The Egyptian Journal of Hospital Medicine (October 2025) Vol. 101, Page 4754-4761

# Classic vs Extended Thymectomy in Myasthenia Graves

**Abd Elaziz Abas Taalab*, Sarah Mohammed Abdel El-Sadek**,**
**Mostafa Hossam Abd-Elomty Abd-Elsatar* Mohamed Gamal El-Din Hagag****
* General Surgery Department Faculty of Medicine, ** Cardiothoracic Surgery Department,
Menoufia University, Menoufia, Egypt
***Corresponding author:** Mostafa Hossam Abd-Elomty Abd-Elsatar, **Email:** mostafahossam9427@gmail.com,
**Mobile:** +201127272600

## ABSTRACT

**Background:** Myasthenia gravis (MG) is a chronic autoimmune disease associated with fluctuating muscle weakness and thymic abnormalities. Thymectomy is an established therapeutic option, however the relative benefits of classic versus extended thymectomy remain a subject of debate.

**Aim:** This study aimed to compare the results of classic and extended thymectomy in cases with myasthenia gravis.

**Methods:** This prospective study has been done on 16 cases with myasthenia gravis at Menoufia University Hospital. They were separated into two groups: Group A (classic thymectomy, 7) and group B (extended thymectomy, 9). Data on operative approach, perioperative outcomes, postoperative hospital stay, and symptom progression at one, two, and three months were collected and analyzed.

**Results:** Surgical approaches differed between groups, with full sternotomy performed in 0% of group A and 33.3% of group B, while uniport video-assisted thoracoscopic surgery (VATS) was more common in group A (71.4%) than in group B (33.3%). The mean operative time was 102.0 ± 34.4 minutes in group A and 120.5 ± 19.7 minutes in group B (p equal to 0.258). ICU stay was 0.29 ± 0.76 days in group A versus 0.78 ± 1.39 days in group B (p equal to 0.536), and hospital stay was 12.0 ± 6.3 versus 10.3 ± 4.9 days, respectively (p=0.681). Plasmapheresis requirements were similar (2.29 ± 1.50 vs. 2.22 ± 1.79 sessions). At one month, mean symptom scores were 10.86 in group A and 9.33 in group B. At 2 months, 6.57 versus 6.11 and at three months, 6.00 versus 4.11, with no statistically significant differences. No postoperative complications were reported in either group.

**Conclusion:** Both classic and extended thymectomy were efficient and safe for the management of myasthenia gravis, with comparable short-term outcomes. Extended thymectomy showed a trend toward longer operative time and slightly greater symptom improvement at three months, but differences were not statistically significant. Larger multicenter researches with longer monitoring are required to determine long-term advantages.

**Keywords:** Thymectomy, Myasthenia gravis, Classic thymectomy, Extended thymectomy, Surgical outcomes.

## INTRODUCTION

MG is an autoimmune neuromuscular disorder described by fluctuating skeletal muscle weakness, ranging from isolated ocular symptoms to severe generalized weakness and respiratory failure. The disease mechanism is attributed to autoantibodies targeting acetylcholine receptors (AChR), resulting in impaired neuromuscular transmission. The thymus gland is believed to have a central role in MG pathogenesis [1].

The prevalence of MG is approximately 20 per 100,000 individuals. It shows sex-and age-related variation, with a peak incidence among females in the 2nd and 3rd decades of life, and a later peak among men in the 6th and 7th decades. Overall, women are influenced nearly twice as often as men [2].

Pharmacological therapy for MG includes anticholinesterase agents, corticosteroids and immunosuppressive drugs such as azathioprine, cyclophosphamide, and cyclosporine, in addition to plasmapheresis and intravenous immunoglobulin [1, 2]. Despite these options, surgical thymectomy remains an important therapeutic strategy. Since Blalock's first report in 1939 of a patient who achieved remission after thymectomy for thymic tumor, the procedure has been increasingly applied to patients with MG even in the absence of thymoma [3, 4].

Several surgical approaches to thymectomy have been illustrated, including transsternal, transcervical, and VATS approaches, with variable extents of mediastinal and cervical fat tissue removal [5–7]. Likewise, different surgical techniques have been developed—classic, extended, and maximal thymectomy—but their relative benefits remain debated [5, 7]. The American Academy of Neurology has concluded that current evidence does not establish the superiority of one approach or technique over another. Nevertheless, the extent of thymic resection and surgical expertise are key determinants of long-term outcomes [8, 9]. In this context, the present study aimed to compare the results of classic versus extended thymectomy in cases with MG.

