# Comparing clinical outcomes of thymectomy in Myasthenia Gravis patients by Video Assisted Thoracoscopy Versus transsternal approach

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## Abstract

**Background:** Myasthenia gravis (MG) is an auto-immune disease associated with abnormal antibodies binding to the acetylcholine receptors at the neuromuscular junction of the skeletal muscle, which causes destruction and modification of the neuromuscular junction. Thymectomy is the preferred standard treatment in younger non-thymoma patients with myasthenia gravis as well as in patients with early stage thymoma.

**Aim:** To assess and find the more suitable and beneficial solution either VATS or trans-sternal thymectomy to manage Myasthenia gravis

**Methods**: The study was conducted in Cardiothoracic Surgery Department, Zagazig University Hospitals in 2022, 36 cases were included as a comprehensive sample. Patients were divided into two groups, one for each of the two treatment modalities; VATS or trans-sternal thymectomy to manage Myasthenia gravis

**Results:** Trans-sternal group showed significant longer hospital stay 5.1 days. Also, pain score in first three days postoperative was significantly higher in trans-sternal group. There were significant differences between the two groups regarding wound infection, post-operative analgesics and length of hospital stay. Patients with VATS had lower pain score, fewer wound infections and less analgesics dosage. VATS exhibited significantly shorter hospital stays. Postoperative follow up showed decrease in anti-myasthenic drugs dose in both groups without statistically significant. In trans-sternal group 3 cases need to plasmapheresis and only two cases in VATS group. Without any case of recurrent along postoperative follow up period.

**Conclusion:**Our data suggest that VATS thymectomy has some advantages over open surgery, including shorter length of hospital stay, less pain, less need of analgesics, less trauma to chest wall, faster healing, fewer post operative complications, earlier return to normal activities and cosmotic satisfaction

**Keywords:** Video-Assisted Thoracoscopic Surgery (VATS), trans-sternal approach, thymectomy

## 1. Introduction

Myasthenia gravis (MG) is an auto-immune disease associated with abnormal antibodies binding to the acetylcholine receptors at the neuromuscular junction of the skeletal muscle, which causes destruction and modification of the neuromuscular junction. Patients usually present with weakness of the skeletal muscle, respiratory muscles, ocular muscles and bulbar muscles **[1].**

It is triggered by antibody-mediated loss of acetylcholine receptors which are assumed to be produced by the thymus. Thymic changes commonly seen in MG include thymic follicular hyperplasia, thymic atrophy, thymoma, and thymolipoma**[2].**

The treatment of MG mainly aims at a complete stable remission, and the modalities that are used nowadays include symptomatic treatments – mostly Acetyl cholinesterase inhibitors, short-term immune therapy, and long-term immune therapy including thymectomy**[3].**

Thymectomy is the preferred standard treatment in younger non-thymoma patients with myasthenia gravis as well as in patients with early stage thymoma **[4].**

We aimed at this study to assess and find the more suitable and beneficial solution either VATS or trans-sternal thymectomy to manage Myasthenia gravis.

## 2. Subjects and methods:

The study was Retrospective and prospective cohort study conducted in Cardiothoracic Surgery Department, Zagazig University Hospitals in 2022 on Patients complaining of signs and symptoms of Myasthenia gravis, assuming that all cases met the inclusion and exclusion criteria was included. During the study period (6 months) ,6 cases/ month,36 cases were included as a comprehensive sample.

**Inclusion criteria:**

Inclusion criteria for VATS thymectomy: thymic hyperplasia or Thymic mass less than 7 cm in diameter.

Inclusion criteria for open thymectomy: Thymic mass 7 cm in diameter or more or Previous thoracic surgery with adhesions.

**Exclusion criteria:**

Exclusion criteria for VATS thymectomy: Thymic mass 7 cm in diameter or more or Previous thoracic surgery with adhesions.

Exclusion criteria for open thymectomy: Thymic hyperplasia or Thymic mass less than 7 cm in diameter.

Patients were divided into two groups, one for each of the two treatment modalities.

**Preoperative preparation**:

All patients were considered to:

1. **Complete history taking:**

   Age, sex, occupation i.e. exposure to any of the different industrial materials, history of smoking including duration, type and number of packs per day. History of weight loss, night fever, cough, hemoptysis, symptoms of progressive airway obstruction e.g. dyspnea, stridor, symptoms of obstructive pneumonia and symptoms of eye lid drop, difficult swallowing, weakness of limbs, difficult breathing due to respiratory muscles involvement

2. **General and local examination:**

   Vital signs, general look i.e. cachexia. Evaluation motor power of muscles of face(Ptosis), muscles of both upper and lower limbs. local examination of neck whether there's visible or palpable mass neck mass or palpable lymph nodes, shape, surface, consistency, and mobility of this mass.

