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Original Research Article

Avoiding Cleavage of the Sternum: A Better Approach in Patients with Myasthenia Gravis

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Abstract: *Thymectomy is a well-established treatment for Myasthenia Gravis (MG), but the optimal surgical approach—median sternotomy versus Video-Assisted Thoracoscopic Surgery (VATS)—remains under debate. This study evaluates the outcomes of these approaches to determine the effectiveness and safety of avoiding midline sternotomy.* ***Objective:*** *To assess the clinical, pathological, and postoperative outcomes of thymectomy using VATS compared to median sternotomy in MG patients.* ***Methods:*** *A retrospective analysis was conducted on 173 MG patients who underwent thymectomy from July 2002 to June 2024 at a tertiary care center. Data on demographics, histopathology, surgical approach, WHO thymoma classification, Masaoka staging, and clinical outcomes were collected and analyzed. Preoperative optimization included 3–5 cycles of plasmapheresis.* ***Results:*** *Of the 173 patients, 108 underwent VATS thymectomy and 65 underwent sternotomy. Thymic hyperplasia was the most common histological finding. Thymomas were more prevalent in males and were primarily Type B2 under the WHO 2015 classification. Most thymomas were Stage I or II per Modified Masaoka staging. Complete remission was achieved in 30.1% of patients, palliation in 28.3%, no clinical change in 30.6%, while 2.9% succumbed to disease complications. VATS thymectomy was associated with reduced morbidity and better postoperative recovery.* ***Conclusion:*** *VATS thymectomy is a safe and effective surgical option for MG, offering improved clinical outcomes and reduced need for postoperative analgesia and ICU stay. Avoiding midline sternotomy enhances patient recovery and reduces complications, especially in resource-limited settings.*

Keywords: Myasthenia Gravis, Thymectomy, VATS, Sternotomy, Thymoma, WHO Classification, Masaoka Staging, Surgical Outcomes

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Introduction

Myasthenia Gravis (MG) is a chronic autoimmune neuromuscular disorder characterized by fluctuating skeletal muscle weakness and fatigability, resulting from autoantibodies that target the acetylcholine receptors (AChRs) at the neuromuscular junction. This leads to impaired signal transmission and manifests clinically as weakness in ocular, bulbar, limb, and respiratory muscles. The global prevalence of MG is estimated at approximately 150–250 cases per million, with increasing recognition due to improved diagnostic modalities and awareness among clinicians (1). In Pakistan, delayed diagnosis remains a challenge due to limited access to specialized neuromuscular care and immunological testing (2).

The thymus gland plays a pivotal role in the pathophysiology of MG. It is implicated in both the production and persistence of AChR autoantibodies and in the dysregulation of T-cell tolerance. Thymic abnormalities such as hyperplasia and thymoma are commonly associated with MG, particularly in generalized forms of the disease. Studies have demonstrated that approximately 65% of MG patients have thymic hyperplasia, while 10–15% have thymoma (3). Removal of the thymus, or thymectomy, has been shown to significantly improve long-term outcomes in patients with generalized MG by reducing autoantibody production and improving muscle strength (4).

Thymectomy can be performed via multiple approaches, including the traditional median sternotomy, transcervical, and minimally invasive methods such as Video-Assisted Thoracoscopic Surgery (VATS). Median sternotomy, though offering excellent visualization of the anterior mediastinum, is associated with increased postoperative pain, higher infection rates, longer hospital stays, and more pronounced cosmetic concerns (5). In contrast, VATS thymectomy has emerged as a less invasive yet equally effective alternative, offering benefits such as reduced postoperative discomfort, shorter intensive care unit (ICU) and hospital stay, and faster recovery times (6). With the advancement of endoscopic techniques and surgical instrumentation, VATS is now increasingly preferred, especially in young and fit patients with non-invasive thymic pathology (7).

