regarding to patient's operation data

	Open Thymectomy Group (n = 15)		**VATS Thymectomy Group (n = 15)**		**Test of Sig.**	**P-Value**
	No	**%**	**No**	**%**		
Anesthesia						
General, single lung ventilation	0	0	15	100	-----	<0.001*
General, two lung ventilation	15	100	0	0		
Surgical Approach						
Median full sternotomy	10	66.7	0	0	X^2=30.00	<0.001*
Mini Sternotomy	5	33.3	0	0		
Uniportal Rt sided approach VATS	0	0	15	100		
Epidural Analgesia	15	100	0	0	-----	<0.001*
Conversion to open	0	0	2	13.3	-----	0.483
Incomplete excision						
Complete extended excision with negative margins of specimen	15	100	13	86.7	-----	0.483
Incomplete excision with positive margins of specimen	0	0	2	13.3		
ICU stay						
1 Day	0	0	15	100	-----	<0.001*
2 Days	15	100	0	0		
Intra operative blood loss						
Min.-Max.	200-300		50-300		U=25.00	<0.001*
Mean ± SD	250.00±42.258		106.67±82.086			

Complications in open Thymectomy Group showed that 10 (66.7%) had wound infection and 5(33.3%) had chest infection while in VATS Thymectomy Group 5(33.3%) had phrenic nerve injury. There were statistically significant differences between the two groups according to wound and chest infection **[Table 3].**

Table [3]: Comparison between the two groups as regard to patient's complications

Complications	**Open Thymectomy Group (n = 15)**		**VATS Thymectomy Group (n = 15)**		**P-Value**
	No.	**%**	**No.**	**%**	
Wound infection	10	66.7	0	0	<0.001*
Chest infection	5	33.3	0	0	0.042*
Phrenic nerve injury	0	0	2	13.3	0.483

Table 4: showed that there was statistically significant difference between open thymectomy group and VATS thymectomy group as regard postoperative bleeding (p-value= 0.005) and hospital stay P<0.001.

Table 4: Comparison between both groups regarding to patient's postoperative bleeding

Postoperative bleeding	**Open Thymectomy Group (n = 15)**	**VATS Thymectomy Group (n = 15)**	**U**	**P-Value**
Min.-Max.	100-200	50-250	47.50	0.005*
Mean ± SD	150.00±42.258	100.00±65.465		
Hospital stay	**Open Thymectomy Group (n = 15)**	**VATS Thymectomy Group (n = 15)**	**U**	**P-Value**
Min.-Max.	3-7	2-4	20.00	<0.001*
Mean ± SD	5.00±1.690	2.53±0.743		

There was statistically significant difference between open thymectomy group and VATS thymectomy group as regard narcotic requirement where P<0.001 and pain score (p<0.001) and there is no statistically significant difference regarding analgesia required 14 days postoperative P=0.483 **[Table 5].**

Table 5: Comparison between the two groups as regard to patient's pain

	Open Thymectomy Group (n = 15)		**VATS Thymectomy Group (n = 15)**		**Test of Sig.**	**P-Value**
	No	**%**	**No**	**%**		
Narcotic requirement						
No	0	0	13	86.7	-----	<0.001*
Morphine	15	100	2	13.3		
Pain score						
Range	8-9		4-8		U=10.00	<0.001*
Mean ± SD	8.33±0.488		5.27±1.163			
Analgesia required 14 days postoperative						
No	15	100	13	86.7	-----	0.483
Yes	0	0	2	13.3		

The current study showed that was 33.3% in open thymectomy compared to 13.3% in VATS while there was no significant difference **(Figure 1)**.