## PATIENTS AND METHODS

**Study design and setting:** This prospective randomized research has been performed at Menoufia University Hospitals on cases with MG who have been scheduled for thymectomy. Patients have been randomly allocated into



Received: 02/05/2025
Accepted: 04/07/2025

two groups: Group A, who had extended thymectomy, and group B, who had classic thymectomy.

**Inclusion criteria:** Male or female patients scheduled for thymectomy. Patients diagnosed with myasthenia gravis and fulfilling one or more of the following: Positive acetylcholine receptor (AChR) antibodies. Thymic hyperplasia. Thymoma. Non-thymomatous myasthenia gravis. Cases that failed to respond adequately to medical treatment and plasmapheresis.

**Exclusion criteria:** Previous history of cardiac or thoracic surgery. Patients on mechanical ventilation due to respiratory failure.

**Preoperative evaluation:** All cases had complete history taking and physical examination, involving vital signs, chest examination, and lymph node assessment. Disease severity has been assessed utilizing the Myasthenia Gravis Activities of Daily Living Scale (MG-ADL). Laboratory investigations included arterial blood gases, complete blood count, kidney and liver function tests, coagulation profile, ABO blood typing and viral markers for HBV, HCV, and HIV. Serum anti-acetylcholine receptor antibodies have been measured in all MG cases. Radiological evaluation included chest X-ray (posteroanterior view) and contrast-enhanced chest computed tomography (CT). An electrocardiogram (ECG) has been also done.

**Surgical procedures:** The surgical method utilized was sternotomy, mini-sternotomy, or video-assisted thoracoscopic surgery (VATS).

**Group A (Extended thymectomy):** All thymic tissue together with anterior and part of the middle mediastinal fat was excised by sharp dissection, extending from the lower poles of the thyroid gland to the diaphragm. The dissection boundaries were the phrenic nerves bilaterally, and adipose tissue beneath this region was removed, including up to the left vagus and recurrent laryngeal nerves. No effort was made to dissect the thymus gland separately.

**Group B (Classic thymectomy):** Only the thymic tissue was excised, while mediastinal fat was preserved.

**Postoperative assessment and follow-up:** Postoperatively, patients were evaluated for symptom improvement, need for assisted ventilation, frequency of plasmapheresis, duration of hospital stay, and occurrence of wound infection. After discharge, patients were followed in The Cardiothoracic Surgery Outpatient Clinic weekly during the first month and monthly for the subsequent three months. Clinical assessment included evaluation of symptomatic improvement, requirement for plasmapheresis, wound status, and serum AChR antibody levels. Postoperative outcomes were further evaluated utilizing the MG-ADL and changes in required doses of preoperative medications.

**Ethical Considerations: Ethical approval was granted by The Local Ethics Committee of The Cardiothoracic Surgery Department, Faculty of Medicine, Menoufia University. Written informed consents were attained from all participants before their inclusion in the research. Prior to the participants have been admitted in this investigation, the nature and purpose of the research, in addition to the risk/benefit evaluation has been clarified to them. The study followed The Declaration of Helsinki through its execution.**

### *Statistical analysis*

Statistical analysis has been performed utilizing SPSS software version 28 for Windows. Descriptive statistics summarized patients' demographic and clinical data. Categorical parameters have been presented as frequencies and percentages, whereas continuous parameters were expressed as mean ± SD, median, and interquartile range (IQR). Comparisons of categorical parameters were performed utilizing Fisher's exact test. For continuous data, the Independent Samples T-test was applied to normally distributed parameters, while the Mann-Whitney U Test was used for non-normally distributed parameters. A $p \leq 0.05$ has been regarded statistically significant.

## RESULTS

Our research illustrated that the mean age of patients in the classic thymectomy group was 36.86 ± 11.99 years compared to 26.33 ± 10.75 years in the extended thymectomy group, with a statistically insignificant variance (p = 0.093). The median age was 37.00 years (IQR: 35.00–47.00) in the classic group versus 25.00 years (IQR: 20.00–35.00) in the extended group. Regarding gender distribution, males represented 57.1% (n=4) of the classic group and 44.4% (n=4) of the extended group, while females accounted for 42.9% (n=3) and 55.6% (n=5) respectively (p = 1). Preoperative symptoms revealed no myasthenic crises in the classic group, whereas one case (11.1%) in the extended group experienced a crisis (p = 1). Duration of illness showed wide variation, with a mean of 11.71 ± 13.15 months in the classic group versus 25.67 ± 45.82 months in the extended group, but the median was similar at 4 months in both. MG-ADL scores averaged 12.43 ± 3.05 in the classic group than 11.11 ± 2.67 in the extended group (p equal to 0.372). All patients in both groups tested positive for AChR antibodies. In contrast, one patient (14.3%) in the classic group was positive for anti-muscle antibodies compared to none in the extended group (p = 0.437) (Table 1).