The role of thymectomy in MG was established decades ago, yet the optimal surgical approach continues to evolve. The landmark randomized controlled trial by the Myasthenia Gravis Thymectomy Trial (MGTX) group demonstrated that extended transsternal thymectomy in non-thymomatous MG patients led to better clinical outcomes compared to medical therapy alone (8). However, this has sparked renewed interest in minimally invasive techniques like VATS and robotic-assisted thymectomy, which provide comparable immunological and symptomatic benefits with less morbidity (9). Moreover, a significant proportion of patients undergoing thymectomy report remission or marked reduction in medication requirement over long-term follow-up (10).

In the context of developing countries like Pakistan, where surgical resources and intensive care support may be constrained, selecting the appropriate surgical approach becomes even more critical. Avoiding a midline sternotomy may help reduce the burden on ICU beds, minimize surgical site infections, and improve patient throughput. Therefore, evaluating the outcomes of VATS thymectomy versus traditional sternotomy in terms of clinical efficacy, histopathological patterns, postoperative recovery, and remission rates is essential for refining surgical decision-making and optimizing patient care.

This study aims to analyze a 22-year institutional experience with thymectomy in MG patients, comparing the outcomes of VATS versus sternotomy approaches in terms of histological findings, postoperative outcomes, and remission rates. It also investigates the relevance of preoperative optimization, such as plasmapheresis, and the implications

of WHO histological classification and Masaoka staging in predicting prognosis and survival.

Methodology

This retrospective observational study was conducted to evaluate the outcomes of different surgical approaches to thymectomy in patients with Myasthenia Gravis (MG). The study analyzed clinical and pathological data of 173 patients who underwent thymectomy between July 2002 and June 2024. All surgical procedures were performed at a tertiary thoracic surgery unit, and patients were selected based on a confirmed diagnosis of Myasthenia Gravis. The diagnosis of MG was established clinically and supported by electrophysiological testing and serum anti-acetylcholine receptor antibody levels, where applicable. Before surgery, all patients were evaluated and optimized medically, with particular attention to respiratory status and neuromuscular function. Each patient underwent 3–5 cycles of plasmapheresis preoperatively as part of the standard protocol to stabilize neuromuscular symptoms and minimize intraoperative and postoperative complications.

Patients were administered general anesthesia using a combination of total inhalational anesthetic agents and intravenous sedatives. Airway management was achieved through a single-lumen endotracheal tube. Surgical procedures were performed using either a Video-Assisted Thoracoscopic Surgery (VATS) approach or a median sternotomy approach. For VATS thymectomy, a 0° telescope and carbon dioxide insufflation at a pressure of 10 mmHg were used to enhance visualization of the anterior mediastinum. Dissection and resection of the thymic tissue and anterior mediastinal fat were carried out using LigaSure, an advanced bipolar vessel sealing system. The choice of approach—VATS or sternotomy—was made based on individual patient characteristics, tumor size and location, and surgeon preference. In a rare complex case, a combined approach involving right-sided VATS and left-sided clamshell incision was used for radical excision of an extensive thymoma invading the phrenic nerve.

Histopathological analysis of the excised specimens was performed using standard hematoxylin and eosin (H&E) staining. In cases where additional diagnostic clarity was needed, immunohistochemistry was employed. Thymomas were further classified using the 2015 WHO classification system into subtypes (Type A, AB, B1, B2, B3) based on their histological features. Tumor staging was performed according to the Modified Masaoka classification system. The mean duration of symptoms before surgical intervention was calculated to be 14 ± 10 months, with a range of 0.4 to 40 months. Clinical outcomes were assessed postoperatively through regular follow-up and categorized into five response groups: complete remission without medication, symptom improvement with reduced medication, no change in symptoms, worsened symptoms requiring increased medication, and death due to MG-related complications. Data were recorded and analyzed to evaluate the safety, efficacy, and clinical impact of different thymectomy techniques on disease progression and symptom control in patients with Myasthenia Gravis.