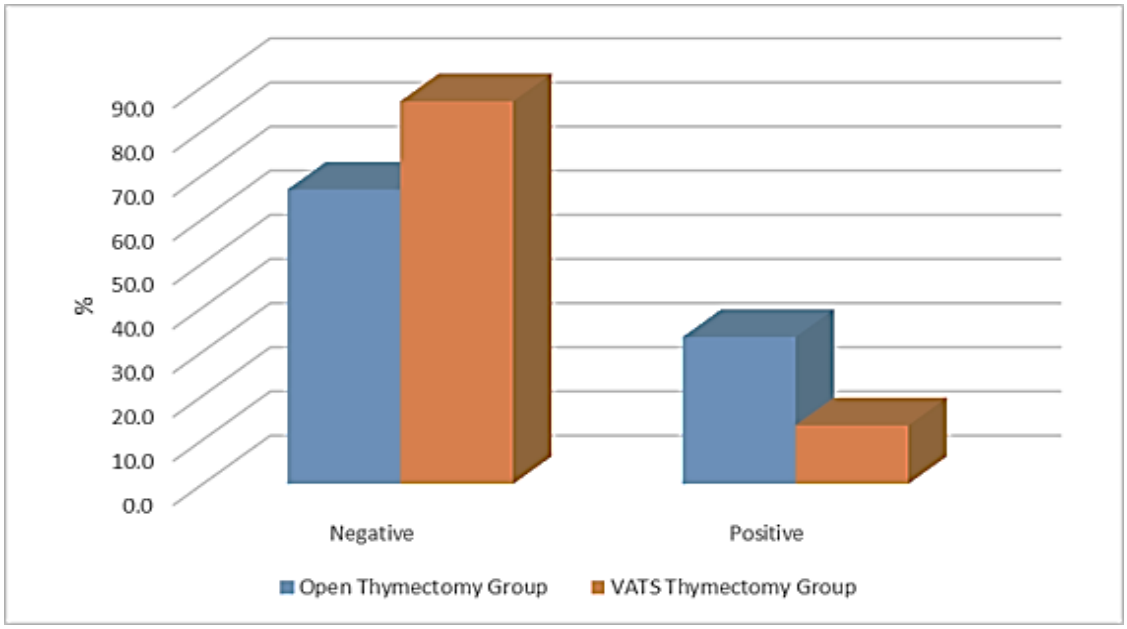

Figure (1): Comparison between two groups as regard to patient's Degree of symptom improvement 6 months postoperative.

DISCUSSION

Ages in the VATS Thymectomy Group varied from 18 to 65 years old, with a Mean ± SD 40.20±16.459 years, while those in the Open Thymectomy Group ranged from 37 to 65 years old, with a Mean ± SD 49.67±11.992 years. Additionally, the Open Thymectomy Group included 10 (66.7%) males and 5 (33.3%) females, whereas the VATS Thymectomy Group had 8 (53.3%) males and 7 (46.7%) females. with no discernible change. Similarly, in a research done by **Pennathur *et al***. 18 patients had VATS resection and 22 patients had open thymectomy. In terms of age and gender, they discovered no discernible differences between the groups under study [7]

Only two patients in the VATS group in our study had conversion to an open thoracotomy method, with a 13.3% conversion rate. This could have been caused by bleeding from the right internal mammary artery. in contrast to **Ersen *et al.*** who reported a 2.5% conversion rate to open thymectomy. [8]

In the present study, patients in the VATS group demonstrated a significantly shorter duration of ICU admission and overall hospital stay compared with those in the open surgery group. Supporting this finding, **Anna Åkerström** and his colleagues carried out a separate study involving 152 individuals with myasthenia gravis and/or thymoma who underwent thymectomy (118 by open surgery and 34 by VATS). Their analysis revealed that hospital stays were notably longer in patients treated with the open approach compared to those managed with VATS [9].

The current study found that complete excision was documented with open approach more than VATS although there was no significant difference. Although the criteria varied slightly across different VATS mostly done for tumor size less than 5 cm [10] or 6 cm. [11] In addition, the mass must be adequately distant from the innominate vein and other critical structures such as the major vessels, heart, and trachea, and there should be no signs of direct invasion [12].

The current study revealed statistically significant greater blood loss with open thymectomy (150±42.258 ml) compared to VATS (100±65.465 ml). This was in agreement with **Yuan *et al.*** study who also demonstrated greater blood loss with open thymectomy (114.74 vs 194.51 ml) with less chest tube quantity [13].

Only two incidences of phrenic nerve injury were documented with the VATS group, but there was no discernible difference between the two groups. Our study also demonstrated a statistically significant lower risk of sequelae, such as wound and chest infection, with VATS thymectomy compared to open. Following conservative treatment, two patients shown a good improvement. Also, **Ersen *et al***. found that VATS caused 6.7% more phrenic nerve damage than open surgery (0%) [8].

Degree of symptom improvement 6 months postoperatively can reflect lower recurrence rate for VATS compared to open thymectomy. The relatively higher rate observed with VATS may be attributed to the extensive handling of thymomas within the narrow operative field of the anterior mediastinum, which increases the likelihood of capsule rupture. In addition, the dissection of the mediastinal pleura during the procedure may contribute to possible tumor cell dissemination [14].

In a study done by **Cheng *et al.*** 44 patients underwent VATS thymectomy and were monitored for an average of 39.6 months showed no evidence of recurrence [15].

Similarly, **Augustin *et al.*** documented nine thymoma cases managed by VATS thymectomy, all of whom remained recurrence-free after a mean follow-up of 25 months[16].

Our current findings also demonstrated that the VATS group experienced significantly lower postoperative pain scores and required less narcotic analgesia compared to patients treated with open thymectomy. These results are consistent with those of **Sobhy *et al.***who compared 22 VATS cases with 34 transsternal thymectomy cases. Their study confirmed significantly reduced pain levels, decreased fentanyl requirements, and lower rates of wound infection and pneumonia in the VATS group [17].

CONCLUSION

VATS thymectomy is a viable option for both benign and malignant thymic conditions, offering low morbidity and mortality. Compared to open thymectomy, it provides distinct advantages, including shorter hospitalization, reduced intraoperative blood loss, fewer postoperative infections, and faster overall recovery.

Consent for publication: Not relevant.

Data availability: The data sets generated and/or analyzed in this study can be obtained from the corresponding author upon reasonable request.

Competing interests: The authors reported no conflicts of interest.

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