**Table (1):** Comparison of demographics and clinical data for classic and extended thymectomy groups

| Variable | Classic Thymectomy (num.=seven) | Extended Thymectomy (num.=nine) | P-value |
|---|---|---|---|
| Demographics | | | |
| Age (years) | 36.86 ± 11.99 | 26.33 ± 10.75 | 0.093 |
| Age, Median (IQR) | 37.00 (35.00–47.00) | 25.00 (20.00–35.00) | |
| Gender: Male | 4 (57.1%) | 4 (44.4%) | 1 |
| Gender: Female | 3 (42.9%) | 5 (55.6%) | |
| Symptoms | | | |
| Crises in 6 months | 0 (0.0%) | 1 (11.1%) | 1 |
| Mechanical ventilation | 0 (0.0%) | 0 (0.0%) | -- |
| Duration (months) | 11.71 ± 13.15 | 25.67 ± 45.82 | 1 |
| Duration, Median (IQR) | 4.00 (3.00–24.00) | 4.00 (3.00–6.00) | |
| Daily Life Activity | | | |
| MG-ADL | 12.43 ± 3.05 | 11.11 ± 2.67 | 0.372 |
| MG-ADL, Median (IQR) | 13.00 (9.00–15.00) | 11.00 (11.00–12.00) | |
| Preoperative Investigations | | | |
| AChR antibodies positive | 7 (100.0%) | 9 (100.0%) | 1 |
| Anti-muscle antibodies positive | 1 (14.3%) | 0 (0.0%) | 0.437 |

Medication use before surgery showed similar patterns between both groups. Immune suppression with azathioprine (Imuran) was used in 57.1% (n=4) of cases in the classic thymectomy group, than 44.4% (n=4) in the extended thymectomy group (p = 1). Steroid use (Solupred) was reported in 42.9% (n=3) of the classic group and 66.6% (n=6) of the extended group (p = 0.615). Pystinon was universally prescribed in both groups (100%). The average number of pystinon doses per day was 3.57 ± 0.79 in the classic thymectomy group compared to 3.78 ± 0.44 in the extended thymectomy group, with insignificant variance (p equal to 0.470). The median daily dose was 3 in the classic group and 4 in the extended group (Table 2).

**Table (2):** Comparison of medication use between classic and extended thymectomy groups

| **Medication** | **Classic Thymectomy (n=7)** | **Extended Thymectomy (n=9)** | **P-value** |
|---|---|---|---|
| **Immune suppression (Azathioprine) (Imuran)** | 4 (57.1%) | 4 (44.4%) | 1 |
| **prednisolone** | 3 (42.9%) | 6 (66.6%) | 0.615 |
| **pyridostigmine** | 7 (100%) | 9 (100%) | -- |
| **Numbers of pystinon doses per day** | | | 0.470 |
| (Mean ± SD) | 3.57 ± 0.79 | 3.78 ± 0.44 | |
| Median (IQR) | 3.00 (3.00–4.00) | 4.00 (4.00–4.00) | |

Regarding surgical approach, no patients in the classic thymectomy group underwent full sternotomy, while it was performed in 33.3% (n=3) of cases in the extended group (p equal to 0.213). Mini sternotomy was reported in 28.6% (n=2) of the classic group and none in the extended group (p = 0.175). VATS multi-port was not used in the classic group but was applied in 33.3% (n=3) of the extended group (p = 0.213). In most cases in the classic group, 71.4% (n=5), underwent VATS uni-port compared to 33.3% (n=3) in the extended group (p equal to 0.315). Operation time was slightly longer in the extended thymectomy group with a mean of 120.50 ± 19.74 minutes versus 102.00 ± 34.41 minutes in the classic group, although this wasn't statistically significant (p equal to 0.258) **(Table 3).** Postoperative outcomes showed that none of the cases in either group needed re-intubation. ICU stay was slightly longer in the extended thymectomy group, with a mean of 0.78 ± 1.39 days compared to 0.29 ± 0.76 days in the classic group, though not significant (p = 0.536). The need for plasmapheresis.