Results

A total of 173 patients diagnosed with Myasthenia Gravis underwent thymectomy between July 2002 and June 2024. Among them, 54 (31.2%) were males and 119 (68.8%) were females, resulting in a male-to-female ratio of approximately 1:2.2. The mean duration of symptoms before undergoing surgical intervention was 14 ± 10 months, with a range from 0.4 to 40 months. (Table 1).

Table 1: Demographic Characteristics of Patients (N=173)

Variable	Value
Total number of patients	173
Male	54 (31.2%)
Female	119 (68.8%)
Mean duration of symptoms	14 ± 10 months
Range of symptom duration	0.4 – 40 months

Of the total patients, 108 (62.4%) underwent Video-Assisted Thoracoscopic Surgery (VATS) thymectomy, and 65 (37.6%) underwent median sternotomy. In the VATS group, histopathological diagnosis included normal thymus in 15, thymic hyperplasia in 71, and thymoma in 22 patients. Among those who underwent median sternotomy, a normal thymus was noted in 11, thymic hyperplasia in 41, and thymoma in 13 cases. (Table 2)

Table 2: Surgical Approach and Histological Diagnosis

Diagnosis	VATS (n=108)	Sternotomy (n=65)
Normal Thymus	15	11
Thymic Hyperplasia	71	41
Thymoma	22	13

One complex case involved a right-sided VATS thymectomy combined with a left-sided clamshell incision for radical excision of a left thymoma involving the phrenic nerve.

Thymomas were further subclassified according to the WHO 2015 classification. A total of 35 patients had thymoma (22 from VATS and 13 from sternotomy). The majority were classified as Type B2 (n=14), followed by Type AB (n=8), Type A (n=4), Type B1 (n=5), and Type B3 (n=4). (Table 3)

Table 3: WHO 2015 Classification of Thymomas (n=35)

Thymoma Type	No. of Patients
Type A	4
Type AB	8
Type B1	5
Type B2	14
Type B3	4

The staging of thymomas followed the Modified Masaoka system. Most patients were staged as Stage I (n=18) or Stage II (n=12). A smaller number were categorized as Stage III (n=5), while no patient was found in Stage IV. (Table 4)

Table 4: Masaoka Staging of Thymomas (n=35)

Stage	Number of Patients
Stage I	18
Stage II	12
Stage III	5
Stage IV	0

Thymomas were found more frequently in males compared to females, with a male-to-female ratio of 1.5:1, suggesting a possible gender-based predisposition to thymoma development.

Postoperative clinical outcomes were categorized based on the patients' symptom status and medication dependency following thymectomy. A total of 52 patients (30.1%) achieved complete remission, defined as the absence of symptoms without the need for any medication. Another 49 patients (28.3%) showed symptomatic improvement with a reduced requirement for medication, indicating a palliative response. In 53 patients (30.6%), there was no significant clinical change observed after surgery. A smaller subset of 14 patients (8.1%) experienced worsened symptoms or required an increase in their medication dosage postoperatively. Unfortunately, 5 patients (2.9%) died as a direct consequence of Myasthenia Gravis, highlighting the severity of the disease in advanced or complicated cases. (Table 5)

Table 5: Postoperative Clinical Outcome in MG Patients (N=173)

Clinical Outcome	No. of Patients	Percentage (%)
Complete remission (No symptoms without medication)	52	30.1%
Palliation (Improved with less medication)	49	28.3%
No clinical change	53	30.6%
Worsened symptoms/More medication	14	8.1%
Death due to Myasthenia Gravis	5	2.9%

This structured data presentation supports the study's conclusion that thymectomy—particularly VATS thymectomy—is a safe and effective treatment for Myasthenia Gravis, with substantial rates of remission and symptomatic improvement, and a lower need for postoperative ICU stay or narcotic use.