3. **Radiographic assessment:** CT chest,Neck Ultrasound, MRI, PET-CT scanning in thymoma cases.

4. **Laboratory studies:**

   CBC, Coagulation profile, inflammatory markers, KFT,LFTas preparation for surgery.

**5. Plasmapheresis:**

Plasma exchange and rapid immune modulating treatments with intravenous immunoglobulins: They are used in situations requiring rapid recovery, such as myasthenic crisis, or preparation for thymectomy operation if indicated **[5]**

**Surgical maneuvers:**

One of the two study groups were undergone VATS thymectomy, the other was operated for trans sternal thymectomy. A trans-sternal approach was carried out in supine position and under general anesthesia. A single lumen endotracheal tube was used, a midline median sternotomy incision was made dividing the sternum, and the thymus gland were completely excised, as well as the anterior mediastinal fat from the lower neck level down to the diaphragm.

In VATS procedure, the patient is given anesthesia in supine position. For most procedures, a double lumen tube is the preferred. The position of the Double lumen tube is confirmed with a fiberoptic bronchoscopy through the lumen after placement. The cuff is carefully positioned to ensure proper fit. After confirming proper tube and cuff placement. The table is arched to allow for adequate surgical exposure.

Semi-supine position of 30 degree with a roll under the shoulder ,the right arm of the patient must be abducted in the same sit of the surgery which always the right side

Two incisions were made at the anterior axillary line to insert the 5mm ports, one in the 3rd inter costal space, the second one in the fourth inter costal space and the other working 10 mm ports in the fifth inter costal space at the mid- clavicular line

Carbon dioxoid insufflation under the pressure of 10 mmhg pressure at 5 liters per minute flow rate was used to enhance lung collapse

Both surgeon and the assistant stand on the same side while the nurse stand at the the opposite side and the screen visualized well by both surgeon and assistant, in our operating room we have two screens, the technician always available in the operator room . the surgeon start identification of SVC, phrenic nerve and innominate vein and,then dissection of all thymic tissue and pericardial fat,bipolar ligasure diathermy was used in the dissection

Thoracoscope was inserted through a 5mm port to visualize the thymus, then dissection was performed using a dissecting instrument through a 5mm port, and finally the thymus and all adjacent fatty tissue were dissected using an endobag

**Post operative follow up:**

Both study groups were then be followed up in early and late post- operative course. Data were collected concerning:

a. Pain score and analgesics doses
b. Post operative complication as atelectasis, pneumonia and myasthenic crisis
c. Wound infection and sepsis
d. Post operative stay in hospital
e. Dose af antimyasthenic drugs post-operative and need of plasmapheresis.
f. Symptoms and signs of remission (De Filippi class)

**Statistical analysis:**

The data was collected and arranged by the SPSS program.Parametric variables were described as mean two standard deviations and significance was assessed through two tailed tests. Significant consider at P value of < 0.05.

## 3. Results:

**Table 1: Demographic data of studied groups**

| | | VATS | Trans-sternal | P value |
|---|---|---|---|---|
| **Age (years)** mean± SD | | 28.3± 6.6 | 31.1± 7.9 | 0.26 |
| | | **N(%)** | **N(%)** | |
| **Gender** | Male | 6(33.3) | 3(16.7) | 0.24 |
| | Female | 12(66.7) | 15(83.3) | |
| **Co-Morbidity** | COPD | 1(5.6) | 2(11.1) | 0.83 |
| | Renal Dysfunction | 1(5.6) | 1(5.6) | |
| | IHD | 2(11.1) | 1(5.6) | |
| | Asthma | 1(5.6) | 1(5.6) | |
| | DM | 1(5.6) | 2(11.1) | |
| | HTN | 1(5.6) | 1(5.6) | |

Independent t-test; Chi square test; Significant at P < 0.05.

This study results showed that 25% of participants was male and 75% were female, in VATS group 66.7% were female while in Trans-sternal group 83.3% were female. The age was ranged from 18 to 48years with mean age of 28.3 and 31.1years for VATS and Trans-sternal.

In trans-sternal group upper limb weakness was most frequent symptoms 55.6%, while in VATS group was equal frequency.