**Table (3):** Comparison of surgical approach and operation time between classic and extended thymectomy groups

| Variable | Classic Thymectomy (n=7) | Extended Thymectomy (n=9) | P-value |
|---|---|---|---|
| Surgical Approach | | | |
| Full sternotomy | 0 (0.0%) | 3 (33.3%) | 0.213 |
| Mini sternotomy | 2 (28.6%) | 0 (0.0%) | 0.175 |
| VATS – multi-port | 0 (0.0%) | 3 (33.3%) | 0.213 |
| VATS – uni-port | 5 (71.4%) | 3 (33.3%) | 0.315 |
| Operation Time (min) | | | |
| Mean ± SD | 102.00 ± 34.41 | 120.50 ± 19.74 | 0.258 |
| Median (IQR) | 96.00 (90.00–135.00) | 125.00 (113.00–135.00) | |

Plasmapheresis was comparable between groups, with a mean of 2.29 ± 1.50 sessions in the classic group and 2.22 ± 1.79 sessions in the extended group (p = 1). The duration of intercostal tube placement was also similar, averaging 2.29 ± 0.49 days in the classic group and 2.44 ± 1.13 days in the extended group (p = 1). The mean hospital stay was 12.00 ± 6.32 days for the classic group and 10.33 ± 4.95 days for the extended group, with insignificant variance (p equal to 0.681) (Table 4).

**Table (4):** Comparison of post-operative hospital outcomes between classic and extended thymectomy groups

| **Variable** | **Classic Thymectomy (n=7)** | **Extended Thymectomy (n=9)** | **P-value** |
|---|---|---|---|
| **Need for intubation** | 0 (0.0%) | 0 (0.0%) | -- |
| **ICU Stay (days)** | | | 0.536 |
| (Mean ± SD) | 0.29 ± 0.76 | 0.78 ± 1.39 | |
| Median (IQR) | 0.00 (0.00–0.00) | 0.00 (0.00–1.00) | |
| **Plasmapheresis** | | | |
| (Mean ± SD) | 2.29 ± 1.50 | 2.22 ± 1.79 | 1 |
| Median (IQR) | 2.00 (2.00–3.00) | 2.00 (2.00–3.00) | |
| **ICT Duration (days)** | | | 1 |
| (Mean ± SD) | 2.29 ± 0.49 | 2.44 ± 1.13 | |
| Median (IQR) | 2.00 (2.00–3.00) | 2.00 (2.00–3.00) | |
| **Hospital Stay (days)** | | | 0.681 |
| (Mean ± SD) | 12.00 ± 6.32 | 10.33 ± 4.95 | |
| Median (IQR) | 11.00 (6.00–20.00) | 10.00 (7.00–10.00) | |

At one month follow-up, the mean symptom score was 10.86 ± 3.58 in the classic thymectomy group and 9.33 ± 1.94 in the extended group (p = 0.292), with median scores of 10.00 (IQR 9.00–14.00) and 10.00 (IQR 9.00–11.00) respectively. At two months, symptoms improved in both groups with mean scores of 6.57 ± 4.79 for classic and 6.11 ± 2.57 for extended thymectomy (p = 0.808). By three months, the mean score further decreased to 6.00 ± 4.58 in the classic group and 4.11 ± 3.44 in the extended group (p equal to 0.361), with corresponding median scores of 6.00 (IQR 2.00–9.00) and 4.00 (IQR 1.00–8.00). All patients (100%) in both groups continued pyridostigmine therapy throughout follow-up, and no complications were reported at any interval (Table 5).

**Table (5):** Comparison of out-patient follow-up at one, two, and three months between classic and extended thymectomy groups

| Follow-up Period | Variable | Classic Thymectomy (n=7) | Extended Thymectomy (n=9) | P-value |
|---|---|---|---|---|
| One month | Symptoms (Mean ± SD) | 10.86 ± 3.58 | 9.33 ± 1.94 | 0.292 |
| | Symptoms (Median, IQR) | 10.00 (9.00–14.00) | 10.00 (9.00–11.00) | |
| | Medications (Pyridostigmine) | 7 (100.0%) | 9 (100.0%) | -- |
| | Complications | 0 (0.0%) | 0 (0.0%) | -- |
| Two months | Symptoms (Mean ± SD) | 6.57 ± 4.79 | 6.11 ± 2.57 | 0.808 |
| | Symptoms (Median, IQR) | 5.00 (4.00–10.00) | 5.00 (4.00–9.00) | |
| | Medications (Pyridostigmine) | 7 (100.0%) | 9 (100.0%) | -- |
| | Complications | 0 (0.0%) | 0 (0.0%) | -- |
| Three months | Symptoms (Mean ± SD) | 6.00 ± 4.58 | 4.11 ± 3.44 | 0.361 |
| | Symptoms (Median, IQR) | 6.00 (2.00–9.00) | 4.00 (1.00–8.00) | |
| | Medications (Pyridostigmine) | 7 (100.0%) | 9 (100.0%) | -- |
| | Complications | 0 (0.0%) | 0 (0.0%) | -- |