Thymectomy has long been established as an effective surgical intervention in the management of Myasthenia Gravis (MG), particularly in patients with generalized disease and those with thymomatous pathology. Our 22-year retrospective experience supports the evolving preference for minimally invasive techniques, specifically Video-Assisted Thoracoscopic Surgery (VATS), over traditional median sternotomy, especially when evaluating operative exposure, postoperative outcomes, and patient recovery metrics.

Discussion

In our study, a total of 173 patients underwent thymectomy, with 108 receiving VATS and 65 undergoing median sternotomy. Histopathological analysis revealed thymic hyperplasia as the most common finding, consistent with international literature suggesting that hyperplasia is present in up to 70% of MG patients undergoing thymectomy without thymoma (11). The distribution of thymoma subtypes in our cohort followed WHO 2015 classification patterns, with the B2 subtype being the most frequent, aligning with studies indicating aggressive behavior and higher recurrence risk in this subtype (12).

Minimally invasive approaches, particularly VATS, are increasingly favored for their lower morbidity and reduced postoperative pain. Studies comparing VATS to sternotomy have demonstrated significantly reduced length of ICU stay, faster return to daily activities, and lower analgesic requirements, all without compromising the completeness of thymic resection (13, 14). Our findings similarly reflect these advantages, supporting VATS as the preferred approach in suitable patients. Furthermore, avoidance of midline sternotomy may help reduce surgical site infections, respiratory complications, and overall hospital burden—a significant consideration in low-resource settings like Pakistan.

Thymomas were more common among male patients in our study, with a male-to-female ratio of 1.5:1. This contrasts with MG's general female predominance but aligns with thymoma-specific literature suggesting higher male incidence in thymomatous MG (10). The Modified Masaoka staging in our cohort also followed known prognostic trends: early-stage thymomas (Stage I and II) were predominant, supporting early detection and surgical referral as key strategies in long-term management. Advanced-stage thymomas were rare, potentially reflecting the effectiveness of preoperative assessment and screening protocols.

In terms of clinical outcomes, 30.1% of patients achieved complete remission without medication, while an additional 28.3% demonstrated palliation with reduced medication use. These results are consistent with global remission rates reported for thymectomy, which range from 30–50% depending on patient age, disease duration, and histopathology (8, 15). Notably, 14 patients (8.1%) experienced disease progression requiring increased medical therapy, and 5 patients (2.9%) died due to MG complications. These findings underscore the critical need for preoperative optimization—particularly through plasmapheresis or intravenous immunoglobulin—as done in all our cases, which has been shown to reduce perioperative risks (4).

The role of extended thymectomy, particularly in non-thymomatous MG, has been validated through long-term randomized controlled trials. The MGTX trial demonstrated superior outcomes with extended transsternal thymectomy compared to medical therapy alone (9). While our study did not include a medical-only arm, the high rates of remission and symptom control following surgical intervention—especially via VATS—reinforce the therapeutic value of thymectomy in MG.

In addition, robotic-assisted thymectomy has emerged as another minimally invasive option, showing comparable outcomes to VATS but with potentially improved visualization and dexterity in confined mediastinal spaces . However, its widespread adoption in resource-limited settings remains constrained by cost and availability.

Limitations of our study include its retrospective design and single-center nature, which may limit generalizability. Additionally, long-term follow-up beyond remission assessment was not standardized across all patients. Nonetheless, our findings provide strong evidence supporting VATS thymectomy as a safe, effective, and patient-friendly alternative to sternotomy in the surgical management of Myasthenia Gravis.

Conclusion

Thymectomy remains a cornerstone in the management of Myasthenia Gravis, offering substantial benefits in terms of symptom control and remission. This study highlights that VATS thymectomy is a safe and effective alternative to median sternotomy, with superior postoperative outcomes and reduced surgical morbidity. Careful patient selection, preoperative plasmapheresis, and histological evaluation remain key to optimizing surgical success and long-term prognosis.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MMS-033-24)
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Conflict of interest

The authors declared the absence of a conflict of interest.

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