**Table 2: Comparison of preoperative data between studied groups**

| | | VATS | Trans-sternal | P value |
|---|---|---|---|---|
| **Time to surgery**(months) Median (IQR) | | 14.4(6,18) | 13.2(6,18) | 0.79 |
| **Preoperative prednisolone** (mg) | | 24.9± 11.7 | 29.5± 11.9 | 0.2 |
| **Preoperative Mestinon (mg)** | | 240± 60 | 320±120 | 0.2 |
| **Myasthenia crisis 1M before surgery** | | 2(11.1) | 1(5.6) | 0.75 |
| | | **N(%)** | **N(%)** | |
| **MGFA class** | I | 2(11.1) | 2(11.1) | 0.87 |
| | IIa | 3(16.7) | 2(11.1) | 0.93 |
| | IIb | 1(5.6) | 3(16.7) | 0.1 |
| | IIIa | 4(22.2) | 3(16.7) | 0.25 |
| | IIIb | 3(16.7) | 3(16.7) | 0.66 |
| | Iva | 2(11.1) | 2(11.1) | 0.66 |
| | IVb | 1(5.6) | 2(11.1) | 0.75 |
| | V | 2(11.1) | 1(5.6) | 0.75 |
| **AChR antibody** | Positive | 14(77.8) | 15(83.3) | 0.83 |
| | Negative | 4(22.2) | 3(16.7) | |
| **plasmapheresis** | | 4(22.2) | 5(27.8) | 0.76 |

| | | | | |
|---|---|---|---|---|
| **Preoperative CT finding** | Normal Thymus | 9(50) | 8(44.4) | 0.36 |
| | Thymic hyperplasia | 7(38.9) | 7(38.9) | |
| | Thymoma | 2(11.1) | 2(11.1) | |
| | Thymic cyst | 0 | 1(5.6) | |

Significant at $P < 0.05$.

Patients in both groups were assessed preoperatively according to MGFA classification and there was no significant difference between the two groups identified. There were no significant differences regarding the findings of preoperative CT, preoperative steroids, plasmapheresis and acetylcholine receptor antibody-positive patients.

**Table 3: Operative data of studied groups**

| | **VATS** | **Trans-sternal** | **P value** |
|---|---|---|---|
| **Operative Time** (min) | 142.8± 31.7 | 124.2± 32.6 | 0.25 |
| **Blood loss** (ml) | 129.2 ± 45.3 | 133.1 ± 52.6 | 0.83 |

Independent t-test; Significant at $P < 0.05$.

Our results showed that the mean operative time in VATS was 142.8 min and in trans-sternal 124.2 min.

Results showed that there were no significant differences between the two procedures when it came to duration of operation, amount of blood loss

**Table 4: Post-operative data of studied groups(during hospital stay)**

| | | **VATS** | **Trans-sternal** | **P value** |
|---|---|---|---|---|
| **Pain VAS score** | 1st day | 2.7± 1.02 | 4.8± 0.8 | **0.001*** |
| | 2nd day | 2.2± 1 | 4± 1.01 | **0.001*** |
| **Complications** | Extubation in OR | 16(88.9) | 14(77.8) | 0.82 |
| | Myasthenic crisis | 1(5.6) | 2(11.1) | 0.66 |
| | Wound infection | 1(5.6%) | 2(11.1%) | 0.55 |
| | Atelectasis | 1(5.6) | 2(11.1) | 0.66 |
| | Pneumonia | 1(5.6) | 1(5.6) | 0.85 |
| **ICU stay** (hours) | | 22.75 ± 4.73 | 26.34 ± 3.71 | 0.2 |
| **Length of hospital stay** (days) | | 3.6± 0.9 | 5.1± 1.9 | **0.05*** |
| **Analgesics doses**(mg) (PCA with pethidine) | | 25.23± 8.3 | 54.27 ± 12.9 | **<0.01*** |

Independent t-test; Chi square test; * Significant; Significant at $P < 0.05$.

Trans-sternal group showed significant longer hospital stay 5.1 days. Also, pain score in first three days postoperative was significantly higher in trans-sternal group.

There were significant differences between the two groups regarding wound infection, postoperative analgesics and length of hospital stay. Patients with VATS had lower pain score, fewer wound infections and less analgesics dosage. VATS exhibited significantly shorter hospital stays. Results showed that there were no significant differences between the two procedures when it came to postoperative complications e.g. extubation, atelectasis, myasthenic crisis, re-intubation and pneumonia after the operation and the duration of ICU stay.