## DISCUSSION

MG is a chronic autoimmune neuromuscular disorder categorized by fluctuating weakness and fatigability of voluntary muscles, commonly involving the ocular, limb, bulbar, and respiratory muscles [(10)].The disease is primarily driven by autoantibodies against acetylcholine receptors (AChR) or other neuromuscular junction components, leading to impaired transmission and fatigability [(11)]. Abnormalities of the thymus, including hyperplasia and thymoma, are strongly implicated in MG pathogenesis, highlighting the thymus as a central player in disease initiation and maintenance [(12)].

Thymectomy has been employed for decades as a therapeutic and, in thymomatous cases, curative approach to MG [(13)]. Its role in improving symptoms, reducing immunosuppressive therapy, and inducing remission is well documented, particularly in non-thymomatous, AChR-positive patients. However, the optimal extent of thymic resection remains debated [(14)]. While classic transsternal thymectomy ensures reliable access to the anterior mediastinum, residual ectopic thymic tissue may persist. Extended thymectomy, which involves removal of both thymic tissue and perithymic fat, aims for a more complete resection and theoretically superior immunological outcomes [(15)].

With the rise of minimally invasive approaches, it remains unclear whether the greater operative complexity of extended thymectomy provides tangible clinical benefits over the classic procedure [(16)]. This issue is crucial for guiding surgical practice and tailoring interventions to patient and disease characteristics.

In the present study, we prospectively compared classic and extended thymectomy in 16 patients with MG. Group A underwent classic thymectomy, and group B underwent extended thymectomy. Insignificant variances have been observed among groups regarding immediate postoperative outcomes. ICU stay averaged 0.29 ± 0.76 days in the classic group and 0.78 ± 1.39 days in the extended group, while intercostal tube duration was 2.29 ± 0.49 days versus 2.44 ± 1.13 days respectively. These outcomes are consistent with prior researches reporting that extended thymectomy, while more extensive, does not confer significant advantages in immediate recovery. **Sobhy *et al.*** [(15)] found insignificant variance in ICU stay or perioperative complications between minimally invasive and extended open thymectomy, despite wider tissue removal in the latter. Similarly, **El-Akkawi *et al.*** [(17)] reported comparable median chest tube durations (around 2 days) across both open and minimally invasive techniques, with no added benefit of extended resections. Moreover, **Yuan *et al.*** [[18]] reported that chest tube durations of approximately 2–2.5 days are typical across thymectomy approaches, which is aligning with our results.

In our study, the postoperative need for plasmapheresis was comparable between groups, averaging 2.29 ± 1.50 sessions in the classic thymectomy group and 2.22 ± 1.79 in the extended group. This outcome appeared to be influenced more by perioperative disease severity rather than the surgical extent. **Chen *et al.*** [(16)] similarly reported that the requirement for plasmapheresis was primarily determined by patients' preoperative disease status and antibody burden, rather than the type of thymectomy performed. Their findings emphasized that perioperative immunomodulation strategies are not dictated by the surgical approach.

No significant variance was observed in hospitalization, with a mean duration of 12.00 ± 6.32 days in the classic group and 10.33 ± 4.95 days in the extended group. These results align with **Castillo-Larios *et al.*** [(19)], who found that hospital stay was shorter following minimally invasive thymectomy (3 days) compared to open thymectomy (6 days), representing a 32% reduction. Similarly, **Imielski *et al*.** [20] noted that minimally invasive procedures were associated with hospital stays that were approximately 42% shorter than those following transsternal thymectomy.

At one month postoperatively, symptom scores measured utilizing the MG-ADL scale were comparable between groups, with mean scores of 10.86 in the classic group and 9.33 in the extended group. Medication use also remained similar. **Lee *et al*.** [21] reported comparable short-term outcomes between the two procedures, suggesting that longer follow-up may be required to demonstrate potential advantages of extended thymectomy, particularly in terms of immunological remission and reduced medication requirements.