**Table 5: Post-operative follow up of studied groups(during 6 m follow up )**

| | | VATS | Trans-sternal | P value |
|---|---|---|---|---|
| **Dose of anti-myasthenic drugs post** | The same | 5(27.8) | 6(33.3) | 0.71 |
| | Decrease | 13(72.2) | 12(66.7) | |
| **Need of plasmapheresis post-operative** | | 2 (11.1) | 3(16.7) | 0.63 |

Chi square test; Significant at $P < 0.05$.

Postoperative follow up showed decrease in anti-myasthenic drugs dose in both groups without statistically significant.

In trans-sternal group 3 cases need to plasmapheresis and only two cases in VATS group. Without any case of recurrent along postoperative follow up period.

**Table 6: De Filippi Class between studied groups(6m follow up)**

| De Filippi Class | VATS | | Transsternal | | P value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| **Class 1 (Complete remission)** | 8 | 44.4 | 6 | 33.3 | 0.67 |
| **Class 2 (asymptomatic, decreased medication)** | 4 | 22.2 | 5 | 27.8 | 0.55 |
| **Class 3 (improved, decreased symptoms or decreased medication)** | 3 | 16.7 | 4 | 22.2 | 0.66 |
| **Class 4 (no change)** | 2 | 11.1 | 2 | 11.1 | 0.56 |
| **Class 5 (worsening symptoms)** | 1 | 5.6 | 1 | 5.6 | 0.66 |

Significant at $P < 0.05$.

Regarding follow-up time for about 6 months, both techniques were assessed according to the De Filippi postoperative classification. The results of surgery revealed a non-significant difference between the two procedures in terms of complete remission rates, clinical improvement, improved, decreased symptoms or decreased medication, no change, worsening symptoms

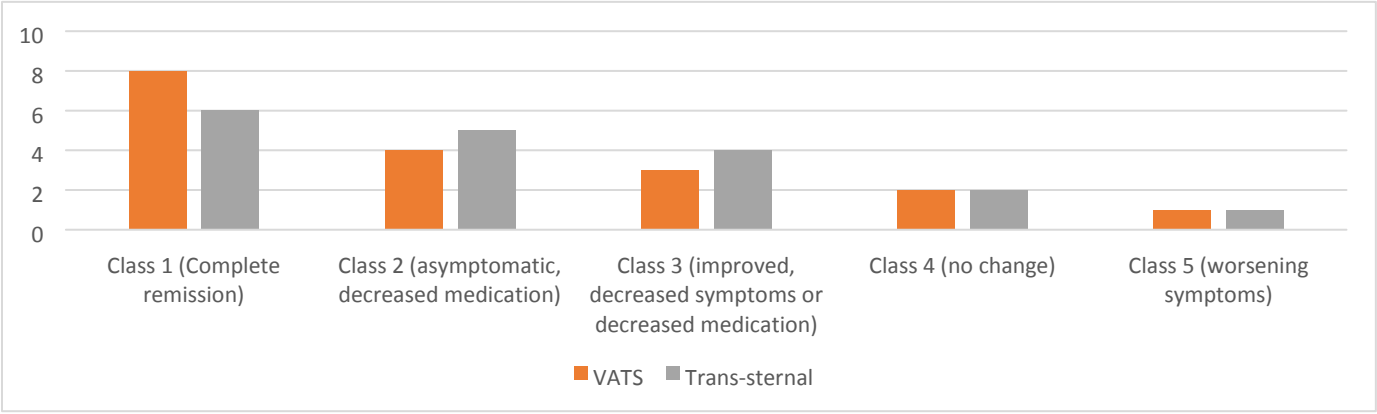


Figure 1: De Filippi Class between studied groups

## 4. Discussion:

Myasthenia gravis (MG) is an auto-immune disease associated with abnormal antibodies binding to the acetylcholine receptors at the neuromuscular junction of the skeletal muscle, which causes destruction and modification of the neuromuscular junction. Patients usually present with weakness of the skeletal muscle, respiratory muscles, ocular muscles and bulbar muscles **[1].**

The surgical techniques used to remove the thymus vary widely around the world. The most frequently advised method in Europe and North America is trans sternal thymectomy because it makes it simple to reach and manage important arterial structures in the anterior mediastinum. However, a lateral thoracotomy is also employed. 10% or so of thymectomies are performed with minimally invasive techniques. Instead, roughly 35% of resections in Asia are currently performed with VATS**[6].**