No complications were reported during the first month of follow-up in either group. This finding supports the results of **Solis-Pazmino *et al*.** [22] who observed low complication rates for both classic and extended thymectomy. Their study emphasized that both approaches are safe, with surgical decisions best guided by long-term disease control rather than immediate postoperative complications.

Although our short-term findings suggest comparable outcomes, extended thymectomy may demonstrate benefits over longer follow-up. **Zhang *et al*.** [23] stated that extended thymectomy has been correlated with superior long-term outcomes including better disease control, reduced corticosteroid dependency, and improved quality of life. Their data suggest that the advantages of extended thymectomy may become more evident over time, particularly in younger patients with generalized MG, highlighting the importance of extended postoperative monitoring.

Our study demonstrated that both classic and extended thymectomy groups exhibited progressive symptom improvement at two and three months postoperatively with no statistically significant differences suggesting that both approaches offer comparable short-term benefits in terms of symptom relief. This observation is consistent with the finding of **Laakso *et al*.** [24] who stated that clinical improvement following thymectomy in myasthenia gravis typically begins within the initial months after surgery irrespective of whether a limited or extended resection is performed.

At three months, we observed a trend toward lower symptom scores in the extended thymectomy group, although the variance wasn't statistically significant, which is aligning with **Kooshesh *et al*.** who showed that extended thymectomy was associated with more pronounced improvement and reduced dependence on immunosuppressive therapy, effects that became evident over longer follow-up periods beyond one year [25].

Importantly, no complications were documented in either group during the two- or three-month follow-up, supporting the favorable safety profile of both procedures, which has also been highlighted by **Cavalcanti *et al*.** [26]. Interestingly, the gradual but non-significant improvement in the extended thymectomy group may support the hypothesis of **Kojima *et al*.** [27] who suggested that extended thymectomy allows for more complete resection of ectopic thymic tissue, potentially reducing the risk of disease persistence or relapse.

Taken together, our findings support existing evidence that early postoperative outcomes of both classic and extended thymectomy are largely equivalent, while the subtle advantages of extended resection may emerge gradually over time. However, the limited interval of our research may not have been sufficient to detect the long-term benefits of thymectomy. **Zhang *et al*.** [23] emphasized that the full therapeutic impact, particularly in terms of remission and medication independence, may take up to three years to become apparent.

Our study showed a trend toward longer operative time in the extended thymectomy group, although this difference wasn't statistically significant. This finding aligns with **Tosi *et al*.** [28] who stated that extended thymectomy often requires more meticulous dissection and broader exposure, thereby prolonging operative duration, however they emphasized that increasing surgeon expertise and adoption of minimally invasive tools can mitigate this difference over time [28].

With regard to perioperative complications, no cases of bleeding, phrenic nerve injury, or conversion to open surgery were observed in either group, supporting the conclusions of **Di Crescenzo *et al*.** [29] who demonstrated that both classic and extended thymectomy can be safely performed with minimal complications when appropriate dissection planes are respected and surgical expertise is ensured. Similarly, the absence of conversions in our series underscores the feasibility and safety of minimally invasive approaches, which is consistent with the findings of **O'Sullivan *et al*.** [30] who advocated for the utilization of video-assisted thoracoscopic surgery (VATS) even in extended thymectomy, reporting very low conversion rates with careful preoperative planning and intraoperative navigation.

In terms of clinical symptoms, our results showed comparable disease burden between groups, with only one patient in the extended thymectomy group experiencing a crisis within the prior six months and no cases requiring mechanical ventilation, which is in line with the work of **Collins *et al*.** [31] who attributed the low preoperative crisis rates in surgical candidates to effective medical optimization using corticosteroids and acetylcholinesterase inhibitors**.** Furthermore, the longer—though statistically non-significant—disease duration in the extended thymectomy group mirrors observations by **Kaufman *et al*.** [32] who noted that extended thymectomy is often preferred for patients with more prolonged disease or progressive symptoms, as it permits broader resection of thymic tissue and ectopic foci implicated in persistent disease activity.

Regarding medical therapy, our study found insignificant variances between classic and extended thymectomy groups in the use of immunosuppressive agents or corticosteroids, with all patients requiring pyridostigmine and the extended thymectomy group demonstrating only a slightly higher mean daily dose. These outcomes are consistent with **Evoli *et al*.** [33] who noted that patients with more active or long-standing disease—often those selected for extended thymectomy—may require greater symptomatic control with anticholinesterase therapy before surgery.

**STRENGTHS:** A major strength of this study lies in its direct comparison of classic and extended thymectomy under uniform perioperative protocols, thereby enhancing internal validity and allowing for meaningful evaluation of postoperative outcomes. Furthermore, the inclusion of clinical symptom assessment, medication usage, and structured follow-up offered a comprehensive overview of both surgical approaches.

**LIMITATIONS:** The relatively small sample size may have reduced statistical power, potentially obscuring true differences between groups, while the single-center design limits external validity. Additionally, the short follow-up period prevents conclusions about longer-term outcomes such as sustained remission or disease recurrence, underscoring the need for larger multicenter studies with extended follow-up.

## CONCLUSION

Our study demonstrated that both classic and extended thymectomy were safe and effective surgical approaches for patients with myasthenia gravis, with comparable short-term outcomes in terms of symptom relief, medication use, and postoperative recovery. While extended thymectomy showed a trend toward longer operative time and slightly greater symptom improvement at three months, these differences were not statistically significant. The findings suggest that the choice of surgical technique may be tailored to individual case characteristics and disease severity with further research needed to clarify long-term outcomes and remission rates.

**Consent for publication:** I certify that each author has granted permission for the work to be submitted.
**Funding:** No fund.
**Availability of data and material:** Available.
**Conflicts of interest:** None.

## REFERENCES

1. **Masaoka A, Yamakawa Y, Niwa H *et al*. (1996):** Extended thymectomy for myasthenia gravis patients: a 20-year review. Ann Thorac Surg., 62 (3): 853-9.
2. **Jaretzki A, Penn A, Younger D *et al*. (1988):** Maximal" thymectomy for myasthenia gravis. Results. J Thorac Cardiovasc Surg., 95 (5): 747-57.
3. **Menghesha H, Schroeter M, Doerr F *et al*. (2022):** Der Stellenwert der Thymektomie ohne Thymom in der Therapie der Myasthenia gravis [The value of thymectomy in the treatment of non-thymomatous myasthenia gravis]. Chirurg., 93 (1): 48-55. German.
4. **Patel G, Reddy B, Patil P (2022):** Maximal Thymectomy via Mini Sternotomy with Pleural Preservation. South Asian J Cancer, 11 (3): 229-234.
5. **Ng W, Hartley L (2021):** Effectiveness of thymectomy in juvenile myasthenia gravis and clinical characteristics associated with better outcomes. Neuromuscul Disord., 31 (11): 1113-1123.
6. **Jaretzki A, Sonett J (2007):** Evaluation of results of thymectomy for MG requires accepted standards. Ann Thorac Surg., 84 (1): 360-1.
7. **Chen K, Li Y, Yang H (2022):** Poor responses and adverse outcomes of myasthenia gravis after thymectomy: Predicting factors and immunological implications. J Autoimmun., 132: 102895. doi: 10.1016/j.jaut.2022.102895.
8. **Lee Y, Samarasinghe Y, Patel J *et al*. (2023):** The short and long-term effects of open vs minimally invasive thymectomy in myasthenia gravis patients: a systematic review and meta-analysis. Surg Endosc., 37 (5): 3321-3339.
9. **Derderian S, Potter D, Bansal S *et al*. (2020):** Open versus thoracoscopic thymectomy for juvenile myasthenia gravis. J Pediatr Surg., 55 (9): 1850-1853.
10. **Berrih-Aknin S, Frenkian-Cuvelier M, Eymard B (2014):** Diagnostic and clinical classification of autoimmune myasthenia gravis. J Autoimmun., 48: 143-8. doi: 10.1016/j.jaut.2014.01.003.
11. **Verschuuren J, Huijbers M, Plomp J *et al*. (2013):** Pathophysiology of myasthenia gravis with antibodies to the acetylcholine receptor, muscle-specific kinase and low-density lipoprotein receptor-related protein 4. Autoimmun Rev., 12 (9): 918-23.
12. **Shelly S, Agmon-Levin N, Altman A, Shoenfeld Y (2011):** Thymoma and autoimmunity. Cell Mol Immunol., 8 (3): 199-202.
13. **Aydin Y, Ulas A, Mutlu V *et al*. (2017):** Thymectomy in myasthenia gravis. Eurasian J Med., 49 (1): 48-52.
14. **Rath J, Taborsky M, Moser B *et al*. (2022):** Short-term and sustained clinical response following thymectomy in

patients with myasthenia gravis. Eur J Neurol., 29 (8): 2453-62.