With the advantages of minimal invasiveness and rapid recovery, VATS thymectomy has been gaining popularity in recent years in the treatment of thymic disorders and myasthenia gravis. It has been shown that VATS is typically associated with reduced blood loss, shorter operative time, less trauma to the chest wall, shorter hospital stay, faster healing, and earlier return to normal activities. Video-assisted thoracoscopic surgery may also reduce the rate of postoperative complications by reducing tissue damage, postoperative pain, and the risk of infection**[7].**

Demographic data revealed that there was a predominance of female sex in both of the study's two groups as MG is an autoimmune disease that common in females, although the difference was not statistically significant. Furthermore, there was no statistically significant difference between the two groups in terms of age, BMI, comorbidities or the classification of the American Society of Anesthesiologists (ASA) or Myasthenia Gravis Foundation of America (MGFA).

In our research,operative data showed that the difference between the two groups regarding operative time and perioperative blood loss was not statistically significant and that was similar to **Erşen et al[1]** this may be due to skills of surgeons and well established sets of thoracoscopy.

In post operative data regarding measurements of VAS for pain score revealed significant differences between the two groups. VATS patients had lower pain score. This explained the fewer number of doses of analgesics in VATS group. Our results were comparable to those of **A.Toker and B. Özkan [8]**.

Our finding showed significant lower VAS score in VATS group than trans-sternal group, while **Erşen et al[1]** reported lower pain score in open group (3.5 Vs 4.3) without statistical significant (p=0.118).

lower VAS score in VATS group may be due to small surgical incision of VATS , less tissue damage with less chance of infection and discomfort When compared to open thymectomy .

**S. J. Youssef et al. [9].** indicated that minimally invasive thymectomy procedures like VATS tend to lower the need of narcotic analgesics **[9].**

Our findings also showed that the duration of hospital stay in the VATS group was significantly shorter. This may be explained by small surgical wounds in the VATS, less risk of wound infection and complication as atelectasis and pneumonia.

Our results showed that The incidence of wound infection in VATS group VS trans sternal group was (5.6% Vs11.1%) with no statistically difference this may be due to good anti septic measures in both groups.

Compared post operative complication our study showed that there were no significant differences between both groups regarding atelectasis,myasthenic crisis, reintubation and pneumonia . In spite of expected higher rate of complications due technical difficulties of Video-assisted thoracoscopic surgery, recent reports on VATS thymectomy did not reveal any major complications **[10].**

Regarding follow-up time for about 6 months, both techniques were assessed according to the De Filippi postoperative classification. The results of surgery revealed a non-significant difference between the two procedures in terms of complete remission rates, clinical improvement, improved, decreased symptoms or decreased medication, no change, worsening symptoms. Our results are consistent with **Toolabi et al.,[11] and Bachmann et al.[12]**

Several studies compared the peri-operative and post-operative outcomes of VATS and classic transsternal thymectomy in MG and in other conditions as well, such as in thymoma or in anterior mediastinal tumors **[13].**

In agreement with **J. Jurado *et al* [10]**, our result showed that VATS was effective for treating MG with shorter hospital stay,decreased VAS for pain score and less postoperative complications such compared to classic trans-sternal thymectomy.

Our results were similar with the literature **Erşen et al[1] Yuan et al[14] Pennathur et al[15]**, VATS thymectomy associated with shorter postoperative length of hospital, less postoperative drainage and shorter duration of chest tube drainage.

In addition, VATS thymectomy resulted in a decrease in the dosage of analgesics. **Christison-Lagay et al[16]** reported that VATS a was safe and minimally morbid operation that could achieve comparable results to classic trans-sternal thymectomy in the amount of medication, duration of hospital stays and admission-related hospital expenses, and a reduced or comparable operating time matched with that reported for a historical series of open thymectomies.

Raza and Woo also concluded that the VATS approach to thymectomy in compared to trans-sternal approach is a safe and effective technique with fewer complications and minimally invasive that allows for faster healing and return to normal activity **[17].**

Our research come in line with recent studies of **Erşen et al[1]** and **Xieet al [18]**reporting the superiority of VATS for thymectomy over open surgery. In terms of hospital stay, intraoperative blood loss, and cosmetic satisfaction when compared with open access surgery.

## 5. Conclusion:

Our data suggest that VATS thymectomy has some advantages over open surgery, including shorter length of hospital stay, less pain, less need of analgesics, less trauma to chest wall, faster healing, fewer post operative complications, earlier return to normal activities and cosmotic satisfaction.

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