15. **Sobhy E, Al Kindi A, Al Jabri N, Salem A (2022):** Thoracoscopic versus classic trans-sternal thymectomy for myasthenia gravis: single-center experience. Zagazig Univ Med J., 28 (4): 740-7.
16. **Chen K, Li Y, Yang H (2022):** Poor responses and adverse outcomes of myasthenia gravis after thymectomy: predicting factors and immunological implications. J Autoimmun., 132: 102895. doi: 10.1016/j.jaut.2022.102895.
17. **El-Akkawi, A. I., & Eckardt, J. (2021):** Comparison of surgical outcomes after robotic assisted thoracic surgery, video-assisted thoracic surgery and open resection of thymoma. Mediastinum., 5: 11. doi: 10.21037/med-20-56.
18. **Yuan Z, Cheng G, Sun K *et al*. (2014):** Comparative study of video-assisted thoracic surgery versus open thymectomy for thymoma in one single center. Journal of thoracic disease, 6 (6): 726-733.
19. **Castillo-Larios R, Hernandez-Rojas D, Spaulding A *et al*. (2022):** Assessment of length of stay and cost of minimally invasive versus open thymectomies in patients with myasthenia gravis in Florida. Gland Surg., 11 (6): 957-62.
20. **Imielski B, Kurihara C, Manerikar A *et al*. (2020):** Comparative effectiveness and cost-efficiency of surgical approaches for thymectomy. Surgery, 168 (4): 737-42.
21. **Lee Y, Samarasinghe Y, Patel J *et al*. (2023):** The short and long-term effects of open vs minimally invasive thymectomy in myasthenia gravis patients: a systematic review and meta-analysis. Surg Endosc., 37 (5): 3321-39.
22. **Solis-Pazmino P, Baiu I, Lincango-Naranjo E *et al*. (2021):** Impact of the surgical approach to thymectomy upon complete stable remission rates in myasthenia gravis: a meta-analysis. Neurology, 97 (4): e357-68.
23. **Zhang J, Chen Y, Zhang H *et al*. (2021):** Yang Z, Zhang P. Effects of thymectomy on late-onset non-thymomatous myasthenia gravis: systematic review and meta-analysis. Orphanet J Rare Dis., 16 (1): 232. doi: 10.1186/s13023-021-01860-y
24. **Laakso S, Myllynen C, Strbian D, Atula S (2021):** Comorbidities worsen the prognosis of generalized myasthenia gravis post-thymectomy. J Neurol Sci., 427: 117549. doi: 10.1016/j.jns.2021.117549.
25. **Kooshesh K, Foy B, Sykes D *et al*. (2023):** Health consequences of thymus removal in adults. N Engl J Med., 389 (5): 406-17.
26. **Cavalcanti N, Palmeira P, Jatene M *et al*. (2021):** Early thymectomy is associated with long-term impairment of the immune system: a systematic review. Front Immunol., 12: 774780. doi: 10.3389/fimmu.2021.774780.
27. **Kojima T, Uhara K, Mori J (2023):** Health consequences of thymus removal in adults. N Engl J Med., 389 (18): 1724. doi: 10.1056/NEJMc2310640.
28. **Tosi D, Damarco F, Franzi S *et al*. (2022):** Mohamed S, Palleschi A, Mendogni P. Outcomes of extended surgical resections for locally advanced thymic malignancies: a narrative review. Gland Surg., 11 (3): 611-621.
29. **Di Crescenzo VG, Napolitano F, Panico C *et al*. (2017):** Surgical approach in thymectomy: Our experience and review of the literature. Int J Surg Case Rep., 39: 19-24. doi: 10.1016/j.ijscr.2017.07.028.
30. **O'Sullivan K, Kreaden U, Hebert A *et al*. (2019):** A systematic review of robotic versus open and video assisted thoracoscopic surgery (VATS) approaches for thymectomy. Ann Cardiothorac Surg., 8 (2): 174-193.
31. **Collins S, Roberts H, Hewer I (2020):** Anesthesia and perioperative considerations for patients with myasthenia gravis. AANA J., 88 (6): 485-491
32. **Kaufman A, Palatt J, Sivak M *et al*. (2016):** Thymectomy for myasthenia gravis: complete stable remission and associated prognostic factors in over 1000 cases. Semin Thorac Cardiovasc Surg., 28 (2): 561-8
33. **Evoli A, Meacci E (2019):** An update on thymectomy in myasthenia gravis. Expert Rev Neurother., 19 (9): 823-33.